APPENDIX A – REGULATORY INFORMATION AND CORRESPONDENCE

APPENDIX A.1

TDEC ORDER

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION

IN THE MATTER OF:	)	
	)	
TENNESSEE VALLEY AUTHORITY	)	**ORDER NUMBER: OGC15-0177**
	)	
RESPONDENT	)	

COMMISSIONER'S ORDER

PREAMBLE

This Order (Order) has two purposes. First, it is intended to establish a transparent, comprehensive process for the investigation, assessment, and remediation of unacceptable risks, resulting from the management and disposal of coal combustion residuals (CCR) at the Tennessee Valley Authority's (TVA) coal-fired power plants in Tennessee.[1] Second, it is intended to establish the process whereby the Tennessee Department of Environment and Conservation (Department) will oversee TVA's implementation of the federal CCR rule to insure coordination and compliance with Tennessee laws and regulations that govern the management and disposal of CCR.

On December 19, 2014, the Administrator of the Environmental Protection Agency (EPA) signed a final rule that establishes a comprehensive set of requirements for the disposal of CCR from electric utilities. This rule was published in the *Federal Register* on April 17, 2015, 80 Fed. Reg. 21302-21501, and becomes effective on October 19, 2015.

[1] This order does not apply to TVA's Gallatin Fossil Plant. CCR management and disposal activities at that facility are subject to an enforcement lawsuit filed on behalf of the Department on January 7, 2015.

EPA's regulations specifically do not preempt state law requirements, and EPA recognized in its rulemaking the significant role that states play in implementing requirements for managing CCR. EPA strongly encouraged states to adopt and implement the CCR criteria as state law. Following the December 2008 Kingston ash spill, Tennessee amended its laws and regulations to reduce the risk of another such event. Among the changes made are requirements that all new or expanded coal ash disposal facilities must include a Resource Conservation and Recovery Act of 1976 (RCRA) Subtitle D equivalent liner and final cap. Further, pursuant to T.C.A. §68-211-107(c) all solid waste disposal facilities must have groundwater monitoring and if sampling results indicate that ground water protection standards are exceeded, an assessment monitoring program is required. Further, required corrective measures are specified in Chapter 0400-11-01-.04 of the Rules and Regulations of the State of Tennessee.

Therefore, this Order is issued pursuant to the provisions of Tennessee's Waste Management and Remediation laws and in furtherance of the public policies specified therein.

PARTIES

I.

Robert J. Martineau, Jr. is the duly appointed Commissioner of the Tennessee Department of Environment and Conservation.

II.

Tennessee Valley Authority is a federal agency and instrumentality of the United States Government pursuant to the Tennessee Valley Authority Act of 1933, as amended, 16 U.S.C.

Sections 831-831ee. Service of process may be made on William D. Johnson CEO at 400 Summit Hill Drive, Knoxville, TN, 37902-1499

JURISDICTION

III.

Pursuant to T.C.A. §68-211-103(8), "[s]olid waste" is defined as "spent material, byproducts, . . . ash, sludge, and all discarded material including solid, liquid, [or] semisolid . . . material resulting from industrial, commercial, and agricultural operations." CCR are solid waste.

IV.

Pursuant to T.C.A. §68-211-107(a), "[t]he Department is authorized to exercise general supervision over the operation and maintenance of solid waste processing facilities and disposal facilities or sites. Such general supervision shall apply to all the features of operation or maintenance *which* do or *may* affect the public health and safety or the quality of the environment *and which* do or *may affect* the proper processing and disposal of solid wastes." (Emphasis added).

V.

Pursuant to T.C.A. §68-211-107(c) "[t]he Department shall require all solid waste disposal facilities to have a groundwater monitoring program and report sampling results to the department at least once each year. *If sampling results indicate that ground water protection standards are exceeded, the owner or operator of the facility shall commence an assessment monitoring program, in accordance with regulations adopted by the board and carry out all corrective measures specified by the commissioner*." (Emphasis added). Further, required

corrective measures are specified in Chapter 0400-11-01-.04 of the Rules and Regulations of the State of Tennessee.

SCOPE OF THE ORDER

VI.

This Order shall apply to all "CCR disposal areas" at the coal-power plant sites listed below that TVA operates or has operated in Tennessee (hereinafter sites or plants). "CCR disposal areas" include all areas where CCR disposal has occurred, including without limitation, all permitted landfills, all "non-registered" landfills (landfills that existed before they were subject to regulation), and all current and former surface water impoundments that contain CCR.

- Allen Fossil Plant
- Cumberland Fossil Plant
- Johnsonville Fossil Plant
- Kingston Fossil Plant
- Bull Run Fossil Plant
- John Sevier Fossil Plant
- Watts Bar Plant

ORDER

VII.

WHEREFORE, I, Robert J. Martineau, Jr., hereby ORDER TVA to perform the following actions and comply with the conditions set-out below.

A. Site-Wide CCR Investigation, Assessment and Remediation

TVA shall conduct an investigation of CCR disposal areas at the TVA plant sites listed in Section VI by taking the following actions:

a. Within 60 days of the issuance of this Order, an investigation conference shall be scheduled at which TVA shall brief the Department on its CCR management plans at each of the listed plant sites and provide information concerning CCR disposal, releases, existing risk analysis, sampling information, etc. At this briefing, TVA shall discuss and provide information about:

i. Groundwater monitoring and other environmental data at each plant site, including any exceedances of groundwater protection standards and the detection of CCR constituents listed in Appendix III and Appendix IV of the CCR rule in ground water, surface water, or soil;

ii. Biological monitoring reports and whole effluent toxicity testing that TVA may have conducted near each plant site;

iii. The hydrology, geology, and hydrogeology of each plant site with an emphasis on the geology at the locations where TVA has disposed of CCR;

iv. The results of soil borings and analysis of rock cores at each site, including soil, rock, and CCR materials encountered in the borings as well as the analytical work performed on soil boring samples;

v. Any surface seeps and other observable surface releases from CCR impoundments to surface water;

vi. Plans and schedule for closing wet impoundments and converting CCR processes to dry; and

vii. The history of CCR activities at each site.

b. During the investigation conference, the Department and TVA shall discuss what additional documents and/or information TVA shall be required to provide the Department to complete the investigation. Any additional documents requested by the Department shall be provided as expeditiously as practicable, but no later than 45 days, after the conference. Documents may be provided in paper or electronic format or may be posted at a secure internet link.

c. The Department recognizes that TVA and EPA exchanged detailed information about the condition of its CCR impoundments and that this information is at http://www.epa.gov/osw/nonhaz/industrial/special/fossil/surveys2/index.htm. TVA need not provide copies of reports or analyses found at this internet site.

d. Following the initial investigation conference and the review of available information about CCR at each plant site, the Department shall identify what, if any, additional information is needed to complete the investigation of each site. The Department shall discuss with TVA the basis for this determination and a schedule for providing the additional information on a per-site basis. TVA shall develop Environmental Investigation Plans (EIPs) for each site and submit them to the Department. Each EIP shall include a schedule of the work to be performed to fully identify the extent of soil, surface water, and ground water contamination by CCR. TVA shall implement the EIP in accordance with a schedule approved by the Department. Within 60 days

of completion of the EIP, TVA shall submit an Environmental Assessment Report (EAR) to the Department. The EAR shall provide an analysis of the extent of soil, surface water, and ground water contamination by CCR at the site. The Department shall evaluate the EAR to determine if the extent of CCR contamination has been fully defined.

e. The process set-out in VII A. item d. above, shall be repeated until the Department determines there is sufficient information to adequately characterize the extent of CCR contamination in soil, surface water, and ground water at each site.

f. Upon approval of each EAR by the Department, TVA shall submit, within 60 days, a Corrective Action/Risk Assessment (CARA) Plan. The CARA Plan shall specify all actions TVA plans to take at the site and the basis of those actions. Corrective measures may include (1) soil, surface water, and ground water remediation, (2) risk assessment and institutional controls, or (3) no further corrective action. As appropriate for the site, the final approved CARA Plan shall include:

i. The method(s) TVA will employ to remove and/or close in place CCR material at the site;

ii. The method(s) TVA will employ to remediate CCR contaminated soil, surface water, and ground water at the site;

iii. The method(s) TVA proposes to restore any natural resources damaged as a result of the CCR waste water treatment and on-site CCR disposal:

iv. A plan for monitoring the air and water in the area during the cleanup process;

v. A plan to ensure that public and private water supplies are protected from CCR contamination and that alternative water supplies are provided to local citizens if CCR

contamination above ground water protection standards is detected in ground water drinking wells; and,

vi. A plan addressing both the short term and long term management of CCR at the site, including remediation and stabilization of the CCR surface impoundment(s) and/or landfill and/or non-registered disposal site(s), to include design drawings and appropriate supporting engineering calculations.

g. The CARA Plan shall include a schedule of activities to be completed by TVA. The Department and TVA shall discuss the draft CARA Plan and any changes that the Department may determine are necessary for tentative approval of a plan. Following completion of the Public Involvement process set-out in Section B. of this Order, the Department shall decide to either accept or reject the CARA Plan. Should the Department disapprove the CARA Plan, the Department shall provide comments to TVA identifying the deficiencies. TVA shall correct the deficiencies and resubmit the CARA Plan to TDEC for approval.

B. Public Involvement

The Department shall identify opportunities for TVA and the Department to involve the public during the site investigation, assessment, and remediation processes of this Order. This shall include TVA providing the Public notice of all EIP and CARA Plans. Each Public Notice shall contain a summary of the proposed plan and it shall be published in a manner specified by the Department. The Public shall have a minimum of 30 days to comment on each plan; and, if any comments are received, TVA shall have 30 days to provide the Department responses to the comments. After consideration of all Public comments and TVA's responses, the Department will approve, modify, or reject each EIP and CARA Plan.

C. Additional Time

TVA may request a time extension for any deadline in this Order, or in plans approved pursuant to this Order, prior to the deadline. The Commissioner may grant the time extension for good cause shown by TVA; provided, however, that the Department and TVA recognize that deadlines set by the CCR rule cannot be extended except as allowed therein.

D. CCR Rule Implementation

1. CCR Rule Compliance: The requirements of Sections A. and B. of this Order are supplemental to the CCR rule and are not intended to impede or delay actions that TVA takes in compliance with CCR rule requirements. The Department recognizes that TVA may, in compliance with CCR rule requirements, elect to close CCR surface impoundments and/or landfills before the full extent of contamination at a site has been determined. However, if TVA elects to do so, it may later be required by Section A. of this Order to take other and further remedial actions.

2. Notice of CCR Documents: As required by the CCR rule, TVA shall notify the Department when it posts CCR-related documents on its CCR rule public website. The Department in its discretion may request that TVA provide it electronic or paper copies of specific documents.

3. Department Review Process: The Department shall have 60 days to review CCR rule related plans, demonstrations, and assessments, after they are placed on TVA's public CCR rule website. If the Department does not inform TVA that it has comments on a plan, demonstration, or assessment within this 60-day period, TVA may proceed with such plan, demonstration, or assessment. If the Department informs TVA that it has comments, the Department and TVA shall meet to discuss those comments within 30 days. Thereafter, TVA shall appropriately

modify its plans, demonstrations, or assessments to respond to the Department's final comments and resubmit the plan, demonstration, or assessment to the Department. Thirty (30) days thereafter, unless informed otherwise by the Department, TVA may proceed with such plan, demonstration, or assessment. The Department's review and comment on a CCR-rule plan, demonstration, or assessment shall not be deemed its approval of actions required under Section A of this Order. However, TVA may assume the risk of implementing a CCR-rule plan, demonstration, or assessment.

4. Preliminary Activities: Notwithstanding any other provision of this Order, TVA may proceed immediately with preliminary activities (e.g., pond surface water drawdown, contouring, etc.) that are necessary to prepare CCR-surface impoundments and/or landfills for closure; provided, however, that discharges from permitted outfalls must remain within limits set forth in applicable National Pollutant Discharge Elimination System permits.

E. Reimbursement of Costs

TVA shall pay all costs associated with the Department's oversight of the implementation of this Order. These costs shall include, but are not limited to, mileage, lab expense, salary, benefit, and administrative costs for the Department's employees and other state employees actively employed in oversight of work under this Order (including preparation for and attendance at meetings), at the current State overhead rate. Oversight costs also include expenditures for separate office space and related expenses, services contracted for by the Department that facilitate or support the Department's oversight of work under this Order, including, but not limited to, the review of documents submitted by TVA to the Department as required by the CCR rule. The Department shall provide TVA with periodic statements

reflecting oversight costs incurred. Within 60 days of the receipt of each such statement, TVA shall pay to the Department the amount invoiced.

F. Point of Contact and Written Communications

The Department and TVA shall designate two individuals to serve as the primary technical and compliance points of contact for implementation of this Order, in writing, sent to the other party. Either party may change a designated point of contact at any time by informing the other party to the change in writing.

G. Assessment Conferences

At any time deemed necessary by the Department, the Department may schedule an assessment conference that TVA shall attend.

H. Termination of Order

Upon completion of all tasks set forth in this Order, the Department shall issue to TVA a letter stating the requirements of this Order have been fulfilled and no further action of TVA is required under this Order; provided, however, that the Department may terminate the Order earlier if changes in conditions warrant this, including changes in applicable regulations

ASSESSMENT OF CIVIL PENALTIES

VIII.

If TVA does not meet the requirements of this Order, TVA shall pay the following administrative penalties upon request by the Department:

a. Failure to comply with any specific requirement, including deadlines set-out in this Order or which are specified in schedules that are approved by the Department pursuant

to this Order: FIVE THOUSAND DOLLARS ($5,000) per noncompliance and ONE THOUSAND DOLLARS ($1,000) for each day until the noncompliance is remedied.

b. Failure to comply with CCR rule requirements: FIVE THOUSAND DOLLARS ($5,000) for each noncompliance and ONE THOUSAND DOLLARS ($1,000) for each day until the noncompliance is remedied.

The Department, in its discretion, may waive a potential penalty in whole or in part for good cause including, but not limited to, a showing by TVA that events beyond its control (i.e., a force majeure event such as act of God, acts of war or terrorism, and construction, labor or equipment delays) impeded or prevented it from complying.

SITE ACCESS

IX.

During the effective period of this Order, and until the Department determines that all activities under this Order have been completed, the Department and its representatives or designees, upon presentation of credentials, shall have access during normal business hours and, upon reasonable notice, at non-business hours to the sites listed in Section VI. of this Order. Such access may be for the purpose of monitoring activities; verifying data; conducting investigation; inspecting and copying records, logs, or other documents that are not subject to a legally applicable privilege; and/or conducting other activities associated with the implementation of this Order. Nothing herein shall limit or otherwise affect the Department's right of entry, pursuant to any applicable statute, regulation or permit. The Department and its representative shall comply with all reasonable health and safety plans published by TVA or its contractor and used by site personnel for the purpose of protecting life and property.

RESERVATION OF RIGHTS

X.

This Order shall not be construed as waiving any right or authority available to the Commissioner to further assess TVA for liability for civil penalties or damages incurred by the State. The right to order further investigation, remedial action, and/or monitoring and maintenance is also specifically reserved. Further, this Order shall not be construed as waiving, settling, or in any manner compromising any natural resource damage claims which the Department or the State of Tennessee may have under Section 107 of CERCLA or any other statute, rule, regulation, or common law.

Issued this 6th day of August, 2015, by the Commissioner of the Tennessee Department of Environment and Conservation.

8/6/15
Date

Robert J. Martineau, Jr.
Commissioner
Department of Environment and Conservation

NOTICE OF RIGHTS

Tennessee Code Annotated ("T.C.A.") §68-211-113 and §68-212-215(d) allows the Respondent to appeal this Order. To do so, a written petition setting forth the grounds (reasons) for requesting a hearing must be RECEIVED by the Commissioner within THIRTY (30) DAYS of the date the Respondent received this Order and Assessment or this Order and Assessment become final (not subject to review).

If an appeal is filed, an initial hearing will be conducted by an Administrative Law Judge (ALJ) as a contested case hearing pursuant to the provisions of T.C.A. §68-211-113, T.C.A. §68-212-215(d), T.C.A. §4-5-301 *et seq.* (the Uniform Administrative Procedures Act), and Rule 1360-04-01 *et seq.* (the Department of State's Uniform Rules of Procedures for Hearing Contested Cases Before State Administrative Agencies). Such hearings are legal proceedings in the nature of a trial. Individual Respondents may represent themselves or be represented by an attorney licensed to practice law in Tennessee. Artificial Respondents (corporations, limited partnerships, limited liability companies, etc.) cannot engage in the practice of law and therefore may only pursue an appeal through an attorney licensed to practice law in Tennessee. Low income individuals may be eligible for representation at reduced or no cost through a local bar association or legal aid organization.

At the conclusion of any initial hearing the ALJ has the authority to affirm, modify, or deny the Order. This includes the authority to modify (decrease or increase) the penalty within the statutory confines of T.C.A. §68-211-117 and T.C.A. §68-212-213 (from $100 to $10,000 per day per violation). Furthermore, the ALJ, on behalf of the Board, has the authority to assess additional damages incurred by the Department including, but not limited to, all docketing expenses associated with the setting of the matter for a hearing and the hourly fees incurred due to the presence of the ALJ and a court reporter.

Any petition for review (appeal) must be directed to the Commissioner of the Tennessee Department of Environment and Conservation, c/o E. Joseph Sanders, General Counsel, Department of Environment and Conservation, 2nd Floor William R. Snodgrass Bldg., 312 Rosa Parks Avenue, Nashville, Tennessee 37243-1548. Payments of any civil penalty and/or damages shall be made payable to the "Treasurer, State of Tennessee" and sent to the Division of Fiscal

Services - Consolidated Fees Section, Tennessee Department of Environment and Conservation, 10th Floor, William R. Snodgrass Bldg., 312 Rosa Parks Avenue, Nashville, Tennessee 37243. The case number, OGC15-0177, should be written on all correspondence regarding this matter.

E. Joseph Sanders BPR# 6691
General Counsel
Department of Environment & Conservation
312 Rosa L. Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548
PH 615-532-0131

APPENDIX A.2
REGULATORY CORRESPONDENCE

Robert Wilkinson, P.G., CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Phone: (615) 598-3272
e-mail: Robert.S.Wilkinson@tn.gov

David W. Salyers, P.E.
Commissioner

Bill Lee
Governor

April 5, 2024

Shawn Rudder
Sr. Manager
Waste Permits, Compliance, and Monitoring
Tennessee Valley Authority
1101 Market Street, BR 4A
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC15-0177
TVA Watts Bar Coal Fired Fossil Fuel Plant
In Situ Treatment Pilot Test Work Plan

Dear Mr. Rudder:

On March 8, 2024, Tennessee Valley Authority (TVA) submitted the In Situ Treatment Pilot Test Work Plan for the TVA Watts Bar Coal Fired Fossil Power Plant (WBF). The Tennessee Department of Environment and Conservation (TDEC) has completed its review of the submittal and has found it to be acceptable.

Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 598-3272.

Sincerely,

Robert Wilkinson, P.G., CHMM

CC:	Pat Flood	Angela Adams	James Clark
	Rob Burnette	Chris Vail	Caleb Nelson
	Judy Low	Anna Fisher	Kelly Love
	Roy Quinn	Julie Arp	Brandon Boyd

Department of Environment & Conservation

May 14, 2024

Shawn Rudder
Sr. Manager
Waste Permits, Compliance, and Monitoring
Tennessee Valley Authority
1101 Market Street, BR 4A
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC15-0177
TVA Watts Bar Coal Fired Fossil Fuel Plant
Environmental Assessment Report Revision 1

Dear Mr. Rudder:

On March 29, 2024, Tennessee Valley Authority (TVA) submitted the Environmental Assessment Report (EAR) Revision 1 for the TVA Watts Bar Coal Fired Fossil Power Plant (WBF) documenting the results from the implementation of the Environmental Investigation Plan (EIP). The Tennessee Department of Environment and Conservation (TDEC) has completed its review of the submittal and has found it to be acceptable.

Per the Commissioner's Order OGC15-0177 (Order), TVA shall submit, within 60 days of EAR approval, a Corrective Action/Risk Assessment (CARA) Plan specifying all actions TVA plans to take at the TVA WBF and the basis of those actions. The TVA WBF CARA Plan will be submitted to TDEC by July 12, 2024.

Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 598-3272.

Sincerely,

Robert Wilkinson, P.G., CHMM
CCR Technical Manager

CC:			
	Pat Flood	Angela Adams	James Clark
	Rob Burnette	Chris Vail	Caleb Nelson
	Judy Low	Anna Fisher	Brian Fowler
	Brandon Boyd	Julie Arp	Roy Quinn

Department of Environment & Conservation

May 17, 2024

Shawn Rudder
Sr. Manager
Waste Permits, Compliance, and Monitoring
Tennessee Valley Authority
1101 Market Street, BR 4A
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC15-0177
TVA Watts Bar Coal Fired Fossil Fuel Plant
Interim Groundwater Flow and Geochemical Modeling Technical Memorandums Revision 0

Dear Mr. Rudder:

On April 3, 2024, Tennessee Valley Authority (TVA) submitted the Interim Groundwater Flow and Geochemical Modeling Technical Memorandums Revision 0 for the TVA Watts Bar Coal Fired Fossil Fuel Plant (WBF). The Tennessee Department of Environment and Conservation (TDEC) requested that our subcontractor, Civil & Environmental Consultants, Inc. (CEC), provide subject matter experts to assist in the review of the submittal. TDEC and CEC have completed their review of the submittal and are providing comments in the attached tables.

Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 598-3272.

Sincerely,

Robert Wilkinson, P.G., CHMM
CCR Technical Manager

CC:	Pat Flood	Angela Adams	James Clark
	Rob Burnette	Chris Vail	Caleb Nelson
	Judy Low	Anna Fisher	Brian Fowler
	Brandon Boyd	Julie Arp	Roy Quinn

TVA WBF Interim Groundwater Flow Modeling Technical Memorandum
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
3.2	Hydrogeologic Framework	10 of 58	2	1-2	Due to the depositional environment, are the alluvial sands and gravels in the uppermost aquifer laterally discontinuous? Is this aquifer fully confined over the entirety of the modeled area?
3.2.1	Coal Combustion Residuals	10 of 58	3	1-2	Are slug tests from temporary wells adequate for determining hydraulic conductivity conductivity values from more permeable units? Were permanent wells and/or pumping tests considered for determining hydrogeologic properties?
3.2.1	Coal Combustion Residuals	10 of 58	4	1	Vertical hydraulic conductivity range of the CCR material (10-3 to 10-7 cm/sec) would be expected to have significant influence on the groundwater model. Is the variability associated with different compositions and/or changes in disposal practices? How is that variability incorporated in the model?
3.2.2	Alluvium	10 of 58	1	1	Is the fluvial sequencing localized or consistent in proximity to the river? Are there any geological features (e.g. historical stream alignments, point bars) which have the potential to contribute as preferential pathways?
3.2.2	Alluvium	11 of 58	1	1	Figure 12 shows a thicker coarse grained alluvial sequence in the groundwater flow model cross section on the north west side of the slag disposal area at a good distance from the river. Please provide the rational for this differing from the lithologic sequencing in the text.
3.2.3	Residuum	11 of 58	2	1	Vertical hydraulic conductivity estimates are provided for both alluvium and residuum as combined values. Is the residuum expected to have a significantly different vertical hydraulic conductivity than the alluvium?
3.2.4	Bedrock	11 of 58	1	4	Are published estimates of hydraulic conductivity available to be used as a basis in the groundwater model?
3.3	Surface Water and Hydrogeologic Boundaries	12 of 58	1	4-5	The text states that *"flow within the Tennessee River is primarily controlled by regulated releases"* and the *"seasonal influence of the operating reservoir levels is apparent."* Were transient solutions considered in the modeling process?
3.3	Surface Water and Hydrogeologic Boundaries	12 of 58	2	2	The average daily stage has a significant range of values. Were the ranges in stage and precipitation used as part of a sensitivity analysis?
4.1	Modeling Approach	14 of 58	1	3	Was any other guidance used in the development of the model (e.g. boundary conditions, calibration, and/or sensitivity analysis)?
5.1.1	Horizontal Discretization	15 of 58	1	1	What parameters informed the orientation of the model grid?

TVA WBF Interim Groundwater Flow Modeling Technical Memorandum
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
5.1.2	Vertical Discretization	15 of 58	1	4	Figure 12 shows a thicker coarse grained alluvial sequence in the groundwater flow model cross section on the north west side of the slag disposal area at a good distance from the river. Please provide the rational for this differing from the lithologic sequencing in the text.
5.1.2	Vertical Discretization	16 of 58	1-6	NA	Recommend adding a groundwater flow model cross section figure with the layers color coded and cell boundaries visible.
5.2	Hydraulic Properties	17 of 58	3rd of Section	1	Reference is made to Exhibit 15a. The title of the y-axis in the Exhibit 15a drawing on page 49 of 58 is incorrect. The y-axis should be labeled *"Horizontal Hydraulic Conductivity (feet per day)"* . It is currently labeled as vertical hydraulic conductivity.
5.2	Hydraulic Properties	17 of 58	4	2	The text states that *"Model-calibrated vertical hydraulic conductivity values are generally above the range of laboratory testing results. The laboratory results are inferred to be biased towards lower permeability materials".* Please provide additional detail on why model computed data is preferential to laboratory values or documentation that the lab testing is intrinsically biased.
5.2	Hydraulic Properties	17 of 58	5	1	The text states that *"Aquifer storage parameters are required inputs for performing transient model simulations"* . Were transient simulations run?
5.2	Hydraulic Properties	17 of 58	5	4, 6	Figure 12 shows a near surface coarse grained alluvial sequence in the groundwater flow model cross section on the north west side of the slag disposal area. Is the aquifer unconfined in this area?
5.3.1	Recharge	18 of 58	1, 3	NA	Please further clarify how recharge is calculated from discussed precipitation values. Are calibrated recharge values intended to reflect wet season, dry season, or an average? Were the calibrated recharge values used to inform the groundwater elevation data dates or stages for surface water bodies?
5.3.1	Recharge	18 of 58	4	NA	Are there any locations (e.g. topographic lows, basins) with significantly increased recharge?
5.3.2	Tennessee River	19 of 58	1	1-2	Constant head boundaries in close proximity to a targeted area have the potential to contribute a continuous source or sink of water to the hydrologic system. Recommend discussing why a constant head boundary was appropriate for the surface water bodies versus river boundary conditions or for drains for smaller surface water features.

TVA WBF Interim Groundwater Flow Modeling Technical Memorandum
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
5.3.2	Tennessee River	19 of 58	1	1-2	The text states that the *"boundary head was reassigned to be 681.62 feet amsl based on average stage data recorded at the Watts Bar tailwater gauge during a 30-year period"* . Is there a trend over that period? Did the modeling allow for establishing an upstream to downstream gradient (i.e. changing constant head values). Do equal downstream and upstream constant head elevations adequately simulate actual river changes?
5.3.3	Other Surface Water Features	19 of 58	2	1	Do the stormwater ponds and drainage improvements have a consistent pond of water to be modeled as constant head boundary conditions?
5.3.3	Other Surface Water Features	19 of 58	2	1	Were head-dependent flux boundary conditions (e.g. general head with conductance) considered as an alternate to constant head?
5.3.4	Drain (Head-Dependent Flux Boundary)	19 of 58	2	2	What hydraulic conductivity values were used in calculating the conductance of the drain?
5.3.5	Subsurface Structures Horizontal Flow Barrier	20 of 58	1	1	Which layers were impacted by the horizontal flow barrier?
6.2.1	Steady State Calibration	22 of 58	1	2	How many pore water and groundwater elevations during the period of August 2019 to August 2021 were used to average groundwater elevations? Was a seasonality or a trend observed? Were these years have more or less precipitation compared to previous years? Did all wells, including temporary wells, used in calibration have complete data sets for the entire period?
6.2.1	Steady State Calibration	22 of 58	1	2	Why were 30 years of stage values used for the constant head boundary conditions used versus constant head boundary conditions for the period of August 2019 to August 2021?
6.2.1	Steady State Calibration	22 of 58	1	2	Wells in proximity to surface water bodies are more susceptible to changes in stage of the surface water body. Averages from these wells may be skewed with respect to wells less susceptible to groundwater elevation swings. Were individual gauging events evaluated in the calibration process? Please comment why averages are more appropriate.
6.3.1	Steady State Average Conditions	22 of 58	1	5-8	Recommend discussing the calibration targets and if possible, the qualitative improvement in pre-calibration versus post-calibration residual statistics.

TVA WBF Interim Groundwater Flow Modeling Technical Memorandum
Summary of Comments

Section Number	Section Title	Page	Paragraph	Line	Comment
6.3.1	Steady- State Average Conditions	22 of 58	1	9	The sentence is given: *"Root mean square (RMS) error (of the residuals) is 2.3....."* . The previous sentence mentioned the standard deviation of the residuals as 2.3. The root mean square error is the standard deviation of residuals. Therefore, these two sentences are redundant as they are referencing the same statistic.
6.3.1	Steady- State Average Conditions	22 of 58	1	10	In Table 3 on page 32 of 58, the residuals show better agreement for the modeled groundwater levels versus actual levels measured for wells screened within Layers 3 and 4 than for simulations run for wells screened in Layer 2. There is more error relative to predicting the groundwater levels for the MODFLOW simulations for wells in Layer 2. Examples: Mean Residual for Wells in Layer 2 = 2.91 ft., Mean Residual for Wells in Layer 3 = 1.44 ft., Mean Residual for Wells in Layer 4 = 0.72 ft.
6.3.1	Steady State Average Conditions	22 of 58	2	1	As presented in Table 3, simulated heads in pore water were lower than observed heads in 5 of the 8 locations with one by 5.9' and another by 6.4' feet. How did the residual statistics for pore water wells compare to groundwater wells? How did the computed head elevation compare to the bottom of the Layer 2 cell elevation for these locations?
6.3.1	Steady State Average Conditions	23 of 58	1	5	The text states that, *"modeling approach was not intended to introduce complexity without sufficient supporting data"* . Is supporting data needed from the CCR areas to refine the modeling for its eventual intended use?
6.3.1	Steady State Average Conditions	23 of 58	1	1	How do the residual statistics between the pore water and groundwater differ?
6.3.1	Steady State Average Conditions	23 of 58	3	2	Given the modeling objectives are to, *"create a quantitative tool capable of predicting groundwater flow under varying conditions"* , does the model fully capture the interaction between pore water, surface water, and groundwater? Given the build as a steady state model, using averages for stage, recharge, and groundwater level, is the model predicting *"under varying conditions"* or once specific set of conditions? Has a sensitivity analysis been completed?
6.3.1	Steady State Average Conditions	23 of 58	4	3	What is the difference in the modeled pore water gradient and the observed pore water gradient? Exhibit 18 suggests a decrease in the calculated head residuals approaching the River.

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Section Number	Section Title	Page	Paragraph	Line	Comment
7.0	Baseline Simulations	24 of 58	1st	1	Will the MODFLOW model with the data inputs and outputs be made available for review as part of the revised technical memorandum with the Draft CARA Plan? Would be beneficial to see if the model and its inputs and the output.
7.1	Simulated Steady State Groundwater Flow	24 of 58	2	2	Different periods were used for hydrologic, hydrogeologic, and precipitation data periods with the hydrogeologic data period being the shortest. Was consideration given to using the same period for all inputs? If so, was a statistical analysis performed to evaluate how historic hydrologic and precipitation trends compared to the smaller hydrogeologic period window? In other words, do each of the inputs with different time periods actually represent average conditions for the same time period?
7.1	Simulated Steady State Groundwater Flow	24 of 58	4	3	Given the model *"simulates primarily vertical flow through Layers 1 and 2"* , are additional refinements and/or data collection warranted to improve the pore water modeling?
7.1	Simulated Steady State Groundwater Flow	24 of 58	4	4	The text states that *"upward flow components are simulated in the vicinity of surface water bodies (local discharge)"* . Is this expected to be dependent on stage?
Exhibit 21	Simulated Baseline Flow Direction	57 of 58	N/A	NA	Legend needs to include the red and blue dots that are not arrows. Also, the legend needs to include the definitions for arrows of differing sizes. Are the areas with red and blue dots referring to vertical flow? They are difficult to see in the drawing.

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Section Number	Section Title	Page	Paragraph	Line	Comment
1.0	Introduction and Objectives	7 of 29	All	NA	Will the PHREEQC model with the data inputs and outputs be made available for review as part of the revised technical memorandum with the Draft CARA Plan? Would be beneficial to see the model output and input data.
1.0	Introduction and Objectives	7 of 29	6	1 and 2	The reference is made to Appendix H.2 of the CARA Plan throughout this document. These geochemical inputs to the model are not made available for review. Refer to Comment 1 above.
2.0	Background and Approach	9 of 29	1	1-3	Provide a reference for the review that determined that the changes in chemistry between pore water and groundwater could not be explained by physical processes.
2.0	Background and Approach	9 of 29	2	1-5	Given the proximity of the Tennessee River, the groundwater modeling demonstrating the River as a contributing source to groundwater, the primary flow direction in CCRs as being vertical, and large fluctuations in stage, provide additional detail that river contributions do not significantly impact local groundwater chemistry.
3.0	Overview of Geochemical System	10 of 29	NA	NA	Provide additional detail on the geochemical conceptual model to include all geochemical and hydrologic processes that may potentially occur that could alter future water quality for constituents of interest.
3.0	Overview of Geochemical Systems	10 of 29	2nd (1st bullet)	NA	Sentence reads as follows: *"……..whereby constituents adsorb onto metal hydroxides that are often coating soil mineral surfaces, or constituents desorb (i.e., reaction is reversible) and become dissolved in groundwater; controlled by the pH of groundwater."* This process is not only controlled by pH but also by redox conditions. If the metal hydroxides are used as alternate electron acceptors during the oxidation or organic carbon sources in the groundwater, the metal hydroxides will be reduced, mobilizing not only dissolved iron, aluminum and manganese into the groundwater but also the trace metals that were adsorbed to the metal hydroxides, such as cobalt and cadmium.
3.0	Overview of Geochemical Systems	10 of 29	2nd (3rd bullet)	NA	Sentence reads as follows: *"Mineral precipitation or dissolution – a process where constituents in groundwater combine to form a soil mineral; minerals are also subject to dissolution (i.e., reaction is reversible) under certain conditions of groundwater pH and oxidation-reduction potential."* In addition to pH and redox, the specific concentrations of the reaction constituents will also dictate as to whether there is precipitate formation or not (i.e. super-saturation).

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Section Number	Section Title	Page	Paragraph	Line	Comment
3.0	Overview of Geochemical System	10 of 29	2	1-2	Recommend summarizing the hydrogeological conceptual site model and the availability of water (infiltration; flow) to drive geochemical reactions. Define hydrogeological/hydrological boundaries which may impede/facilitate availability of water. Does the vertical flow direction of the pore water from the CCR units and contributions from surface water alter the approach?
3.1	Study Area Description	10 of 29	1	2-3	The text states that, *"groundwater quality at groundwater monitoring wells located on the downgradient edge of the CCR units is influenced primarily by near-field hydrologic and geochemical processes"* . Please further define the relationship between the unconsolidated materials in a hydrologic context (i.e. how water bodies influence the local system). For the Slag Disposal Area, did temporary well locations near the river have fluctuation patterns that were similar to the river stage fluctuations. Do river stage fluctuations result in a transient equipotential boundary from competing hydrologic contributing sources (river vs pore vs residuum/bedrock groundwater) which has the potential to affect groundwater chemistry in proximity to the boundary?
3.1	Study Area Description	10 of 29	1	3	The text states, *"geochemical processes influencing groundwater quality occur in the unconsolidated materials above bedrock, which include residuum and alluvial deposits associated with the geomorphic history of the Tennessee River"* . Given the complex sequence of alluvial deposits as noted in Section 3.2, is additional data needed to understand the range in both lithology and mineralogy?
3.2	Geochemical Framework	11 of 29	1	3-5	Does the variability in vertical sequence of alluvial sediment grain sizes between coarsening upwards to coarsening downwards change the secondary geochemical modification in response to chemical weathering of unconsolidated materials? Is secondary geochemical modification absent where unconsolidated materials are absent?
3.2.1	Coal Combustion Residuals	11 of 29	2	1-2	Recommend including a summary of geochemical testing of CCR and pore water chemistry.

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Section Number	Section Title	Page	Paragraph	Line	Comment
3.2.2	Alluvium	12 of 29	1	3	The text in 3.2.2 states, *"the upper fine-grained unconsolidated materials are primarily comprised of clays and silts that grade downward to coarser-grained sands and gravels where much of the groundwater flows."* The text in section 3.2 states, *"Alluvial deposits reflect typical floodplain depositional sequences with deposits sorted primarily by grain size as a function of changes in the sediment transport capacity of surface water. Depending on a given location in the floodplain, the vertical sequence of sediment grain sizes can vary from coarsening upwards to coarsening downwards."* Please clarify.
3.2.2	Residuum	12 of 29	1	1	The Slag Disposal Area is underlain by the Conasauga Group Middle and the Nolichucky Shale. How does the parent bedrock contribute to the geochemical make up of the residuum?
3.3	Geochemistry of CCR Constituents	12 of 29	All	NA	References are made to modeling the adsorption of trace metals onto both iron and aluminum hydroxide minerals. Why were manganese hydroxides/oxides left out of the model as a redox sensitive constituent and mechanism for adsorption of trace metals? Oxidized manganese plays such a key role in trace metal adsorption within groundwater, along with iron. Per the boring logs in Appendix H.2 of the EAR, there are manganese-bearing soils in the well logs for WBF-101A, WBF 103, WBF 106, WBF 106A, and WBF-106B. It would seem that the model would be improved by including the attenuating properties of these manganese hydroxide/oxide soils.
4.1	Modeling Approach	14 of 29	1	1	Groundwater Flow Modeling Technical Memorandum has not been finalized. Recommend revisiting TM after finalization of the flow model and better understanding the contributing sources to groundwater.
4.2	Computer Code	14 of 29	1	1-3	Recommend providing additional detail on why the selected code is optimum for the defined problem. Identify database and any modifications to the database.
5.1.1	Slag Disposal Area – WBF-104 Transect	15 of 29	1	1	The transect for WBF-104 for geochemical modeling crosses multiple bedrock unit which, as discussed, have the potential to exert a secondary geochemical modifications. How is this potential variability addressed?
5.1.1	Slag Disposal Area – WBF-104 Transect	15 of 29	1	4	The average annual groundwater flow velocity of approximately 2,750 feet per year was determined from the groundwater model. According to Exhibit 22 of the Groundwater Modeling Technical Memo, very few areas have a simulated groundwater flow velocity greater than 1,000 feet/year, of which none of those areas are under the Slag Disposal Area. How was the 2,750 feet per year value determined?

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5.1.2	Slag Disposal Area – WBF-106 Transect	16 of 29	1	4	The hydraulic gradient in the groundwater model simulated elevation contours for the WBF-106 Transect appears similar to the WBF-104 Transect. What input is driving the velocity differential between the transects?
5.2	Geochemical Properties: Table 1	17 of 29	Table	NA	Curious as to why the geometric mean was chosen to calculate the overall mean of the values in Table 1? Do the data vary by several orders of magnitude?
6.1	Model Calibration Approach	18 of 29	1	1	Groundwater modeling suggested that the river as a constant head boundary condition is a potential contributing source to the hydrologic system. How is the surface water-groundwater interaction affect the pore water-groundwater interaction in the vicinity of the river?
6.1	Model Calibration Approach	18 of 29	1	3-4	Are changes in the hydrology and geochemistry of the system limited to corrective action options, or will it also account for regional trends or changes in inputs? How has the hydrology and geochemistry of the system changed over the period of record?
6.2	Selection of Calibration Data	18 of 29	1	1	Verify through trend analysis that groundwater and pore water chemistry reflect equilibrium conditions.
6.2	Selection of Calibration Data	18 of 29	1	4	Verify there is not evidence of sulfate reduction which would preclude sulfate as a tracer.
7.1.1	Slag Disposal Area – WBF-104 Transect	20 of 29	2	1-5	Exhibit 4 modeled chloride and sulfate are significantly outside the box plot for groundwater data. Proved additional discussion on the model results with respect to model calibration.
7.1.1	Slag Disposal Area – WBF-104 Transect	20 of 29	2	1-5	Exhibit 5 modeled chloride and sulfate are significantly outside the box plot for groundwater data. Proved additional discussion on the model results with respect to model calibration.
8.0	Model Limitations	22 of 29	1	2	Include additional discussion PHREEQC programmatic and/or database limitations.
Exhibits	NA	NA	NA	NA	Recommend including number of data points (n) for box plots.
Exhibits	NA	NA	NA	NA	Exhibits 2 and 3 have the legends indicating the red dashed box is for CUF not WBF.
Exhibits	NA	NA	N/A	N/A	In Exhibits 4 and 5, what is the theory as to what is causing the over-estimation of the relatively conservative anions chloride and sulfate in the model output?

Appendix G
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Comment Number	Commentor	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (May 17, 2024)	TVA Response (September 6, 2024)
1	TDEC	3.2	Hydrogeologic Framework	10 of 58	2	1-2	Due to the depositional environment, are the alluvial sands and gravels in the uppermost aquifer laterally discontinuous? Is this aquifer fully confined over the entirety of the modeled area?	The alluvial sand and gravels in the uppermost aquifer are interpreted to be generally laterally continuous beneath the CCR units. The sand and gravels in the uppermost aquifer transition to residuum at higher elevations to the west and north of the CCR units. The uppermost aquifer is modeled as fully confined where it is present.
2	TDEC	3.2.1	Coal Combustion Residuals	10 of 58	3	1-2	Are slug tests from temporary wells adequate for determining hydraulic conductivity conductivity values from more permeable units? Were permanent wells and/or pumping tests considered for determining hydrogeologic properties?	Slug tests from temporary wells in conjunction with laboratory testing were used to characterize properties of CCR material and inform the hydraulic properties assigned to CCR within the Model. Slug tests are considered to be an appropriate and widely used method for characterizing hydraulic properties. Additional slug tests at permanent wells and pump tests are not considered to be warranted at this time.
3	TDEC	3.2.1	Coal Combustion Residuals	10 of 58	4	1	Vertical hydraulic conductivity range of the CCR material (10-3 to 10-7 cm/sec) would be expected to have significant influence on the groundwater model. **Is the variability associated with different compositions and/or changes in disposal practices?** How is that variability incorporated in the model?	The range of vertical hydraulic conductivity of the CCR material is 1.0×10-7 to 1.3×10-6 cm/sec. As discussed in Section 3.2.1, CCR material is interpreted to exhibit variable hydrogeologic properties depending on the type of material, placement method, and post-placement compaction/mixing. CCR material is modeled as a single hydraulic conductivity zone, Vertical hydraulic conductivity of the CCR material was incorporated into the model as a calibration parameter. The applied vertical hydraulic conductivity of CCR material, based on the model calibration process, is within the range of values estimated from site-specific testing. Based on the Model calibration and the current understanding of the hydrogeologic system, an acceptable match of flow directions/system responses is achieved with the applied simplifications.
4	TDEC	3.2.2	Alluvium	10 of 58	1	1	Is the fluvial sequencing localized or consistent in proximity to the river? Are there any geological features (e.g. historical stream alignments, point bars) which have the potential to contribute as preferential pathways?	Refer to the response to Comment #1 for a general discussion of the conceptual understanding of the alluvial hydrostratigraphy. Exhibit 8 depicts the location of historical streams, which may represent primary flowpaths within the uppermost aquifer. This was incorporated into the Model.
5	TDEC	3.2.2	Alluvium	11 of 58	1	1	Figure 12 shows a thicker coarse grained alluvial sequence in the groundwater flow model cross section on the north west side of the slag disposal area at a good distance from the river. Please provide the rational for this differing from the lithologic sequencing in the text.	The difference in thickness between the interpolated cross section and the model discretization in this area is the result of the calibration process. The subsurface information to the west of the Slag Disposal Area is sparse and the hydraulic conductivity was changed through the calibration process to better match the heads observed at WBF-103.
6	TDEC	3.2.3	Residuum	11 of 58	2	1	Vertical hydraulic conductivity estimates are provided for both alluvium and residuum as combined values. Is the residuum expected to have a significantly different vertical hydraulic conductivity than the alluvium?	The vertical hydraulic conductivity of fine-grained unconsolidated materials (alluvial silts and clays or residual clays) are expected to be similarly low.
7	TDEC	3.2.4	Bedrock	11 of 58	1	4	Are published estimates of hydraulic conductivity available to be used as a basis in the groundwater model?	*Regional Groundwater Flow Model Development – Fiscal Year 2016 Progress Report U.S. Department of Energy Oak Ridge Reservation Oak Ridge, Tennessee (DOE, 2017)* reports hydraulic conductivity for the Nolichucky Shale and the Conasauga Group to range over approximately 8 orders of magnitude from 7.8E-7 to 16.1 ft/d based on field measurements.
8	TDEC	3.3	Surface Water and Hydrogeologic Boundaries	12 of 58	1	4-5	The text states that *"flow within the Tennessee River is primarily controlled by regulated releases"* and the *"seasonal influence of the operating reservoir levels is apparent."* Were transient solutions considered in the modeling process?	Sensitivity of Model output to changes in stage are reported in Section 8.5 of the Groundwater Modeling Technical Memorandum.
9	TDEC	3.3	Surface Water and Hydrogeologic Boundaries	12 of 58	2	2	The average daily stage has a significant range of values. Were the ranges in stage and precipitation used as part of a sensitivity analysis?	Refer to response for Comment #8. Precipitation was not part of a sensitivity analysis.
10	TDEC	4.1	Modeling Approach	14 of 58	1	3	Was any other guidance used in the development of the model (e.g. boundary conditions, calibration, and/or sensitivity analysis)?	The referenced ASTM guidance covers defining the study objectives, development of a conceptual model, selection of computer code, model construction, calibration, sensitivity analysis, predictive simulations, and documentation. No additional guidance was used.
11	TDEC	5.1.1	Horizontal Discretization	15 of 58	1	1	What parameters informed the orientation of the model grid?	The finite difference grid is typically oriented such that the primary flow direction in the model area is aligned with the rows and columns of the grid. Flow calculations are oriented along rows and columns, so diagonal flows are calculated in a stair-step manner, thus orienting the rows and columns in the direction of flow will reduce errors and increase stability. Groundwater flow is generally radial towards the Tennessee River so no preferred orientation was identified.
12	TDEC	5.1.2	Vertical Discretization	15 of 58	1	4	Figure 12 shows a thicker coarse grained alluvial sequence in the groundwater flow model cross section on the north west side of the slag disposal area at a good distance from the river. Please provide the rational for this differing from the lithologic sequencing in the text.	Refer to response for Comment #5.
13	TDEC	5.1.2	Vertical Discretization	16 of 58	1-6	NA	Recommend adding a groundwater flow model cross section figure with the layers color coded and cell boundaries visible.	It is difficult to clearly show cell boundaries at the scale of the Model domain. However, modifications to Exhibit 12 to more clearly indicate layer boundaries will be incorporated as part of the rev1 submission.

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14	TDEC	5.2	Hydraulic Properties	17 of 58	3rd of Section	1	Reference is made to Exhibit 15a. The title of the y-axis in the Exhibit 15a drawing on page 49 of 58 is incorrect. The y-axis should be labeled *"Horizontal Hydraulic Conductivity (feet per day)"* . It is currently labeled as vertical hydraulic conductivity.	Exhibit (now identified as Exhibit 14a) revised accordingly.
15	TDEC	5.2	Hydraulic Properties	17 of 58	4	2	The text states that *"Model-calibrated vertical hydraulic conductivity values are generally above the range of laboratory testing results. The laboratory results are inferred to be biased towards lower permeability materials".* Please provide additional detail on why model computed data is preferential to laboratory values or documentation that the lab testing is intrinsically biased.	Laboratory testing for vertical hydraulic conductivity is typically performed on lower permeability materials. Model-estimated vertical hydraulic conductivity for coarser-grained materials is above the range of laboratory test results; it is interpreted that the coarser-grained materials are not represented by the laboratory results for samples described as silt and clay.
16	TDEC	5.2	Hydraulic Properties	17 of 58	5	1	The text states that *"Aquifer storage parameters are required inputs for performing transient model simulations"* . Were transient simulations run?	Transient simulations are included in the closure and corrective action simulations presented in Section 8 of the Groundwater Modeling Technical Memorandum.
17	TDEC	5.2	Hydraulic Properties	17 of 58	5	4, 6	Figure 12 shows a near surface coarse grained alluvial sequence in the groundwater flow model cross section on the north west side of the slag disposal area. Is the aquifer unconfined in this area?	Refer to the response to Comments 1 and 5.
18	TDEC	5.3.1	Recharge	18 of 58	1, 3	NA	Please further clarify how recharge is calculated from discussed precipitation values. Are calibrated recharge values intended to reflect wet season, dry season, or an average? Were the calibrated recharge values used to inform the groundwater elevation data dates or stages for surface water bodies?	The recharge values are intended to reflect recent, average conditions over the two-year calibration period. Similarly, the applied river stage is the average recorded during the two-year calibration period.
19	TDEC	5.3.1	Recharge	18 of 58	4	NA	Are there any locations (e.g. topographic lows, basins) with significantly increased recharge?	No locations were identified for inclusion in the Model.
20	TDEC	5.3.2	Tennessee River	19 of 58	1	1-2	Constant head boundaries in close proximity to a targeted area have the potential to contribute a continuous source or sink of water to the hydrologic system. Recommend discussing why a constant head boundary was appropriate for the surface water bodies versus river boundary conditions or for drains for smaller surface water features.	Constant head boundaries "may be used to represent such features as surface-water bodies of constant level that are in full contact with the aquifer" (Harbaugh 2005). A constant head boundary was deemed appropriate for the Tennessee River due to the size of the surface water body and the maintenance of the surface water body stage via upstream (and downstream) dam operations.
21	TDEC	5.3.2	Tennessee River	19 of 58	1	1-2	The text states that the *"boundary head was reassigned to be 681.62 feet amsl based on average stage data recorded at the Watts Bar tailwater gauge during a 30-year period"* . Is there a trend over that period? Did the modeling allow for establishing an upstream to downstream gradient (i.e. changing constant head values). Do equal downstream and upstream constant head elevations adequately simulate actual river changes?	The applied river stage was modified to reflect the average recorded during the two-year calibration period. Seasonal trends associated with the operating reservoir levels are apparent as well as short-term responses to precipitation. No gradient was applied to the Tennessee River as it more generally resembles a lake level and actual gradient is assumed to be minor over the distance of the Model domain.
22	TDEC	5.3.3	Other Surface Water Features	19 of 58	2	1	Do the stormwater ponds and drainage improvements have a consistent pond of water to be modeled as constant head boundary conditions?	The storm water ponds simulated as constant heads consistently hold water. Stage elevations are not available and were estimated based upon aerial photography and digital elevation models.
23	TDEC	5.3.3	Other Surface Water Features	19 of 58	2	1	Were head-dependent flux boundary conditions (e.g. general head with conductance) considered as an alternate to constant head?	Yes, general head boundaries were considered but the decision was made to reduce the complexity in light of the uncertainty related to potential estimates of conductance.
24	TDEC	5.3.4	Drain (Head-Dependent Flux Boundary)	19 of 58	2	2	What hydraulic conductivity values were used in calculating the conductance of the drain?	Conductance was calculated within the modeling preprocessor software (GMS) based upon length of the drain that crosses an individual cell and a hydraulic conductivity (100 ft/d) set to facilitate removal of groundwater through the drain, if available.
25	TDEC	5.3.5	Subsurface Structures Horizontal Flow Barrier	20 of 58	1	1	Which layers were impacted by the horizontal flow barrier?	Based on design drawings, the horizontal flow barrier was placed in Model Layers 1 through 5 representing installation through the unconsolidated materials and extending through did upper bedrock. This information was added to Section 5.3.5.
26	TDEC	6.2.1	Steady State Calibration	22 of 58	1	2	How many pore water and groundwater elevations during the period of August 2019 to August 2021 were used to average groundwater elevations? Was a seasonality or a trend observed? Were these years have more or less precipitation compared to previous years? Did all wells, including temporary wells, used in calibration have complete data sets for the entire period?	The number and distribution of porewater and groundwater measurements over the calibration time period varied by location. The time period selected for calibration was selected because it coincided with the investigations conducted to support the EAR and had the highest number of unique locations available to support calibration. There is a seasonality observed in hydrographs with high resolution data. The data set was short compared to precipitation trends that might affect groundwater levels. As is typically done for modeling, averages of available data were used because complete data sets for all wells do not exist.
27	TDEC	6.2.1	Steady State Calibration	22 of 58	1	2	Why were 30 years of stage values used for the constant head boundary conditions used versus constant head boundary conditions for the period of August 2019 to August 2021?	The applied stage values for the constant head boundary conditions were modified to reflect the average stage recorded during the two-year calibration period.
28	TDEC	6.2.1	Steady State Calibration	22 of 58	1	2	Wells in proximity to surface water bodies are more susceptible to changes in stage of the surface water body. Averages from these wells may be skewed with respect to wells less susceptible to groundwater elevation swings. Were individual gauging events evaluated in the calibration process? Please comment why averages are more appropriate.	Individual gauging events were not evaluated in the calibration process. Sensitivity of model output to changes in stage is evaluated in Section 8.5. The steady-state model was constructed and calibrated to represent recent, average conditions to establish a baseline against which the closure and corrective action simulations can be compared. Averages are appropriate for simulating how the system may respond to future closure and corrective actions over years to decades.

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29	TDEC	6.3.1	Steady State Average Conditions	22 of 58	1	5-8	Recommend discussing the calibration targets and if possible, the qualitative improvement in pre- calibration versus post-calibration residual statistics.	Statistical comparison of post-calibration target residuals are provided in Table 3. The iterative calibration process was not retained.
30	TDEC	6.3.1	Steady- State Average Conditions	22 of 58	1	9	The sentence is given: *"Root mean square (RMS) error (of the residuals) is 2.3 "* . The previous sentence mentioned the standard deviation of the residuals as 2.3. The root mean square error is the standard deviation of residuals. Therefore, these two sentences are redundant as they are referencing the same statistic.	Both statistics are used to measure model fit, but there are nuanced differences in the way they are calculated; the similarity of the two statistics typically produces similar (if not the same) result.
31	TDEC	6.3.1	Steady- State Average Conditions	22 of 58	1	10	In Table 3 on page 32 of 58, the residuals show better agreement for the modeled groundwater levels versus actual levels measured for wells screened within Layers 3 and 4 than for simulations run for wells screened in Layer 2. There is more error relative to predicting the groundwater levels for the MODFLOW simulations for wells in Layer 2. Examples: Mean Residual for Wells in Layer 2 = 2.91 ft., Mean Residual for Wells in Layer 3 = 1.44 ft., Mean Residual for Wells in Layer 4 = 0.72 ft.	Comment acknowledged.
32	TDEC	6.3.1	Steady State Average Conditions	22 of 58	2	1	As presented in Table 3, simulated heads in pore water were lower than observed heads in 5 of the 8 locations with one by 5.9' and another by 6.4' feet. How did the residual statistics for pore water wells compare to groundwater wells? How did the computed head elevation compare to the bottom of the Layer 2 cell elevation for these locations?	Table 3 has been updated based upon Model updates documented in the Groundwater Modeling Technical Memorandum. Simulated heads in pore water are lower that observed heads in 4 of the 8 locations. A summary of key pore water and groundwater residual statistics is provided below for comparison: PW Residual Mean: 0.01 GW Residual Mean: -0.29 PW Residual Standard Deviation: 2.1 GW Residual Standard Deviation: 1.9 PW Scaled RMS: 0.1253 GW Scaled RMS: 0.0596 The computed head for the bottom of Layer 2 compared to the simulated phreatic surface is presented in Exhibit 23b (upper panel) which presents a color flood of this metric.
33	TDEC	6.3.1	Steady State Average Conditions	23 of 58	1	5	The text states that, *"modeling approach was not intended to introduce complexity without sufficient supporting data"* . Is supporting data needed from the CCR areas to refine the modeling for its eventual intended use?	Based on the Model calibration and the current understanding of the hydrogeologic system, the calibrated Model is considered a reliable tool to meet the objectives of the modeling study.
34	TDEC	6.3.1	Steady State Average Conditions	23 of 58	1	1	How do the residual statistics between the pore water and groundwater differ?	Refer to response for Comment #32.
35	TDEC	6.3.1	Steady State Average Conditions	23 of 58	3	2	Given the modeling objectives are to, *"create a quantitative tool capable of predicting groundwater flow under varying conditions"* , does the model fully capture the interaction between pore water, surface water, and groundwater? Given the build as a steady state model, using averages for stage, recharge, and groundwater level, is the model predicting *"under varying conditions"* or once specific set of conditions? Has a sensitivity analysis been completed?	Based on the Model calibration and the current understanding of the hydrogeologic system, the calibrated Model is considered a reliable tool to meet the objectives of the modeling study. The variability discussed is intended to reflect the comparison of the considered closure and corrective actions. The variability in not referring to time varying conditions of stage, recharge, or groundwater level. Sensitivity of model output to changes in stage is evaluated in Section 8.5.
36	TDEC	6.3.1	Steady State Average Conditions	23 of 58	4	3	What is the difference in the modeled pore water gradient and the observed pore water gradient? Exhibit 18 suggests a decrease in the calculated head residuals approaching the River.	As shown on Exhibit 18a, the modeled and observed horizontal pore water gradient (as inferred based on gauging data from the indicated event date) are similar.
37	TDEC	7	Baseline Simulations	24 of 58	1st	1	Will the MODFLOW model with the data inputs and outputs be made available for review as part of the revised technical memorandum with the Draft CARA Plan? Would be beneficial to see if the model and its inputs and the output.	A summary of the input data is provided in Sections 5 and 6 of the TM, including the referenced Tables (#1 through #3) and Exhibits (#10 through #15), which summarize the model input in a more accessible format than the MODFLOW input file**s**. Similarly, the output is described in Section 7 and summarized in Exhibits 19 through 21 and present the output data in more accessible format than the MODFLOW output files. For these reasons, the model input and output files are not planned to be included in the CARA Plan.
38	TDEC	7.1	Simulated Steady State Groundwater Flow	24 of 58	2	2	Different periods were used for hydrologic, hydrogeologic, and precipitation data periods with the hydrogeologic data period being the shortest. Was consideration given to using the same period for all inputs? If so, was a statistical analysis performed to evaluate how historic hydrologic and precipitation trends compared to the smaller hydrogeologic period window? In other words, do each of the inputs with different time periods actually represent average conditions for the same time period?	Refer to responses for Comments #18 and #28.

Appendix G
TVA WBF Interim Groundwater Modeling Technical Memorandum
Summary of Comments and TVA Responses
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Comment Number	Commentor	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (May 17, 2024)	TVA Response (September 6, 2024)
39	TDEC	7.1	Simulated Steady State Groundwater Flow	24 of 58	4	3	Given the model *"simulates primarily vertical flow through Layers 1 and 2"* , are additional refinements and/or data collection warranted to improve the pore water modeling?	This statement is consistent with the conceptual site model in which flow through the more permeable layers is primarily horizontal and flow through the less permeable strata is primarily vertical. Vertical flow of pore water is expected and does not mean that pore water modeling needs to be improved.
40	TDEC	7.1	Simulated Steady State Groundwater Flow	24 of 58	4	4	The text states that *"upward flow components are simulated in the vicinity of surface water bodies (local discharge)"* . Is this expected to be dependent on stage?	Based on an evaluation of hydrographs presented in Appendix H.1 of the EAR, the groundwater flow direction does not change due to river stage. An upward gradient is consistent with the location of the Tennessee River at a topographic low.
41	TDEC	Exhibit 21	Simulated Baseline Flow Direction	57 of 58	N/A	NA	Legend needs to include the red and blue dots that are not arrows. Also, the legend needs to include the definitions for arrows of differing sizes. Are the areas with red and blue dots referring to vertical flow? They are difficult to see in the drawing.	The flow vectors are scaled to Model-simulated flow velocity. Larger arrows indicate relatively greater velocities; smaller arrows may appear as dots and indicate relatively lower velocities. This information was added as a note to the Exhibits that display velocity vectors.

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Appendix H
TVA WBF Interim Geochemical Modeling Technical Memorandum
Summary of Comments and TVA Responses
September 6, 2024

Comment Number	Commentor	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (May 17, 2024)	TVA Response (September 6, 2024)
1	TDEC	1.0	Introduction and Objectives	7 of 29	All	NA	Will the PHREEQC model with the data inputs and outputs be made available for review as part of the revised technical memorandum with the Draft CARA Plan? Would be beneficial to see the model output and input data.	The groundwater, pore water and solid material geochemistry are provided in Appendix H.2 and the interpretation is detailed in Appendix H.1. A summary of the input data is provided in a table in Appendix H.1, which provides a more useable format than the input files do. Similarly, the output is summarized in exhibits because the output files are difficult to interpret on their own. For these reasons, the model input and output files are not being included in the CARA Plan.
2	TDEC	1.0	Introduction and Objectives	7 of 29	6	1 and 2	The reference is made to Appendix H.2 of the CARA Plan throughout this document. These geochemical inputs to the model are not made available for review. Refer to Comment 1 above.	See response to Comment #1.
3	TDEC	2.0	Background and Approach	9 of 29	1	1-3	Provide a reference for the review that determined that the changes in chemistry between pore water and groundwater could not be explained by physical processes.	The word "review" in this case was used to indicate inspection of the water quality data, not that there exists a separate document describing review of the data. Word changed to "inspection" to avoid confusion.
4	TDEC	2.0	Background and Approach	9 of 29	2	1-5	Given the proximity of the Tennessee River, the groundwater modeling demonstrating the River as a contributing source to groundwater, the primary flow direction in CCRs as being vertical, and large fluctuations in stage, provide additional detail that river contributions do not significantly impact local groundwater chemistry.	The groundwater modeling does not show the Tennessee River as a contributing source to groundwater. Also, the hydrographs included in the Environmental Assessment Report (EAR) show that groundwater elevations along the eastern edge of the Slag Disposal Area are higher than Tennessee River elevations indicating that the river is not impacting local groundwater chemistry. In addition, there is no indication from the analytical data from WBF-104 that fluctuations in river stage influence cobalt concentrations.
5	TDEC	3.0	Overview of Geochemical System	10 of 29	NA	NA	Provide additional detail on the geochemical conceptual model to include all geochemical and hydrologic processes that may potentially occur that could alter future water quality for constituents of interest.	The list in Section 3.0 is complete for the geochemical conceptual site model.
6	TDEC	3.0	Overview of Geochemical Systems	10 of 29	2nd (1st bullet)	NA	Sentence reads as follows: *" whereby constituents adsorb onto metal hydroxides that are often coating soil mineral surfaces, or constituents desorb (i.e., reaction is reversible) and become dissolved in groundwater; controlled by the pH of groundwater*." This process is not only controlled by pH but also by redox conditions. If the metal hydroxides are used as alternate electron acceptors during the oxidation or organic carbon sources in the groundwater, the metal hydroxides will be reduced, mobilizing not only dissolved iron, aluminum and manganese into the groundwater but also the trace metals that were adsorbed to the metal hydroxides, such as cobalt and cadmium.	The reviewer is correct. The implicit assumption in the sentence referenced is that redox conditions do not change, or that redox conditions do not change sufficiently to induce the reaction described by the reviewer. The third bullet in Section 3.0 addresses the precipitation or dissolution of metal hydroxides influenced by redox conditions and pH.
7	TDEC	3.0	Overview of Geochemical Systems	10 of 29	2nd (3rd bullet)	NA	Sentence reads as follows: *" Mineral precipitation or dissolution - a process where constituents in groundwater combine to form a soil mineral; minerals are also subject to dissolution (i.e., reaction is reversible) under certain conditions of groundwater pH and oxidation-reduction potential."* In addition to pH and redox, the specific concentrations of the reaction constituents will also dictate as to whether there is precipitation formation or not (i.e. super-saturation).	The reviewer is correct that the concentrations of mineral-specific constituents is a factor controlling mineral precipitation and dissolution. Clarification text has been added.
8	TDEC	3.0	Overview of Geochemical System	10 of 29	2	1-2	Recommend summarizing the hydrogeological conceptual site model and the availability of water (infiltration; flow) to drive geochemical reactions. Define hydrogeological/hydrological boundaries which may impede/facilitate availability of water. Does the vertical flow direction of the pore water from the CCR units and contributions from surface water alter the approach?	See Section 3.2 for the conceptual site model as it relates to pore water, groundwater, and geochemical reactions. Additional hydrogeological information is provided in the Groundwater Flow Modeling Technical Memorandum (TM) (Appendix G) and the EAR. Hydrogeological/hydrological boundaries that might impede/facility availability of water are discussed in Appendix G. Vertical flow of pore water is implicitly included. See response to Comment #4 regarding surface water.
9	TDEC	3.1	Study Area Description	10 of 29	1	2-3	The text states that, *"groundwater quality at groundwater monitoring wells located on the downgradient edge of the CCR units is influenced primarily by near-field hydrologic and geochemical processes"* . Please further define the relationship between the unconsolidated materials in a hydrologic context (i.e. how water bodies influence the local system). For the Slag Disposal Area, did temporary well locations near the river have fluctuation patterns that were similar to the river stage fluctuations. Do river stage fluctuations result in a transient equipotential boundary from competing hydrologic contributing sources (river vs pore vs residuum/bedrock groundwater) which has the potential to affect groundwater chemistry in proximity to the boundary?	See response to Comment #4 regarding surface water.
10	TDEC	3.1	Study Area Description	10 of 29	1	3	The text states, *"geochemical processes influencing groundwater quality occur in the unconsolidated materials above bedrock, which include residuum and alluvial deposits associated with the geomorphic history of the Tennessee River"* . Given the complex sequence of alluvial deposits as noted in Section 3.2, is additional data needed to understand the range in both lithology and mineralogy?	The range in lithology is well represented by the available borehole logs provided in the EAR. The range in mineralogy is considered reasonably sampled as presented in Appendix H.2.

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Appendix H
TVA WBF Interim Geochemical Modeling Technical Memorandum
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Comment Number	Commentor	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (May 17, 2024)	TVA Response (September 6, 2024)
11	TDEC	3.2	Geochemical Framework	11 of 29	1	3-5	Does the variability in vertical sequence of alluvial sediment grain sizes between coarsening upwards to coarsening downwards change the secondary geochemical modification in response to chemical weathering of unconsolidated materials? Is secondary geochemical modification absent where unconsolidated materials are absent?	As shown in H.2, the bulk, or majority, of minerals in the unconsolidated materials is chemically inert on the time-scale of processes influencing the concentrations of constituents at issue. Secondary mineral phases, such as iron hydroxide, form as a result of iron transport in groundwater and changes in redox conditions. The extent to which grain size influences groundwater flow is the effect on secondary mineral formation. The geochemical model does not carry that level of resolution, nor for that matter, does the groundwater flow model. Bedrock was not modeled; therefore, the absence of secondary geochemical modification where unconsolidated materials are absent was not evaluated.
12	TDEC	3.2.1	Coal Combustion Residuals	11 of 29	2	1-2	Recommend including a summary of geochemical testing of CCR and pore water chemistry.	The geochemical modeling is not about the CCR material or pore water chemistry, but rather the effects of pore water on groundwater chemistry and how closure and groundwater corrective actions affect groundwater chemistry. Therefore, the reader is directed to the EAR should more detail about the geochemistry of CCR material and pore water chemistry be desired. A summary of pore water and soil geochemistry analytical results pertinent to geochemical modeling are provided in Appendix H.2.
13	TDEC	3.2.2	Alluvium	12 of 29	1	3	The text in 3.2.2 states, *"the upper fine-grained unconsolidated materials are primarily comprised of clays and silts that grade downward to coarser-grained sands and gravels where much of the groundwater flows."* The text in section 3.2 states, *"Alluvial deposits reflect typical floodplain depositional sequences with deposits sorted primarily by grain size as a function of changes in the sediment transport capacity of surface water. Depending on a given location in the floodplain, the vertical sequence of sediment grain sizes can vary from coarsening upwards to coarsening downwards."* Please clarify.	The former statement reflects the general conditions as represented in the conceptual site model for this plant. The second statement is a high level generalized description of any alluvial depositional system associated with a meandering river system.
14	TDEC	3.2.2	Residuum	12 of 29	1	1	The Slag Disposal Area is underlain by the Conasauga Group Middle and the Nolichucky Shale. How does the parent bedrock contribute to the geochemical make up of the residuum?	As residuum is bedrock weathered in place, the geochemical make up of residuum is a reflection of the parent rock geochemical make up.
15	TDEC	3.3	Geochemistry of CCR Constituents	12 of 29	All	NA	References are made to modeling the adsorption of trace metals onto both iron and aluminum hydroxide minerals. Why were manganese hydroxides/oxides left out of the model as a redox sensitive constituent and mechanism for adsorption of trace metals? Oxidized manganese plays such a key role in trace metal adsorption within groundwater, along with iron. Per the boring logs in Appendix H.2 of the EAR, there are manganese-bearing soils in the well logs for WBF-101A, WBF 103, WBF 106, WBF 106A, and WBF-106B. It would seem that the model would be improved by including the attenuating properties of these manganese hydroxide/oxide soils.	Adsorption to manganese hydroxides was not included in the geochemical model for two reasons: (1) there are currently no compilation of equilibrium constants to represent the surface complexation of metals with manganese hydroxides; and (2) though manganese is more geochemical reactive than either iron or aluminum, the abundance of manganese is usually orders of magnitude lower than the abundance of aluminum and iron. Model projections without manganese hydroxide adsorption likely underestimate the amount of adsorption, producing results that are probably conservatively high. Text in Sections 3.3.1 and 3.3.2 has been modified to address the reviewers comment.
16	TDEC	4.1	Modeling Approach	14 of 29	1	1	Groundwater Flow Modeling Technical Memorandum has not been finalized. Recommend revisiting TM after finalization of the flow model and better understanding the contributing sources to groundwater.	The Groundwater Flow Modeling TM (Appendix G) has been finalized since the initial submittal of the Interim Geochemical Modeling TM. Pertinent information from Appendix G has been incorporated into to the complete version of the Geochemical Modeling TM (Appendix H.1).
17	TDEC	4.2	Computer Code	14 of 29	1	1-3	Recommend providing additional detail on why the selected code is optimum for the defined problem. Identify database and any modifications to the database.	Additional text has been added to Section 4.2 to support model section.
18	TDEC	5.1.1	Slag Disposal Area – WBF-104 Transect	15 of 29	1	1	The transect for WBF-104 for geochemical modeling crosses multiple bedrock unit which, as discussed, have the potential to exert a secondary geochemical modifications. How is this potential variability addressed?	The current geochemical model focuses on groundwater flow in the unconsolidated material and does not consider changes in bedrock lithology.
19	TDEC	5.1.1	Slag Disposal Area – WBF-104 Transect	15 of 29	1	4	The average annual groundwater flow velocity of approximately 2,750 feet per year was determined from the groundwater model. According to Exhibit 22 of the Groundwater Modeling Technical Memo, very few areas have a simulated groundwater flow velocity greater than 1,000 feet/year, of which none of those areas are under the Slag Disposal Area. How was the 2,750 feet per year value	The value reported is a legacy value from before the groundwater flow modeling was completed. The actual value used in geochemical modeling is 18 feet per year. The text has been revised.
20	TDEC	5.1.2	Slag Disposal Area – WBF-106 Transect	16 of 29	1	4	The hydraulic gradient in the groundwater model simulated elevation contours for the WBF-106 Transect appears similar to the WBF-104 Transect. What input is driving the velocity differential between the transects?	The current groundwater velocities for geochemical modeling at WBF-104 and WBF-106 are 18 feet per year and 16 feet per year, respectively, based on the revised groundwater flow modeling results.
21	TDEC	5.2	Geochemical Properties: Table 1	17 of 29	Table	NA	Curious as to why the geometric mean was chosen to calculate the overall mean of the values in Table 1? Do the data vary by several orders of magnitude?	The values listed in Table 1 are actually arithmetic mean values and not geometric mean values. The text has been updated accordingly.
22	TDEC	6.1	Model Calibration Approach	18 of 29	1	1	Groundwater modeling suggested that the river as a constant head boundary condition is a potential contributing source to the hydrologic system. How is the surface water-groundwater interaction affect the pore water-groundwater interaction in the vicinity of the river?	See response to Comment #4.
23	TDEC	6.1	Model Calibration Approach	18 of 29	1	3-4	Are changes in the hydrology and geochemistry of the system limited to corrective action options, or will it also account for regional trends or changes in inputs? How has the hydrology and geochemistry of the system changed over the period of record?	The focus of the analysis is the CCR facility and contributing area as defined in the document. It is not anticipated that changes in the regional system would be large enough to change a planned corrective measure.

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Appendix H
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Comment Number	Commentor	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (May 17, 2024)	TVA Response (September 6, 2024)
24	TDEC	6.2	Selection of Calibration Data	18 of 29	1	1	Verify through trend analysis that groundwater and pore water chemistry reflect equilibrium conditions.	For geochemical modeling, steady-state (or equilibrium) conditions are not required. The geochemical model is constructed using data collected and evaluated as presented in Appendix H.2.
25	TDEC	6.2	Selection of Calibration Data	18 of 29	1	4	Verify there is not evidence of sulfate reduction which would preclude sulfate as a tracer.	Verified. There are no indications that conditions are sufficiently chemically reducing to support sulfate reduction.
26	TDEC	7.1.1	Slag Disposal Area – WBF-104 Transect	20 of 29	2	1-5	Exhibit 4 modeled chloride and sulfate are significantly outside the box plot for groundwater data. Proved additional discussion on the model results with respect to model calibration.	The text has been modified as suggested.
27	TDEC	7.1.1	Slag Disposal Area – WBF-104 Transect	20 of 29	2	1-5	Exhibit 5 modeled chloride and sulfate are significantly outside the box plot for groundwater data. Proved additional discussion on the model results with respect to model calibration.	Sulfate and chloride concentrations are within their respective range measured in groundwater in the revised model and exhibit.
28	TDEC	8.0	Model Limitations	22 of 29	1	2	Include additional discussion PHREEQC programmatic and/or database limitations.	Additional discussion of model limitations has been added to Section 9.0 as suggested.
29	TDEC	Exhibits	NA	NA	NA	NA	Recommend including number of data points (n) for box plots.	The number of data points represented in the box plots has been added to exhibit title as (N=11).
30	TDEC	Exhibits	NA	NA	NA	NA	Exhibits 2 and 3 have the legends indicating the red dashed box is for CUF not WBF.	The exhibit legends have been updated with the correct references.
31	TDEC	Exhibits	NA	NA	N/A	N/A	In Exhibits 4 and 5, what is the theory as to what is causing the over-estimation of the relatively conservative anions chloride and sulfate in the model output?	In the revised model, chloride and sulfate are no longer over-estimated on Exhibit 5. The differences on Exhibit 4 are attributed to the combined effects of history. There are no data available that indicate concentrations during active operations or in the period between active operations and unit closure. Water chemistry for pore water represents current conditions; whereas, groundwater chemistry reflects both transport and geochemical reaction with unconsolidated material. As a result, there are differences among constituents considered reasonably chemically conservative. Additional text has been added to the discussion on the calibration results presented in Exhibit 4. As stated in the technical memorandum, more important is that the model fairly represents the operative geochemical processes such that a reasonable comparison of outcomes among potential corrective actions would be produced.

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Department of Environment & Conservation

June 18, 2024

Shawn Rudder
Sr. Manager
Waste Permits, Compliance, and Monitoring
Tennessee Valley Authority
1101 Market Street, BR 4A
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC15-0177
TVA Watts Bar Coal Fired Fossil Fuel Plant
Human Health and Ecological Risk Assessment Revision 0

Dear Mr. Rudder:

On April 3, 2024, Tennessee Valley Authority (TVA) submitted Human Health and Ecological Risk Assessment (HHERA) Revision 0 for the TVA Watts Bar Coal Fired Fossil Fuel Plant (WBF). The Tennessee Department of Environment and Conservation (TDEC) requested that our subcontractor, Civil & Environmental Consultants, Inc. (CEC), provide subject matter experts to assist in the review of the submittal. TDEC and CEC have completed their review of the submittal and are providing comments in the attached tables.

Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 598-3272.

Sincerely,

Robert Wilkinson, P.G., CHMM
CCR Technical Manager

CC:	Pat Flood	Angela Adams	James Clark
	Rob Burnette	Chris Vail	Caleb Nelson
	Judy Low	Anna Fisher	Brian Fowler
	Brandon Boyd	Julie Arp	Roy Quinn

TVA WBF HHERA
Summary of TDEC Comments

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Section Number	Section Title	Page	Paragraph	Line	Comment
General Comment	NA	NA	NA	NA	A groundwater screening step was absent from the HHERA. Screening groundwater results against both human health and ecological screening levels in the HHERA is recommended. It is recognized the groundwater results have been compared to GWPS as part of the EI/EAR. Including the results of this comparison in the HHERA will result in a more comprehensive HHERA. Groundwater screening against ecological surface water screening levels does not appear to have been performed in previous WBF investigations/reports and is recommended due to the Watts Bar Facility CCR Management Units being in such close proximity to the Tennessee River. Because ecological screening levels for surface water can be lower than GWPS for certain CCR constituents this may expand the list of constituents evaluated as a basis for corrective actions considered in the forthcoming WBF CARA plan.
Section 5.3.4	Weight of Evidence	51 of 536	Last Complete	NA	In response to the reported Target Organ HI of 2.0 for the on-site worker, the following is presented in the text: "*In addition, risks to onsite workers were calculated assuming no health and safety protocols were used to control or mitigate exposure. If standard health and safety protocols (e.g., wearing of protective clothing) are used during future maintenance activities, potential risks to onsite workers are expected to be lower than estimated.*" Are there any mechanisms in place, or that are being considered, that will help ensure that standard health and safety protocols will be followed? The fourth bullet on page iv of the Executive Summary states in part "*Estimated risks to an onsite worker potentially exposed to CCR material within the Ash Pond is greater than the noncancer threshold of 1; however, implementing standard health and safety protocols is expected to lower the potential risks.*" This sentence gives the impression that implementation of standard health and safety protocols is more of a certainty than the preceding sentence from Section 5.3.4.
Section 5.3.4	Weight of Evidence	52 of 536	2	NA	"*This indicates that mercury in fish tissue from the Tennessee River near the WBF Plant is unrelated to the TDEC Order CCR units at the WBF Plant.*" Please revise the sentence as follows: "*This indicates that mercury in fish tissue from the Tennessee River near the WBF Plant* ***could be*** *unrelated to the TDEC Order CCR units at the WBF Plant.*"

TVA WBF HHERA

Summary of Subcontractor Comments

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Section Number	Section Title	Page	Paragraph	Line	Comment
Executive Summary	NA	9 of 536	1	1	*"only exposures under anticipated future, post-closure conditions of the CCR units are evaluated in the HHERA."* The data that form the basis of the quantitative assessment are current conditions, Does this statement imply that anticipated future, post-closure conditions will remain the same as current conditions, even if the HHRA identifies a chemical exposure that represents an unacceptable risk? Seems like this HHERA evaluated future uses under current conditions.
1.3	Scope	14 of 536	3	11	*". . . assume current environmental conditions are representative of post-closure conditions and consider current and anticipated future land use."* Same comment as above.
5	Human Health Risk Assessment	33 of 536	1	5	*"Results of this HHRA will be used in the CARA Plan to evaluate whether corrective measures are needed."* If corrective measures are needed, that would change future conditions. So you can see the "circular reasoning" here. Perhaps a statement to the effect that anticipated future land use is not expected to vary from existing/current conditions.
5	Human Health Risk Assessment	33 of 536	NA	7th bullet	Exposure Factors Handbook: 2011 Edition (USEPA 2011). There is a 2017 update for soil and dust exposures that might be relevant to the HHRA.
5.1.1.1	Release Mechanisms	35 of 536	2	2	*"These potential seeps are not evaluated further in this HHRA."* Suggest reiterating that they "were identified in inaccessible areas" (and therefore an incomplete exposure pathway) as mentioned in Section 4.1.2
5.1.1.2.1	Potential Onsite Receptors	36 of 536	3	8	*" If substantive repairs that would take more than 20 days to complete are necessary, a site-specific health and safety plan specifying procedures to protect onsite workers would be required."* Do you think there is a need to quantitatively evaluate a short-term contract worker? Would the "risks" just be addressed with the health and safety plan measures that would be implemented?
5.1.1.2.2	Potential Onsite Receptors	36 of 536	1	5	*". . . there are a limited number of human receptors possibly relevant to the scope of the TDEC Order."* Could you briefly explain why the Order limits the number of receptors at the "local recreational areas"? Were these receptors agreed upon in past documents regulating all facilities?

Section Number	Section Title	Page	Paragraph	Line	Comment
5.1.1.3	Pathways of Exposure	38 of 536	NA	NA	*"An exposure pathway is considered complete when. . ."* Suggest using EPA's established definition: *"EPA 1989: A pathway is complete if there are: (1) a source or chemical release from a source, (2) an exposure point where contact can occur, and (3) an exposure route by which contact can occur. Otherwise, the pathway is incomplete.. "*
5.1.1.3.2	Resident	40 of 536	1	4	*"Public water surrounding the WBF Plant is supplied by the Town of Decatur Water System, Watts Bar Utility District and Town of Spring City Water Utility that source their water from locations either upstream of the WBF Plant or a spring located 3.5 miles south of the WBF Plant."* Wouldn't these conditions support the lack of a complete exposure pathway? The paragraph is a bit confusing in that firstly, ingestion of groundwater is stated as not being a complete pathway. Then, the second paragraph in Section 5.1.1.3.2 mentions how offsite residents will be exposed to potable water from these municipal water departments, although the intakes are either located upstream of the plant or a spring 3.5 miles south of the plant.
5.1.1.3.4	Recreational User – Consumer of Locally-Caught Sport Fish	41 of 536	4	1	*"The adult fish intake rate of 32.7 g/day used in the development of the SSLHH is higher than the current USEPA national-level consumption rate for ambient water quality criteria (22 g/day; USEPA 2015); and nearly twice the previous national-level consumption rate (17.5 g/day; USEPA 2010)."* This approach is appropriately protective but wondered if there are any State-specific freshwater fish consumption rates that would illustrate how protective this assumption is. Is there any information that has been presented with the multiple fish ingestion surveys that have been performed in Tennessee (mercury; PCBs; etc.).
5.1.1.3.4	Recreational User – Consumer of Locally-Caught Sport Fish	41 of 536	5	4	*"Rather, only total mercury was measured, which was protectively evaluated as methyl mercury in the HHRA."* Since speciation was not conducted, we agree with the approach. This was mentioned again in Section 5.1.3.1 and do you consider this a data gap for the risk assessment?
5.2.2	Noncarcinogenic Dose-Response Assessment Methodology	45 of 536	1	1	*"Substances that produce adverse noncarcinogenic effects are generally thought to have a threshold dose below which the adverse effect is not likely to be observed over the period of exposure."* Suggest adding a reference for this statement.

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Section Number	Section Title	Page	Paragraph	Line	Comment
5.3.1	Methods for Estimating Cancer Risk and Noncancer Hazard for Chemicals	48 of 536	1	3	*"To account for potential cumulative impacts from exposure to multiple COPCs, COPC-specific ILCR and HQ estimates were summed to produce cumulative ILCR and HI estimates, respectively".* For HQs, should this be limited to COPCs with similar target organs as described in the following paragraph?
5.3.1.1	On-Site Worker	49 of 536	2	3	*"The HI of 2 is primarily attributable to arsenic (HQ = 1.2) and thallium (HQ = 0.49)."* EPA Region 4 (2018): Cancer risk values and hazard index (HI) values may express more than one significant figure, but for decision-making purposes one significant figure should be used.
6.1.1.2	Chemicals of Potential Ecological Concern	60 of 536	4	1	*"No COPECs were identified for further quantitative evaluation in the ERA, as presented in Table 6-1. As such, this finding, as well as additional qualitative LOE, will be used to evaluate whether concentrations of CCR Parameters in media to which a receptor is potentially exposed to for the WBF Plant are protective of ecological health."* If these statements are true and are supported (as supported by the results of the EAR), further evaluation and discussions are basically unnecessary. Perhaps a stronger statement here that could be provided would indicate that although qualitative evaluations are provided in ensuring sections, unacceptable ecological risks associated with CCR from the WBF Plant are highly unlikely.
6.3.1	Tennessee River	69 of 536	2	2	*"Benthic invertebrate community RBI results for the Tennessee River as depicted in Exhibit 4-4 showed adjacent and downstream sampling locations as having 'Excellent' biological integrity, while upstream communities scored comparably much lower."* This is another good example of qualitative support for the low likelihood of unacceptable ecological risk being caused by CCR parameters. Please indicate here as to why the lower RBI results were observed upstream (due to habitat differences?).
6.3.1	Tennessee River	69 of 536	4	3	*"RFAI results showed that a balanced indigenous population is currently being demonstrated in Chickamauga Reservoir headwater region downstream of the WBF Plant."* This is yet another LOE to substantiate the claim the CCR constituents are not adversely impacting fish in the area of the WBF Plant. As the quantitative and qualitative data are overwhelmingly in support of low risk throughout this report, Please also mention these fish results in Section 7.2 under "Tennessee River".

Section Number	Section Title	Page	Paragraph	Line	Comment
Tables	Table 4-3: Surface Stream Water Data Summary and Comparisons to Ecological Screening Levels	85 of 536	NA	NA	Maximum concentrations of potential COCs are basically at least an order of magnitude lower than screening levels. This is strong evidence that ecological risks to aquatic receptors are very low, if not negligible. Please consider emphasizing the gap between maximum concentrations and screening levels.
Tables	Table 4-4: Sediment Data Summary and Comparisons to Ecological Screening Levels	87 of 536	NA	NA	Although not as pronounced as surface water comparisons, the fact that all maximum detected concentrations of CCR parameters are below sediment screening levels is also strong evidence that ecological risks to aquatic receptors, including benthic macroinvertebrates, are very low, if not negligible.
Tables	Table 4-5: Fish Filet Data Summary and Comparisons to Human Health Screening Levels	90 of 536	NA	NA	Table 4-5 has a second page added that contains no data. Extra page needs to be removed.
Tables	Table 6-1: COPECs Identified for the ERA	99 of 536	NA	NA	There are no data listed in Table 6-1.
Appendix C					
Appendix C.1: EAR Statistical Analysis (Appendix E of the WBF Plant EAR)	Appendix E: Statistical Analysis (from EAR)	248 - 508 of 536	Entire Section	NA	Please refer to the comments for statistical analyses that were presented in the comments from the review team for EAR Rev 0 and EAR Rev 1 and ensure these have been incorporated in the Appendix C.1 report version presented in this HHERA report.

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix C.1-EAR Statistical Analysis (Appendix E of the WBF Plant EAR)	Attachment E.1-A - Summary Statistics Tables	262-264 of 536	Table	NA	Concerns remain about the recommendations of the underlying distribution for the derivation of UTLs from the ProUCL software were described in the TEAMs call with TVA and TDEC for the GAF CARA on March 25, 2024. Recommendations and suggested revisions to background soil BTVs were sent to all parties on the TEAMs call via email on March 25, 2024. These same concerns are relevant to the derivation of UTLs for the data from the WBF EAR. It does not appear that any of the UCLs that were presented in the EAR have been revised per the concerns presented in the May 25, 2024 presentation.
Appendix C.1-EAR Statistical Analysis (Appendix E of the WBF Plant EAR)/Appendix E.4-Statistical Analysis of Seep Investigation	Attachment D.2 - Summary of Descriptive Statistics-	408 of 536	DO and Temp Table	NA	The DO meter that was used to obtain these DO measurements in this table either was not calibrated or needs service. Based on the measured water temps in the table, the maximum DO should be no higher than 9.7 mg/L. However, the DO readings in the table are as high as 11.65 mg/L.
Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	Table C.2-1 data for cadmium in ash pond	Ash Pond Line 2	Note "d" at the bottom of the table states that the 95% UCL was not calculated for cadmium at the ash pond; however, ProUCL output for cadmium for the ash pond is given in the ProUCL output in Appendix C.3-1. Please remove the ProUCL output for cadmium at the ash pond in Appendix C.3-1 for consistency with Note "d".

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	Table C.2-1 data for cadmium in Slag Area	Slag Area Line 8 of table	95% UCL is shown as 2.24 mg/kg as derived by KM (t-interval based) method. In the Appendix C.3 ProUCL Output, on page 493 of 536, there is a conflict in the results for the two GOF tests used to determine whether the 13 data values best fit a normal distribution. The Shapiro Wilk test indicated that the data do not fit a normal distribution (1% Type I error), while the Lilliefors test indicated that the data do fit the normal distribution (1% Type I error). On page 495 of 536, the ProUCL output states the following: "When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL." If there is a split decision of the GOF tests, the user is to move to the next distribution in line that has a unanimous GOF result for the given distribution. This would mean that the gamma distribution is to be used per ProUCL instructions. Even though the ProUCL output indicates to use the 95% KM (t), in my discussions with the developers of ProUCL, this is the intended protocol to follow. This was also verified in CEC's distribution fitting work performed in March 2024 for the GAF site. As a result, the 95% KM Adjusted Gamma UCL is the preferred estimate to use.
Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	Table C.2-1 data for cadmium in Slag Area	Slag Area Line 8 of table	How was the mean calculated in the table for cadmium for the Slag Area? Was the non-detect set to the reporting limit and the arithmetic mean performed or was KM used?
Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	Table C.2-1 data for cadmium in ash pond	Ash Pond Line 4	Note "d" at the bottom of the table states that the 95% UCL was not calculated for Radium 226 at the ash pond; however, ProUCL output for Radium 226 for the ash pond is given in the ProUCL output in Appendix C.3-1. Please remove the ProUCL output for Radium 226 at the ash pond in Appendix C.3-1 for consistency with Note "d".

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1	General Comment	NA	NA	A groundwater screening step was absent from the HHERA. Screening groundwater results against both human health and ecological screening levels in the HHERA is recommended. It is recognized the groundwater results have been compared to GWPS as part of the EI/EAR. Including the results of this comparison in the HHERA will result in a more comprehensive HHERA. Groundwater screening against ecological surface water screening levels does not appear to have been performed in previous WBF investigations/reports and is recommended due to the Watts Bar Facility CCR Management Units being in such close proximity to the Tennessee River. Because ecological screening levels for surface water can be lower than GWPS for certain CCR constituents this may expand the list of constituents evaluated as a basis for corrective actions considered in the forthcoming WBF CARA plan.	A subsection for groundwater has been added to Section 4.4 as follows: "Section 4.4.2 Groundwater As described in the *Proposed Receptor-Specific Screening Levels for Human Health (SSL_{HH})* (Appendix B.1), the potential migration of CCR Parameters in onsite groundwater to offsite locations where there may be private potable wells or springs was addressed by the water use survey. In addition, analytical results of groundwater samples collected as part of the EI were compared to approved groundwater screening levels and presented in the WBF Plant EAR. These approved human health screening levels for CCR Parameters in groundwater are based on regulatory standards. Summary statistics of CCR Parameters in groundwater are provided in Appendix E.3 of Appendix C.1. Based on the overall results of the water use survey as discussed in Section 4.1.3 (i.e., groundwater flow is generally from the west-northwest to the east-southeast toward the Tennessee River, groundwater flow in the vicinity of the CCR units is bounded to the east by the Tennessee River, and no wells or springs potentially used for domestic or business purposes were identified in the Survey Area), current and historical CCR management associated with the WBF Plant has not affected water supply wells or springs located downgradient of the WBF Plant. Therefore, exposure pathways associated with offsite use of groundwater and springs as a drinking water source were not considered complete, and as a result, no further quantitative assessment of groundwater is presented in this report. However, TVA will implement corrective actions to meet groundwater protection standards (GWPS) as part of the CARA Plan." Please note that surface stream water, sediment, benthic invertebrate community, and fish community health assessment data were collected for the Tennessee River. These data provide a more accurate representation of potential exposures and effects to ecological receptors. While groundwater itself does not directly contribute to the assessment, potential contributions from groundwater to aquatic receptor exposures (if any) would be captured by the Tennessee River data.
2	Section 5.3.4	Weight of Evidence	51 of 536	In response to the reported Target Organ HI of 2.0 for the on-site worker, the following is presented in the text: "*In addition, risks to onsite workers were calculated assuming no health and safety protocols were used to control or mitigate exposure. If standard health and safety protocols (e.g., wearing of protective clothing) are used during future maintenance activities, potential risks to onsite workers are expected to be lower than estimated.* " Are there any mechanisms in place, or that are being considered, that will help ensure that standard health and safety protocols will be followed? The fourth bullet on page iv of the Executive Summary states in part *"Estimated risks to an onsite worker potentially exposed to CCR material within the Ash Pond is greater than the noncancer threshold of 1; however, implementing standard health and safety protocols is expected to lower the potential risks.* " This sentence gives the impression that implementation of standard health and safety protocols is more of a certainty than the preceding sentence from Section 5.3.4.	Please note standard health and safety protocols are consistent with TVA safety policies and procedures. For clarity, the executive summary has been revised to: "There are no unacceptable risks to offsite human receptors related to the CCR units. Estimated risks to an onsite worker potentially exposed to CCR material within the Ash Pond is greater than the noncancer threshold of 1; however, when standard health and safety protocols are used, potential risks to onsite workers are expected to be lower than estimated." Section 5.3.4 has been revised to: "In addition, risks to onsite workers were calculated assuming no health and safety protocols were used to control or mitigate exposure. When standard health and safety protocols (e.g., wearing of protective clothing) are used during future maintenance activities, potential risks to onsite workers are expected to be lower than estimated. Furthermore, if substantive repairs are necessary, a site-specific health and safety plan specifying procedures to protect onsite workers would be required."
3	Section 5.3.4	Weight of Evidence	52 of 536	"*This indicates that mercury in fish tissue from the Tennessee River near the WBF Plant is unrelated to the TDEC Order CCR units at the WBF Plant."* Please revise the sentence as follows: *"This indicates that mercury in fish tissue from the Tennessee River near the WBF Plant* ***could be*** *unrelated to the TDEC Order CCR units at the WBF Plant."*	The referenced sentence has been revised to: "This indicates that mercury in fish tissue from the Tennessee River near the WBF Plant is likely unrelated to the TDEC Order CCR units at the WBF Plant."
4	Executive Summary	NA	9 of 536	*"only exposures under anticipated future, post-closure conditions of the CCR units are evaluated in the HHERA."* The data that form the basis of the quantitative assessment are current conditions, Does this statement imply that anticipated future, post-closure conditions will remain the same as current conditions, even if the HHRA identifies a chemical exposure that represents an unacceptable risk? Seems like this HHERA evaluated future uses under current conditions.	Please note the statement referenced is specifying the risk assessment evaluation is based on the assumption that the CCR units are closed. The statement is not meant to imply that actual concentrations of CCR Parameters in the CCR units would be the same in the future since that is outside the scope of the risk assessment. As indicated in Section 5.0, the concentrations of CCR Parameters in CCR material, surface stream water and fish filet tissue were assumed to represent future conditions only for the purpose of the risk assessment, so the results of the HHRA could be used in the CARA Plan to evaluate whether corrective measures are needed. For clarity, the sentence has been expanded to: "Because the focus of the human health risk assessment (HHRA) is on the CCR units (not historical WBF Plant operations or the closure activities for the CCR units), only exposures under anticipated future, post-closure conditions of the CCR units are evaluated in the HHERA."

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5	1.3	Scope	14 of 536	*". . . assume current environmental conditions are representative of post-closure conditions and consider current and anticipated future land use."* Same comment as above.	Please see response to comment #4. For clarity the statement referenced has been reworded to: "Potential risks to human and ecological receptors from exposures to CCR Parameters in offsite abiotic (surface stream water and sediment) and biotic (benthic invertebrate and fish tissue) media assume current environmental conditions are representative of post-closure conditions (i.e., closed CCR units covered by geosynthetic cover systems) and consider current and anticipated future land use."
6	5.0	Human Health Risk Assessment	33 of 536	*"Results of this HHRA will be used in the CARA Plan to evaluate whether corrective measures are needed."* If corrective measures are needed, that would change future conditions. So you can see the "circular reasoning" here. Perhaps a statement to the effect that anticipated future land use is not expected to vary from existing/current conditions.	Please see response to comment #4. The following sentences have been added to the beginning of Section 5.1.1.2.1: "Land use within the WBF Plant property is industrial. There are no planned changes in land use."
7	5.0	Human Health Risk Assessment	33 of 536	Exposure Factors Handbook: 2011 Edition (USEPA 2011). There is a 2017 update for soil and dust exposures that might be relevant to the HHRA.	The *Exposure Factors Handbook: 2011 Edition* (USEPA 2011) is cited in Section 5 because the adolescent body weight used to estimate risks for adolescent recreationally users - consumers of locally-caught sport fish was calculated from values in Table 8 of that document. Information from *Update for Chapter 5 of the Exposure Factors Handbook Soil and Dust Ingestion* (USEPA 2017) was not used in the HHRA.
8	5.1.1.1	Release Mechanisms	35 of 536	*"These potential seeps are not evaluated further in this HHRA."* Suggest reiterating that they "were identified in inaccessible areas" (and therefore an incomplete exposure pathway) as mentioned in Section 4.1.2	The third paragraph of Section 5.1.1.1 has been revised to the following: "As described in Section 4.1.2, three AOIs (AOI02, AOI03 and AOI04) were further evaluated in the CARA Plan to determine if corrective measures are needed. These AOIs were located in areas covered by riprap, making them inaccessible. Consequently, they are not evaluated further in this HHRA because the exposure pathways are incomplete (Exhibit 5-1)."
9	5.1.1.2.1	Potential Onsite Receptors	36 of 536	*" If substantive repairs that would take more than 20 days to complete are necessary, a site-specific health and safety plan specifying procedures to protect onsite workers would be required."* Do you think there is a need to quantitatively evaluate a short-term contract worker? Would the "risks" just be addressed with the health and safety plan measures that would be implemented?	As noted in Section 5.1.1.2.1, after final closure of the CCR units, worker exposure to CCR material is expected to be infrequent, non-recurring, and of short duration (i.e., no more than 20 days within a single one-year period). Potential exposures that may last more than 20 days are not anticipated, and as a result, are not quantitatively evaluated in the HHRA. However, should substantive repairs be necessary, measures implemented under an approved plant specific health and safety plan and in accordance with TVA safety policies and procedures would be expected to address the potential risks to onsite workers.
10	5.1.1.2.2	Potential Onsite Receptors	36 of 536	*". . . there are a limited number of human receptors possibly relevant to the scope of the TDEC Order."* Could you briefly explain why the Order limits the number of receptors at the "local recreational areas"? Were these receptors agreed upon in past documents regulating all facilities?	The recreational receptor scenarios described in Appendix B were previously reviewed and accepted by TDEC for use in HHRAs conducted under the TDEC Order program. Recreational activities near WBF are associated with the Tennessee River. There is a public boat ramp on the opposite side of the river upstream of WBF near the Watts Bar Dam. There are no public recreational facilities or access along the shoreline of the WBF Plant. This reach of the Tennessee River below the Watts Bar Dam is a popular location for boating and fishing. The three recreational receptor scenarios evaluated in the HHRA - swimmer, beachcomber, and consumer of sport-caught fish are expected to have the highest potential exposures to CCR constituents that could be associated with the TDEC Order CCR Units.
11	5.1.1.3	Pathways of Exposure	38 of 536	*"An exposure pathway is considered complete when. . ."* Suggest using EPA's established definition: *"EPA 1989: A pathway is complete if there are: (1) a source or chemical release from a source, (2) an exposure point where contact can occur, and (3) an exposure route by which contact can occur. Otherwise, the pathway is incomplete.. "*	Although Section 6.3.4 of RAGS Part A lists three elements of a complete exposure pathway, Section 6.3 of RAGS Part A states the following: "An exposure pathway generally consists of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium (or media in cases involving media transfer of chemicals), (3) a point of potential human contact with the contaminated medium (referred to as the exposure point), and (4) an exposure route (e.g., ingestion) at the contact point." This description of a complete exposure pathway is provided in Section 5.1.1. For clarity, the second paragraph of Section 5.1.1.3 has been revised to refer to Section 5.1.1: "As discussed in Section 5.1.1, an exposure pathway is considered complete when there is potential for a receptor to be exposed to COPCs in an exposure media through an identified exposure route, as defined for relevant onsite and offsite human receptors in Section 5.1.1.2."

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12	5.1.1.3.2	Resident	40 of 536	*"Public water surrounding the WBF Plant is supplied by the Town of Decatur Water System, Watts Bar Utility District and Town of Spring City Water Utility that source their water from locations either upstream of the WBF Plant or a spring located 3.5 miles south of the WBF Plant."* Wouldn't these conditions support the lack of a complete exposure pathway? The paragraph is a bit confusing in that firstly, ingestion of groundwater is stated as not being a complete pathway. Then, the second paragraph in Section 5.1.1.3.2 mentions how offsite residents will be exposed to potable water from these municipal water departments, although the intakes are either located upstream of the plant or a spring 3.5 miles south of the plant.	Please note that the first sentence in Section 5.1.1.3.2 discusses potential exposure to CCR Parameters in groundwater. The remainder of the paragraph discusses potential exposure to CCR Parameters in surface stream water with public water utilities intakes. Because CCR Parameters were detected in surface stream water samples from the Tennessee River adjacent and downstream of the WBF Plant, data for these samples were conservatively screened against human health screening levels for domestic water supply. As noted in Section 5.1.1.3.2, no CCR Parameters were detected above these screening levels, and therefore no COPCs were identified for this exposure scenario.
13	5.1.1.3.4	Recreational User - Consumer of Locally-Caught Sport Fish	41 of 536	*"The adult fish intake rate of 32.7 g/day used in the development of the SSL_{HH} is higher than the current USEPA national-level consumption rate for ambient water quality criteria (22 g/day; USEPA 2015); and nearly twice the previous national-level consumption rate (17.5 g/day; USEPA 2010)."* This approach is appropriately protective but wondered if there are any State-specific freshwater fish consumption rates that would illustrate how protective this assumption is. Is there any information that has been presented with the multiple fish ingestion surveys that have been performed in Tennessee (mercury; PCBs; etc.).	Fish consumption rates used in the HHRA were taken from Table 9b in EPA. *2014. Estimated Fish Consumption rates for the U.S. Population and Selected Subpopulations*. EPA-820-R-14-002. The adult fish consumption rate (32.7 g/day) used in the HHRA is the 95th percentile estimate for freshwater and estuarine fish consumed by people in the Inland South (Tennessee). The current EPA national-level fish consumption rate (22.0 g/day) for development of (freshwater) ambient water quality standards is the 90th percentile rate for all geographic areas from the same source (Table 9b. USEPA 2014). EPA modeled estimated fish consumption rates using information from 24-hour dietary recall surveys conducted by NHANES from representative samples of participants by geographic region across the US. The Tennessee Water Resources Agency (TWRA) conducts annual creel surveys to evaluate the health of the fisheries in TN's major reservoirs and tailwaters. TRWA surveyors interview anglers about fishing effort, catch rates, and harvest and release rates by species. Information about how much of the catch is actually eaten by the angler or their family is not part of the survey.
14	5.1.1.3.4	Recreational User - Consumer of Locally-Caught Sport Fish	41 of 536	*"Rather, only total mercury was measured, which was protectively evaluated as methyl mercury in the HHRA."* Since speciation was not conducted, we agree with the approach. This was mentioned again in Section 5.1.3.1 and do you consider this a data gap for the risk assessment?	Although mercury speciation analysis was not conducted on fish tissue samples, risks estimated assuming mercury is present as methyl mercury in fish tissue, along with the qualitative LOEs provided in Section 5.3.4, are thought to adequately characterize potential risk to a recreational user – consumer of locally-caught sport fish from mercury in fish.
15	5.2.2	Noncarcinogenic Dose-Response Assessment Methodology	45 of 536	*"Substances that produce adverse noncarcinogenic effects are generally thought to have a threshold dose below which the adverse effect is not likely to be observed over the period of exposure."* Suggest adding a reference for this statement.	A reference to RAGS Part A (USEPA 1989a) has been added for this statement.
16	5.3.1	Methods for Estimating Cancer Risk and Noncancer Hazard for Chemicals	48 of 536	*"To account for potential cumulative impacts from exposure to multiple COPCs, COPC-specific ILCR and HQ estimates were summed to produce cumulative ILCR and HI estimates, respectively".* For HQs, should this be limited to COPCs with similar target organs as described in the following paragraph?	Please note consistent with RAGS Part A (USEPA 1989) which states "If the HI is greater than unity as a consequence of summing several hazard quotients of similar value, it would be appropriate to segregate the compounds by effect and by mechanism of action and to derive separate hazard indices for each group", COPC-specific HQs are initially summed to a cumulative HI estimate. A target organ-specific HI was only calculated when a cumulative HI estimate was greater than 1.
17	5.3.1.1	On-Site Worker	49 of 536	*"The HI of 2 is primarily attributable to arsenic (HQ = 1.2) and thallium (HQ = 0.49)."* EPA Region 4 (2018): Cancer risk values and hazard index (HI) values may express more than one significant figure, but for decision-making purposes one significant figure should be used.	Comment noted. The HI of 2 was used for decision-making purposes.
18	6.1.1.2	Chemicals of Potential Ecological Concern	60 of 536	*"No COPECs were identified for further quantitative evaluation in the ERA, as presented in Table 6-1. As such, this finding, as well as additional qualitative LOE, will be used to evaluate whether concentrations of CCR Parameters in media to which a receptor is potentially exposed to for the WBF Plant are protective of ecological health."* If these statements are true and are supported (as supported by the results of the EAR), further evaluation and discussions are basically unnecessary. Perhaps a stronger statement here that could be provided would indicate that although qualitative evaluations are provided in ensuring sections, unacceptable ecological risks associated with CCR from the WBF Plant are highly unlikely.	Since both quantitative and qualitative LOEs were used in the HHERA as indicated in Section 2.2 and the section referenced is the Chemicals of Potential Ecological Concern section, subsequent text in Sections 6.3 and 6.4 are more appropriate locations for presenting the conclusions that there are no unacceptable risks.
19	6.3.1	Tennessee River	69 of 536	*"Benthic invertebrate community RBI results for the Tennessee River as depicted in Exhibit 4-4 showed adjacent and downstream sampling locations as having 'Excellent' biological integrity, while upstream communities scored comparably much lower."* This is another good example of qualitative support for the low likelihood of unacceptable ecological risk being caused by CCR parameters. Please indicate here as to why the lower RBI results were observed upstream (due to habitat differences?).	The referenced sentence has been expanded to reference Section 4.1.4.2 which includes additional details about habitat-related stress upstream. "Benthic invertebrate community RBI results for the Tennessee River as depicted in Exhibit 4-4 showed adjacent and downstream sampling locations as having 'Excellent' biological integrity, while upstream communities scored comparably much lower (Section 4.1.4.2).

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20	6.3.1	Tennessee River	69 of 536	*"RFAI results showed that a balanced indigenous population is currently being demonstrated in Chickamauga Reservoir headwater region downstream of the WBF Plant."* This is yet another LOE to substantiate the claim the CCR constituents are not adversely impacting fish in the area of the WBF Plant. As the quantitative and qualitative data are overwhelmingly in support of low risk throughout this report, Please also mention these fish results in Section 7.2 under "Tennessee River".	The following sentence has been added to the end of the first paragraph under 'Tennessee River' in Section 7.2: "RFAI results showed that a balanced indigenous population is currently being demonstrated in Chickamauga Reservoir headwater region downstream from the WBF Plant."
21	Tables	Table 4-3: Surface Stream Water Data Summary and Comparisons to Ecological Screening Levels	85 of 536	Maximum concentrations of potential COCs are basically at least an order of magnitude lower than screening levels. This is strong evidence that ecological risks to aquatic receptors are very low, if not negligible. Please consider emphasizing the gap between maximum concentrations and screening levels.	Screening levels are conservative and protective of freshwater aquatic life. As a result, concentrations of CCR Parameters below screening levels is already a strong LOE that there are no unacceptable risks. As such, no changes were made.
22	Tables	Table 4-4: Sediment Data Summary and Comparisons to Ecological Screening Levels	87 of 536	Although not as pronounced as surface water comparisons, the fact that all maximum detected concentrations of CCR parameters are below sediment screening levels is also strong evidence that ecological risks to aquatic receptors, including benthic macroinvertebrates, are very low, if not negligible.	Comment noted.
23	Tables	Table 4-5: Fish Filet Data Summary and Comparisons to Human Health Screening Levels	90 of 536	Table 4-5 has a second page added that contains no data. Extra page needs to be removed.	Formatting has been updated.
24	Tables	Table 6-1: COPECs Identified for the ERA	99 of 536	There are no data listed in Table 6-1.	Please note the various shading and symbols in the table are defined in the notes of the table (e.g., white cells indicate a CCR Parameter was either not detected or was detected below the respective screening levels).
25	Appendix C.1: EAR Statistical Analysis (Appendix E of the WBF Plant EAR)	Appendix E: Statistical Analysis (from EAR)	248 - 508 of 536	Please refer to the comments for statistical analyses that were presented in the comments from the review team for EAR Rev 0 and EAR Rev 1 and ensure these have been incorporated in the Appendix C.1 report version presented in this HHERA report.	Appendix C.1 as included in the HHERA is identical to the final 'Appendix E' submitted in the WBF Plant EAR that was revised based on previous received comments. The responses to previous comments and the revised WBF EAR (including Appendix E) were accepted by TDEC on May 14, 2024. As such, responses to previous comments have already been incorporated in the HHERA Appendix C.1.
26	Appendix C.1- EAR Statistical Analysis (Appendix E of the WBF Plant EAR)	Attachment E.1- A - Summary Statistics Tables	262- 264 of 536	Concerns remain about the recommendations of the underlying distribution for the derivation of UTLs from the ProUCL software were described in the TEAMs call with TVA and TDEC for the GAF CARA on March 25, 2024. Recommendations and suggested revisions to background soil BTVs were sent to all parties on the TEAMs call via email on March 25, 2024. These same concerns are relevant to the derivation of UTLs for the data from the WBF EAR. It does not appear that any of the UCLs that were presented in the EAR have been revised per the concerns presented in the May 25, 2024 presentation.	Comments regarding the data distributions relied on to evaluate UTLs that were adopted as soil background threshold values (BTVs) for WBF were received in the WBF EAR Comments. These comments were addressed in the responses to comments provided in the final WBF EAR that was accepted by TDEC on May 14, 2024. In the responses to comments provided in support of the final WBF EAR, it was also noted that the results for the background soil investigation may be re-evaluated if they are necessary to inform corrective action decisions.
27	Appendix C.1- EAR Statistical Analysis (Appendix E of the WBF Plant EAR)/Appendix E.4-Statistical Analysis of Seep Investigation	Attachment D.2 - Summary of Descriptive Statistics-	408 of 536	The DO meter that was used to obtain these DO measurements in this table either was not calibrated or needs service. Based on the measured water temps in the table, the maximum DO should be no higher than 9.7 mg/L. However, the DO readings in the table are as high as 11.65 mg/L.	As noted in the response to comments provided in the final WBF EAR (accepted by TDEC on May 14, 2024), the original data collection sheets were re-evaluated for the WBF seep investigation. Values used for the statistical evaluation are consistent with the original recorded results.
28	Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	Note "d" at the bottom of the table states that the 95% UCL was not calculated for cadmium at the ash pond; however, ProUCL output for cadmium for the ash pond is given in the ProUCL output in Appendix C.3-1. Please remove the ProUCL output for cadmium at the ash pond in Appendix C.3-1 for consistency with Note "d".	Appendix C.3-1 has been revised to exclude those COPCs associated with footnote 'd' in Table C.2-1 (cadmium and radium-226 for the Ash Pond).

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March 17, 2025

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29	Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	95% UCL is shown as 2.24 mg/kg as derived by KM (t-interval based) method. In the Appendix C.3 ProUCL Output, on page 493 of 536, there is a conflict in the results for the two GOF tests used to determine whether the 13 data values best fit a normal distribution. The Shapiro Wilk test indicated that the data do not fit a normal distribution (1% Type I error), while the Lilliefors test indicated that the data do fit the normal distribution (1% Type I error). On page 495 of 536, the ProUCL output states the following: "When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL." If there is a split decision of the GOF tests, the user is to move to the next distribution in line that has a unanimous GOF result for the given distribution. This would mean that the gamma distribution is to be used per ProUCL instructions. Even though the ProUCL output indicates to use the 95% KM (t), in my discussions with the developers of ProUCL, this is the intended protocol to follow. This was also verified in CEC's distribution fitting work performed in March 2024 for the GAF site. As a result, the 95% KM Adjusted Gamma UCL is the preferred estimate to use.	As noted by the reviewer, the 95% KM (t) UCL (2.24 mg/kg) was selected as the EPC for cadmium in CCR material (slag disposal area) relied on in the HHERA. It is noted in the ProUCL guidance that the t-UCL is very robust to deviations from assumptions of normality and "can be applied to most data sets in cases where assumptions about normality of the underlying distributional form may be violated", while gamma UCLs and lognormal H-UCLs are considered much more sensitive to underlying distributional assumptions. It is also noted in the ProUCL guidance that there are limitations around the accuracy of GOF tests for smaller sample sizes (e.g., <20). Given the sample size (n=13), the limitations of applying normality testing to such a sample size, and the robust nature of the t-UCL as described above, the conclusion of 'approximate normal' was considered sufficient to support adoption of the 95% KM (t) UCL in this case. In addition, a second evaluation of the distribution using the ProUCL GOF module wherein the single non-detect value was replaced with a normal ROS estimate found both Shapiro-Wilk and Lilliefors to agree that data appear normal at a 1% significance level, which further supports the assumption of normality. Finally, it is noted that the ProUCL guidance also indicates in Section 2.2.1.3 that when sample sizes are smaller and the conclusions of two different distribution tests result in different conclusions, "the collective project team should determine which conclusion to use in the decision making process.". Therefore, given the rationale provided above to support adoption of the 95% KM (t) UCL in this case and given that both the selected value (2.24 mg/kg) and the 95% KM Adjusted Gamma UCL value suggested by the reviewer (3.78 mg/kg) are less than the identified human health screening level for cadmium in soil/CCR material of 5.4 mg/kg (see Table 3 in Appendix B.1), this selection would not affect the conclusions of the risk assessment. Therefore, the project team continues to support the selection of 2.24 mg/kg as the EPC for cadmium in CCR material (slag disposal area) in this case.
30	Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	How was the mean calculated in the table for cadmium for the Slag Area? Was the non-detect set to the reporting limit and the arithmetic mean performed or was KM used?	Please note consistent with the column heading "Mean Concentration for Detected Results", the mean was calculated as an arithmetic mean using detected results only and does not include the non-detect result.
31	Appendix C.2 - Exposure Point Concentrations	TABLE C.2-1 - CCR Material Data Summary and Exposure Point Concentra-tions for COPCs	483 of 536	Note "d" at the bottom of the table states that the 95% UCL was not calculated for Radium 226 at the ash pond; however, ProUCL output for Radium 226 for the ash pond is given in the ProUCL output in Appendix C.3-1. Please remove the ProUCL output for Radium 226 at the ash pond in Appendix C.3-1 for consistency with Note "d".	Please see response to comment #28.

DRAFT

Department of Environment & Conservation

July 8, 2024

Shawn Rudder
Sr. Manager
Waste Permits, Compliance, and Monitoring
Tennessee Valley Authority
1101 Market Street, BR 4A
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC15-0177
TVA Watts Bar Coal Fired Fossil Fuel Plant
Corrective Action/Risk Assessment Plan Revision 0 Extension Request

Dear Mr. Rudder:

The Tennessee Department of Environment and Conservation (TDEC) has received the Tennessee Valley Authority's (TVA) letter requesting an extension per Section VII.C of Commissioner's Order OGC 15-0177 for the TVA Watts Bar Coal Fired Fossil Fuel Plant (WBF) Corrective Action/Risk Assessment (CARA) Plan Revision 0 to September 6, 2024. TDEC approves the request for extension.

Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 598-3272.

Sincerely,

Robert Wilkinson, P.G., CHMM
CCR Technical Manager

CC:

Pat Flood	Angela Adams	James Clark
Rob Burnette	Chris Vail	Caleb Nelson
Judy Low	Ahmet Bulbulkaya	Brian Fowler
Brandon Boyd	Anna Fisher	Roy Quinn
Julie Arp		

Bureau of Environment • Davy Crockett Tower, 5th Floor
500 James Robertson Parkway • Nashville, TN 37243
Cell: (615) 598-3272
Robert.S.Wilkinson@tn.gov
www.tn.gov/environment

DRAFT

Department of Environment & Conservation

December 17, 2024

Shawn Rudder
Sr. Manager
Waste Permits, Compliance, and Monitoring
Tennessee Valley Authority
1101 Market Street, BR 4A
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC15-0177
TVA Watts Bar Coal Fired Fossil Fuel Plant
Corrective Action/Risk Assessment Plan Revision 0

Dear Mr. Rudder:

The Tennessee Valley Authority (TVA) submitted the Corrective Action/Risk Assessment (CARA) Plan Revision 0 for the TVA Watts Bar Coal Fired Fossil Fuel Power Plant (TVA WBF) on September 6, 2024. The Tennessee Department of Environment and Conservation (TDEC) has completed its review of the submittal and is providing comments in the attached table (Attachment 1).

TDEC requested that our subcontractor, Civil & Environmental Consultants, Inc. (CEC), provide subject matter experts to assist in the review of the CARA Plan Revision 0. CEC and their technical consultants, Energy and Environment, and Environmental Information Logistics, LLC have completed their review and provided comments in the attached table (Attachment 2).

Please address the attached comments in an updated document (CARA Plan Revision 1) with a cover letter summarizing TVA's response to each comment and subsequent modifications to TDEC no later than March 17, 2025.

Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 598-3272.

Sincerely,

Robert Wilkinson, P.G., CHMM
CCR Technical Manager

CC:			
	Pat Flood	Angela Adams	James Clark
	Rob Burnette	Chris Vail	Caleb Nelson
	Judy Low	Ahmet Bulbulkaya	Brian Fowler
	Anna Fisher	Brandon Boyd	Tabitha Esther

Department of Environment & Conservation

Attachment 1

Bureau of Environment • Davy Crockett Tower, 5th Floor
500 James Robertson Parkway • Nashville, TN 37243
Tel: 615-598-3272

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Section Number	Section Title	Page	Paragraph	Line	Comment
Exhibit ES-1	Planned WBF Plant CCR Unit Closure and Corrective Actions Implementation Schedule	12 of 128	NA	NA	Please label the Former Coal Yard Storage Area and the upgradient ponded area (Closed Metal Cleaning Pond) that are described on page vii as areas that will be subject to additional actions. The drainage improvements area is not clearly delineated. See Exhibit 5-1 for a more thorough delineation of this area. Also, from the figure it is not clear what the Areas of Interest represent. Why not describe them as potential seeps as is done in subsequent exhibits?
Abbreviations	NA	13 of 128	NA	NA	Please add TM to abbreviations.
3.2	Overall Environmental Investigation Findings	38 of 128	6th Bullet	NA	The first mention in the text of the AOIs is the following: *"During the EI, three Areas of Interest (AOIs) were identified east of the Slag Disposal Area along the Tennessee River bank. Based on the EI data and using the supplemental investigation results, additional evaluation of the AOIs was recommended and is addressed in this CARA Plan. No AOIs were identified near the Ash Pond."* It would be much clearer to the reader if the AOIs are clearly described as potential seeps, as is indicated by the Table on Page 26 and in some of the exhibits. It almost appears that there is a reluctance to describe the AOIs as potential seeps. In general, more information should be provided regarding the investigative history of these areas - why are they a concern? What has the EI data indicated? If there reasons for not referring to the AOIs as potential seeps please explain. Also, it is unclear what additional evaluations have occurred, and how additional evaluation is addressed in the CARA plan. Please explain.
3.2	Overall Environmental Investigation Findings	39 of 128	Table (Summary of Findings Requiring Further Evaluation in the CARA Plan)	NA	This table, with the fourth column heading of *"Seeps"*, indicates that the Areas of Interest are potential seeps. Additional information related to the phrase *"...Requiring Further Evaluation..."* will be helpful in relation to the potential seeps. Has the further evaluation happened or is it planned? If it is planned, what exactly is planned?

DRAFT

Section Number	Section Title	Page	Paragraph	Line	Comment
4.1.1	Onsite Worker	41 of 128	2 and 3	NA	The following two sentences end section 4.1.1 on Page 28: *"Estimated risks to an onsite worker potentially exposed to CCR material within the Ash Pond are greater than the noncancer threshold of one; however, implementing standard health and safety protocols is expected to lower any potential risks." "These findings support the conclusion that there are no unacceptable risks for an onsite worker potentially exposed to CCR material while making short-term repairs to the Slag Disposal Area and that the potential risk to a worker exposed to CCR material within the Ash Pond can be managed through standard health and safety protocols."* Rather than solely relying on managing risks *"through standard health and safety protocols"* it is preferred that the uncertainties associated with the arsenic and thallium toxicity values used for the risk calculations, as pointed out in the Weight of Evidence section (Section 5.3.4) of the HHERA, are brought more into the CARA Plan risk summary discussion. The fact that the non-cancer risks are can be considered non-additive is an important one. This results in separate HQs of 1.2 for arsenic and 0.49 for thallium. Also legitimate lines of evidence include using chronic values for sub-chronic exposures. Also, the phrase *"can be managed through standard health and safety protocols"* can be interpreted as implying a program of active management of health and safety procedures for on-site workers beyond reliance on existing OSHA health and safety protocols. If this is what is intended please provide additional details about how such a program will be managed by TVA.
5.5	Planned CCR Unit Closure Method	56 of 128	NA	NA	Did TVA consider CBR of the Slag Disposal Area only? Given the demonstrated performance of the already completed CIP of the Ash Pond, it seems that evaluating CBR for both units concurrently could potentially skew the evaluation results.
5.5	Planned CCR Unit Closure Method	57 of 128	Bullet Point 5	NA	*"CIP, in conjunction with upgradient drainage modifications, is anticipated to address three AOIs identified along the eastern edge of the Slag Disposal Area. Installation of a geosynthetic cover system over the Slag Disposal Area, the adjacent Drainage Improvements Area, and western ponded area, along with upgradient drainage modifications including removal of remnant coal at the Former Coal Yard Storage Area, will promote positive drainage around the Slag Disposal Area and further control and minimize infiltration through the cover system into this CCR unit, thereby further minimizing post-closure escape of CCR constituents."* It is unclear what aspect of the AOIs needs to addressed. Please clarify and explain.

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Section Number	Section Title	Page	Paragraph	Line	Comment
5.5.2.2	Slag Disposal Area Closure-in-Place	66 of 128	2	NA	*"In conjunction with the installation of a geosynthetic cover system, it is expected that the collective drainage modifications planned will serve to address AOI2, AOI3, and AOI4 located adjacent to this CCR unit. As described in Chapter 2.1.1.2, the Drainage Improvements Area Project was previously conducted based on historical seepage identified at the WBF Plant. As noted in the EAR findings, following implementation of that project, the historical seepage was observed to cease. Based on the performance of these past drainage modifications, it is anticipated that the planned closure and drainage modifications included in this CARA Plan will address the three AOIs identified at this CCR unit."* It is unclear what needs to be addressed. Please clarify and explain.
6.5.5.1	Corrective Measures Considered and Assessed	76 of 128	NA	NA	Please define TM.
7.1	Natural Resource Restoration Plan	81 of 128	NA	NA	Will the installation of the buttress require any natural resource restoration or mitigation?
Exhibit 3-2	Slag Disposal Area Cross-Section A-A' Conceptual Site Model	120 of 128	NA	NA	In this exhibit the AOIs are listed under the heading Potential Seeps. However, their approximate location is not depicted in the figure. The description of the AOIs states in part that – *"Based on the EI data, and using the supplemental investigation results, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed."* Please explain the chronology of the supplemental investigations. When will the further evaluation occur?
Exhibit 3-4	Overall Findings Near WBF Plant CCR Units	122 of 128	NA	NA	In this exhibit, the locations of the AOIs are clearly represented. The description of the seeps is the same as Exhibit 3-2: *"Based on the EI data, and using the supplemental investigation results, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed."* When and how will further evaluation happen?

Department of Environment & Conservation

Attachment 2

Bureau of Environment • Davy Crockett Tower, 5th Floor
500 James Robertson Parkway • Nashville, TN 37243
Tel: 615-598-3272

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Section Number	Section Title	Page	Paragraph	Line	Comment
ES	Executive Summary	12 of 128	NA	NA	Exhibit ES-1: If the aerial is in plan view, recommend including a scale.
2.2.2	Surface Water Hydrology	26 of 128	1	5	Does the former small tributary to the Tennessee River following an alignment through the Slag Disposal Area have the potential to present a preferential pathway for constituent transport? The sand/shale interface at WBF-B03 was at an elevation of 664.6, while the sand/shale interface at WBF-104 is at elevation 666.6.
2.2.5	Uppermost Aquifer and Groundwater Flow	33 of 128	1	3	The text states: "Groundwater in the confined aquifer is not in contact with the CCR material inside the CCR units where the aquitard is present because the aquitard physically separates them." Are there areas where the aquitard is not present specifically with respect to the eastern portion of Slag Disposal Area? Do the figures on Pg 16 and 17 show CCR material underlain by alluvial sand or bedrock?
2.2.5	Groundwater Flow Directions, Boundaries, and Divides	34 of 128	NA	NA	Recommend scale for figure.
Chapter 4	Human Health and Ecological Risk Assessment Summary	40 of 128	2	4	*"Estimated risk to an onsite worker potentially exposed to CCR material within the Ash Pond are greater than the noncancer threshold of one; however, implementing standard health and safety protocols is expected to lower any potential risks."* Please provide more detail related to arsenic exposure and what specific health and safety changes would be needed to reduce the noncancer exposure risks.
5.4.3	Key Site-Specific Considerations	55 of 148	3	1	Please explain how much land would need to be available for a landfill to support the CBR option. Could partial CBR be used in a CCR consolidation scenario? Could the Former Coal Yard be used as a CCR landfill? That would eliminate or reduce a large number of the off-site health and safety concerns as well as long term groundwater and stability concerns.
6.5	Planned CCR Unit Corrective Actions	75 of 128	1	NA	The text states that the *"time required to achieve this condition where GWPS have been attained and would be maintained without continued corrective action is uncertain due to a variety of factors* ". Please define the factors. Can this time required to achieve this be modeled?

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Section Number	Section Title	Page	Paragraph	Line	Comment
6.5.1.1	Corrective Measures Considered and Assessed	76 of 128	5	2	How will pH adjustment affect non-target metals species? Given the alluvial sands and the hydraulic connection to the Tennessee River, is pH-adjusted groundwater expected to mix with surface water?
6.5.1.1	Corrective Measures Considered and Assessed	76 of 128	5	3	As part of full-scale system design, recommend examining geochemical transformations with the potential to impart changes to the formation matrix (e.g. reduced permeability) and/or foul the horizontal reagent injection system.
6.5.1.2	Planned Corrective Action	79 of 128	NA	NA	Will the Seismic Mitigation - Toe Berm Buttress obscure the interface between treated groundwater and surface water?
6.6	CCR Unit Corrective Action Summary	80 of 128	5	3	The text states: *"The time required to achieve this condition where GWPS have been attained and would be maintained without continued corrective action is uncertain due to a variety of factors, but routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a five- to 10-year timeframe."* A groundwater model is used to demonstrate source control. Will a fate and transport model be developed to support the attenuation of concentrations of target constituents in groundwater moving downgradient of the Slag Disposal Area?
Exhibit 6-1	Planned WBF Plant CCR Unit Groundwater Corrective Actions	126 of 128	NA	NA	Boring logs in the vicinity of the Tennessee River indicate interbedded/lenses of clays and silts within the saturated alluvium (WBF-B03). How will a horizontal well distribute sodium hydroxide across lower permeability sequences? Or are stacked horizontal wells being considered given the thickness of the unit and the anisotropy between horizontal and vertical permeability?

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix C Closure Method Assessment TM	2.2	57 of 623	3	1-2	Please explain how much land would need to be available for a landfill to support the CBR option. Could partial CBR be used in a CCR consolidation scenario? Could the Former Coal Yard be used as a CCR landfill? That would eliminate or reduce a large number of the off-site health and safety concerns as well as long term groundwater and stability concerns.
Appendix C Closure Method Assessment TM	Table 1	83 of 623	1		60 truck loads per day appears to be a low estimate. What were the assumptions used to determine this number?
Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	2.2	143 of 623	2	7	The question needs to be addressed somewhere in the final CARA as to specifically how we going to define the exit from corrective action status relative to the Upper Confidence Limits about the mean and comparisons to GWPS for each of the constituents of concern. Per the TDEC Solid Waste Policy and Guidance Manual (updated September 2023), page 43, Phase 3 assessment is considered "complete when contamination is below GW protection standards for 3 years or alternate DSWM established timeframe". This requirement is per TDEC solid waste regulations given in 0400-11-01-.04(7)(a)9(v)(II), which specifically states "Compliance with the ground water protection standard has been achieved by demonstrating that concentrations of constituents listed in Appendix II of this rule have not exceeded the ground water protection standard(s) for a period of three consecutive years using approved statistical procedures and performance standards." The "approved statistical procedures" are provided in the US Environmental Protection Agency's (EPA) Unified Guidance, which states that the entire confidence interval for the mean for the given well/constituent pair of concern must be below the Groundwater Protection Standard (GWPS) to demonstrate compliance in corrective action. Specifically, this involves demonstrating that the upper 95% confidence limit about the mean for a one-sided interval is below the GWPS for three consecutive years.

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	2.2	143 of 623	4	4	Do the additional groundwater data collection during the CARA Plan finalization and corrective action final design processes include delineating the extent of impact surrounding WBF-104 and WBF-106?
Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	2.2	143 of 623	5	1-5	Given the thickening alluvial sequences approaching the Tennessee River, was a groundwater extraction with a paired slurry wall considered for mitigating potential backflow from the Tennessee River?
Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	3.1.1.2	146 of 623	Entire Section	NA	A couple of big picture questions after reviewing this section and Appendix I.1 for NaOH/NaHCO3 injection near WBF-104 and 106 associated with the Slag Disposal Area: 1) Besides the adsorption of Co and Cd on the surface of ferrihydrite and cation exchange on the surface of clays, is it also possible that the precipitation of calcite, MgCO3, BaCO3, and other carbonate based precipitates are also acting as a sorption surface for the Co and Cd? I did not see any analysis for bicarbonate alkalinity in the analysis of the groundwater in the bench scale treatments. Was this analysis performed? Are we saturated with respect to certain carbonate constituents in the groundwater? 2) What happens after treatment ends? The pH will return to 6 or less. What mechanism will keep the adsorbed Co and Cd from re-mobilizing into the groundwater (i.e., re-bound) when the NaOH injection permeable reactive barrier system is no longer operational? Is source reduction via pore water removal and capping of the slag disposal area expected to eventually lower Co and Cd to levels that, even with Co and Cd re-mobilization, the total concentrations for both metals will still be below GWPS? Will the post treatment anticipated results for groundwater quality be demonstrated as part of the final CARA plan?

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	3.1.1.2	146 of 623	Entire Section	NA	As part of the bench scale treatability studies, were other metals analyses performed for the microcosm and column tests (or are planned for the pilot study) other than those shown in the Tables of APPENDIX I.1 - IN SITU TREATMENT TECHNICAL MEMORANDUM - DRAFT? Specifically, what about impacts to the mobility of, for example, Chromium (VI) and nickel as the pH of the groundwater is raised to 8 to 8.5?
Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	Exhibit 1	156 of 623	NA	NA	What criteria were used to determine the lengths of the in-situ treatment areas? Are the treatment areas intended to fully capture groundwater impacts?
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	5.2	237 of 623	6	1	Text states: *"Hydraulic conductivity was a primary calibration variable and is discussed more in Section 0."* Please correct the reference.
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	5.3	239 of 623	4	2	"**Error! Reference source not found**" - error associated with reference back to section within the Table of Contents.

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	5.3.2	240 of 623	2	4	Text states: *"Sensitivity of the model results to change in river stage will be evaluated and the results included in the revised Technical Memorandum to be submitted with the Draft CARA Plan."* Update accordingly.
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	6.3	243 of 623	1	10	"**Error! Reference source not found**" - error associated with reference back to section within the Table of Contents.
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	7.1	245 of 623	1	1	The recharge/surface water volumetric flow split (48%/52% respectively to 91%/9% respectively) titled significantly towards recharge in the updated steady state model. Please explain which boundary conditions triggered this change and the rationale for making the change. Does the change in volumetric flow split now significantly in favor of recharge have the potential to overestimate recharge improvements under the CIP scenario?
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.1.2	247 of 623	NA	NA	Statement is made in report that *"The units of flux are typically provided in cubic feet per day (cfd) or gallons per minutes (gpm).* " However, units of flux are given in flow/cross-sectional area, for example as gallons per minute/ ft^2. When the flux values are given in the CARA as gpm, are these "flux" values already taking the entire cross-sectional area of a given zone or boundary into account so that the "flux" value is actually the total flow rate across the boundary?

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.3.1.2	252 of 623	2	1	A DRN package is typically used to model drainage systems like ditches or tile drains, while WEL package is used to represent pumping wells or recharge wells. Please comment why the DRN with a set drain elevation was better suited for a vertical extraction well scenario versus a well with a programmed extraction rate under the WEL package. Was the drain extraction rate quality cross-checked by modeling an extraction well?
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.3.1.2	252 of 623	2, 7	2, 2-3	The text states that a steady state simulation was completed and that steady state "particle traces were examined to determine if the proposed well layout and target pumping elevations would capture the particles and demonstrate hydraulic control." Were any transient simulations run to determine the approximate elapsed time between activating the pump well and establishing groundwater capture at the southern end of the Slag Disposal area?
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.3.1.2	252 of 623	4	4	Recommend that additional delineation and additional pumping tests will be required during the design phase to refine the design of the extraction systems if selected. Hydraulic conductivity data derived from slug tests have the potential to not fully represent larger scale aquifer properties and yield. Given the potential variability of alluvial sequencing to influence the hydrogeology at scale, additional field testing in the design phase is recommended.
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	Exhibit 14b	282 of 623	NA	NA	Is a label missing for "Plant-Specific Estimates"?
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	Exhibit 28	298 of 623	NA	NA	On the northern side of the Slag Disposal Area, does particle tracking near the sheet piles as a modeled as a horizontal flow barrier indicate a mitigation of back flow from the Tennessee River/Constant Head Boundary?

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	Exhibit 29	299 of 623	NA	NA	The historical stream alignment is indicated on the exhibit. Please comment on the historical stream and the effect on pore water extraction.
Appendix H.1 - Geochemical Modeling Technical Memorandum - Draft	8.1, 8.1.1, and 8.1.1.1	332 of 623	1	12	Statement is provided as follows: *"In contrast with cobalt, the cadmium reported in groundwater at well WBF-104 is interpreted to be sourced from complexation with sulfate."* What are the test results or geochemical modeling results that is the basis of this interpretation that cadmium is primarily from sulfate complexes?
Appendix H.1 - Geochemical Modeling Technical Memorandum - Draft	8.3.2	335 of 623	2	8	Along with the previous comment, the following statement is made in the report: *"For cadmium, it was interpreted that cadmium concentration reported at WBF-104 was controlled by the complexation with sulfate. Thus, the amount of iron hydroxide available to facilitate adsorption is insensitive to cadmium attenuation at the WBF Plant."* Where is the pE/pH diagram for Cadmium species in the CARA Plan? Cadmium sulfate is highly soluble. Precipitation of cadmium sulfate would require high concentrations of cadmium and sulfate. Do model results show geochemical conditions that are conducive for cadmium sulfate precipitation?
Appendix H.1 - Geochemical Modeling Technical Memorandum - Draft	Exhibit 6	344 of 623	NA	NA	What is the proposed explanation for the steep decline in cadmium concentrations at approximately year 120 at WBF-104? What are the geochemical mechanisms behind this steep drop?

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix H.2 - Geochemistry Investigation Fieldwork Summary and Evaluation	4.2.3	365 of 623	1	7	Based on this summary paragraph on CEC capacity in the Slag Disposal area soils, cation exchange with clays is expected to play a minor role in Co and Cd attenuation at this site. However, total organic carbon (TOC) was of sufficient concentrations to impact ORP. Are there plans to incorporate organic carbon sorption to the geochemical modeling for the next phase of the CARA Plan? Also, based on the mineral phase testing in Section 4.2.2.1, and geochemical modeling, will there be sufficient mineral-phase sorption sites for Co and Cd in order to sufficiently reduce concentrations below GWPS, since clay cation exchange capacities are low.
Appendix H.2 - Geochemistry Investigation Fieldwork Summary and Evaluation	4.2.3	365 of 623	2	3	Since TOC is sufficiently high enough to affect ORP, once the slag disposal area is to be capped, it would appear that the ORP in the groundwater below the slag disposal area will move to more reducing conditions, since O2-rich rainwater infiltration over the slag disposal area will be dramatically decreased (coupled with the degradation of natural organic matter). Based on geochemical modeling, how low is the ORP expected to decrease during this time of natural organic matter degradation? Will the ORP drop enough to dissolve iron minerals and decrease the number of sorption sites for Co and Cd? How long will this phase of more reducing conditions last?
Appendix H.2, Attachment A - Surface Water Investigation Summary - Draft	Table 1	406 of 623	NA	NA	Dissolved oxygen readings for WBF-SW-04 and WBF-SW-07 are higher than saturated dissolved oxygen limitations for the freshwater samples taken for water temperatures of 10.2 C (at WBF-SW-04) and 20.1 C (at WBF-SW-07). D.O. was listed as 12.12 mg/L for WBF-SW-04 which exceeds the saturation limit of 11.2 mg/L at 10.2 C. D.O. was listed as 10.85 mg/L for WBF-SW-07 which exceeds the saturation limit of 9.07 mg/L at 20.1 C.
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.1.2	425 of 623	4	16	The following statement is provided in this section: *"Lithium in SB05 and SB02 and cadmium in SB02 were not identified above the laboratory detection limit in the exchangeable fraction, which is the extraction step most indicative of geochemically reactive lithium and cadmium."* Since only two soil samples were extracted as part of the bench scale studies, there is considerable uncertainty associated with the results due to the heterogeneity of the soils under the slag disposal area. The fact that no lithium was detected in the extraction fraction of the abovementioned soil samples certainly affects/skews the outcomes from the bench scale simulations relative to assessing the potential secondary response mobility of lithium under the simulations.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.2.2	428 of 623	NA	NA	Report states: "*Molybdenum and lithium concentrations were not analyzed in the NaOH reagent demand tests but were tested in the NaHCO3 reagent demand test and subsequent phases.*" Based on the previous comment, lithium was not detected in the extraction phase for the 2 soil samples used in the testing, so Li would not be expected to mobilize to appreciable levels during the reagent demand testing.
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.2.2	429 of 623	NA	NA	Regarding reagent demand testing results, the report states: *"Similar to results at WBF-104, the reagent demand tests indicated that, except for limestone, increasing the groundwater pH in the vicinity of monitoring well WBF-106 decreased cobalt concentrations."* The results for pH adjustment using NaOH are expected to be more favorable than limestone and NaHCO3 due to reaction kinetics associated with the use of a strong base. One question is relative to the use of a strong caustic and the costs and maintenance and safety issues associated with operating an injection system long-term with this material. It may be worthwhile to keep NaHCO3 under consideration as an option for pH control for the pilot testing. NaHCO3 will not react as fast as NaOH and will require more material amounts but should ultimately move the pH to the optimal range of 7.5 to 8.
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.3 and 2.4.3.1	429 of 623	1	NA	Why was there not a microcosm test for WBF-104 for NaHCO3?

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Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.3 and 2.4.3.2	430 of 623	NA	NA	Bullets 4 and 6 demonstrate the potential for releasing secondary anions into the groundwater as a result of raising the pH, with arsenic and molybdenum increasing in concentration in response to the NaOH reaction to raise groundwater pH. This should be thoroughly investigated as part of the pilot testing and final geochemical modeling of the groundwater for the slag disposal site. Bullet 5 mentions no lithium increases in the groundwater but the soil samples used for the test do not have detected concentrations of lithium in the exchangeable fraction. Lithium increases in groundwater as a result of pH adjustment increases (due to desorption and formation of soluble lithium complexes) are also a concern and should be evaluated as part of the pilot test analyses.
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.4 and 2.4.4.2	433 of 623	NA	NA	Could the fact that the concentrations of cobalt and cadmium decreased but did not reach their targeted GWPS be due to the possibility that all of the available sorption sites for Co and Cd at the beginning of the test were ultimately exhausted early on (i.e., Day 9)?
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.4 and 2.4.4.2	435 of 623	NA	NA	Report states: *"Similar to WBF-104, results from the column test conducted with media from the area surrounding monitoring well WBF-106 indicate that the dose of NaOH applied to the influent groundwater raised pH to the target range of 7.00 to 8.00 SU and resulted in significant decreases in dissolved cobalt. However, cobalt concentrations were not reduced to below the GWPS and suggest the target pH could have been set at a higher level."* Could it be that the available sorption sites in the soil media provided for the test assembly became saturated and perhaps a pH increase beyond 8 would not make a difference?
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.5	435 of 623	NA	NA	Was the alkalinity analyzed as part of the column tests and supplemental column tests? Could there be carbonate based precipitates forming inside the column, acting as a further sink and providing sorption sites for metals, as well as arsenic?
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.7	440 of 623	3	1	If the *"dominant mechanism of attenuation assessed in this study was cobalt and cadmium sorption through pH adjustment"* , do the kinetics allow for desorption/mobility of other constituents to occur?

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Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	Table 10	463 of 623	NA	NA	Microcosm results suggest maintenance of elevated pH is required for mitigating constituent concentrations. Assuming source control is successful, will performance monitoring points between the source and injections be added to the groundwater monitoring program to determine when the injections can terminate?
Appendix L - Seismic Stability Mitigation Evaluation	2.1	607 of 623	1	1	Please provide evaluation sheets for all alternatives considered.
Appendix L - Seismic Stability Mitigation Evaluation	3.1	609 of 623	2	3	What is the anticipated design life?

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1	TDEC	Exhibit ES-1	Planned WBF Plant CCR Unit Closure and Corrective Actions Implementation Schedule	12 of 128	Please label the Former Coal Yard Storage Area and the upgradient ponded area (Closed Metal Cleaning Pond) that are described on page vii as areas that will be subject to additional actions. The drainage improvements area is not clearly delineated. See Exhibit 5-1 for a more thorough delineation of this area. Also, from the figure it is not clear what the Areas of Interest represent. Why not describe them as potential seeps as is done in subsequent exhibits?	Exhibit ES-1 has been updated to include the labels requested. Please note that although the Former Metal Cleaning Pond is now labeled, additional closure actions are not planned for that location. Additional closure actions are planned for the 'upgradient ponded area' that is now also labeled on this exhibit. Please see response to Comment #3 regarding use of the term 'AOI'. Text has been added to the Executive Summary, and Chapters 1.2 and 3.2 to define the term AOI within the CARA Plan.
2	TDEC	Abbreviations	NA	13 of 128	Please add TM to abbreviations.	This acronym has been removed from text, so the abbreviation is no longer necessary to be added.
3	TDEC	3.2	Overall Environmental Investigation Findings	38 of 128	The first mention in the text of the AOIs is the following: *"During the EI, three Areas of Interest (AOIs) were identified east of the Slag Disposal Area along the Tennessee River bank. Based on the EI data and using the supplemental investigation results, additional evaluation of the AOIs was recommended and is addressed in this CARA Plan. No AOIs were identified near the Ash Pond."* It would be much clearer to the reader if the AOIs are clearly described as potential seeps, as is indicated by the Table on Page 26 and in some of the exhibits. It almost appears that there is a reluctance to describe the AOIs as potential seeps. In general, more information should be provided regarding the investigative history of these areas - why are they a concern? What has the EI data indicated? If there reasons for not referring to the AOIs as potential seeps please explain. Also, it is unclear what additional evaluations have occurred, and how additional evaluation is addressed in the CARA plan. Please explain.	Additional information regarding the EI findings for these AOIs has been added to Chapter 3.2. Text also has been added to the Executive Summary, and Chapters 1.2 and 3.2 to define the term AOI within the CARA Plan to be consistent with nomenclature from previous submittals. Referring to the AOIs only as potential seeps excludes other potential contributing factors such as potential drainage issues. Further evaluation of the AOIs was conducted to identify if corrective actions are needed. Two lines of evidence indicate that no corrective actions are needed and that the AOIs would be mitigated by the planned closure actions as discussed below and described in Chapters 5.5 and 5.5.2.2. - First, the former surface stream that was shown on the 1935 topographic map that flowed through the footprint of the Slag Disposal Area and could be a preferential flow path was further evaluated. During the EI, cone penetration testing (CPT) was conducted at the approximate intersection of the former surface stream with the boundary of the Slag Disposal Area. The conclusion of the CPT evaluation was that soils in the vicinity of the stream alignment were similar to soils in other nearby areas (see Appendix G.1 of the EAR). A preferential flow path was not identified. In addition, comparison of the 1935 and 1942 topographic maps indicates that the stream was mislocated on the 1935 map and did not traverse the location of the Slag Disposal Area and is not a preferential pathway for groundwater flow. - Second, the HHERA concluded that there are no unacceptable risks to offsite human or ecological receptors associated with the WBF Plant CCR units (see Chapter 4 and Appendix B). As documented in the HHERA, these AOIs were considered incomplete pathways for direct contact because they were covered by riprap, and exposures to receptors were evaluated using Tennessee River surface stream water and sediment sampling data. Based on the incomplete pathway for the AOIs, and the overall finding of no unacceptable risks, corrective actions for the AOIs are not warranted. The AOI risk assessment considerations have been added to Chapter 4.0. Closure activities, removal of remnant coal, and drainage modifications (including actions at the upgradient ponded area) planned for the Slag Disposal Area described in Chapter 5.5.2.2 are expected to mitigate the AOIs, and as described in Chapter 7.2.5, TVA will implement AOI monitoring following completion of CCR unit closure activities to document AOI conditions.
4	TDEC	3.2	Overall Environmental Investigation Findings	39 of 128	This table, with the fourth column heading of *"Seeps"* , indicates that the Areas of Interest are potential seeps. Additional information related to the phrase *"...Requiring Further Evaluation..."* will be helpful in relation to the potential seeps. Has the further evaluation happened or is it planned? If it is planned, what exactly is planned?	The column header in the summary table has been revised to 'AOIs'. See response to Comment #3.

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5	TDEC	4.1.1	Onsite Worker	41 of 128	The following two sentences end section 4.1.1 on Page 28: *"Estimated risks to an onsite worker potentially exposed to CCR material within the Ash Pond are greater than the noncancer threshold of one; however, implementing standard health and safety protocols is expected to lower any potential risks." "These findings support the conclusion that there are no unacceptable risks for an onsite worker potentially exposed to CCR material while making short-term repairs to the Slag Disposal Area and that the potential risk to a worker exposed to CCR material within the Ash Pond can be managed through standard health and safety protocols."* Rather than solely relying on managing risks *"through standard health and safety protocols"* it is preferred that the uncertainties associated with the arsenic and thallium toxicity values used for the risk calculations, as pointed out in the Weight of Evidence section (Section 5.3.4) of the HHERA, are brought more into the CARA Plan risk summary discussion. The fact that the non-cancer risks are can be considered non-additive is an important one. This results in separate HQs of 1.2 for arsenic and 0.49 for thallium. Also legitimate lines of evidence include using chronic values for sub-chronic exposures. Also, the phrase *"can be managed through standard health and safety protocols"* can be interpreted as implying a program of active management of health and safety procedures for on-site workers beyond reliance on existing OSHA health and safety protocols. If this is what is intended please provide additional details about how such a program will be managed by TVA.	The referenced paragraph has been revised as indicated below to include additional lines of evidence provided in the weight of evidence of the HHERA (Appendix B) and clarification of standard health and safety protocols. "Using the estimated exposures and published toxicity data, risk estimates for the onsite worker are below acceptable state thresholds for cancer and noncancer risk, except for an onsite worker potentially exposed to CCR material within the Ash Pond through incidental ingestion and dermal contact while making short-term repairs. Estimated risks to an onsite worker potentially exposed to CCR material within the Ash Pond are greater than the noncancer threshold of one, and were attributable to arsenic (1.2) and thallium (0.49). However, these risks are likely overestimated because their effects are not likely to be additive and chronic toxicity values protective of long-term exposures were conservatively used for arsenic to estimate the sub-chronic effects of short-term exposures. Further, when TVA's standard health and safety protocols are applied, such as wearing appropriate protective clothing, potential risks to onsite workers are expected to be lower than estimated. **These findings support the conclusion that there are no unacceptable risks for an onsite worker potentially exposed to CCR material while making short-term repairs to the Slag Disposal Area and that the potential risk to a worker exposed to CCR material within the Ash Pond can be managed through standard health and safety protocols."** Based these revisions, the use of the term 'standard health and safety protocols' has been retained and used in the CARA Plan main text.
6	TDEC	5.5	Planned CCR Unit Closure Method	56 of 128	Did TVA consider CBR of the Slag Disposal Area only? Given the demonstrated performance of the already completed CIP of the Ash Pond, it seems that evaluating CBR for both units concurrently could potentially skew the evaluation results.	In this and prior CARA Plans, TVA individually evaluated each CCR unit for potential impacts associated with CBR or CIP. This approach was used to provide both an individual comprehensive relative comparative assessment for each CCR unit and a site-wide relative assessment that rolls up impacts from each of the units requiring closure at the TDEC Order plant. Appendix C presents resource impacts in CCR unit-specific comparison tables for both closure methods and provides a summary of both the individual and site-wide relative assessment in the Appendix C text and in Section 5.2 of the Main CARA text. The intent of the site-wide summaries is not to skew the findings one way or another, but to summarize the impacts of a site-wide CIP or CBR approach based on identified unit-specific impacts. This provides TDEC and the public with the range of potential impacts associated with each closure method. TVA acknowledges that there are a variety of possible hybrid closure alternatives which involve one CCR unit utilizing CIP while another utilizes CBR, or different consolidation scenarios. Site-wide CIP and CBR closure scenarios are introduced in the CARA Plan to present the spectrum of potential impacts possible. Hybrid closure combinations as suggested in this comment would already be within the ranges presented in the individual CCR unit comparisons. The impacts presented in the relative closure method assessment are used alongside regulatory closure requirements and schedules, facility operational schedules, continued operating and maintenance requirements, overall risk mitigation, program management obligations, and long-range facility plans to inform unit-by-unit closure method decisions.
7	TDEC	5.5	Planned CCR Unit Closure Method	57 of 128	*"CIP, in conjunction with upgradient drainage modifications, is anticipated to address three AOIs identified along the eastern edge of the Slag Disposal Area. Installation of a geosynthetic cover system over the Slag Disposal Area, the adjacent Drainage Improvements Area, and western ponded area, along with upgradient drainage modifications including removal of remnant coal at the Former Coal Yard Storage Area, will promote positive drainage around the Slag Disposal Area and further control and minimize infiltration through the cover system into this CCR unit, thereby further minimizing post-closure escape of CCR constituents."* It is unclear what aspect of the AOIs needs to addressed. Please clarify and explain.	See response to Comment #3.
8	TDEC	5.5.2.2	Slag Disposal Area Closure-in-Place	66 of 128	*"In conjunction with the installation of a geosynthetic cover system, it is expected that the collective drainage modifications planned will serve to address AOI2, AOI3, and AOI4 located adjacent to this CCR unit. As described in Chapter 2.1.1.2, the Drainage Improvements Area Project was previously conducted based on historical seepage identified at the WBF Plant. As noted in the EAR findings, following implementation of that project, the historical seepage was observed to cease. Based on the performance of these past drainage modifications, it is anticipated that the planned closure and drainage modifications included in this CARA Plan will address the three AOIs identified at this CCR unit."* It is unclear what needs to be addressed. Please clarify and explain.	See response to Comment #3.

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9	TDEC	6.5.5.1	Corrective Measures Considered and Assessed	76 of 128	Please define TM.	The term has been spelled out and no longer uses an acronym.
10	TDEC	7.1	Natural Resource Restoration Plan	81 of 128	Will the installation of the buttress require any natural resource restoration or mitigation?	Because the buttress construction would include placing material within protected Waters of the United States, it will require both State and federal permitting which would likely have a mitigation component. As scheduled, the permitting and design phase will occur after CARA Plan approval and at that time, Resource Agencies will agree on what mitigation and/or restoration is warranted.
11	TDEC	Exhibit 3-2	Slag Disposal Area Cross-Section A-A' Conceptual Site Model	120 of 128	In this exhibit the AOIs are listed under the heading Potential Seeps. However, their approximate location is not depicted in the figure. The description of the AOIs states in part that – *"Based on the EI data, and using the supplemental investigation results, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed."* Please explain the chronology of the supplemental investigations. When will the further evaluation occur?	Exhibit 3-2 has been revised to identify the category as 'Area of Interest' and includes a note to refer the reader to Exhibit 3-4 for their locations. See response to Comment #3 for a description of the additional evaluations in the CARA Plan and where they are discussed. . Also, text in Chapter 3.2 has been revised to explain that the supplemental investigation obtained piezometer data and was completed prior to publication of the EAR.
12	TDEC	Exhibit 3-4	Overall Findings Near WBF Plant CCR Units	122 of 128	In this exhibit, the locations of the AOIs are clearly represented. The description of the seeps is the same as Exhibit 3-2: *"Based on the EI data, and using the supplemental investigation results, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed."* When and how will further evaluation happen?	See response to Comment #3. Also, the category for the AOI description has been changed to 'Area of Interest'
13	Subcontractor	ES	Executive Summary	12 of 128	Exhibit ES-1: If the aerial is in plan view, recommend including a scale.	The current view is consistent with the EAR and other CARAs. This is meant to be the general overview and summary for the document.
14	Subcontractor	2.2.2	Surface Water Hydrology	26 of 128	Does the former small tributary to the Tennessee River following an alignment through the Slag Disposal Area have the potential to present a preferential pathway for constituent transport? The sand/shale interface at WBF-B03 was at an elevation of 664.6, while the sand/shale interface at WBF- 104 is at elevation 666.6.	See response to Comment #3.
15	Subcontractor	2.2.5	Uppermost Aquifer and Groundwater Flow	33 of 128	The text states: "Groundwater in the confined aquifer is not in contact with the CCR material inside the CCR units where the aquitard is present because the aquitard physically separates them." Are there areas where the aquitard is not present specifically with respect to the eastern portion of Slag Disposal Area? Do the figures on Pg 16 and 17 show CCR material underlain by alluvial sand or bedrock?	The figures do not show CCR material underlain by alluvial sand or bedrock in the eastern portion of the Slag Disposal Area. Boring logs show the Slag Disposal Area is underlain by fine-grained materials.
16	Subcontractor	2.2.5	Groundwater Flow Directions, Boundaries, and Divides	34 of 128	Recommend scale for figure.	The current exhibit is the same as the EAR and consistent with the other CARA Plans.
17	Subcontractor	Chapter 4	Human Health and Ecological Risk Assessment Summary	40 of 128	*"Estimated risk to an onsite worker potentially exposed to CCR material within the Ash Pond are greater than the noncancer threshold of one; however, implementing standard health and safety protocols is expected to lower any potential risks."* Please provide more detail related to arsenic exposure and what specific health and safety changes would be needed to reduce the noncancer exposure risks.	Additional text has been added related to standard health and safety protocols and the relationship to potential arsenic exposures (please refer to comment #5).
18	Subcontractor	5.4.3	Key Site- Specific Consideration s	55 of 148	Please explain how much land would need to be available for a landfill to support the CBR option. Could partial CBR be used in a CCR consolidation scenario? Could the Former Coal Yard be used as a CCR landfill? That would eliminate or reduce a large number of the off-site health and safety concerns as well as long term groundwater and stability concerns.	TVA's preliminary estimate of the acreage needed to construct an onsite landfill to contain about 760,000 cubic yards of CCR material is approximately 14 acres, which includes a 10 foot bench for stability. Based on this estimate, there is not sufficient flat land available to construct a new landfill with capacity for the total amount of CCR material from both units. For reference, the southern slope of the former Coal Yard is a steep drop off into variable hilly topography of the drainage improvements area. For the CARA comparative closure assessment, TVA did not include a hybrid consolidation approach, for the reasons provided in the response to Comment #6 above. TVA's preliminary estimate of the future capacity of a new, geosynthetically lined landfill that could be constructed within the former Coal Yard footprint is about 450,000 cubic yards. If such a landfill were built, offsite disposal of about 310,000 cubic yards of CCR material would still be required. TVA did not include this alternative because of the time required to design, permit, and construct a new onsite landfill and the associated potential adverse environmental impacts of that construction, given that about half of the CCR material would still need to be disposed offsite.

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19	Subcontractor	6.5	Planned CCR Unit Corrective Actions	75 of 128	The text states that the *"time required to achieve this condition where GWPS have been attained and would be maintained without continued corrective action is uncertain due to a variety of factors* ". Please define the factors. Can this time required to achieve this be modeled?	Some of the factors are listed in Section 3.1.1.2 of Appendix D. This statement is meant to acknowledge that the ability to model the time to achieve GWPS is limited by the available technical tools; however, resolution of these uncertainties is not needed to select a corrective measure for implementation as a corrective action.
20	Subcontractor	6.5.1.1	Corrective Measures Considered and Assessed	76 of 128	How will pH adjustment affect non-target metals species? Given the alluvial sands and the hydraulic connection to the Tennessee River, is pH-adjusted groundwater expected to mix with surface water?	Based on available data and information, the reversal of flow to introduce surface stream water into groundwater is not observed (see Appendix H.1 of the EAR). Because of this, pH adjusted groundwater is not expected to mix with surface stream water.
21	Subcontractor	6.5.1.1	Corrective Measures Considered and Assessed	76 of 128	As part of full-scale system design, recommend examining geochemical transformations with the potential to impart changes to the formation matrix (e.g. reduced permeability) and/or foul the horizontal reagent injection system.	The potential for the reagent injections to precipitate metals and reduce the formation permeability was evaluated during the treatability and pilot testing phases. While a small degree of iron oxide precipitation was observed in the effluent in several columns during the treatability testing, flow rates through the columns did not decrease indicating there were no adverse effects. A decrease in the injection flow rates and a corresponding increase in the injection pressures were observed during pilot testing. However, the changes stabilized during the test and there were no adverse effects related to amendment delivery. Injection flow rates and pressures will continue to be monitored during the remainder of the pilot test. These factors will be further considered as part of full-scale system design, and the injection parameters will be monitored during the start up period of the full-scale system to confirm that the geochemical reactions that occur due to the reagent injections do not negatively impact the performance.
22	Subcontractor	6.5.1.2	Planned Corrective Action	79 of 128	Will the Seismic Mitigation - Toe Berm Buttress obscure the interface between treated groundwater and surface water?	This will not be an issue because compliance with GWPS will be monitored at wells between the CCR unit and the buttress system.
23	Subcontractor	6.6	CCR Unit Corrective Action Summary	80 of 128	The text states: *"The time required to achieve this condition where GWPS have been attained and would be maintained without continued corrective action is uncertain due to a variety of factors, but routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a five- to 10-year timeframe."* A groundwater model is used to demonstrate source control. Will a fate and transport model be developed to support the attenuation of concentrations of target constituents in groundwater moving downgradient of the Slag Disposal Area?	A fate and transport model is not planned to be developed because of the limitations with modeling the transport of metals. The geochemical models are used to predict the fate of metals.
24	Subcontractor	Exhibit 6-1	Planned WBF Plant CCR Unit Groundwater Corrective Actions	126 of 128	Boring logs in the vicinity of the Tennessee River indicate interbedded/lenses of clays and silts within the saturated alluvium (WBF-B03). How will a horizontal well distribute sodium hydroxide across lower permeability sequences? Or are stacked horizontal wells being considered given the thickness of the unit and the anisotropy between horizontal and vertical permeability?	The planned corrective action is conceptual. It is acknowledged that pre-design investigations will be required to define the extent of the required system and to provide detailed lithologic information to finalize the design.
25	Subcontractor	Appendix C Closure Method Assessment TM	2.2	57 of 623	Please explain how much land would need to be available for a landfill to support the CBR option. Could partial CBR be used in a CCR consolidation scenario? Could the Former Coal Yard be used as a CCR landfill? That would eliminate or reduce a large number of the off-site health and safety concerns as well as long term groundwater and stability concerns.	Please see response to Comment #18 above.
26	Subcontractor	Appendix C Closure Method Assessment TM	Table 1	83 of 623	60 truck loads per day appears to be a low estimate. What were the assumptions used to determine this number?	Operational considerations leading to the trucking assumption of 60 trucks per day considered several factors. Available work area, traffic, and adjacent facility operations were included in preliminary evaluations of daily truck traffic estimates, along with possible offsite landfill acceptance limits. Onsite work areas were also considered based on potential equipment and staff working the site in a safe manner. Ingress/egress from the units, wheel washing, as well as overall ability to access the site using a single public roadway and navigating ongoing operations and traffic from the adjacent Watts Bar Nuclear, Equipment Support Services, and Watts Bar Hydro facilities were also considered.

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27	Subcontractor	Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	2.2	143 of 623	The question needs to be addressed somewhere in the final CARA as to specifically how we going to define the exit from corrective action status relative to the Upper Confidence Limits about the mean and comparisons to GWPS for each of the constituents of concern. Per the TDEC Solid Waste Policy and Guidance Manual (updated September 2023), page 43, Phase 3 assessment is considered "complete when contamination is below GW protection standards for 3 years or alternate DSWM established timeframe". This requirement is per TDEC solid waste regulations given in 0400-11-01-.04(7)(a)9(v)(II), which specifically states "Compliance with the ground water protection standard has been achieved by demonstrating that concentrations of constituents listed in Appendix II of this rule have not exceeded the ground water protection standard(s) for a period of three consecutive years using approved statistical procedures and performance standards." The "approved statistical procedures" are provided in the US Environmental Protection Agency's (EPA) Unified Guidance, which states that the entire confidence interval for the mean for the given well/constituent pair of concern must be below the Groundwater Protection Standard (GWPS) to demonstrate compliance in corrective action. Specifically, this involves demonstrating that the upper 95% confidence limit about the mean for a one-sided interval is below the GWPS for three consecutive years.	Additional text regarding the regulatory requirement for determining the end of corrective actions has been added to Chapter 6.3.2. Discussion of the statistical methods for evaluation of monitoring data is not included because the specific methods selected for this purpose will be based on a future data set that will be used to determine the end of corrective actions.
28	Subcontractor	Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	2.2	143 of 623	Do the additional groundwater data collection during the CARA Plan finalization and corrective action final design processes include delineating the extent of impact surrounding WBF-104 and WBF-106?	Yes, the additional groundwater data collection during the CARA Plan finalization and corrective action final design processes includes delineating the extent of impact surrounding WBF-104 and WBF-106.
29	Subcontractor	Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	2.2	143 of 623	Given the thickening alluvial sequences approaching the Tennessee River, was a groundwater extraction with a paired slurry wall considered for mitigating potential backflow from the Tennessee River?	A slurry wall between the CCR unit and the Tennessee River was not modeled because it may be undesirable to have a slurry wall at that location after operation of a groundwater extraction system ceases, were such a system to be constructed.
30	Subcontractor	Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	3.1.1.2	146 of 623	A couple of big picture questions after reviewing this section and Appendix I.1 for NaOH/NaHCO3 injection near WBF-104 and 106 associated with the Slag Disposal Area: 1) Besides the adsorption of Co and Cd on the surface of ferrihydrite and cation exchange on the surface of clays, is it also possible that the precipitation of calcite, MgCO3, BaCO3, and other carbonate based precipitates are also acting as a sorption surface for the Co and Cd? I did not see any analysis for bicarbonate alkalinity in the analysis of the groundwater in the bench scale treatments. Was this analysis performed? Are we saturated with respect to certain carbonate constituents in the groundwater? 2) What happens after treatment ends? The pH will return to 6 or less. What mechanism will keep the adsorbed Co and Cd from re-mobilizing into the groundwater (i.e., re-bound) when the NaOH injection permeable reactive barrier system is no longer operational? Is source reduction via pore water removal and capping of the slag disposal area expected to eventually lower Co and Cd to levels that, even with Co and Cd re-mobilization, the total concentrations for both metals will still be below GWPS? Will the post treatment anticipated results for groundwater quality be demonstrated as part of the final CARA plan?	1) Adsorption to carbonate surfaces is not anticipated, although some co-precipitation with carbonate minerals may be expected. Regardless, the intent of this technical memorandum is not to evaluate every potential mechanism of metal removal, but to evaluate the primary and secondary responses to reagent addition. 2) Alkalinity was measured for column tests using NaOH. An evaluation of SI for carbonates show that aragonite, calcite and dolomite are near saturation (-1.0 < SI < 1.0) with MnCO3 as the only other carbonate approaching or above saturation. 3) Upon closure, input from pore water and infiltration will be negated and metals influx concentrations from groundwater will be that of background. 4) The geochemical model technical memorandum has simulations that use post treatment conditions to predict concentrations. 5) A pilot study is currently being conducted which will allow for increased understanding and better design prior to full scale implementation. As part of the pilot test, the potential for metal concentration changes will be evaluated.
31	Subcontractor	Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	3.1.1.2	146 of 623	As part of the bench scale treatability studies, were other metals analyses performed for the microcosm and column tests (or are planned for the pilot study) other than those shown in the Tables of APPENDIX I.1 - IN SITU TREATMENT TECHNICAL MEMORANDUM - DRAFT? Specifically, what about impacts to the mobility of, for example, Chromium (VI) and nickel as the pH of the groundwater is raised to 8 to 8.5?	Chromium and nickel were not evaluated during this bench-scale testing. During pilot scale testing, metals that may experience a secondary effect from increased pH will be evaluated. The target pH values are anticipated to not impact the stability of Cr or Ni.

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32	Subcontractor	Appendix D - Corrective Measures Assessment Technical Memorandum-Draft	Exhibit 1	156 of 623	What criteria were used to determine the lengths of the in-situ treatment areas? Are the treatment areas intended to fully capture groundwater impacts?	The extent of the planned corrective actions shown is conceptual and is generally based on assuming that the corrective action would be implemented over a distance halfway between wells with statistically significant concentrations of CCR constituents above a groundwater protection standard and the next closest well that has no CCR constituents with statistically significant concentrations above a groundwater protection standard (For Well WBF-106, the western limit extends to the upgradient edge of the Slag Disposal Area). The CARA Plan acknowledges the need to conduct pre-design investigations to delineate the required extent of and select a corrective action for groundwater along the downgradient edge of the CCR unit adjacent to the Tennessee River that has statistically significant concentrations of CCR constituents above groundwater protection standards.
33	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	5.2	237 of 623	Text states: *"Hydraulic conductivity was a primary calibration variable and is discussed more in Section 0."* Please correct the reference.	Text has been edited as follows "Hydraulic conductivity was a primary calibration variable and is discussed more in Section 6."
34	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	5.3	239 of 623	"**Error! Reference source not found**" - error associated with reference back to section within the Table of Contents.	Text corrected to reference Table 2.
35	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	5.3.2	240 of 623	Text states: *"Sensitivity of the model results to change in river stage will be evaluated and the results included in the revised Technical Memorandum to be submitted with the Draft CARA Plan."* Update accordingly.	Text has been updated as follows "Sensitivity of the model results to change in river stage is evaluated in Section 8.5."
36	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	6.3	243 of 623	"**Error! Reference source not found**" - error associated with reference back to section within the Table of Contents.	Text corrected to reference Table 3.
37	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	7.1	245 of 623	The recharge/surface water volumetric flow split (48%/52% respectively to 91%/9% respectively) titled significantly towards recharge in the updated steady state model. Please explain which boundary conditions triggered this change and the rationale for making the change. Does the change in volumetric flow split now significantly in favor of recharge have the potential to overestimate recharge improvements under the CIP scenario?	The apparent difference was not the result of a change in model construction. Recharge and surface water components of the water budget were misreported in the interim Groundwater Modeling Technical Memorandum. The calculation was subsequently corrected in the updated Groundwater Flow Modeling Technical Memorandum. The correct values are 91%/9%.
38	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.1.2	247 of 623	Statement is made in report that *"The units of flux are typically provided in cubic feet per day (cfd) or gallons per minutes (gpm).* " However, units of flux are given in flow/cross-sectional area, for example as gallons per minute/ ft^2. When the flux values are given in the CARA as gpm, are these "flux" values already taking the entire cross-sectional area of a given zone or boundary into account so that the "flux" value is actually the total flow rate across the boundary?	Yes, the reported flux values incorporate the cross sectional area. Groundwater flux is reported in volume per unit time and is equal to the unit flux or Darcy flux times the cross sectional area.
39	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.3.1.2	252 of 623	A DRN package is typically used to model drainage systems like ditches or tile drains, while WEL package is used to represent pumping wells or recharge wells. Please comment why the DRN with a set drain elevation was better suited for a vertical extraction well scenario versus a well with a programmed extraction rate under the WEL package. Was the drain extraction rate quality cross- checked by modeling an extraction well?	The following clarification has been added to the text of Section 8.3.1.2 -"The MODFLOW drain package is a specified head boundary type that allows simulation of extraction wells operated to maintain a set head elevation in contrast to the well package which simulates extraction at a set flow rate (specified flux). The drain boundary is anticipated to more closely simulate how the hydraulic control system may be operated. It is anticipated that extraction would be operated to maintain a head elevation that would result in hydraulic control of the targeted zone." The reported rate is a model calculated value and represents the simulated extraction rate necessary to maintain the specified head. Therefore, it was not necessary to check the drain extraction rate with a series of specified flux boundary conditions using the Well Package.
40	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.3.1.2	252 of 623	The text states that a steady state simulation was completed and that steady state "particle traces were examined to determine if the proposed well layout and target pumping elevations would capture the particles and demonstrate hydraulic control." Were any transient simulations run to determine the approximate elapsed time between activating the pump well and establishing groundwater capture at the southern end of the Slag Disposal area?	Transient simulations for groundwater extraction were not conducted.

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Comment Number	Commentor	Section Number	Section Title	Page	TDEC Comment (December 17, 2024)	TVA Response (March 17, 2025)
41	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	8.3.1.2	252 of 623	Recommend that additional delineation and additional pumping tests will be required during the design phase to refine the design of the extraction systems if selected. Hydraulic conductivity data derived from slug tests have the potential to not fully represent larger scale aquifer properties and yield. Given the potential variability of alluvial sequencing to influence the hydrogeology at scale, additional field testing in the design phase is recommended.	The groundwater flow model provides a conceptual-level demonstration of the feasibility of implementing hydraulic control. In some cases, additional pumping tests may be performed during the design phase to refine the design of the extraction systems, as described in the third bullet of this section.
42	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	Exhibit 14b	282 of 623	Is a label missing for "Plant-Specific Estimates"?	A label has been added to Exhibits 14a and 14b to explain the symbol used for the site-specific estimates.
43	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	Exhibit 28	298 of 623	On the northern side of the Slag Disposal Area, does particle tracking near the sheet piles as a modeled as a horizontal flow barrier indicate a mitigation of back flow from the Tennessee River/Constant Head Boundary?	The directional flow from the Tennessee River side of the hydraulic control system was not specifically evaluated through particle tracking. However, the presence of a partial hydraulic flow barrier would be anticipated to reduce flow from the east.
44	Subcontractor	Appendix G - Groundwater Flow Modeling Technical Memorandum - Draft	Exhibit 29	299 of 623	The historical stream alignment is indicated on the exhibit. Please comment on the historical stream and the effect on pore water extraction.	The Historical Stream Alignment was not intentionally included on Exhibit 29. The Exhibit has been revised with the Historical Stream Alignment removed. Also, see the response to Comment #3.
45	Subcontractor	Appendix H.1 - Geochemical Modeling Technical Memorandum - Draft	8.1, 8.1.1, and 8.1.1.1	332 of 623	Statement is provided as follows: *"In contrast with cobalt, the cadmium reported in groundwater at well WBF-104 is interpreted to be sourced from complexation with sulfate."* What are the test results or geochemical modeling results that is the basis of this interpretation that cadmium is primarily from sulfate complexes?	Text in this section has been revised to clarify that cadmium in groundwater is controlled by aqueous complexation with sulfate which is more thermodynamically stable than free ion cadmium, the latter of which is available for sorption reactions. This explanation is based on the geochemical model results.
46	Subcontractor	Appendix H.1 - Geochemical Modeling Technical Memorandum - Draft	8.3.2	335 of 623	Along with the previous comment, the following statement is made in the report: *"For cadmium, it was interpreted that cadmium concentration reported at WBF-104 was controlled by the complexation with sulfate. Thus, the amount of iron hydroxide available to facilitate adsorption is insensitive to cadmium attenuation at the WBF Plant."* Where is the pE/pH diagram for Cadmium species in the CARA Plan? Cadmium sulfate is highly soluble. Precipitation of cadmium sulfate would require high concentrations of cadmium and sulfate. Do model results show geochemical conditions that are conducive for cadmium sulfate precipitation?	Text in this section has been revised to clarify that the reference to cadmium sulfate complex is to the aqueous cadmium sulfate species, not the solid phase of cadmium sulfate.
47	Subcontractor	Appendix H.1 - Geochemical Modeling Technical Memorandum - Draft	Exhibit 6	344 of 623	What is the proposed explanation for the steep decline in cadmium concentrations at approximately year 120 at WBF-104? What are the geochemical mechanisms behind this steep drop?	The decline in cadmium concentration referred to by the reviewer corresponds to groundwater transport that is primarily controlled by physical processes.
48	Subcontractor	Appendix H.2 - Geochemistry Investigation Fieldwork Summary and Evaluation	4.2.3	365 of 623	Based on this summary paragraph on CEC capacity in the Slag Disposal area soils, cation exchange with clays is expected to play a minor role in Co and Cd attenuation at this site. However, total organic carbon (TOC) was of sufficient concentrations to impact ORP. Are there plans to incorporate organic carbon sorption to the geochemical modeling for the next phase of the CARA Plan? Also, based on the mineral phase testing in Section 4.2.2.1, and geochemical modeling, will there be sufficient mineral-phase sorption sites for Co and Cd in order to sufficiently reduce concentrations below GWPS, since clay cation exchange capacities are low.	The measured CEC incorporates the exchange related to both soil and organic matter. The use of TOC to estimate organic adsorption is limited. The nature of the OM needs to be evaluated to determine if adsorption will occur. Some organic adsorption can be slowly reversible, resulting in minimal release of metals. The detected TOC is likely humus, which is resistant to further decay and will have minimal impacts on ORP. The model relies upon adsorption to iron and aluminum oxides with CEC providing minimal reduction in concentrations.
49	Subcontractor	Appendix H.2 - Geochemistry Investigation Fieldwork Summary and Evaluation	4.2.3	365 of 623	Since TOC is sufficiently high enough to affect ORP, once the slag disposal area is to be capped, it would appear that the ORP in the groundwater below the slag disposal area will move to more reducing conditions, since O2-rich rainwater infiltration over the slag disposal area will be dramatically decreased (coupled with the degradation of natural organic matter). Based on geochemical modeling, how low is the ORP expected to decrease during this time of natural organic matter degradation? Will the ORP drop enough to dissolve iron minerals and decrease the number of sorption sites for Co and Cd? How long will this phase of more reducing conditions last?	The measured CEC incorporates the exchange related to both soil and organic matter. The use of TOC to estimate organic adsorption is limited. The nature of the OM needs to be evaluated to determine if adsorption will occur, and the impacts it will have on the solubility of the metals since chelation can also increase solubility. Some organic adsorption can be slowly reversible, resulting in minimal release of metals. The detected TOC is likely humus, which is resistant to further decay (~2% per year at the surface). The reducing decay would likely be much slower. With such limited decay of OM, the impacts on ORP will be limited especially given the upgradient oxidized groundwater source. Well oxidized water does exist in confined aquifers.

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Comment Number	Commentor	Section Number	Section Title	Page	TDEC Comment (December 17, 2024)	TVA Response (March 17, 2025)
50	Subcontractor	Appendix H.2, Attachment A - Surface Water Investigation Summary - Draft	Table 1	406 of 623	Dissolved oxygen readings for WBF-SW-04 and WBF-SW-07 are higher than saturated dissolved oxygen limitations for the freshwater samples taken for water temperatures of 10.2 C (at WBF-SW- 04) and 20.1 C (at WBF-SW-07). D.O. was listed as 12.12 mg/L for WBF-SW-04 which exceeds the saturation limit of 11.2 mg/L at 10.2 C. D.O. was listed as 10.85 mg/L for WBF-SW-07 which exceeds the saturation limit of 9.07 mg/L at 20.1 C.	Comment acknowledged. The DO meter was calibrated (100% air saturation) at the beginning, and checked for measurement drift at the end of each day. Calibration was successful and end of day DO values were within specification. The noted readings were therefore considered valid and attributable to a location-specific condition such as a biogenic source of oxygen in the water (e.g., photosynthesis), a relatively rapid increase in sample temperature, or excessive aeration during the measurement of DO measurements (although none was noted).
51	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.1.2	425 of 623	The following statement is provided in this section: *"Lithium in SB05 and SB02 and cadmium in SB02 were not identified above the laboratory detection limit in the exchangeable fraction, which is the extraction step most indicative of geochemically reactive lithium and cadmium."* Since only two soil samples were extracted as part of the bench scale studies, there is considerable uncertainty associated with the results due to the heterogeneity of the soils under the slag disposal area. The fact that no lithium was detected in the extraction fraction of the abovementioned soil samples certainly affects/skews the outcomes from the bench scale simulations relative to assessing the potential secondary response mobility of lithium under the simulations.	Comment acknowledged. The goal of the bench-scale tests was not to identify the exact mechanisms, but to evaluate the response to geochemical change. The responses in Li and Cd concentrations were monitored during the bench-scale tests. Pilot study implementation and evaluation will enhance the observations from the bench-scale testing.
52	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.2.2	428 of 623	Report states: "*Molybdenum and lithium concentrations were not analyzed in the NaOH reagent demand tests but were tested in the NaHCO3 reagent demand test and subsequent phases."* Based on the previous comment, lithium was not detected in the extraction phase for the 2 soil samples used in the testing, so Li would not be expected to mobilize to appreciable levels during the reagent demand testing.	Comment acknowledged.
53	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.2.2	429 of 623	Regarding reagent demand testing results, the report states: *"Similar to results at WBF-104, the reagent demand tests indicated that, except for limestone, increasing the groundwater pH in the vicinity of monitoring well WBF-106 decreased cobalt concentrations."* The results for pH adjustment using NaOH are expected to be more favorable than limestone and NaHCO3 due to reaction kinetics associated with the use of a strong base. One question is relative to the use of a strong caustic and the costs and maintenance and safety issues associated with operating an injection system long- term with this material. It may be worthwhile to keep NaHCO3 under consideration as an option for pH control for the pilot testing. NaHCO3 will not react as fast as NaOH and will require more material amounts but should ultimately move the pH to the optimal range of 7.5 to 8.	NaHCO3 has not been ruled out for further evaluation and may be carried through to pilot-scale testing for reasons stated.
54	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.3 and 2.4.3.1	429 of 623	Why was there not a microcosm test for WBF-104 for NaHCO3?	Correct, there was not a microcosm test for NaHCO3 for this location.
55	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.3 and 2.4.3.2	430 of 623	Bullets 4 and 6 demonstrate the potential for releasing secondary anions into the groundwater as a result of raising the pH, with arsenic and molybdenum increasing in concentration in response to the NaOH reaction to raise groundwater pH. This should be thoroughly investigated as part of the pilot testing and final geochemical modeling of the groundwater for the slag disposal site. Bullet 5 mentions no lithium increases in the groundwater but the soil samples used for the test do not have detected concentrations of lithium in the exchangeable fraction. Lithium increases in groundwater as a result of pH adjustment increases (due to desorption and formation of soluble lithium complexes) are also a concern and should be evaluated as part of the pilot test analyses.	The evaluation of secondary effects on all potential constituents of concern will be completed in each future phase of evaluation/implementation.
56	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.4 and 2.4.4.2	433 of 623	Could the fact that the concentrations of cobalt and cadmium decreased but did not reach their targeted GWPS be due to the possibility that all of the available sorption sites for Co and Cd at the beginning of the test were ultimately exhausted early on (i.e., Day 9)?	The pH increase is anticipated to facilitate precipitation of metal hydroxides, thereby creating new adsorption sites. It should be noted that these are bench-scale laboratory tests and further pilot-scale testing is required to better evaluate *in situ* conditions where new metal hydroxides would continue to form and replenish any decrease in available adsorption sites
57	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.4 and 2.4.4.2	435 of 623	Report states: *"Similar to WBF-104, results from the column test conducted with media from the area surrounding monitoring well WBF-106 indicate that the dose of NaOH applied to the influent groundwater raised pH to the target range of 7.00 to 8.00 SU and resulted in significant decreases in dissolved cobalt. However, cobalt concentrations were not reduced to below the GWPS and suggest the target pH could have been set at a higher level."* Could it be that the available sorption sites in the soil media provided for the test assembly became saturated and perhaps a pH increase beyond 8 would not make a difference?	See response to Comment #56. A higher pH target value may be evaluated during pilot-scale testing.
58	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.4.5	435 of 623	Was the alkalinity analyzed as part of the column tests and supplemental column tests? Could there be carbonate based precipitates forming inside the column, acting as a further sink and providing sorption sites for metals, as well as arsenic?	See response to Comment #30. Metals adsorption to carbonate surfaces are not anticipated; however, some metals may coprecipitate with carbonate minerals. Co-precipitation is not thought to be a main contributor to metals reduction at these locations.

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59	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	2.7	440 of 623	If the *"dominant mechanism of attenuation assessed in this study was cobalt and cadmium sorption through pH adjustment"* , do the kinetics allow for desorption/mobility of other constituents to occur?	The potential for other constituents to become mobilized during pH adjustment was considered in this evaluation and included in the report.
60	Subcontractor	Appendix I.1 - In Situ Treatment Technical Memorandum - Draft	Table 10	463 of 623	Microcosm results suggest maintenance of elevated pH is required for mitigating constituent concentrations. Assuming source control is successful, will performance monitoring points between the source and injections be added to the groundwater monitoring program to determine when the injections can terminate?	Yes, a performance monitoring plan will be developed. Enhancement of the implementation plan will be included in future testing, such as a pilot-scale testing.
61	Subcontractor	Appendix L - Seismic Stability Mitigation Evaluation	2.1	607 of 623	Please provide evaluation sheets for all alternatives considered.	The alternative evaluation sheets were pre-decisional and were used in the internal evaluation process. The CARA Plan only presents the toe berm buttress as the recommended seismic mitigation solution.
62	Subcontractor	Appendix L - Seismic Stability Mitigation Evaluation	3.1	609 of 623	What is the anticipated design life?	The proposed seismic stability buttress is to be constructed using rip-rap consisting of quarried stone material approved for use by entities such as TDOT. The quarried materials are anticipated to withstand standard environmental conditions, weathering, erosion, and mechanical wear provided proper installation. The design life assumes minimal degradation due to factors such as freeze-thaw cycles, hydraulic forces, and biological growth. However, routine inspections and maintenance will be required to address issues such as displacement of rip-rap, sediment accumulation, or degradation of underlying soil.
NA	TVA	Appendix E and K	NA	NA	Edits made to Appendices without TDEC/Subcontractor comments for consistency with other Plant CARA Plan documents or WBF CARA main text	Appendix E - Groundwater Monitoring Plan (Sections 1.0, 1.1, 2.0, 2.1, 2.1.2, 2.3, 2.4, 3.2.1, 3.2.2, 3.2.4, 3.2.4.2, 3.2.5, 3.2.6, 4.2, 5.1, 5.2, 6.0, and 6.1, Tables 1 and 2, Abbreviations) Appendix K - Pore Water Extraction TM (Section 5.2.2.1, Exhibit 2)

APPENDIX C –
CLOSURE METHOD ASSESSMENT

Appendix C – Closure Method Assessment Technical Memorandum – DRAFT

TDEC Commissioner's Order
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant

December 5, 2025

Prepared for:
Tennessee Valley Authority
Chattanooga, TN 37402

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Log

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Date Revised for Reissuance. No other changes made to this Appendix	December 5, 2025

Sign-off Sheet

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

Prepared by: _____

Sarah-Emma Watkins, Senior Associate, Environmental Project Manager

Reviewed by: _____

John McInnes, LPG, Senior Principal Geologist

Approved by: _____

Carole Farr, PG, Senior Principal Geologist

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Abbreviations

CARA	Corrective Action/Risk Assessment
CBR	Closure-by-Removal
CCR	Coal Combustion Residuals
CIP	Closure-in-Place
CY	Cubic Yard
EAR	Environmental Assessment Report
EPRI	Electric Power Research Institute
GHG	Greenhouse Gas
HHERA	Human Health and Ecological Risk Assessment
NEPA	National Environmental Policy Act
PEIS	Programmatic Environmental Impact Statement
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order OGC15-0177
TM	Technical Memorandum
TVA	Tennessee Valley Authority
WBF	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this Closure Method Assessment Technical Memorandum (TM) to support the planned closure actions provided for the Slag Disposal Area and the Ash Pond at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The overall objective of the closure method assessment is to compare relative impacts related to alternative closure methods for the WBF Plant coal combustion residuals (CCR) units in support of fulfilling the requirements of the Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order No. OGC15-0177 (TDEC Order) issued to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan has been prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of CCR exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate operational changes planned or in progress by TVA.

This TM provides a relative qualitative analysis and summary of potential impacts of closure-by-removal (CBR) and closure-in-place (CIP) on 22 environmental and socioeconomic resource areas, as well as cost to complete the actions, for each CCR unit at the WBF Plant. Specifically, this assessment compares the relative impacts of alternative CIP actions (e.g., geosynthetic cover system installation) in this CARA Plan to CBR.

There are two CCR units at the WBF Plant that were included in the TDEC Order: Slag Disposal Area and Ash Pond, which are closed surface impoundments. General information regarding these CCR units is provided in Chapter 2 of the CARA Plan and is summarized in this TM. As discussed in the CARA Plan and summarized below, the WBF Plant is currently inactive and each CCR unit was closed in place in accordance with applicable regulations in effect at the time of closure. The site-specific considerations and assumptions included in the WBF CCR unit closure alternative assessment are presented in Chapter 2.0 of this TM.

The resource areas that are evaluated herein were identified during the National Environmental Policy Act (NEPA) evaluation for the *Final Ash Impoundment Closure Environmental Impact Statement Part I – Programmatic NEPA Review* (PEIS). Part I of the PEIS provided a programmatic evaluation of closure of a hypothetical surface impoundment and identified the screening and evaluation factors that would be applicable for TVA's evaluation of future closure of other surface impoundments at its coal-fired power plants (TVA 2016). Part II of the PEIS applied the screening and evaluation factors identified in the programmatic evaluation to site-specific CCR units. The Part II evaluations relied on the Electric Power Research Institute's (EPRI) 2016 qualitative application of relative impact framework to ten TVA surface impoundments located at TVA facilities (TVA 2016a, EPRI 2016c). The report qualitatively compares these impoundments to a hypothetical site that was previously quantitatively modeled by EPRI. Based on the programmatic and site-specific analyses, TVA identified CIP as its preferred alternative for the ten facilities evaluated.

In summary, the evaluations of the potential impacts to each resource area presented in this TM are high-level qualitative analyses of existing information and environmental documentation including, but not limited to the PEIS, the *Environmental Assessment Report* (EAR), the *Human Health and Ecological Risk Assessment* (HHERA), and other relevant reports referenced in this CARA Plan. The analysis provides an assessment of the relative potential impacts of a closure option on a given resource area. This was performed to support identification of the planned closure method presented in the CARA Plan for the WBF Plant CCR units. Where available, updated demographic, socioeconomic, environmental justice, transportation, and greenhouse gas (GHG) information was included for analysis in this TM. Attachment A provides supporting information for the analysis of environmental justice, transportation, and climate change resource areas.

Since the closure method assessment is made separately for CCR units at WBF Plant, the resource areas are evaluated in separate tables for each unit: Ash Pond (Table 1) and Slag Disposal Area (Table 2). Exhibit 1 is a map of the site including the CCR units and is provided as reference.

2.0 SITE-SPECIFIC CONSIDERATIONS AND ASSUMPTIONS

TVA has incorporated planned operational activities and other CCR unit-specific information that would affect closure implementation in the site-specific assessments for CIP compared to CBR for WBF Plant CCR units. As described in Chapter 2.0 of the CARA Plan, the WBF Plant is not active, and all CCR units discussed in this CARA have previously been closed in accordance with applicable laws and regulations in effect at the time of closure.

While not currently planned for the WBF Plant CCR units, TVA continues to evaluate means to beneficially use CCR material in a manner consistent with regulatory requirements while maximizing value to the Tennessee Valley. This comparative closure method assessment only reflects current conditions at the CCR units and does not include future harvesting for beneficial use activities. If implemented in the future, harvesting would be performed in accordance with a TDEC-approved plan, and the final closure configuration and closure schedules would be based on the actual grades and elevations following completion of any future harvesting activities. These may differ from the site-specific considerations and assumptions presented below.

T TVA will continue to refine the assumptions used for the closure alternative evaluations as this CARA Plan is reviewed and finalized. Before implementation of this CARA Plan, TVA will comply with current applicable regulations for disposal of the waste and discharge of water, as appropriate, and obtain any required permits.

TVA has incorporated the following considerations and assumptions into the comparative closure method assessment.

2.1 MATERIAL VOLUMES

The following table provides a summary of the material volumes for each of the CCR units in this assessment. The CCR material volumes used are those identified in the EAR for each CCR unit. Site-specific assumptions regarding non-CCR material volumes are discussed further in Chapter 2.3 below.

CCR Unit and Operational Removal Volumes

CCR Unit	**Ash Pond**	**Slag Disposal Area**
Total CCR Material Volume for CIP or CBR (CY)	190,000	570,000
CBR Total Material Volume to Offsite Landfill (CY)	190,000	570,000
Total Material Volume to Offsite Landfill (CY)	760,000	

Note: Volumes provided in cubic yards (CY) using previously published values, rounded to two significant figures. As such, the total site volume may not reflect the sum of the volumes of each CCR unit.

Soil Borrow Material Volumes for CCR Unit Closure Activities

CCR Unit	**Ash Pond**		**Slag Disposal Area**	
Closure Method	**CIP**	**CBR**	**CIP**	**CBR**
Borrow for CIP o(CY)	-	-	64,000	-
Borrow for Upgradient Drainage Modifications (CY)	-	-	65,000	58,000
Total Borrow Material Volume (CY)	-	-	130,000*	58,000*

Note: Total borrow volume in cubic yards (CY) for CIP is approximate and has been rounded in this assessment. Additionally, offsite disposal of existing sheet pile wall materials is not included in this assessment.

Rock Riprap for Seismic Mitigation

*CCR Unit**	**Ash Pond**		**Slag Disposal Area**	
Closure Method	**CIP**	**CBR**	**CIP**	**CBR**
Total Rock Material Volume (CY)	20,000	-	180,000	-

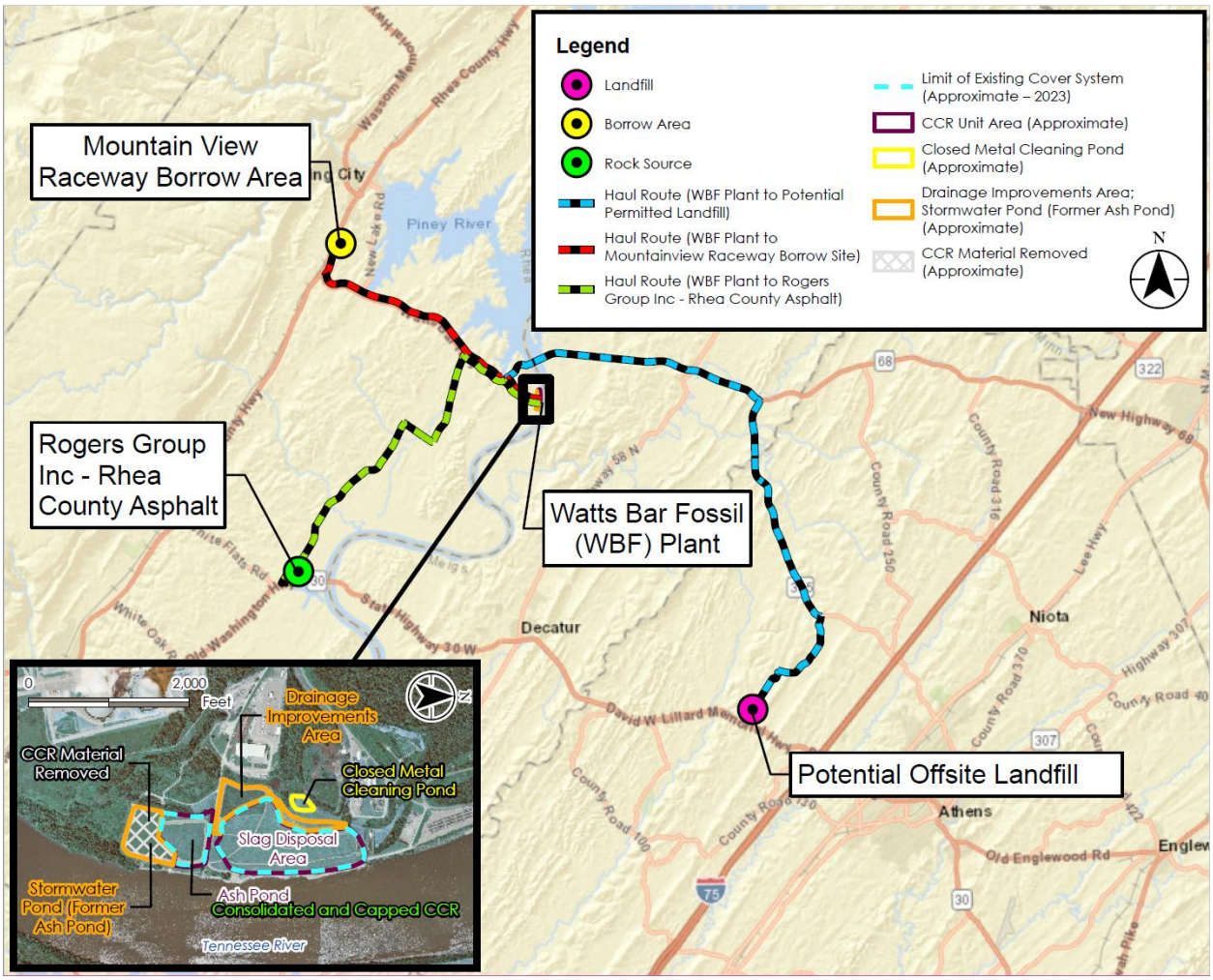
Note: Offsite disposal of existing sheet pile wall materials is not included in this assessment.

2.2 LANDFILL AND BORROW AREA LOCATIONS

There is no adequate land available within the WBF Plant property to build a new landfill for the CBR alternative, and there is no identified onsite borrow source for either soil or rock riprap required for the CIP alternative. Therefore, this evaluation assumes a potential offsite landfill location for CCR material disposal, the Mountainview Raceway site as the source for borrow soil, and the Rogers Group Inc. site as the source for rock riprap.

For this evaluation, the potential offsite landfill is assumed to be located approximately 19 miles southeast of the WBF Plant. If CBR were to be pursued, TVA would coordinate with TDEC to identify an approved, offsite permitted landfill before it is used. The Mountainview Raceway Borrow Site is located approximately eight miles northwest of the WBF Plant and has been historically used by TVA as a borrow source for other projects. The rock riprap source is assumed to be Rogers Group Inc. It is approximately 13 miles southwest of the WBF Plant and has been historically used as a rock source. Locations of the assumed landfill, borrow area, and rock source location are provided in the graphic below.

Location of Potential Offsite Landfill, and Soil and Rock Borrow Areas



2.3 CONSTRUCTION SCHEDULE AND SEQUENCING CLOSURE

The provided duration of closure activities in this analysis assumes:

- Both CIP and CBR alternatives for the Slag Disposal Area include the following actions:
    - Regrading and revegetating of the Former Coal Yard Storage Area (TVA completed removal of the remnant coal in 2024/2025).
    - Regrading of the upgradient drainage modification area will be implemented to promote positive drainage.
- CIP for the Slag Disposal Area includes the following planned actions:
    - Installation of a geosynthetic cover system over both the Slag Disposal Area and the adjacent Drainage Improvements Area.

  - The ponded area west of the Slag Disposal Area will be filled with excavated CCR material, alluvial material, or borrow soil and regraded, and a geosynthetic cover system installed (see below for excavated CCR or alluvial material information).

- CIP includes construction of a toe berm buttress of rock riprap along the riverbank of the Slag Disposal Area and Ash Pond to improve the slope stability of these CCR units.
  - Transport of the rock riprap for the buttress is assumed to be hauled by trucks and staged onsite for construction. TVA is continuing to consider barge transport of these materials.
  - Prior to installation of the buttress, CCR material may need to be excavated from the Slag Disposal Area from behind the former unloading dock sheet pile wall. If this CCR material is removed at this location, it would be placed in the drainage modifications' location in the southwestern portion of the Slag Disposal Area and Drainage Improvements Area prior to cover system installation.
  - Installation of the buttress may require excavation of alluvial material from the Tennessee River to be able to place the rock riprap directly on bedrock. This evaluation assumes that 6,000 cubic yards (CY) of alluvial material will be excavated and placed within the Slag Disposal Area prior to cover system installation. TVA will evaluate alternative installation approaches once additional geotechnical data are obtained during final design of this closure action. Potential impacts associated with this assumed activity are included in the Slag Disposal Area CIP evaluation.
  - During installation of the buttress, the existing sheet pile wall along the eastern perimeter of the CCR unit may be modified. It is assumed any removed material from the sheet pile wall will be placed in the Slag Disposal Area if it comingled with CCR material or if not, it would be used onsite (i.e., offsite disposal is not required).

- The duration of CIP activities in this analysis assumes that CIP of the CCR units would be performed relatively concurrently for applicable units. The duration of CBR activities in this assessment is based on a physical constraints for access and egress at the site, construction activities at each CCR unit and operational considerations for the CBR duration estimate including available work area, wheel washing, traffic associated with adjacent facility operations, and possible offsite landfill daily acceptance limits.

The analysis provides both a site-wide duration and estimated duration of either CIP or CBR closure activities for each CCR unit at the WBF Plant. The durations for CBR closure activities used in this evaluation assumes there is sufficient capacity at the potential offsite landfill, and that there are no permitting or construction needs, or waste receiving limits at that landfill.

Additional information on planned closure actions is provided in Chapter 5.5 of the CARA Plan.

3.0 ASH POND

3.1 CCR UNIT INFORMATION

The Ash Pond CCR unit is approximately seven acres in area and is bounded by a perimeter dike. CCR material present in the Ash Pond is comingled stacked fly ash placed as part of closure and sluiced fly ash. The estimated total volume of CCR material is about 190,000 CY (TVA 2024).

The Ash Pond was closed in 2015. As part of the closure project, CCR material was excavated from the southern area of the Ash Pond and consolidated and capped in the northern area of the Ash Pond using a geosynthetic and soil cover system (CDM Smith 2015). A clay divider dike was constructed from an onsite borrow area between the capped portion of the Ash Pond and the remaining area of the Ash Pond (CDM Smith 2015). The southern portion of the former Ash Pond was converted into a permitted stormwater pond for the site.

Based on the performance of the existing cover system, TVA is not planning any modifications to the cover system or drainages at the Ash Pond. However, as part of the closure activities for this CCR unit, TVA is planning to construct a toe berm buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress will begin at the riverbank southeast of the existing cover system at the Ash Pond and extend north along the riverbank to the north end of the Slag Disposal Area. Targeted excavation of alluvial material within the river channel (along the toe of the riverbank) may be required to allow the riprap to be placed directly on the weathered bedrock.

3.2 RELATIVE RESOURCE AREA IMPACT ASSESSMENT

In Table 1, impacts of CBR and CIP were evaluated for 22 environmental and socioeconomic resource areas, as well as cost. Where applicable, a relative assessment is provided for each resource area identifying which closure method exhibits greater adverse or beneficial impact.

For the Ash Pond, CBR is assessed to have a greater beneficial impact for geology and seismology by eliminating the residual potential for release of CCR material in the event of a seismic event. Additionally, revegetation of the excavated area with native plants and grasses could provide higher quality habitat for local wildlife.

Generally, these impacts are only slightly more beneficial than CIP. Adverse impacts were identified resulting from CBR of approximately 190,000 CY of CCR material. CBR would require about 3 years of closure activities, including permitting and design, excavation and transportation of CCR material to an offsite landfill and construction activities to grade and revegetate the area. Disposal of CCR material would require a total of approximately 11,000 truckloads (60 truckloads per day). Anticipated total greenhouse gas (GHG) emissions during CBR would be more than 10 times what would be anticipated during CIP, despite the planned construction of a rock riprap buttress as part of CIP. The construction activities associated with CBR lead to multiple environmental and human (both worker and community) health and safety impacts including potential impacts to 11 communities with environmental justice concerns near the WBF Plant and landfill.

In comparison, despite a similar timeline, CIP for the Ash Pond only requires the construction of a toe berm buttress. CIP requires substantially fewer truckloads (about 1,200 total truckloads, six per day) to transport rock riprap to the Ash Pond from the source approximately 13 miles away. After the installation of the toe berm buttress, the CIP alternative largely consists of operation and maintenance activities which require less disturbance, are smaller in scale, and have fewer potential adverse impacts on the majority of resource areas analyzed. Although CIP has minor adverse impacts or fewer beneficial impacts for some resource areas, fewer environmental and human health and safety impacts are expected during CIP than for CBR because less CCR material is handled.

4.0 SLAG DISPOSAL AREA

4.1 CCR UNIT INFORMATION

The Slag Disposal Area is a closed CCR unit that covers about 27 acres and was formed by a railroad embankment and a natural knoll to the west, stacked CCR material to the east, and a dike and spillway to the south constructed to discharge process water (TVA 1969). CCR material present in the Slag Disposal Area is comingled sluiced and stacked fly ash, bottom ash, and slag. The estimated total volume of CCR material is about 570,000 CY (TVA 2024).

The Slag Disposal Area was closed with a soil cover system in 2009. The Slag Disposal Area soil cover system consisted of a 1-foot-thick vegetative cover over a one-foot-thick compacted clay layer. A separate drainage improvements project was completed in 2015 at the Drainage Improvements Area (located immediately west of the Slag Disposal Area) to place fill, improve drainage, and remove water around the Slag Disposal Area (AECOM 2016).

TVA plans to modify the existing soil cover system at this CCR unit with a geosynthetic cover system to further control and minimize infiltration through the cover system, thereby further reducing the post-closure loss of CCR constituents. This includes extending the cover system across the footprint of the area currently known as the Drainage Improvements Area as well as across an existing ponded area directly west of the CCR unit. Stormwater drainage modifications will include filling the ponded area directly west of the CCR unit and regrading the surrounding and upgradient areas prior to the geosynthetic cover system installation. At the Former Coal Yard Storage Area, remnant coal was removed by TVA in 2024/2025, and the area will be regraded and revegetated. The total estimated volume of CCR material disposal is about 570,000 CY.

As part of the closure activities for this CCR unit, TVA is planning to construct a buttress of rock riprap along the riverbank of the Slag Disposal Area as a seismic stability mitigation measure, such that the CCR unit will meet or exceed slope stability criteria for post-earthquake, global stability. The buttress will begin at the riverbank southeast of the existing cover system, integrate with the buttress at the Ash Pond, and extend north along the riverbank to the north end of the Slag Disposal Area. Targeted excavation of alluvial material within the river channel (along the toe of the riverbank) may be required to allow the riprap to be placed directly on the weathered bedrock. As part of this action, the existing sheet pile wall in the northern portion of the Slag Disposal Area may be modified to allow installation of the toe berm buttress, and the planned geosynthetic cover system modification will cover the western edge of the buttress along this CCR unit.

4.2 RELATIVE RESOURCE AREA IMPACT ASSESSMENT

In Table 2, impacts of CBR and CIP were evaluated for 22 environmental and socioeconomic resource areas, as well as cost. Where applicable, a relative assessment is provided for each resource area identifying which closure method exhibits greater adverse or beneficial impact.

For the Slag Disposal Area, CBR is assessed to have a greater beneficial impact for geology and seismology by eliminating the residual potential for release of CCR material in the event of a seismic

episode. Additionally, revegetation of the excavated area with native plants and grasses could provide higher quality habitat for local wildlife.

Generally, these impacts are only slightly more beneficial than CIP. Adverse impacts were identified resulting from CBR of approximately 570,000 CY of CCR material. CBR would require about 4 to 5 years of closure activities, including permitting and design, excavation and transportation of CCR material to an offsite landfill, and construction activities to grade and revegetate both the former CCR unit area and implement the upgradient drainage modifications. Disposal of CCR material, implementation of upgradient drainage modifications, and regrading of the Former Coal Yard Storage Area, would require approximately 34,000 truckloads (up to approximately 60 truckloads per day). Anticipated total GHG emissions for CBR are approximately 30% higher than total GHG emission for CIP. This is due to a greater number of hauling trucks and the emissions associated worker vehicle trips and offroad equipment over a longer construction duration. The construction activities associated with CBR lead to multiple environmental and human (both worker and community) health and safety impacts as well as potential impacts to 13 communities with environmental justice concerns near the WBF Plant, Mountainview Racetrack borrow site, and offsite landfill.

In contrast, CIP requires fewer truckloads (about 19,000 total, 110 per day) to transport rock riprap material used for construction of the rock buttress, borrow soils for upgradient drainage modifications, and regrading and revegetation of the Former Coal Yard Storage Area. During CIP, approximately 180,000 CY of rock riprap would be transported to the Slag Disposal Area for the planned rock buttress, requiring 11,000 truckloads (60 per day) to the rock source located approximately 13 miles from the unit. The transportation and placement of the rock would require additional heavy equipment.

As noted above, CIP is assessed to have minor adverse impacts or less beneficial impacts for some resource areas. Because fewer truckloads of material are required and less CCR material is handled during CIP, fewer environmental and human health and safety impacts are expected with CIP than for CBR.

5.0 RELATIVE CUMULATIVE IMPACTS

As stated above for each unit, CBR has potential adverse impacts that are not associated with the activities that would occur during CIP. This finding is more pronounced when considering the cumulative impacts of CBR for both CCR units. Additionally, TVA has already closed the WBF Plant and associated CCR units to develop the Watts Bar Nuclear Plant, which has been in commercial operation since 1996. Since these past actions have already occurred, present actions are integrated into existing baseline conditions evaluated in this assessment. Additional actions not related to CCR unit closure that were identified within the vicinity of the WBF Plant include the installation of sanitary lift pumps, which is not expected to have a significant contribution to cumulative impacts.

CBR of both CCR units at the WBF Plant would eliminate potential seismic impacts by removing CCR material from the units and may improve socioeconomic impacts due to construction activities. However, the large amount of CCR material to be excavated during CBR increases the potential to release constituents into the environmental media during removal activities. Furthermore, impacts to air quality, GHG emissions, transportation, solid and hazardous waste, and public health and safety would be longer term (about three years for CIP versus about five to six years for CBR) due to the CCR units being closed sequentially. Additionally, CBR would impact 13 communities with environmental justice concerns near the WBF Plant, the borrow area, and the offsite landfill. Overall, the magnitude of impacts would be higher for CBR than with CIP for many resource areas.

CIP of both CCR units would result in fewer, but more time-compressed construction-related impacts, due to the shorter duration of concurrent construction activities. Intermittent noise and transportation would impact recreational areas along the river due to the construction of the toe berm buttress and cover system. Construction could also provide a long-term beneficial impact to the aquatic habitat along the riverbank. Additionally, CIP would impact 18 communities with environmental justice concerns near the WBF Plant, the borrow area, rock source, and the offsite landfill. Although CIP requires the construction of a toe berm buttress along the river for both CCR units prior to closure, site-wide CIP would take about half the time required to complete site-wide CBR.

Finally, both CBR and CIP would amplify adverse impacts to air quality, transportation, GHG emissions, and health and safety. However, CIP has fewer potential environmental and human health and safety impacts, as well as an overall reduction in transportation impacts, compared to CBR.

6.0 RELATIVE IMPACT SUMMARY

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

For many resources evaluated, the relative impacts of CIP and CBR were similar. CBR has a greater beneficial impact for geology and seismology by eliminating the residual potential for release of CCR material. Impacts from noise would also be more adverse during CIP due to the concurrent nature of construction activities, which concentrates construction activities and the number of daily truck trips occurring on local roads and highways over a shorter period of time. Additionally, revegetation of the excavated area with native plants and grasses could provide higher quality habitat for local wildlife.

However, these similar and more beneficial impacts are outweighed by adverse impacts associated with CBR that are not associated with CIP. Additionally, transportation impacts are higher for CBR, increasing traffic on some roads by up to 48%. The adverse impacts associated with CBR, particularly associated with the excavation and transport of CCR material, are greater than the adverse impacts associated with CIP for installation of a geosynthetic cover system and implementing upgradient drainage modifications at the Slag Disposal Area and construction of the rock riprap buttress for both CCR units. Compared to CIP, CBR results in greater adverse impacts related to transportation and construction, using more than twice as many truckloads as would be required for CIP and resulting in potentially greater adverse worker and public safety impacts. CBR also results in greater potential impacts to surrounding environmental media. Additionally, CBR associated GHG emissions are 180% higher than for CIP. CBR, with disposal of CCR material at an offsite landfill also introduces potential adverse impacts to the surrounding communities with environmental justice concerns near the WBF Plant as well as those near the offsite landfill. Due to the increased handling of CCR material during CBR and the transportation of the material to the offsite landfill, there are greater potential adverse environmental and human health and safety impacts and a larger potential offsite impact footprint than during CIP. CIP impacts would be more localized to the WBF Plant.

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TABLES

Table 1 Resource Impact Evaluation – Ash Pond

Resource Area	Closure-in-Place The Ash Pond was CIP in 2015 in accordance with closure requirements at the time. TVA is not planning any modifications to the existing cover system or drainages. Additional closure activities for the Ash Pond include constructing a buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress would begin at the Ash Pond, just north of the Stormwater Pond outfall, and extend north along the riverbank to the north end of the Slag Disposal Area. The complete closure timeline assumes concurrent CIP actions and is expected to take about 2 to 3 years. (2)	Closure-by-Removal For CBR, approximately 190,000 cubic yards (CY) of CCR material would be excavated from the Ash Pond and disposed of at an offsite landfill. The onsite area would be regraded and revegetated or developed for future uses.(1) The complete closure timeline assumes sequential CBR actions and is expected to take about 3 years. (3)
Closure Cost (4) Groundwater corrective action costs are not included because groundwater corrective action would be implemented if required regardless of closure method.	$3.2 million to $6.1 million	$26 million to $49 million
Air Quality The affected environment is the regional airshed, primarily Rhea County to the west-northwest of the site and Meigs County (across the Tennessee River) to the east-southeast of the site. The United States Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards for criteria pollutants. Current air quality is consistent with approved state implementation plans.	Less adverse impacts than CBR. Tailpipe emissions associated with operations and maintenance of the closed Ash Pond would be minor and limited to the immediate area surrounding the WBF Plant. CIP actions would include the construction of a rock buttress on the shore side of the Ash Pond, which is expected to involve hauling and placement of approximately 20,000 CY of 300-pound riprap. Tailpipe emissions and localized fugitive dust emissions would occur from construction equipment and hauling trucks. Even with construction of the rock buttress, CIP would entail lower total tailpipe emissions and fugitive dust emissions than from CBR. This is because emissions from construction and hauling activity are proportional to total volume of material moved, and in CIP the total volume of material moved would be less than CBR.	Greater adverse impacts than CIP. Temporary impacts from tailpipe emissions would be greater in quantity and duration relative to CIP, even with construction of a rock buttress on the shore side of the Ash Pond, due to the significantly greater volume of material moved in total for CBR. Potential track-out of particulate matter would be greater with CCR material hauling activities, requiring more frequent mitigation. The route to the offsite landfill is approximately 19 miles. Tailpipe emissions from trucking would be greater relative to CIP. Construction tailpipe emissions and fugitive dust emissions would also occur near any CCR material destination facilities as material is unloaded and placed for final disposal.
Climate Change and Greenhouse Gases (GHG) GHGs absorb and emit radiation within the thermal infrared range which leads to global warming. Prominent GHGs include carbon dioxide, methane, and nitrous oxides. GHG emissions are predominantly associated with activities related to energy production, changes in land use, transportation, and waste and water generation. Additional information for Greenhouse Gas Emissions can be found in Attachment A.	Less adverse impacts and lower GHG emissions than CBR. Construction related GHG emissions would be generated from rock buttress installation and would be fewer than CBR Total construction-related greenhouse gas emissions from the CIP would be approximately 560 metric tons of CO_2 equivalent. Long term CIP impacts would be limited to GHG emissions associated with operations and maintenance, which would emit less GHG emissions than construction worker trips and offroad equipment associated with CBR.	Greater adverse impact and higher GHG emissions than CIP. Construction related GHG emissions would be generated from the excavation of the Ash Pond and regrading of the area. CBR is expected to result in more hauling trucks which would generate almost 10 times more GHG emissions from vehicle trips and offroad equipment relative to CIP. Total construction-related greenhouse gas emissions from the CBR would be approximately 6,000 metric tons of CO_2 equivalent Additional GHG emissions would be generated to fill, seed, and sod the area.
Land Use The footprint of the Ash Pond is located within Federally owned land that is currently used for industrial purposes. Installation of the rock buttress during CIP activities would encroach into the Tennessee River.	Minor adverse impacts. Minor adverse impacts associated with encroachment of the rock buttress within the Tennessee River. However, there would be no change in industrial land use within the terrestrial environment.	No impacts. There is no change in industrial land use. Minor beneficial impact as land could be used for alternative use following closure.
Prime Farmland According to the Tennessee Urban Growth and Prime Farmland GIS Mapper (2016), the Ash Pond is not considered Soil Survey Geographic Database (SSURGO) prime farmland.	No impact. There is no change in the use of the land.	No impact. There is no change to the use of the land.

Table 1 Resource Impact Evaluation – Ash Pond		
Resource Area	**Closure-in-Place** The Ash Pond was CIP in 2015 in accordance with closure requirements at the time. TVA is not planning any modifications to the existing cover system or drainages. Additional closure activities for the Ash Pond include constructing a buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress would begin at the Ash Pond, just north of the Stormwater Pond outfall, and extend north along the riverbank to the north end of the Slag Disposal Area. The complete closure timeline assumes concurrent CIP actions and is expected to take about 2 to 3 years. (2)	**Closure-by-Removal** For CBR, approximately 190,000 cubic yards (CY) of CCR material would be excavated from the Ash Pond and disposed of at an offsite landfill. The onsite area would be regraded and revegetated or developed for future uses.(1) The complete closure timeline assumes sequential CBR actions and is expected to take about 3 years. (3)
Geology and Seismology Onsite geologic mapping indicates that the WBF Plant is underlain by Cambrian age limestone and shale bedrock of the Conasauga Group Middle, and the Nolichucky Shale. Unconsolidated deposits onsite overlie the bedrock and consist of artificial fill, and a mixture of native alluvium deposited by the Tennessee River. Low frequency ground motion that could affect site structures is primarily controlled by very large earthquakes originating in the New Madrid Seismic Zone. High frequency ground motion that could affect site structures is controlled by local, moderate size earthquakes originating in the East Tennessee Seismic Zone.	Less beneficial impact than CBR. The closure method design would meet closure standards for slope stability and structural integrity. The global slope stability and the veneer slope stability for the Ash Pond meets the established factor of safety criteria for the static and seismic load cases, except for the post-earthquake, global stability load case. TVA plans to construct a buttress of riprap along the riverbank of the Ash Pond, such that the Ash Pond would meet or exceed slope stability criteria for post-earthquake, global stability. The Ash Pond has adequate structural integrity, and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material. Post-closure routine monitoring and buttress maintenance would address future changes.	Greater beneficial impact than CIP. The closure method design would meet closure standards for slope stability and structural integrity. CBR would eliminate residual potential (compared to CIP) for release of CCR material via slope stability failures, structural integrity issues, and/or loss of bedrock structural support.
Groundwater The coarse-grained unconsolidated alluvial deposits above bedrock are defined as the uppermost aquifer. The uppermost aquifer is under confined conditions and is typically overlain by clays that act as an aquitard. The groundwater flow direction within the uppermost aquifer is generally from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow in the vicinity of the Ash Pond is bounded to the east by the Tennessee River.	Both CIP and CBR have beneficial impact. Because a cover system is currently in place, operations and maintenance of the Ash Pond would require minimal CCR material handling or disturbance. CCR constituent concentrations in onsite groundwater are below GWPS downgradient of the Ash Pond.	Both CIP and CBR have beneficial long-term impact; CBR has greater potential for temporary adverse impacts than CIP. CBR would reduce impacts to groundwater by removing CCR material from the Ash Pond. However, there is a potential to release constituents into groundwater during removal activities.
Surface Water The surface waters evaluated under the WBF Plant Environmental Assessment Report (EAR) include the Tennessee River.	Minor temporary adverse impacts possible during construction. CIP activities would include the installation of a rock buttress between the Ash Pond and the Tennessee River to stabilize and reinforce the slope. Placement of the rock within the river would replace existing substrate and may create temporary impacts to surface water resulting from the suspension of sediment and other benthic disturbance during construction activities; however, erosion and sediment controls would be implemented during construction to minimize the risk of sediment contributions and increased turbidity within the Tennessee River. Impacts would be temporary, and once construction of the rock buttress is complete, no adverse impacts to surface water resources are anticipated. The implementation of coarse substrate, associated with the rock buttress, may ultimately provide a net positive habitat benefit, as described in the Aquatic Ecology section below. There are no risks of CCR impacts to surface waters under this alternative, as contaminated sediments would not be disturbed.	No adverse impacts anticipated. CBR is not expected to adversely impact surface water with implementation of erosion, sediment, and dust controls, as disturbance is limited to areas outside the channel. However, the relative potential of release of CCR constituents to surface waters during CBR would be greater than CIP due to the volume of material handled during closure activities and the exposure of the CCR material to the environment. The exposure and disturbance of contaminated sediments required by CBR may also increase risk of exposure to the surrounding environment despite erosion, sediment, and dust controls to minimize transport of material via air and water vectors. Following completion of construction, operations and maintenance associated with the graded, revegetated work area are anticipated to be minimal and are unlikely to result in surface water impacts. Planting maintenance and monitoring may be required but would not negatively affect surface waters.

Table 1 Resource Impact Evaluation – Ash Pond		
Resource Area	**Closure-in-Place** The Ash Pond was CIP in 2015 in accordance with closure requirements at the time. TVA is not planning any modifications to the existing cover system or drainages. Additional closure activities for the Ash Pond include constructing a buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress would begin at the Ash Pond, just north of the Stormwater Pond outfall, and extend north along the riverbank to the north end of the Slag Disposal Area. The complete closure timeline assumes concurrent CIP actions and is expected to take about 2 to 3 years. (2)	**Closure-by-Removal** For CBR, approximately 190,000 cubic yards (CY) of CCR material would be excavated from the Ash Pond and disposed of at an offsite landfill. The onsite area would be regraded and revegetated or developed for future uses.(1) The complete closure timeline assumes sequential CBR actions and is expected to take about 3 years. (3)
Floodplains The Ash Pond was originally developed within the floodplain of the Tennessee River. The 100- and 500-year flood elevations on the Tennessee River at this location are approximately 697 and 700 feet, respectively. The perimeter dike is 720 feet.	Impacts due to fill for Rock Buttress. The top elevation of the dike along the Ash Pond is above the 500-year floodplain elevation, protecting the Ash Pond from inundation and minimizing potential for transport of CCR materials over, through, or around the structure crest during flood events, at least up to the 500-year storm. Installation of the proposed rock buttress, riverward of the clay dike at the Ash Pond, would result in placement of fill within the 100-year floodplain. Benches would be installed within the buttress structure to provide flood relief; however, the structure itself encroaches into the channel by approximately 30 feet and raises the ground elevation within the existing floodplain.	No adverse impacts. The top elevation of the dike along the Ash Pond is above the 500-year floodplain elevation, protecting the Ash Pond from inundation and minimizing potential transport of CCR materials over, through, or around the structure crest and onto the floodplain prior to or during dredging, at least up to the 500-year storm. Additionally, erosion and sediment controls would be in place during CCR removal to further reduce this risk. No fill within the floodplain is anticipated under this alternative. On completion of CCR removal, the dike would be regraded and the material would be reused as fill within the excavated area. Construction activities would occur outside of the floodplain and would not alter its elevation. During earthwork, erosion and sediment controls would be modified and implemented accordingly to avoid transport of sediment and potentially contaminated materials onto the floodplain. Once CBR is completed, potential impacts from direct CCR material exposure to floodplains during flood events would be eliminated. In addition, grading of the Ash Pond would increase the floodplain storage area. Accordingly, CBR construction activities would not affect existing Tennessee River floodplain elevations or function.
Vegetation Vegetation on the Ash Pond and side slopes is maintained grass. There are some isolated areas of erosion and poor grass establishment.	No adverse impacts. Impacts would be limited to operational and maintenance-related activities to maintain grass. If necessary, replacement vegetation cover would remain similar and would be relatively easy to reestablish.	Greater long-term beneficial impacts than CIP. Negligible impacts during construction-phase disturbance. The transition of the Ash Pond to an area seeded with non-invasive species with the intent to establish diversified vegetation is considered more beneficial in the long-term.
Wildlife Habitat on the Ash Pond and side slopes consists of a cover of maintained grass. This does not include aquatic habitat as that is discussed in the aquatic ecology resource area.	Minor long-term beneficial impact. Due to the minimal wildlife habitat, proposed actions during the construction phase are not anticipated to impact the local wildlife population.	Greater beneficial impacts than CIP. Due to the minimal wildlife habitat, proposed actions during the construction phase are not anticipated to impact the local wildlife population. The transition of the Ash Pond to an area seeded with non-invasive species with the intent to establish diversified vegetation would create higher quality habitat for local wildlife and be more beneficial in the long-term.

Table 1 Resource Impact Evaluation – Ash Pond		
Resource Area	**Closure-in-Place** The Ash Pond was CIP in 2015 in accordance with closure requirements at the time. TVA is not planning any modifications to the existing cover system or drainages. Additional closure activities for the Ash Pond include constructing a buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress would begin at the Ash Pond, just north of the Stormwater Pond outfall, and extend north along the riverbank to the north end of the Slag Disposal Area. The complete closure timeline assumes concurrent CIP actions and is expected to take about 2 to 3 years. (2)	**Closure-by-Removal** For CBR, approximately 190,000 cubic yards (CY) of CCR material would be excavated from the Ash Pond and disposed of at an offsite landfill. The onsite area would be regraded and revegetated or developed for future uses.(1) The complete closure timeline assumes sequential CBR actions and is expected to take about 3 years. (3)
Aquatic Ecology Benthic macroinvertebrate communities were evaluated from seven transect locations within the Tennessee River for the purposes of the WBF Plant Environmental Assessment Report (EAR). Also included were CCR tissue concentration testing from fish and Asiatic clams within three reaches of the Tennessee River, upstream and downstream of the Watts Bar Dam.	Minor temporary adverse impacts with net positive effects on aquatic ecology in the long term. CIP does not require disturbance or handling of soils containing CCR. Minor, temporary adverse impacts to aquatic resources are possible during rock buttress installation activities due to potential increased turbidity resulting from dredging to accommodate rock placement within the Tennessee River; however, erosion and sediment controls would be in place during installation, including coffer dam and turbidity curtain applications, to minimize or eliminate sediment contributions and turbidity effects. Permanent impacts associated with the rock buttress structure include fill placement at the toe of the existing streambank, covering existing edge habitat, although the installation of coarse stone material for the buttress provides complex, stable, and structural habitat that can be colonized by the benthic community. It is likely that organisms would rapidly recolonize this area from upstream sources and would not be negatively impacted in the long term. As existing habitat contains limited structural features, the habitat modifications associated with the rock buttress may increase species richness and ultimately may benefit the benthic macroinvertebrate community.	No adverse impacts anticipated. CBR is not expected to adversely impact surface water quality, and by extension aquatic ecology, with implementation of effective erosion, sediment, and dust controls. However, the relative potential of release of CCR constituents to surface waters during CBR would be greater than CIP due to the volume of material handled during closure activities and the exposure of the CCR material to the environment. The longer duration of exposure and disturbance of contaminated sediments required by CBR may also increase possible minor exposures to the surrounding environment despite erosion, sediment, and dust controls to minimize transport of material via air and water vectors. Following completion of construction activities, operations and maintenance associated with the graded, revegetated work area are anticipated to be minimal and are unlikely to affect aquatic communities. Planting maintenance and monitoring may be required but would not negatively affect aquatic conditions in surface water resources.
Threatened and Endangered Species Wildlife habitat is predominantly absent from the Ash Pond. There is little to no quality habitat for threatened and endangered species. This does not include aquatic habitat as that is discussed in the aquatic ecology resource area.	No adverse impacts, minor beneficial impacts. Because the Ash Pond is already disturbed with maintained grass and little to no quality habitat present, impacts to threatened and endangered species are not anticipated.	No adverse impacts, minor beneficial impacts. Due to the lack of quality habitat, adverse impacts to threatened and endangered species are not anticipated during the construction phase of the project. The transition of the Ash Pond to an area seeded with non-invasive species with the intent to establish diversified vegetation would create higher quality habitat and be more beneficial in the long-term.
Wetlands The jurisdictional wetlands adjacent to the Ash Pond has a hydrology that is dominated by water levels within the adjacent Tennessee River.	No adverse impacts. No adverse impacts to wetland resources are anticipated, as CIP has already occurred, and CIP does not require disturbance or handling of soils containing CCR. During construction of the rock buttress, wetlands are not expected to be impacted with the implementation of effective erosion, sediment, and dust controls. The work area does not intersect jurisdictional wetlands.	No adverse impacts anticipated. The work area does not intersect jurisdictional wetlands; therefore, no adverse impacts to wetland resources are anticipated. Under both alternatives, erosion, sediment, and dust control measures, designed to protect adjacent resources during construction activities, would contain and minimize transport of potentially contaminated materials. However, the relative potential release to wetlands during CBR would be greater than CIP due to the volume and handling of contaminated sediments, which could increase possible minor exposures to the surrounding environment despite erosion, sediment, and dust controls to minimize transport of material via air and water vectors. Following completion of construction activities, operations and maintenance associated with the graded, revegetated work area are anticipated to be minimal and are unlikely to affect wetland resources. Planting maintenance and monitoring may be required but are not proposed within jurisdictional wetland areas.

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Resource Area	**Closure-in-Place** The Ash Pond was CIP in 2015 in accordance with closure requirements at the time. TVA is not planning any modifications to the existing cover system or drainages. Additional closure activities for the Ash Pond include constructing a buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress would begin at the Ash Pond, just north of the Stormwater Pond outfall, and extend north along the riverbank to the north end of the Slag Disposal Area. The complete closure timeline assumes concurrent CIP actions and is expected to take about 2 to 3 years. (2)	**Closure-by-Removal** For CBR, approximately 190,000 cubic yards (CY) of CCR material would be excavated from the Ash Pond and disposed of at an offsite landfill. The onsite area would be regraded and revegetated or developed for future uses.(1) The complete closure timeline assumes sequential CBR actions and is expected to take about 3 years. (3)
Socioeconomic Resources Local economic activity can be stimulated through various project actions. Changes to regional economic activity, jobs, housing availability, public services, and government tax collections are impacted by the cost of the project undertaken.	Temporary beneficial impact. Results in beneficial impacts to local economic activity as measured by the duration of operations and maintenance supported jobs. Increase in local tax revenues are also likely to be modest. Determining sufficiency of existing local public services and housing availability for the expected increased population due to the influx of workers has not been quantitatively assessed at this time but is unlikely to present a challenge.	Temporary beneficial impact. Results in beneficial impacts to local economic activity as measured by the duration of supported jobs and increase in economic output. Increase in local tax revenues are also likely to be modest. Determining sufficiency of existing local public services and housing availability for the expected increased population due to the influx of workers has not been quantitatively assessed at this time but is unlikely to present a challenge.
Environmental Justice Within a 4-mile radius of the WBF Plant, there are a total of three communities with environmental justice (EJ) concerns. Within a 4-mile radius of the offsite landfill, there are a total of eight communities with EJ concerns. Within a 4-mile radius of the Rogers Group Inc. rock source site, there are a total of five communities with EJ concerns. Attachment A provides supporting information for the communities with EJ concerns included in this evaluation.	Less adverse impact than CBR. CIP would require approximately 1,200 truckloads to the rock source over a duration of about 2 to 3 years. Overall, CIP would result in less adverse impacts to transportation, air quality, visual resources, climate change and greenhouse gases in the communities with EJ concerns. CIP would reduce impacts to the communities with EJ concerns because overall actions associated with the operations and maintenance of the Ash Pond (trucking, transportation, etc.) are less than CBR and does not require the disposal of CCR material in an offsite landfill.	Greater adverse impact than CIP. CBR would require approximately 11,000 truckloads to the offsite landfill over a duration of approximately 3 years. CBR would result in greater adverse impacts from transportation, air quality, visual resources, climate change and GHG emissions in the communities with EJ concerns both near the WBF Plant, as well as at the offsite landfill where the CCR material would be disposed. Impacts associated with CBR would be greater than those associated with CIP due to the increased number of truckloads necessary to transport CCR material to the offsite landfill and the higher likelihood of CCR coming into contact with the surrounding area as a result of increased disturbance associated with CCR handling. However, meaningful public engagement would be conducted to identify mitigation strategies that would reduce the magnitude and likelihood of traffic and health and safety impacts to these communities.
Natural Areas, Parks, and Recreation There are no natural areas within the vicinity of the WBF Plant; however, the eastern portion of the Ash Pond borders the Tennessee River. There is one boat ramp along the Tennessee River north of the Ash Pond that does not have public access. Additionally, the Leuty Cemetery is located less than 0.1 mile west of the Ash Pond. The Yellow Creek Wildlife Management Area is approximately 1.8 miles to the west.	Minor impacts. CIP would result in the installation of a rock buttress within the Tennessee River. The structure would not inhibit normal recreational use of boats along the waterway. In addition, the rock buttress may attract fish and other recreational catch within the Tennessee River by providing refuge and substrate to native aquatic populations. Construction activities would create intermittent noise and transportation effects to the recreational area. However, noise and transportation effects would be minimized through the use of standard construction and traffic controls.	Minor adverse impacts. CBR would result in potential minor visual impacts on the Tennessee River but no direct impacts to other managed or natural areas. Indirect impacts could include intermittent noise and transportation effects to the recreational area. Noise and transportation effects would be minimized through the use of standard construction and traffic controls.

Table 1 Resource Impact Evaluation – Ash Pond		
Resource Area	**Closure-in-Place** The Ash Pond was CIP in 2015 in accordance with closure requirements at the time. TVA is not planning any modifications to the existing cover system or drainages. Additional closure activities for the Ash Pond include constructing a buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress would begin at the Ash Pond, just north of the Stormwater Pond outfall, and extend north along the riverbank to the north end of the Slag Disposal Area. The complete closure timeline assumes concurrent CIP actions and is expected to take about 2 to 3 years. (2)	**Closure-by-Removal** For CBR, approximately 190,000 cubic yards (CY) of CCR material would be excavated from the Ash Pond and disposed of at an offsite landfill. The onsite area would be regraded and revegetated or developed for future uses.(1) The complete closure timeline assumes sequential CBR actions and is expected to take about 3 years. (3)
Transportation The transportation network servicing the WBF Plant and the Ash Pond consists of local roads connecting to the state highway network. The WBF Plant also has a riverport on the Tennessee River for the transport of coal and other bulk materials. Closure evaluations for the Ash Pond concluded that barge and rail transport were not reasonable modes of offsite transport of CCR material or rock buttress materials at the WBF Plant, so this analysis is limited to trucking. See Attachment A for supporting transportation information.	Less adverse impacts than CBR. CIP would require approximately 1,200 truckloads to the rock source over a duration of about 2 to 3 years. The impacts from CIP would be minimal. CIP requires fewer truckloads, generating approximately 6 truckloads daily which is less than what would be required for CBR. Fewer truckloads per day on local roads and highways would result in less traffic congestion. Some roads would experience up to a 3% increase in annual average daily traffic during this time, which is less than what would be expected during CBR activities. The primary long-term impact would be in vehicular traffic in the area associated with ongoing operation and maintenance of the Ash Pond.	Greater adverse impacts than CIP. Because there is no onsite landfill available, all 190,000 CY of CCR material would be disposed at an offsite landfill. Removing the CCR material from the Ash Pond would produce approximately 11,000 truckloads. The total removal and disposal activities would take up to approximately 3 years and would generate as many as 60 truckloads daily. The impacts would be more substantial than for CIP, with some local roads experiencing up to a 24% increase in average daily traffic. Impacts would include increased congestion from solid waste transfer trucks on the local road network for up to approximately 3 years, possibly lowering the level of service in some instances and increasing the possibility of accidents over the duration of offsite disposal during CBR activities. CBR would also increase the wear and tear on the local roads from solid waste transfer trucks resulting in higher maintenance costs.
Visual Resources The Ash Pond occupies land on the eastern portion of the property, south of the Slag Disposal Area. It is located west of WBF Plant and is situated along its western coastline. It is generally screened from views to the north, south, and west by the Watts Bar Nuclear Plant, and mature vegetation. The Ash Pond is visible or perceived to be visible from the Tennessee River. Visibility is not anticipated beyond the eastern shore of the river due to the existing mature vegetation and/or topography. Available views would likely include the existing transmission infrastructure, the Watts Bar Nuclear Plant, and other industrial infrastructure.	Greater potential beneficial impacts than CBR. The impact would be neutral/beneficial. With the Ash Pond remaining, its visual presence in views would be similar to current conditions. It would remain as a natural-appearing area where intermittently visible from outside the WBF Plant. The addition of a rock buttress, although made of natural material, would add the element of a hardened edge; however, this would be contained to a specific area and would only be seen as a small portion of the overall landscape. The activities associated with CIP and CBR would occur over similar timelines; however, the number of trucks necessary to complete CIP activities would be nine times less than what would be necessary during CBR activities. During the approximately 2- to 3-year closure period, construction activities would be less acute than CBR and would pose less of an impact to public viewsheds during this time.	Greater adverse impact than CIP. The presence and motion of equipment and machinery used throughout the duration of closure activities would be more acute than those necessary during CIP activities, resulting in more concentrated visual impacts in certain areas along the Tennessee River. CBR would have more long-term impacts than CIP due to the removal of the Ash Pond, which would remove a relatively low landform from views to the east from within the Tennessee River, presumably revealing more of the industrial lands beyond. In addition, transportation and disposal of the removed CCR may cause adverse visual impacts at the site of the new disposal area.
Cultural Resources The WBF Plant has been previously surveyed for cultural resources. These surveys were conducted to satisfy the requirements of Section 106 of the National Historic Preservation Act of 1966. The WBF Plant has been recommended as eligible for listing on the National Register of Historic Places (NRHP). The Ash Pond is not considered a contributing resource to the Plant's eligibility. Over 700 archeologic sites have been identified on the on the Watts Bar Reservoir, and a number of sites are located in proximity to the Ash Pond area. These sites would be avoided by proposed activities.	No adverse or beneficial impacts. No previously recorded sites lie within the channel in proximity to the Ash Pond; therefore, the removal of sediments from the river as part of the closure process should have no impacts to known resources. Previously recorded site 40RH6 was identified within the Ash Pond. However, this area has been heavily disturbed, and it is not believed that the closure activities would have adverse impacts to this site due to the levels of previous disturbance.	No adverse or beneficial impacts. No impacts due to use of previously disturbed lands. The offsite landfill that CCR material would be transported to would have previously undergone historical resource review to evaluate potential impacts.

Table 1 Resource Impact Evaluation – Ash Pond

Resource Area	Closure-in-Place The Ash Pond was CIP in 2015 in accordance with closure requirements at the time. TVA is not planning any modifications to the existing cover system or drainages. Additional closure activities for the Ash Pond include constructing a buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure. The buttress would begin at the Ash Pond, just north of the Stormwater Pond outfall, and extend north along the riverbank to the north end of the Slag Disposal Area. The complete closure timeline assumes concurrent CIP actions and is expected to take about 2 to 3 years. (2)	Closure-by-Removal For CBR, approximately 190,000 cubic yards (CY) of CCR material would be excavated from the Ash Pond and disposed of at an offsite landfill. The onsite area would be regraded and revegetated or developed for future uses.(1) The complete closure timeline assumes sequential CBR actions and is expected to take about 3 years. (3)
Noise The WBF Plant is bordered by wooded area and the Yellow Creek Wildlife Management Area to the west, the Watts Bar Nuclear Plant to the southwest, Chickamauga Lake to the east, and utility spaces to the north. The nearest residential areas to the WBF plant are a mobile home park, located approximately 0.7 mile from the western edge of the WBF Plant property and additional residential homes located approximately 0.7 miles south of the WBF plant property. The 2009 Watts Bar Reservoir Land Management Plan EIS concluded that the facility presents no direct noise impact to the surrounding community since there are no sensitive receptors within 500 feet of the WBF Plant.	Greater adverse impacts than CBR. Impacts from CIP would involve the construction of a rock buttress for seismic stability along the shore side of the project, maintenance of the existing closure system and associated traffic on local roads. CIP activities would occur over a duration of approximately 2 to 3 years. The Rogers Group Inc. site would be used as a rock source for the buttress. Single-family residential homes are located within 500 feet of this site. The site is currently operational and generates noise that is already received by the homes. The activity generated from sourcing the rock should not significantly increase the noise output already generated from these facilities. Lastly, CIP actions would be concurrent, which results in fewer total truckloads during construction, but more truckloads per day compared to CBR. A greater numbers of truckloads per day could result in higher daily noise levels at the surrounding noise-sensitive receptors. CIP would result in a moderate increase in noise levels along the local roads, haul routes, and at the rock source site lasting up to the approximate 2- to 3-year duration of closure activities.	Less adverse impacts than CIP. Impacts from CBR would include construction equipment and construction-related traffic on the local roads, as well as adding indirect noise impacts to receptors along the haul route to the offsite landfill. Noise from closure activities at the Ash Pond would have no direct impact since there are no sensitive receptors within 500 feet of the facility. CBR actions would be sequential, which results in a higher number of total truckloads during the duration of construction, but less truckloads per day as compared to CIP. Less volume of truckloads per day could result in lower daily noise levels at the surrounding noise sensitive receptors, but the slightly elevated noise levels from truck activity would last longer as compared with CIP. CBR would also result in a moderate increase in noise levels along the local roads and haul routes for approximately 3 years. No receptors by the rock or fill dirt sources would be impacted.
Solid and Hazardous Waste The Ash Pond consists of approximately 190,000 CY of comingled CCR (sluiced fly ash overlain by stacked fly ash which was placed as part of the previous closure process). The entire 190,000 CY is above the phreatic surface. The CCR material is not regulated as a hazardous waste and is managed as solid waste.	Potential adverse impacts. Generation of typical construction debris and small volumes of solid waste. Possible sustained generation of small quantities of hazardous or special waste in the form of waste oil or solvents from parts washers, etc. generated as part of onsite maintenance of construction equipment over a similar time period. TVA would manage hazardous and special waste in accordance with applicable federal, state, and local laws and regulations and TVA best management practices.	Potential adverse impacts. Generation of typical construction debris and small volumes of solid waste. Possible sustained generation of small quantities of hazardous or special waste in the form of waste oil or solvents from parts washers, etc. generated as part of onsite maintenance of construction equipment over a similar time period. TVA would manage hazardous and special waste in accordance with applicable federal, state, and local laws and regulations and TVA best management practices.
Public Health and Safety This resource addresses possible worker and public safety impacts from the proposed alternatives.	Less potential adverse impacts than CBR. The Human Health Risk Assessment concluded that there are no unacceptable risks to offsite human receptors related to the Ash Pond.	Greater potential adverse impacts than CIP. CBR would result in potential impacts during construction and transportation activities. CBR would have notably greater potential adverse impacts to worker safety and traffic related safety associated with excavation of the CCR material and its transportation to the offsite landfill.

Notes:

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

Table 2 Resource Impact Evaluation – Slag Disposal Area

Resource Area	Closure-in-Place	Closure-by-Removal
	The Slag Disposal Area was CIP in 2009 in accordance with then-current regulatory requirements. CIP activities at the Slag Disposal Area include upgradient drainage modifications, the installation of a geosynthetic cap system, and the replacement of the existing sheet pile with a rock buttress on the northern portion of the Slag Disposal Area in compliance with seismic stability standards. The cap system would capture all limits of coal combustion residuals (CCR) material (Slag Disposal Area footprint as well as Drainage Improvements Area). In addition, the Former Coal Yard Storage Area would be regraded and revegetated, and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes concurrent CIP actions and is expected to take about 3 years. (2)	For CBR, approximately 570,000 cubic yards (CY) of CCR material would be excavated from the Slag Disposal Area and disposed of at an offsite landfill.(1) The onsite area would be regraded and revegetated or developed for future uses. In addition, the Former Coal Yard Storage Area would be regraded and revegetated and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes sequential actions and is expected to take about 4 to 5 years.(3)
Closure Cost (4) Groundwater corrective action costs are not included because groundwater corrective action would be implemented if required regardless of closure method.	$15 million to $28 million	$87 million to $170 million
Air Quality The affected environment is the regional airshed, primarily Rhea County to the west-northwest of the site and Meigs County (across the Tennessee River) to the east-southeast of the site. The United States Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards for criteria pollutants. Current air quality is consistent with approved state implementation plans.	Less adverse impacts than CBR. Tailpipe emissions associated with operations and maintenance of the closed Slag Disposal Area would be minor and limited to the immediate area surrounding the WBF Plant. During construction, hauling of borrow material from the Mountainview Raceway Borrow Site (8 miles northwest of the WBF Plant) would occur as needed. The construction of a rock buttress on the shore side of the Slag Disposal Area is expected to involve hauling and placement of approximately 180,000 CY of 300-pound riprap. Tailpipe emissions and localized fugitive dust emissions would occur from construction equipment and hauling trucks. The CIP option, even with construction of the rock buttress, would entail lower total tailpipe emissions and fugitive dust emissions than from CBR. This is because emissions from construction and hauling activity are proportional to total volume of material moved, and in CIP the total volume of material moved would be less than CBR.	Greater adverse impacts than CIP. Temporary impacts from tailpipe emissions would be greater in quantity and duration relative to CIP, even with construction of a rock buttress on the shore side of the Slag Disposal Area, due to the significantly greater volume of material moved in total for CBR. Potential track-out of particulate matter would be greater with CCR material hauling activities, requiring more frequent mitigation. The trip to the offsite landfill is approximately 19 miles. Tailpipe emissions from trucking would be greater relative to CIP. Construction tailpipe emissions and fugitive dust emissions would also occur near any CCR material destination facilities as material is unloaded and placed for final disposal.
Climate Change and Greenhouse Gases (GHG) GHGs absorb and emit radiation within the thermal infrared range which leads to global warming. Prominent GHGs include carbon dioxide, methane, and nitrous oxides. GHG emissions are predominantly associated with activities related to energy production, changes in land use, transportation, and waste and water generation. Additional information for Greenhouse Gas Emissions can be found in Attachment A.	Fewer adverse impact and lower total GHG emissions than CBR. Construction-related GHG emissions would be generated from re-grading the Slag Disposal Area, installing a cover system, and the installation of a rock buttress. Long-term, the CIP impacts would be limited to GHG emissions associated with operations and maintenance, which would be less GHG emissions than construction worker trips and offroad equipment associated with CBR. Total construction-related greenhouse gas emissions from the CIP would be approximately 4,100 metric tons of CO_2 equivalent	Greater adverse impacts and higher total GHG emissions than CIP. CBR is expected to result in a greater number of hauling trucks and a longer construction duration, which would generate more GHG emissions from vehicle trips and offroad equipment than under CIP. Total construction-related greenhouse gas emissions from the CBR would be approximately 14,000 metric tons of CO_2 equivalent. Additional GHG emissions would also be generated to fill, seed, and sod the exposed area.
Land Use The footprint of the Slag Disposal Area is located within Federally owned land that is currently used for industrial purposes. Installation of the rock buttress during CIP activities would encroach into the Tennessee River.	Minor adverse impacts. Minor impacts associated with encroachment of the rock buttress within the Tennessee River. However, there would be no change in industrial land use within the terrestrial environment.	No impact. There is no change in industrial land use. Minor beneficial impact as land could be used for alternative use following closure.

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Prime Farmland According to the Tennessee Urban Growth and Prime Farmland GIS Mapper (2016), the Slag Disposal Area is not considered Soil Survey Geographic Database (SSURGO) prime farmland.	No impact. There is no change in the use of the land.	No impact. There is no change to the use of the land.
Geology and Seismology Onsite geologic mapping indicates that the WBF Plant is underlain by Cambrian age limestone and shale bedrock of the Conasauga Group Middle, and the Nolichucky Shale. Unconsolidated deposits onsite overlie the bedrock and consist of artificial fill, and a mixture of native alluvium deposited by the Tennessee River. Low frequency ground motion that could affect site structures is primarily controlled by very large earthquakes originating in the New Madrid Seismic Zone. High frequency ground motion that could affect site structures is controlled by local, moderate size earthquakes originating in the East Tennessee Seismic Zone.	Less beneficial impact than CBR. The closure method design would meet closure standards for slope stability and structural integrity. The global slope stability and the veneer slope stability for the Slag Disposal Area meets the established factor of safety criteria for the static and seismic load cases, except for the post-earthquake, global stability load case. TVA plans to construct a buttress of riprap along the riverbank of the Slag Disposal Area, such that the Slag Disposal Area would meet or exceed slope stability criteria for post-earthquake global stability. The Slag Disposal Area has adequate structural integrity, and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material. Post-closure routine monitoring, and maintenance would address future changes.	Greater beneficial impact than CIP. The closure method design would meet closure standards for slope stability and structural integrity. CBR would eliminate residual potential (compared to CIP) for release of CCR material via slope stability failures, structural integrity issues, and/or loss of bedrock structural support.
Groundwater The coarse-grained unconsolidated alluvial deposits above bedrock are defined as the uppermost aquifer. The uppermost aquifer is considered to be under confined conditions and is typically overlain by clays that act as an aquitard. The groundwater flow direction within the uppermost aquifer is generally from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow in the vicinity of the Slag Disposal Area is bounded to the east by the Tennessee River. CCR constituents were above GWPS for cobalt (wells MW-1, WBF-104 and WBF-106) and cadmium (well WBF-104).	Both CIP and CBR have beneficial impact. Installation of the geosynthetic cover system along with drainage modifications in adjacent and upgradient areas would reduce infiltration of precipitation and surface water and require minimal CCR material handling or disturbance. The duration of closure activities is estimated to be about 3 years.	Both CIP and CBR have beneficial long-term impact; CBR has greater potential for temporary adverse impacts than CIP. CBR would reduce impacts to groundwater by removing CCR material from the Slag Disposal Area. However, there is a potential to release constituents into groundwater during removal activities. The duration of removal activities is estimated to be about 4 to 5 years, and the extended timeline for CBR would delay implementation of source control.

Table 2 Resource Impact Evaluation – Slag Disposal Area		
Resource Area	**Closure-in-Place** The Slag Disposal Area was CIP in 2009 in accordance with then-current regulatory requirements. CIP activities at the Slag Disposal Area include upgradient drainage modifications, the installation of a geosynthetic cap system, and the replacement of the existing sheet pile with a rock buttress on the northern portion of the Slag Disposal Area in compliance with seismic stability standards. The cap system would capture all limits of coal combustion residuals (CCR) material (Slag Disposal Area footprint as well as Drainage Improvements Area). In addition, the Former Coal Yard Storage Area would be regraded and revegetated, and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes concurrent CIP actions and is expected to take about 3 years. (2)	**Closure-by-Removal** For CBR, approximately 570,000 cubic yards (CY) of CCR material would be excavated from the Slag Disposal Area and disposed of at an offsite landfill.(1) The onsite area would be regraded and revegetated or developed for future uses. In addition, the Former Coal Yard Storage Area would be regraded and revegetated and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes sequential actions and is expected to take about 4 to 5 years.(3)
Surface Water The surface waters evaluated under the WBF Plant Environmental Assessment Report (EAR) include the Tennessee River.	Temporary adverse impacts possible during construction. CIP is not expected to adversely impact surface water with proper implementation of erosion, sediment, and dust controls. The relative potential for release of CCR constituents to surface waters during CIP activities would be less than CBR given that there is already a cover system in place over the CCR material. Expanding the existing cover system with the proposed geosynthetic cap would require minimal handling of contaminated materials, in contrast to ground disturbance directly within the Slag Disposal Area during CBR. Further, the upgradient drainage modifications would reroute stormwater away from the Slag Disposal Area to avoid runoff from entering the adjacent Tennessee River. In addition, CIP activities would include the installation of a rock buttress between the Slag Disposal Area and the Tennessee River to stabilize and reinforce the slope. Placement of the rock within the river may create minor temporary impacts to surface water resulting from the suspension of sediment and other benthic disturbance during construction activities; however, erosion and sediment controls would be implemented during construction to minimize or eliminate the risk of sediment contributions and increased turbidity within the Tennessee River. Any unlikely impacts resulting from erosion and sediment control failures during construction would be temporary. Further, the necessary removal of 6,000 CY of river sediment to accommodate installation of the rock buttress would be performed via suction excavator and hydraulically conveyed to an onsite temporary storage location. This approach would minimize the chance of direct or indirect transfer of sediment to the river during handling. On completion of construction activities, operations and maintenance associated with the geosynthetic cap system, rock buttress and upgradient drainage modifications are anticipated to be minimal and are unlikely to result in surface water impacts, provided the cap is functioning as intended. Additionally, temporary impacts to the upgradient pond would occur during installation of the geosynthetic liner; however, no permanent impacts are anticipated, assuming erosion and sediment controls continue to function as intended. Any disturbance would be returned to pre-construction grades following installation. I	Temporary adverse impacts possible during construction. CBR is not expected to adversely impact surface water with implementation of erosion, sediment, and dust controls. However, the relative potential of release of CCR constituents to surface waters during CBR would be greater than CIP due to the volume of material handled during closure activities and the exposure of the CCR material to the environment. The longer duration of exposure and disturbance of contaminated sediments required by CBR may also increase risk of exposure to the surrounding environment despite erosion, sediment, and dust controls to minimize transport of material via air and water vectors. Following completion of construction activities, operations and maintenance associated with the graded, revegetated work area are anticipated to be minimal and are unlikely to result in surface water impacts. Planting maintenance and monitoring may be required but would not negatively affect surface waters. Temporary impacts to the upgradient pond would occur during installation of the geosynthetic liner; however, no permanent impacts are anticipated, assuming erosion and sediment controls continue to function as intended. Any disturbance would be returned to pre-construction grades following installation.

Table 2 Resource Impact Evaluation – Slag Disposal Area

Resource Area	Closure-in-Place	Closure-by-Removal
	The Slag Disposal Area was CIP in 2009 in accordance with then-current regulatory requirements. CIP activities at the Slag Disposal Area include upgradient drainage modifications, the installation of a geosynthetic cap system, and the replacement of the existing sheet pile with a rock buttress on the northern portion of the Slag Disposal Area in compliance with seismic stability standards. The cap system would capture all limits of coal combustion residuals (CCR) material (Slag Disposal Area footprint as well as Drainage Improvements Area). In addition, the Former Coal Yard Storage Area would be regraded and revegetated, and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes concurrent CIP actions and is expected to take about 3 years. (2)	For CBR, approximately 570,000 cubic yards (CY) of CCR material would be excavated from the Slag Disposal Area and disposed of at an offsite landfill.(1) The onsite area would be regraded and revegetated or developed for future uses. In addition, the Former Coal Yard Storage Area would be regraded and revegetated and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes sequential actions and is expected to take about 4 to 5 years.(3)
Floodplains The Slag Disposal Area was originally developed within the floodplain of the Tennessee River. The 100- and 500-year flood elevations on the Tennessee River at this location are approximately 697 and 700 feet, respectively.	No adverse impacts. The top elevation of the dike along the Slag Disposal Area is above the 500-year floodplain elevation, protecting the Slag Disposal Area from inundation and minimizing potential for transport of CCR materials over the structure crest during flood events at least up to the 500-year storm. Installation of the proposed rock buttress, riverward of the existing dike at the Slag Disposal Area, would result in placement of fill within the 100-year floodplain. Benches would be installed within the buttress structure to provide flood relief; however, the structure itself encroaches into the channel by approximately 30 feet and raises the ground elevation within the existing floodplain.	No adverse impacts. The top elevation of the dike along the Slag Disposal Area is above the 500-year floodplain elevation, protecting the Slag Disposal Area from inundation and eliminating the potential for transport of CCR materials over the structure crest during flood events at least up to the 500-year storm. Erosion and sediment controls would be applied surrounding the dredging area during construction, regardless of dike modifications. The dike would remain in place during excavation of CCR materials from the Slag Disposal Area, but it would be subsequently re-graded to reuse the material as backfill. There would be no net fill within the 500-year floodplain, and no impacts to the 100-year or 500-year floodplains are anticipated to result from the CBR alternative. Once CBR is completed, potential impacts from direct CCR material exposure to floodplains during flood events would be eliminated. In addition, grading of the Slag Disposal Area would increase floodplain storage area. Accordingly, CBR construction activities would not affect existing Tennessee River floodplain elevations or function.
Vegetation Vegetation on the Slag Disposal Area and side slopes is maintained grass. There are some isolated areas of erosion and poor grass establishment.	Minor long-term beneficial impact. Negligible impacts during construction-phase disturbance regardless of whether there is revegetation with turf or grass cover. Implementation of a grass cover would result in minor long-term beneficial impacts. Implementation of a turf cover would result in minor long-term adverse impacts.	Greater long-term beneficial impacts than CIP. Negligible impacts during construction-phase disturbance. The transition of the Slag Disposal Area to an area seeded with non-invasive species with the intent to establish diversified vegetation is considered more beneficial in the long-term.
Wildlife Habitat on the Slag Disposal Area consists of a cover of maintained grass. This does not include aquatic habitat as that is discussed in the aquatic ecology resource area.	Minor long-term beneficial impact. Due to the minimal wildlife habitat, proposed actions during the construction phase are not anticipated to impact the local wildlife population. The revegetation of the Slag Disposal Area to permanently maintained grass cover could have minor and slightly beneficial long-term impacts to wildlife. Implementation of a turf cover would result in minor long-term adverse impacts.	Greater beneficial impacts than CIP. Due to the minimal habitat, proposed actions during the construction phase are not anticipated to impact the local wildlife population. The transition of the Slag Disposal Area to an area seeded with non-invasive species with the intent to establish diversified vegetation would create higher quality habitat for local wildlife and be more beneficial in the long-term.

Table 2 Resource Impact Evaluation – Slag Disposal Area

Resource Area	Closure-in-Place	Closure-by-Removal
	The Slag Disposal Area was CIP in 2009 in accordance with then-current regulatory requirements. CIP activities at the Slag Disposal Area include upgradient drainage modifications, the installation of a geosynthetic cap system, and the replacement of the existing sheet pile with a rock buttress on the northern portion of the Slag Disposal Area in compliance with seismic stability standards. The cap system would capture all limits of coal combustion residuals (CCR) material (Slag Disposal Area footprint as well as Drainage Improvements Area). In addition, the Former Coal Yard Storage Area would be regraded and revegetated, and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes concurrent CIP actions and is expected to take about 3 years. (2)	For CBR, approximately 570,000 cubic yards (CY) of CCR material would be excavated from the Slag Disposal Area and disposed of at an offsite landfill.(1) The onsite area would be regraded and revegetated or developed for future uses. In addition, the Former Coal Yard Storage Area would be regraded and revegetated and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes sequential actions and is expected to take about 4 to 5 years.(3)
Aquatic Ecology Benthic macroinvertebrate communities were evaluated from seven transect locations within the Tennessee River for the purposes of the WBF Plant Environmental Assessment Report (EAR). Also included were CCR tissue concentration testing from fish and Asiatic clams within three reaches of the Tennessee River, upstream and downstream of the Watts Bar Dam.	Minor temporary adverse impacts with net positive effects in the long term. Minor, temporary adverse impacts to aquatic resources are possible during rock buttress installation activities due to potential increased turbidity resulting from rock buttress construction within the Tennessee River; however, erosion and sediment controls would be in place during installation, including coffer dam and turbidity curtain applications, to minimize or eliminate sediment contributions and turbidity effects. Permanent impacts associated with the rock buttress structure include fill placement at the toe of the existing streambank, covering existing edge bed and bank habitat at the toe of slope. Although the installation of coarse stone material for the buttress provides complex, stable, and structural habitat that can be colonized by the benthic community. It is likely that organisms would rapidly recolonize this area from upstream sources and would not be negatively impacted in the long term. As existing habitat contains limited structural features, the habitat modifications associated with the rock buttress may increase species richness and ultimately may benefit the benthic macroinvertebrate community.	No adverse impacts anticipated. CBR is not expected to adversely impact surface water quality and, by extension, aquatic ecology, with implementation of effective erosion, sediment, and dust controls. However, the relative potential of release of CCR constituents to surface waters during CBR would be greater than CIP due to the volume of material handled during closure activities and the exposure of the CCR material to the environment. The longer duration of exposure and disturbance of contaminated sediments required by CBR may also increase possible minor exposures to the surrounding environment despite erosion, sediment, and dust controls to minimize transport of material via air and water vectors. Following completion of construction activities, operations and maintenance associated with the graded, revegetated work area are anticipated to be minimal and are unlikely to affect aquatic communities. Planting maintenance and monitoring may be required but would not negatively affect aquatic conditions in surface water resources.
Threatened and Endangered Species Wildlife habitat is predominantly absent from the Slag Disposal Area. Some areas are temporarily planted with grass when not in use. This does not include aquatic habitat as that is discussed in the aquatic ecology resource area.	No adverse impacts, minor beneficial impacts. Because the Slag Disposal Area is already disturbed with maintained grass and little to no quality habitat present, impacts to threatened and endangered species is not anticipated	No adverse impacts, minor beneficial impacts. Due to the lack of quality habitat, adverse impacts to threatened and endangered species are not anticipated during the construction phase of the project. The transition of the Slag Disposal Area to an area seeded with non-invasive species with the intent to establish diversified vegetation would create higher quality habitat and be more beneficial in the long-term.
Wetlands The jurisdictional wetlands adjacent to the CCR units have a hydrology that is influenced by water levels within the adjacent Tennessee River.	No adverse impacts anticipated. For CIP, no adverse impacts to wetland resources are anticipated from construction activities during expansion of the geosynthetic cap system, rock buttress installation, regrading and revegetation of the Former Coal Yard Storage Area, and implementation of upgradient drainage modifications in the vicinity of the Slag Disposal Area. Wetlands are not expected to be impacted with the implementation of effective erosion, sediment, and dust controls, given the comparably short construction duration under the CIP alternative. Once installed, operations and maintenance associated with the geosynthetic cap system and upgradient drainage modifications are anticipated to be minimal and are unlikely to affect jurisdictional wetlands, provided the cap is functioning as intended.	No adverse impacts anticipated. Existing wetlands are located adjacent to the southwestern boundary of the Slag Disposal Area; however, jurisdictional areas do not appear to cross into it, based on historical delineation. If limits of disturbance are confined to the current boundary of the Slag Disposal Area, no impacts to wetland resources are anticipated. Over-excavation, if required, could impact a narrow strip along the wetland fringe. Under both alternatives, erosion, sediment, and dust control measures, designed to protect adjacent resources during construction activities, would contain and minimize transport of potentially contaminated materials. However, the relative potential release to wetlands during CBR would be greater than CIP due to the volume and handling of contaminated sediments, which could increase possible minor exposures to the surrounding environment despite erosion, sediment, and dust controls to minimize transport of material via air and water vectors. Following completion of construction activities, operations and maintenance associated with the graded, revegetated work area are anticipated to be minimal and are unlikely to affect wetland resources. Planting maintenance and monitoring may be required but are not proposed within jurisdictional wetland areas.

Table 2 Resource Impact Evaluation – Slag Disposal Area

Resource Area	Closure-in-Place	Closure-by-Removal
	The Slag Disposal Area was CIP in 2009 in accordance with then-current regulatory requirements. CIP activities at the Slag Disposal Area include upgradient drainage modifications, the installation of a geosynthetic cap system, and the replacement of the existing sheet pile with a rock buttress on the northern portion of the Slag Disposal Area in compliance with seismic stability standards. The cap system would capture all limits of coal combustion residuals (CCR) material (Slag Disposal Area footprint as well as Drainage Improvements Area). In addition, the Former Coal Yard Storage Area would be regraded and revegetated, and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes concurrent CIP actions and is expected to take about 3 years. (2)	For CBR, approximately 570,000 cubic yards (CY) of CCR material would be excavated from the Slag Disposal Area and disposed of at an offsite landfill.(1) The onsite area would be regraded and revegetated or developed for future uses. In addition, the Former Coal Yard Storage Area would be regraded and revegetated and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes sequential actions and is expected to take about 4 to 5 years.(3)
Socioeconomic Resources Local economic activity can be stimulated through various project actions. Changes to regional economic activity, jobs, housing availability, public services, and government tax collections are impacted by the cost of the project undertaken.	Less beneficial impact than CBR. Results in minor positive impacts to local economic activity as measured by operations and maintenance supported jobs. Increase in local tax revenues are also likely to be modest. Determining sufficiency of existing local public services and housing availability for the expected increased population due to the influx of workers has not been quantitatively assessed at this time but is unlikely to present a challenge.	Greater beneficial impact than CIP. Results in larger positive impacts to local economic activity as measured by supported jobs and increase in economic output. Increase in local tax revenues are also likely to be much larger than CIP. Determining sufficiency of existing local public services and housing availability for the expected increased population due to the influx of workers has not been quantitatively assessed at this time but is unlikely to present a challenge.
Environmental Justice Within a 4-mile radius of the WBF Plant, there are a total of three communities with environmental justice (EJ) concerns. Within a 4-mile radius of the offsite landfill, there are a total of eight communities with EJ concerns. Within a 4-mile radius of the Mountainview Racetrack borrow site, there are a total of two communities with EJ concerns. Within a 4-mile radius of the Rogers Group Inc. rock source site, there are a total of five communities with EJ concerns. Attachment A provides supporting information for the communities with EJ concerns included in this evaluation.	Less adverse impact than CBR. CIP would produce approximately 19,000 truckloads of borrow material and rock. The borrow and rock riprap material would be transported from the Mountainview Racetrack Borrow Site and rock source to the Slag Disposal Area. These actions would occur over a duration of approximately 3 years. Overall, CIP would result in less adverse impacts to transportation, air quality, natural areas, parks, and recreation, visual resources, solid and hazardous waste, public health and safety, climate change and GHG in the communities with EJ concerns. CIP would reduce impacts to communities with EJ concerns because overall actions associated with the operations and maintenance of the Slag Disposal Area (trucking, transportation, etc.) are less than CBR and does not require the disposal of large amounts of CCR material to an offsite landfill.	Greater adverse impact than CIP. CBR would require the removal of approximately 34,000 truckloads of CCR that would be transported to the offsite landfill. In addition, approximately 3,400 truckloads of borrow soil would be transported from the Mountainview Racetrack Borrow Site to the Slag Disposal Area . These actions would occur over a duration of approximately 4 to 5 years. CBR would result in greater adverse impacts from transportation, air quality, natural areas, parks, and recreation, visual resources, solid and hazardous waste, climate change and GHG in the communities with EJ concerns near the WBF Plant, offsite landfill, and the Mountainview Racetrack Borrow Area. Impacts associated with CBR would be greater than those associated with CIP due to the increased number of truckloads necessary to transport CCR material to the offsite landfill and the higher likelihood of CCR coming into contact with the surrounding area as a result of increased disturbance associated with CCR handling. Nonetheless, meaningful public engagement would be conducted to identify mitigation strategies that would reduce the magnitude and likelihood of traffic and health and safety impacts to these communities.
Natural Areas, Parks, and Recreation There are no natural areas within the vicinity of the WBF Plant; however, the eastern portion of the Slag Disposal Area borders the Tennessee River. There is one boat ramp to the east of the Slag Disposal Area that does not have public access. Additionally, the Leuty Cemetery is located 0.1 mile southwest of the Slag Disposal Area. The Yellow Creek Wildlife Management Area is approximately 1.8 miles to the west.	Minor impacts. CIP would result in the installation of a rock buttress within the Tennessee River. The structure would not inhibit normal recreational use of boats along the waterway. In addition, the rock buttress may attract fish and other recreational catch within the Tennessee River by providing refuge and substrate to native aquatic populations. Construction activities would create intermittent noise and transportation effects to the recreational area. However, noise and transportation effects would be minimized through the use of standard construction and traffic controls.	Minor adverse impacts. CBR would result in potential minor visual impacts on the Tennessee River but no direct impacts to other managed or natural areas. Indirect impacts could include intermittent noise and transportation effects to the recreational area. Noise and transportation effects would be minimized through the use of standard construction and traffic controls.

Table 2 Resource Impact Evaluation – Slag Disposal Area		
Resource Area	**Closure-in-Place** The Slag Disposal Area was CIP in 2009 in accordance with then-current regulatory requirements. CIP activities at the Slag Disposal Area include upgradient drainage modifications, the installation of a geosynthetic cap system, and the replacement of the existing sheet pile with a rock buttress on the northern portion of the Slag Disposal Area in compliance with seismic stability standards. The cap system would capture all limits of coal combustion residuals (CCR) material (Slag Disposal Area footprint as well as Drainage Improvements Area). In addition, the Former Coal Yard Storage Area would be regraded and revegetated, and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes concurrent CIP actions and is expected to take about 3 years. (2)	**Closure-by-Removal** For CBR, approximately 570,000 cubic yards (CY) of CCR material would be excavated from the Slag Disposal Area and disposed of at an offsite landfill.(1) The onsite area would be regraded and revegetated or developed for future uses. In addition, the Former Coal Yard Storage Area would be regraded and revegetated and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes sequential actions and is expected to take about 4 to 5 years.(3)
Transportation The transportation network servicing the WBF Plant and the Slag Disposal Area consists of local roads connecting to the state highway network. The WBF Plant also has a riverport on the Tennessee River for the transport of coal and other bulk materials. Closure evaluations for the Slag Disposal Area concluded that barge and rail transport were not reasonable modes of offsite transport of CCR material at the WBF Plant, so this analysis is limited to trucking. See Attachment A for supporting transportation information.	Less adverse impacts than CBR. CIP would require approximately 19,000 truckloads (approximately 110 truckloads per day) associated with the transportation of borrow material and the transportation of rock for buttress construction over a duration of approximately 3 years. The impacts from CIP would be less adverse than the impacts associated with CBR. CIP requires fewer total truckloads along local roads and highways for a shorter duration with some roads experiencing up to a 44% increase in annual average daily traffic during this time. The primary long-term impact would include vehicular traffic in the area associated with ongoing operation and maintenance of the Slag Disposal Area.	Greater adverse impacts than CIP. Because there is no onsite landfill available, all 570,000 CY of CCR material would be disposed at an offsite landfill. In addition, the transfer of 58,000 CY of borrow material to the Slag Disposal Area would produce a total of approximately 34,000 truckloads to be transported on local roads and highways. The total CBR activities would generate as many as 60 truckloads daily over a duration of about 4 to 5 years, with some local roads experiencing up to a 24% increase in average daily traffic during this time. Impacts would include increased use of local roads and highways over a longer period of time compared to CIP. CBR would also increase the wear and tear on the local roads from solid waste transfer trucks resulting in higher maintenance costs.
Visual Resources The Slag Disposal Area occupies the WBF Plant's eastern most property situated along the shores of the Tennessee River. The Slag Disposal Area is generally screened from views to the northwest, west, and southwest by the Watts Bar Nuclear Plant and mature vegetation. It is also screened to the south and portions of the north by mature vegetation. As the Slag Disposal Area is approximately 720 feet above mean sea level, portions of it may be visible to the north and south; however, it would be visible to the east within the Tennessee River. Visibility is not anticipated beyond the eastern shore of the river due to the existing mature vegetation and/or topography. Available views would likely include the existing transmission infrastructure, the Watts Bar Nuclear Plant, and other industrial infrastructure (in use or decommissioned).	Greater potential beneficial impacts than CBR. CIP impacts would be neutral/beneficial. With the Slag Disposal Area remaining and with additional soils and vegetation or other natural-appearing material on top of the geomembrane, its visual presence would be similar to current conditions. It would remain as a natural-appearing area where intermittently visible from outside the WBF Plant. The addition of a rock buttress, although made of natural material, would add the element of a hardened edge – this is likely to be contained to a specific area and would be seen as only a small portion of the overall landscape. In addition, the presence of construction equipment would not pose a significant impact to public viewsheds due to the current industrial uses that take place at the property.	Greater adverse impact than CIP. Removal of the Slag Disposal Area would remove a relatively low landform from views to the north and east, presumably revealing more of the lands beyond. However, existing utility infrastructure would remain. The presence and motion of equipment and machinery used during closure activities would occur over a longer duration than CIP and would result in long-term temporary impacts. Transportation and storage of the removed CCR may cause adverse visual impacts at the site of the new disposal area.
Cultural Resources The WBF Plant has been previously surveyed for cultural resources. These surveys were conducted to satisfy the requirements of Section 106 of the National Historic Preservation Act of 1966. The WBF Plant has been recommended as eligible for listing on the National Register of Historic Places (NRHP). The Slag Disposal Area is not considered a contributing resource to the Plant's eligibility. Over 700 archeologic sites have been identified on the on the Watts Bar Reservoir, and a number of sites are located in proximity to the Slag Disposal Area. These sites would be avoided by proposed activities.	No adverse or beneficial impacts. No previously recorded sites lie within the channel in proximity to the Slag Disposal Area; therefore, the removal of sediments from the river as part of the closure process should have no impacts to known resources. Previously recorded site 40RH5 was identified within the Slag Disposal Area. However, this area has been heavily disturbed and it is not believed that the closure activities would have adverse impacts to this site due to the levels of previous disturbance.	No adverse or beneficial impacts. No impacts due to use of previously disturbed lands. The offsite landfill that CCR material would be transported to would have previously undergone historical resource review to evaluate potential impacts.

Table 2 Resource Impact Evaluation – Slag Disposal Area

Resource Area	Closure-in-Place	Closure-by-Removal
	The Slag Disposal Area was CIP in 2009 in accordance with then-current regulatory requirements. CIP activities at the Slag Disposal Area include upgradient drainage modifications, the installation of a geosynthetic cap system, and the replacement of the existing sheet pile with a rock buttress on the northern portion of the Slag Disposal Area in compliance with seismic stability standards. The cap system would capture all limits of coal combustion residuals (CCR) material (Slag Disposal Area footprint as well as Drainage Improvements Area). In addition, the Former Coal Yard Storage Area would be regraded and revegetated, and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes concurrent CIP actions and is expected to take about 3 years. (2)	For CBR, approximately 570,000 cubic yards (CY) of CCR material would be excavated from the Slag Disposal Area and disposed of at an offsite landfill.(1) The onsite area would be regraded and revegetated or developed for future uses. In addition, the Former Coal Yard Storage Area would be regraded and revegetated and a geosynthetic liner would be installed at an upgradient pond. The complete closure timeline assumes sequential actions and is expected to take about 4 to 5 years.(3)
Noise The WBF Plant is bordered by wooded area and the Yellow Creek Wildlife Management Area to the west, the Watts Bar Nuclear plant to the southwest, Chickamauga Lake to the east, and utility spaces to the north. The nearest residential areas to the WBF plant are a mobile home park, located approximately 0.7 mile from the western edge of the WBF Plant property and additional residential homes located approximately 0.7 miles south of the WBF plant property. The 2009 Watts Bar Reservoir Land Management Plan EIS concluded that the facility presents no direct noise impact to the surrounding community since there are no sensitive receptors within 500 feet of the WBF Plant.	Greater adverse impacts than CBR. Impacts from CIP would involve the construction of a rock buttress for seismic stability along the shore side of the project, additional CIP activities and maintenance of the proposed closure system, upgradient drainage modifications, and regrading and revegetation of the Former Coal Yard Storage Area and associated traffic on local roads. CIP activities would occur over a duration of approximately 3 years. The Rogers Group Inc. site would be used as a rock source for the buttress. Single-family residential homes are located within 500 feet of this rock source. The site is currently operational and generates noise that is already received by the homes. The activity generated from sourcing the rock should not significantly increase the noise output already generated from these facilities. The Mountain View Raceway Borrow Area would be used as a fill source for CIP, as there is currently inadequate fill dirt present at the WBF Plant. Fill activities would involve haul trucks and construction equipment to fill the trucks. Again, single-family residential homes are located within 500 feet of the raceway. Hauling fill material could generate elevated sources of noise from added equipment and traffic during daytime hours. Lastly, CIP actions would be concurrent, which results in fewer total truckloads during construction, but more truckloads per day compared to CBR. A greater number of truckloads per day could result in higher daily noise levels at the surrounding noise-sensitive receptors. Therefore, CIP would result in a moderate increase in noise levels along the local roads, haul routes, and at the raceway site lasting up to the approximate 3-year duration of closure activities.	Less adverse impacts than CIP. Impacts from CBR would include construction equipment and construction-related traffic on the local roads, as well as adding indirect noise impacts to receptors along the haul route to the offsite landfill. Additionally, noise would be generated from upgradient drainage modifications and regrading and revegetation of the Former Coal Yard Storage Area, and associated traffic on local roads. The Mountain View Raceway Borrow Area would be used as a fill source for upgradient actions at the Slag Disposal Area, as there is currently inadequate fill dirt present at the WBF Plant. Fill activities would involve haul trucks and construction equipment to fill the trucks. Single-family residential homes are located within 500 feet of the raceway. Hauling of fill material could generate elevated sources of noise from added equipment and traffic during daytime hours. CBR actions would be sequential, which results in more total truckloads during construction, but less truckloads per day as compared with CIP. Less volume of truckloads per day could result in lower daily noise levels at the surrounding noise-sensitive receptors, but the slightly elevated noise levels from truck activity would last longer as compared with CIP. Noise from closure activities at the Slag Disposal Area would have no direct impact since there are no sensitive receptors within 500 feet of the facility. CBR would also result in a moderate increase in noise levels along the local roads and haul routes for about 4 to 5 years. No receptors by the rock source would be impacted.
Solid and Hazardous Waste The Slag Disposal Area consists of approximately 570,000 CY of comingled CCR (sluiced and stacked fly ash, bottom ash, and slag). Of the 570,000 cubic yards of CCR, approximately 295,000 is above the phreatic surface and 275,000 is below the phreatic surface. The CCR material is not regulated as a hazardous waste and is managed as solid waste.	Less potential adverse impacts than CBR. Generation of typical construction debris and small volumes of solid waste. Possible sustained generation over a shorter time period of small quantities of hazardous or special waste during CIP in the form of waste oil or solvents from parts washers, etc. generated as part of onsite maintenance of construction equipment. TVA would manage hazardous and special waste in accordance with applicable federal, state, and local laws and regulations and TVA best management practices.	Greater potential adverse impacts than CIP. Generation of typical construction debris and small volumes of solid waste. Possible sustained generation over a longer time period of small quantities of hazardous or special waste during CBR in the form of waste oil or solvents from parts washers, etc. generated as part of onsite maintenance of construction equipment. TVA would manage hazardous and special waste in accordance with applicable federal, state, and local laws and regulations and TVA best management practices.
Public Health and Safety This resource addresses possible worker and public safety impacts from the proposed alternatives.	Less potential adverse impact than CBR. CIP would result in temporary potential impacts during cover system construction activities. The Human Health Risk Assessment evaluation shows that there are no unacceptable risks to offsite human receptors related to the Slag Disposal Area.	Greater potential adverse impacts than CIP. CBR would result in potential impacts during construction and transportation activities. CBR would have notably greater potential adverse impacts to worker safety and traffic related safety associated with excavation of the CCR material and its transportation to the offsite landfill.

Notes:

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

EXHIBITS

Exhibit No.

1

Title

WBF Plant Overview

DRAFT

Client/Project

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

Project Location

Spring City, Tennessee

175668050

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

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- National Pollutant Discharge Elimination System (NPDES) Outfalls (Historical)
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

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

Stantec TVA

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ATTACHMENT A - ADDITIONAL ENVIRONMENTAL JUSTICE AND TRANSPORTATION CLOSURE METHOD AND ASSESSMENT INFORMATION

Attachment A – Additional Environmental Justice, Transportation and Greenhouse Gas Closure Method Assessment Information – DRAFT

TDEC Commissioner's Order
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, TN 37402

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

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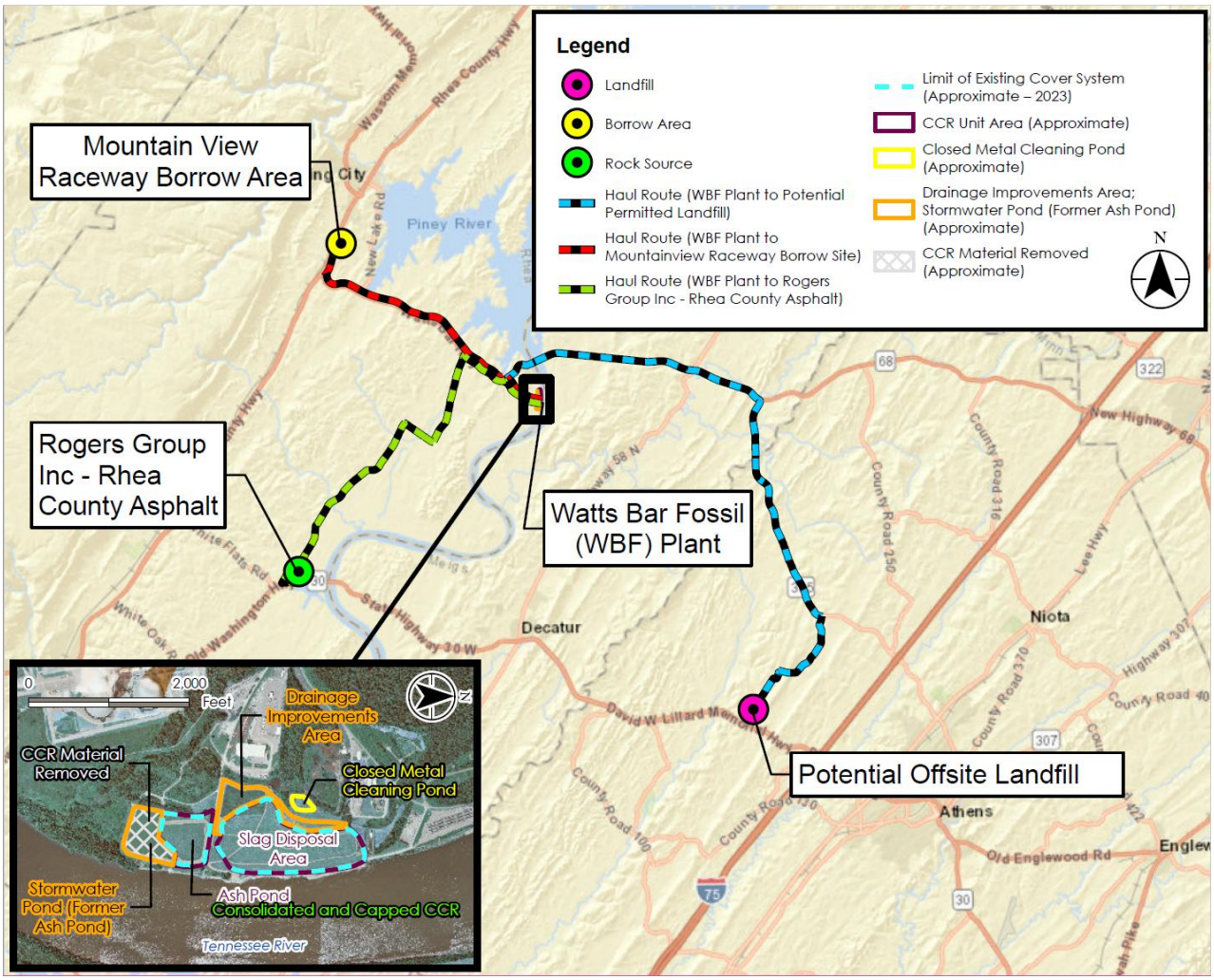
Abbreviations

AADT	Average Annual Daily Traffic
CBR	Closure-by-removal
CCR	Coal Combustion Residual
CIP	Closure-in-place
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalents
CY	Cubic Yards
EJ	Environmental Justice
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
N/A	Not Applicable
N_2O	Nitrous Oxide
%	Percent
PEIS	Programmatic Environmental Impact Statement
TCDS	Traffic Count Database System
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
WBF	Watts Bar Fossil Plant

1.0 Introduction

This attachment was created to support the conclusions made in Appendix C: Closure Method Assessment. It provides additional background information and calculations that were completed for the development of the Environmental Justice (EJ), Transportation, and Climate Change and Greenhouse Gas (GHG) resource areas.



2.0 Environmental Justice

EJ is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (United States Environmental Protection Agency [USEPA] 2023). Meaningful involvement includes the ability of people to effectively participate in platforms through which information exchange and communications occur.

TVA defines communities with environmental justice concerns according to the following thresholds:

- Communities where the percentage of minorities within a given census block group exceeds 50 percent (%) or exceeds a meaningfully greater threshold; for this analysis TVA has used a threshold of 20%.
- Communities where the low-income level within the census block group is equal to or exceeds the comparative county level.

Promising Practices for EJ Methodologies in NEPA describes a disproportionately high and adverse effect on a community with environmental justice concerns as effects that are predominantly borne by environmental justice populations or are appreciably more severe or greater in magnitude on the minority or low-income population than the adverse effect suffered by the non-minority or non-low-income population (USEPA 2016).

In compliance with TVA guidance, this assessment provides an analysis of whether Closure-In-Place (CIP) and Closure-By-Removal (CBR) have a disproportionately high and adverse effect on communities with environmental justice concerns. Communities with environmental justice concerns were defined on the block group level. Data from the U.S. Census Bureau's 2017-2021 American Community Survey Five-Year Estimates were referenced to help determine the presence of communities with environmental justice concerns at the Watts Bar Fossil (WBF) Plant and the block groups within a four-mile radius of the WBF Plant, potential offsite landfill, Mountainview Raceway Borrow Site, and Rogers Group Inc. rock source site. Using this criteria, the following communities with environmental justice concerns were identified.

- Within a four-mile radius of WBF Plant, there is/are: one minority community with environmental justice concerns and two low-income communities with environmental justice concerns. Therefore, there is a total of three communities with environmental justice concerns near the WBF Plant.
- Within a four-mile radius of the offsite potential landfill, there is/are: two minority communities with environmental justice concerns and six low-income communities with environmental justice concerns. Therefore, there is a total of eight communities with environmental justice concerns near the offsite potential landfill.
- Within a four-mile radius of the Mountainview Raceway Borrow Site, there is/are: no minority communities with environmental justice concerns and two low-income communities with

environmental justice concerns. Therefore, there is a total of two communities with environmental justice concerns near the offsite borrow area.

- Within a four-mile radius of the Rogers Group Inc. rock source site, there is/are: three minority communities with environmental justice concerns and two low-income communities with environmental justice concerns. Therefore, there is a total of five communities with environmental justice concerns near the offsite rock source.

Low-income and minority populations are provided below in Tables 1 and 2. In addition, Exhibit 1 identifies low-income populations by block group and Exhibit 2 shows minority populations by block group.

Table 1: Low-Income Populations Near the WBF Plant, Offsite Potential Landfill, Mountainview Raceway Borrow Site, and Rogers Group Inc. Rock Rip Rap Source

Low Income Populations																									
	McMinn County										Meigs County				Rhea County								McMinn Co.	Meigs Co.	Rhea Co.
Census Tract	9701.02	9701.03	9701.03	9701.04	9702.01	9702.01	9702.02	9702.02	9708.01	9708.01	9601	9601	9602	9602	9750	9750	9751	9751	9751	9752	9752	9752			
Block Group	2	1	2	2	1	2	1	3	1	3	2	3	1	3	1	2	1	2	3	1	2	3			
Total Low-Income Persons	1,048	747	540	226	479	555	682	484	793	468	314	387	737	754	1,162	230	1,016	472	687	858	684	926	21,230	5,198	12,744
Low-Income %	3.34	9.1	7.04	0	55.11	24.14	29.33	18.6	12.36	21.97	9.04	26.5	14.7	20.82	23.7	4.35	12.3	6.78	18.9	8.04	13.5	12.5	14.62	16.89	14.66
20% > than County Average?	No	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No	No	No	N/A	N/A	N/A
Meet EJ Criteria?	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	N/A	N/A	N/A
*Source: U.S. Census, American Community Survey 2018-2022, Table B17017 N/A=Not applicable																									

Table 2: Minority Populations Near the WBF Plant, Offsite Potential Landfill, Mountainview Raceway Borrow Site, and Rogers Group Inc. Rock Rip Rap Source

Minority Populations																									
	McMinn County										Meigs County				Rhea County								McMinn Co.	Meigs Co.	Rhea Co.
Census Tract	9701.02	9701.03	9701.03	9701.04	9702.01	9702.01	9702.02	9702.02	9708.01	9708.01	9601	9601	9602	9602	9750	9750	9751	9751	9751	9752	9752	9752			
Block Group	2	1	2	2	1	2	1	3	1	3	2	3	1	3	1	2	1	2	3	1	2	3			
Total Minority Persons	2,644	2,115	1,142	497	1,055	999	1,629	1,088	2,098	1,194	785	915	1,895	1,732	2,948	567	2,320	875	1,690	2,196	1,723	2,396	6,921	1,234	3,960
Minority %	14.64	8.09	22.5	5.84	13.18	30.23	11.11	11.4	6.63	1.17	0	21.1	5.86	12.3	7.46	13.9	1.21	1.03	1.95	25.6	2.09	8.68	15.51	11.53	14.39
20% > than County Average?	No	No	Yes	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	No	No	Yes	No	No	N/A	N/A	N/A
>50% of Block Group Population?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	N/A	N/A	N/A
Meet EJ Criteria?	No	No	Yes	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	No	No	Yes	No	No	N/A	N/A	N/A
*Source: U.S. Census, American Community Survey 2018-2022, Table B17017 N/A=Not applicable																									

3.0 Transportation

This section provides background information for the transportation impacts discussed in Appendix C. The WBF Plant Final Ash Impoundment Closure Part I Environmental Impact Statement (TVA 2016), that evaluated the closure of coal combustion residual impoundments, identified that barge and rail transport were not reasonable modes of offsite transport of Coal Combustion Residual (CCR) material at the WBF Plant, so this analysis is limited to transportation by trucking.

Transportation impacts from trucking exist for both CBR and CIP. In the following sections, current Annual Average Daily Traffic (AADT) counts are used to identify percent increases for traffic on haul routes associated with each closure option.

3.1 Both Closure-by-Removal & Closure-in-Place

TVA is planning a comprehensive set of supplementary closure initiatives for the Slag Disposal Area. These encompass cover system modifications, including the installation of a geosynthetic cover system, implementation of upgradient drainage modifications, and regrading and revegetation activities within the Former Coal Yard Storage Area. Collectively, these initiatives are proposed to reinforce control and minimize infiltration through the cover system into the CCR units and post-closure escape of CCR constituents.

Both CBR and CIP would require the transportation of 820 cubic yards (CY) of borrow for upgradient drainage modifications and regrading for the Former Coal Yard Storage Area associated with the Slag Disposal Area. These actions would require 60 daily truck trips on private and local roads. The table below shows the AADT and percentage increase of traffic on routes related to these actions per day.

Table 3: Average Daily Traffic Volume (2023) Associated with the Upgradient Drainage Modifications and Regrading Related to the Slag Disposal Area

Roadway	AADT Volume*
Watts Bar Drive	1,000
TN 68 N	5,426
US Hwy 27	8,011

*Source: Traffic Count Database System (TCDS) (ms2soft.com) *There are no published daily traffic records for Watts Bar Drive. Traffic volumes on roads in close proximity to Watts Bar Drive are under 1,000 vehicles per day. Due to the similar nature of the roads along the proposed route, it is expected that the traffic volumes on Watts Bar Drive is also less than 1,000 vehicles per day. As a conservative estimate, 1,000 vehicles per day is assumed for Watts Bar Drive.

The following methodology was used to estimate the impact from the transfer trucks to the AADT on the roads associated with the upgradient drainage modifications and regrading activities during CBR and CIP activities.

- The daily number of truck trips was estimated by multiplying the loads required to move the material from the Slag Disposal Area as shown in the table above by two (to account for deadhead travel between the WBF Plant and the borrow area after dumping a load of borrow material).

- The daily number of truck trips was added to the AADT for each road.

Impacts on AADT associated with the upgradient drainage modifications and regrading of the Former Coal Yard Storage Area for CBR and CIP for each road is shown in the table below.

Table 4: Cumulative Traffic Impacts Associated with Upgradient Drainage Modifications and Regrading the Former Coal Yard Storage Area

Roadway	Current AADT	Truck Trips	AADT with increased truck traffic due to CBR*	Traffic Increase (%)
Watts Bar Drive	1,000	60	1,060	6
TN 68 N	5,426	60	5,486	1
US Hwy 27	8,011	60	8,071	1

*The estimated impact of transporting borrow material for backfill and cover is not included in the calculations above

3.2 Closure-by-Removal

To identify the transportation impacts associated with CBR, the number of trips by solid waste transfer trucks required to move CCR material from the WBF Plant to the offsite landfill for disposal was estimated and the route (roadways) of transportation from the WBF Plant to the offsite landfill was identified. During CBR, construction activities for both the Slag Disposal Area and Ash Pond would be happening consecutively. Therefore, cumulative daily impacts are analyzed on an individual unit basis.

The CCR material would be transported from WBF Plant to the offsite landfill using side loading solid waste dump trucks with secure tarps. These vehicles have a capacity of approximately 17 CY. The table below shows the estimated volume of CCR material expected to be removed per day from each unit and the corresponding number of truck loads required to transfer the CCR material to the offsite landfill, per day. The number of truck trips per day assumes both travel to the offsite landfill and from the offsite landfill back to WBF Plant.

Table 5: Number of Dump Trucks Travelling to Landfill Per Day

CCR Unit	Volume Removed Per Day	Truck Capacity (CY)	Number of Truckloads per Day
Slag Disposal Area	1,000	17	60
Ash Pond	1,000	17	60

Approximately 760,000 CY of CCR material, including an estimated 570,000 CY from the Slag Disposal Area, and 190,000 CY from the Ash Pond, would be taken to the offsite landfill. The likely route from WBF Plant to the offsite landfill includes several local roadways in the affected environment. The route from WBF Plant to the offsite landfill includes Watts Bar Drive, TN 68 N, TN 305 S, Co. Rd. 172, Co. Rd. 108, and Co. Rd 168. The table below shows AADT volume on the roads that make up the route from WBF Plant to the offsite landfill.

Table 6: Average Daily Traffic Volume (2023) Along the WBF Plant Proposed Haul Routes

Roadway	AADT Volume*
Watts Bar Drive	1,000
TN 68 N	5,426
TN 305 S	4,722
Co. Rd. 172	1,388
Co. Rd. 108	1,388
Co. Rd. 168	1,388

Source: Traffic Count Database System (TCDS) (ms2soft.com)
*There are no published daily traffic records for Watts Bar Drive. Traffic volumes on roads in close proximity to Watts Bar Drive are under 1,000 vehicles per day. Due to the similar nature of the roads along the proposed route, it is expected that the traffic volumes on Watts Bar Drive are also less than 1,000 vehicles per day. As a conservative estimate, 1,000 vehicles per day is assumed for Watts Bar Drive. There are also no published daily traffic records for county roads 108 and 168. Traffic volumes from the nearest road containing AADT data was used for these two routes.

The following methodology was used to estimate the impact from the transfer trucks to the AADT on the roads along the route from the WBF Plant to the offsite landfill during CBR activities.

- The daily number of truck trips was estimated by multiplying the loads required to remove the CCR material from each CCR unit as shown in the table above by two (to account for deadhead travel between the WBF Plant and the offsite landfill after dumping a load of CCR material)
- The daily number of truck trips was added to the AADT for each road.

Impacts to AADT resulting from CBR for each road along the route between the WBF Plant and the offsite landfill is shown in the tables below.

Table 7: Cumulative Traffic Impacts Associated with the Closure-by-Removal for the Slag Disposal Area

Roadway	Current AADT	Truck Trips	AADT with increased truck traffic due to CBR*	Traffic Increase (%)
Watts Bar Drive	1,000	160	1,120	12.00
TN 68 N	5,426	160	5,546	2.21
TN 305 S	4,722	160	4,842	2.54
TN Co Rd. 172	1,388	160	1,508	8.65
Co. Rd 108	1,388	160	1,508	8.65
Co. Rd. 168	1,388	160	1,508	8.65

*The estimated impact of transporting borrow material for upgradient drainage modifications and regrading are not included in the calculations above.

Table 8: Cumulative Traffic Impacts Associated with the Closure-by-Removal for the Ash Pond

Roadway	Current AADT	Truck Trips	AADT with increased truck traffic due to CBR*	Traffic Increase (%)
Watts Bar Drive	1,000	120	1,120	12.00
TN 68 N	5,426	120	5,546	2.21
TN 305 S	4,722	120	4,842	2.54
TN Co Rd. 172	1,388	120	1,508	8.65
Co Rd 108	1,388	120	1,508	8.65
Co Rd. 168	1,388	120	1,508	8.65

*The estimated impact of transporting borrow material for backfill and cover are not included in the calculations above.

3.3 Closure-in-Place

To identify the transportation impacts associated with CIP, the number of trips by solid waste transfer trucks required to move borrow material from the offsite borrow area to WBF Plant was estimated and the route (roadways) of transportation from the borrow area to the WBF Plant was identified. Borrow material is only required for closure at the Slag Disposal Area. Therefore, the transportation data does not include the Ash Pond.

Borrow material would be transported from the borrow area to the WBF Plant using side loading solid waste dump trucks with secure tarps. These vehicles have a capacity of approximately 17 CY. No borrow material would be required for CIP for Ash Pond, therefore the table below shows the estimated volume of borrow material expected to be transported per day for the CIP of the Slag Disposal Area and the corresponding number of truck loads required to transfer the borrow material to WBF Plant, per day. The number of truck trips per day assumes both travel to WBF Plant from the borrow area and from the WBF Plant back to the borrow area.

Table 9: Number of Dump Trucks Travelling to Borrow Area Per Day

CCR Unit	Volume Per Day	Truck Capacity (CY)	Number of Truckloads per Day
Slag Disposal Area (Closure)	400	17	20

The likely route from the WBF Plant to the borrow area includes several local roadways in the affected environment. The route from WBF Plant to the borrow area includes Watts Bar Drive, TN 68 N, and US Hwy 27. The table below shows average daily traffic volume on the roads that make up the route from WBF Plant to the borrow area.

Table 10: Average Daily Traffic Volume (2023) Along the WBF Plant Proposed Haul Routes

Roadway	AADT Volume*
Watts Bar Drive	1,000
TN 68 N	5,426
US Hwy 27	8,011

Source: Traffic Count Database System (TCDS) (ms2soft.com) *There are no published daily traffic records for Watts Bar Drive. Traffic volumes on roads in close proximity to Watts Bar Drive are under 1,000 vehicles per day. Due to the similar nature of the roads along the proposed route, it is expected that the traffic volumes on Watts Bar Drive are also less than 1,000 vehicles per day. As a conservative estimate, 1,000 vehicles per day is assumed for Watts Bar Drive.

The following methodology was used to estimate the impact from the transfer trucks to the AADT on the roads along the route from the WBF Plant to the borrow areas during CIP activities.

- The daily number of truck trips was estimated by multiplying the loads required to move the borrow material to each CCR unit shown in the table above by two (to account for deadhead travel between the WBF Plant and the borrow area after dumping a load of borrow material)
- The daily number of truck trips number was added to the AADT for each road.

Impacts to AADT resulting from CIP for each road along the route between the WBF Plant and the borrow area is shown in the table below.

Table 11: Borrow Material Traffic Impacts Associated with the Closure-in-Place for the Slag Disposal Area

Roadway	Current AADT	Truck Trips	AADT with increased truck traffic due to CIP*	Traffic Increase (%)
Watts Bar Drive	1,000	40	1,040	4.00
TN 68 N	5,426	40	5,466	0.74
US Hwy 27	8,011	40	8,051	0.50

Additional to borrow material transportation, approximately 200,000 CY of rock would be transported to the Slag Disposal Area for the planned rock buttress. This includes 180,000 rock material for Slag Disposal Area and 20,000 for Ash Pond. The rock material would be transported into the area via 17 CY dump trucks. The utilization of one excavator and one bulldozer is required to move the rock material into place.

Table 12: Number of Dump Trucks Traveling to WBF Plant from Rock Source

CCR Unit	Volume Per Day	Truck Capacity (CY)	Number of Truckloads per Day
Slag Disposal Area	860	17	60
Ash Pond	100	17	6

The likely route from the Rock Source to WBF Plant include several local roadways in the affected environment. The route from the Rock Source to the WBF Plant includes Watts Bar Drive, TN 68 N, Old Dixie Hwy, and Old Washington Hwy. The table below shows average daily traffic volume on the roads that make up the route from the Rock Source to the WBF Plant.

Table 13: Average Daily Traffic Volume (2023) Along the Rock Source Routes

Roadway	AADT Volume*
Watts Bar Drive	1,000
TN 68 N	5,426
Old Dixie Hwy	752
Old Washington Hwy	3,690

*Source: Traffic Count Database System (TCDS) (ms2soft.com) *There are no published daily traffic records for Watts Bar Drive. Traffic volumes on roads in close proximity to Watts Bar Drive are under 1,000 vehicles per day. Due to the similar nature of the roads along the proposed route, it is expected that the traffic volumes on Watts Bar Drive are also less than 1,000 vehicles per day. As a conservative estimate, 1,000 vehicles per day is assumed for Watts Bar Drive.

Table 14: Rock Buttress Traffic Impacts Associated with the Closure-in-Place for the Slag Disposal Area

Roadway	Current AADT	Truck Trips	AADT with increased truck traffic due to CIP*	Traffic Increase (%)
Watts Bar Drive	1,000	120	1,240	24.00
TN 68 N	5,426	120	5,666	4.42
Old Dixie Highway	752	120	992	31.91
Old Washington Hwy	3,690	120	3,930	6.50

Table 15: Rock Buttress Traffic Impacts Associated with the Closure-in-Place for the Ash Pond

Roadway	Current AADT	Truck Trips	AADT with increased truck traffic due to CIP*	Traffic Increase (%)
Watts Bar Drive	1,000	10	1,020	2.00
TN 68 N	5,426	10	5,446	0.37
Old Dixie Highway	752	10	772	2.66
Old Washington Hwy	3,690	10	3,710	0.54

The table below provides a summary of the truck traffic in total for CIP (including the additional Slag Disposal Area Actions mentioned in section 3.1 and the Rock Butress).

Table 16: Additional Truck Traffic - CIP Total (includes additional Slag Actions)

Roadway	Annual Average Daily Traffic Volume	Slag Disposal Area (Truck Trips)	Ash Pond (Truck Trips)	Cumulative Construction Phase Traffic	Traffic Increase (%)
Watts Bar Drive	1,000	220	10	1,460	46.00
TN 68 N	5,426	220	10	5,886	8.48
US Hwy 27	8,011	00	-	8,211	2.50
Old Dixie Highway	752	120	10	1,012	34.57
Old Washington Hwy	3,690	120	10	3,950	7.05

The duration of CIP activities in this analysis assumes that CIP of the CCR units would be performed relatively concurrently for applicable units following removal of the coal at the Former Coal Yard Storage Area. The sum of all truckloads per day for all actions in CIP, except for coal removal at the Former Coal Yard Storage Area.

4.0 Greenhouse Gas Emissions

The purpose of this section is to estimate the Greenhouse Gas Emissions (GHGs) associated with CIP and CBR options for the two CCR units at WBF Plant discussed in the CARA Plan.

4.1 Scope and Methodology

The construction emission estimates for the CCR units were calculated based on the trucking of graded material, off-road construction equipment, and construction worker trips required under CIP and CBR. For the purposes of the GHG emissions analysis, construction years does not include permitting and design of the closure action, which is expected to take approximately two years depending on the CCR unit.

As described in Appendix C and the main text of the CARA Plan, both CCR units were evaluated for CBR and CIP activities.

4.1.1 TRUCKING FOR CIP AND CBR

During CIP, the Slag Disposal Area would be graded using soil from a borrow source located eight miles from the CCR units and revegetated. During CBR, the CCR material within both CCR units would be excavated and hauled approximately 19 miles to an offsite landfill. Both CIP and CBR alternatives would utilize borrow material for upgradient drainage modifications and for regrading the Former Coal Yard Storage Area associated with actions for the Slag Disposal Area. CIP would also require importing rock from approximately 13 miles from the site. Trucks were assumed to have a carrying capacity of 17 CY and would make two trips per haul (one trip to the site with an empty truck and one trip from the site with grading material) with an average truck vehicle speed of 40 miles per hour assuming trucks would travel on a mix of highway, county, and city roadways (State Regulations Today 2024). The GHG emissions from trucks were calculated based on the USEPA MOVES3 calculations and emission factors for carbon dioxide (CO_2) and nitrous oxide (N_2O), respectively (USEPA 2020). N_2O emissions were converted to carbon dioxide equivalents (CO_2e) based on the global warming potential of 298 (Intergovernmental Panel on Climate Change [IPCC] 2006).

Total trucking estimates for cover soil, coal removal, and CCR removal for each CCR unit are provided in Table 17. The trucking estimates for the rock buttress construction under CIP are provided in Table 18.

Table 17: CIP and CBR Truck Trips per CCR Unit (not Including Rock Buttress)

CCR Unit	Closure-in-Place				Closure-by-Removal			
	Construction Years[1]	Total Borrow Material (CY)	Total Truck Trips[2]	Daily Truck Trips[2]	Construction Years[1]	Total Removed CCR Volume (CY)	Total Truck Trips[2]	Daily Truck Trips[2]
Slag Disposal Area	1	64,000	8,000	40	3.3	570,000	68,000	120
Slag Disposal Area (Upgradient Drainage Modifications and Regrading)	1	65,000	7,600	60	1	58,000	6,800	40
Slag Disposal Area (Excavation for Buttress)	1	6,000	N/A[3]					
Ash Pond	1	-	-	-	1.8	190,000	22,000	120

Total material and truck trips represent rounded estimates.

[1] For the purposes of the GHG emissions analysis construction years does not include permitting and design of the closure action, which is expected to take approximately 2 years depending on the CCR unit. Construction years does include regrading (approximately 1 year for each unit).

[2] Total truck trips per day account for truck trips from the site to the landfill and back to the site. Therefore, each truckload is associated with two truck trips.

[3] Excavation of alluvial material would be completed with suction excavator and placed within the Slag Disposal Area.

Table 18: Closure in Place Rock Buttress Trucking

CCR Unit	Amount of Rock (CY)	Total Number of Truck Trips*	Number of Trucking Days
Slag Disposal Area	180,000	22,000	210
Ash Pond	20,000	2,400	210

Total rock and truck trips represent rounded estimates.

*Total truck trips per day account for truck trips from the site to the landfill and back to the site. Therefore, each truckload is associated with two truck trips.

4.1.2 OFF-ROAD CONSTRUCTION EQUIPMENT

In June 2016, TVA prepared a programmatic Final Ash Impoundment Closure Environmental Impact Statement (PEIS) that addresses the closure of CCR impoundments at its coal-fired powered plants including the WBF Plant. According to the document, CIP would include dozers (up to 10), compactors (up to five), dump trucks (up to 20), scrapers/pans (up to 10), track hoes (up to five), cranes, and diesel pumps. The PEIS did not provide the maximum number of cranes or diesel pumps. Up to two cranes and two diesel

pumps were assumed for this analysis as the maximum number under CIP and CBR. CBR would use the same types of equipment and vehicles as CIP, but in greater quantities because of the excavation and transport of CCR material (TVA 2016). The PEIS determined that CIP and CBR would generate up to 350 truck trips per day to haul borrow material or CCR. Therefore, it was assumed that closing a CCR unit that generates 350 trucks per day would require the maximum amount of construction equipment. The amount of construction equipment required under CIP and CBR in this WBF Plant comparative analysis was determined by taking the fraction of daily truck trips required by the closure type and unit and the maximum daily truck trips to determine a ratio. This ratio was then multiplied by the maximum construction equipment. For example, under CIP, the Slag Disposal Area would generate 40 truck trips per day, approximately 11% of the maximum truck trips evaluated for a CCR unit within the PEIS. Additionally, under CIP, the CCR units would require the construction of a rock buttress which would require a bulldozer, an excavator for placing rock as well as a suction excavator for dredging the alluvial. The amount of construction equipment assumed for each CCR unit under CIP and CBR is provided in the table below.

All equipment was assumed to be diesel powered and operate up to eight hours per day (California Emissions Estimator Model [CalEEMod] 2022).

Table 19: Off-Road Construction Equipment per CCR unit

Unit	Closure-in-Place		Closure-by-Removal	
	Equipment	Unit*	Equipment	Unit*
Slag Disposal Area (Closure)	Dozers	2	Dozers	4
	Compactors	1	Compactors	2
	Dump Trucks (onsite)	3	Dump Trucks (onsite)	7
	Scrapers/pans	2	Scrapers/pans	4
	Track hoes	1	Track hoes	2
	Cranes	1	Cranes	1
	Diesel Pumps	1	Diesel Pumps	1
	Bulldozer (rock buttress)	1	-	-
	Excavator (rock buttress)	1	-	-
	Suction Excavator (rock buttress)	1	-	-
Slag Disposal Area (Upgradient Drainage Modifications)	Dozers	2	Dozers	2
	Compactors	1	Compactors	1
	Dump Trucks (onsite)	4	Dump Trucks (onsite)	4
	Scrapers/pans	2	Scrapers/pans	2
	Track hoes	1	Track hoes	1
	Cranes	1	Cranes	1
	Diesel Pumps	1	Diesel Pumps	1
Ash Pond	Dozers	None.	Dozers	4

Unit	Closure-in-Place		Closure-by-Removal	
	Equipment	Unit*	Equipment	Unit*
	Compactors	None.	Compactors	2
	Dump Trucks (onsite)	None.	Dump Trucks (onsite)	7
	Scrapers/pans	None.	Scrapers/pans	4
	Track hoes	None.	Track hoes	2
	Cranes	None.	Cranes	1
	Diesel Pumps	None.	Diesel Pumps	1
	Bulldozer (rock buttress)	1	-	-
	Excavator (rock buttress)	1	-	-

* Equipment was rounded up to the nearest whole number.

The emissions from the construction equipment were calculated based on the USEPA's AP-42 emission factors for gasoline and industrial engines (USEPA 1996).

4.1.3 CONSTRUCTION WORKER TRIPS

According to the TVA's 2016 PEIS, a construction workforce of 75 to 100 per day could be expected to support closure activities for both CIP and CBR. The daily number of construction workers assumed per CCR unit are provided in Table 20.

Table 20: Construction Workers per Day per CCR unit

CCR unit	Closure-in-Place	Closure-by-Removal
Slag Disposal Area	75	75
Ash Pond	75	75

GHG emissions from construction worker trips were calculated based on USEPA's CO_2 emission factors for gasoline powered passenger vehicles (USEPA 2023).

4.1.4 WORKDAYS PER YEAR

CIP and CBR were assumed to have 150 and 250 workdays per year, respectively. For CIP, borrow material could only be harvested seven months per year. Based on the assumptions of 4.2 weeks per months and five working days per week, a maximum of 150 working days were used for the calculations. For the suction excavation required for the rock buttress, engineering estimates assumed 150 working days would be required. For CBR, the excavation of CCR material can occur year-round, resulting in 250 working days per year.

4.2 Results

As shown in Table 21, annual GHG emissions generated by CBR would exceed CIP. The total GHG emissions generated by the Ash Pond CBR would exceed CIP as well; however, the total GHG emissions generated by Slag Disposal Area under CBR would be less than CIP. CBR GHG emissions are higher due to the increased daily construction equipment and the removal of CCR material. However, for the Slag Disposal Area, CIP would require a longer construction duration and, as result, would result in higher GHG emissions as compared to CBR.

Table 21: Greenhouse Gas Emissions from CIP and CBR

CCR Unit	Closure-in-Place		Closure-by-Removal		Percent Change	
	Annual (MT CO_2e/year)	Total (MT CO_2e)	Annual (MT CO_2e/year)	Total (MT CO_2e)	Annual	Total
Slag Disposal Area (Closure)[2,4]	1,600	2,700	3,800	12,000	140%	360%
Slag Disposal Area (Upgradient Drainage Modifications and Former Coal Yard Storage Area Regrading)[3]	1,500	1,500	1,400	1,400	0%	0%
Slag Disposal Total[5]	**3,000**	**4,100**	**5,200**	**13,700**	**74%**	**230%**
Ash Pond Total[1,6]	**560**	**560**	**3,400**	**6,000**	**500%**	**960%**
Total[7]	3,600	4,700	8,600	20,000	140%	320%

[1]Totals for CBR assume equipment and worker emissions would occur throughout entire construction phase (including regrading). However, hauling emissions would only take place during construction.

[2]Closure in Place for Slag Removal (Closure) and Ash Pond includes dredging and placing of the rock buttress activities. Assumptions for these activities are included within CIP Assumptions. Construction equipment for the rock buttress and workers would require 3 years. Equipment for the CCR unit would require 1 year.

[3]Slag Disposal Area would include Upgradient Drainage Modifications. The trucking and construction equipment emissions were calculated separately (see calculation tabs).

[4]For CBR, closure, and Upgradient Drainage Modifications would occur sequentially therefore the annual maximum emissions would occur during one year of Slag Disposal Area (Closure)

[5]CIP would occur concurrently, therefore annual emissions are the total of closure, and Upgradient Drainage Modifications- borrow)

[6]Hauling truck trips for CBR would occur within one year, therefore annual hauling emissions were utilized within the total.

[7]GHG emissions represent rounded numbers.

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EXHIBITS

Exhibit No.
1

DRAFT

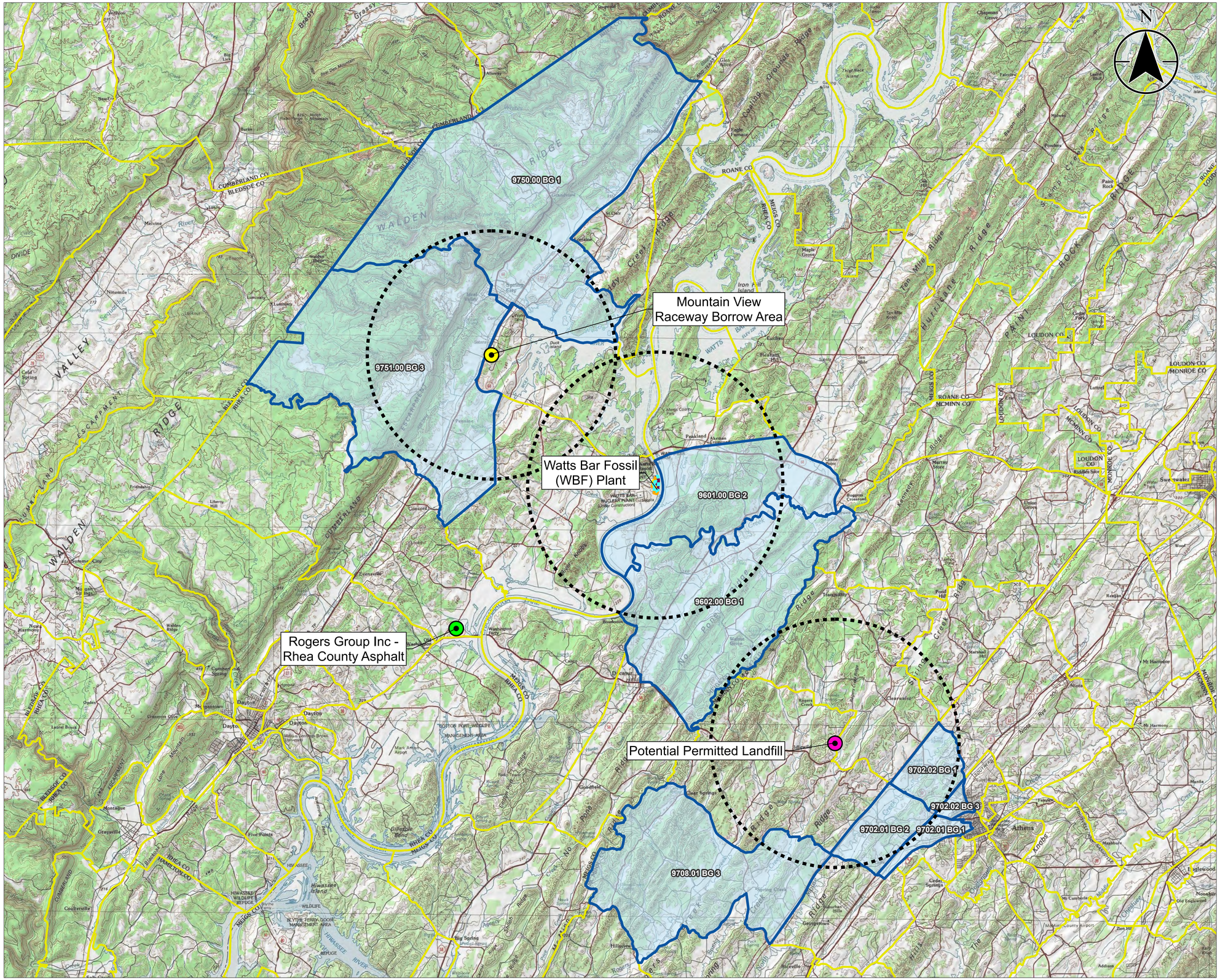
Title
Environmental Justice Low-Income Populations

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-29
Technical Review by ES on 2024-08-29

0 1.5 3 4.5 6 Miles
1:95,040 (At original document size of 22x34)



Legend

- Landfill
- Borrow Area
- Rock Source
- Limit of Existing Cover System (Approximate – 2023)
- 4-Mile Buffer
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- Low Income EJ Population

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Topographic Background Provided by Esri basemap - USA Topo Maps
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Exhibit No.
2

DRAFT

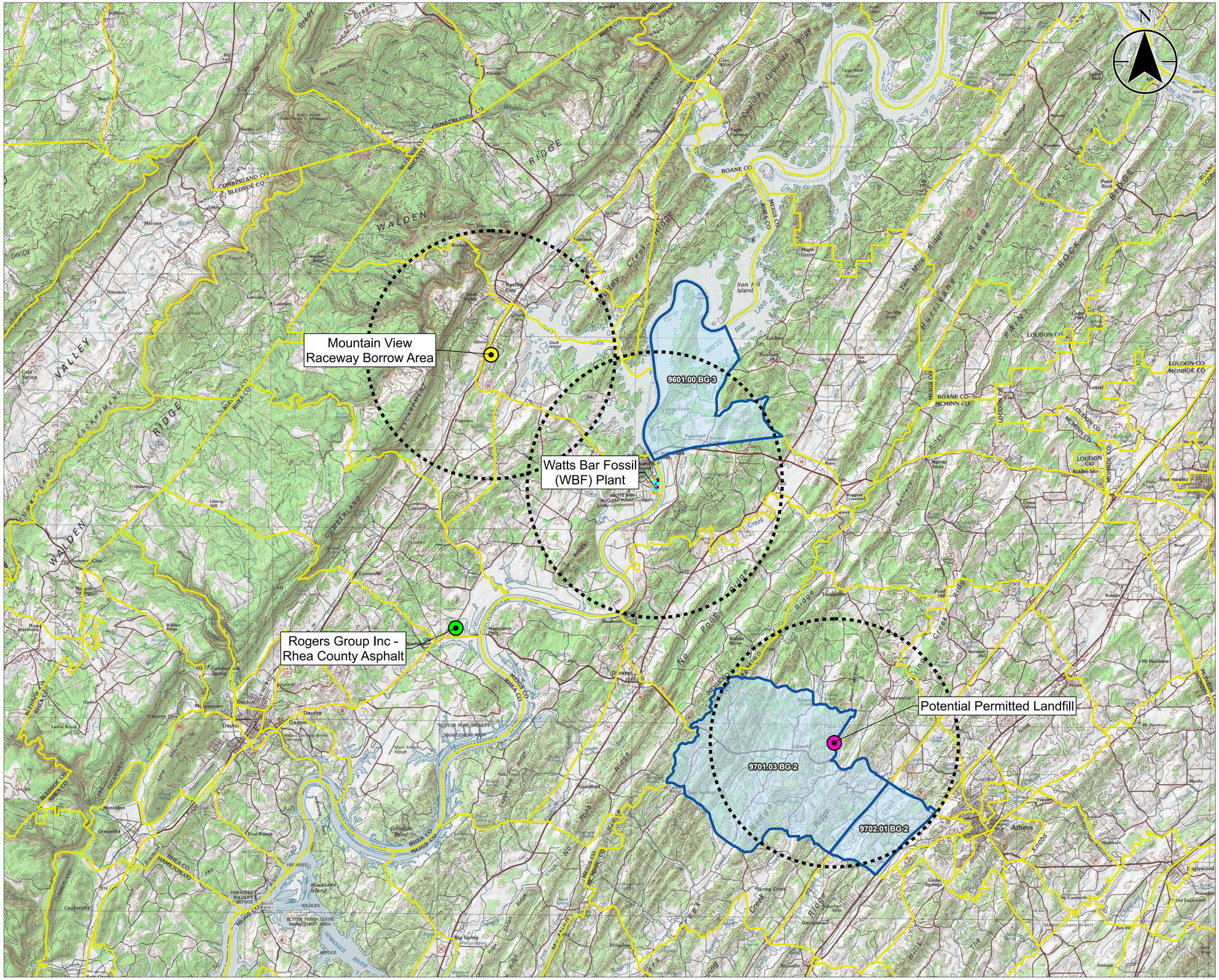
Title
Environmental Justice Minority Populations

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-29
Technical Review by ES on 2024-08-29

0 1.5 3 4.5 6 Miles
1:95,040 (At original document size of 22x34)



Legend

- Landfill
- Borrow Area
- Rock Source
- Limit of Existing Cover System (Approximate – 2023)
- 4-Mile Buffer
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- Minority EJ Population

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Topographic Background Provided by Esri basemap - USA Topo Maps Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed

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APPENDIX D – CORRECTIVE MEASURES ASSESSMENT

Appendix D - Corrective Measures Assessment Technical Memorandum - DRAFT

TDEC Commissioner's Order
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Revisions to Corrective Measure Alternative	December 5, 2025

Sign-Off Sheet

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

Prepared by _____

Steven Reiners, CHMM, Senior Principal

Reviewed by _____

John Griggs, PG, Senior Principal

Approved by _____

Carole M. Farr, PG, Senior Principal Geologist

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LIST OF EXHIBITS

Exhibit 1 Planned WBF Plant CCR Unit Groundwater Corrective Actions

LIST OF ATTACHMENTS

Attachment A Potential Corrective Measure Strategies

Abbreviations

CARA	Corrective Action Risk Assessment
CCR	Coal Combustion Residuals
DSWM	Tennessee Divisions of Waste Management
EAR	Environmental Assessment Report
EI	Environmental Investigation
EIST	Enhanced *In Situ* Treatment
GWPS	Groundwater Protection Standards
HHERA	Human Health and Ecological Risk Assessment
MNA	Monitored Natural Attenuation
NaOH	Sodium Hydroxide
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order No. OGC15-0177
TM	Technical Memorandum
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION AND OBJECTIVES

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this Corrective Measures Assessment Technical Memorandum (TM) to summarize the assessment of potential corrective measures, where required, at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The overall objective of the corrective measures assessment is to identify corrective actions at the WBF Plant coal combustion residuals (CCR) units or within adjacent environmental media in support of fulfilling the requirements of the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan has been prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate operational changes planned or in progress by TVA.

This TM documents the implementation of the assessment of corrective measures process described in Chapter 6 of the CARA Plan. The specific objectives of the corrective measures assessment are summarized as follows:

- Summarize the environmental investigation (EI) and risk assessment findings that require corrective action and identification of planned corrective measures
- Identify potentially applicable corrective measure technologies that may meet the standards specified by the TDEC Division of Solid Waste Management (DSWM), which would also fulfill the requirements of the TDEC Order (e.g., attain groundwater protection standards [GWPS])
- Assemble applicable corrective measure technologies into corrective measure alternatives based on site-specific technology evaluations
- Evaluate the corrective measure alternatives using factors specified in TDEC regulations, supplemented with additional factors specified by TVA
- Identify a planned corrective action for each CCR unit or adjacent environmental media at the WBF Plant where corrective action is required.

2.0 BACKGROUND

The following presents brief descriptions of the WBF Plant CCR units and a summary of key findings from the WBF Plant Environmental Assessment Report (EAR) and CARA Plan human health and ecological risk assessment (HHERA, CARA Plan Appendix B). Further information regarding the EAR and HHERA findings are summarized in CARA Plan Chapters 3 and 4, respectively.

2.1 CCR UNITS

There are two CCR units at the WBF Plant, both of which are included in the TDEC Order:

- Ash Pond
- Slag Disposal Area.

The Ash Pond is a closed surface impoundment that covers about seven acres and is bounded by a perimeter dike. CCR material present in the Ash Pond is comingled CCR consisting of stacked fly ash placed as part of closure and sluiced fly ash. The estimated total volume of CCR material is about 190,000 cubic yards. The Ash Pond was closed in 2015 under TDEC Permit TN0005461 in accordance with State regulations applicable at the time of closure. As part of the closure project, CCR material was excavated from the southern area of the Ash Pond and consolidated and capped in the northern area of the Ash Pond using a geosynthetic and soil cover system. A clay divider dike was constructed from an onsite borrow area between the capped portion of the Ash Pond and the remaining area of the Ash Pond. The southern portion of the former Ash Pond was converted into a permitted stormwater pond (Permit No. TNR058427) for the site.

The Slag Disposal Area is a closed CCR unit that covers about 27 acres and was formed by a railroad embankment and a natural knoll to the west, stacked CCR material to the east, and a dike and spillway to the south constructed to discharge process water. CCR material present in the Slag Disposal Area is comingled sluiced and stacked fly ash, bottom ash, and slag, and the estimated total volume of CCR material is about 570,000 cubic yards. During operation of the Slag Disposal Area, process water and CCR material were also sent into the area now identified as the Drainage Improvements Area, which was an extension of the Slag Disposal Area. Following the 1982 plant retirement, approximately 161,000 tons of slag were reclaimed for beneficial use in manufacturing products. This activity occurred from 1996 to 2005, until a majority of the material usable at that time was recovered. The Slag Disposal Area was closed with a soil cover system in 2009 under TDEC Permit TNR190741 in accordance with State regulations applicable at the time of closure. The Slag Disposal Area cover system consisted of a one-foot thick vegetative cover over a one-foot thick compacted clay layer. A separate drainage improvements project was completed in 2015 at the Drainage Improvements Area to place fill, improve drainage, and remove water around the Slag Disposal Area to address historical seepage at the WBF Plant. The Drainage Improvements Area is located immediately adjacent to, and upgradient of, the Slag Disposal Area as shown in Exhibit 1. The Drainage Improvements Area was investigated during the EI and based on those findings, was recommended for further evaluation in the CARA Plan (see CARA Plan Chapter

3). As such, the Slag Disposal Area and Drainage Improvements Area are discussed together in this CARA Plan, including in this TM.

2.2 SUMMARY OF INVESTIGATION AND RISK ASSESSMENT FINDINGS REQUIRING CORRECTIVE ACTION

Environmental media identified for corrective action in this CARA Plan are based on both EAR findings and HHERA results. The EAR findings were based on comparison of groundwater, sediment, surface stream water, and ecological sample analytical results for CCR constituents to TDEC-approved screening levels. Further evaluation of these environmental media in the HHERA (CARA Plan, Appendix B) concluded that there are no unacceptable risks to human or ecological receptors based on United States Environmental Protection Agency (USEPA) guidance for assessing potential exposures to sediment, surface stream water, or groundwater, and potential risks to future onsite workers would be mitigated by implementing standard health and safety protocols. Therefore, corrective action is only required for groundwater in order to attain GWPS consistent with regulatory requirements at the two wells identified below:

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

The GWPS established for the CARA Plan are based on regulatory standards (see CARA Plan Chapter 6.1) and are presented in Table 1, which includes GWPS for cadmium and cobalt.

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

Well MW-1 was identified in the EAR as requiring further evaluation because it exhibited statistically significant concentrations of cobalt above the TDEC-approved screening level. Based on the boring log information, the well was screened in clay, which does not represent the uppermost aquifer. In addition, MW-1 is generally located between two adjacent CCR units that are essentially contiguous and is positioned upgradient of the Ash Pond. Groundwater passing MW-1 continues to flow approximately east-

southeast toward the downgradient boundary of the Ash Pond. There are no exceedances of GWPS in groundwater at wells screened in the uppermost aquifer along the downgradient (eastern) boundary of the Ash Pond. For the reasons described above, well MW-1 is not appropriately positioned to serve as a compliance well. Therefore, TVA has identified MW-1 as an observation well (CARA Plan Appendix E) that does not require evaluation for potential corrective action.

3.0 ASSEMBLY OF CORRECTIVE MEASURE ALTERNATIVES

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

- Hydraulic Control (also often called hydraulic containment) and Treatment
- Enhanced *In Situ* Treatment (EIST)
- Monitored Natural Attenuation (MNA).

Descriptions of these approaches for groundwater corrective measures are provided in Attachment A.

These potential corrective measure technologies were further evaluated, and then retained technologies were assembled into corrective measure alternatives for groundwater at the Slag Disposal Area.

3.1 SLAG DISPOSAL AREA

The development of corrective measure alternatives to be considered for groundwater at the Slag Disposal Area is described below. Throughout the discussion of corrective measure alternatives, the Slag Disposal Area is considered to include the Drainage Improvements Area (see Section 2.1 and Exhibit 1).

3.1.1 Further Evaluation of Potential Corrective Measure Technologies

Hydraulic control and treatment, EIST and MNA were further evaluated to assess each of these technologies' potential applicability as corrective measures to address statistically significant concentrations of cadmium and cobalt above GWPS in groundwater wells downgradient of the Slag Disposal Area. Based on this further evaluation, some of these technologies were not retained for further consideration as primary groundwater corrective measure alternatives for the Slag Disposal Area as described below. In the future, as the implemented corrective action progresses and conditions change, some of these corrective measure technologies may be applicable for further study and considered for targeted implementation as part of the groundwater corrective action. The future integration of additional corrective measures or modifications of the implemented corrective actions would be completed using an adaptive management process (see CARA Plan Chapter 6.5) in coordination with, and with approval by, TDEC and in accordance with applicable regulations.

3.1.1.1 Monitored Natural Attenuation

MNA relies on the natural geochemical system to attenuate concentrations of target constituents by adsorption onto unconsolidated materials or by other geochemical or physical processes. Descriptions of cadmium and cobalt geochemistry are provided in the Geochemical Modeling TM (CARA Plan, Appendix H.1).

Based on the cobalt concentrations in groundwater evaluated in this CARA Plan, MNA alone would not provide control of the groundwater moving downgradient of the Slag Disposal Area, and there is uncertainty as to the length of time required following completion of the additional planned closure actions for MNA to attain and maintain GWPS for cobalt at WBF-104 and WBF-106 (and cadmium at WBF-104). Therefore, based on these data, MNA was not retained as a primary groundwater corrective measure alternative for the Slag Disposal Area at this time.

3.1.1.2 Enhanced *In Situ* Treatment

EIST is an established technology that relies on the corrective measure to change geochemical conditions within the aquifer to immobilize and reduce the concentrations of the target constituents. A bench scale study was conducted to evaluate pH adjustment as an *in situ* treatment approach to reduce cadmium and cobalt concentrations in a laboratory setting before field application (CARA Plan, Appendix I.1). The study used soil and groundwater collected from the WBF-104 and WBF-106 well locations and found that sodium hydroxide (NaOH) has the greatest potential to effectively adjust pH to treat cobalt at both well locations and cadmium at the WBF-104 location. The results of supplemental laboratory column testing designed to evaluate higher doses of NaOH at WBF-104 indicate that GWPS for cadmium and cobalt were attained in test columns within 23 days, and that concentrations of other metals were also maintained below GWPS after that time.

An EIST field pilot test was then performed to provide further insight into dosing, dosing frequency, and responses at the field scale (Appendix I.3). The *in situ* treatment field pilot system was successful in delivering sodium hydroxide (NaOH) reagent to the subsurface, increasing the pH of groundwater close to the injection wells, and lowering cobalt concentrations. However, uncertainty remains regarding the ability of *in situ* treatment to consistently maintain the target pH range and achieve GWPS throughout the targeted treatment zone without mobilizing other metals. The lack of significant pH increases in certain downgradient wells indicates that much of the alkalinity provided by addition of the NaOH reagent was consumed within a short distance from the injection wells, which may have contributed to the difficulty in reducing cobalt concentrations consistently below the GWPS. Increasing the injection volume caused the pH in the injection wells to increase above the target range and temporarily increased arsenic and vanadium concentrations above the GWPS until after injections stopped and the pH decreased. These results suggest that using a buffering reagent (e.g., sodium bicarbonate) could provide benefit. Additional field pilot testing would be required to further evaluate combinations of reagents, dosing, dosing frequency, and responses to determine if *in situ* treatment can be consistently effective under the site-specific conditions at the WBF Plant pilot test area. Therefore, *in situ* treatment was not retained as a primary groundwater corrective measure alternative for the Slag Disposal Area at this time.

3.1.1.3 Hydraulic Control and Treatment

Hydraulic control relies on groundwater extraction to control movement of groundwater. Groundwater extraction and treatment is used worldwide as a reliable, proven technology for hydraulic control, and is easily implemented and sustainable. A calibrated numerical groundwater flow model was used to evaluate a number of elements potentially affecting hydraulic control (see Groundwater Flow Modeling TM [CARA Plan Appendix G], and Groundwater Extraction Evaluation TM [CARA Plan Appendix J]). A

focal point of the groundwater flow modeling was to evaluate the feasibility of implementing this corrective measure technology in the conditions present at the Slag Disposal Area.

The modeling simulated groundwater extraction from the uppermost aquifer along portions of the downgradient boundary of the Slag Disposal Area near wells WBF-104 and WBF-106. The results of the modeling showed that groundwater extraction would provide hydraulic control at an implementable total flow rate until GWPS are attained and maintained.

The groundwater extraction system would be installed immediately upgradient of the monitoring wells along the downgradient Slag Disposal Area boundary (i.e., between the downgradient monitoring wells and the downgradient Slag Disposal Area boundary). The normal flow of groundwater in the uppermost aquifer would be intercepted by the extraction system, preventing it from moving downgradient of the Slag Disposal Area. Given the close proximity of the groundwater extraction system to the downgradient monitoring wells, it is anticipated that GWPS would be attained at the monitoring wells within just a few years following groundwater extraction implementation. After GWPS are attained at the Slag Disposal Area monitoring wells, the groundwater extraction system would continue to operate, capturing groundwater and preventing it from moving downgradient of the Slag Disposal Area.

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

The time required to achieve this groundwater corrective action objective is uncertain due to a variety of factors. These factors include, for example, the initial magnitude of concentrations above the GWPS, the manner in which physical and geochemical processes act on different CCR constituents, the rate at which pore water hydraulic heads decrease following implementation of the planned additional closure actions, and the rate of groundwater flow within the uppermost aquifer. However, routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a 5- to 10-year timeframe. Also, the groundwater corrective action objective might be achieved at some locations sooner than others, and corrective action in such locations could conclude sooner as part of the routine monitoring, operation, and maintenance of the corrective action.

Extracted groundwater would be pumped through a conveyance pipeline and treated (if needed) prior to discharge under applicable permit(s). Potential groundwater extraction approaches are further evaluated in the Groundwater Extraction Evaluation TM (CARA Plan, Appendix J), and potential treatment approaches for extracted groundwater are further evaluated in the Water Treatment and Discharge Evaluation TM (CARA Plan Appendix L). The actual groundwater extraction locations and rates, the water treatment (if needed) and discharge approach, and associated details would be developed in the corrective action final design process following CARA Plan approval.

Based upon these further evaluations of hydraulic control and treatment technologies, groundwater extraction and treatment was retained as a primary groundwater corrective measure alternative for the Slag Disposal Area.

3.1.2 Slag Disposal Area Corrective Measure Alternatives

Based on the further evaluation of potential corrective measure technologies presented above, EIST and MNA were not retained as primary groundwater corrective measure alternatives for the Slag Disposal Area at this time. Based on the further evaluation of hydraulic control technologies, groundwater extraction and treatment was retained as a corrective measure alternative to address cadmium and cobalt in groundwater at the Slag Disposal Area.

In summary, the only corrective measure alternative retained for consideration to address statistically significant concentrations of cadmium and cobalt above GWPS in groundwater at the downgradient boundary of the Slag Disposal Area is:

- Hydraulic Control using Groundwater Extraction and Treatment.

This corrective measure alternative for the Slag Disposal Area is described in the subsection below.

3.1.2.1 Hydraulic Control Using Groundwater Extraction and Treatment

Groundwater flow modeling and other evaluations were performed to support the evaluation of hydraulic control using groundwater extraction and treatment as a corrective action for groundwater at the Slag Disposal Area as described in Section 3.1.1.3 above (also see CARA Plan Appendix G). Design drawings further describing this corrective action approach are provided in CARA Plan Appendix F.1. Based on the evaluations performed, it is estimated that GWPS would be attained at downgradient monitoring wells WBF-104 and WBF-106 within just a few years of implementation, and that subsequent operation would continue to capture groundwater, preventing it from moving downgradient of the Slag Disposal Area until groundwater extraction is no longer needed to maintain GWPS at the downgradient wells. The actual groundwater extraction locations and rates, the water treatment (if needed) and discharge approach, and associated details would be developed in the corrective action final design process following the CARA Plan approval.

Groundwater would be extracted from the uppermost aquifer along targeted portions of the downgradient boundary of the Slag Disposal Area as described above. A variety of groundwater pumps and controllers are available that can provide a suitable range of flow rates, are compatible with the groundwater geochemical conditions, and are not reactive with the metals in the groundwater. There are also options available for compatible conveyance piping, instrumentation, and other equipment. If needed, water treatment could be accomplished prior to discharge using technologies proven effective for removal of cadmium and cobalt from extracted groundwater. Effluent would be discharged under applicable permit(s).

During the final design of the corrective action, a corrective action performance monitoring plan that includes an adaptive management process will be developed to facilitate corrective action implementation

and provide data to assess if the desired results are achieved. The performance monitoring plan and adaptive management process are further described in CARA Plan Chapter 7.2.2.

4.0 PLANNED CORRECTIVE ACTIONS

Based on the evaluation presented above of potential corrective measure technologies to address statistically significant concentrations of constituents above GWPS in groundwater at the Slag Disposal Area, the planned groundwater corrective action is hydraulic control using groundwater extraction and treatment. Groundwater will be extracted from the uppermost aquifer along targeted portions of the downgradient boundary of the Slag Disposal Area near wells WBF-104 and WBF-106 (Exhibit 1). Extracted groundwater will be pumped through a conveyance pipeline, treated (if needed), and discharged under applicable permit(s). During the final design of the corrective action, a corrective action performance monitoring plan that includes an adaptive management process will be developed to facilitate corrective action implementation and provide data to assess if the desired results are achieved. The performance monitoring plan and adaptive management process are further described in CARA Plan Chapter 7.2.2.

Table 6-2 in the CARA Plan explains how the corrective action requirements contained in TDEC DSWM regulations were considered and will be addressed by the planned corrective actions, which also fulfills the requirements in the TDEC Order. An overall schedule for implementation and completion of corrective actions is also provided in Chapter 8 of the CARA Plan.

4.1 COMPLETION OF CORRECTIVE ACTIONS

For the Slag Disposal Area, pursuant to TDEC DSWM 0400-11-01-.04(7)(a)9(v), the corrective actions will be considered complete when the GWPS have been achieved for the constituents shown in Table 1, concentrations of those constituents have not exceeded the GWPS for three consecutive years, and the actions required to complete the corrective measures are satisfied.

Pursuant to TDEC DSWM 0400-11-01-.04(7)(a)9(iv), TVA will manage solid waste associated with corrective actions in a manner that is protective of human health and the environment and complies with applicable waste disposal requirements.

Pursuant to TDEC DSWM (7(0400-11-01-.04(7)(a)9(vi), once a corrective action has been completed, TVA will submit to TDEC within 14 days a certification that the corrective action has been completed.

5.0 CONCLUSIONS

TVA has completed this Corrective Measures Assessment TM in a manner consistent with requirements in the TDEC Order and the provisions of TDEC DSWM 0400-11-01-.04(7) to assess corrective measure alternatives. Potential corrective measure technologies are described and evaluated, leading to the identification of a planned corrective action approach for groundwater at the Slag Disposal Area.

The planned corrective action for groundwater at the Slag Disposal Area is hydraulic control using groundwater extraction and treatment. Groundwater will be extracted from the uppermost aquifer along the targeted portions of the downgradient Slag Disposal Area boundary, pumped through a conveyance pipeline, treated (if needed), and discharged under applicable permit(s). During the final design of the corrective action, a corrective action performance monitoring plan that includes an adaptive management process will be developed to facilitate corrective action implementation and provide data to assess if the desired results are achieved. The performance monitoring plan and adaptive management process are further described in CARA Plan Chapter 7.2.2. The groundwater extraction is anticipated to attain GWPS at the downgradient monitoring wells within just a few years of implementation. After GWPS are attained at the monitoring wells, the groundwater extraction system will continue to operate, capturing groundwater and preventing it from moving downgradient of the Slag Disposal Area until groundwater extraction is no longer needed to maintain GWPS at the monitoring wells. The time required to achieve this groundwater corrective action objective is uncertain due to a variety of factors, but routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a 5- to 10-year timeframe. Also, the groundwater corrective action objective might be achieved at some locations sooner than others, and corrective action in such locations could conclude sooner as part of the routine monitoring, operation, and maintenance of the corrective action.

Following approval of the CARA Plan, the corrective actions will be initiated within a reasonable period of time pursuant to TDEC DSWM 0400-11-01-.04(7)(a)8(iv), as described in Chapter 8.3 of the CARA Plan.

6.0 REFERENCES

Tennessee Department of Environment and Conservation (TDEC). (2015). *Commissioner's Order No. OGC15-0177*. August 6, 2015.

United States Environmental Protection Agency (USEPA). (2015). Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites. 2015.

TABLE

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

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

Notes:

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

µg/L: micrograms per liter

pCi/L: picoCuries per liter

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EXHIBIT

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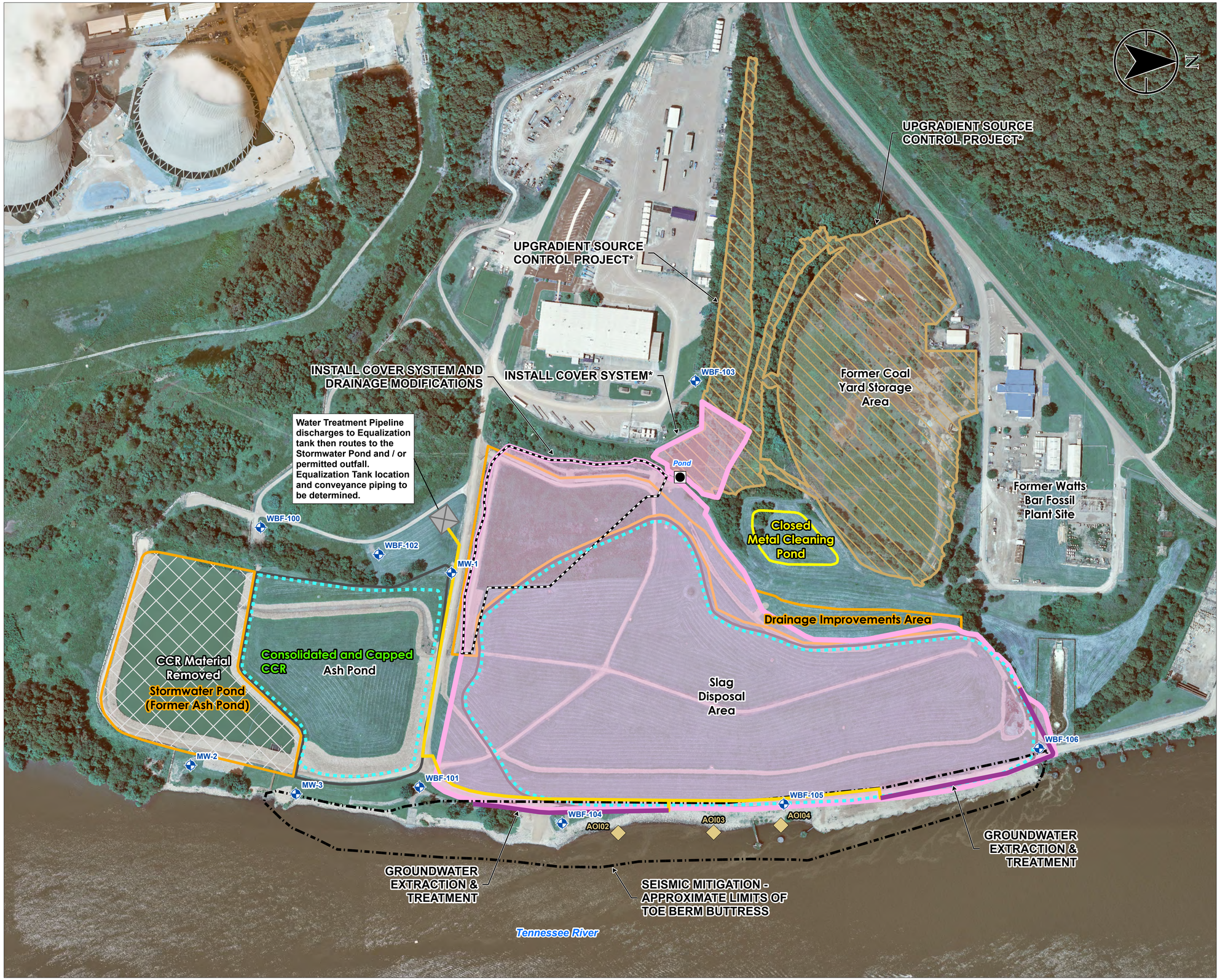

Exhibit No.
1

DRAFT

Title
Planned WBF Plant CCR Unit Groundwater Corrective Actions

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

Project Location
Spring City, Tennessee

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

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

Legend

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

CCR: Coal combustion residuals

*Additional planned actions (see Chapter 5)

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

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

See Appendix E for Groundwater Monitoring Plan.

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

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ATTACHMENT A

Potential Corrective Measure Strategies

1.0 GROUNDWATER CORRECTIVE MEASURE STRATEGIES

This attachment describes technologies that have been identified as potentially applicable for groundwater corrective action at TVA's TDEC Order CCR units. Three potentially applicable technologies have been identified: hydraulic control and groundwater treatment, enhanced *in situ* treatment (EIST), and monitored natural attenuation (MNA). Each of these technologies is described below. For the purposes of the descriptions below, a constituent of interest (COI) is defined as a CCR constituent in groundwater that requires corrective action.

1.1 HYDRAULIC CONTROL AND GROUNDWATER TREATMENT

Hydraulic control is a reliable, proven technology that has been employed for decades to control impacted groundwater. Control is typically achieved through the use of submersible pumps to extract groundwater from collection galleries, wells or trenches. The applicability and orientation of a hydraulic control system is largely based on site-specific conditions such as aquifer dimensions and hydraulic conductivity, presence of confining layers, depth, gradient, characteristics of the COIs, and presence of receiving water bodies or wells. Hydraulic control systems can be effective at controlling the migration of constituents in groundwater, particularly when there are sensitive systems nearby or a continuing source of contamination. Typical groundwater extraction deployment approaches for hydraulic control are summarized below:

- Vertical Wells: The use of vertical wells is a proven technology that can be used in unconsolidated soils and bedrock. The number of wells, spacing between wells and well depths are a function of aquifer characteristics and the targeted control zone.
- Horizontal Wells: The use of horizontal wells potentially allows for the installation of more well screen along a zone of COI impacts in comparison with vertical wells, thus improving the overall efficiency of the extraction system. The use of horizontal wells is not recommended for aquifers where there is large differential between high and low groundwater elevations as it may be difficult to pinpoint the COI recovery zone. Deep horizontal wells may not be as practical as vertical wells depending on site-specific conditions.
- Trenching Systems: Trenches function in a manner similar to horizontal wells but are installed with conventional excavation techniques. The use of trenches may be cost-effective when COIs are present at shallow depths and with high groundwater flow rates. Groundwater collection galleries function in a manner similar to trenches but usually target a particular location whereas trenches are employed where a long, linear extraction feature is needed.

The basis of design for a hydraulic control system is typically focused on developing a detailed hydrogeologic Conceptual Site Model (CSM) and a groundwater flow model. The CSM serves as the basis for developing a numerical groundwater flow model that is calibrated and verified against actual site conditions. The calibrated groundwater flow model is then used to evaluate a variety of approaches (e.g., vertical wells, horizontal wells, trenches) and configurations, and to estimate the groundwater extraction rates necessary to hydraulically control the target zone. Understanding extraction rate requirements is important for developing an effective means of treating extracted groundwater (if treatment is needed).

Extracted groundwater often requires treatment to remove or reduce the concentrations of COIs prior to discharge to a receiving water body, publicly owned treatment works, land application, or re-injection through a well system. Bench-scale testing is often performed to assist in selecting the preferred water treatment technology. Treatment of the extracted groundwater may be completed onsite or offsite using treatment methodologies such as:

- pH Adjustment: In cases where low pH is the primary COI, the groundwater can be treated by simple pH adjustment. Increasing the pH of the groundwater is accomplished by the addition of caustic solution (e.g., sodium hydroxide) at a rate that can be determined through bench-scale testing. Similarly, high pH groundwater can be treated through the addition of an acidic solution at a rate that can be determined through bench-scale testing. Other treatment methods discussed below may also require some pH adjustment to facilitate treatment.

- Chemical Precipitation: COIs can be removed from groundwater by raising the pH, using sodium hydroxide, calcium carbonate, or sulfides to convert the soluble COI to an insoluble form that precipitates out from the water stream. Bench-scale testing can be used to determine the addition rates of chemical precipitates and the percent COI removal that can be achieved through this process.

- Adsorption: COIs can be removed from groundwater by passing groundwater through an adsorption media such as bentonite, activated alumina, granular activated carbon, or iron-impregnated silica sands. COIs are adsorbed onto the surface of the media and removed from the groundwater. The adsorption material has a finite service life due to the amount of available treatment surfaces on the media. This adsorption material must be periodically replaced when the available surfaces are consumed with the COI. Bench-scale testing can be used to define the groundwater/media contact time for COI removal and estimate the active life of the adsorption media before it requires replacement.

- Ion Exchange: In this process, an ion on the surface of the treatment media is exchanged with the ion that is removed from the impacted groundwater. Ion exchange is a proven technology with different media performing better for different COIs. This technology can be expensive depending on the cost of the ion exchange media. Advances in the beneficial reuse of high calcium content biomaterials has made the use of this technology attractive for some COIs. Bench-scale testing may be completed to determine if ion exchange is a viable technology for consideration. Bench- scale testing can also determine the necessary contact time between the impacted groundwater and ion exchange media, and the service life of the ion exchange media.

A groundwater monitoring program is typically an integral part of any hydraulic control system. The monitoring program tracks changes in groundwater levels and COI concentrations to provide feedback on the effectiveness of the hydraulic control system.

The time frame to achieve GWPS with a hydraulic control system is strongly dependent on the site's hydrogeologic conditions, the degree and extent of COI impact, and the geochemical behavior of COIs in the subsurface. These inherent site conditions often function as rate limiting characteristics and should be considered when developing the schedule for achieving GWPS.

1.2 ENHANCED IN SITU TREATMENT (EIST)

Enhanced *in situ* treatment of groundwater is an established technology for a variety of site conditions and contaminants. This alternative includes measures implemented *in situ* (i.e., within the aquifer) to immobilize or reduce the concentration of COIs. *In situ* technologies can be deployed in a variety of configurations depending on the extent of COIs and their proximity to potential receptors. Examples of EIST approaches include:

- Infiltration galleries: Regularly spaced injection wells would be installed in the target area to allow for delivery of a reagent to stabilize or transform COIs in-place. An injection gallery allows for repeated treatments as needed to meet remedy goals.
- Direct injection: Regularly spaced injection points can be advanced into the target area to allow for one-time delivery of a reagent to stabilize or transform COIs in-place.
- Permeable reactive barrier: Excavation of a trench perpendicular to groundwater flow direction can be backfilled with a permeable treatment media that allows groundwater to flow through it while reducing concentrations of COIs through chemical, physical, and/or biological processes.

Evaluation of EIST approaches for CCR constituents is typically dependent upon a detailed hydrogeologic CSM, a groundwater flow model, and a geochemical model. The CSM serves as the basis for developing a numerical groundwater flow model and a geochemical model that are calibrated and verified against actual site conditions. The flow field from the groundwater model serves as an input to the geochemical model along with site-specific geochemical data. The geochemical model is then used to evaluate potential COI attenuation rates and long-term stability for the EIST approach.

Bench-scale testing can be used to evaluate potential reagents to be used *in situ*. Bench-scale testing is designed to develop an understanding of the geochemistry and assess the effectiveness of prospective reagents. Bench-scale testing can also be used to inform the scope and necessity of field-scale pilot testing.

EIST may be an applicable remedial alternative based on site-specific conditions, such as:

- Localized area of impacts: COIs have been detected above GWPS within a limited number of wells. This indicates that *in situ* treatment would need to be deployed over a limited region. Additional investigations would be conducted to define the targeted treatment area.
- Metals treatment technologies: Removal of COIs with multiple treatment technologies have been demonstrated in industrial wastewater applications. Potential treatment alternatives include advanced filtration, co-precipitation, redox manipulation, adsorption, and ion exchange. The most effective alternative(s) would be selected based on the geochemistry of the groundwater and potential bench-scale treatability testing. Bench-scale testing can help determine the preferred treatment media, groundwater/treatment media contact time, and effectiveness of an EIST system in achieving GWPS.

A groundwater monitoring program is typically an integral part of any EIST system. The monitoring program tracks changes in COI concentrations providing feedback on the effectiveness of the EIST system.

Several critical site-specific conditions need to be considered when evaluating the applicability of an EIST system, including:

- Site Access: EIST systems can require access for heavy equipment and a working platform to excavate trenches. Uneven or wooded terrain would complicate site preparation activities and may make installation infeasible.
- Dike Stability: The installation of an EIST could require the use of trenches. The location of the trenches in relationship to CCR unit dikes requires careful evaluation to make sure that stability of the dike structures is maintained.
- Depth: Installation of EIST systems can be limited by the design depth and soil types present. Depending on depth and soil characteristics, specialized installation techniques may be required. For example, single-pass trenching machines can install EIST systems in sandy materials without obstructions but are limited to a maximum depth of approximately 50 feet below ground surface. Slurry trenching techniques can be used to reach deeper impacts, but additional site infrastructure is required to support the installation.
- Geochemistry: The valence state of COIs, pH and redox potential of groundwater, and chemical makeup of the subsurface must be evaluated to determine the applicability of an EIST system.

1.3 MONITORED NATURAL ATTENUATION (MNA)

Monitored Natural Attenuation is a corrective action strategy that involves establishing a program to monitor the physical, chemical, or biological processes that occur naturally at a site. These processes can often work to reduce the toxicity, concentration, or mobility of site COIs in a time frame that is acceptable and can be comparable to other technologies. MNA is increasingly employed at sites where COI concentrations are near threshold levels (e.g., groundwater protection standards [GWPS]), do not have an immediate pathway to sensitive receptors, and are not resultant from an on-going source. These conditions increase the likelihood that natural processes can attenuate COI concentrations in an acceptable time frame.

The basis of a MNA remedy for CCR constituents is typically centered on developing a detailed hydrogeologic conceptual site model (CSM), a groundwater flow model, and a geochemical model. The CSM serves as the basis for developing a numerical groundwater flow model and a geochemical model that are calibrated and verified against actual site conditions. The flow field from the groundwater model serves as an input to the geochemical model along with site-specific geochemical data. The geochemical model is then used to evaluate potential COI attenuation rates and stability of the attenuated COI mass.

MNA implementation would consist of designing a monitoring and assessment program to demonstrate that the COI concentrations present in the groundwater are being reduced by natural processes during and following any closure measures implemented as an outcome of the CARA process. Existing and potentially new monitoring wells at the facility would be used to characterize reduction in COI concentrations over time.

Reliance on natural processes rather than active treatment may require institutional controls to restrict access to affected zones. MNA relies upon naturally occurring processes to reduce COI levels and, by itself, does not provide a means to affect change in the subsurface environment. This strategy can be effective, especially when used in combination with unit closure and source control.

APPENDIX E –
GROUNDWATER MONITORING PLAN

Appendix E - Groundwater Monitoring Plan - DRAFT

TDEC Commissioner's Order
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, TN 37402

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Revisions to Align with CARA Plan and Corrective Measure Alternatives	December 5, 2025

Sign-off Sheet

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

Prepared by _____

Benjamin Schutt, Environmental Engineer

Reviewed by _____

Matthew Dagon, LPG, Principal Geologist

Approved by _____

Carole M. Farr, PG, Senior Principal Geologist

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Abbreviations

amsl	Above Mean Sea Level
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
CCR Rule	Title 40, Code of Federal Regulations Part 257, Subpart D
COC	Chain of custody
DSWM	Division of Solid Waste Management
EAR	Environmental Assessment Report
GWMP	Groundwater Monitoring Plan
GWPS	Groundwater Protection Standards
ID	Identification
IDW	Investigation Derived Waste
L/min	Liter per minute
MCL	Maximum contaminant level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mg/L	Milligrams/Liter
NTU	Nephelometric Turbidity Unit
%	Percent
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/ Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order No. OGC15-0177
TVA	Tennessee Valley Authority
Unified Guidance	USEPA *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*, March 2009
UPLs	Upper Prediction Limits
USEPA	United States Environmental Protection Agency
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

This document provides the groundwater monitoring plan (GWMP) that will be used to perform and document groundwater monitoring and associated activities in fulfillment of the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order). The TDEC Order applies to specifically identified coal combustion residual (CCR) units owned by the Tennessee Valley Authority (TVA) located or operating at recently active fossil-power-generation plants. The scope of this document pertains to the groundwater monitoring systems for the two CCR units located at the TVA Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee, including the Ash Pond and the Slag Disposal Area (Exhibit 1). The GWMP also provides the procedures for groundwater monitoring activities according to TVA's quality assurance/quality control (QA/QC) requirements.

Groundwater compliance monitoring activities at the WBF Plant CCR units will be conducted in accordance with TDEC Rule 0400-11-01-.04(7)(a) – *Ground Water Protection/Monitoring Standards*, as described further in Section 1.1. Groundwater compliance monitoring activities conducted at the Ash Pond CCR unit will also fulfill the TDEC Division of Solid Waste Management (DSWM) requirements. The schedule for groundwater sample collection, data analysis, and subsequent reporting is modeled after requirements under the Title 40, Code of Federal Regulations Part 257, Subpart D (CCR Rule). Groundwater monitoring and associated activities conducted at the two CCR units will also fulfill State regulatory requirements.

Groundwater compliance monitoring activities to be conducted at the Ash Pond and Slag Disposal Area CCR units will be initiated following TDEC approval of the Corrective Action/Risk Assessment (CARA) Plan. TVA will update this GWMP as needed following final design or during implementation of the CARA Plan if changes to the monitoring network are required for the CCR units. Changes to this GWMP will be coordinated with and approved by TDEC.

The groundwater sampling frequency will be semiannual, and confirmation sampling may be conducted after semiannual sampling events at TVA's discretion. The semiannual sampling frequency will supersede the State requirement of quarterly sampling currently being implemented. Groundwater samples will be analyzed for the constituents provided in Sections 2.3 and 2.4. Groundwater data will be evaluated in accordance with the statistical methods described in Section 5 for each semiannual period. The statistical evaluation to determine whether CCR-related constituents listed in Section 2.4 are detected at statistically significant levels (SSLs) above groundwater protection standards (GWPS) will be prepared for each semiannual reporting period. A semiannual report will be submitted to TDEC within 120 days of completing each semiannual groundwater sampling event. The reports will include groundwater sample statistical analysis and the associated recording of groundwater elevations from the groundwater sampling events (see Section 6).

1.1 GROUNDWATER MONITORING PLAN OBJECTIVES

This GWMP documents methods and procedures for groundwater monitoring at the WBF Plant CCR units. Groundwater monitoring methods and procedures will adhere to applicable United States

Environmental Protection Agency (USEPA) and TVA Environmental Technical Instruction documents. Adoption of this GWMP is proposed to coincide with TDEC approval of the WBF CARA Plan.

In accordance with TDEC Rule 0400-11-01-.04(7)(a)6(iv), TVA has prepared this plan to monitor groundwater quality in the vicinity of the following two WBF Plant CCR units, as shown on Exhibit 1:

- Ash Pond
- Slag Disposal Area.

This GWMP describes activities necessary to:

- Collect groundwater samples in the vicinity of the two CCR units, and includes procedures and techniques for sample collection, sample preservation and shipment, analytical procedures, chain of custody (COC) control, and QA/QC
- Determine whether constituents listed in Section 2.3 exhibit statistically significant increases (SSIs) above background concentrations
- Determine whether constituents listed in Section 2.4 exhibit SSLs above GWPS
- Prepare mid-year and end-of-year statistical analysis memoranda to summarize whether constituents listed in Section 2.4 exhibit SSLs above GWPS
- Quantify the direction and rate of groundwater flow
- Provide groundwater monitoring data for submittal to the State of Tennessee DSWM
- Prepare groundwater monitoring reports after each sampling event and describe the contents of those reports
- Provide notifications to the State of Tennessee to comply with State rules.

This plan includes a brief description of hydrogeological conditions at the WBF Plant as it relates to potential migration of CCR constituents. A comprehensive discussion of hydrogeological site conditions and groundwater data can be found in the *Environmental Assessment Report* (EAR) (TVA 2024) for the WBF Plant.

1.2 LOCATION AND BACKGROUND

The WBF Plant is a former TVA coal-fired power plant in Rhea County, located in east Tennessee on the west bank of the Tennessee River immediately downstream of Watts Bar Dam and is accessible from TN Highway 68. The WBF Plant was constructed between 1940 and 1945 and operated intermittently from 1945 to 1982. TVA retired the steam plant generating units in 1982. Following the 1982 plant retirement, approximately 161,000 tons of slag were reclaimed for beneficial reuse in manufacturing products. This activity occurred from 1996 to 2005, until a majority of the usable material was recovered. TVA terminated the air permit for the WBF Plant in 1997 and deconstructed the main powerhouse in 2012 (CDM Smith

2013). The total area of the CCR units is approximately 34 acres. The Slag Disposal Area and Ash Pond were used for stormwater management and were closed as described in the following paragraphs (TVA 2007).

In 2009, the Slag Disposal Area was capped with soil and closed under TDEC Permit TNR190741 in accordance with applicable regulations in effect at the time of closure. The Slag Disposal Area cap consisted of a 1-foot thick vegetative cover over a 1-foot thick compacted clay layer (TVA 2009). During inspections following the closure, poor surface drainage was observed in the area west of the Slag Disposal Area. A separate drainage improvements project was completed in 2015 to place fill, improve drainage, and remove water around the Slag Disposal Area (AECOM 2016).

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

1.3 HYDROGEOLOGICAL CONDITIONS

The WBF Plant is located in the Tennessee River valley in the western portion of the Appalachian Valley Physiographic Province, also known as the Valley and Ridge Province (Fox 1942). The natural unconsolidated materials consist primarily of alluvium overlying bedrock. Alluvium refers to native materials (i.e., clay, silt, sand, or gravel) that are deposited by moving water. Unconsolidated material thicknesses ranged from approximately 0 to 32 feet. The unconsolidated materials are thickest near the river and thinner at greater distances from the river. The alluvium can be differentiated into silts, clays, sands, and gravels, which exhibit a coarsening downward sequence. The upper fine-grained alluvium layer varies in thickness from approximately 0 to 27 feet and is primarily comprised of clay and silty clays. Clay soils of variable thickness are present under the CCR units. The lower alluvial layer, ranging in thickness from 0 to 20 feet, is primarily silty sand, sand, and gravel.

The unconsolidated materials are underlain by bedrock comprised of the Conasauga Group, specifically the Conasauga Group Middle and the Nolichucky Shale. The upper bedrock consists of dark gray-green shale, weathered in the upper few feet, with varying amounts of gray limestone. The bedrock surface slopes east toward the Tennessee River, with elevations ranging from 696 feet above mean sea level (amsl) west of the Slag Disposal Area to 664 feet amsl along the Tennessee River.

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

Groundwater generally flows from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow rates range from approximately 35 to 50 feet per year. Physiographic features that affect groundwater flow in the vicinity of the WBF Plant include the steep topography of the ridges to the northwest, relatively flat floodplain of the Tennessee River, and the Tennessee River. In the vicinity of the CCR units, groundwater flow is bounded to the east by the Tennessee River.

2.0 GROUNDWATER MONITORING SYSTEMS

This section describes the groundwater monitoring systems associated with the WBF Plant CCR units, including compliance monitoring wells and observation wells. For the purposes of this GWMP, compliance monitoring wells comprise the certified groundwater monitoring system and will be used to monitor groundwater quality and measure groundwater levels at background and downgradient locations. These wells will also trigger assessment monitoring requirements or drive corrective action goals and targets. Observation wells will be used primarily to observe changes in groundwater levels over time and, at TVA's discretion, be used to monitor groundwater quality. This section also includes the sampling frequency for these wells and the groundwater monitoring constituents that will be analyzed during each sampling event.

This GWMP will be reviewed periodically and revised as needed to document updates and changes to the monitoring plan. Any revisions to the GWMP will be submitted to TDEC for review and approval.

2.1 PLANNED GROUNDWATER MONITORING SYSTEMS

The planned groundwater monitoring systems associated with the WBF Plant CCR units consist of the Ash Pond and Slag Disposal Area.

- Ash Pond: one background monitoring well (WBF-103), three downgradient monitoring wells (MW-2, MW-3, and WBF-101), and three observation wells (MW-1, WBF-100, and WBF-102).
- Slag Disposal Area: one background monitoring well (WBF-103) and four downgradient monitoring wells (WBF-101, WBF-104, WBF-105, and WBF-106).

Exhibit 2 shows the locations of these compliance groundwater monitoring wells and the observation wells for the two CCR units where monitoring is planned as part of this GWMP.

2.1.1 Ash Pond

The planned groundwater monitoring system for the Ash Pond is depicted on Exhibit 3. General information regarding the design and construction of the compliance monitoring wells and observation wells is summarized in Table 1. The compliance monitoring network consists of a total of four monitoring wells screened in the uppermost aquifer. The monitoring well network includes one background monitoring well (WBF-103) located northwest of the CCR unit and three downgradient monitoring wells (MW-2, MW-3, and WBF-101) located primarily on the east side of the CCR unit. Three observation wells (MW-1[1], WBF-100, and WBF-102), screened in unconsolidated materials, are located west of the CCR unit.

[1] MW-1 was identified in the EAR for further evaluation due to statistically significant cobalt concentrations above the TDEC-approved screening level. The well is screened in clay rather than the uppermost aquifer and is located upgradient of the Ash Pond between two contiguous CCR units. Because MW-1 is not appropriately positioned to serve as a compliance well, TVA has designated it as an observation well that does not require evaluation for potential corrective action.

2.1.2 Slag Disposal Area

The planned groundwater monitoring system for the Slag Disposal Area is depicted on Exhibit 4. General information regarding the design and construction of the compliance monitoring wells and observation wells is summarized in Table 2. The compliance monitoring network consists of a total of five monitoring wells screened in the uppermost aquifer. The monitoring well network includes one background monitoring well (WBF-103) located west of the CCR unit and four downgradient monitoring wells (WBF-101, WBF-104, WBF-105, and WBF-106) located primarily on the east side of the CCR unit.

2.2 SAMPLING FREQUENCY AND DURATION

The groundwater sampling frequency will be semiannual. Confirmation sampling may be conducted after semiannual sampling events at TVA's discretion. TVA will conduct two sampling events approximately six months apart to collect samples and characterize groundwater flow direction, groundwater flow rates, and groundwater quality. Groundwater monitoring and reporting will be performed until the end of the post-closure period for each CCR unit in accordance with TDEC Rule 0400-11-01-.04.02(8)(d).

2.3 GROUNDWATER MONITORING CONSTITUENTS – DETECTION MONITORING

Groundwater monitoring constituents that will be analyzed during each sampling event for detection monitoring are provided below in Table 3. Samples will be collected from compliance monitoring wells and may be collected from observation wells at TVA's discretion (see Tables 1 and 2).

Table 3 Groundwater Quality Monitoring Constituents – Detection Monitoring

Detection Monitoring Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids

2.4 GROUNDWATER MONITORING CONSTITUENTS – ASSESSMENT MONITORING

Groundwater monitoring constituents that will be analyzed during each sampling event for assessment monitoring are provided below in Table 4. Samples will be collected from compliance monitoring wells and may be collected from observation wells at TVA's discretion (see Tables 1 and 2).

Table 4 Groundwater Quality Monitoring Constituents – Assessment Monitoring

Assessment Monitoring Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined

3.0 GROUNDWATER MONITORING PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, collect groundwater samples, and obtain groundwater and surface water elevation measurements.

3.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling personnel will conduct the following:

- Provide notification to TVA and TDEC of scheduled field activities
- Coordinate field activities with the Laboratory Coordinator, including ordering sample bottles and preservatives, obtaining coolers and deionized water, if needed, and notifying the laboratory of sampling dates
- Obtain required calibrated field instruments, including health and safety equipment, water level meters, and equipment needed for measuring field water quality parameters that define stability during well purging
- Obtain a control box for dedicated pumps
- Complete sample paperwork and field forms to the extent possible prior to deploying into the field, including COC forms, and sample labels
- Obtain ice prior to groundwater sample collection for sample preservation.

3.2 MONITORING METHODS AND PROTOCOL

3.2.1 Groundwater and Surface Water Level Measurements

Water levels will be measured in compliance monitoring wells and observation wells (see Tables 1 and 2). Water levels will be measured in relation to a surveyed reference point (e.g., top of well casing) using an electronic water level indicator. The elevation will be recorded to the nearest 0.01 foot. To the extent possible, the field team will minimize the length of time between collection of the first and last water level measurement. At a minimum, measurements will be made within the same day.

3.2.2 Well Purging

Following the measurement of groundwater levels, compliance monitoring wells will be purged using bladder pumps dedicated to each well. Low-flow purging techniques will be used to collect a representative groundwater sample for measurement of field water quality parameters. When using low-flow sampling methods, the well will be purged at the rate known to induce minimal drawdown. If pump settings are unknown, purging will begin at a pumping rate of 0.1 liter per minute (L/min) and will be slowly increased to a setting that induces little or no drawdown, if possible. Pumping rates will not exceed 0.5 L/min.

Field water quality parameters, including pH, specific conductance, dissolved oxygen, turbidity, oxidation/reduction potential, and temperature, will be measured during purging. Field parameters will be measured using a multi-parameter sonde equipped with a flow-through cell. Turbidity will be measured in a static sample collected from the discharge of the flow-through cell after other field parameter readings are taken utilizing a portable turbidity meter.

Purging will continue until field measurements of water quality parameters stabilize during three consecutive readings at three to five minute intervals. The stabilization criteria include:

- pH: ±0.1 Standard Units
- Specific conductance: ±three percent (%) microSiemens per centimeter
- Dissolved oxygen: ±10% for values greater than 0.5 milligrams/Liter (mg/L) or below 0.5 mg/L
- Turbidity: below 5 Nephelometric Turbidity Units (NTUs) or ±10% for values above 5 NTUs.

Once the field parameters have stabilized, a groundwater sample will be collected. For low yield wells, field parameters will be measured at the time of sample collection in an open sample container using a multi-parameter sonde. Final water quality parameters, turbidity, and water level measurements will be made after each sample is collected.

If after two hours of purging field parameters have not stabilized, then groundwater samples will be collected and the efforts to stabilize parameters will be recorded in the field notes. If turbidity stabilizes above 5 NTUs, then a filtered groundwater sample will be collected and field sampling personnel will collect a quality control filter blank and tubing blank, as described in Section 4.2.

Purging beginning and end times, pumping rates, field water quality parameter readings, and groundwater levels will be recorded throughout the purging operation on field forms.

Low yield wells will be purged until standing water is removed. Groundwater samples will be collected with a low-flow pump, as soon as water levels return to 80% of the pre-purge water level within the well, but no later than 24 hours after the well purge, as described in Section 3.2.5.

3.2.3 Field Equipment Description, Testing/Inspection, and Maintenance

A list of anticipated equipment for the field activities described herein is provided below. A final list of equipment will be prepared by the Field Team Leader prior to mobilization to the field. Field equipment will be inspected, tested, and calibrated (as applicable) prior to initiation of fieldwork by Field Sampling Personnel and, if necessary, repairs will be made prior to equipment use. If a piece of equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced. Additional information regarding field equipment inspection and testing will be included in the Quality Assurance Project Plan (QAPP). A list of anticipated equipment for the field activities includes, but is not limited to the following:

- Global Positioning System (sub-meter accuracy preferred)

- Digital camera
- Batteries
- Flow measurement supplies (e.g. graduated cylinder, stopwatch)
- Water level indicator meter
- Oil/water interface meter
- Photoionization detector (if needed)
- Sample filtration device and filters
- Dedicated well sampling pumps, fittings, and tubing
- Stainless steel clamps
- Pump controller and power supply
- Air compressor, air line heads, and end fittings
- Generator (if needed)
- Multi-parameter sonde with flow-through cell equipped to measure the required groundwater quality parameters
- Turbidity meter
- Necessary supplies for equipment calibrations.

3.2.4 Field Documentation

Field documentation associated with groundwater monitoring activities will primarily be recorded on field forms, logbooks and/or using digital media (e.g., geographic information system or global positioning system documentation). Additional information regarding field documentation is provided below. Project field forms used to record field measurements, analyses, and observations will be maintained by the Field Team Leader.

3.2.4.1 DAILY FIELD ACTIVITIES

Field observations and measurements will be recorded and maintained daily to chronologically document field activities, including sample collection and management. Field observations and measurements will be recorded on field forms.

Deviations from this GWMP will be documented in the field notes during sampling and data collection operations. TVA will approve deviations before they occur.

3.2.4.2 GROUNDWATER MONITORING FIELD FORMS

Field forms will be used to record field measurements and observations for specific tasks. Groundwater sampling forms will be used to document groundwater level measurements, stabilization parameters, and field observations at each monitoring well location. Water level gauging forms will be used to record water level measurements.

3.2.4.3 CHAIN OF CUSTODY FORMS

COC forms and shipping documents will be prepared and retained. Field Quality Control samples will be documented in both the field notes and on sample COC records. COC forms will be reviewed daily by the Field Team Leader for completeness, and a quality control check of samples in each cooler will be compared to sample identifications (IDs) on the corresponding COC form prior to shipment. Additional information regarding COC forms is included in Section 4.2.2 of this GWMP.

3.2.5 Collection of Samples

A final reading of water quality parameters will be conducted and documented on field forms at the time of sample collection. Groundwater samples will be collected in appropriate, laboratory provided, pre-preserved sample containers. Samples will be collected directly from the pump discharge line.

The sampler will wear clean nitrile (or equivalent) gloves when handling sample containers and will not touch the interior of containers or container caps. New gloves will be used at each sample location. When filling sample bottles, care will be taken to minimize sample aeration (i.e., water will be directed down the inner walls of the sample bottle) and overfilling will be avoided. Each sample bottle will be capped before filling the next bottle.

If the final turbidity value prior to sampling exceeds 5 NTUs, then a filtered sample will be collected in addition to a non-filtered sample. The sample will be filtered by passing the water through a 0.45-micron filter. Filtered samples will be used to assess the potential influence of turbidity on analytical results.

Issues that could affect the quality of samples will be recorded in the field notes along with the action(s) taken to resolve the issue. These could include observations such as clogged sampling tubes, highly turbid samples, or defective materials or equipment.

3.2.6 Preservation and Handling

Sample containers will be labeled and once each sample bottle is filled, the cap will be secured. Each sample bottle will be checked to make sure it is sealed, labeled legibly, and externally clean. A signed and dated custody seal will be applied to the sample bottle. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment by taping the cooler drain shut and lining the bottom of the cooler with packing material or bubble wrap. Sample containers will be placed in the cooler in an upright position. Small uniformly sized containers will be stacked in an upright configuration and packing material will be placed between layers. Plastic containers will be placed between glass containers when possible.

A temperature blank will be placed inside each cooler to measure sample temperature upon arrival at the laboratory, if requested, and provided by the analytical laboratory. Loose ice will be placed around and among the sample containers to cool the samples to less than six degrees Celsius during shipment. Because radium does not require thermal preservation, sample containers for radium do not need to be cooled. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a resealable plastic bag taped to the inside lid of the cooler. A copy of the COC form will be retained with the field notes in the project files. A unique cooler ID number will be written on the COC form and the shipping label placed on the outside of the cooler. The total number of coolers required to ship the samples will be recorded on the COC form. If multiple coolers are required to ship samples contained on a single COC form, then the original copy will be placed in cooler 1 of X with copies (marked as such) placed in the additional coolers. Two signed and dated custody seals will be placed on alternate sides of the cooler lid. Packaging tape (i.e., strapping tape) will be wrapped around the cooler to secure the sample shipment.

Upon receipt of the samples, the analytical laboratory will open the cooler and will acknowledge receipt of the cooler on the COC form and will verify that the custody seals have not been previously broken. The laboratory will note the condition and temperature of the samples upon receipt and will identify discrepancies between the contents of the cooler and COC form. If there are discrepancies, the Laboratory Project Manager will immediately contact the Laboratory Coordinator and Field Team Leader to resolve the issue and note the resolution on the laboratory check-in sheet. The analytical laboratory will then forward a copy of the COC form to the QA Oversight Manager.

3.2.7 Sample Analyses

Groundwater samples will be submitted to the TVA-approved laboratory for analysis for the constituents listed in Sections 2.3 and 2.4. In accordance with the TDEC solid waste policy manual guidance, unless otherwise approved, analytical methods will be USEPA methods from USEPA Publication SW-846 and other accepted analytical methods.

3.2.8 Equipment Decontamination Procedures

Decontamination will be performed for non-dedicated groundwater sampling equipment to prevent cross-contamination. Pumps that are dedicated to each well do not need to be decontaminated.

Decontamination activities will be performed away from surface water bodies. Decontamination of non-disposable sampling equipment or instruments will be performed using water and other appropriate non-phosphate and non-boron detergent. Following decontamination, fluids will be disposed in accordance with Section 3.2.9.

Decontamination of sampling equipment and instruments (i.e., water level meters, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the field notes. Additional information regarding equipment decontamination procedures will be in the QAPP.

3.2.9 Waste Management

Investigation derived waste (IDW) generated during implementation of this GWMP may include, but is not limited to:

- Purge water
- Personal protective equipment
- Decontamination fluids
- Used calibration solutions
- General trash.

IDW will be handled in accordance with the WBF Plant specific waste management plan. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The following sections provide details regarding QA/QC requirements specific to groundwater sampling and analysis conducted under this GWMP.

4.1 OBJECTIVES

The data quality objectives process is a tool employed during the project planning stage to confirm that data generated from the semiannual groundwater sampling events are appropriate and of sufficient quality to address the groundwater monitoring objectives.

Specific quantitative acceptance criteria for analytical precision and accuracy for the matrices are presented in the QAPP.

4.2 QUALITY CONTROL CHECKS

Up to six types of field QA/QC samples will be collected during sampling activities: (1) field duplicate samples, (2) matrix spike/matrix spike duplicate (MS/MSD) samples, (3) equipment blanks, (4) field blanks, potentially (5) filter blanks, and potentially (6) tubing blanks. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are in accordance with TVA procedures and processes and are specified below. A sampling event is defined as the number of field days required to complete the scope for a semiannual groundwater monitoring event, not including confirmation sampling. Confirmation sampling is considered as a separate sampling event.

Field Duplicate Samples – One duplicate sample will be collected for every 20 samples or once per sampling event. Duplicate samples will be prepared as blind duplicates and will be collected in two sets of identical, laboratory-prepared sample bottles. The primary and duplicate samples will be labeled according to the procedure in Section 4.2.1. Sample identifier information will not be used to identify the duplicate samples. The associated primary sample for each duplicate sample will be noted in the field notes. The duplicate sample will be analyzed for the same constituents as the primary sample.

MS/MSD Samples – A sufficient volume of sample will be collected for use as the MS/MSD. MS/MSD samples will be collected to allow matrix spike samples to be run by the analytical laboratory to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 groundwater samples collected or once per sampling event. Additional sample volume intended for use as the MS/MSD must be identified in the comments field on the COC records and sample labels. The location of the MS/MSD sample collection will be noted in the field notes. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with the exception of constituents that are not amenable to MS/MSD.

For constituents such as total dissolved solids and radium that are not amenable to the MS/MSD procedure, additional sample volume will be collected for laboratory duplicate analysis per the QAPP.

Equipment Blanks (Rinsate Blanks) – At the discretion of the TVA Project Manager, equipment blanks (rinsate blanks) may not be required when new, certified-cleaned, dedicated, or disposable sampling equipment is used. When collected, one equipment (rinsate) blank will be collected for each sampling event. The equipment blank will be collected at a groundwater sampling location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment (e.g., a decontaminated water level meter), and then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the field notes. The sample will be analyzed for the same analytes as the sample collected from the monitoring well location where the equipment blank is prepared.

Field Blanks – One field blank sample will be prepared per sampling team per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes as other samples collected that day, except for pH.

Filter and Tubing Blanks – Filter blanks will be collected at a frequency of one per event, per sample team, when dissolved constituents are collected for analysis. The filter blank will be collected at a groundwater sampling location by passing laboratory-supplied deionized water through an unused in-line filter used for collection of dissolved metals and then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the field notes. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. If the tubing used to collect the filter blank is not certified clean or dedicated tubing, then a tubing blank will be collected at a frequency of one per event, per sample team.

4.2.1 Sample Labels and Identification System

Sample IDs will be recorded on each sample container label, custody record, and in the field notes. Each sample container will have a sample label affixed and secured with clear package tape as necessary so that the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification will be included in the QAPP.

4.2.2 Chain of Custody

The possession and handling of individual samples must be traceable from the time of sample collection until the time the analytical laboratory reports the sample analyses results to TVA. Field staff will be responsible for sample security and record keeping in the field.

The COC form documents the sample transfer from the field to the laboratory, identifies the contents of a shipment, provides requested analysis from the laboratory, and tracks custody transfers. Additional information regarding COC procedures will be included in the QAPP.

5.0 STATISTICAL ANALYSIS

Groundwater quality data from each sampling event will be statistically evaluated to determine if there has been a statistically significant change in groundwater chemistry. Historical background data will be used to establish statistical limits. Statistical analysis will be completed following methodology described by the USEPA in *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance*, March 2009 (Unified Guidance). The following subsections provide a summary of the statistical analysis that will be performed, as applicable, for the groundwater results from the compliance monitoring wells.

5.1 DETECTION MONITORING STATISTICS

When detection monitoring is performed, interwell prediction limits are used to evaluate the constituents listed in Section 2.3. Interwell prediction limits based on pooled upgradient well data to establish a background limit for an individual constituent and to establish upper prediction limits (UPLs). Groundwater results from downgradient compliance wells are compared against these UPLs to assess whether there are SSIs above background. As new data are obtained from background wells, they will be incorporated into the background data set. To assess whether a SSI occurred, the reported result for each well-constituent pair will be compared to the UPL (or for pH, the upper and lower bounds of the prediction interval), to identify statistically significant increases above background concentrations. The detection monitoring constituents listed in Section 2.3 will continue to be statistically evaluated if a CCR unit is in assessment monitoring (see Section 5.2).

5.2 ASSESSMENT MONITORING STATISTICS

When in assessment monitoring, the groundwater monitoring data for constituents listed in Section 2.4 are compared to a GWPS using statistical procedures required by TDEC Rule 0400-11-01-.04(7)(a)4(v) following the statistical analysis methodology described by the Unified Guidance. These methods will be used for statistical analysis of monitoring data from each CCR unit covered under this GWMP. GWPS have been established in accordance with TDEC 0400-11-01-.04(7)(a)1 as the larger of maximum contaminant levels (MCLs), published human health risk-based limits, or background concentrations.

Comparisons will be made against the GWPS using a confidence band or confidence interval statistical approach. Confirmation sampling may be conducted after sampling events at TVA's discretion. The monitoring data will be used to construct the confidence bands or confidence intervals following methodology described in the Unified Guidance. Cross-sections of each confidence band or confidence interval will be compared to the GWPS for the most recent assessment monitoring event in each case for the purpose of identifying SSLs above a GWPS. A well-constituent pair is considered out of compliance only if its average constituent level (with 95% confidence, as estimated via the confidence band or confidence interval cross-section) is above the GWPS at the time of the most recent sampling event.

If, after assessment monitoring is implemented, the concentrations of detection and assessment monitoring constituents (Sections 2.3 and 2.4) are shown to be below GWPS but above background values, then CCR units would remain in assessment monitoring under TDEC Rule 0400-11-01-.04(7)(a)6(iii)(IV) and 40 CFR § 257.95(f). If the concentration of detection and assessment monitoring constituents (Sections 2.3 and 2.4) are shown to be at or below background values for two consecutive

semiannual sampling events, the CCR units in assessment monitoring would return to a detection monitoring program under TDEC Rule 0400-11-01-.04(7)(a)6(iii)(III) and 40 CFR § 257.95(e).

6.0 REPORTING

Two semiannual groundwater monitoring reports will be prepared for the WBF Plant CCR units to summarize the results from the two semiannual sampling events each year. The reports will incorporate the requirements from TDEC DSWM 0400-11-01-.04. The statistical evaluations used to determine whether CCR-related constituents listed in Section 2.4 are detected at SSLs above GWPS will be prepared for each semiannual reporting period. Each semiannual report will be submitted to TDEC within 120 days of completing the semiannual groundwater sampling events.

The reports will include the following:

- Field measurements, sampling-related data and site observations
- Identification of groundwater wells that were installed or decommissioned during the preceding semi-annual period, along with a narrative description of why these actions were taken
- Alternate source demonstrations completed during the previous monitoring period, if applicable
- Analytical data for constituents listed in Section 2.3 and Section 2.4
- A summary of groundwater sampling activities and observations for the reporting period
- Groundwater and surface water elevation data
- Hydraulic conductivity and groundwater flow rate calculations, and direction of groundwater flow for each groundwater sampling event, including piezometric surface maps
- Statistical analysis results.

Additional supporting information will include:

- Field forms and groundwater sampling forms including documentation of field instrument calibration, groundwater and surface water elevation data, and field parameter stabilization data
- Copies of the COC forms and the laboratory analytical reports
- Certification by a person representing TVA as described in TDEC Rule 0400-11-01.02(3)(a)7, 8 and 10.

6.1 TDEC NOTIFICATIONS

Following each groundwater sampling event, TVA will provide TDEC notifications for the following:

- If an SSI over background is determined, TVA will send a notice to the TDEC Commissioner within 14 days of which constituents in Section 2.3 have shown statistically significant changes from background levels under TDEC Rule 0400-11-01-.04(7)(a)5(iii)(I), or
- If a concentration over a GWPS is identified, TVA will send a notice to the TDEC Commissioner within 14 days of which constituents in Section 2.4 have shown concentrations above the GWPS under TDEC Rule 0400-11-01-.04(7)(a)6(iii)(I).

6.2 POSTING AND NOTIFICATION REQUIREMENTS

Following each groundwater sampling event, TVA will provide the following:

- Statistical analysis of groundwater data completed following methodology described by the Unified Guidance
- Notifications to the State of Tennessee to comply with State rules.

7.0 REFERENCES

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TABLES

Table 1 - Planned Groundwater Monitoring System - Ash Pond
Watts Bar Fossil Plant

Monitoring Well	Screened Formation	Screened Interval (feet btoc)	Ground Surface Elevation (feet NGVD 29)	Well Inside Diameter (inches)	Well Installation Date	Compliance Monitoring Well		Observation Well
						Background Well	Downgradient Well	
MW-1	Alluvial Silts and Clays	23.3 - 33.3	709.4	2	7/25/2014			X
MW-2	Alluvial Sand	22.7 - 32.4	701.3	2	7/25/2014		X	
MW-3	Alluvial Sand	21.6 - 31.6	693.2	2	7/25/2014		X	
WBF-100	Alluvial Sand / Alluvial Silts and Clays	47.7 - 57.8	737.4	4	11/10/2016			X
WBF-101	Alluvial Clay and Silts / Alluvial Sand	27.3 - 37.1	698.7	4	6/12/2019		X	
WBF-102	Alluvial Sand with Clay	19.4 - 24.2	719.2	4	7/9/2019			X
WBF-103	Alluvial Sand with Clay / Alluvial Sand	17.0 - 21.8	721.1	4	6/10/2019	X		

Notes:

btoc – below top of casing
NGVD 29 – National Geodetic Vertical Datum 1929

DRAFT

Table 2 - Planned Groundwater Monitoring System – Slag Disposal Area
Watts Bar Fossil Plant

Monitoring Well	Screened Formation	Screened Interval (feet btoc)	Ground Surface Elevation (feet NGVD 29)	Well Inside Diameter (inches)	Well Installation Date	Compliance Monitoring Well	
						Background Well	Downgradient Well
WBF-101	Alluvial Clay and Silts / Alluvial Sand	27.3 - 37.1	698.7	4	6/12/2019		X
WBF-103	Alluvial Clay and Silts / Alluvial Sand	17.0 - 21.8	721.1	4	6/10/2019	X	
WBF-104	Alluvial Clay and Silts / Alluvial Sand	18.8 - 28.6	694.9	4	6/13/2019		X
WBF-105	Alluvial Silty Sand	28.3 - 33.1	700.9	4	7/9/2019		X
WBF-106	Alluvial Clay / Alluvial Silty Sand and Alluvial sand	27.8 - 37.6	701.7	4	6/26/2019		X

Notes:
btoc – below top of casing
NGVD 29 – National Geodetic Vertical Datum 1929

DRAFT

EXHIBITS

Exhibit No.
1

DRAFT

Title
WBF Plant Overview

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-11-11
Technical Review by BL on 2025-11-11

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

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

CCR: Coal combustion residuals

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

Stantec TVA

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U:\TVA-EIP\175668050_WBF_WastePlan\gis\mxd\CARA\Ex1_PlantOverview\WBF_PlantOverview.aprx 1_WBF_Plant_Overview2 Revised: 2025-11-11 By: mbough

Exhibit No.
2

DRAFT

Title
Planned Groundwater Monitoring System – Plant-wide

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

Project Location
Spring City, Tennessee

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

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

Legend

- Compliance Monitoring Well
- Observation Well
- Other Wells and Piezometers
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

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

Stantec TVA

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U:\TVA-EIP\175668050_WBF_WorkPlan\gis\mxd\CARA\GW_MonitoringPlan\2_WBF_Planned_GWMonSystem_PW.mxd Revised: 2024-04-11 By: mbough

Exhibit No.
3

DRAFT

Title
Planned Groundwater Monitoring System – Ash Pond

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

Project Location
Spring City, Tennessee

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

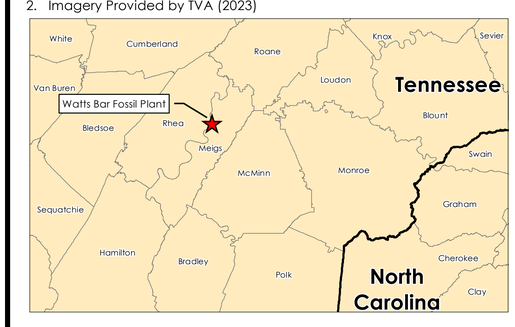
0 100 200 300 400 Feet
1:1,200 (At original document size of 22x34)

Legend

- Compliance Monitoring Well
- Observation Well
- Other Wells and Piezometers
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals
Only wells and piezometers associated with the Ash Pond are shown. Other wells and piezometers may exist in the vicinity.

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



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U:\TVA-EIP\175668050_WBF_WorkPlan\gis\mxd\CARA\GW_MonitoringPlan\3_WBF_Planned_GWMonSystem_AshPond.mxd Revised: 2024-04-11 By: mbaugh

Exhibit No.
4

DRAFT

Title
Planned Groundwater Monitoring System – Slag Disposal Area

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

Project Location
Spring City, Tennessee

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

0 100 200 300 400 Feet
1:1,200 (At original document size of 22x34)

Legend

- Compliance Monitoring Well
- Other Wells and Piezometers
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals
Only wells and piezometers associated with the Slag Disposal Area are shown. Other wells and piezometers may exist in the vicinity.

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

Stantec TVA

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L:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_MonitoringPlan\4_WBF_Planned_GWMonSystem_Slag.mxd Revised: 2024-04-11 By: mbough

APPENDIX F –
DESIGN DRAWINGS AND CLOSURE / POST-CLOSURE PLANS

APPENDIX F.1

DESIGN DRAWINGS

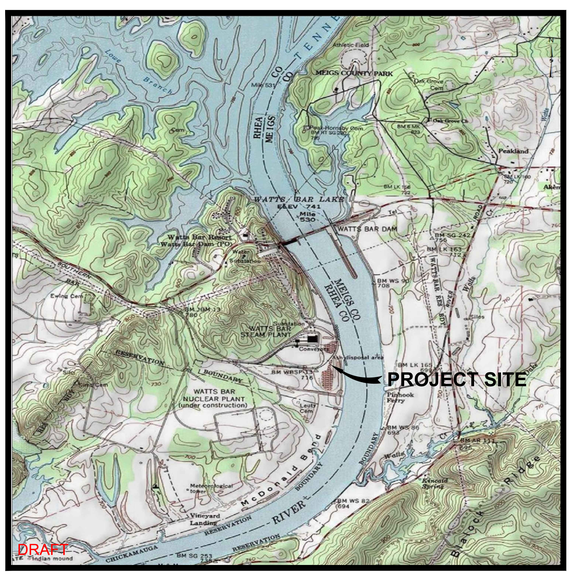
TDEC ORDER
CORRECTIVE ACTION AND RISK ASSESSMENT PLAN
WATTS BAR STEAM PLANT
RHEA COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY

PREPARED BY

Stantec



VICINITY MAP
NOT TO SCALE

INDEX OF DRAWINGS:

10WXXX–01	COVER DRAWING
10WXXX–02	GENERAL NOTES
10WXXX–03	EXISTING CONDITIONS AND BASELINE LAYOUT
10WXXX–04	EXISTING CONDITIONS AND BASELINE LAYOUT
10WXXX–05	SOURCE CONTROL AND CAPPING LIMITS
10WXXX–06	SOURCE CONTROL AND CAPPING LIMITS
10WXXX–07	SOURCE CONTROL PROFILE PROJECT BASELINE
10WXXX–08	SOURCE CONTROL PROFILE COAL YARD BASELINE
10WXXX–09	SOURCE CONTROL PROFILE SLAG STORAGE BASELINE
10WXXX–10	COAL YARD PLAN DRAINAGE MODIFICATIONS
10WXXX–11	COAL YARD DITCH PROFILE & CROSS SECTION
10WXXX–12	GROUNDWATER EXTRACTION WELLS
10WXXX–13	GROUNDWATER EXTRACTION WELLS
10WXXX–14	PROFILES – ZONE A & ZONE B VERTICAL GROUNDWATER EXTRACTION WELLS
10WXXX–15	DETAILS
10WXXX–16	DETAILS

CARA REV. 2 SUBMITTAL

30% SUBMITTAL
ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R–	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	ACC	–	–	N/A	N/A	TVA	–	–	D

ISSUED FOR REVIEW

DISCIPLINE INTERFACE

SCALE: NONE — EXCEPT AS NOTED

YARD
–

CARA PLAN
COVER DRAWING

FOR SUPPORTING DESIGN CALCULATIONS SEE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

Stantec
3052 Beaumont Centre Circle
Lexington, Kentucky 40513-1703
www.stantec.com

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R | DATE | 14 | C | 10WXXX–01 | R B

STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 09/12/2025 USER: CLINEMBEARD, ADAM
V:\1756\ACTIVE\175686500\TECHNICAL_PRODUCTION\DRAWINGS\SHEET_FILES\WBFGD\REVREVREVREVREVREV6_PDF\SHEET_FILES\01_WBFGD_001_CVR.DWG

GENERAL NOTES

GENERAL NOTES:

1. THE CORRECTIVE MEASURES AND INFORMATION SHOWN HEREIN IS PART OF THE ONGOING TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION (TDEC) COMMISSIONER'S ORDER. THE ENVIRONMENTAL ASSESSMENT REPORT (EAR) AND THE CORRECTIVE ACTION AND RISK ASSESSMENT (CARA) PLAN CAN BE FOUND UNDER SEPARATE COVER DESCRIBING THE CORRECTIVE MEASURES AND BASIS OF DESIGN.
2. THESE PLANS ARE MEANT TO OUTLINE THE RECOMMENDED DESIGN TO BE TAKEN AROUND THE COAL COMBUSTION RESIDUAL (CCR) UNITS IN SUPPORT OF CLOSURE AND CORRECTIVE ACTION AS OUTLINED IN CARA PLAN. FURTHER DELINEATION AND DETAILED DESIGN OF THE ACTIVITIES WILL BE COMPLETED FOLLOWING APPROVAL OF THE CARA PLAN BY TDEC. DETAILED DESIGN MAY IMPACT LOCATIONS OF MEASURES, BUT THE INTENT TO REMEDIATE GROUNDWATER SHALL REMAIN.
3. DEFINITIONS: WHENEVER THE FOLLOWING TERMS ARE USED IN THESE PLANS FOR CONSTRUCTION, IT IS UNDERSTOOD THAT THEY REPRESENT THE FOLLOWING:

   ASH MANAGEMENT PLAN (AMP): A DOCUMENT IN ACCORDANCE WITH TENNESSEE CODE ANNOTATED SECTION 68-211-106(J) (HENCEFORTH, '106(J)') TO SUPPORT HOW TVA AND ITS CONTRACTOR(S) WILL MANAGE THE COAL COMBUSTION RESIDUALS (CCR) AT WBF. THIS INCLUDES BACKGROUND INFORMATION, OPERATIONAL PROCEDURES, NECESSARY INTERMEDIATE ACTIONS, AND QUALITY CONTROL PROCEDURES OF THOSE MANAGEMENT ACTIVITIES.

   CARA: CORRECTIVE ACTION AND RISK ASSESSMENT.

   CONTRACTOR: ENTITY RESPONSIBLE FOR CONSTRUCTION.

   CONSTRUCTION MANAGER: AN INDIVIDUAL EMPLOYED BY TVA FOR COORDINATION OF CONSTRUCTION ACTIVITIES.

   CONSTRUCTION QUALITY ASSURANCE (CQA) MANAGER: A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF TENNESSEE SHALL BE DESIGNATED AS THE CQA MANAGER. THE CQA MANAGER SHALL BE RESPONSIBLE FOR DOCUMENTING QUALITY ASSURANCE FOR THE PROJECT WHICH INCLUDES BUT IS NOT LIMITED TO MANAGEMENT OF CONSTRUCTION MONITORING, TESTING, AND RELATED DOCUMENTATION AS OUTLINED HEREIN. COLLECTION AND REVIEW OF QUALITY ASSURANCE (QA) DATA RECEIVED FROM THE INSTALLER OR MANUFACTURER TO ASSESS CONFORMANCE WITH PROJECT REQUIREMENTS SHALL ALSO BE A FUNCTION OF THE CQA MANAGER.

   THE CQA MANAGER SHALL DEVELOP AND SIGN THE CONSTRUCTION CERTIFICATION REPORT AT THE COMPLETION OF THE PROJECT.

   CONSTRUCTION QUALITY MANAGEMENT PLAN (QMP): A DOCUMENT THAT ESTABLISHES MINIMUM CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS, TESTING FREQUENCY, AND QUALITY OVERSIGHT RESPONSIBILITY. THIS INCLUDES CONSTRUCTION METHODS AND PERFORMANCE ASPECTS OF MATERIALS UTILIZED DURING CONSTRUCTION.

   OWNER: TENNESSEE VALLEY AUTHORITY (TVA)

   SURVEILLANCE, INSTRUMENTATION, AND MONITORING PLAN (SIMP): A DOCUMENT THAT ESTABLISHES MINIMUM FREQUENCY OF OBSERVATIONS THROUGH VISUAL INSPECTION OR VIA MANUAL AND/OR AUTOMATED INSTRUMENTATION READINGS DURING CONSTRUCTION. THIS INCLUDES PERFORMANCE CRITERIA BASED ON CONSTRUCTION ACTIVITIES, WEATHER, OR STOCKPILING OF MATERIALS TO MODIFY, DELAY OR STOP WORK BASED ON OBSERVATIONS MADE.

   STORMWATER POLLUTION PREVENTION PLAN (SWPPP): A DOCUMENT THAT PRESCRIBES MINIMUM STANDARDS BY WHICH STORMWATER RUNOFF SHALL BE MANAGED DURING CONSTRUCTION.

   TDEC: THE TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION.
4. DESCRIPTION OF WORK

   THE RECOMMENDED DESIGN ARE FOCUSED EFFORTS TO SUPPORT CLOSURE AND REMEDIATE GROUNDWATER IMPACTS IDENTIFIED IN THE EAR. CARE SHALL BE TAKEN TO REDUCE PONDING AND INFILTRATION OF WATER INTO THE CCR, AND ALL MEASURES INSTALLED FOR CORRECTIVE ACTION SHALL COMPLY WITH THE OWNER'S STANDARD OPERATION PROCEDURES AND TECHNICAL INSTRUCTIONS (TI). THIS PROJECT WILL BE CONSTRUCTED IN CONCERT WITH ONGOING OPERATIONS, MAINTENANCE, AND HARVESTING PROJECTS.
5. REFER TO TECHNICAL SPECIFICATIONS SECTION 01 42 00 REFERENCES FOR PROJECT DEFINITIONS AND ROLES AND RESPONSIBILITIES. SPECIFICATIONS TO BE PROVIDED DURING DETAILED DESIGN PHASE (60% LEVEL DESIGN) FOLLOWING APPROVAL OF THE CARA PLAN.
6. THESE PRELIMINARY PLANS FOR CONSTRUCTION, ALONG WITH THE TECHNICAL SPECIFICATIONS, QUALITY MANAGEMENT PLAN (QMP), OTHER REFERENCED SPECIFICATIONS OR STANDARDS, AND APPLICABLE ENVIRONMENTAL AND SAFETY REGULATIONS SHALL BE ADHERED TO BY THE CONTRACTOR DURING CONSTRUCTION OF THIS PROJECT. REFER TO TECHNICAL SPECIFICATIONS SECTION 01 10 00 – SUMMARY OF WORK, PARAGRAPH 1.2 FOR A FULL LIST OF PROJECT DOCUMENTS. SPECIFICATIONS AND QMP TO BE PROVIDED DURING DETAILED DESIGN PHASE (60% LEVEL DESIGN) FOLLOWING APPROVAL OF THE CARA PLAN.
7. THE CONTRACTOR SHALL COMMUNICATE CONSTRUCTABILITY ISSUES, DISCREPANCIES IN THE PLANS FOR CONSTRUCTION OR SPECIFICATIONS, ETC., TO THE CONSTRUCTION MANAGER IMMEDIATELY UPON BECOMING AWARE. THE CONTRACTOR SHALL USE THE OWNER'S REQUEST FOR INFORMATION (RFI) FORM THAT IS CONTAINED IN THE QMP TO COMMUNICATE AND ESTABLISH WRITTEN DOCUMENTATION OF THE ISSUE AND ITS RESOLUTION.
8. CONSTRUCTION ACTIVITIES SHALL BE OBSERVED BY THE CQA MANAGER OR THE DESIGNATED REPRESENTATIVE ON THE CQA TEAM. THE CONTRACTOR SHALL COORDINATE WITH THE ONSITE CQA REPRESENTATIVE AND INFORM THE REPRESENTATIVE OF THE CONTRACTOR'S SCHEDULED WORK SHIFTS TO ENSURE THAT CQA REPRESENTATION OCCURS AS REQUIRED. THE CONTRACTOR SHALL ALSO ALLOW ADEQUATE TIME IN THEIR SCHEDULE FOR THE CQA TEAM TO PERFORM THE CQA TESTS.
9. ONSITE UTILITIES AND UNDERGROUND FACILITIES, WHETHER SHOWN ON THE PLANS OR NOT, SHALL BE PROTECTED BY THE CONTRACTOR FROM DAMAGE BY THE CONTRACTOR'S OPERATIONS. THE CONTRACTOR SHALL COORDINATE WITH THE CONSTRUCTION MANAGER TO LOCATE AND VERIFY ALL UTILITIES PRIOR TO CONSTRUCTION TO ENSURE THERE IS NO CONFLICT WITH THE PLAN PRESENTED HEREIN. IF DAMAGE OCCURS, THE CONTRACTOR SHALL COORDINATE REPAIRS WITH THE CONSTRUCTION MANAGER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE THAT OCCURS AND IS ATTRIBUTED TO THE CONTRACTOR'S OPERATIONS.
10. LIMITS OF CONSTRUCTION SHOWN ON THESE PLANS ARE APPROXIMATE AND MAY BE SUBJECT TO CHANGE. THE CONTRACTOR SHALL CONSULT WITH THE CONSTRUCTION MANAGER TO IDENTIFY FINAL CONSTRUCTION LIMITS FOR THIS WORK AND ACCEPTABLE ACTIVITIES WITHIN THOSE LIMITS. NOTE OWNER MAY PERIODICALLY ACCESS AND WORK WITHIN THE CONSTRUCTION LIMITS. THE CONTRACTOR SHALL COOPERATE AT ALL TIMES WITH THE OWNER, CONSTRUCTION MANAGER, OTHER CONTRACTORS, AND OTHER CONSULTANTS TO HELP RESOLVE ANY SCHEDULING OR OTHER CONFLICTS THAT MIGHT ARISE.
11. THE CONTRACTOR SHALL COORDINATE PLACEMENT OF OFFICES AND EMPLOYEE PARKING WITH THE OWNER AND NO OTHER AREAS SHALL BE USED WITHOUT PERMISSION FROM THE OWNER. THE CONTRACTOR SHALL MAINTAIN THIS AREA IN A CLEAN AND WORKMAN-LIKE MANNER AT ALL TIMES.

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12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR HEALTH AND SAFETY OF ITS PERSONNEL AND SHALL MEET INDUSTRY STANDARD REQUIREMENTS. THE CONTRACTOR SHALL ADHERE TO THE OWNER'S REQUIREMENTS FOR SAFETY DURING CONSTRUCTION, UNLESS SUCH STANDARDS ARE SUPERCEDED BY REGULATORY REQUIREMENTS. ALL OPERATIONS SHALL BE PERFORMED BY THE CONTRACTOR IN STRICT ACCORDANCE WITH OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REQUIREMENTS.
13. THE CONTRACTOR SHALL BE AWARE THAT CCR IS LOCATED WITHIN AREAS OF THE PROJECT WHERE THEY MAY OPERATE EQUIPMENT OR HAVE PERSONNEL. THEY SHOULD ALSO BE AWARE THAT THERE ARE INHERENT RISKS ASSOCIATED WITH WORKING ON CCR INCLUDING BUT NOT LIMITED TO INSTABILITY IN APPARENTLY FIRM SURFACES DURING ACTIVE DRAWDOWN, SOFT BEARING CONDITIONS, AND FUGITIVE DUST EMISSIONS. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THEIR EQUIPMENT AND THE HEALTH AND SAFETY OF THEIR PERSONNEL AND SHALL UTILIZE APPROPRIATE EQUIPMENT/PROVIDE ADEQUATE SAFEGUARDS TO PROMOTE THAT SAFETY. NO PERSON OR EQUIPMENT SHALL ENTER ANY CCR PORTION OF THE MAP UNTIL IT HAS BEEN STABILIZED. CONTRACTOR SHALL COORDINATE WITH THE CONSTRUCTION MANAGER AND ENGINEER TO IDENTIFY THE BEST METHODS FOR INITIAL STABILIZATION OF CCR AREAS PRIOR TO INITIATING MAJOR CONSTRUCTION TASKS.
14. THE CONTRACTOR SHALL PRESERVE AND PROTECT ALL ESTABLISHED TVA BENCHMARKS OR OTHER MONUMENTS ON THE PROJECT SITE. ANY ESTABLISHED MARKER OR BENCHMARK THAT IS DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE REPLACED BY TVA SURVEYING SERVICES AT THE CONTRACTOR'S EXPENSE.
15. BASEMAPPING FOR THIS PROJECT IS BASED UPON SURVEY DATA AND MEASUREMENTS CONDUCTED BY TVA, AS AS DESCRIBED ON DRAWING 10WXXX-03.
16. MATERIALS DELIVERED FOR INCORPORATION INTO THE WORK SHALL BE TEMPORARILY STORED IN AREAS SELECTED BY THE CONTRACTOR AND APPROVED BY THE CONSTRUCTION MANAGER. MATERIALS SHALL BE STORED IN ACCORDANCE WITH THE SUPPLIER'S RECOMMENDATIONS.
17. EXCAVATED MATERIALS TO BE REUSED SHALL BE STOCKPILED IN APPROVED STOCKPILE AREA AS DETERMINED ONSITE BY THE CONSTRUCTION MANAGER. STOCKPILES SHALL BE GRADED TO MAINTAIN POSITIVE DRAINAGE AT ALL TIMES. THE SIDE SLOPES SHALL HAVE MAXIMUM 3H:1V SLOPE. THE TOP OF THE STOCKPILE SHALL HAVE A MINIMUM TWO PERCENT SLOPE. MATERIALS SHALL BE SEGREGATED. NO MATERIAL SHALL BE REMOVED OFFSITE UNTIL PRIOR WRITTEN APPROVAL BY THE CONSTRUCTION MANAGER.
18. ANY PROPOSED MODIFICATIONS TO DESIGN FEATURES AS SHOWN OR DESCRIBED IN THE ISSUED FOR CONSTRUCTION PROJECT DOCUMENTS SHALL BE APPROVED BY THE ENGINEER. TEMPORARY FEATURES IMPLEMENTED TO FACILITATE THE CONSTRUCTION OF THE DESIGN FEATURES SHALL BE ADDRESSED BY METHODS DESCRIBED IN APPROVED PROJECT MANAGEMENT DOCUMENTS AND PRACTICES.
19. VEHICULAR ACCESS TO THE SITE SHALL BE DETERMINED BY THE OWNER. NO CONSTRUCTION ACTIVITIES SHALL BE PERFORMED THAT CAUSE AN INTERFERENCE WITH THROUGH TRAFFIC DURING CONSTRUCTION. CONTRACTOR SHALL PROVIDE APPROVED SIGNAGE BARRIERS AND TRAFFIC SAFETY PERSONNEL RESPONSIBLE FOR DIRECTING CONSTRUCTION AND PLANT TRAFFIC AT ALL POINTS OF INGRESS AND EGRESS. CONTRACTOR SHALL SUBMIT FOR APPROVAL A MAINTENANCE OF TRAFFIC PLAN PRIOR TO BEGINNING CONSTRUCTION.
20. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SITE SECURITY AND PROTECTION OF THE WORK AREA.
21. CERTIFICATIONS OF MATERIAL QUALITY AND CONFORMANCE TO PROJECT REQUIREMENTS SHALL BE SUBMITTED TO THE CONSTRUCTION MANAGER FOR APPROVAL TEN (10) WORKING DAYS PRIOR TO INSTALLATION. THE SUBMITTAL PROCEDURE SHALL BE IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS SECTION 01 31 13, PARAGRAPH 1.5.
22. ALL WORK PERFORMED AND MATERIALS SUPPLIED SHALL BE IN CLOSE CONFORMITY WITH THE LINES, GRADES, CROSS SECTIONS, DIMENSIONS AND MATERIAL REQUIREMENTS AS SHOWN ON THE PLANS FOR CONSTRUCTION OR AS INDICATED IN THE TECHNICAL SPECIFICATIONS AND/OR QMP.
23. ACCEPTABLE CONSTRUCTION TOLERANCES FROM PLAN DIMENSIONS, ELEVATIONS, AND GRADES FOR EARTHWORK, RIPRAP, STRUCTURES, PIPING, AND OTHER MISCELLANEOUS MATERIALS ARE NOTED IN THE RESPECTIVE TECHNICAL SPECIFICATION SECTIONS FOR THOSE MATERIALS AND PRODUCTS.
24. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION SURVEYOR SELECTION, COORDINATION OF ALL CONSTRUCTION RELATED SURVEYING, AND CONSTRUCTION SURVEYING AND FIELD MEASUREMENTS TO VERIFY CONFORMANCE WITH LINES, GRADES, CROSS SECTIONS, AND DIMENSIONS AND TOLERANCES SHOWN ON THESE PLANS FOR CONSTRUCTION. SURVEYING AND FIELD MEASUREMENTS SHALL BE PERFORMED AT APPROPRIATE TIMES THROUGHOUT CONSTRUCTION TO VERIFY PLAN CONFORMANCE AND TO PROVIDE THE NECESSARY DATA FOR PREPARATION OF RECORD DRAWINGS BY THE ENGINEER. THE CONTRACTOR SHALL PROVIDE SUCH AS-BUILT RECORDS OF THE CONSTRUCTED PROJECT TO THE ENGINEER UPON COMPLETION OF CONSTRUCTION.
25. EXISTING GRADE SHALL BE CLEARED, GRUBBED, AND STRIPPED OF ALL VEGETATION PRIOR TO EXCAVATION, OR PLACEMENT OF MATERIAL. ALL STRIPPED TOPSOIL SHALL BE STOCKPILED IN LOCATIONS DESIGNATED BY THE OWNER.
26. SUBSURFACE AND SURFACE WATER DRAINAGE SHALL BE MANAGED AT ALL TIMES BY THE CONTRACTOR TO PREVENT ADVERSE IMPACTS TO THE WORKING AREA. THE CONTRACTORS METHODS FOR CONTROLLING WATER SHALL BE OUTLINED IN THE 'WATER MANAGEMENT PLAN' DESCRIBED IN TECHNICAL SPECIFICATION 01 22 00 – SPECIAL PROVISIONS. WHERE APPLICABLE, DIVERSION PUMP SYSTEMS SHALL BE INSTALLED TEMPORARILY TO MANAGE SUBSURFACE AND SURFACE DRAINAGE AT ALL TIMES DURING CONSTRUCTION. AT A MINIMUM, ALL WATER SHALL BE PUMPED UPSTREAM OF THE TEMPORARY LINED BASIN FOREBAY. HOWEVER, DIVERSION PUMP SYSTEMS SHALL BE CAPABLE OF PUMPING WATER UPSTREAM OF THE POLYMER INJECTION SYSTEM INJECTION POINTS IF ADDITIONAL TREATMENT IS REQUIRED. REFER TO SECTION 01 22 00 – SPECIAL PROVISIONS FOR ADDITIONAL REQUIREMENTS OF THE 'WATER MANAGEMENT PLAN'.
27. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF ALL ACCESS ROADS, STAGING AREAS AND STORAGE AREAS USED DURING CONSTRUCTION, AND SHALL RESTORE SAID AREAS TO THEIR ORIGINAL CONDITION, OR BETTER, ONCE CONSTRUCTION IS COMPLETE UNLESS THE OWNER GIVES WRITTEN PERMISSION TO THE CONTRACTOR TO RETAIN THE AREA "AS IS". ACTIONS MUST BE TAKEN TO MINIMIZE THE TRACKING OF MUD AND SOIL FROM THE PROJECT AREA ONTO THE EXISTING ACCESS ROADS. SOIL TRACKED ONTO THE ACCESS ROADS SHALL BE REMOVED DAILY. UPON COMPLETION OF THE PROJECT, THE CONTRACTOR SHALL REMOVE ALL PERSONNEL AND EQUIPMENT FROM THE SITE, INCLUDING ANY TEMPORARY ITEMS INSTALLED BY THE CONTRACTOR DURING THE COURSE OF THEIR WORK. THE SITE SHALL BE LEFT IN A SIGHTLY CONDITION WITH ALL TRASH AND RUBBISH REMOVED.

INSTRUMENTATION PROTECTION

28. EXISTING INSTRUMENTATION (PIEZOMETERS, SLOPE INCLINOMETERS AND MONITORING WELLS), WHETHER SHOWN ON THE PLANS OR NOT, SHALL BE PROTECTED FROM DAMAGE BY THE CONTRACTOR'S OPERATIONS UNLESS NOTED OTHERWISE.

EROSION PREVENTION AND SEDIMENT CONTROL (EPSC)

29. THE EPSC MEASURES SHOWN SHALL BE CONSIDERED THE MINIMUM; SUPPLEMENTAL MEASURES SHALL BE PROVIDED BY THE CONTRACTOR AS FIELD CONDITIONS DICTATE. ALL EPSC MEASURES (SHOWN HEREIN OR SUPPLEMENTED BY THE CONTRACTOR) SHALL MEET THE REQUIREMENTS OF THE SWPPP AT ALL TIMES.
30. ALL EPSC MEASURES IDENTIFIED ON THESE DRAWINGS SHALL MEET OR EXCEED THE REQUIREMENTS SET FORTH IN THE TENNESSEE EROSION AND SEDIMENT CONTROL HANDBOOK, LATEST EDITION.
31. THE CONTRACTOR SHALL EXERCISE EVERY REASONABLE PRECAUTION AT ALL TIMES TO MINIMIZE SOIL/SEDIMENT EROSION AND PREVENT WATER POLLUTION BY DEPOSITION OF SEDIMENT INTO THE ADJACENT WATERWAYS. EROSION AND SEDIMENT CONTROLS MUST BE USED AND MAINTAINED IN EFFECTIVE OPERATING CONDITION DURING CONSTRUCTION. EXPOSED SOIL AND SEDIMENT MUST BE PERMANENTLY STABILIZED AT THE EARLIEST PRACTICABLE DATE.
32. THE CONTRACTOR SHALL ALSO EXERCISE EVERY PRECAUTION AT ALL TIMES TO PREVENT WATER POLLUTION BY NON-STORMWATER DISCHARGES, INCLUDING SPILLS OR RELEASES OF HAZARDOUS MATERIALS.
33. THE CONTRACTOR SHALL INSPECT, CLEAN, AND MAINTAIN ALL SEDIMENT CONTROL DEVICES AS SHOWN ON THE PLANS FOR CONSTRUCTION AND PROVIDE REPORTING AS REQUIRED BY THE SWPPP AND REGULATIONS ON SAID ITEMS.
34. THE CONTRACTOR IS RESPONSIBLE FOR SITE DRAINAGE THROUGHOUT CONSTRUCTION AND SHALL INSTALL TEMPORARY DRAINAGE STRUCTURES OR PUMP WATER AS NECESSARY TO PREVENT INTERFERENCE WITH THE WORK. SUCH TEMPORARY DRAINAGE FEATURES SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF ENVIRONMENTAL PERMITS AND THE SWPPP.
35. SOIL STOCKPILES THAT WILL NOT BE DISTURBED FOR 14 DAYS OR MORE SHALL BE TEMPORARILY SEEDED WITH WHEAT OR RYE AT A RATE OF 60 LBS/ACRE AND SHALL BE COVERED WITH MULCH.
36. THE CONTRACTOR SHALL CONTROL FUGITIVE DUST EMISSIONS DURING CONSTRUCTION IN SUCH A MANNER AS TO COMPLY WITH APPLICABLE REGULATIONS. DUST CONTROL MEASURES SHALL BE SUBJECT TO APPROVAL OF THE CONSTRUCTION MANAGER.
37. SODDING/SEEDING OF DISTURBED AREAS SHALL BE COMPLETED AS SOON AS PRACTICABLE AFTER GRADING AND/OR BACKFILLING ACTIVITIES HAVE BEEN COMPLETED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VEGETATING ALL DISTURBED AREAS UNLESS OTHERWISE INDICATED ON THE PLANS FOR CONSTRUCTION.
38. SILT FENCES SHALL BE INSTALLED BY THE CONTRACTOR PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES IN ANY AREA AS SHOWN ON THE DRAWINGS. THE CONTRACTOR SHALL INSPECT THE SILT FENCES FOR DAMAGE AND SEDIMENT BUILDUP EVERY 7 DAYS AND WITHIN 24 HOURS OF A PRECIPITATION EVENT THAT PRODUCES 1/2-INCH OR MORE OF RAINFALL. IF THE FENCE FABRIC IS UNDERMINED, TORN, OR IN ANY WAY BECOMES INEFFECTIVE, IT SHALL BE IMMEDIATELY REPAIRED OR REPLACED BY THE CONTRACTOR. SILT FENCES REMOVED TO PROVIDE ACCESS FOR EQUIPMENT AND VEHICLES SHALL BE REPLACED AT THE END OF THE WORK DAY.

ASSET MANAGEMENT

39. THE CONTRACTOR SHALL COORDINATE WITH THE OWNER ON THE LABELING (E.G. TAGS) OF EQUIPMENT INSTALLED FOR MONITORING, MAINTENANCE, AND CARE FOLLOWING COMPLETION OF ALL CONSTRUCTION ACTIVITIES. COORDINATION TO INCLUDE LABELING TYPES, NAMING, AND COORDINATION WITH ANY VIRTUAL DATABASES AND MONITORING SYSTEMS (I.E. SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS) TO ENSURE CONSISTENCY IN NAMING CONVENTIONS.

ABBREVIATIONS:

AP	–	ASH POND
ASTM	–	AMERICAN SOCIETY FOR TESTING AND MATERIALS
CARA	–	CORRECTIVE ACTION AND RISK ASSESSMENT
CCR	–	COAL COMBUSTION RESIDUAL
CQA	–	CONSTRUCTION QUALITY ASSURANCE
DIA	–	DIAMETER
DND	–	DO NOT DISTURB
EAR	–	ENVIRONMENTAL ASSESSMENT REPORT
ELEV	–	ELEVATION
EPSC	–	EROSION PREVENTION AND SEDIMENT CONTROL
GW	–	GROUNDWATER
HDPE	–	HIGH DENSITY POLYETHYLENE
MAX	–	MAXIMUM
MIN	–	MINIMUM
NAD83	–	NORTH AMERICAN DATUM OF 1983
NGVD29	–	NATIONAL GEODETIC VERTICAL DATUM OF 1929
PFM	–	PROCESS FLOW MANAGEMENT
PW	–	PORE WATER
QMP	–	QUALITY MANAGEMENT PLAN
RFI	–	REQUEST FOR INFORMATION
SDA	–	SLAG DISPOSAL AREA
STA	–	STATION
SWPPP	–	STORM WATER POLLUTION PREVENTION PLAN
TBR	–	TO BE REMOVED
TDEC	–	TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
TDOT	–	TENNESSEE DEPARTMENT OF TRANSPORTATION
TI	–	TECHNICAL INSTRUCTION
TYP	–	TYPICAL
UNO	–	UNLESS NOTED OTHERWISE
WBF	–	WATTS BAR FOSSIL PLANT
WBN	–	WATTS BAR NUCLEAR PLANT
WSE	–	WATER SURFACE ELEVATION

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

PLOT DATE: 08/22/2025 USER: CLINGSMEAND, ALNAM
V:\TSK\ACTIVE\72568600\TECHNICAL\PRODUCTION\DRAWING\SHEET_FILES\WBF00\VER\VER-B_P30\SHEET_FILES\02-WBF00L-S02_GNTS.DWG

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	ACC	–	–	N/A	N/A	TVA	–	–	D

ISSUED FOR REVIEW

DISCIPLINE INTERFACE

SCALE: NONE — EXCEPT AS NOTED

YARD
–

CARA PLAN
GENERAL NOTES

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

Stantec
3092 Beaumont Centre Circle
Lexington, Kentucky 40513-1703
www.stantec.com

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

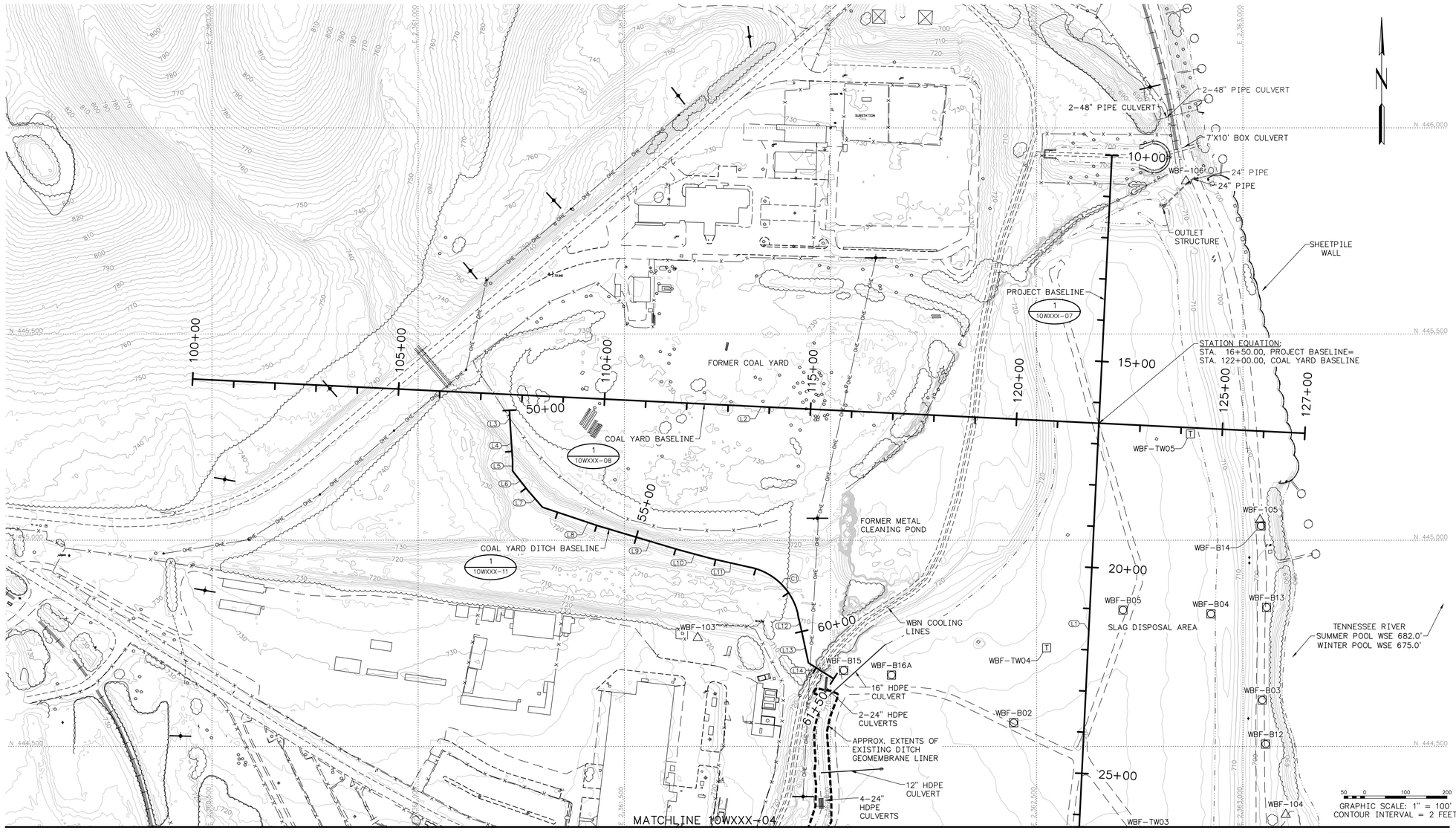
AUTOCAD R | DATE | 14 | C | 10WXXX-02 | R B

STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

14 C 10WXXX-02



SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

METADATA:

HORIZONTAL PROJECTION: PLANT LOCAL GROUND
PLANT LOCAL GROUND COORDINATES ARE BASED ON THE TENNESSEE NAD 27 STATE PLANE COORDINATE SYSTEM, BUT REPRESENT LOCATIONS ON THE GROUND. THEY ARE NOT EQUIVALENT TO GRID POSITIONS.
HORIZONTAL DATUM: LOCAL
VERTICAL DATUM: NGVD 29
H&V ACCURACY: GPS RTK
UNITS: US SURVEY FEET (SFT)

MAPPING SOURCE NOTE:

TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON NOVEMBER 10, 2014 AND SEPTEMBER 12, 2018 BY TUCK MAPPING SOLUTIONS, INC.

LEGEND

- x 1313 SPOT ELEVATION
- CONTROL POINT
- LIGHT POLE
- UTILITY POLE
- POLE
- POWER POLE
- SIGN
- POST
- TREE
- BOLLARD
- BUILDING
- UNPAVED ROAD
- PAVED ROAD
- RIPRAP
- PIEZOMETER
- ABANDONED PIEZOMETER
- SLOPE INCLINOMETER
- ST STORM PIPE
- UGE UNDERGROUND ELECTRIC LINE
- UGP UNDERGROUND PIPE
- TREE LINE
- EDGE OF WATER OR DITCH FLOW LINE
- X FENCE LINE
- 380 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- BASELINE
- L1 BASELINE TANGENT LABEL
- MONITORING WELL
- T TEMPORARY WELL
- PIEZOMETER

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

TABLE OF PROJECT BASELINE COORDINATES

NUMBER	BEGIN STATION	NORTHING	EASTING	LENGTH	BEARING	END STATION	NORTHING	EASTING
L1	10+00.00	445,932.96	2,362,682.62	3200.00'	S2°47'30"W	42+00.00	442,736.76	2,362,526.77

TABLE OF COAL YARD BASELINE COORDINATES

NUMBER	BEGIN STATION	NORTHING	EASTING	LENGTH	BEARING	END STATION	NORTHING	EASTING
L2	100+00.00	445,390.88	2,360,453.58	2700.00'	S87°12'30"E	127+00.00	445,259.38	2,363,150.37

DRAFT

TABLE OF COAL YARD DITCH BASELINE COORDINATES

NUMBER	BEGIN STATION	NORTHING	EASTING	LINE/CHORD LENGTH	LINE/CHORD BEARING	END STATION	NORTHING	EASTING	P.I. STATION	NORTHING	EASTING	DELTA	DEGREE OF CURVE	TANGENT	ARC LENGTH	RADIUS	EXTERNAL
L3	50+00.00	445,315.05	2,361,221.79	36.46'	S2°54'48"E	50+36.46	445,278.64	2,361,223.64									
L4	50+36.46	445,278.64	2,361,223.64	86.52'	S3°48'13"E	51+22.98	445,192.31	2,361,229.38									
L5	51+22.98	445,192.31	2,361,229.38	24.42'	S0°00'00"E	51+47.40	445,167.89	2,361,229.38									
L6	51+47.40	445,167.89	2,361,229.38	59.77'	S38°03'50"E	52+07.17	445,120.83	2,361,266.23									
L7	52+07.17	445,120.83	2,361,266.23	53.88'	S40°59'44"E	52+61.05	445,080.16	2,361,301.58									
L8	52+61.05	445,080.16	2,361,301.58	145.69'	S71°34'54"E	54+06.74	445,034.13	2,361,439.80									
L9	54+06.74	445,034.13	2,361,439.80	199.98'	S73°25'44"E	56+06.72	444,977.09	2,361,631.48									
L10	56+06.72	444,977.09	2,361,631.48	80.64'	S74°54'05"E	56+87.37	444,956.09	2,361,709.34									
L11	56+87.37	444,956.09	2,361,709.34	101.15'	S77°08'27"E	57+88.52	444,933.58	2,361,807.95									
C1	57+88.52	444,933.58	2,361,807.95	159.35'	S45°03'21"E	59+56.52	444821.01	2,361,920.74	58+82.56	444,912.65	2,361,899.63	64°10'11"	38°11'50"	94.04'	168.00'	150.00'	27.04'
L12	59+56.52	444,821.01	2,361,920.74	47.34'	S12°58'16"E	60+03.86	444,774.87	2,361,931.37									
L13	60+03.86	444,774.87	2,361,931.37	73.58'	S11°54'43"E	60+77.43	444,702.88	2,361,946.56									
L14	60+77.43	444,702.88	2,361,946.56	72.57'	S57°47'56"E	61+50.00	444,664.21	2,362,007.96									

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

Stantec
3052 Beaumont Centre Circle
Lexington, Kentucky 40513-1703
www.stantec.com

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

CARA PLAN
EXISTING CONDITIONS AND BASELINE LAYOUT

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R | DATE | 14 | C | 10WXXX-03 | R B

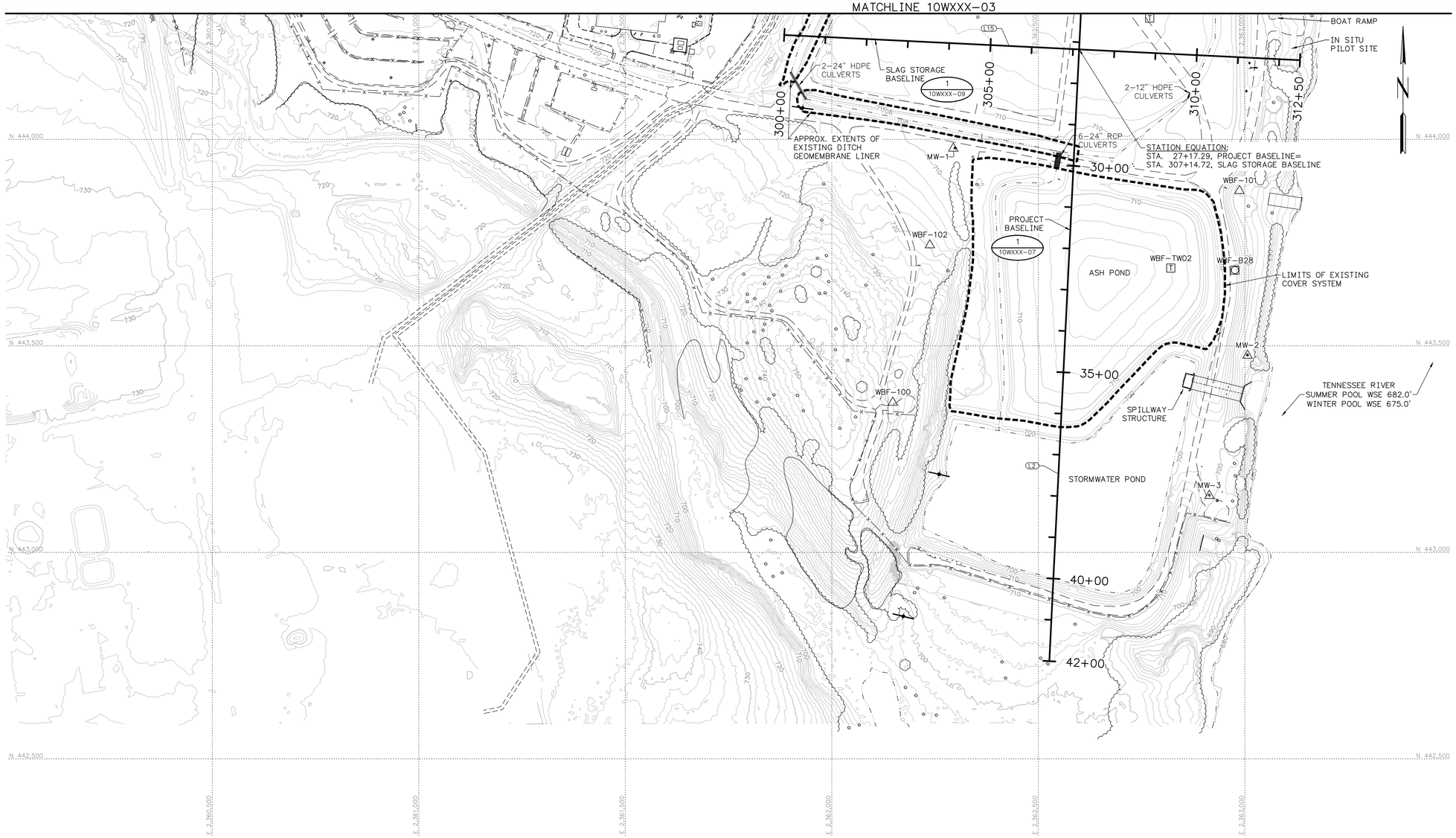
STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 09/12/2025 USER: CLINEMCARD, ADAM
V:\1756\ACTIVE\256680501\CONSTRUCTION\DRAWING\SHEET_FILES\WBF03\VER\VER_FP3\SHEET_FILES\03-04_WBF03_101_EC.DWG

MATCHLINE 10WXXX-03



SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

METADATA:

HORIZONTAL PROJECTION: PLANT LOCAL GROUND
PLANT LOCAL GROUND COORDINATES ARE BASED ON THE TENNESSEE NAD 27 STATE PLANE COORDINATE SYSTEM, BUT REPRESENT LOCATIONS ON THE GROUND. THEY ARE NOT EQUIVALENT TO GRID POSITIONS.
HORIZONTAL DATUM: LOCAL
VERTICAL DATUM: NGVD 29
H&V ACCURACY: GPS RTK
UNITS: US SURVEY FEET (SFT)

MAPPING SOURCE NOTE:

TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON NOVEMBER 10, 2014 AND SEPTEMBER 12, 2018 BY TUCK MAPPING SOLUTIONS, INC.

LEGEND

- × 1313 SPOT ELEVATION
- CONTROL POINT
- LIGHT POLE
- UTILITY POLE
- POLE
- POWER POLE
- SIGN
- POST
- TREE
- BOLLARD
- BUILDING
- UNPAVED ROAD
- PAVED ROAD
- RIPRAP
- PIEZOMETER
- ABANDONED PIEZOMETER
- SLOPE INCLINOMETER
- ST STORM PIPE
- UGE UNDERGROUND ELECTRIC LINE
- UGP UNDERGROUND PIPE
- TREE LINE
- EDGE OF WATER OR DITCH FLOW LINE
- X FENCE LINE
- 380 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- BASELINE
- L1 BASELINE TANGENT LABEL
- MONITORING WELL
- T TEMPORARY WELL
- PIEZOMETER

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

PLOT DATE: 09/23/2025 USER: CLINEMCARD, ALAN
V:\1756\ACTIVE\256860560\ECOR\CIVIL_PRODUCTION\DRAWING\SHEET_FILES\WBF05\REV0\REV0_F03\SHEET_FILES\03-04_WBF05_101_EC.DWG

GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 2 FEET

TABLE OF PROJECT BASELINE COORDINATES								
NUMBER	BEGIN STATION	NORTHING	EASTING	LENGTH	BEARING	END STATION	NORTHING	EASTING
L1	10+00.00	445,932.96	2,362,682.62	3200.00'	S2°47'30"W	42+00.00	442,736.76	2,362,526.77

TABLE OF SLAG STORAGE BASELINE COORDINATES								
NUMBER	BEGIN STATION	NORTHING	EASTING	LENGTH	BEARING	END STATION	NORTHING	EASTING
L15	300+00.00	444,252.51	2,361,885.11	1250.00'	S87°12'30"E	312+50.00	444,191.63	2,363,133.63

DRAFT

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

Stantec
3052 Beaumont Centre Circle
Lexington, Kentucky 40513-1703
www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. ID	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	–
–												
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

CARA PLAN
EXISTING CONDITIONS AND BASELINE LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

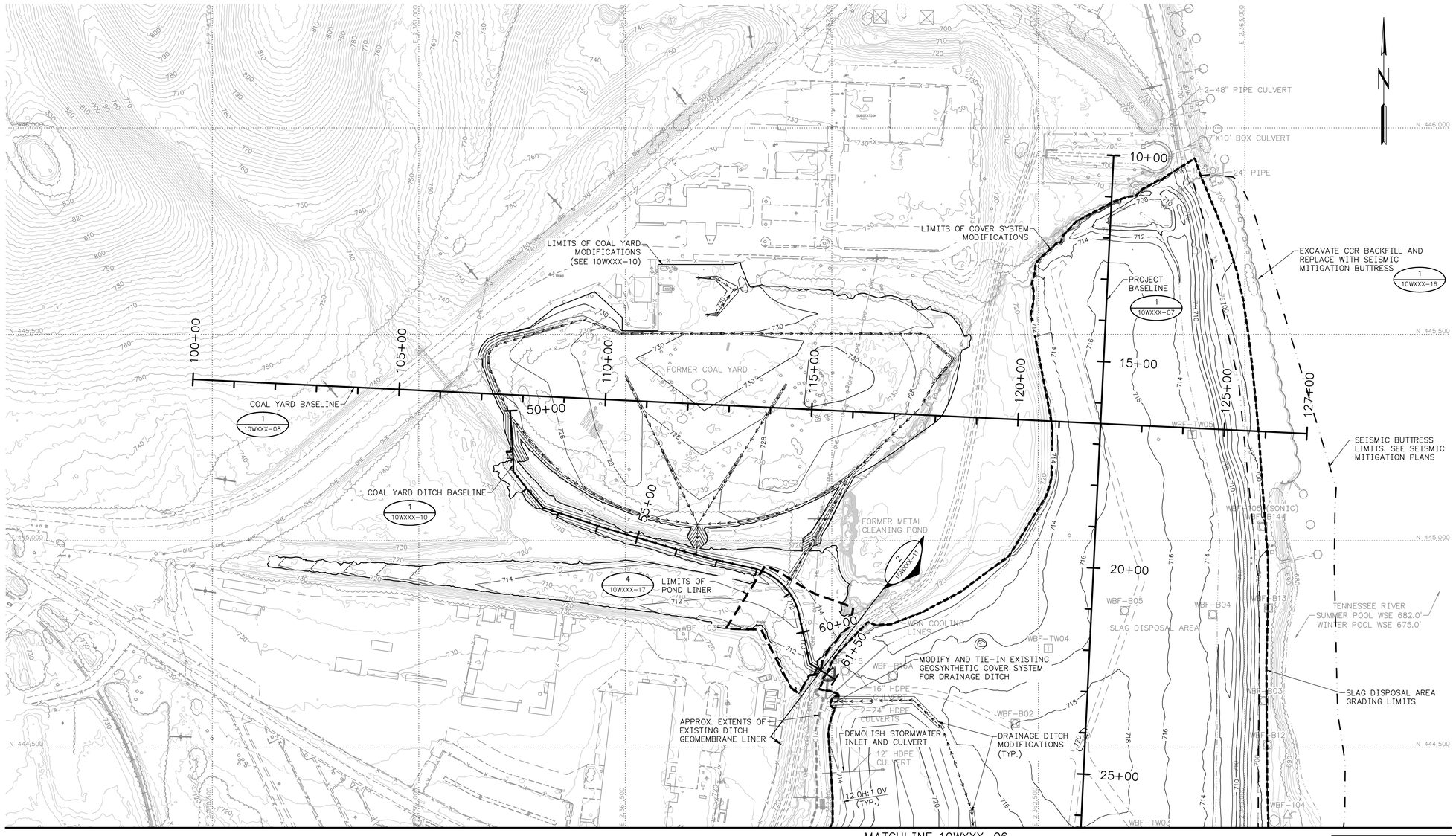
WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R | DATE | 14 | C | 10WXXX-04 | R B

STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



MATCHLINE 10WXXX-06

SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

METADATA:

HORIZONTAL PROJECTION: PLANT LOCAL GROUND
PLANT LOCAL GROUND COORDINATES ARE BASED ON THE TENNESSEE NAD 27 STATE PLANE COORDINATE SYSTEM, BUT REPRESENT LOCATIONS ON THE GROUND. THEY ARE NOT EQUIVALENT TO GRID POSITIONS.
HORIZONTAL DATUM: LOCAL
VERTICAL DATUM: NGVD 29
H&V ACCURACY: GPS RTK
UNITS: US SURVEY FEET (SFT)

MAPPING SOURCE NOTE:

TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON NOVEMBER 10, 2014 AND SEPTEMBER 12, 2018 BY TUCK MAPPING SOLUTIONS, INC.

NOTE:

REFER TO DRAWINGS 10WXXX-17, 10WXXX-03 AND 10WXXX-04 FOR TABLE OF BASELINE COORDINATES.

LEGEND

- x 1313 SPOT ELEVATION
- CONTROL POINT
- LIGHT POLE
- UTILITY POLE
- POLE
- POWER POLE
- SIGN
- POST
- TREE
- BOLLARD
- BUILDING
- UNPAVED ROAD
- PAVED ROAD
- RIPRAP
- PIEZOMETER
- ABANDONED PIEZOMETER
- SLOPE INCLINOMETER
- ST STORM PIPE
- UGE UNDERGROUND ELECTRIC LINE
- UGP UNDERGROUND PIPE
- TREE LINE
- EDGE OF WATER OR DITCH FLOW LINE
- X FENCE LINE
- 380 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 380 PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- MONITORING WELL
- T TEMPORARY WELL
- LIMITS OF POND LINER
- LIMITS OF GRADING
- SEISMIC BUTTRESS
- BASELINE

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 2 FEET

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

DRAFT

Stantec
3052 Beaumont Centre Circle
Lexington, Kentucky 40513-1703
www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	
R B	–	–	RRP	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

CARA PLAN
SOURCE CONTROL AND
CAPPING LIMITS

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

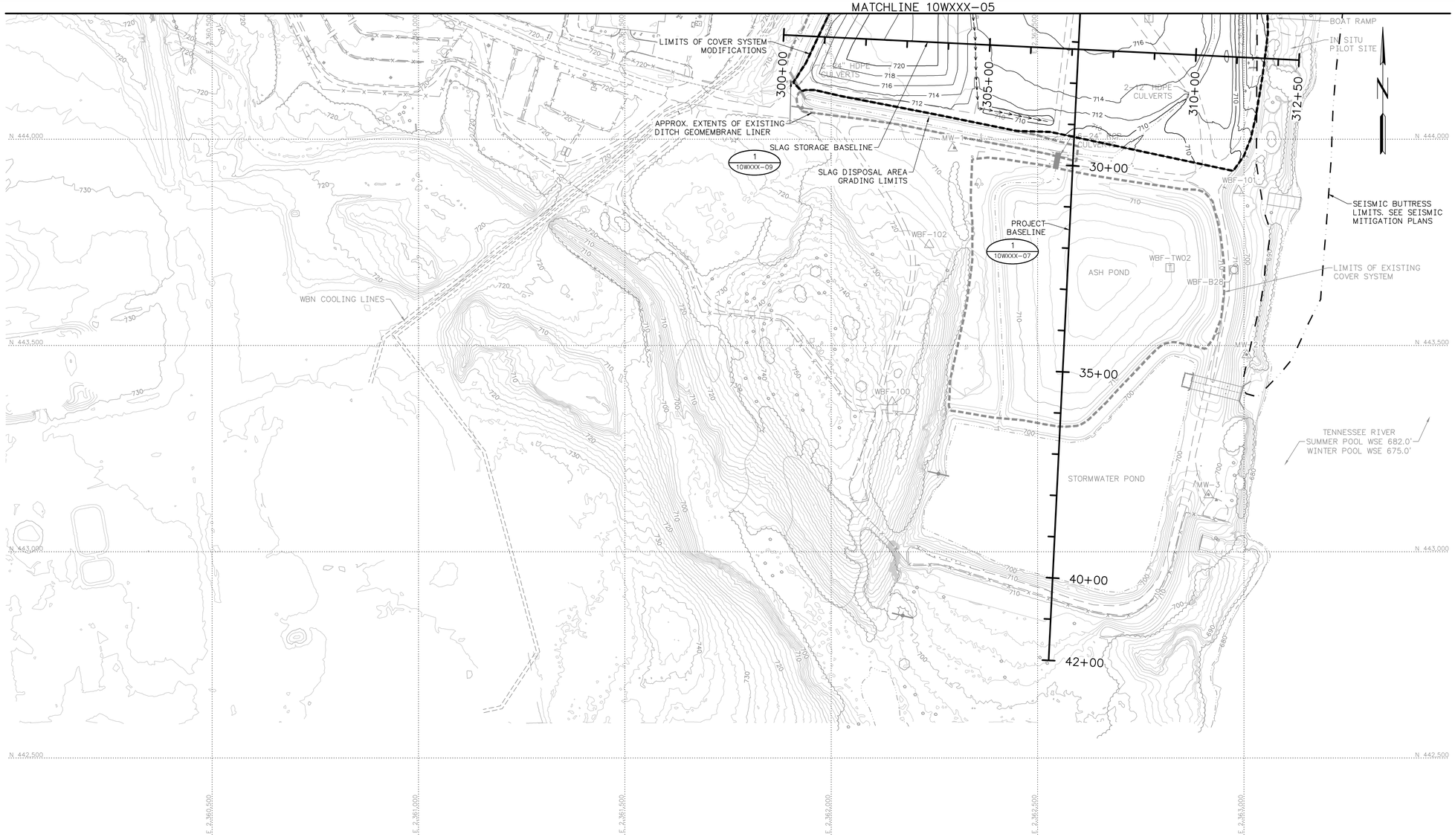
AUTOCAD R | DATE | 14 | C | 10WXXX-05 | R B

PLOT DATE: 09/13/2023, USER: CLINKENBEARD, KCAW
V:\1730\ACTIVE\172566500\TECH\CAL_PRODUCTION\DRAWING\SHEET_FILES\WBF05\REVD\REVD_P30\SHEET_FILES\05-06_WBF05L_103_SCCL.DWG

STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SURVEY CONTROL NOTE:

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METADATA:

HORIZONTAL PROJECTION: PLANT LOCAL GROUND
PLANT LOCAL GROUND COORDINATES ARE BASED ON THE TENNESSEE NAD 27 STATE PLANE COORDINATE SYSTEM, BUT REPRESENT LOCATIONS ON THE GROUND. THEY ARE NOT EQUIVALENT TO GRID POSITIONS.
HORIZONTAL DATUM: LOCAL
VERTICAL DATUM: NGVD 29
H&V ACCURACY: GPS RTK
UNITS: US SURVEY FEET (SFT)

MAPPING SOURCE NOTE:

TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON NOVEMBER 10, 2014 AND SEPTEMBER 12, 2018 BY TUCK MAPPING SOLUTIONS, INC.

NOTE:

REFER TO DRAWINGS 10WXXX-17, 10WXXX-03 AND 10WXXX-04 FOR TABLE OF BASELINE COORDINATES.

LEGEND

- × 1313 SPOT ELEVATION
- CONTROL POINT
- LIGHT POLE
- UTILITY POLE
- POLE
- POWER POLE
- SIGN
- POST
- TREE
- BOLLARD
- BUILDING
- UNPAVED ROAD
- PAVED ROAD
- RIPRAP
- PIEZOMETER
- ABANDONED PIEZOMETER
- SLOPE INCLINOMETER
- ST STORM PIPE
- UGE UNDERGROUND ELECTRIC LINE
- UGP UNDERGROUND PIPE
- TREE LINE
- EDGE OF WATER OR DITCH FLOW LINE
- X FENCE LINE
- 380 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 380 PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- MONITORING WELL
- T TEMPORARY WELL
- LIMITS OF GRADING
- BASELINE
- SEISMIC BUTTRESS

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

50 0 100 200 FEET
GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 2 FEET

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

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REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	RRP	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

CARA PLAN
SOURCE CONTROL AND CAPPING LIMITS

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R | DATE | 14 | C | 10WXXX-06 | R B

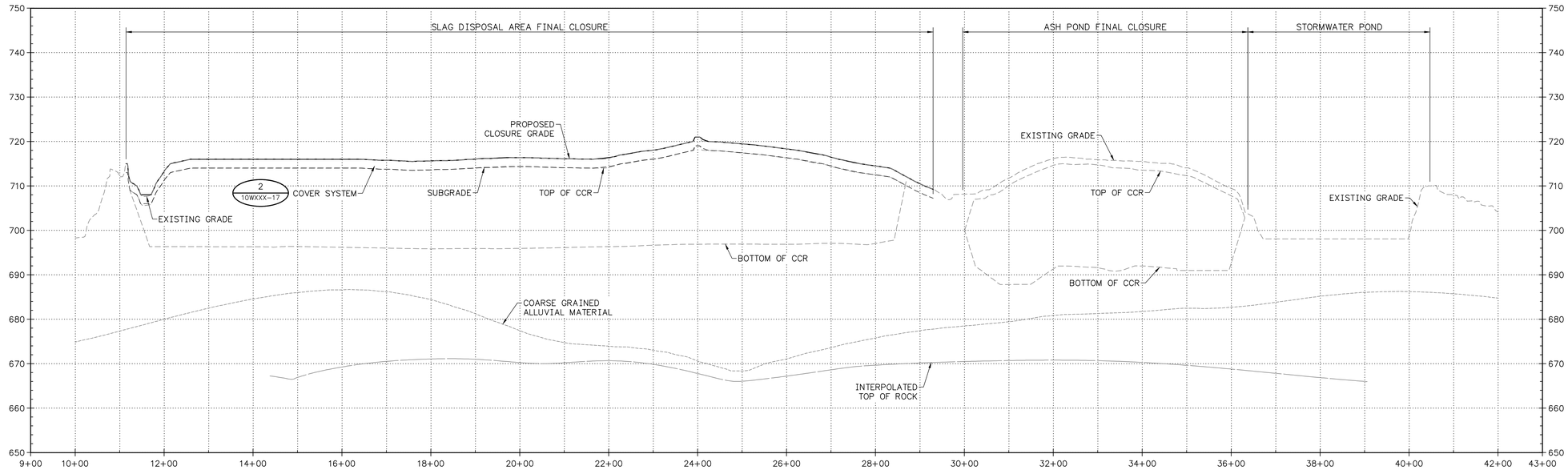
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

STANTEC | B
TASK COMPLETED BY: | REV NO.

DRAFT

PLOT DATE: 09/13/2023, USER: CLINEMBEARD, ACAD V:\1758\ACTIVE\172668500\TECHNICAL_PRODUCTION\DRAWINGS\SHEET_FILES\WBF05\REVD\WBL-P30\SHEET_FILES\05-06_WBF05L_103_SCCL.DWG



1 / 10WXXX-07 PROFILE – PROJECT BASELINE
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

CARA REV. 2 SUBMITTAL

30% SUBMITTAL
ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

PLOT DATE: 09/12/2025 USER: CLINKENBEARD, ADAM
V:\1795\ACTIVE\175868500\TECHNICAL_PRODUCTION\DRAWINGS\SHEET_FILES\WBF00\VER\VER\WB_P00\SHEET_FILES\07-09_WBF05_N01_PROF.DWG

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D

ISSUED FOR REVIEW

DISCIPLINE INTERFACE
1
2
3
4

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
–

CARA PLAN
SOURCE CONTROL PROFILE
PROJECT BASELINE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

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TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R | DATE | 14 | C | 10WXXX-07 | R B

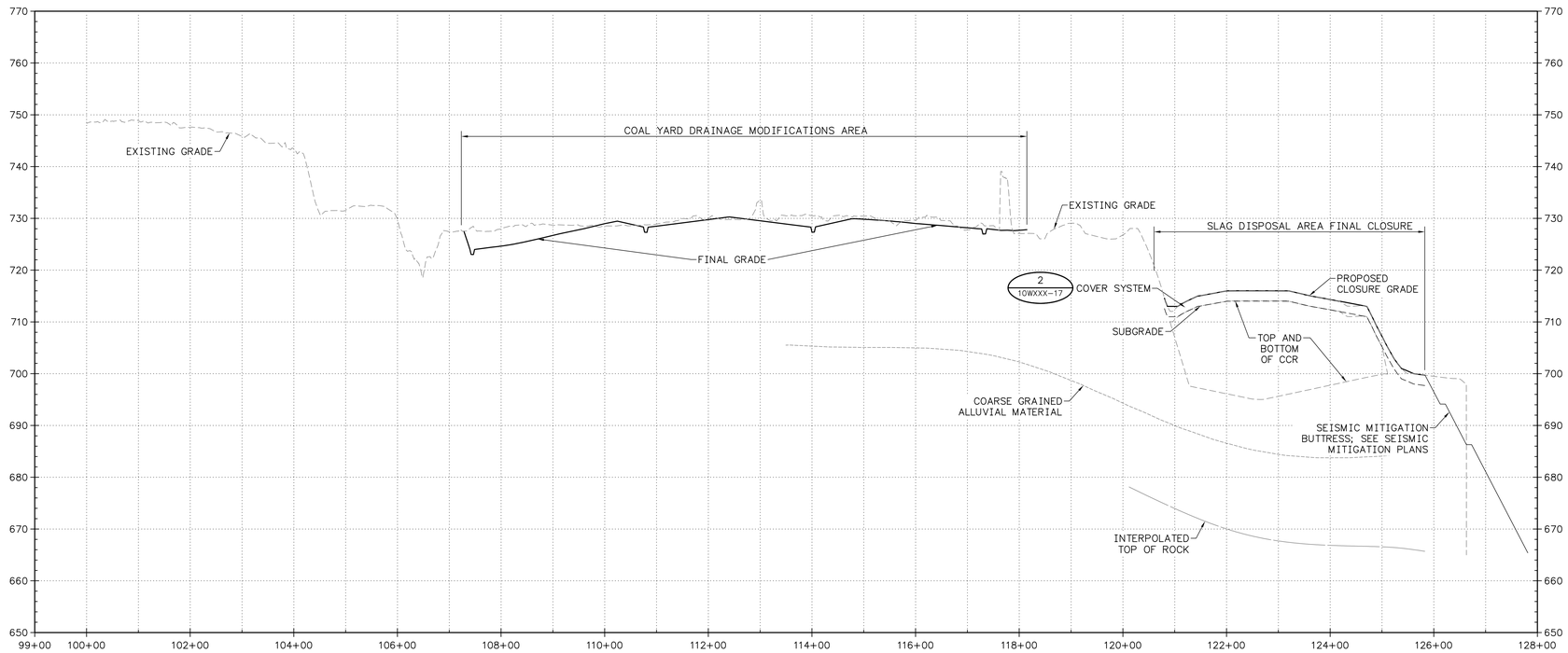
SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

DRAFT

STANTEC	B
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



1 / 10WXXX-08 PROFILE – COAL YARD BASELINE

SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

DRAFT

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	
–												
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
–

CARA PLAN
SOURCE CONTROL PROFILE
COAL YARD BASELINE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

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TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R | DATE | 14 | C | 10WXXX-08 | R B

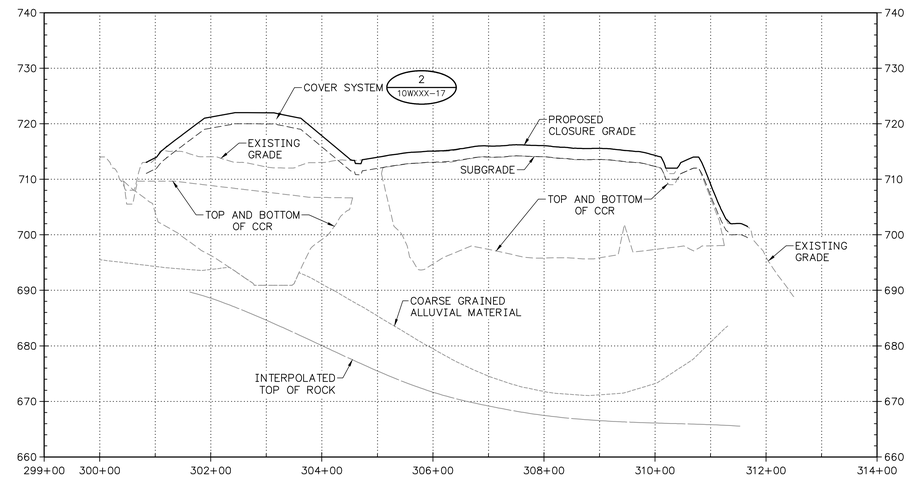
STANTEC	B
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 09/12/2025 USER: CLINGENGREBO, ADAM
X:\1756\ACTIVE\175568500\TECHNICAL_PRODUCTION\DRAWINGS\SHEET_FILES\WBF00\VERVIEW\0_P30\SHEET_FILES\07-10a_WBF00_30U_PROF.DWG

Xref ..\reference files\block base.dwg



1 / 10WXXX-09 PROFILE – SLAG STORAGE BASELINE
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

CARA REV. 2 SUBMITTAL

30% SUBMITTAL
ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

PLOT DATE: 09/12/2025 USER: CLINEDMEARD, ADAM
V:\1750\ACTIVE\172468500\TECHNICAL_PRODUCTION\DRAWING\SHEET_FILES\WBFOR\REVREV0_PKG\SHEET_FILES\07-09_WBF05_301_PROF.DWG

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
–

CARA PLAN
SOURCE CONTROL PROFILE
SLAG STORAGE BASELINE

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

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TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

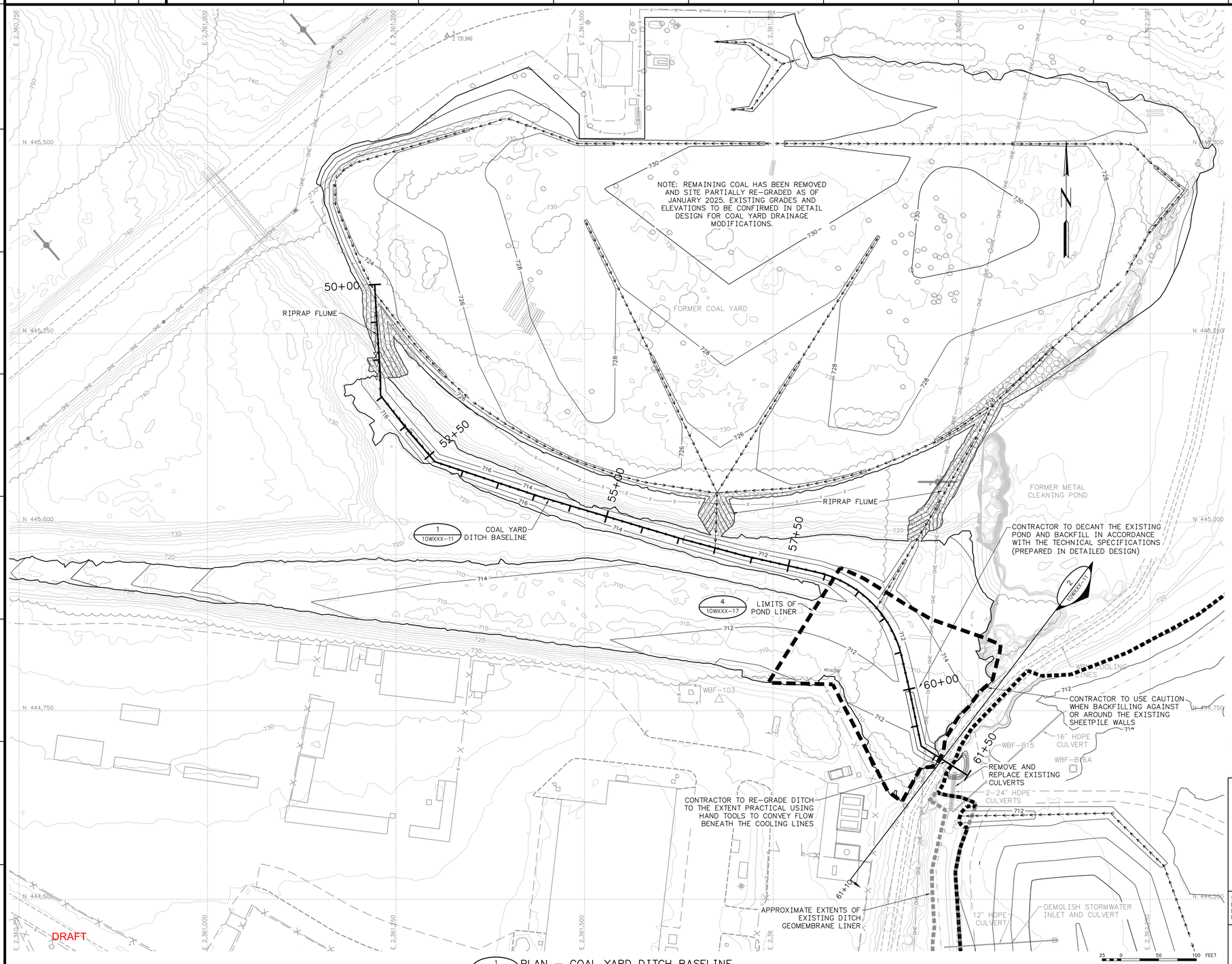
AUTOCAD R | DATE | 14 | C | 10WXXX–09 | R B

DRAFT

STANTEC	B
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



1 / 10WXXX-10 PLAN – COAL YARD DITCH BASELINE
SCALE: 1"=50'

SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

METADATA:

HORIZONTAL PROJECTION: PLANT LOCAL GROUND
PLANT LOCAL GROUND COORDINATES ARE BASED ON THE TENNESSEE NAD 27 STATE PLANE COORDINATE SYSTEM, BUT REPRESENT LOCATIONS ON THE GROUND. THEY ARE NOT EQUIVALENT TO GRID POSITIONS.
HORIZONTAL DATUM: LOCAL
VERTICAL DATUM: NGVD 29
H&V ACCURACY: GPS RTK
UNITS: US SURVEY FEET (SFT)

MAPPING SOURCE NOTE:

TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON NOVEMBER 10, 2014 AND SEPTEMBER 12, 2018 BY TUCK MAPPING SOLUTIONS, INC.

NOTE:

REFER TO DRAWINGS 10WXXX-17, 10WXXX-03 AND 10WXXX-04 FOR TABLE OF BASELINE COORDINATES.

LEGEND

- x 1313 SPOT ELEVATION
- CONTROL POINT
- LIGHT POLE
- UTILITY POLE
- POLE
- POWER POLE
- SIGN
- POST
- TREE
- BOLLARD
- BUILDING
- UNPAVED ROAD
- PAVED ROAD
- RIPRAP
- PIEZOMETER
- ABANDONED PIEZOMETER
- SLOPE INCLINOMETER
- ST — STORM PIPE
- UGE — UNDERGROUND ELECTRIC LINE
- UGP — UNDERGROUND PIPE
- TREE LINE
- EDGE OF WATER OR DITCH FLOW LINE
- x — FENCE LINE
- 380 — INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 380 — PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- MONITORING WELL
- T TEMPORARY WELL
- LIMITS OF CONSTRUCTION
- LIMITS OF POND LINER
- BASELINE

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	RRP	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: 1"=50' (HORIZ.) 1"=10' (VERT.) EXCEPT AS NOTED

YARD
–

CARA PLAN
COAL YARD DRAINAGE MODIFICATIONS

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

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TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

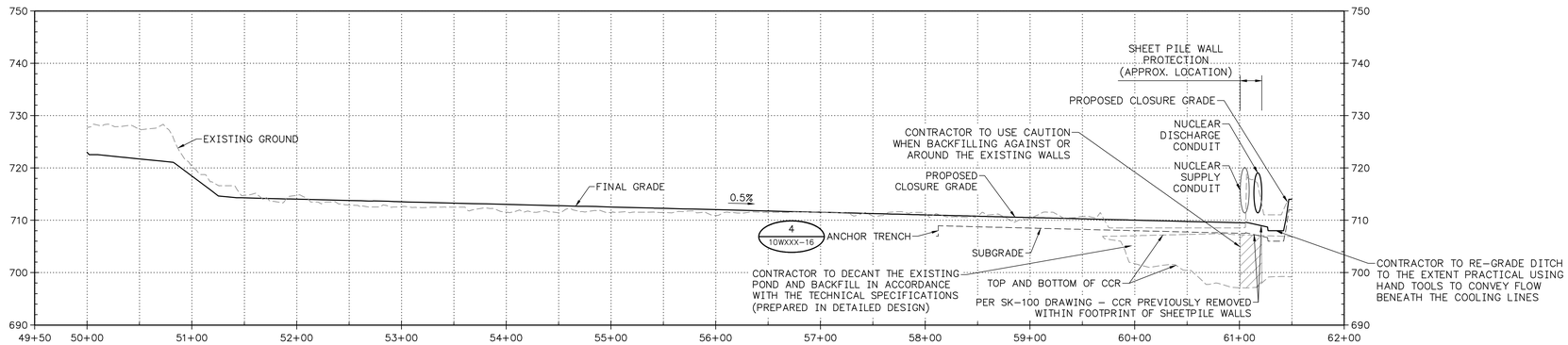
AUTOCAD R | DATE | 14 | C | 10WXXX-10 | R B

PLOT FACTOR:1
W_TVA

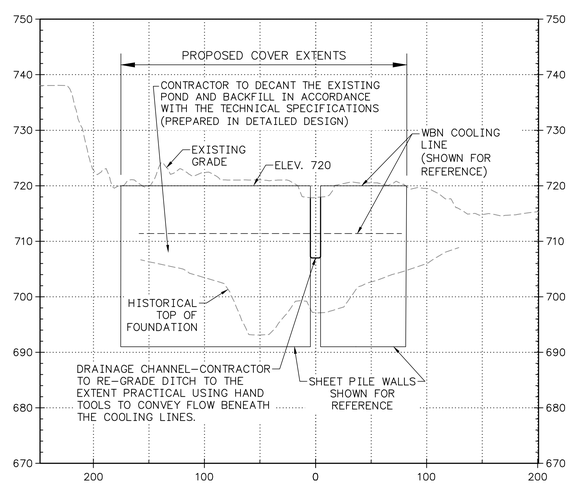
C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT DATE: 10/17/2025 USER: GEORGE, CHLOE
\\US0243-PPFSS01\WORKGROUP\1795\ACTIVE\175686050\TECHNICAL_PRODUCTION\DESIGN\WORKING\EXPORT_TO_CAD\2025\10\DRAWINGS\10-11_MBF05_10A_PP01.DWG



1 / 10WXXX-11 PROFILE – COAL YARD DITCH BASELINE
SCALE: 1"=50' (HORIZONTAL)
1"=10' (VERTICAL)



2 / 10WXXX-11 SECTION – COAL YARD DRAINAGE IMPROVEMENT (STA. 61+10)
SCALE: 1"=50' (HORIZONTAL)
1"=10' (VERTICAL)

DRAFT

CARA REV. 2 SUBMITTAL

30% SUBMITTAL
ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. CD
R –	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	RRP	–	–	N/A	N/A	TVA	–	–	D

DISCIPLINE INTERFACE
1
2
3
4

ISSUED FOR REVIEW

SCALE: 1"=50' (HORIZ.) 1"=10' (VERT.) EXCEPT AS NOTED

YARD
–

CARA PLAN
COAL YARD DITCH
PROFILE & CROSS SECTION

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

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FOSSIL AND HYDRO ENGINEERING

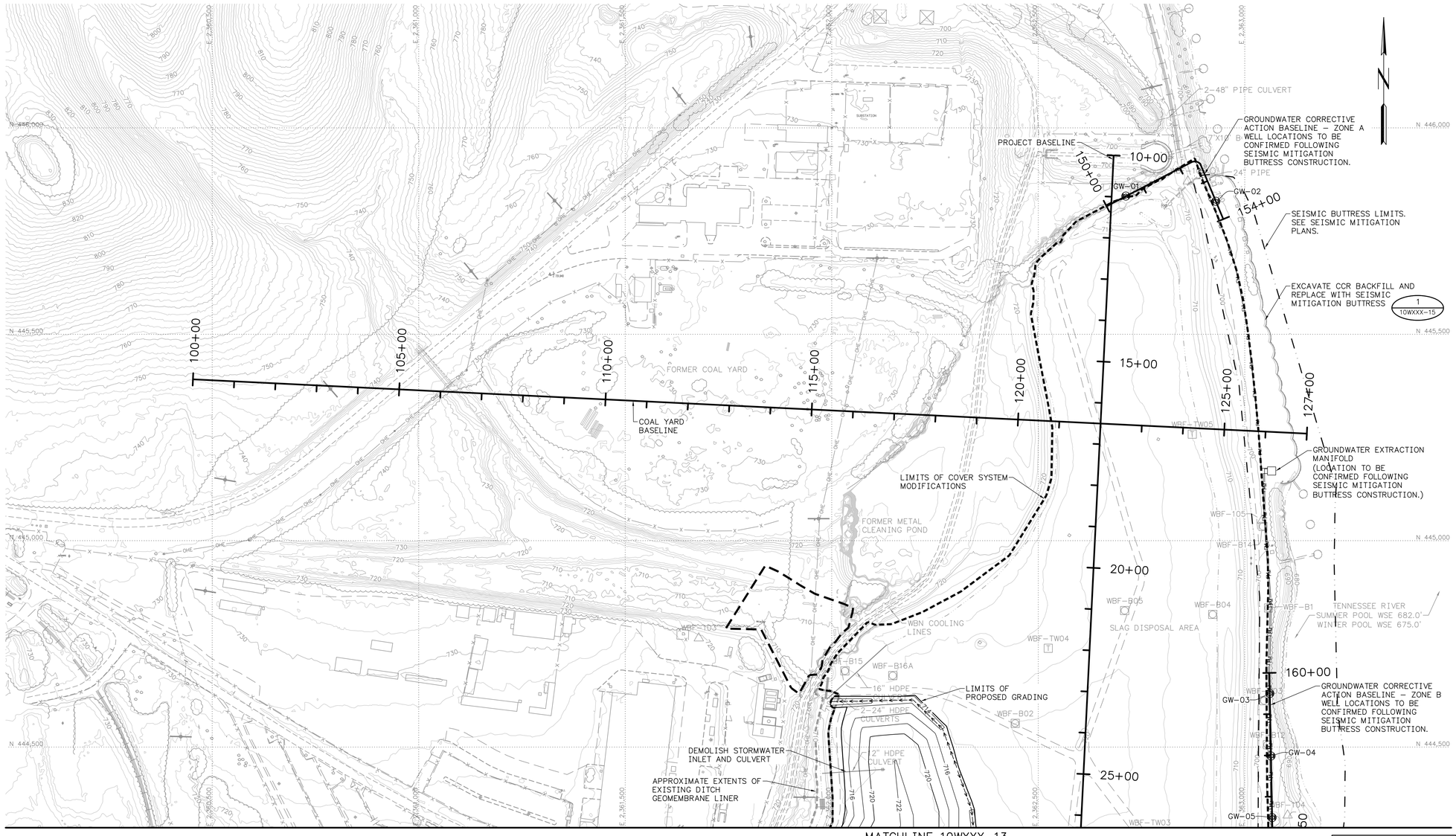
AUTOCAD R | DATE | 14 | C | 10WXXX–11 | R B

STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 08/12/2025 USER: CLINSONMEAND, ADAM
V:\1756\ACTIVE\175660500\TECHNICAL_PRODUCTION\DRAWING\SHEET_FILES\WBF05\VER\VER_B30\SHEET_FILES\10-11_WBF05_104_PRO.DWG



MATCHLINE 10WXXX-13

SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

METADATA:

HORIZONTAL PROJECTION: PLANT LOCAL GROUND
PLANT LOCAL GROUND COORDINATES ARE BASED ON THE TENNESSEE NAD 27 STATE PLANE COORDINATE SYSTEM, BUT REPRESENT LOCATIONS ON THE GROUND. THEY ARE NOT EQUIVALENT TO GRID POSITIONS.
HORIZONTAL DATUM: LOCAL
VERTICAL DATUM: NGVD 29
H&V ACCURACY: GPS RTK
UNITS: US SURVEY FEET (SFT)

MAPPING SOURCE NOTE:

TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON NOVEMBER 10, 2014 AND SEPTEMBER 12, 2018 BY TUCK MAPPING SOLUTIONS, INC.

LEGEND

- x 1313 SPOT ELEVATION
- CONTROL POINT
- LIGHT POLE
- UTILITY POLE
- POLE
- POWER POLE
- SIGN
- POST
- TREE
- BOLLARD
- BUILDING
- UNPAVED ROAD
- PAVED ROAD
- RIPRAP
- PIEZOMETER
- ABANDONED PIEZOMETER
- SLOPE INCLINOMETER
- ST STORM PIPE
- UGE UNDERGROUND ELECTRIC LINE
- UGP UNDERGROUND PIPE
- TREE LINE
- EDGE OF WATER OR DITCH FLOW LINE
- X FENCE LINE
- 380 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 380 PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- MONITORING WELL
- T TEMPORARY WELL
- PIEZOMETER
- BASELINE
- LIMITS OF CONSTRUCTION
- LIMITS OF POND LINER
- GROUNDWATER EXTRACTION WELL

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 2 FEET

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

DRAFT

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. ID	DISCIPLINE INTERFACE
R –	–	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

CARA PLAN
GROUNDWATER EXTRACTION VERTICAL WELLS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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www.stantec.com

AUTOCAD R | DATE | 14 | C | 10WXXX-12 | R B

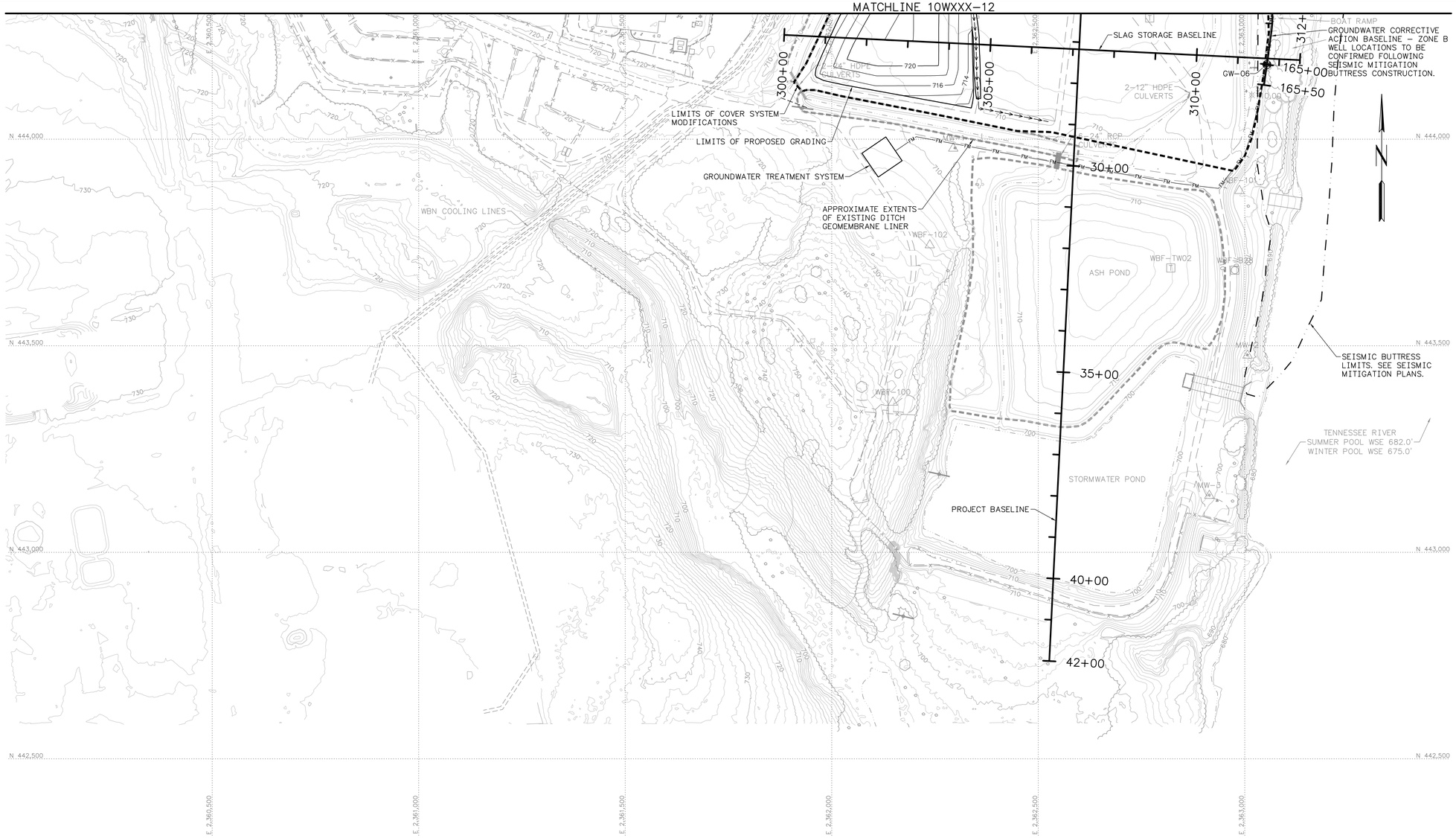
STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

PLOT DATE: 09/16/2025 USER: SHELTON, KEN
\\USG2A2-PPFS03\WORKGROUP\TPM\ACT1&4\17566550\TECH\CAL_PRODUCTION\DRAWINGS\SHEET_FILES\WBF05\REVO\REV0_P30\SHEET_FILES\13-15_WBF05_P30.DWG

MATCHLINE 10WXXX-12



SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

METADATA:

HORIZONTAL PROJECTION: PLANT LOCAL GROUND
PLANT LOCAL GROUND COORDINATES ARE BASED ON THE TENNESSEE NAD 27 STATE PLANE COORDINATE SYSTEM, BUT REPRESENT LOCATIONS ON THE GROUND. THEY ARE NOT EQUIVALENT TO GRID POSITIONS.
HORIZONTAL DATUM: LOCAL
VERTICAL DATUM: NGVD 29
H&V ACCURACY: GPS RTK
UNITS: US SURVEY FEET (SFT)

MAPPING SOURCE NOTE:

TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON NOVEMBER 10, 2014 AND SEPTEMBER 12, 2018 BY TUCK MAPPING SOLUTIONS, INC.

LEGEND

- x 1313 SPOT ELEVATION
- CONTROL POINT
- LIGHT POLE
- UTILITY POLE
- POLE
- POWER POLE
- SIGN
- POST
- TREE
- BOLLARD
- BUILDING
- UNPAVED ROAD
- PAVED ROAD
- RIPRAP
- PIEZOMETER
- ABANDONED PIEZOMETER
- SLOPE INCLINOMETER
- ST STORM PIPE
- UGE UNDERGROUND ELECTRIC LINE
- UGP UNDERGROUND PIPE
- TREE LINE
- EDGE OF WATER OR DITCH FLOW LINE
- X FENCE LINE
- 380 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 380 PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- MONITORING WELL
- T TEMPORARY WELL
- PIEZOMETER
- BASELINE
- LIMITS OF CONSTRUCTION
- LIMITS OF POND LINER
- GROUNDWATER EXTRACTION WELL

CARA REV. 2 SUBMITTAL

30% SUBMITTAL ISSUED FOR REVIEW NOT FOR CONSTRUCTION

50 0 100 200 FEET
GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 2 FEET

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

DRAFT

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D

ISSUED FOR REVIEW

SCALE: 1"=100' EXCEPT AS NOTED

YARD
–

CARA PLAN
GROUNDWATER EXTRACTION
VERTICAL WELLS

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

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TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

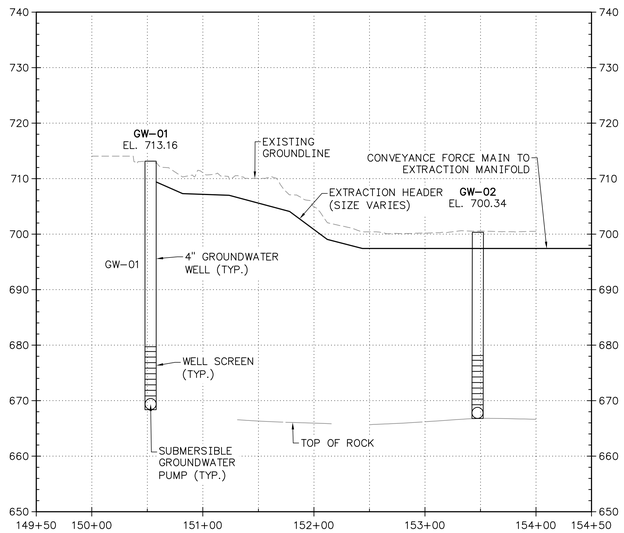
AUTOCAD R | DATE | 14 | C | 10WXXX-13 | R B

STANTEC | B
TASK COMPLETED BY: | REV NO.

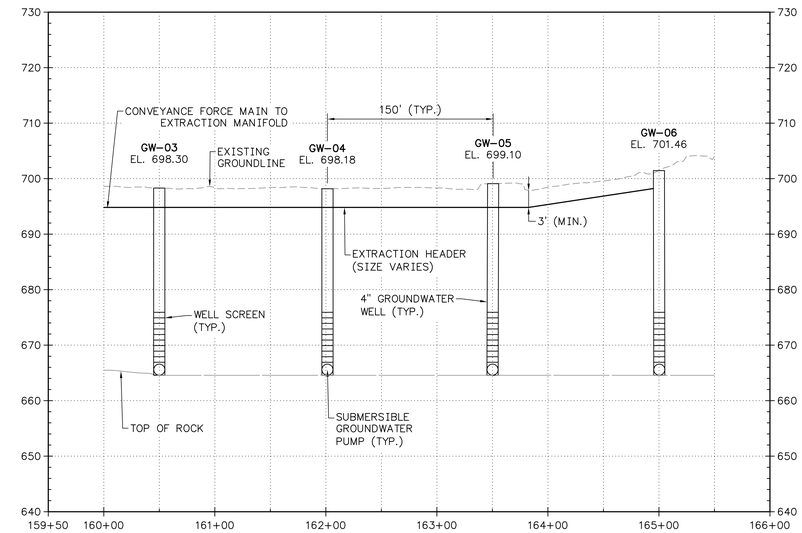
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 09/06/2018 USER: SHELTON, BEN
\\USS2A2-PPFSS01\WORKGROUP\TTSR\VOTTER\170660500\TECHNICAL_PRODUCTION\DRAWINGS\SHEET_FILES\WBFGS\REVIEW\REVB_P30\SHEET_FILES\12-13_WBFGS_100_1941.DWG



1 / 10WXXX-14 PROFILE – GROUNDWATER EXTRACTION – ZONE A
SCALE: 1"=50' (HORIZONTAL)
1"=10' (VERTICAL)



2 / 10WXXX-14 PROFILE – GROUNDWATER EXTRACTION – ZONE B
SCALE: 1"=50' (HORIZONTAL)
1"=10' (VERTICAL)

GROUNDWATER EXTRACTION TABLE

WELL	NORTHING	EASTING	GROUND ELEV. (FT.)	TIP ELEV. (FT.)
GW-01	445,834.75	2,362,712.11	713.16	668.38
GW-02	445,822.20	2,362,930.03	700.34	666.79
GW-03	444,629.82	2,363,060.70	698.30	653.89
GW-04	444,478.38	2,363,063.52	698.18	653.77
GW-05	444,329.20	2,363,066.31	699.10	654.69
GW-06	444,180.75	2,363,053.67	701.46	657.05

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SECTION OR DETAIL NO.
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R –	–	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	TJ	–	–	N/A	N/A	TVA	–	–	D	

ISSUED FOR REVIEW

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
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CARA PLAN
PROFILES – ZONE A & ZONE B
VERTICAL GW EXTRACTION WELLS

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R | DATE | 14 | C | 10WXXX–14 | R B

STANTEC | B
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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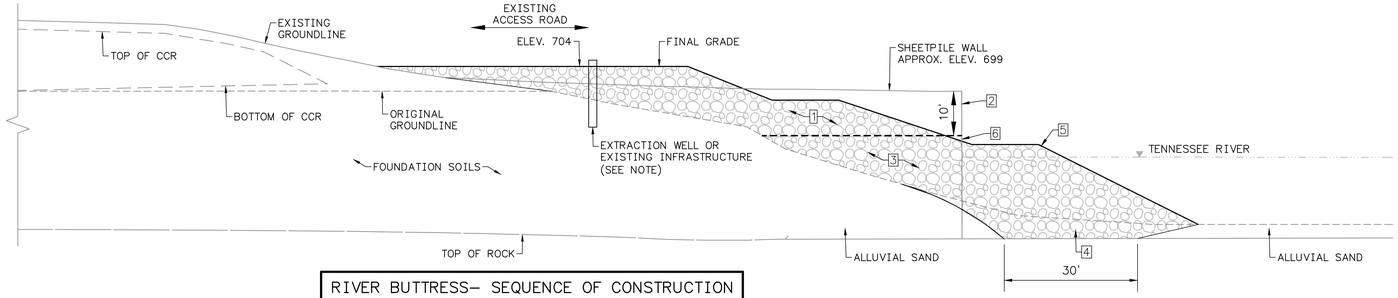
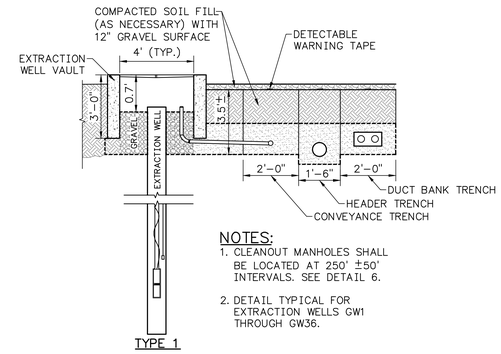


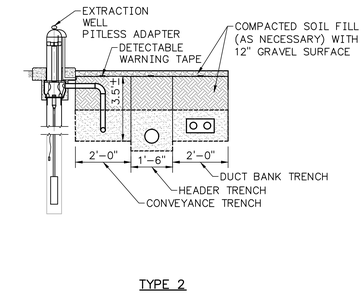
RIVER BUTTRESS– SEQUENCE OF CONSTRUCTION	
1	REMOVE ~10' OF SHEETPILE WALL BACKFILL
2	REMOVE ~10' OF SHEETPILE WALL
3	REMOVE REMAINING SHEETPILE WALL BACKFILL DOWN TO FOUNDATION SOILS
4	DREDGE UNSUITABLE SUBGRADE MATERIAL WITHIN RIVERBANK OR PUSH RIPRAP INTO SUBGRADE MATERIAL
5	PLACE RIPRAP TO FINAL GRADE
6	REMOVE ANY REMAINING SHEETPILE WALL ABOVE BUTTRESS

NOTE:
AN EXTRACTION WELL IS SHOWN FOR REFERENCE BUT EXISTING PIEZOMETERS AND COMPLIANCE WELLS ARE LOCATED ALONG THE APPROXIMATE ROAD CORRIDOR. BUTTRESS AND WELL/PIEZOMETER PAD FINAL ELEVATIONS TO BE ADJUSTED FOR CONTINUITY IN DETAIL DESIGN.

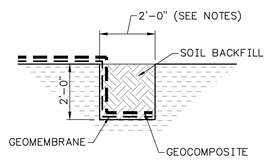
1 / 10WXXX-15 DETAIL – SEISMIC BUTTRESS
NOT TO SCALE



NOTES:
1. CLEANOUT MANHOLES SHALL BE LOCATED AT 250' ±50' INTERVALS. SEE DETAIL 6.
2. DETAIL TYPICAL FOR EXTRACTION WELLS GW1 THROUGH GW36.

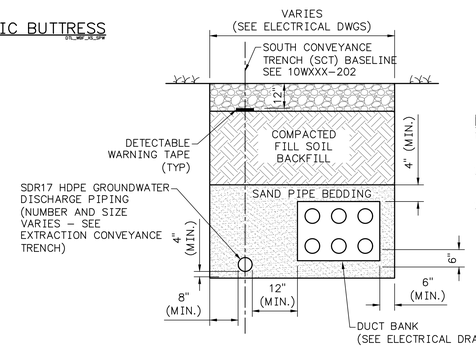


2 / 10WXXX-15 DETAIL – EXTRACTION WELL SECTION
NOT TO SCALE



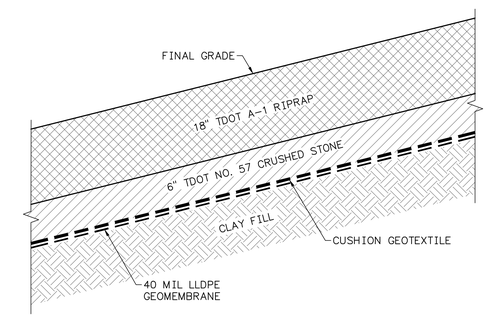
NOTES:
1. SOIL BACKFILL IN ANCHOR TRENCHES SHALL HAVE NO ROCK EXCEEDING 1 INCH MAXIMUM DIMENSION.
2. SOIL BACKFILL SHALL BE COMPACTED USING MANUALLY OPERATED TAMPERS.

3 / 10WXXX-15 DETAIL – ANCHOR TRENCH
NOT TO SCALE

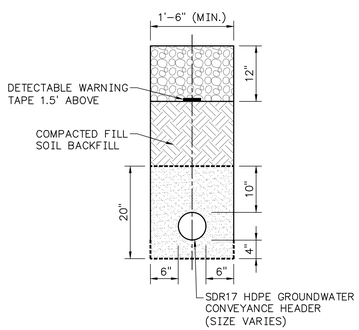


NOTES:
1. THE MINIMUM HDPE CONVEYANCE PIPING COVER SHALL BE 3 FEET.
2. THE MINIMUM DUCT BANK COVER SHALL BE 2 FEET.
3. AT CROSSINGS, HDPE CONVEYANCE PIPING SHALL BE INSTALLED ABOVE THE ELECTRICAL DUCT BANK.

4 / 10WXXX-15 DETAIL – UTILITY/FORCE MAIN TRENCH
NOT TO SCALE



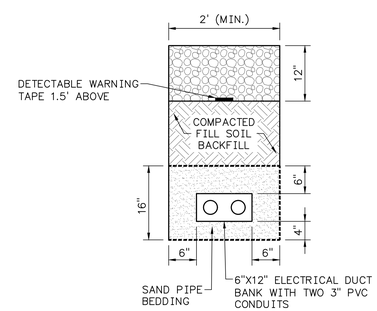
5 / 10WXXX-15 DETAIL – POND LINER
NOT TO SCALE



NOTE:
THE MINIMUM HDPE CONVEYANCE PIPING COVER SHALL BE 3 FEET.

DRAFT

6 / 10WXXX-15 DETAIL – HEADER TRENCH
NOT TO SCALE



NOTES:
1. THE MINIMUM DUCT BANK COVER SHALL BE 2 FEET.
2. AT CROSSINGS, HDPE CONVEYANCE PIPING SHALL BE INSTALLED ABOVE THE ELECTRICAL DUCT BANK.
3. DUCT BANK SHALL BE BURIED DEEPER AT LOCATIONS WHERE CROSSING HDPE CONVEYANCE PIPING.

7 / 10WXXX-15 DETAIL – DUCT BANK TRENCH
NOT TO SCALE

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

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R –	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	ACC	–	–	N/A	N/A	TVA	–	–	D

ISSUED FOR REVIEW

DISCIPLINE INTERFACE: 1, 2, 3, 4

SCALE: AS SHOWN — EXCEPT AS NOTED

YARD
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CARA PLAN
DETAILS

DESIGNED BY: | DRAWN BY: | CHECKED BY: | SUPERVISED BY: | REVIEWED BY: | APPROVED BY: | ISSUED BY:

WATTS BAR STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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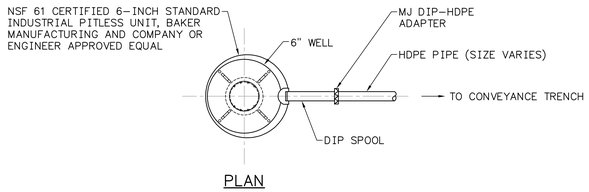
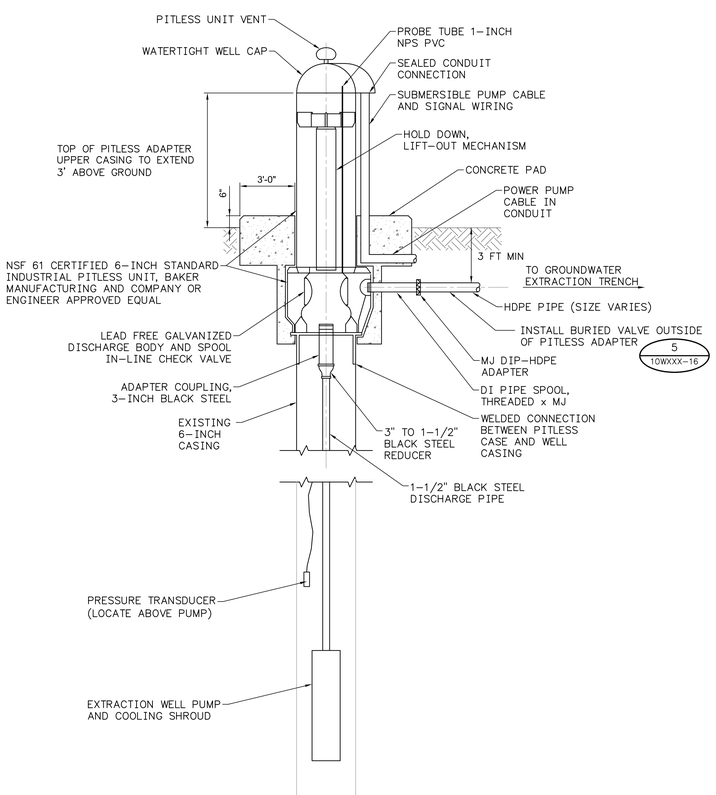


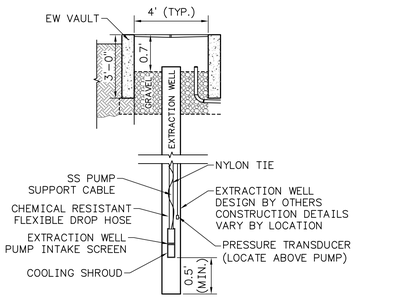
PLAN

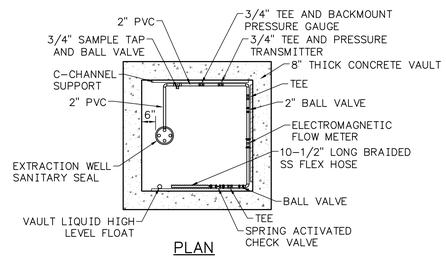


PROFILE

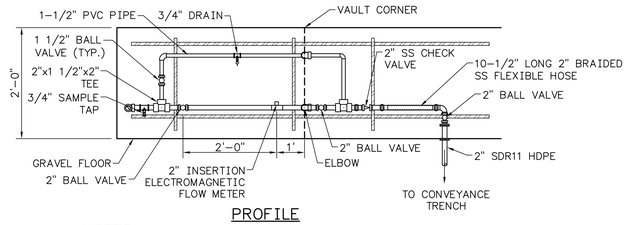
NOTE:
PUMP AND PRESSURE TRANSDUCER MOUNTING ELEVATIONS TO BE PROVIDED BY OWNER.

1 10WXXX-16 DETAIL – GROUNDWATER EXTRACTION WELL (PITLESS ADAPTER)
NOT TO SCALE
DTL_PITLESS_PUMP





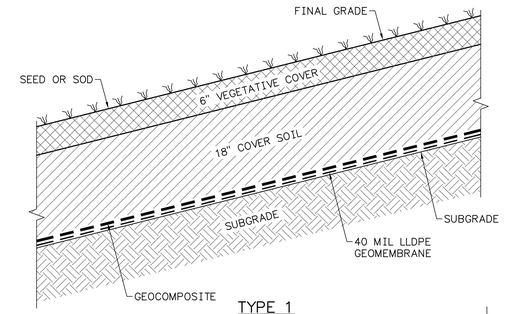
PLAN



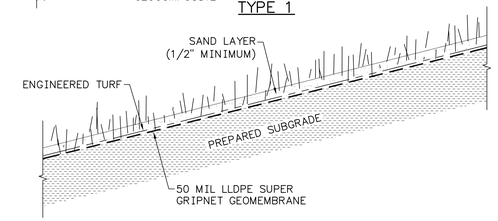
PROFILE

NOTES:
1. DIMENSIONS SHOWN ARE EXAMPLE FOR A 2-INCH FORCE MAIN. PIPE AND APPURTENANCE DIAMETER SUBJECT TO CHANGE BASED ON FLOWS FROM EACH WELL.
2. ALL PVC PIPE & FITTINGS ARE SCHEDULE 80 UNLESS NOTED.
3. ALL BALL VALVES ARE TRUE UNION.
4. ALL IN-VAULT PIPE AND WETTED EQUIPMENT ARE INSULATED AND HEAT-TRACED.
5. VAULT MAY BE UTILIZED FOR GROUNDWATER WELLS IN LIEU OF PITLESS ADAPTERS.

2 10WXXX-16 DETAIL – EXTRACTION WELL VAULT
NOT TO SCALE
DTL_EW_VAULT



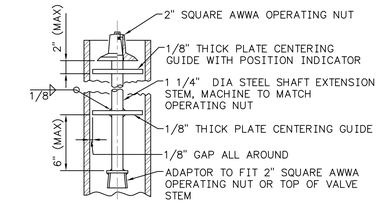
TYPE 1



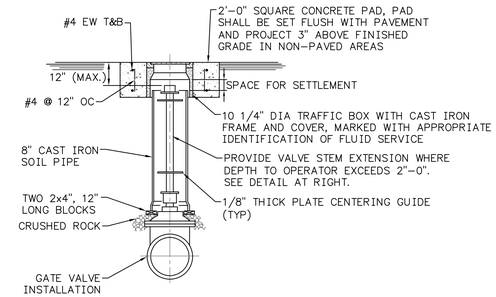
TYPE 2

NOTE:
NO EQUIPMENT SHALL BE OPERATED OVERTOP THE GEOMEMBRANE LAYERS WHEN THERE IS LESS THAN 12-INCHES OF MATERIAL COVER. AT LEAST 12-INCHES OF SOIL OR CRUSHED STONE SHALL BE IN PLACE WHEN LOW GROUND PRESSURE (LGP) EQUIPMENT (6 PSI OR LESS) IS OPERATED DIRECTLY OVERTOP AREAS WITH GEOMEMBRANE DIRECTLY UNDERNEATH. EQUIPMENT IN EXCESS OF 6 PSI CANNOT BE OPERATED OVERTOP THE GEOMEMBRANE WITHOUT AT LEAST 3 FEET OF COVER.

3 10WXXX-16 DETAIL – COVER SYSTEM
NOT TO SCALE
DTL_COVER_SYSTEM

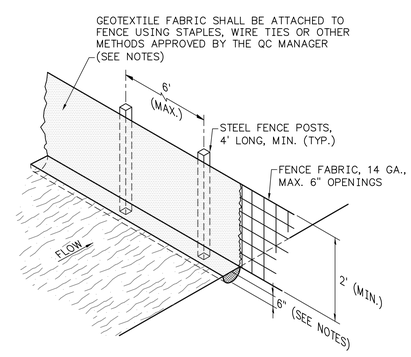


VALVE STEM EXTENSION DETAIL



NOTE:
FOR LUBRICATED PLUG VALVES, EXTEND LUBRICATION LINE TO GRADE PER MANUFACTURER'S INSTRUCTIONS.

5 10WXXX-16 DETAIL – BURIED VALVE INSTALLATION
NOT TO SCALE
DTL_BURIED_VALVE



NOTES:
1. THE BOTTOM 12 INCHES OF THE FABRIC SHALL BE BURIED IN A 6-INCH TRENCH CUT INTO THE GROUND OR COVERED BY 6 INCHES OF FILL MATERIAL TO PREVENT SEDIMENT FROM ESCAPING UNDER THE FENCE. ALL EARTHWORK SHALL BE ON THE UPSTREAM SIDE OF THE FENCE.
2. GEOTEXTILE FABRIC SHALL MEET THE FOLLOWING SPECIFICATIONS: GRAB STRENGTH (ASTM D 4632) – 100 LBS. MIN., WIDTH – 3' MIN., APPARENT OPENING SIZE (ASTM D4751) NO. 30. ULTRAVIOLET DEGRADATION (ASTM D 4355) 80% STRENGTH RETAINED. ELONGATION AT 45LB (ASTM D 4632).

4 10WXXX-16 DETAIL – SILT FENCE
NOT TO SCALE
DTL_SILT_FENCE

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

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R –	–	–	–	–	–	–	–	–	–	–	–
R B	–	–	ACC	–	–	N/A	N/A	TVA	–	–	D

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DISCIPLINE INTERFACE

SCALE: AS SHOWN EXCEPT AS NOTED

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CARA PLAN
DETAILS

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

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PLOT FACTOR:1
W_TVA

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STANTEC | B
TASK COMPLETED BY: | REV NO.

DRAFT

PLOT DATE: 09/15/2025 USER: GLNAGNEWS.ADAM
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APPENDIX F.2

CLOSURE AND POST-CLOSURE PLANS

Appendix F.2 – DRAFT Supplemental Closure/Post-Closure Plan Ash Pond

TDEC Commissioner's Order
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, TN 37402

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal to TDEC	December 5, 2025

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LIST OF EXHIBITS

Exhibit 1 WBF Plant Overview

ATTACHMENT

Attachment 1 – Ash Pond Closure Plan

Abbreviations

CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
DWR	Division of Water Resources
NPDES	National Pollutant Discharge Elimination System
WBF Plant	Watts Bar Fossil Plant
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order No. OGC15-0177
TVA	Tennessee Valley Authority

1.0 INTRODUCTION

This document provides the Supplemental Closure/Post-Closure Plan that will be used to perform closure and post-closure care activities in fulfillment of the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order, TDEC 2015) and TDEC Division of Water Resources regulations. The TDEC Order applies to specifically identified coal combustion residual (CCR) units located at seven current or former fossil power generation plants. The scope of this document pertains to closure and post-closure care activities for the Ash Pond located at the Tennessee Valley Authority (TVA) Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

1.1 SITE LOCATION AND BACKGROUND

The WBF Plant is located on the west bank of the Tennessee River (also referred to as Chickamauga Lake or Chickamauga Reservoir) approximately one mile downstream of TVA Watts Bar Dam in Rhea County Tennessee (Exhibit 1). TVA constructed the WBF Plant between 1940 and 1945, commencing power generation in 1942. It is located entirely on TVA-owned property.

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

1.2 REGULATORY FRAMEWORK

1.2.1 Division of Water Resources

The Division of Water Resources (DWR) issued National Pollutant Discharge Elimination System (NPDES) Permit No. TN0005461 to TVA for permitted wastewater discharges to the Chickamauga Reservoir.

The Ash Pond was closed in 2015 under TDEC Permit TN0005461. TVA developed and implemented a closure plan for the Ash Pond (Attachment 1). Post-closure care activities include vegetative cover monitoring and maintenance, maintaining the final contours, drainage systems maintenance, and post-closure inspections.

1.2.2 TDEC Order

The TDEC Order was issued under the authority of the Tennessee Solid Waste Disposal Act to establish a process for investigating, assessing, and remediating unacceptable risks from management of CCR material at TVA coal-fired plants in the state of Tennessee. TDEC Order requirements for unit closure and

remediation of unacceptable risks were applied to the two TDEC Order CCR units at the WBF Plant in the Corrective Action/Risk Assessment (CARA) Plan. The CARA Plan also specifies the basis and actions TVA plans to take related to closure and groundwater corrective action for TDEC Order CCR units at the WBF Plant. This Supplemental Closure/Post-Closure Plan applies to the Ash Pond.

1.2.3 New Regulations

TVA will continue to comply with new regulations promulgated in the future (both State and Federal) governing CCR management in the state of Tennessee. Updates to this Supplemental Closure/Post-Closure Plan will be made as necessary based on new regulatory requirements.

1.3 PLANNED ADDITIONAL CLOSURE ACTIONS

As described above, the Ash Pond was closed in 2015 by excavating CCR material from the southern area of the Ash Pond and consolidating and capping the CCR material in the northern area of the Ash Pond using a geosynthetic and soil cover system (CDM Smith 2015). The southern portion of the former Ash Pond was converted into a permitted stormwater pond (Tennessee Storm Water Multi-Sector General Permit Tracking No. TNR058427) for the site.

The planned additional closure actions at the Ash Pond include constructing a toe berm buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure, such that the CCR unit will meet or exceed slope stability criteria for post-earthquake, global stability. The buttress will begin at the riverbank southeast of the existing cover system, integrate with the buttress at the Ash Pond, and extend north along the riverbank to the north end of the Slag Disposal Area. Targeted excavation of alluvial material within the river channel (along the toe of the riverbank) may be required to allow the riprap to be placed directly on the weathered bedrock. The riprap toe will act as a buttress across the liquefiable sand zone. After removing existing vegetation, the riprap will extend up the slope above the normal reservoir elevation and will include one or more flat benches, as needed to improve stability.

Based on the current performance of the existing cover system and predicted future long-term conditions, TVA is not planning modifications to the cover system or drainage at the Ash Pond. TVA is evaluating the need to retain or modify the stormwater pond for future plant operations and water management.

Design drawings for the planned additional closure actions are provided in the CARA Plan. The CARA Plan provides the basis for closing the Ash Pond by leaving the CCR material in place with the planned additional closure actions. The planned additional closure activities to be conducted at the Ash Pond described above will be initiated following TDEC approval of the CARA Plan.

1.4 PURPOSE AND OBJECTIVES

This Supplemental Closure/Post-Closure Plan documents the closure and post-closure requirements for the planned additional closure activities at the Ash Pond. The previous closure plan document is provided as Attachment 1.

1.5 CLOSURE SCHEDULE

TVA will implement this supplemental closure and post-closure plan once the CARA Plan is approved. Implementation activities will commence with the detailed design of the planned actions with permitting (if needed) generally proceeding simultaneously. Once the detailed design phase is complete, procurement and then construction will proceed. Following construction completion, TVA will implement post-closure care activities and the planned actions for the CCR unit and conduct groundwater corrective action monitoring.

1.6 FACILITY CONTACT INFORMATION

The party listed below was involved with the permitting, design, operation, maintenance, quality control/quality assurance of the Ash Pond at the WBF Plant.

Owner: Tennessee Valley Authority (TVA)

Contact: Civil Projects & CCP Management, Strategy and Engineering
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402

2.0 CLOSURE PLAN

2.1 CLOSURE REQUIREMENTS

TVA has constructed a geosynthetic-soil cover and stormwater drainage systems at the closed Ash Pond in accordance with Sections 3 and 4 of the Ash Pond closure and post-closure plan (Attachment 1). These actions limit infiltration through the final cover system to lower the hydraulic head, in conjunction with the existing low permeability perimeter dikes and foundation soils.

TVA mitigates the need for further maintenance of the CCR unit through compliance with post- closure care activities, in addition to the final cover system that has been installed. Regularly scheduled inspections to evaluate post-closure conditions and to verify preventive maintenance activities of the unit reduce the need for additional maintenance. Post-closure care activities are addressed below.

The final cover system controls the infiltration of precipitation into the closed CCR unit. The final cover system also acts to cover, control, and prevent the release of CCR material from the closed CCR unit, into surface waters and the atmosphere. The grading plan and stormwater management system promote positive drainage and control infiltration into the CCR material. The final cover system is designed to prevent the exposure of CCR material to the atmosphere.

Sections 2.2 through 2.6 describe the additional closure activities that have been completed and are intended to minimize the need for further maintenance as well as control, minimize, or eliminate threats to public health and the environment post-closure.

Section 3.2 describes the ongoing measures during the post-closure care period established in Section 3.1. These measures are intended to ensure the performance objective of actions completed during closure are continuously met.

TVA will initiate and complete additional closure activities and conduct post-closure care activities in accordance with the approved Supplemental Closure/Post-Closure Plan.

The CARA Plan, as and when approved by TDEC, provides the notification to the TDEC Division Director of the intent to perform the additional closure actions.

The Commissioner's approval of the schedule in the CARA Plan provides approval of a time period to complete the planned additional closure actions.

2.2 FINAL COVER AND ALTERNATIVE FINAL COVER SYSTEMS

TVA has constructed a geosynthetic-soil cover and stormwater drainage systems at the closed Ash Pond in accordance with Sections 3 and 4 of the Ash Pond closure and post-closure plan (Attachment 1).

2.2.1 Geosynthetic Materials

TVA has constructed a geosynthetic-soil cover and stormwater drainage systems at the closed Ash Pond in accordance with Sections 3 and 4 of the Ash Pond closure and post-closure plan (Attachment 1).

2.2.2 Cover Soils

TVA has constructed a geosynthetic-soil cover and stormwater drainage systems at the closed Ash Pond in accordance with Sections 3 and 4 of the Ash Pond closure and post-closure plan (Attachment 1).

2.3 DRAINAGE SYSTEM

TVA has constructed a geosynthetic-soil cover and stormwater drainage systems at the closed Ash Pond in accordance with Sections 3 and 4 of the Ash Pond closure and post-closure plan (Attachment 1).

2.4 VEGETATIVE COVER

TVA has constructed a geosynthetic-soil cover and stormwater drainage systems at the closed Ash Pond in accordance with Sections 3 and 4 of the Ash Pond closure and post-closure plan (Attachment 1).

2.5 OTHER EROSION AND SEDIMENT CONTROL MEASURES

Other erosion and sediment control measures were implemented to minimize and control erosion and sedimentation at the site in accordance with Section 4.6 of the Ash Pond closure and post-closure plan (Attachment 1).

2.6 CLOSURE CERTIFICATION AND NOTIFICATION

Notification with certification of completion of closure will be conducted in accordance with the Ash Pond closure and post-closure plan (Attachment 1) and the CARA Plan.

3.0 POST-CLOSURE PLAN

3.1 POST-CLOSURE CARE PERIOD

Post-closure activities will be conducted in accordance with the Ash Pond closure and post-closure plan (Attachment 1) and the CARA Plan.

3.2 POST-CLOSURE CARE ACTIVITIES

3.2.1 Final Contours, Drainage System, and Vegetative Cover

TVA will maintain the integrity and effectiveness of the final cover system and establish and maintain the vegetative cover as described in Section 6.2 of the Ash Pond closure and post-closure plan (Attachment 1).

Maintaining drainage facilities, sediment ponds, and other erosion/sedimentation control measures will be conducted in accordance with Section 6.2 of the Ash Pond closure and post-closure plan (Attachment 1).

3.2.2 Groundwater Monitoring Plan

Routine groundwater sampling and analysis are currently being conducted for the Ash Pond. Groundwater monitoring will continue during closure and post-closure activities in accordance with Appendix E – Groundwater Monitoring Plan of the CARA Plan.

3.2.3 Inspections

TVA will continue to implement post-closure inspection and maintenance activities in accordance with Section 6.2 of the Ash Pond closure and post-closure plan (Attachment 1).

3.2.4 Post-Closure Certification

Following the completion of the post-closure care period, TVA will submit a certification verifying that post-closure has been completed in accordance with Section 6 of the Ash Pond closure and post closure plan (Attachment 1) and the CARA Plan.

3.3 POST-CLOSURE USE

TVA currently has no plans for future use of the remaining property during the post-closure care period.

3.4 AMENDMENT OF PLAN

Any amendments to this Supplemental Closure/Post-Closure Plan initiated by TVA will include evidence demonstrating that the requirements for approved modifications are met.

4.0 REFERENCES

CDM Smith. (2015). Ash Pond Closure Project - Construction Record Documentation Report. Prepared for Tennessee Valley Authority. March 19, 2015.

Tennessee Department of Environment and Conservation. (2015). *Commissioner's Order No. OGC15-177*. August 6, 2015.

EXHIBITS

Exhibit No.

1

Title

WBF Plant Overview

DRAFT

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2025-09-24
Technical Review by BL on 2025-09-24

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

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

CCR: Coal combustion residuals

Notes

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

Stantec TVA

U:\TVA\EIP\175668050_WBF_WorkPlans\gis\mxd\CARA\ClosurePlan\WBF_ClosurePlan.aprx 1_WBF_Plant_Overview Revised: 2025-09-24 By: mbough

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

ATTACHMENT 1

Ash Pond Closure Plan

DRAFT

Tennessee Valley Authority, 1101 Market Street, BR4A, Chattanooga, Tennessee 37402

November 7, 2013

Mr. Vojin Janjić, Manager
Permit Section
Division of Water Resources
Tennessee Department of Environment
and Conservation
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243

Dear Mr. Janjić:

TENNESSEE VALLEY AUTHORITY (TVA) – WATTS BAR FOSSIL FACILITY (WBF) – NPDES PERMIT NO. TN0005461 – ASH POND CLOSURE PLAN

In accordance with Part III.B of the subject permit, TVA is submitting the enclosed Ash Pond Closure Plan for WBF for your review and approval. The closure plan provides the design for closure of the inactive ash pond, including final grading and capping. Once TVA has received approval for the proposed plan, quarterly updates on progress toward closure will be submitted with the Discharge Monitoring Reports for March, June, September, and December.

If you have questions or need additional information, please contact Travis Markum at (423) 751-2795 in Chattanooga, or by email at trmarkum@tva.gov.

Sincerely,

Terry E. Cheek

Terry E. Cheek, Senior Manager
Water Permits & Compliance

Enclosure

cc: Mr. Glen Pugh, Manager
Division of Solid Waste Management
Department of Environment
and Conservation
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1535

Ms. Jennifer Innes, Manager
Chattanooga Environmental Field Office
Tennessee Department of Environment
and Conservation
State Office Building, Suite 550
540 McCallie Avenue
Chattanooga, Tennessee 37402

DRAFT

TRM:LMB
Enclosure

cc: Mr. Glen Pugh, Manager
Division of Solid Waste Management
Department of Environment
and Conservation
William R. Snodgrass Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1535

Ms. Jennifer Innes, Manager
Chattanooga Environmental Field Office
Tennessee Department of Environment
and Conservation
State Office Building, Suite 550
540 McCallie Avenue
Chattanooga, Tennessee 37402

cc (Enclosure, electronic distribution):
T. E. Cheek, BR 4A-C
V. J. Dotson, Jr, LP 5E-C
A. B. Fisher, BR 4A-C
M. M. Garland, B4 4A-C
M. L. Hayward, LP 5D-C
J. E. Holztrager, WT 3C-K
R. L. Hooper, BR 4A-C
W. C., Markham, Jr, BR 4A-C
T. R. Markum, LP 5D-C
M. W. Moore, PSC 1F-C
M. A. McBryar, CAB 1A-GVA
J. D. Mullins, LP 5G-C
B. G. Roddy, LP 5D-C
B. L. Williams, PSC 1B-C
L. M. Bailey (EDMS), BR 4A-C, Document Type: NPDES Correspondence

DRAFT

TVA Watts Bar Fossil Plant – Spring City, Tennessee

Ash Pond Closure Plan

Tennessee Valley Authority
1101 Market St.
Chattanooga, TN 37402-2801

October 8, 2013

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Section 1
Introduction

As required by National Pollutant Discharge Elimination System (NPDES) permit TN0005461, Tennessee Valley Authority (TVA) is submitting this Ash Pond Closure Plan (herein, "Closure Plan") for the Watts Bar Fossil Plant (WBF) Ash Area, located in Spring City, TN along the Tennessee River. The Closure Plan is being submitted to the Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources (DWR) with additional copies provided for review. This plan provides the conceptual design for ash area closure at the WBF facility in addition to the planned monitoring and maintenance activities for the facility during the post-closure period. The 90% design plan drawings will be submitted to TDEC upon completion in November.

1.1 Background

WBF is located in Spring City, TN and was originally constructed between 1940 and 1945. The site consisted of a main powerhouse building, a coal stockpile and various processing ponds, including ash processing and an ash stilling pond.

In 1982, WBF ceased power production operations and TVA terminated the air permits for the plant in 1997. In 2007, a closure plan was submitted to TDEC and a dome-shaped soil cap was constructed for the Slag Processing Area and Chemical Pond Area. The construction was completed in 2009 under Permit TNR190741. However, the vegetation covers did not adequately establish on the closure areas and the Borrow Area was not stabilized.

In 2012, TVA deconstructed the main powerhouse and the disturbed footprint was backfilled, covered and seeded. During the same year, TVA also initiated the evaluation of the containment dike for the ash pond, as per the recommendations of the Coal Combustion Residue Impoundment Round 11 - Dam Assessment Report for the WBF facility (Revised April 2013 - http://www.epa.gov/wastes/nonhaz/industrial/special/fossil/surveys2/tva_wattsbar_final.pdf).

The first step in the process was to lower the elevation of the containment dike for the pond in order to reduce the total amount of available storage at the site. It should be noted that there were no stability issues with the existing dike. This project to reduce the storage capacity provided by the dike and construction of a new spillway for the pond is currently underway and scheduled for completion in the spring of 2014. The next step will be closure of the Ash/Stilling Pond Area, which includes removal of the ash from the pond and complete closure of the ash area.

This closure plan will specifically address the proposed closure of the Ash/Stilling Pond Area. Closure of the remaining areas of the site will be completed separately.

1.2 Existing Conditions

The Ash Pond Area consists of the "wet" Ash Pond and the dry ash storage area. Refer to Sheet 1 in Appendix A for a site overview of the area.

The following subsections contain a description of the existing pond, along with ongoing and planned improvements.

1.2.1 Ash/Stilling Pond

The Ash/Stilling Pond Area covers approximately 14.3 acres. The upland drainage area to the pond is approximately 180 acres. The area was previously used as an ash pond but now serves as a storm water discharge area. The area was constructed in 1974 by adding a series of culverts (six 24-inch diameter RCP drainage pipes) under the road between the Slag Processing Area and Ash/Stilling Pond and a perimeter dike built with earth fill. In 1977, a splitter dike was constructed within the pond. Due to the deposition of ash over time, two separate sub-areas have formed; a "wet" ash area and a dry ash area. The "wet" ash area contains approximately 85,000 cubic yards (CY) of ash. The dry ash area is located between the existing roadway and the wet ash area and also contains an estimated 85,000 CY of material. The dry ash area has formed over time as the coarser particles settled in an area directly downstream of the discharge culvert. Three riser-barrel (morning glory) outlet structures are located in the southeastern corner of the Ash/Stilling Pond Area that discharges through NPDES Permitted Outfall 002. The existing riser barrels are constructed out of corrugated metal.

1.2.2 Stability Analysis

In April of 2012, a stability analysis of the ash pond area was performed (refer to Appendix E). The analysis considered seepage, static slope stability, and seismic slope stability. As documented in the report, the slope stability analyses indicated acceptable factors of safety under static and seismic loading conditions for all sections.

1.2.3 On-Going Site Improvements

Currently, TVA is constructing improvements to the wet pond area. A new concrete box spillway is being constructed to replace the existing, deteriorated riser-barrel spillway system. In addition, the containment dike is being lowered to reduce the total storage capacity of the pond. Once the new spillway system is complete, the existing spillway barrels will be grouted and abandoned in place. The existing riser pipes will be removed. A portion of the existing pond will remain in place as a stormwater control device for the entire site and upstream drainage area (180 acres). Also, drainage around the existing dry ash area will be diverted to a new stormwater channel to convey water properly through the site to the new stormwater pond. This will all be completed before construction of the Ash Pond Closure project addressed in this plan.

1.3 Regulatory Framework for Closure

NPDES Permit TN0005461 Part III (B) requires an ash pond closure plan be submitted for TDEC approval. The purpose of the Closure Plan is to propose closure actions which will be implemented after approval from TDEC.

1.4 Facility Contact Information

The following is the contact for activities at TVA's Watts Bar Fossil Plant.

Owner:	Tennessee Valley Authority (TVA)
Contact:	Sr. Manager of Water and Waste Compliance

Section 2

Closure Sequence and Schedule

There are various phases proposed for the Ash Pond Closure project. Phase 1 is the conceptual design; Phase 2 is the detailed design; and Phase 3 is the implementation phase of the project, where construction occurs. TVA has completed the conceptual design phase and is currently working through the detailed design phase. The plans included in this document are near 90% at the time of this submittal. The 90% design plans will be completed by November 2013. TVA will submit the 90% plans to TDEC upon completion and will note any significant changes.

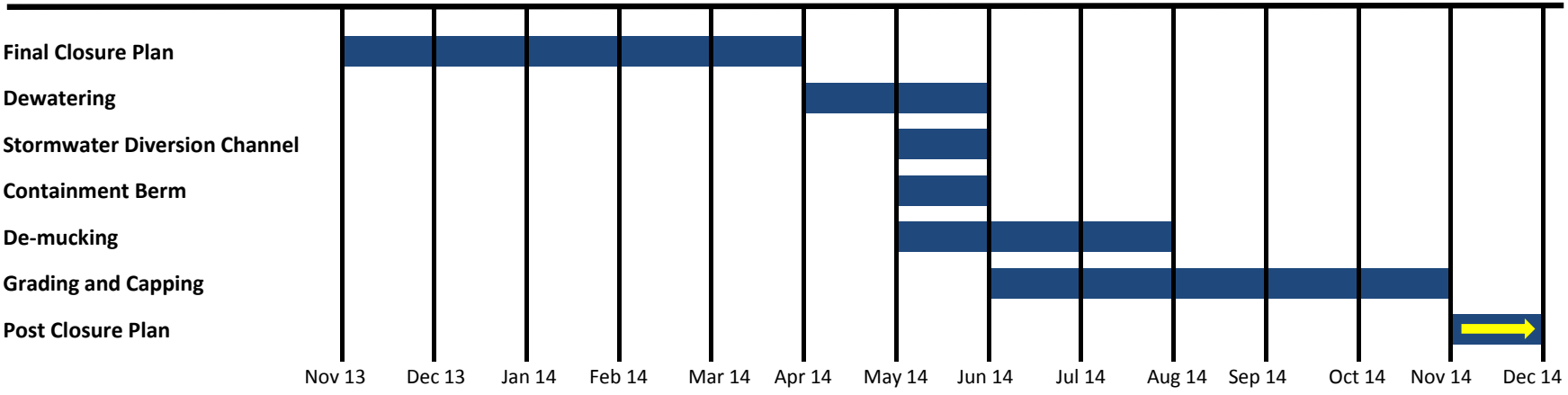
As noted, the site is currently under construction to lower the containment dike and to build a new spillway for the stormwater pond. As such, the Ash Pond has been dewatered. Upon completion of the current project and approval of this closure plan, the following sequence of activities is anticipated:

1. De-mucking and continued dewatering of the wet ash pond.
2. Stacking of the dewatered ash in the existing dry ash area.
3. Construction of a closure cap on the dry ash area.
4. Final conversion of the wet ash pond to a stormwater detention pond.

The figure on the following page provides a full schedule of the project milestones and duration.

DRAFT

Watts Bar Fossil - Ash Pond Closure Schedule



Watts Bar Fossil
Ash Pond Closure Plan
Revised: Oct 2013

Section 3
Site Considerations

Site considerations for closure are presented in this section.

3.1 Closure Strategy and Footprint

Water discharge from the work area during construction will be monitored at Outfall 002, in accordance with the NPDES permit. The recommended project approach is to establish a stormwater management system and cap for the Ash Area. Conceptual drawings of the closure area are provided in Appendix A. The closure is only for the Ash Area north of the Ash/Stilling Pond Area. Ash Area closure will occur in phases and the final cover system will be installed when the final grades are achieved.

The closure area for consideration in this Closure Plan consists of approximately 5.5 acres. The proposed closure plan provides a minimum 2% design grade on the closure cap to properly manage storm water, prevent ponding of water on the final cover and allow ease in mowing vegetation on the final cover. Side slopes of the closure cell will have a minimum slope of 4:1. A minimum 1% grade is provided along the length of the perimeter diversion dikes and ditches. Construction of a perimeter dike between the wet ash and dry ash areas will be required to enhance overall stability of the cap area. A permanent vegetative cover will be established. The design of all these features is detailed in the plans for construction.

3.2 Stormwater Management System

A stormwater management system will be established and installed as part of the closure. The existing stormwater conveyance channel around the dry ash area will be re-routed to the western edge of the dry ash area to enhance future settling time in the final stormwater pond. This ditch will be lined with the same material as the ash closure area to eliminate any contact between natural stormwater and subgrade material which may contain ash. Perimeter diversion dikes and ditches will be constructed at the base of the cap to direct runoff from the closure area to the stormwater pond or the re-routed conveyance channel as appropriate. The proposed stormwater management system is shown on the drawings in Appendix A.

All disturbed areas associated with the Ash Pond Closure project will be graded to allow positive drainage to the final stormwater pond. Additional erosion controls will be addressed with appropriate structural and non-structural sediment and erosion control practices as prescribed in the most recent edition of the Tennessee Erosion and Sediment Control Handbook. The existing Storm Water Pollution Prevention Plan (SWPPP) associated with Permit TNR190741 will be updated to incorporate address the potential impacts of this project.

Section 4
Engineering and Design

A summary of the engineering considerations and design is provided in this section.

4.1 Dewatering Activities

Dewatering of the wet ash storage pond and the dry ash area will be an essential component of the closure process. To facilitate the current spillway project and lowering of the containment dike, the water in the existing wet ash pond has been drained using a series of pumps. This operation was performed using a series of control measures to complete dewatering without exceeding allowable Total Suspended Solids (TSS) concentrations in accordance with the NPDES permit. Dewatering using this method will continue throughout the Ash Pond Closure phase.

In addition to dewatering of the pond, small drainage channels have been excavated within the dry ash area to facilitate additional dewatering of the dry ash materials. Drainage from the dry ash area is directed to the pond for additional settling before being discharged from the site.

4.2 De-Mucking and Stacking During Operations

The de-mucking process involves removal of the ash in the pond following the dewatering process described above. The wet ash material removed will be stacked for drying before the closure cell can be constructed. Removal of CCPs will be deemed complete by visual observation with materials predominately gray in color classified as CCPs. Materials predominately red or brown in color shall be classified native soils and may remain. No visible CCP equates to 10 percent or less of CCP material observed in a grid area. After CCPs are removed and native soils are observed it is anticipated that the Stilling Pond footprint will not require a cap.

Limited area is available for stacking during the de-mucking process. The current plan is to perform all de-mucking and stacking operations within the footprint of the dewatered pond and the existing dry ash area. Due to the limited footprint, there may be instances during the stacking process where ash may be stacked temporarily to an elevation above the existing containment dike for operational purposes and to enhance dewatering.

4.3 Dike Construction

The existing ash pond containment dike will remain in its present location. However, a 325-foot section of the containment dike will be lowered during the current project, as shown on Sheet 3 of Appendix A. The 325-foot section of the containment dike will be lowered approximately 10-feet to reduce the total storage capacity of the stormwater pond. This current project will satisfy conditions stated by EPA in its evaluation of this ash containment facility regarding long-term safety and stability.

4.4 Closure Cover System Design

A geosynthetic final cover system is being proposed to cap the Ash Area. Use of a geosynthetic cap will provide acceptable performance of the cover system while minimizing the quantity of soil cover to be imported.

The geosynthetic final cover is proposed to consist of the following materials and thicknesses, as listed in order of construction (bottom to top):

- 40-mil LLDPE geomembrane;
- Geocomposite drainage layer; and,
- 24-inches of cover soil, the top 6-inches for the support of vegetative cover.

The cap would be graded to provide positive drainage of surface water and seeded to establish a vegetative cover for erosion control. The conceptual final cover design is provided in the drawings in Appendix A. In general, closure activities, including grading, cover system installation, and establishing vegetative cover, will be completed in the shortest practicable time after fill areas within the closure footprint have achieved final grade.

As soon as practical after final grading, a protective vegetative cover of acceptable grasses will be established over disturbed areas of the site. This will include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding of steeper slopes and drainage ways, if necessary. Temporary erosion control blankets may be used, if necessary, to provide seedbed protection and prevent wash-out of seed and fertilizer during vegetation establishment.

The closure will be scheduled to facilitate at least one month in the growing season to establish a grass cover, or alternatively, the entire cover will be re-seeded at the start of the next growing season, after confirming that the grades of the cover and the condition of the cover soil are in accordance with the Closure Plan.

4.5 Grading and Surface Water Management

A conceptual grading plan for surface water management has been developed to allow drainage off the final cover. The maximum final grade of the cover will be designed to:

- Minimizes precipitation run-on from adjacent areas;
- Minimizes erosion (e.g., no steep slopes);
- Optimizes drainage of precipitation falling on closured area (e.g., prevent pooling); and
- Provides a surface drainage system which is consistent with the surrounding area and in no way significantly adversely affects proper drainage from these areas.

In general, cover slopes will be graded at a minimum of 2% which will drain towards perimeter diversion dikes and ditches sloped at a minimum of 1%. Stormwater runoff will be conveyed to the proposed stormwater pond and will discharge to Lake Chickamauga through NPDES Outfall 002, which will be re-located in conjunction with the new spillway.

4.6 Erosion and Sediment Control

As a result of previous on-going closure activities at the site, an existing SWPPP for the site is in place under Permit TNR190741. For this project, the SWPPP will be updated to include all new work activities as well as associated erosion and sediment controls. All controls will be designed in accordance with the TDEC Erosion and Sediment Control Manual.

As part of the Phase 2 construction-level design documents, a plan will be developed to manage Total Suspended Solids (TSS) at Outfall 002 during construction. Controls may include, but are not limited to, diversion of flows, the addition of coagulants, and the use of turbidity curtains.

4.7 Construction Quality Assurance

A Construction Quality Assurance Plan (CQA Plan) will be developed for the ash area closure. Construction inspections will be conducted to document the closure construction and Quality Assurance/Quality Control (QA/QC) testing. Sections of the CQA Plan will include:

- Purpose, Scope, and Project Description
- Limitations of the Plan
- Responsibility and Authority
- QA/QC Program Activities
- Specific Product Submittals and Material Testing Requirements
- Surveying Requirements
- Project Documentation

4.8 Groundwater Monitoring Network

A network of groundwater wells will be used to conduct groundwater monitoring in the vicinity of the Ash Area. The network will consist of one upgradient or background well and two hydraulically downgradient wells, in accordance with the requirements for landfills under the TDEC Division of Solid Waste Management (DSWM) regulations. The upgradient well will be used to establish baseline groundwater quality measurements. The parameters proposed for semi-annual monitoring are the inorganic parameters in Appendix I of the TDEC DSWM regulations. These parameters are routinely used to detect CCP impact to groundwater resulting from the closed area.

The WBF Groundwater Monitoring Plan in Appendix B summarizes the proposed monitoring network for the ash pond closure.

Section 5
Closure Requirements

The following sections summarize requirements for closure and on-going observations.

5.1 Closure Certification

Upon completion of approved closure construction activities, a closure report will be prepared by an independent professional engineer registered in the State of Tennessee to document the completed construction activities. The closure report will be submitted to TDEC for review.

5.2 Groundwater Monitoring Plan

Groundwater sampling will be conducted semi-annually during closure and post closure. After two years, an appropriate number of samples (8) will have been collected to support TVA's statistical analysis method. Prior to that, any exceedances of MCLs will be reported to TDEC.

The CCP boundary will be monitored by a well network of one up-gradient/background well and two down-gradient wells. The up-gradient well is located to be representative of background water quality unaffected by a CCP unit. Down-gradient wells shall be hydraulically down-gradient, and be constructed in such a manner as to detect CCP-related impacts. Wells will be screened in the soil overburden aquifer immediately underlying the site, as the primary receptor of potential migrating CCP-borne constituents in groundwater.

Recommended placement of monitoring wells was based on potentiometric contouring developed from water levels in existing wells, adjacent river level data, hydrogeologic information and/or database information. The proposed plan provided in Appendix B represents a monitoring system for WBF during closure and post-closure that meets the requirements for Class II landfills.

Groundwater will be analyzed for the 17 inorganic constituents identified in Appendix I of TDEC Rule 0400-11-01-.04. Organic compounds identified in Appendix I are not typically constituents of CCPs. Groundwater monitoring data will be reported to TDEC within 60 days after the last day of sampling.

The Ash Pond Closure Groundwater Monitoring Plan summarizes field procedures and groundwater sampling protocols, analysis, and record keeping requirements generally associated with TDEC Class II landfill groundwater monitoring requirements. The plan is included in Appendix B.

5.3 Quarterly Reporting

As required by Part III (B) of NPDES Permit TN0005461, quarterly updates on progress toward closure will be submitted with the Discharge Monitoring Reports for March, June, September, and December after the Closure Plan has been approved by the state. Quarterly reporting will address the estimated future date for complete closure and elimination of ash pond discharges as well as updated information on planning, design, and construction milestones for each upcoming quarter. The quarterly updates will address closure of the areas identified in this Closure Plan. An example reporting form is provided in Appendix C.

5.4 Financial Assurance

As an agency and instrumentality of the United States created by the TVA Act of 1933, 16 U.S.C. § 831-831dd (2006), TVA is not required to provide financial assurance.

Section 6

Post-Closure Plan

TVA will implement a post-closure plan that will involve inspection and monitoring activities. Regularly scheduled inspection shall be performed to verify that the closure plan procedures have been effectively implemented.

6.1 Post-Closure Care Period

The post-closure care period will continue for 30 years after date of final completion of closure of the ash pond and dry ash area unless a shorter period is approved by TDEC. Post closure can be reduced or extended beyond 30 years as groundwater monitoring data prove appropriate.

6.2 Post-Closure Care Activities

During the post-closure care period, the following activities may be performed:

A. Maintain the approved final contours and drainage systems of the site such that precipitation run-on is minimized, erosion of the cover/cap is minimized, precipitation on the fill is controlled and directed off the closure area, and unintended ponding is eliminated.

B. Ensure that a healthy vegetative cover is established and maintained on the site.

C. Maintain the drainage facilities and other erosion/sediment controls (if present) in a functional state until the vegetative cover is established sufficiently to render such maintenance unnecessary. Removal or cessation of maintenance must be approved by TDEC.

D. Maintain and monitor the ground water monitoring system in accordance with the Ground Water Monitoring Plan approved by TDEC. The monitoring system and sampling and analysis program approved as part of this Closure Plan shall be continued during the post-closure period, unless the Closure Plan is modified to establish a different system or program.

E. A post-closure completion report prepared by an independent registered professional engineer licensed in the State of Tennessee shall be submitted to TDEC for review and approval following the post-closure care period.

An inspection form for post-closure care and monitoring activities is included in Appendix D.

Appendix A

Ash Pond Closure Drawings

DRAFT

ISSUED FOR APPROVAL

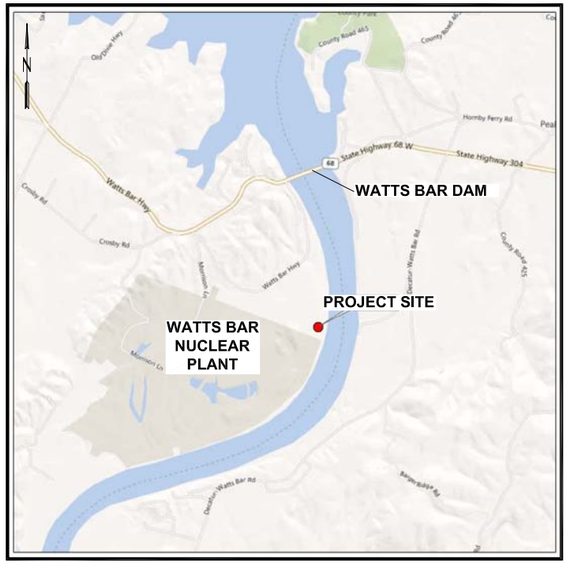
ASH POND CLOSURE PLAN
WATTS BAR FOSSIL PLANT

SPRING CITY, RHEA COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY

PREPARED BY



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CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

INDEX OF SHEETS

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SHEET 1	OVERALL SITE PLAN
SHEET 2	EXISTING CONDITIONS
SHEET 3	PROPOSED ASH POND CLOSURE PLAN
SHEET 4	FINAL COVER AND CLOSURE DETAILS

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ASH POND CLOSURE PLAN
CLOSURE PLAN
COVER SHEET

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K. YANG	M. KOSKI	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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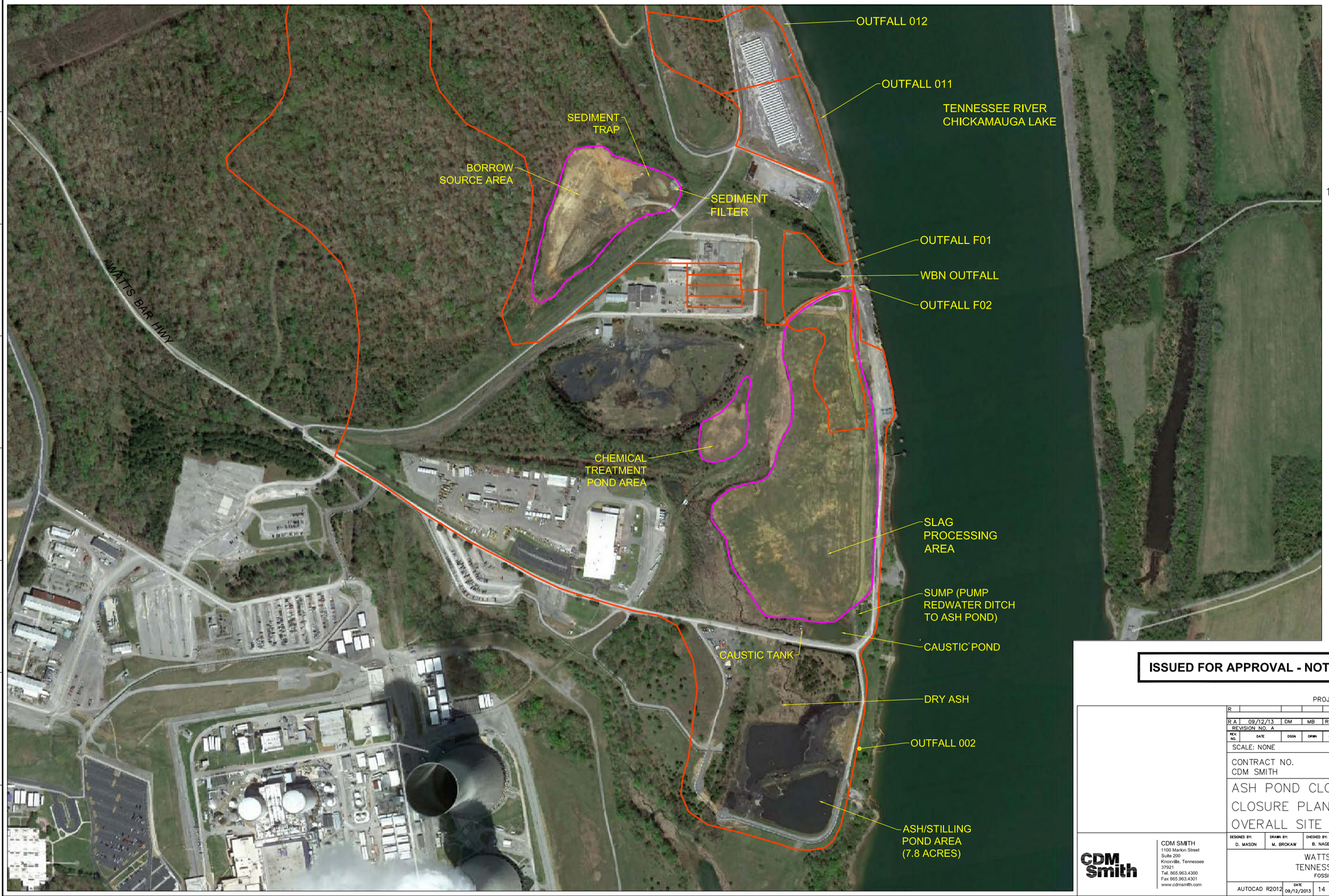

N

1" = 200'

100 0 200

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ASH POND CLOSURE PLAN
CLOSURE PLAN
OVERALL SITE PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D. MASON	M. BROKAW	B. NAGEL	D. MASON	J.MULLINS	M.TURNBOW	J.KAMMEYER

CDM Smith

CDM SMITH
1100 Marlon Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

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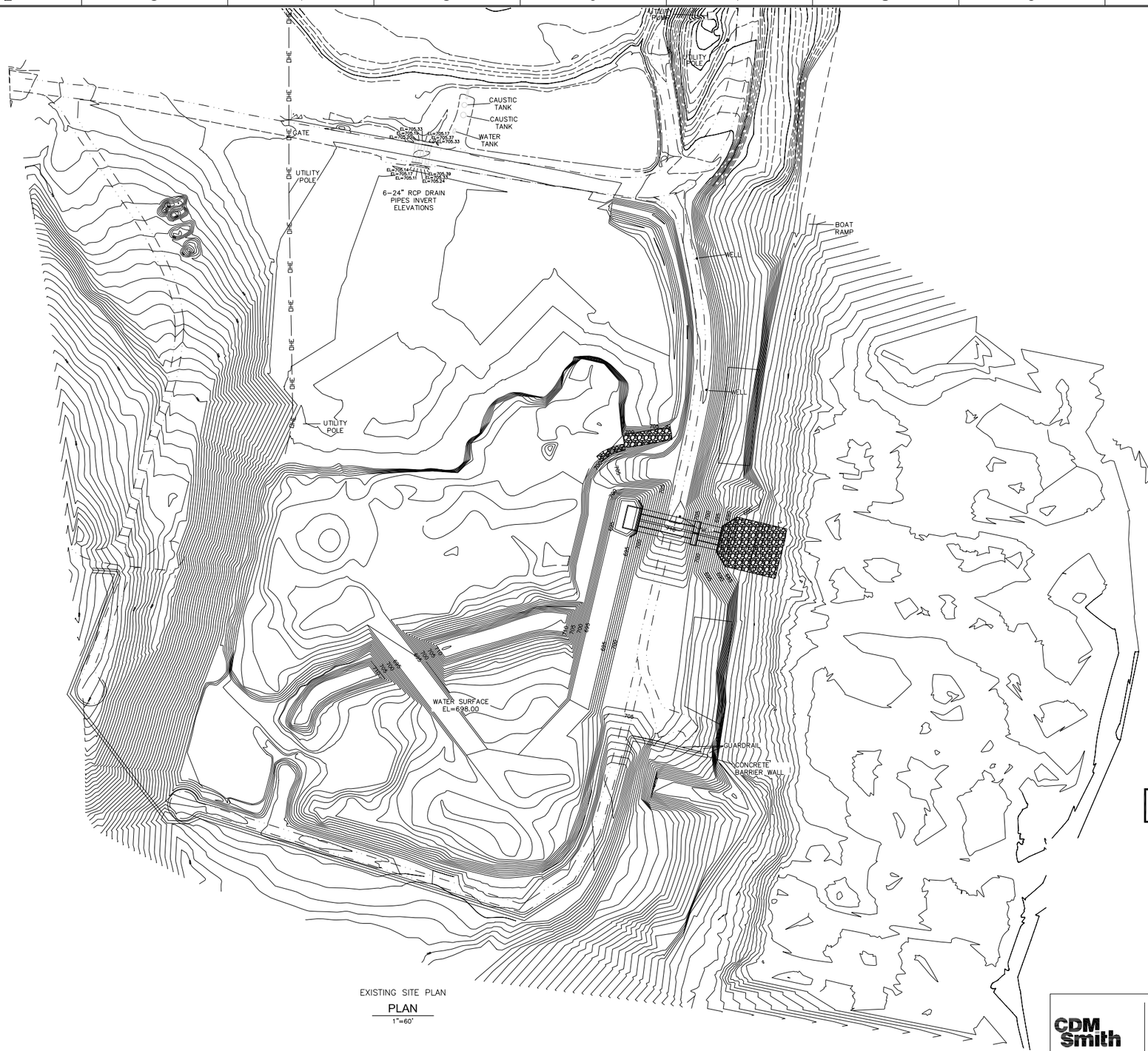

EXISTING SITE PLAN

PLAN

1"=60'

N

1" = 60'

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ASH POND CLOSURE PLAN
CLOSURE PLAN
EXISTING CONDITIONS PLAN

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Suite 200
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37921
Tel. 865.963.4300
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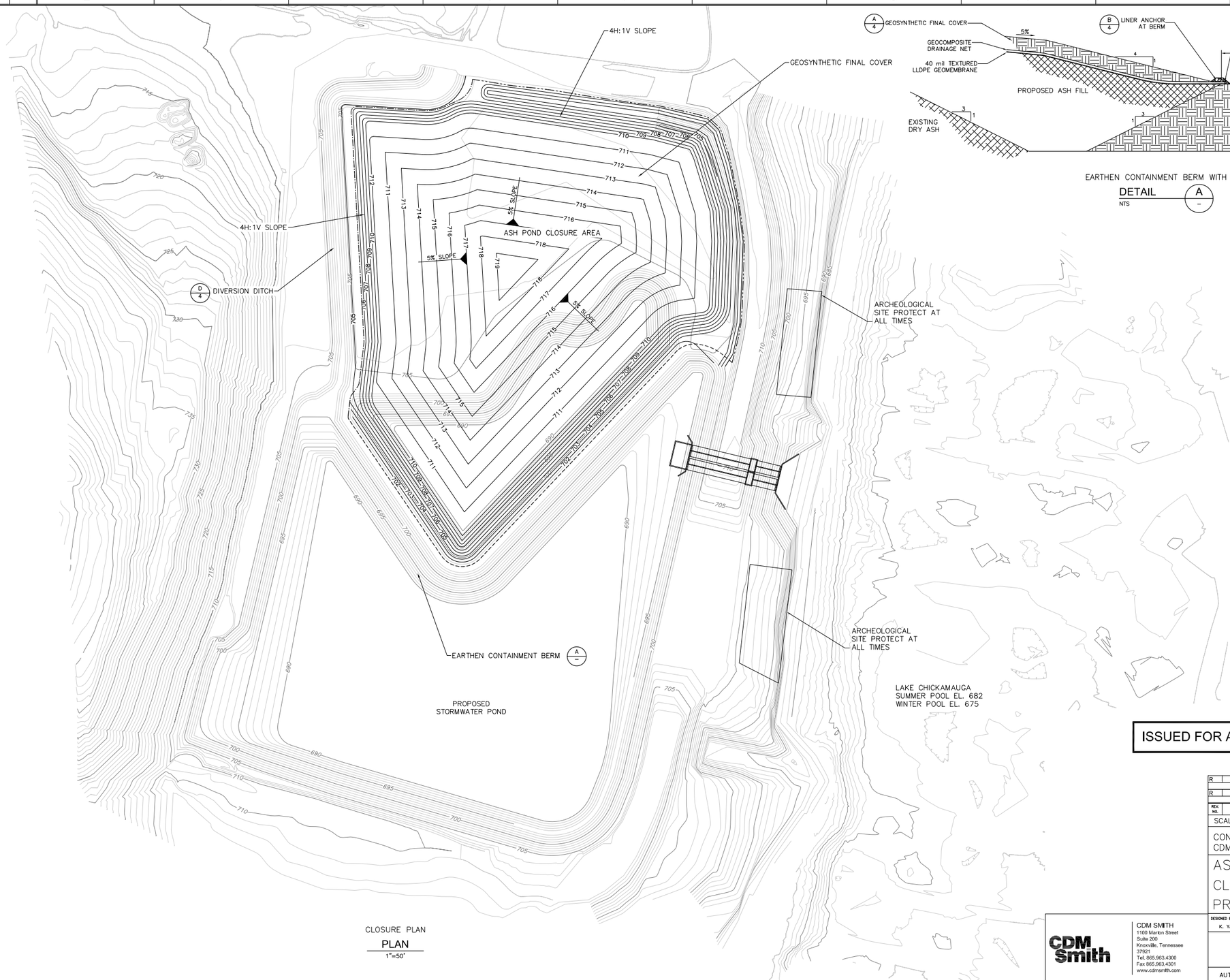
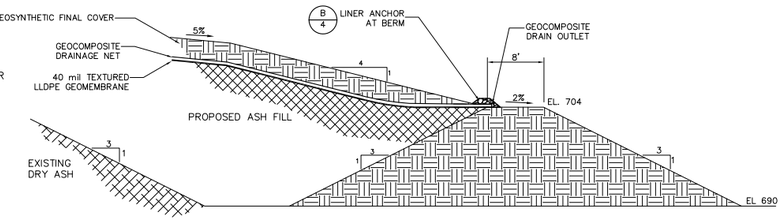
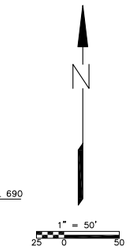


CLOSURE PLAN
PLAN
1"=50'



EARTHEN CONTAINMENT BERM WITH ASH
DETAIL A
NTS



LEGEND:

- GEOCOMPOSITE DRAIN OUTLET AT EARTHEN CONTAINMENT BERM (SEE NOTE 2)
- GEOCOMPOSITE DRAIN OUTLET AT DIVERSION DITCH (SEE NOTE 3)
- GEOCOMPOSITE DRAIN OUTLET AT DRAINAGE DITCH (SEE NOTE 4)

NOTES:

1. PROPOSED GRADES SHOWN REPRESENT TOP OF ASH.
2. ANCHOR GEOMEMBRANE AND DAYLIGHT GEOCOMPOSITE DRAINAGE NET PER DETAIL B ON SHEET 4.
3. JOIN GEOMEMBRANE TO DIVERSION DITCH AND DAYLIGHT GEOCOMPOSITE DRAINAGE NET PER DETAIL D ON SHEET 4.
4. ANCHOR GEOMEMBRANE AND DAYLIGHT GEOCOMPOSITE DRAINAGE NET PER DETAIL C ON SHEET 4.

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ASH POND CLOSURE PLAN
CLOSURE PLAN
PROPOSED ASH POND CLOSURE PLAN

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K. YANG	M. KOSKI	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

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CDM Smith
CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
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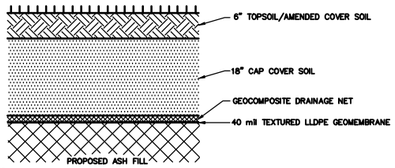
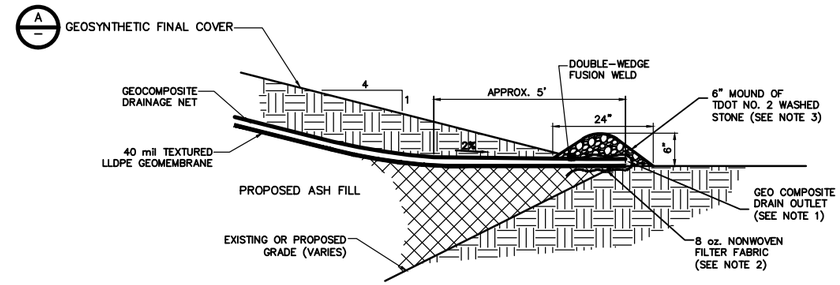


NOTES:

1. CLEAR AND GRUB TREES AND STRIP VEGETATION FROM DRY ASH AREA. DETERMINE EXISTING INTERMEDIATE COVER MATERIAL THICKNESS.
2. REMOVE EXISTING INTERMEDIATE COVER MATERIAL IN AREAS GREATER THAN 12 INCHES.
3. REPAIR EROSION DAMAGE USING REMOVED INTERMEDIATE COVER MATERIAL AND VERIFY MINIMUM 12" INTERMEDIATE COVER MATERIAL LAYER THICKNESS. IMPORT OFF-SITE INTERMEDIATE COVER MATERIAL IF NECESSARY.
4. FOLLOWING THICKNESS VERIFICATION AND PLACEMENT OF PROPOSED ASH FILL, PLACE FINAL COVER GEOSYNTHETICS.

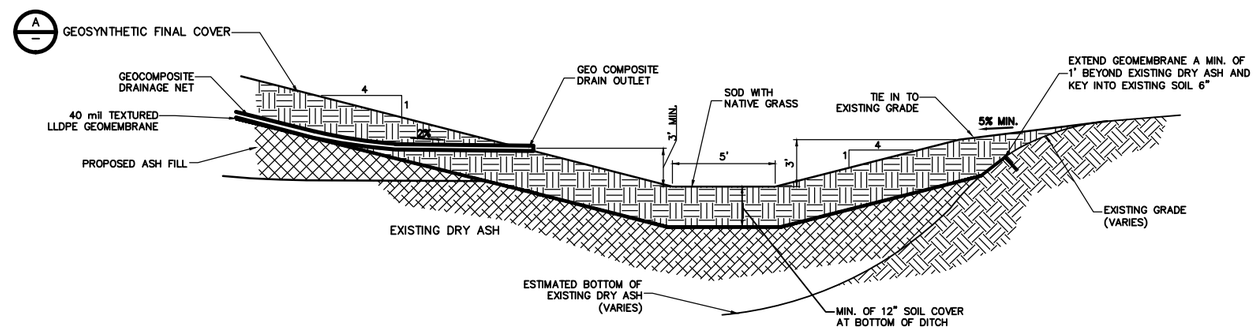
GEOSYNTHETIC FINAL COVER
DETAIL A
NTS



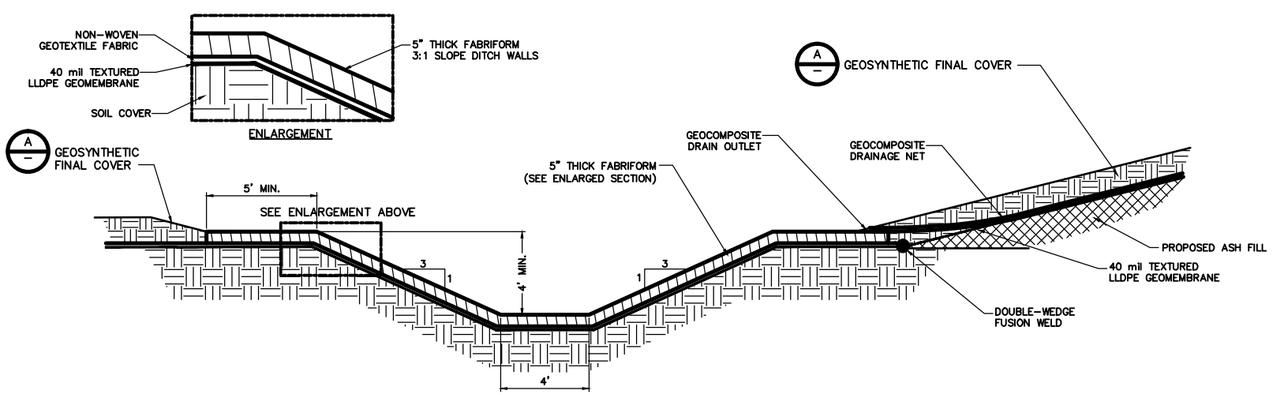
NOTES:

1. INSTALL GEOMEMBRANE AND DRAINAGE NET AND EXTEND A MINIMUM OF 1' PAST EDGE OF STACKED ASH TO PROVIDE A DRAINAGE OUTLET.
2. WRAP 3' STRIPS OF FILTER FABRIC AROUND THE END OF THE GEOMEMBRANE AND DRAIN OUTLET. CONTRACTOR SHALL HEAT AND TACK THE TOP OF THE FILTER FABRIC TO THE GEOCOMPOSITE DRAINAGE NET, OR DOUBLE-WEDGE FUSION WELD AS REQUIRED BY THE ENGINEER.
3. MOUND TDOT NO. 2 WASHED STONE ATOP GEOCOMPOSITE DRAINAGE NET AND FILTER FABRIC. MOUND SHALL BE APPROXIMATELY 6" HIGH, BUT NO GREATER THAN 12". WIDTH SHALL BE NO LESS THAN 24" AND SHALL COVER FILTER FABRIC ENTIRELY.
4. PLACE CAP COVER SOIL AND GRADE TO EDGE OF STONE.

LINER ANCHOR AT BERM
DETAIL B
NTS



LINER ANCHOR AT DRAINAGE DITCH
DETAIL C
NTS



DIVERSION DITCH
DETAIL D
NTS

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ASH AREA CLOSURE PROJECT
CLOSURE PLAN
FINAL COVER AND CLOSURE DETAILS

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K. YANG	M. KOSKI	D.NEAMTU	S.WHITESIDE	J.MULLINS	M.TURNBOW	J.KAMMEYER

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

CDM Smith
CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

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C.A.D. DRAWING
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XX | C | SHEET 4

Appendix B

Groundwater Monitoring Plan

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TVA Watts Bar Fossil Plant – Spring City, Tennessee

Ash Pond Closure

Groundwater Monitoring Plan

Tennessee Valley Authority
1101 Market St.
Chattanooga, TN 37402-2801

October 8, 2013

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Appendix

Appendix A Standard Forms

Section 1
Introduction

This Ash Pond Closure Groundwater Monitoring Plan for the TVA Watts Bar Fossil Plant (WBF) provides the field procedures and groundwater sampling protocols, analysis, and record keeping requirements associated with the ash pond closure.

To date, monitoring wells have not been installed to monitor the WBF ash pond. Recommended placement of monitoring wells in this Plan is based on potentiometric contouring developed from water levels in existing piezometers at the site, adjacent river level data, hydrogeologic information and/or other database information. The well locations are placed to target at the lesser of 150 meters from the Coal Combustion facilities or at the property boundary. The boundary will be monitored by a well network of one upgradient/background well and two downgradient wells. The upgradient well is located to be representative of background water quality unaffected by a CCP unit. Downgradient wells shall be hydraulically downgradient, and be constructed in such as manner as to detect CCP-related impacts. Wells will be screened in the soil overburden aquifer immediately underlying the site, as the primary receptor of potential migrating CCP-borne constituents in groundwater. TVA believes the proposed well locations will provide an adequate monitoring system for the WBF Ash/Settling Pond during closure and post-closure. A site map of the area is provided in **Figure 1-1**. The proposed well locations are provided in Figure 2-1.

1.1 Summary of Site Geology and Hydrogeology

The project area lies within the Tennessee Valley and Ridge Physiographic Province. This province is characterized by a series of elongated low ridges with intervening valleys that trend in the northeast-southwest direction. The geology of the Valley and Ridge consists primarily of sedimentary bedrock dominated by late Cambrian and early Ordovician material. These materials include limestone, sandstone, dolomite, and shale.

A previous subsurface exploration program consisted of ten (13) test borings (B-1, B-2, B-3, B-103, B-104, B-104A, B-105, B-106, B-107, B-108, B-109, B-110, and B-111) and three (3) hand augers (HA-1, HA-2, and HA-3). Test boring depths ranged from 28 to 58.5 feet below existing ground surface (ft-bgs) and hand auger depths ranged from 13 to 16 ft-bgs. Test boring locations B-3, B-103, B-107, and B-110 were converted to groundwater observation piezometers upon completion. The boring and hand-auger locations are shown on **Figure 1-2.**

Subsurface soil conditions were interpreted based on the subsurface explorations performed as part of this program, as well as CDM Smith's understanding of the local geology. Test borings drilled through the containment berm at the site generally encountered fill underlain by alluvial soil underlain by bedrock. Test borings drilled through the splitter dike and in the Dry Ash area at the site generally encountered CCP materials underlain by alluvial soil underlain by bedrock. A description of each unit is provided in sections 1.1.1 to 1.1.4.

1.1.1 Fly Ash/Bottom Ash (CCP Materials)

Fly Ash was encountered in the hand augers (HA-1, HA-2, and HA-3) and borings (B-109, B-110, and B-111) located in the Dry Ash Area, north of the Ash/Stilling Pond. The fly ash material was generally wet, very loose to loose, and fine-grained. Bottom ash was encountered in the borings performed

through the splitter dike (B-104 and B- 104A). The bottom ash material was generally wet, medium dense to dense, and medium- to coarse-grained.

1.1.2 Fill

Fill consisting of clay and silt was encountered in B-103, B-105, B-107, and B-108. The fill material was generally moist, varying in stiffness and was encountered at depths up to 23 ft-bgs.

1.1.3 Alluvial Soil

The fill was underlain by alluvial soils consisting of sand and silt with varying amounts of clay. The stratum typically consisted of soft/loose to stiff/medium dense, gray or brown, sandy silt with varying amounts clay. Typically gravel-sized rounded river stone with varying amounts of sand were encountered within 1 to 5 feet of auger refusal.

1.1.4 Interbedded Limestone and Shale

The alluvial soil was underlain by bedrock consisting of interbedded limestone and shale. The limestone was typically hard, moderately to highly weathered, and extremely thin to thin bedding with very poor rock quality designation. The shale was extremely weathered with very little recovery during coring. The top of bedrock was encountered at the boring locations between EL. 664.4 and EL. 669.2.

1.1.5 Groundwater Conditions

Groundwater levels were measured in the groundwater observation wells installed as part of CDM Smith's geotechnical investigations and are summarized in **Table 1-1**. In general, groundwater elevation readings in the containment berm east of the Ash/Stilling Pond typically ranged from approximately EL. 683 to EL. 684. The groundwater elevation in the Dry Ash Area northwest of the Ash/Stilling Pond was approximately EL. 700, as measured in the observation well installed in this area. Based on the measured groundwater elevations in this area, the water table occurs in the alluvial soil.

Groundwater elevations collected on June 20, 2012 from the wells installed during investigations were used to determine generalized groundwater flow direction for the area, as shown on **Figure 1-2**. The groundwater elevations in the Ash Pond Area indicate that groundwater flow is generally from west to east toward Chickamauga Lake, with eventual discharge to Chickamauga Lake.

DRAFT

Table 1-1
Groundwater Elevation Summary
TVA Watts Bar Fossil Plant
Ash Pond Closure Area

Boring Location	Ground Surface Elevation [1]	Groundwater Level Readings		Date
		feet below ground surface	Elevation (ft)	
B-1	699	12.1	686.9	11/16/2011
		9.3	689.7	1/11/2012
B-2	711	27.4	683.6	1/10/2012
B-3	701	15.7	685.3	11/16/2011
		19.0	682.0	1/10/2012
		18.1	682.9	1/11/2012
		17.4	683.6	6/15/2012
		17.5	683.5	6/20/2012
		17.6	683.4	3/29/2013
B-103	711	27.2	683.8	6/13/2012
		27.3	683.7	6/14/2012
		27.5	683.5	6/15/2012
		27.7	683.3	6/20/2012
B-107	710	27.8	682.2	6/14/2012
		26.2	683.8	6/15/2012
		26.4	683.6	6/20/2012
B-110	707	7.2	699.8	6/20/2012
		4.6	702.4	3/29/2013

Note: Ground surface elevation is approximate. Estimated from hand-held GPS unit.

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Figure No. 1-1
TVA- WATTS BAR FOSSIL PLANT
OVERALL SITE PLAN

MAY 2013

DRAFT

CDM Smith

Figure No. 1-2
GENERAL GROUNDWATER FLOW DIRECTION MAP
TVA- WATTS BAR FOSSIL PLANT
ASH POND AREA
AUG 2007

Section 2

Proposed Groundwater Monitoring System

The proposed monitoring well network for the Ash Pond Area closure will consist of three wells; one new background well and two new downgradient wells. The following nomenclature and well siting rationale will be used for the proposed monitoring wells and surface water location to be installed for the Ash Pond closure area:

MW-1
Monitoring well MW-1 will serve as the background well for the site. It will be installed approximately 300 feet west of the Ash Pond closure area.

MW-2
Monitoring well MW-2 will serve as a compliance well to monitor the uppermost stormwater flow from the southern portion of the closure area. The well will be installed approximately 250-feet from the closure area between the closure area and Chickamauga Lake.

MW-3
Monitoring well MW-3 will serve as a compliance well to monitor the uppermost stormwater flow from the central portion of the closure area, approximately 500 feet north of WBFMW-2. The well will be installed approximately 250-feet from the closure area between the closure area and Chickamauga Lake.

MW-2 and MW-3 will be located hydraulically downgradient of the Ash Pond area, and all will be screened in saturated soil overburden. The monitoring wells will be installed using current industry and regulatory protocols to prevent introducing contaminants during the drilling and installation process. These procedures include, in part: decontamination of the drilling equipment and tools before and after each well by washing with hot, potable water delivered under high pressure; using a new well screen and riser that have been cleaned and sealed in plastic at the factory; and placing washed filter pack sand that is approved by the National Science Foundation (NSF). Other steps employed during the installations will include the workers donning clean, rubber gloves during the handling of downhole equipment and well materials, and using potable water for grouting purposes. Lastly, all fieldwork will be performed and documented under the direct supervision of a qualified hydrogeologist or engineer.

2.1 Monitoring Well Design and Construction

The monitoring well network presented herein has been designed to effectively provide detection monitoring of the uppermost aquifer at the Ash Pond closure area.

2.1.1 Well Network Design

The basis for the well network design is as follows:

- The upgradient well shall be positioned to be representative of the background water flowing under the facility,
- The downgradient wells should be positioned approximately 250 feet away from the CCP waste facility, if feasible,

- All wells shall be screened in similar stratum that would be the most active for contaminant transport.

All of the wells will be screened in the alluvial overburden, above the bedrock. This zone represents the uppermost aquifer at the site, and would likely be the first strata to yield signs of any CCP-borne impact from the ash pond.

2.1.2 Well Selection/Placement Rationale

The wells will be located in the same geologic units so that upgradient and downgradient groundwater quality data can be compared. Based on previous investigations in the closure area, groundwater typically occurs above the bedrock in the alluvium in both the upgradient and downgradient areas of the site.

The background well will be positioned to be free from the influence of any waste disposal facility. The new downgradient wells will provide spatial coverage to detect any impacts on the groundwater quality from the Ash/Settling Pond closure area. Their proposed locations are distributed along the outer boundary of the facility, and screened vertically in the alluvial overburden where migration of contaminants away from the facility would be expected to be detected.

2.1.3 Proposed Monitoring Well Details

A site plan showing the proposed monitoring well locations is provided in **Figure 2-1.** Well construction diagrams and logs will be provided following construction. Anticipated construction details of the proposed monitoring well network for the Ash/Settling Pond closure area are provided in **Table 2-1**.

The well borings will be drilled using 4¼-inch inside diameter hollow-stem augers (nominal 8-inch diameter borehole) through the soil overburden. Standard penetration tests (SPTs) will be performed at five-foot depth intervals through the soil overburden to assist the project engineer in characterizing the subsurface soil materials.

Upon completion of drilling, two-inch diameter Schedule 40 PVC well screen (0.010-inch slots) and riser will be installed in the boreholes. The screen and riser will be flush-joint, threaded PVC pipe. A two-inch diameter Schedule 40 PVC bottom well plug measuring approximately six inches in length will be threaded onto the bottom of the screen. The PVC riser will extend approximately three feet above the ground surface and capped with a locking well expansion plug. Annular backfill will consist of a sand filter pack (20/40 mesh) extending from the bottom of the borehole to an elevation corresponding to approximately two to three feet above the well screen. A minimum two-foot thick bentonite seal will be placed on top of the sand filter pack. Following sufficient hydration of the bentonite seal, the remaining annular backfill, consisting of cement-bentonite grout (5% bentonite by weight), will be tremmied in-place from the top of the seal to the ground surface.

Subsequent wellhead construction will consist of an above-grade, eight-inch square steel locking protective cover set in a five-foot square by approximate four-inch thick concrete surface seal. Lastly, four-inch diameter steel protective barriers filled with concrete will be installed at each corner of the concrete surface seal. A typical monitoring well construction diagram is provided on **Figure 2-2**.

After completing the installation activities, each well will be developed by a combination of bailing and pumping. The bailer will be lowered and raised within the screened interval to create a surging action to dislodge particles within the well and sand filter pack. The bailer will then be removed from the well and emptied. This process will be repeated several times until the turbidity of the water within the well had stabilized. Lastly, a submersible pump will be used to further develop the well until negligible turbidity is achieved.

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Table 2-1
Proposed Groundwater Monitoring System Details
TVA Watts Bar Fossil Plant
Ash Pond Closure Area

Proposed Monitoring Well I.D.	Ground Elevation* (feet AMSL)	Borehole Depth (feet)	Screened Interval (feet bgs)	Sand Pack (feet bgs)	Bentonite Seal (feet bgs)	Well Borehole Diameter (inches)	Well Casing Diameter (inches)	Rationale
MW-1	710+/-	40 (1)(2)	25 - 40(2)	TBD	TBD	8	2	Proposed upgradient background well installed in alluvium. West of Ash Pond Area.
MW-2	690+/-	25 (1)(2)	10 - 25(2)	TBD	TBD	8	2	Shallow compliance well installed in alluvium to monitor flow from the southern portion of the closure area. The well will be installed approximately 250-feet from the closure area between the closure area and Chickamauga Lake.
MW-3	690+/-	25 (1)(2)	10 - 25(2)	TBD	TBD	8	2	Compliance well installed in alluvium to monitor flow from the closure area, approximately 500 feet north of MW-2. The well will be installed approximately 250-feet from the closure area between the closure area and Chickamauga Lake.

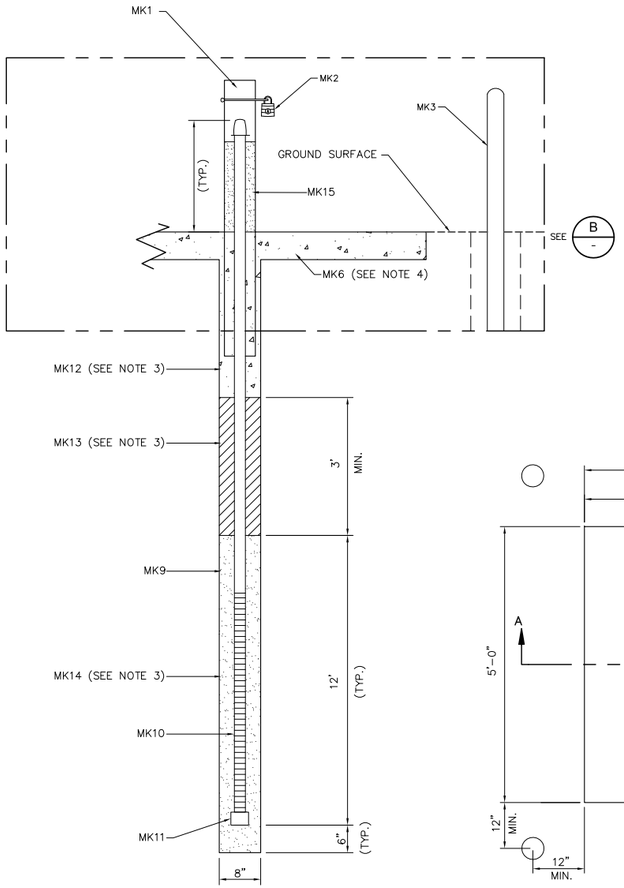
Notes:
(1) Wells will be installed using hollow stem augers.
(2) The borehole and screen interval depths are estimated. Actual depths will depend on subsurface conditions.
AMSL- Above Mean Sea Level
TOC - Top of Casing
NA - Not Applicable

DRAFT

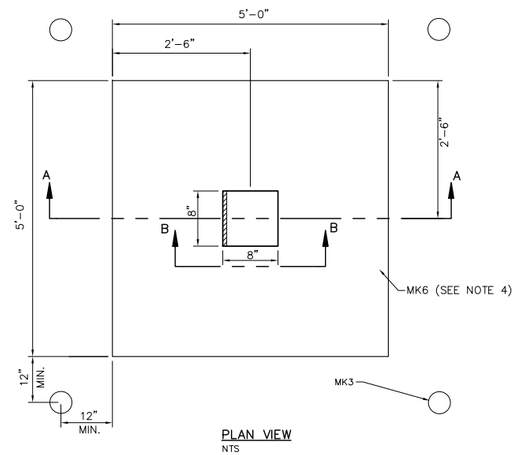
CDM Smith

Figure No. 2-1
PROPOSED GROUNDWATER MONITORING NETWORK
TVA- WATTS BAR FOSSIL PLANT
ASH POND AREA
AUG 2007

DRAFT



PROFILE

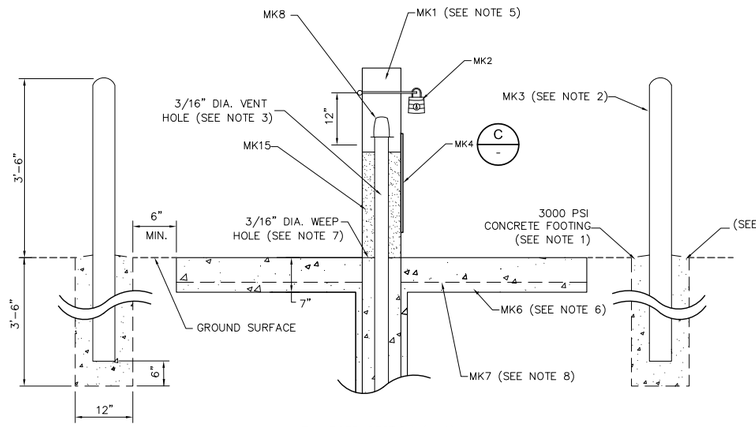


PLAN VIEW
NTS

MONITORING WELL
DETAIL A
NTS

MONITORING WELL NOTES:

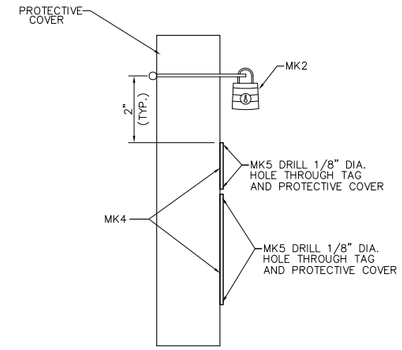
1. BORING TO BE ADVANCED WITH HOLLOW STEM AUGERS THROUGH OVERBURDEN TO TARGET DEPTHS.
2. TARGET TIP ELEVATIONS TO BE DETERMINED FROM PRE-INSTALLATION EXPLORATORY BORINGS.
3. ANNULAR BACKFILL MATERIAL (SAND, BENTONITE, AND GROUT) TO BE TREMMIE-PLACED WITH SOUNDING MEASUREMENTS DURING AND AFTER CONSTRUCTION.
4. SLOPE CONCRETE UPWARD TO PROTECTIVE TO PREVENT PONDING WATER AND SCARIFY SURFACE TO CREATE ROUGH TEXTURE.



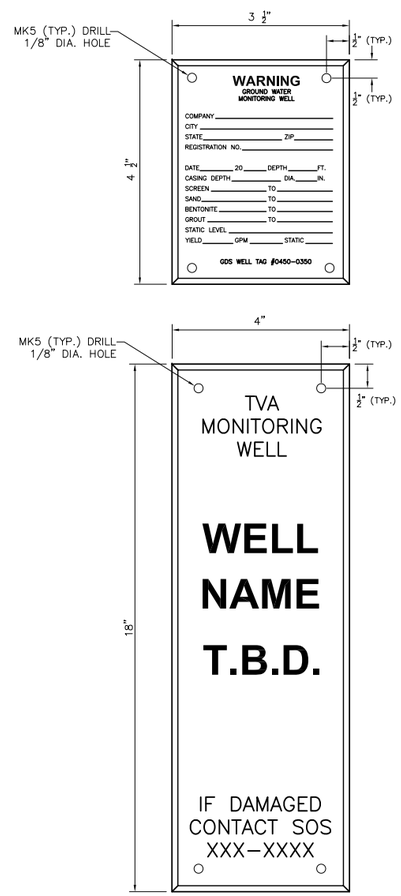
ENLARGED SECTION (A-A)
DETAIL B
NTS

WELLHEAD NOTES:

1. SECURE PROTECTIVE BOLLARDS IN 12" DIA. CONCRETE FOOTING. CONCRETE FOOTING SHALL MAINTAIN A MINIMUM SPACING OF 6" FROM CONCRETE PAD AND 2'-0" FROM ANY ROAD OR OTHER STRUCTURE. IN THE EVENT OF INSUFFICIENT SPACE, 2'-0" SPACING REQUIREMENT SHALL TAKE PRECEDENT.
2. PROTECTIVE BOLLARDS TO BE FILLED WITH 3000 PSI CONCRETE, AND CONE-TAPER THE TOP.
3. DRILL $\frac{3}{16}$" DIA. VENT HOLE 2" BELOW TOP OF THE PVC RISER.
4. NEW PROTECTIVE COVERS DO NOT REQUIRE PAINTING.
5. POSITION PROTECTIVE COVER WITH HINGE AT THE SAME ELEVATION AS TOP OF PVC RISER. FILL INSIDE OF PROTECTIVE COVER WITH CEMENT GROUT TO SAME LEVEL AS CONCRETE PAD.
6. SLOPE CONCRETE UPWARD TO PROTECTIVE COVER AND BOLLARDS TO PREVENT PONDING WATER.
7. DRILL $\frac{3}{16}$" DIA. WEEP HOLE AT TOP OF GROUT INSIDE PROTECTIVE COVER.
8. PLACE WIRE MESH 2" MINIMUM FROM ALL CONCRETE EDGES.



WELL I.D. MOUNTING (B-B)
DETAIL C
NTS



WELL I.D. TAGS (MK4)
DETAIL D
NTS

MARK NUMBERS AND MATERIAL LIST		
MARK NO.	QUANTITY PER WELL	DESCRIPTION
1	1 EACH	GLOBAL SQUARE STEEL PROCOVER, GALVANIZED GDS SQ-PC 8"X8"X5" PROVIDED BY GLOBAL DRILLING SUPPLY, OR EQUIVALENT
2	1 EACH	BRASS MASTER LOCK, KEYED 0896
3	4 EACH	4" DIA. STEEL PIPE BOLLARD-PAINTED YELLOW, GDS GUARD PIPE 4"X5", PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
4	1 EACH	WELL I.D. TAGS
5	8 EACH	DOME HEAD ALUMINUM RIVET #PASD403E, PROVIDED BY HANSON RIVET & SUPPLY CO. OR EQUIVALENT
6	AS REQ.	CONCRETE 3000 PSI
7	AS REQ.	$\frac{3}{16}$"X4"X4" WELDED WIRE. OVERLAPPED 4" AT JOINTS
8	1 EACH	2" SCH. 40 PVC SLIP CAP
9	AS REQ.	2" SCH. 40 PVC RISER. JSF 2"X10"-R "FLUSH THREAD", PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
10	1 EACH	2" DIA. SCH. 40 PVC WELL SCREEN. JSF 2"X10'-010 "FLUSH THREAD" PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
11	1 EACH	2" DIA. SCH. 40 PVC BOTTOM CAP. 2" FEM CAP "FLUSH THREAD" PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
12	AS REQ.	GROUT-PORTLAND TYPE I OR II CEMENT WITH 5% BENTONITE BY WT.
13	AS REQ.	BENTONITE SEAL-PDS TR $\frac{30}{38}$ COATED PELLET PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT. PARTIALLY PRE-HYDRATE PRIOR
14	AS REQ.	FILTER SAND- GLOBAL NO. 7 (20X40MESH) PROVIDED BY GLOBAL DRILLING SUPPLY OR EQUIVALENT
15	AS REQ.	FINE SAND- PROVIDED BY GLOBAL DRILING SUPPLY OR EQUIVALENT

PRELIMINARY- NOT FOR CONSTRUCTION

PROJECT REVISION HISTORY

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV BY
R											
R A	08/26/13	MC	MB	RN	MC	JM	MT	JK	-	-	-

REVISION NO. A

SCALE: NONE — EXCEPT AS NOTED

FIGURE 2-2

TYPICAL MONITORING WELL CONSTRUCTION DETAILS WATER QUALITY MONITORING PLAN

CDM Smith

CDM SMITH
1100 Marion Street
Suite 200
Knoxville, Tennessee
37921
Tel. 865.963.4300
Fax 865.963.4301
www.cdmsmith.com

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. COLONE	M. BROKAW	B. NAGEL	M. COLONE	J.MULLINS	M.TURNBOW	J.KAMMEYER

WATTS BAR FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R2012 | DATE 08/26/2013 | 14 | C | R A

CDM SMITH | A
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Section 3

Groundwater Sampling and Analysis Procedures

The following section briefly summarizes the primary components of the groundwater sampling and analysis plan. These components are described in detail in the following paragraphs; though generally follow the protocols for well purging and groundwater sample collection procedures presented in the U.S. Environmental Protection Agency (USEPA) publication SW-611, Procedures Manual for Ground-Water Monitoring at Solid Waste Disposal Facilities (USEPA, 1980). The document contains protocol for groundwater level measurements, groundwater sample collection, preservation, shipment, record-keeping, chain of custody, quality assurance and quality control, and copies of groundwater quality data field worksheets; and other pertinent forms.

3.1 Groundwater Level Measurements

The depth to water surface from the top of each reference point (e.g., top of well casing) will be measured in each well to the nearest 0.01 foot with an electronic water level indicator before pumping or bailing begins. The groundwater level measurements will be taken for all wells prior to purging and sampling of any well. The total depth of the well will be measured using a weighted tape. The volume of water present in the well prior to sampling will be calculated and recorded along with other well measurements and observations on the Groundwater Data Field Worksheet (TVA Form 30066A) in **Appendix A**. The water level indicator will be cleaned after each measurement by rinsing with distilled water and wiping dry as it is wound on the reel.

3.2 Groundwater Purging and Sampling

A sheet of plastic will be spread on the ground prior to well purging to minimize the potential for contamination caused by contact of the equipment with the ground surface. Wells will be purged prior to sampling to ensure that representative groundwater is obtained from the uppermost aquifer. Either the low-flow minimal drawdown or volume-averaging purging methods will be performed. Low-flow sampling will be performed in general accordance with USEPA published protocols (USEPA 1996A and 1996B) or the American Society for Testing and Materials standard practice (ASTM, 2002). Volume-averaging purging will be performed by removing a minimum of three columns of water from a well using a variable-speed submersible pump or bailer.

For low-flow sampling, field parameters will be continuously monitored while purging using a calibrated, in-line, multi-parameter, flow-through cell. Sample collection will begin after stabilization of the field parameters. Parameter stability will be defined as three successive readings taken at 3- to 5-minute intervals that are within ±0.1 for pH, ±3% for conductivity, ±10% for turbidity (or less than 10 NTU), and ±3% °C for groundwater temperature. For the volume averaging purging method, field parameters will be measured periodically during purging in an open sample container using a calibrated multi-parameter water quality meter, but purging will be considered complete upon the removal of three columns of water from the well.

Time, purge rate, and groundwater level will be periodically recorded throughout the purging operation. Well purge water will be handled in accordance with applicable investigation derived waste (IDW) protocols and regulations.

If a low yielding well is purged dry, a sample will be collected using a new disposable Teflon bailer or pump as soon as sufficient water is present in the well to obtain the necessary sample volume.

Samples will be collected directly from the pump discharge line (or disposable bailer) in new certified sample containers containing appropriate preservatives (where applicable). Clean nitrile (or equivalent) gloves will be worn when handling sample containers and the sampling equipment. When filling sample bottles, care will be taken to minimize sample aeration and overfilling. Sample bottles will be filled one at a time and capped before filling the next bottle. Samples will be placed on ice immediately after collection.

All sample containers will be labeled with permanent sample identifications (ID). This sample ID number will be unique for each sample collected and will be cross-referenced on all field sheets and on the sample chain of custody (COC) form. An example COC is provided in Appendix A.

Any problem observed that might affect the quality of these procedures will be identified and recorded on the field data sheet, along with the action(s) taken to resolve it. Problems that might affect quality include clogged sampling tubes, highly turbid samples, defective material or equipment, failure to comply with quality procedures, or atmospheric/ambient conditions.

3.3 Field Instruments and Equipment

Field equipment will be calibrated according to the manufacturer's specification. Calibration results will be recorded in the project field logbook. Field equipment will also receive routine maintenance checks in order to minimize equipment breakdown. Maintenance checks will generally coincide with the calibration procedures. Any equipment found to be operating improperly will be taken out of use, and a note stating the time and date of this action will be made in the field log book.

In the instance that a piece of field equipment malfunctions, it will be repaired, replaced, or recalibrated, as necessary. This will be performed according to the instrument manufacturer's operation and maintenance manual. Once completed, the time and date of its return to service will also be recorded. Experienced personnel will perform all field equipment preventive maintenance. The preventive maintenance requirements and procedures for laboratory analytical equipment will be specified in the laboratory quality assurance (QA) manuals.

3.4 Sampling Equipment and Decontamination Procedures

To minimize the potential for cross contamination, non-dedicated sampling equipment (i.e., submersible pumps, water-level indicator, and other non-disposable sampling equipment) will be decontaminated prior to use and following the sampling of each well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires that are in contact with the well) will be decontaminated by first flushing/rinsing with either (a) deionized (DI) water or potable tap water if no organic contaminants are present in the groundwater, or (b) a non-phosphate detergent solution (e.g., Liqui-Nox®), if organic contamination is suspected. Equipment will then undergo final flushing/rinsing with DI water to remove initial rinsate.

3.5 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made using the analytical data. DQOs are determined by the intended use of the analytical data. Therefore, DQOs must be specific for each site and project activity.

This groundwater monitoring plan provides the information necessary to develop and implement field sampling, COC forms, laboratory analysis, and chemical data reporting procedures that will provide adequate coverage and analytical data. The minimum data documentation requirements for the groundwater monitoring activities are outlined as follows.

3.5.1 Sampling Quality Control Data and Information

The following information shall be recorded and maintained:

- Sender's COC forms;
- Date and time each sample was taken;
- Map or diagram indicating sample locations;
- Any notable observations (color, clarity, texture, reaction with preservatives, etc.);
- Trip Blank (if Volatile Organic Compounds (VOCs) or Semi-Volatile Organic Compounds (SVOCs) are sampled);
- Equipment Blank (Rinsate Blank);
- Identity of field duplicates (a minimum of one duplicate for every 20 or fewer samples).

3.5.2 Laboratory Quality Assurance/Quality Control (QA/QC) Data

The following information shall be recorded and maintained:

- Lab -completed COC forms;
- Date and time of receipt at the laboratory;
- Condition of samples upon receipt at the laboratory;
- Sample identification number or designation;
- Sample preparation, extraction, cleanup, or digestion method(s) and date(s);
- Analytical method (name, number, and source) and date of analysis; and
- Final analytical results
- Case narrative (Includes deviations from standard analytical or preparatory procedure(s); quality control problems encountered—whether stemming from system, instrumentation, analyst error, or sample matrix; corrective measures taken; if corrective measures as called for in the method were not taken; results of corrective measures taken; etc.).

3.6 Field Quality Control Samples

Field QC samples will routinely include one set of equipment blanks and one pair of duplicate samples collected from a single monitoring well. If VOC or SVOC sampling is performed, one trip blank will also be collected. QC samples will be identified on the sample container label and on the COC documentation.

3.6.1 Trip Blanks

A trip blank will be prepared in the laboratory and accompany sample containers at all times. It will be logged on the COC and handled in the same manner as other samples, except that it will remain unopened. Typically, trip blanks are only used when groundwater samples are collected for VOCs.

Based on the selected analytical parameters, trip blanks are not anticipated to be necessary. However, if trip blanks are necessary, there will be one analyzed per sampling event.

3.6.2 Equipment Rinsate Blanks

An equipment rinsate blank is prepared in the field using deionized/distilled water provided by the laboratory. The lab-provided water is poured over/through sampling equipment that has been previously decontaminated. The rinsate is then collected into the appropriate sample bottles and analyzed for the same parameters as the primary groundwater samples. The purpose of this blank is to confirm that field conditions and/or the equipment are not introducing contaminants to the samples. Equipment rinsate blanks will be collected at a rate of 1/week/matrix or 1/20 samples/matrix, whichever is less, with a minimum of one rinsate blank every sampling event.

3.6.3 Field Duplicate Samples

A field duplicate sample will be collected simultaneously with a primary field sample using the same sample collection methodology. The results will provide some indication of the homogeneity of the sample medium and the precision of the field sampling and laboratory sample analysis. Accurate field notes will be used to match each duplicate to its corresponding investigatory sample. Field duplicate samples will be transported to the laboratory along with other samples. Field duplicates will be collected at a rate of 1/10/matrix, whichever is less, with a minimum of one duplicate blank every sampling event.

3.7 Chain-of-Custody Control

The groundwater monitoring program is designed to confirm the integrity of samples from time of collection to time of laboratory data reporting. This includes the ability to trace the possession and handling of samples from the time of collection through analysis and final disposition. All environmental samples will be handled under strict COC procedures, beginning in the field. The designated Field Team Leader will be the field sample custodian and will be responsible for verifying that the procedures are followed. Sample custody for field activities will include the use of COC forms, sample labels, custody seals, and field logbooks.

When the COC is initiated at the laboratory, the laboratory personnel responsible for shipping sampling containers will have initiated and signed the COC form and sealed the shipping container with a COC seal. The field staff will acknowledge receipt and container integrity by signing the COC form, noting any discrepancies. If custody of the samples (and sample containers) are exchanged during field sampling, such transfer must be documented on the COC form. When samples are sent to the analytical laboratory, the shipping method and tracking number will be recorded on the COC prior to shipping and in the field logbook, and the Field Team Leader will retain a copy of the completed COC. An example COC form is included in Appendix A.

3.8 Laboratory Analyses

The unfiltered groundwater samples will be analyzed for the 17 inorganic constituents listed in Appendix I of Rule 0400-11-01-.04 (**Table 3-1**). With the exception of mercury, and fluoride, the

inorganics will be analyzed by EPA Method 6010/6020. Mercury will be analyzed by EPA Method 7470/7471, and Fluoride by EPA method 300 as shown in Table 3-1. Any deviation from these analytical methods will be documented in the narrative of groundwater monitoring reports.

Analysis of required constituents will be performed in accordance with USEPA SW-846 methods. Laboratory reporting limits will be the lowest practical quantitation limits that can be reliably achieved within specified limits of precision and accuracy with a target of at least four times below MCLs in Appendix III of Rule 0400-11-01-.04 or other Groundwater Protection Standards (GWPS) approved by TDEC.

The laboratory will maintain detailed records of analytical procedures for a minimum of five years, in order to support the validity of the analytical work. Each laboratory data report will verify that the approved analytical method was performed and that QA/QC checks were within the established protocol limits. The verification must be provided by the laboratory project manager, laboratory manager, or QA officer. Any QA problems encountered during sample analysis will be clearly described in the laboratory report.

3.9 Recordkeeping

A project field logbook(s) will be maintained by TVA or their representative. The logbook and field data sheets addendum to the logbook will be used to record pertinent data and observations for each sampling event. Between sampling events the logbook will be maintained by the project lead in a secure location (e.g., office project file). A sample field data sheet, form TVA 30066A, is included in Appendix A.

TVA will maintain records of groundwater monitoring data including monitoring reports, laboratory analytical reports, and groundwater elevation data. TVA will retain other relevant and appropriate project information in project files including field notes, correspondence, and reference information. These records will be maintained throughout the post-closure care period.

Table 3-1
Appendix I Inorganic Constituents and Analytical Methods
for Detection Monitoring
TVA Watts Bar Fossil Plant
Ash Pond Closure Area

PARAMETER	UNITS	ANALYTICAL METHOD
Antimony	ug/l	SW-846 6010/EPA 200
Arsenic	ug/l	SW-846 6010/EPA 200
Barium	ug/l	SW-846 6010/EPA 200
Beryllium	ug/l	SW-846 6010/EPA 200
Cadmium	ug/l	SW-846 6010/EPA 200
Chromium	ug/l	SW-846 6010/EPA 200
Cobalt	ug/l	SW-846 6010/EPA 200
Copper	ug/l	SW-846 6010/EPA 200
Fluoride	ug/l	EPA 300
Lead	ug/l	SW-846 6010/EPA 200
Mercury	ug/l	SW-846 7470/EPA 200
Nickel	ug/l	SW-846 6010/EPA 200
Selenium	ug/l	SW-846 6010/EPA 200
Silver	ug/l	SW-846 6010/EPA 200
Thallium	ug/l	SW-846 6010/EPA 200
Vanadium	ug/l	SW-846 6010/EPA 200
Zinc	ug/l	SW-846 6010/EPA 200

Section 4

Groundwater Monitoring Program

The following section describes the Groundwater Monitoring Program that is proposed for the Watts Bar Fossil Plant Ash Pond Area which in lieu of any specific regulations for ash pond closures, follows the TDEC Solid Waste regulations established in Rule 0400-11-01-.04. The proposed Detection Monitoring Program for the Area will be implemented upon closure, and TDEC's approval of this plan. The Area will be closed in accordance with the schedule provided in the Closure Plan.

4.1 Detection Monitoring Program

The ash pond area at WBF does not have an existing groundwater monitoring network. Because no historical sampling has occurred, data is needed to establish a statistical baseline and initial background concentrations in the wells. In order to establish baseline data levels, 8 samples shall be collected and analyzed from each of the newly installed wells within the first two years following installation. During the sampling events, groundwater samples from the monitoring wells will be analyzed for the inorganic constituents listed in **Table 3-1**.

None of the volatile organic compounds listed in Appendix I of TDEC Solid Waste Regulations are expected to be present in coal combustion products. Therefore only the inorganic parameters are proposed for the Detection Monitoring Program. The analytical methods used to analyze all samples will be the appropriate methods from EPA Publication SW-846, and are listed in **Table 3-1**.

The laboratory reporting limits (PQL or PQL equivalent such as EQL, RL, LOQ, etc.) will be the lowest practical quantitation limits that can be reliably achieved within specified limits of precision and accuracy, with a target of at least four times below all established ground water protection standards in Appendix I of Rule 0400-11-01-.04, or other ground water protection standards approved by TDEC. There are SW-846 methods (e.g., 6010B) that have a few analytes (e.g. antimony, cadmium, and thallium) with practical quantitation limits (laboratory reporting limits) that are greater than groundwater protection standard(s). In those few cases, another SW-846 method (e.g., 6020) will be used with the laboratory reporting limits being the lowest PQL that can be reliably achieved within specified limits of precision and accuracy.

Groundwater monitoring will be conducted semi-annually after closure for long-term monitoring, unless statistical or MCL exceedance triggers additional action by TDEC. While sampling, the Field Data Sheet (TVA Form 30066A) will be used to document that all samples will be unfiltered.

4.1.1 Reporting

TVA will submit to TDEC the groundwater sampling and analysis results, statistical determinations, and associated recordings of the groundwater surface elevations within 60 days of the last day of sampling, unless otherwise directed by TDEC. The groundwater monitoring reports will provide the following:

- A description of the sampling procedures performed (including field measurements of pH, conductivity, temperature, turbidity, etc.; and calculations/measurements of purge volumes),

the date(s) and time(s) of field activities (including field instrument calibration and decontamination), and the weather conditions at the site when the activities were performed.

- The mean sea level (MSL) elevation of the top of the casing for each monitoring well, the location and the groundwater surface elevations for each monitoring point, and the groundwater flow direction and gradient.
- A description of the results of the inspections of all monitoring wells pad, aboveground casing, locking cap, and lock.
- A scaled map of the facility showing the locations of all monitoring points and the MSL potentiometric surface determined from water level measurements collected during the event, the property boundaries, and closed fill areas.
- A list of the monitoring parameters and the methods used to analyze the samples.
- Copies of the COC forms and the laboratory report sheets.
- Tables summarizing the most recent analytical data for each monitoring point compared to background groundwater quality concentrations and groundwater protection standards.
- The statistical method described in Section 4.1.2 will be used in evaluating monitoring data.
- The results of the statistical evaluation to determine whether or not there has been a statistically significant increase above background values for all naturally occurring parameters/constituents monitored.
- A conclusion section that summarizes the results of the groundwater sampling event, notes anything unusual, and provides the appropriate sampling/analyses determinations (based on the appropriate groundwater monitoring program) and the approximate start date for the next planned sampling event. The conclusion shall also summarize all naturally occurring constituents that are statistically significant above background values, all detected constituents that do not naturally occur, and all constituents that exceed the groundwater protection standards established.
- Certification by a person representing TVA as described in Rule 0400-11-01-.04.

4.1.2 Statistical Data Evaluation

An interwell statistical analysis, consistent with the requirements of Rule 0400-11-01-.04 will be the methodology applied to future monitoring data to assure timely detection of statistical exceedances at the compliance monitoring boundary. Normality testing will be used to evaluate the data at a 0.01 or 0.05 significance level, in accordance with Rule 0400-11-01-.04 (7) (a) 4. (vi). Generally, only 25% of the data are either normally or log-normally distributed, while 75% are non-normal. The high percentage of non-normally distributed data is generally due to a high percentage of measurements below analytical reporting limits.

In general the NPI method assumes that the distribution of baseline and future compliance sampling data are identical in the absence of contamination from a facility. An upper prediction limit (UPL) for each constituent is determined based on the maximum concentration detected during the baseline

sampling period. A baseline data set will be compiled by collecting 8 semi-annual samples from the upgradient and downgradient wells.

4.1.2.1 Statistical Methods

When the statistical characteristics of monitoring data match the distribution described above, that indicates that the prediction interval methods adapted by Gibbons (1990 and 1994) would likely be applicable to the groundwater detection monitoring program. Either parametric or nonparametric prediction interval methods would be applied depending on normality of individual constituent data. In general, one-sided upper prediction limits (UPLs) derived from n baseline measurements from each well and having a (1-α) probability of including at least one of two future measurements at the well would be computed for each constituent using the methods of Gibbons (1994, pp. 8-76), where α is the Type 1 (false-positive) error level. Future sample measurements from each well will be compared to baseline UPLs developed from a minimum of eight baseline monitoring events for each well. If a new measurement exceeds a UPL, one verification resample would be collected from each monitoring well having a statistical exception. The resample would be analyzed only for the exceeded constituent(s). Should the resample result exceed the UPL, the exception would be deemed statistically significant; otherwise, the original UPL exception would be considered insignificant.

A site-wide Type 1 error rate as discussed above in Section 4.1.2 would be maintained in application of the parametric prediction interval method. The corresponding individual sample constituent error rates for comparisons would be computed and reported based on the number of compliance locations, constituents, and verification resamples using the methodology presented in ASTM D6312-98 (ASTM, 2005). For nonparametric prediction interval testing, the confidence level is based only on the number of sample data in the baseline dataset and the number of resamples. Constituent UPLs would be continually updated as new sample measurements are added to the pool of data.

Statistical analysis of monitoring data will be performed using MANAGES (version 3.0) data management and evaluation software (Electric Power Research Institute [EPRI], 2006), or similar data management and software programs. The statistical analysis includes characterization of the data, assumption testing, and specific statistical comparisons to test hypotheses, which involve testing for trends and seasonality, and interpretation of results. All methods used will be in accordance with the following USEPA guidance and ASTM standards:

- Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Unified Guidance Office of Resource Conservation and Recovery Program Implementation and Information Division USEPA, EPA 530-R-09-007, March 2009.
- ASTM D7048 Standard Guide for Applying Statistical Methods for Assessment and Corrective Action Environmental Monitoring Programs.
- ASTM D6312 Standard Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs.

Monitoring well data will also be compared to the TDEC MCLs listed in Appendix III of Rule 0400- 11-01-.04. If the MCL is exceeded during a subsequent sampling event, the well will be resampled to conduct confirmation sampling. If all the resample measurements exceed the MCL, the original exceedance will be confirmed. If the resample results are below the MCL, the original exceedance is considered insignificant.

4.2 Assessment Monitoring Program

If groundwater detection monitoring results indicate either a SSI above background for any naturally occurring constituent or a confirmed detection of any required monitoring parameter that does not occur naturally, TDEC DSWM will be notified within 14 days of this finding.

4.3 Post Closure Monitoring

Groundwater monitoring will be conducted semi-annually following the Ash Pond closure for long-term monitoring purposes, unless exceedances trigger additional from TDEC.

4.4 Monitoring Well Abandonment

Well abandonment is conducted to prevent the well from becoming a conduit for water or contaminants to migrate from the ground surface to the aquifer or between aquifers. Well abandonment will be performed by a Tennessee licensed driller in a manner consistent with TDEC Rules and ASTM standards. The preferred method of abandonment is to completely remove the wells outer casing (sometimes known as surface casing), the riser pipe, and the well screen from the borehole; however, certain situations may warrant grouting the well or a portion of the casing in place (e.g., if removing a well that is grouted into rock would potentially create a greater migratory pathway to the aquifer, then the well will be properly sealed in place).

Wells that have been constructed with an outer casing will be filled from the bottom of the well, up to the bottom of the outer casing using the positive displacement method ("tremie method"). A Type-1 Portland cement (ASTM C-150 or equivalent) mixed with potable water and 3-5% bentonite will be used as the plugging material. The cement mixture will be allowed to cure, and the tremie method may be performed in lifts or stages depending on boring depth. The wells outer casing will then be removed by either overdrilling or excavation and winch line extraction. The borehole will then be sealed to a depth of approximately 2 feet below the ground surface with the cement mixture using the tremie method. In situations where removal of the outer casing is impractical or not feasible, the casing will be cut approximately 2 feet below ground surface and the entire length of pipe will be sealed with the cement mixture using the tremie method. After the cement mixture has hardened, the boring will be topped off with material that matches the surrounding ground surface (e.g., soil and seeded, asphalt, stone, etc.).

Piezometers installed at the site for the geotechnical investigation will be properly abandoned prior to beginning closure activities. If the integrity of a permanent monitoring well is compromised (or is suspected of being compromised) prior to the completion of the Post Closure Monitoring period, TDEC DSWM will be promptly notified and the well will be properly abandoned in a manner consistent with the methods referenced above. A replacement well will be installed if required by TDEC DSWM. At the completion of the Post Closure Monitoring period, all monitoring wells associated with the landfill monitoring network will be properly abandoned.

Section 5
References

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U.S. Environmental Protection Agency, Report EPA/530/SW-611; 68-01-3210; PB84-174820, 266 p.
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USEPA, 1996B. Low Stress (Low-Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells. Revision 2. USEPA Region I. July, 1996.

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Appendix A

Sample Monitoring Forms

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Preliminary Groundwater Data Field Worksheet

Sheet _____ of _____

Project/Site	Well Number 84068	Purge Date	Year	Month	Day

Depth to Water (m) 4195	Bottom of Well (m) 4194	Well Diameter (mm) 4188	Survey Leader	Field Crew
☐ Depth of Screen	☐ Open Bore Hole			

(m) 4191	To	(m) 4190	Sample Label	☐ Unfiltered ☐ Filtered ☐ Both Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume	Target Purge Volume	Actual Purge Volume
[( )m - ( )m] x ( )L/m =	(L)	(L)	(L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): _____

Sample Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): _____

Notes and WQ Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge →										

Remarks: _____

Reviewed By: _____ Survey Leader _____ Date _____ Project Leader _____ Date

Sample Collector:			
Sample Date			Time
Year	Month	Day	ET CT
Pump Duration:			min 72004

"999" = 2 days

Sample Readings

	4193	4192	10	400	300	94	90
Analysis Time ET CT	Pump Rate (L/min)	Pump Depth (m)	Temp °C EPA 170.1	pH (s.u.) EPA 150.1	DO (mg/L) EPA 360.1	COND (umhos/cm) EPA 120.1	(+/-) ORP (mv) SM 2580B	Turbidity (NTU) EPA 180.1

Additional Sample Data

Analyst:					Well Diameter (mm)	Vol. Factor (L/m)
Date Analyzed	415	431	436	437	12.7 (0.5 in)	0.127
Year / Month / Day	Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)	51 (2 in)	2.027
Turbidity 1350 ☐ Clear ☐ Slightly Turbid ☐ Turbid ☐ Highly Turbid	Time:	Time:	Time:	Time:	76 (3 in)	4.560
	Initial:	Initial:	Initial:	Initial:	102 (4 in)	8.107
					127 (5 in)	12.668
					153 (6 in)	18.228
Color:	Bottles Required	☐ Ferrous	☐ Mineral	☐ Phenol	Others (list):	
Odor:	☐ BOD ☐ TOC	☐ Metals	☐ Dis. Mineral	☐ Filt TIC		
	☐ COD ☐ TIC	☐ Dis. Metals	☐ Nutrient	☐ TSS/TDS		

>>> Select a Laboratory <<<

#N/A
#N/A
#N/A
#N/A

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Your Company Name here	Tel/Fax:	Lab Contact:	Carrier:	_____ of _____ COCs
Address	Analysis Turnaround Time			Job No.
City/State/Zip	Calendar (C) or Work Days (W) _____			
(xxx) xxx-xxxx P hone	TAT if different from Below _____			
(xxx) xxx-xxxx F AX	☐ 2 weeks			SDG No.
Project Name:	☐ 1 week			
Site:	☐ 2 days			
P O #	☐ 1 day			Sampler:

Sample Identification	Sample Date	Sample Time	Sample Type	Matrix	# of Cont.	Filtered Sample																			Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification

☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For _____ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

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Appendix C
Quarterly Report Form

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TVA Watts Bar Fossil Plant
Ash Pond Closure Plan
Quarterly Reporting

Closure Area:	
Quarter:	
Start Date:	
End Date:	

Description:	

Completed this Quarter:	

Projected next Quarter:	

List of Revised Attachments:	

Appendix D
Post-Closure Monitoring Checklist

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Post-Closure Inspection and Maintenance Report Form - Quarterly Inspection

Location/Feature Inspected	Date of Inspection	Time of Inspection	Inspection After Significant Rainfall	Observed Maintenance Deficiency (see list below)	Condition (see below)	Corrective Action Required/Other Remarks	Date Repair Completed

Condition Code: G = Good; **M** = Marginal (needs maintenance within 7-days); **P** = Poor (needs immediate maintenance); **C** = Needs to be cleaned
O = Other (Explain in Corrective Action Section)

INSPECTION CHECKLIST			
GROUND SUBSIDENCE	**SLOPE STABILITY**	**MONITORING WELLS**	**OUTFALLS/HYDRAULIC STRUCTURES**
1. Evidence of cracking	9. Rotational/block failure	15. Well identification not visible	22. Erosion observed
2. Evidence of depression	10. Maintenance sloughing	16. Well cap unlocked or insecure	23. Sedimentation observed
3. Evidence of sinkhole	11. Evidence of seeps	17. Ponded water in well vicinity	24. Inlet/outlet obstruction
4. Evidence of ponding	**CHANNELS/LININGS**	18. Subsidence in well vicinity	**GENERAL/OTHER SITE FEATURES**
FINAL COVER	12. Erosion observed	19. Erosion in well vicinity	25. Evidence of unauthorized entry
5. Animal burrows observed	13. Sedimentation observed	20. Collision damage	26. Damage/missing facility signage
6. Stressed vegetation observed	14. Lining deterioration/displacement	21. Well casing degradation	27. Other deficiency observed
7. Undesired vegetation present			
8. Excavation in final cover			

PRECIPITATION DATA		
	Rain Data	
Date	Intensity	Amt

	Name	Title	Signature
Inspector Information:			

Appendix E

Stability Analysis (April 2012)

DRAFT

CDM Smith
5400 Glenwood Ave, Suite 300
Raleigh, North Carolina 27612
tel: 919 325-3500
fax: 919 781-5730

April 30, 2012

Mr. James D. Mullins, P.E.
Senior Program Manager
Tennessee Valley Authority
CCP Engineering
1101 Market Street, LP 5E-C
Chattanooga, TN 37402

Subject: Report – Revision No. 1
Existing Conditions Stability Analyses
Ash Pond Area at Watts Bar Fossil Plant

Dear Mr. Mullins:

The purpose of this letter report is to present the results of the existing conditions stability analyses performed by CDM Smith for the Ash/Stilling Pond area at the Watts Bar Fossil (WBF) plant near Spring City, Tennessee. These analyses were performed to support the U.S. Environmental Protection Agency's assessment of the Tennessee Valley Authority's (TVA) Coal Combustion Products (CCP) disposal facilities.

Project Background

The WBF plant is directly downstream of the Watts Bar Dam and Lock and abuts the west bank of the Tennessee River. Currently, the WBF plant is not operational and decommissioning is underway. The WBF plant was a coal-fired power plant built by TVA between 1940 and 1945. The plant was operated in two stages, from end of construction to 1957 and from 1970 to 1982. During the plant operation, ash and boiler slag generated by the plant were stockpiled and stored on-site.

In 2010, TVA contracted with CDM Smith to perform Phase I preliminary design services to support final closure of the WBF plant as part of the WBF Plant Coal Combustion Products Closure Project. The final closure encompasses multiple areas which include disposal facilities, impoundments, and stormwater ponds permitted in accordance with multiple regulations. The project includes closure of five (5) main areas: (i) the Borrow Source Area, (ii), Slag Processing Area (iii), Chemical Pond Area, (iv) Ash/Stilling Pond Area, and (v) Riverbank Area, as shown on **Figure 1**.

As part of this work, TVA requested that CDM Smith provide an existing condition evaluation for the stability of the Ash/Stilling Pond Area. This evaluation considered stability of the Ash/Stilling

Pond Area under static and seismic loading conditions based upon available data, as described herein.

Available Information

During the preliminary design phase for the closure, CDM Smith reviewed the following available information provided by TVA:

- MACTEC geotechnical report at Borrow Area
- QA/QC reports for closure construction at Chemical Pond and Slag Disposal Area during 2006 to 2009.
- TVA Disposal Facility Assessment, Phase I Plant Summary, Watts Bar Fossil Plant (WBF), by Stantec, 2009.
- Final Report – Development of Hazard Deaggregation Inputs for Use in Risk Analysis of Fossil Plants, by AMEC GeoMatrix, March 2010.
- Watts Bar Fossil Plant, Annual Inspection Report for Ash/Waste Disposal Areas, from 1967 through 2008.
- Watts Bar Fossil Plant, Slag Disposal Area Closure Plan, Project Planning Document, approved by TVA in January 2007.
- Fly Ash, Bottom Ash, and Scrubber Gypsum Study, by Law Engineering, November 1995.
- TVA Coal Combustion Products Management Program, Master Programmatic Document (Revision 1.0), December 7, 2009.

In addition, CDM Smith performed the following site-specific investigations to supplement the available data:

- Site walk and surficial soil sampling in the Borrow Area and Slag Disposal Area in August 2011.
- Bulk sampling and laboratory testing of underwater ash samples from the Ash/Stilling Pond Area in August 2011.

- Site survey of the Slag Disposal Area and Ash/Stilling Pond Area in December of 2011. Survey was performed by TVA at the request of CDM Smith.
- Subsurface exploration program along west bank of Tennessee River consisting of three geotechnical borings and installation of two groundwater observation wells.

The subsurface exploration program was completed in January 2012 and boring logs and water level readings from the wells are currently available and included as **Attachment A**. Laboratory testing results for disturbed and undisturbed samples collected in these borings are also contained in Attachment A.

Existing Conditions Evaluation

The existing conditions stability analyses for the Ash/Stilling Pond Area were performed at two critical cross-sections, as shown on **Figure 2**. The two critical cross-sections were selected at locations exhibiting the steepest exterior embankment slopes and riverbank slopes. The locations of the geotechnical borings completed in January 2012 are also shown on this figure. Cross-section A-A' extends through the Wet Ash Pond Area and Cross-Section B-B' extends through the Dry Ash Area, as shown on **Figures 3A** and **3B**, respectively. The cross-sections were developed based upon available topographic survey, design plans for the ponds, and the subsurface conditions encountered in the test borings. Currently there are no bathymetric survey data available for the river bank slope below normal water level. For this evaluation, the river bank slope was assumed to follow the same natural slope above water level and extend to the top of the bedrock at the river bed.

Selection of Design Parameters

The engineering design properties of the ash and soil layers for the seepage and stability analysis of the cross-sections are summarized in **Tables 1a and 1b**. The basis for selection of the design properties is also listed in the tables. In general, ash properties were estimated based upon available data from similar TVA facilities and soil properties were estimated based upon the subsurface investigation data, empirical correlations, and experience in similar geologic conditions.

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Table 1a: Parameters used in SEEP/W Seepage Analyses

Layer	Material	k_h		k_h / k_v	Basis of Parameter Selection
		ft/day	cm/sec		
	Ash Material	0.45	1.6E-04	20	Based on comparison between laboratory testing data for existing ash material and TVA's CCP material database
1	Fill	0.0028	1.0E-06	10	From Peck[1]; typical value for mixture of sand, clay, and silt.
2A	Medium Stiff to Stiff Clay	0.0014	5.0E-07	15	From Peck; typical value for low-permeability soil.
2B	Soft Clay and Silt	0.0014	5.0E-07	15	From Peck; typical value for low-permeability soil.
3	Sand	2.83	1.0E-03	4	From Peck; typical value for sand.
4	Weathered Rock and Gravel	28.35	1.0E-02	4	From Peck; typical value for sand and gravel mixtures.
5	Interbedded Shale and Limestone Bedrock	0.0006	2.0E-07	1	From Domenico[2]; page 39; high-end value for Shale bedrock.

Reference:

1. Ralph B. Peck, 'Foundation Engineering', 2nd edition, 1974; page 43.

2. Patrick A. Domenico, 'Physical and Chemical Hydrogeology', 2nd edition, 1997.

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Table 1b: Strength Parameters used in SLOPE/W Stability Analyses

Layer	Material	Unit Weight, pcf	Friction Angle, degrees	Undrained Shear Strength, psf	Basis of Parameter Selection[1]
	Ash Material (wet)	70	20	-	Comparison between laboratory testing data for existing ash material and TVA's CCP material database
	Ash Material (dry)	85	25	-	
1	Fill	120/115[2]	32	-	Selected based on lower 1/3 N-values[3] from B-2 and B-3
2A	Medium Stiff to Stiff Clay	110/105[2]	29	1300	Selected based upon lower 1/3 pocket penetrometer readings[4] from B-2 and B-3 and laboratory shear strength testing on U-1 from B-2.
2B	Soft Clay and Silt	110	28	500	Selected based upon N-values and pocket penetrometer readings[4] from B-2 and B-3
3	Sand	120	30	-	Selected based on Lower 1/3 N-values[3] from B-2 and B-3
4	Weathered Rock and Gravel	125	40	-	Based upon experience in similar geologic conditions
5	Bedrock	Impenetrable			Assumed

Notes:

1. Correlation of N-value and friction angle from Ralph B. Peck, 'Foundation Engineering', 2nd edition, 1974; page 310.
2. Values listed are saturated/moist unit weights.
3. Lower 1/3 value is defined as the value where at least 2/3 of all the readings are greater or equal. N-value is defined as the sum of the blows to drive the 2nd and 3rd 6-inch-increments of each split spoon sample.
4. Pocket penetrometer readings were performed on split spoon samples and Shelby tube sample during drilling.

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Laboratory strength data was not available at the time of the issue of the original report. However, laboratory results for an undisturbed Shelby Tube sample (U-1) taken in the medium to stiff clay layer (Layer 2A) in boring B-2 are now available. Based upon the laboratory results and the insitu data from borings B-2 and B-3 (pocket penetrometer), the undrained shear strength for this layer has been revised to 1300 psf. The undrained shear strength data for Layer 2A and Layer 2B are shown on **Figure 4**.

For stability analyses under seismic conditions, peak ground acceleration for the WBF plant site was selected based upon a review of the "*Final Report - Development of Hazard Deaggregation Inputs for Use in Risk Analysis of Fossil Plants*", by AMEC GeoMatrix, dated March 28, 2010 and the USGS 2008 Hazards Map available at http://earthquake.usgs.gov. **Table 2** summarizes the data from the three TVA plants closest to WBF and the USGS Hazard Map values for the WBF. Based upon these data, the peak ground acceleration for WBF was interpolated to be 0.042g for a 500-year return period and a 0.116g for a 2500-year return period. Ground motion corresponding to a 2500-year return period is consistent with seismic stability guidance provided by the TVA Master Programmatic Document (Revision 1.0). A peak ground acceleration of 0.116g was used in the stability analyses under seismic conditions.

Table 2: Summary of Available Seismic Hazards Results (AMEC Report and USGS)

Plant	Latitude	Longitude	Return Period (years)	Probability of Exceedance	PGA, (g)	
					AMEC Report	USGS
Bull Run	36.00	-84.15	2500	2% in 50 years	0.131	0.155
			500	10% in 50 years	0.043	0.044
Kingston	35.90	-84.51	2500	2% in 50 years	0.115	0.134
			500	10% in 50 years	0.041	0.041
Watts Bar	35.61	-84.78	2500	2% in 50 years	***0.116***	0.135
			500	10% in 50 years	***0.042***	0.042
Widows Creek	34.90	-85.75	2500	2% in 50 years	0.1	0.115
			500	10% in 50 years	0.038	0.038

Bolded values were interpolated from tabulated data.

Seepage Analyses and Results

The phreatic surface for each stability analysis was developed from seepage analyses performed with the SEEP/W 2007 software package by GEO-SLOPE International, Ltd. This computer program uses the inputted geometry, soil, rock, and ash properties, and boundary conditions (surface water and groundwater conditions) to develop a steady-state seepage profile. For our analyses, the model was calibrated using the field data gathered during the recent geotechnical investigation by CDM Smith including:

- Water levels observed in the Ash/Stilling Pond
- Groundwater levels measured in the observation wells
- River level elevation data available at "http://www.tva.gov/lakes/wbh_o.htm" for the dates/times.

Once the model was calibrated, the steady-state phreatic surface was developed for normal pool conditions in the Ash/Stilling Pond (EL. 705).

Static Slope Stability Analyses and Results

Analyses for overall (global) stability under static conditions were performed using the SLOPE/W 2007 modeling software package from GEO-SLOPE. This computer program uses the inputted slope geometry, soil, rock, and ash properties, and phreatic surface and calculates the factors of safety against deep-seated circular failures. Phreatic surfaces generated by SEEP/W were imported to SLOPE/W for the static and seismic slope stability analyses. The Spencer method was selected for the slope stability analyses. The minimum acceptable static factor of safety against overall slope failure is 1.5 for normal pool conditions.

Effective stress strength parameters were used for all materials in static analyses. The stability analyses are included in **Attachment B** and the minimum factors of safety for deep-seated circular failure surfaces are presented in **Table 3**. Failure surfaces less than 5 feet deep are considered to be sloughing/surficial failures. The stability analyses did exhibit some lower factors of safety for sloughing/surficial failures along the river bank, but these failure surfaces did not extend into the pond berm such that the global stability of the ash pond would be impacted. Results presented herein considered the deep-seated failures that extend into the ash pond areas only. All factors of safety for static conditions equal or exceed the minimum required.

Table 3: Results of Slope Stability Analyses – Static Conditions

Run #	Modeling Scenario	Calculated Factor of Safety	
		Inboard Slope	Outboard Slope
A-1	Static Slope Stability at Wet Pond	1.9	1.8
B-1	Static Slope Stability at Dry Ash Area	2.4	1.5

Seismic Slope Stability Analyses and Results

The stability analyses under seismic loading conditions were performed using a pseudostatic method, where the added inertial load from an earthquake is represented by a horizontal pseudostatic coefficient. Based upon the Standard Penetration Test N-values and fines content of the subsurface soils, the soils at the site are not considered to be susceptible to liquefaction. The analyses assumed no liquefaction of the subsurface soils and undrained shear strength parameters were used for the natural clay soils (Layer 2A and Layer 2B). The peak ground acceleration was estimated as 0.116g. Tolerable deformations were assumed for cases where the pseudostatic factor of safety is greater than 1.0. Normal pool conditions were assumed (El. 705).

The stability analyses are included in Attachment B and the minimum factors of safety for deep-seated circular surfaces are presented in **Table 4**. All factors of safety for seismic (pseudostatic) conditions equal or exceed the minimum required.

Table 4: Results of Slope Stability Analyses – Seismic Conditions

Run #	Modeling Scenario	Calculated Factor of Safety	
		Inboard Slope	Outboard Slope
A-2	Seismic Conditions at Wet Pond	1.4	1.1
B-2	Seismic Conditions at Dry Ash Pond	1.3	1.0

Conclusions

The slope stability analyses indicate acceptable factors of safety under static and seismic loading conditions for all sections. The seismic slope stability analyses presented in this letter use a pseudostatic approach to represent existing conditions. For seismic assessment of the closure

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design, TVA will employ a comprehensive risk-based approach, with design and mitigation decisions based upon the probability and consequences of failure. This approach is outlined in the document *"Seismic Risk Assessment, Closed CCP Storage Facilities, Tennessee Valley Authority"* dated March, 2010 and included as **Attachment C**.

Limitations

This letter report has been prepared for specific application to the subject project in accordance with generally accepted geotechnical engineering practices. No other warranty, express or implied, is made. In the event that any changes occur, the conclusions and recommendations presented in this memorandum should not be considered valid, unless changes are reviewed and conclusions of this memorandum are modified or verified in writing.

STEPHEN L. WHITESIDE
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 108556
STATE OF TENNESSEE

Stephen L. Whiteside

4/30/12

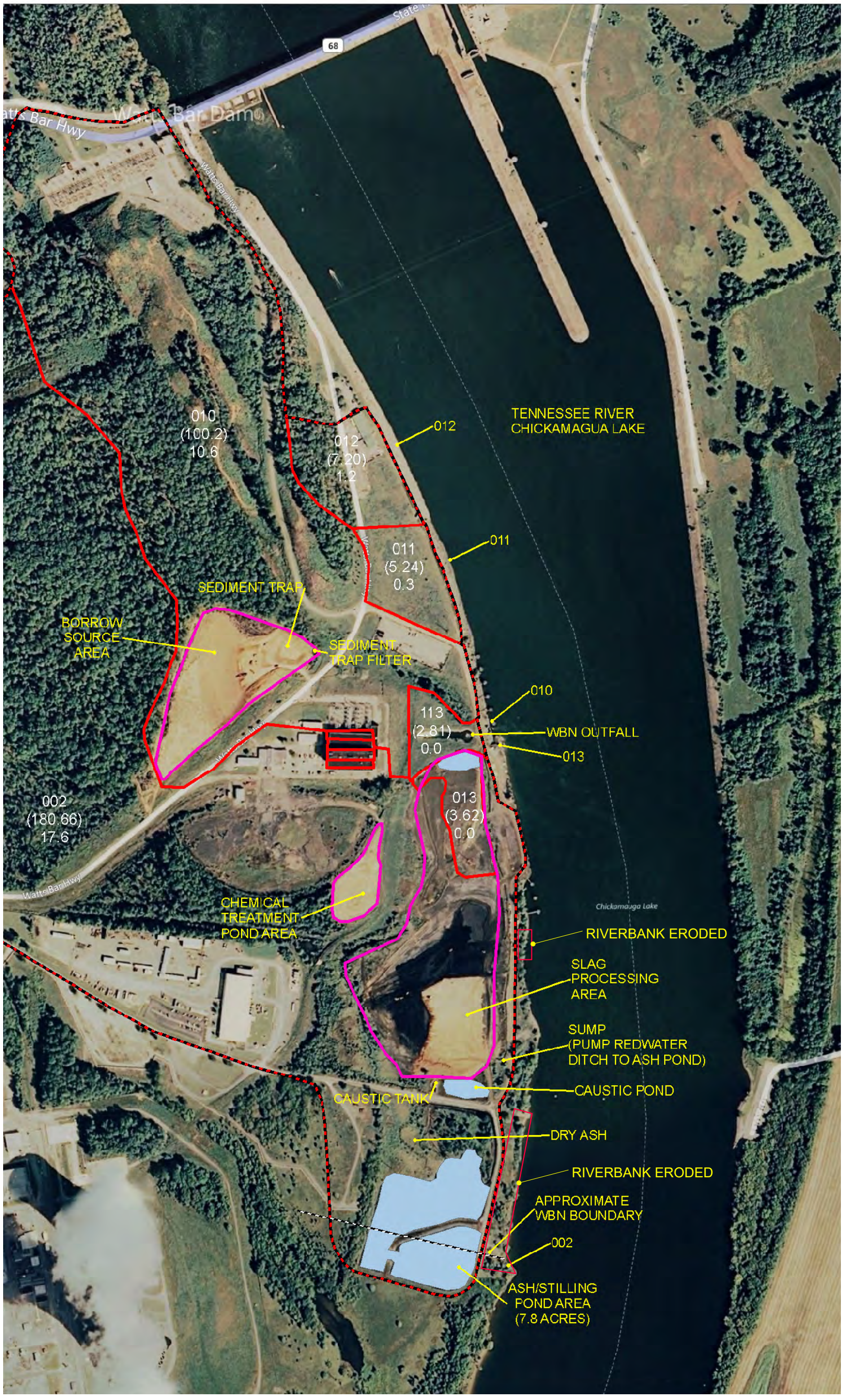
Very truly yours,

Stephen L. Whiteside

Stephen L. Whiteside, P.E.
Vice President
CDM Smith Inc.

cc: Michael Bachand, CDM Smith
Jintao Wen, CDM Smith
Danielle Neamtu, CDM Smith

FIGURES



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Watts Bar Fossil Plant
Tennessee Valley Authority
Coal Combustion Products Closure Project

Locations of Closure Areas

Figure 1

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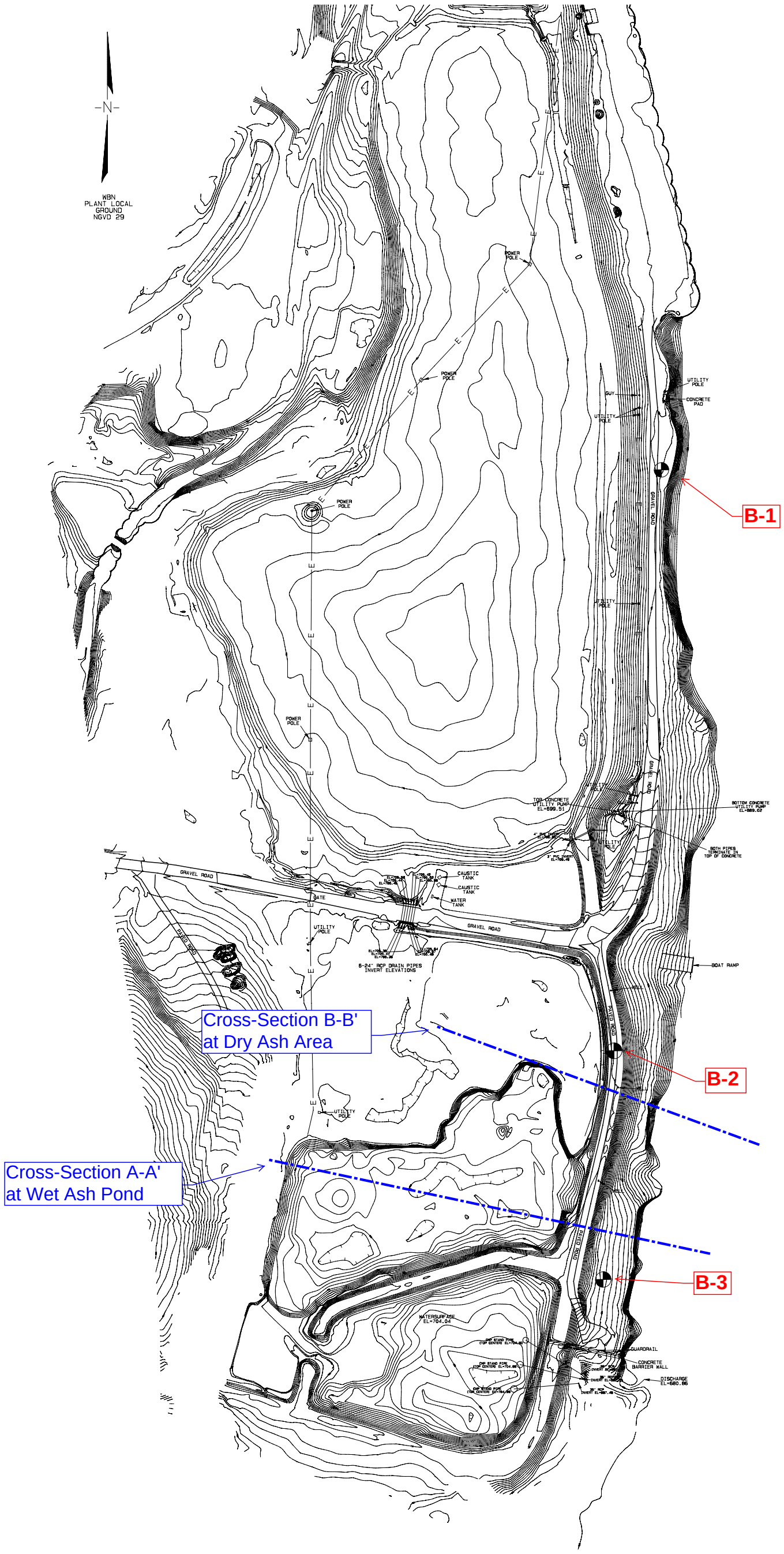

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Watts Bar Fossil Plant
Tennessee Valley Authority
Coal Combustion Products Closure Project

Borings and Cross-Section Locations

Figure 2

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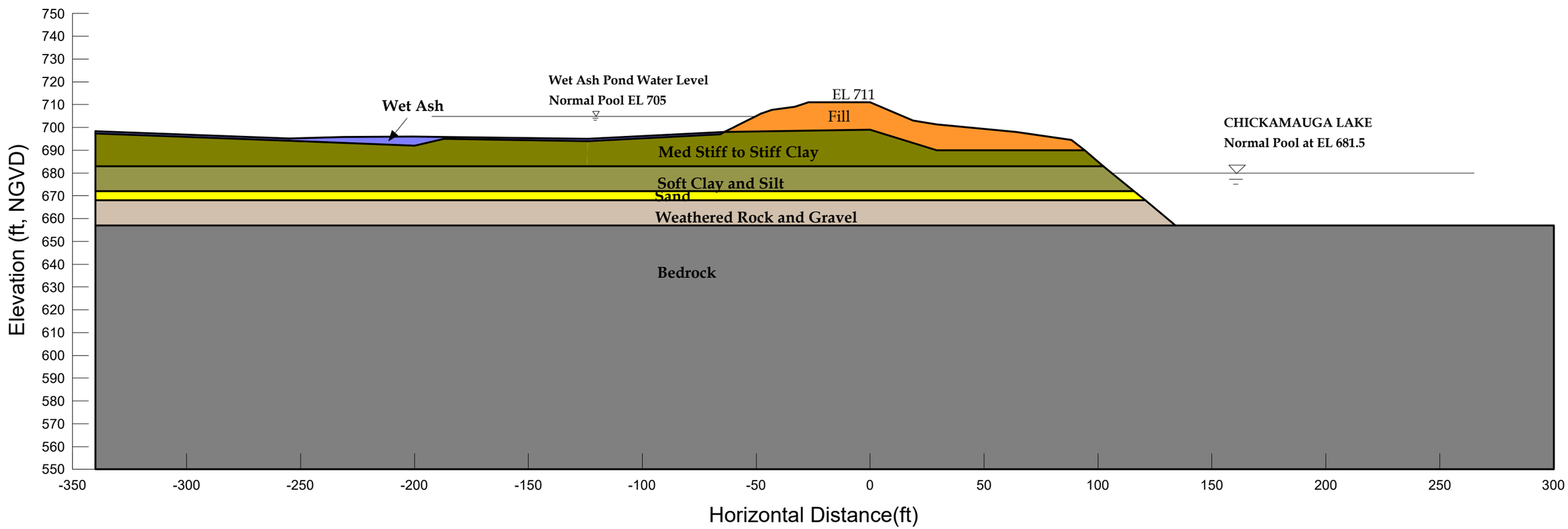
TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section A-A' at Wet Ash Pond Area



CDM Smith

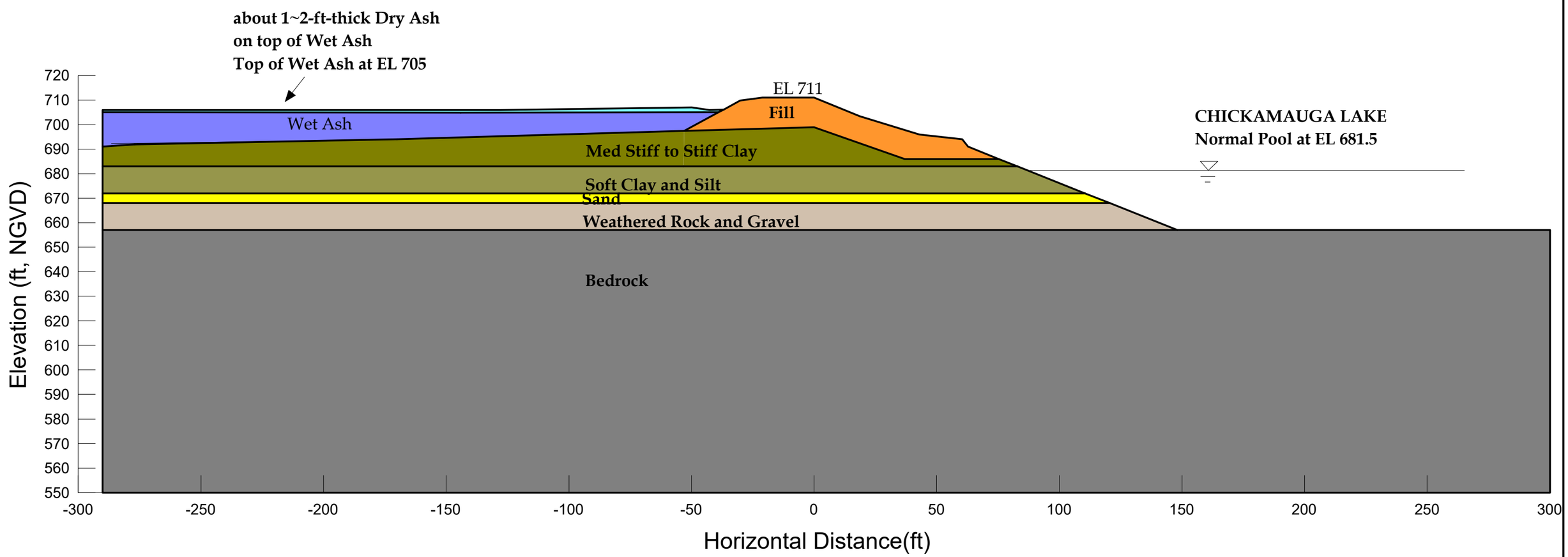
Watts Bar Fossil Plant
Tennessee Valley Authority
Coal Combustion Products Closure Project

Cross-Section A-A' at Wet Ash Pond Area

Figure 3A

DRAFT

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section B-B' at Dry Ash Area



CDM Smith

Watts Bar Fossil Plant
Tennessee Valley Authority
Coal Combustion Products Closure Project

Cross-Section B-B' at Dry Ash Area

Figure 3B

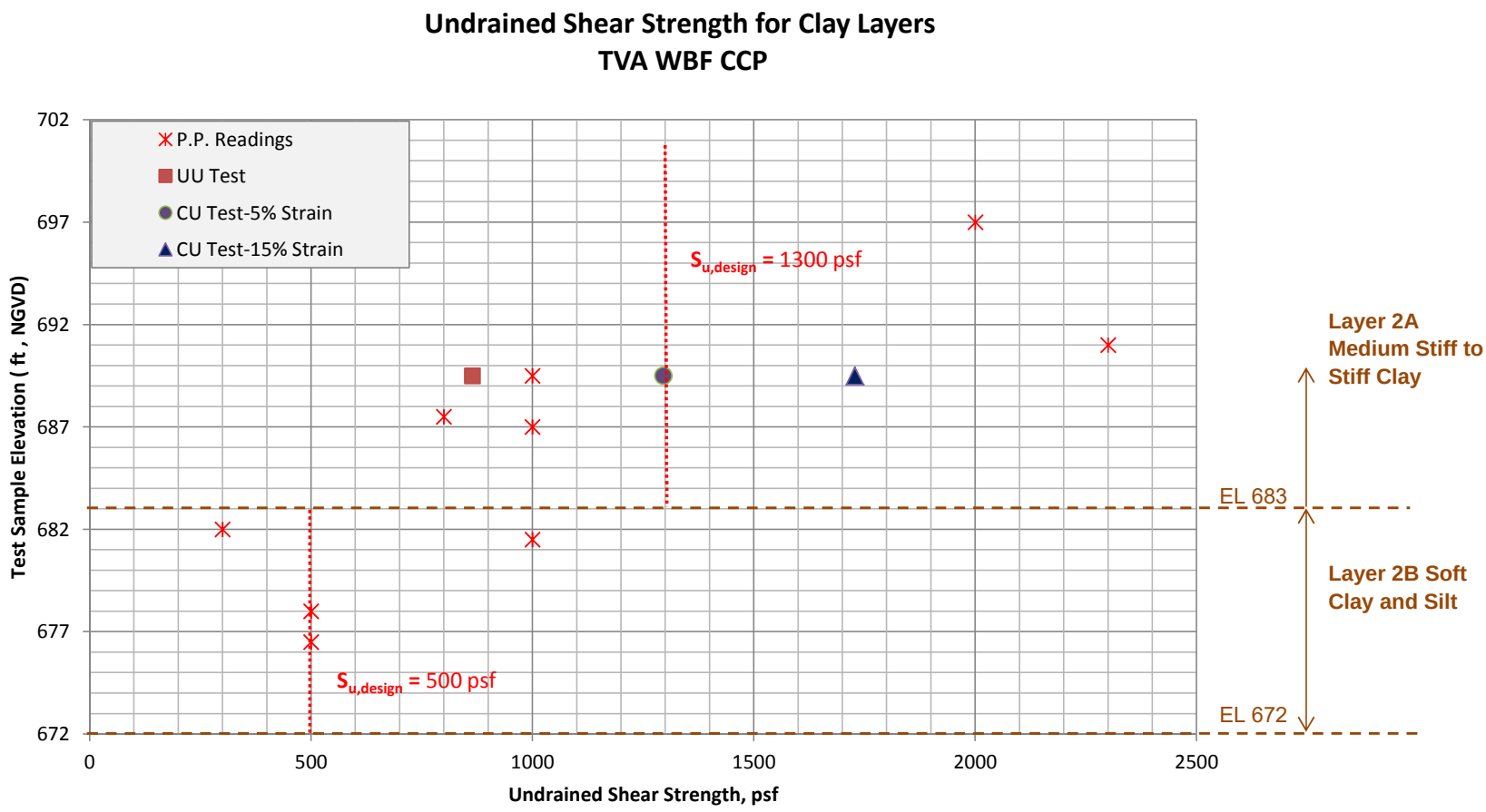


Figure 4. Undrained Shear Strength for Natural Clays

ATTACHMENT A

CDM Smith

BOREHOLE LOG
B-1

Client: TVA
Project Location: Spring City, TN
Project Name: TVA Watts Bar Fossil Plant
Project Number: 83529

Drilling Contractor: Total Depth Drilling
Drilling Method/Rig: 3.25" HSA/CME-55
Drillers: Tim Hall
Drilling Date: Start: 11-16-11 **End:** 11-17-11
Borehole Coordinates:
N 466,232.90 E 2,331,561.10

Surface Elevation (ft.): 699
Total Depth (ft.): 44.6
Depth to Initial Water Level (ft-bgs): 9.3
Abandonment Method: Converted to observation well
Field Screening Instrument:
Logged By: M. Howe

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
			699.0					
SS	S-1	12/11	0		10 40		GW FILL	2-inches GRAVEL. Moist to wet, dense to very dense, tan-brown and gray, GRAVEL and SILT. **-FILL-**
SS	S-2	24/22			12 17 27 22			Moist, dense, dark brown and yellow-brown, fine to coarse SAND, little silt, gravel, trace clay.
SS	S-3	24/18		0.25	13 19 21 11			Moist, hard, orange-brown to blue-gray and tan, SILT, some sand.
			694.0					
SS	S-4	24/20	5	1.0	3 8 5 6			Moist, stiff, tan to blue-gray mottling, CLAY, trace silt, sand, and wood fragments.
SS	S-5	24/16		0.75	2 3 2 2			Moist, medium stiff, tan to blue-gray, CLAY, trace silt, sand, and gravel.
SS	S-6	24/18	689.0 10	0.5	3 3 4 6			Moist, medium stiff, medium brown to tan-brown, SILT, some sand, trace gravel.
SS	S-7	24/18			2 2 2 2		SC/SM	Wet, very loose to loose, fine SAND, some clay, little silt. **- ALLUVIAL SOIL -**
			684.0					

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 pounds, drop height = 30 inches
Split spoon = 2 inches OD, 24 inches long

Borehole coordinates are approximate based upon handheld GPS and elevations are estimated by overlaying coordinates with the survey.

Reviewed by: Danielle Neamtu **Date:** 4-25-12

CDM Smith

BOREHOLE LOG
B-1

Client: TVA
Project Name: TVA Watts Bar Fossil Plant
Project Location: Spring City, TN
Project Number: 83529

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
			684.0 15				SC/SM	
SS	S-8	24/24	679.0	0.75	2 3 4 5		CL	Moist to wet, medium stiff, red-brown to tan-brown, CLAY, little to some sand.
			20					
SS	S-9	24/24	674.0	0.5	2 4 4 5			Moist to wet, medium stiff to stiff, orange-brown to gray-tan, CLAY, some silt, trace to little sand.
			25					
SS	S-10	24/24	669.0		1 2 3 7		SM/SC	Wet, loose, gray to tan, fine SAND, little silt, clay.
			30					
SS	S-11	15/10			11 67 100/3"		SC/SM	Moist to wet, very dense, gray, fine to coarse SAND, little clay, silt, trace gravel. **-WEATHERED ROCK-** Auger refusal at 33.0 feet below ground surface.
NQ	C-1	63/6	664.0 35		2:45 1:45 2:15 8:30 3:15		GW	Split-spoon refusal at 34.3 feet below ground surface. **RUN 1: 34.3 to 39.6 feet-bgs** REC = 9.5%, RQD = 0% Moderately hard, highly weathered, green and brown to gray, aphanitic, INTERBEDDED SHALE, LIMESTONE, and RIVER ROCK; extremely thin bedding, low angle jointing, very close spacing, rough, discolored, open, quartz vugs.

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BOREHOLE LOG
B-1

Client: TVA
Project Name: TVA Watts Bar Fossil Plant
Project Location: Spring City, TN
Project Number: 83529

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
					3:00		GW	
NQ	C-2	60/7.5	659.0 / 40		8:15 5:00 4:15 6:45 3:30		SHALE/LS	**RUN 2: 39.6 to 44.6 feet-bgs** REC = 12.5%, RQD = 0% Moderately hard to hard, highly weathered, gray, aphanitic, INTERBEDDED SHALE and LIMESTONE; very thin to extremely thin bedding, low angle jointing, very close to close spacing, rough, discolored, open, calcite veins.
			654.0 / 45					Boring terminated at 44.6 feet below ground surface.
			649.0 / 50					
			644.0 / 55					
			639.0 / 60					

CDM Smith

BOREHOLE LOG
B-2

Client: TVA
Project Location: Spring City, TN
Project Name: TVA Watts Bar Fossil Plant
Project Number: 83529

Drilling Contractor: Total Depth Drilling
Drilling Method/Rig: 3.25" HSA/CME-55
Drillers: Allan Fowler
Drilling Date: Start: 1-10-12 **End:** 1-10-12
Borehole Coordinates:
N 465,036.40 E 2,331,471.00

Surface Elevation (ft.): 711
Total Depth (ft.): 46.1
Depth to Initial Water Level (ft-bgs): 27.4
Abandonment Method: Grouted to ground surface
Field Screening Instrument:
Logged By: M. Howe

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
			711.0					
			0				ASPHALT	3-inches ASPHALT PAVEMENT.
							GW	8-inches GRAVEL BASE.
SS	1	24/23		3.0	5 6 8 9		FILL	Moist, stiff, orange brown, CLAY, **-FILL-**
SS	2	24/24		>4.5	3 6 10 14			Moist, very stiff, orange brown, CLAY, some silt, trace gravel. Moist, very stiff, dark brown, CLAY, some silt, trace gravel.
			706.0 5					
SS	3	24/24		>4.5	5 8 11 12			Moist, very stiff, dark brown with gray mottling, CLAY, some silt.
SS	4	24/24		4.0	5 8 10 11			Moist, very stiff, dark brown with light brown and gray mottling, CLAY, some silt.
SS	5	24/24	701.0 10	4.5	4 6 7 9			Moist, stiff, dark brown with gray and light brown mottling, CLAY, some silt.
SS	6	24/14	696.0	2.0	3 6 7		CH	Moist, stiff, orange to yellow brown, CLAY, little sand (in lenses). **- ALLUVIAL SOIL -**

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 pounds, drop height = 30 inches
Split spoon = 2 inches OD, 24 inches long

Borehole coordinates are approximate based upon handheld GPS and elevations are estimated by overlaying coordinates with the survey.

Reviewed by: Danielle Neamtu **Date:** 4-25-12

CDM Smith

BOREHOLE LOG
B-2

Client: TVA
Project Name: TVA Watts Bar Fossil Plant
Project Location: Spring City, TN
Project Number: 83529

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
			696.0		8		CH	
			15					
SS	7	24/24	691.0 / 20	2.3	3 3 5 5		CL	Moist, medium stiff to stiff, medium brown to tan, CLAY, trace to little sand.
ST	1	24/24		1.0				Shelby tube sample collected from 20.5 to 22.5 feet below ground surface. Moist to wet, medium brown, CLAY, little silt, trace sand.
SS	8	24/19		0.8	2 3 3 3			Moist, medium stiff, medium brown, CLAY, trace to little silt.
			686.0 / 25					
SS	9	24/24	681.0 / 30	1.0	1 2 3 3			Moist to wet, medium stiff, medium brown, CLAY, little silt, trace sand.
SS	10	24/24	676.0 / 35	0.5	1 2 2 2			Wet, soft to medium stiff, medium brown, CLAY, some silt, little sand.
					1			Wet, loose, medium brown, fine to medium SAND, trace silt.

CDM Smith

BOREHOLE LOG
B-2

Client: TVA
Project Name: TVA Watts Bar Fossil Plant
Project Location: Spring City, TN
Project Number: 83529

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. / Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
SS	11	24/24	671.0 / 40		2 4 6		SP-SM	
SS	12	23/23	666.0 / 45		1 11 13			Wet, medium dense, medium brown, fine to medium SAND, trace silt.
					100/5"		SW/GW	Wet, very dense, gray, fine to coarse SAND and GRAVEL, trace silt. **-WEATHERED ROCK-**
SS	13	1/1			100/1"			Auger refusal at 46.0 feet below ground surface. Split-spoon refusal at 46.1 feet below ground surface.
			661.0 / 50					
			656.0 / 55					
			651.0 / 60					

CDM Smith

BOREHOLE LOG
B-3

Client: TVA
Project Location: Spring City, TN
Project Name: TVA Watts Bar Fossil Plant
Project Number: 83529

Drilling Contractor: Total Depth Drilling
Drilling Method/Rig: 3.25" HSA/CME-55
Drillers: Tim Hall
Drilling Date: Start: 11-15-11 **End:** 11-16-11
Borehole Coordinates:
N 464,593.80 E 2,331,431.10

Surface Elevation (ft.): 701
Total Depth (ft.): 54.8
Depth to Initial Water Level (ft-bgs): 18.1
Abandonment Method: Converted to observation well
Field Screening Instrument:
Logged By: M. Howe

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
			701.0					
			0		2		TOPSOIL	2-inches TOPSOIL.
SS	S-1	24/18		3.5	4 5 6		FILL	Moist, stiff, medium brown to dark brown, CLAY, trace sand, **-FILL-**
SS	S-2	24/24		1.0	4 7 12 9			Moist, very stiff, medium brown to dark brown with orange, CLAY, trace sand.
SS	S-3	24/20	696.0 / 5	2.0	4 6 6 5			Moist, stiff, medium brown with orange, SILT, some sand.
SS	S-4	24/22		1.0	6 5 7 5			Moist, medium dense, medium brown to orange-brown, fine SAND, little silt.
SS	S-5	24/19		1.0	4 4 7 5			Moist, stiff, medium brown to orange-brown, CLAY, little sand.
			691.0 / 10					Moist, medium dense, medium brown to orange-brown, fine SAND, some silt, clay.
SS	S-6	24/22		1.0	3 4 5 5		CL	Moist to wet, stiff, medium brown, CLAY, little silt. **- ALLUVIAL SOIL -**
			686.0					

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
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CS - California Sampler
BX - 1.5" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
AGS - Above Ground Surface

REMARKS

Hammer weight = 140 pounds, drop height = 30 inches
Split spoon = 2 inches OD, 24 inches long

Borehole coordinates are approximate based upon handheld GPS and elevations are estimated by overlaying coordinates with the survey.

Reviewed by: Danielle Neamtu **Date:** 4-25-12

CDM Smith

BOREHOLE LOG
B-3

Client: TVA
Project Name: TVA Watts Bar Fossil Plant
Project Location: Spring City, TN
Project Number: 83529

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
			686.0 15				CL	
SS	S-7	24/10	681.0 20	0.3	1 1 1 2		CL-ML	Wet, very soft to soft, medium brown to tan-brown, SILT and CLAY, little sand.
SS	S-8	24/24	676.0 25	0.5	2 1 2 2		CL	Wet, soft, medium brown to tan-brown, CLAY, some silt, trace sand.
SS	S-9	24/24	671.0 30		2 1 2 3		SP-SM	Wet, very loose, medium brown to gray-brown, fine SAND, little silt.
SS	S-10	24/15	666.0 35		2 8 11 12			Wet, medium dense, tan to gray, fine to coarse SAND, some gravel, trace silt.
SS	S-11	8/8			48 100/2"		SM/SC	Wet, very dense, gray, fine to coarse SAND, little silt, clay, trace gravel. **-WEATHERED ROCK-**

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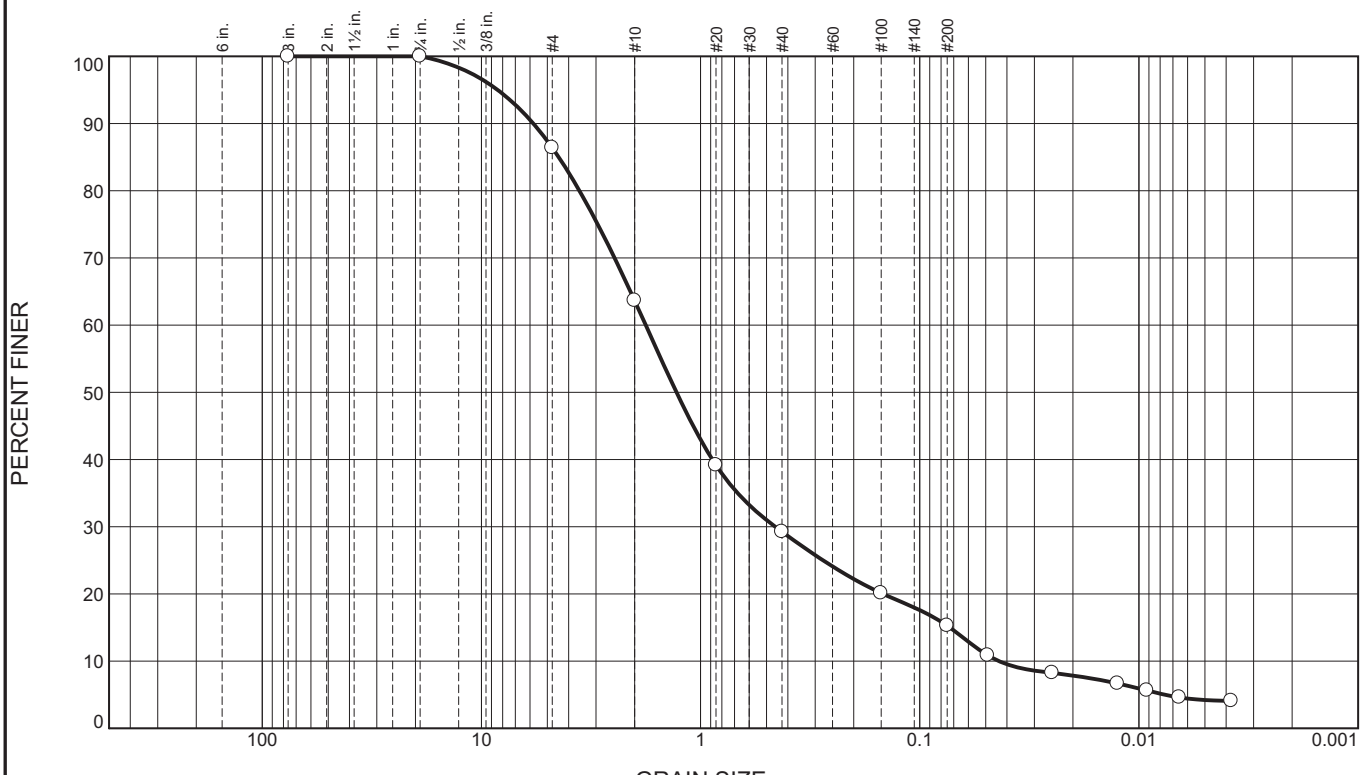
BOREHOLE LOG
B-3

Client: TVA
Project Name: TVA Watts Bar Fossil Plant
Project Location: Spring City, TN
Project Number: 83529

Sample Type	Sample Number	Sample Adv/Rec (inches)	Elev. Depth (ft.)	Pocket Penetrometer Reading (tsf)	Blows per 6-in	Graphic Log	USCS Designation	Material Description
			661.0 / 40				SM/SC	Split-spoon refusal at 38.7 feet below ground surface. Auger refusal at 40.4 feet below ground surface.
NQ	C-1	52.8/6			7:30 6:00 6:00 5:15 2:00		GW	**RUN 1: 40.4 to 44.8 feet-bgs** REC = 9%, RQD = 0% Moderately hard to hard, highly weathered, brown and orange to gray, aphanitic, interbedded SHALE, LIMESTONE, and RIVER ROCK; extremely thin bedding, low angle jointing, very close spacing, rough, discolored, open, calcite veins.
NQ	C-2	60/14	656.0 / 45		4:30 7:00 6:00 7:15 8:15		SHALE/LS	**RUN 2: 44.8 to 49.8 feet-bgs** REC = 23%, RQD = 0% Moderately hard to hard, highly weathered,gray, aphanitic, interbedded LIMESTONE and SHALE; very thin bedding, low angle jointing, very close spacing, rough, discolored, open, calcite veins.
NQ	C-3	60/9.5	651.0 / 50		9:45 16:15 7:30 8:15 6:45		SHALE/LS	**RUN 3: 49.8 to 54.8 feet-bgs** REC = 16%, RQD = 0% Moderately hard, highly weathered,gray, aphanitic, interbedded LIMESTONE and SHALE; extremely thin to very thin bedding, low angle jointing, very close spacing, rough, discolored, open.
			646.0 / 55 641.0 / 60					Boring terminated at 54.8 feet below ground surface.

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.6	22.8	34.4	13.9	11.1	4.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
3/4	100.0		
#4	86.4		
#10	63.6		
#20	39.1		
#40	29.2		
#100	20.1		
#200	15.3		

* (no specification provided)

Material Description

Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 5.8002 D_{85}= 4.4393 D_{60}= 1.7795
D_{50}= 1.2880 D_{30}= 0.4565 D_{15}= 0.0730
D_{10}= 0.0435 C_u= 40.87 C_c= 2.69

Classification

USCS= SM AASHTO=

Remarks

As received moisture content=6.9%
Soil classification and description based on
Visual Manual Procedure ASTM D2488

Source of Sample: B-1 **Depth:** 1-3
Sample Number: S-2 **Date:** 11/16/2011

CDM Smith

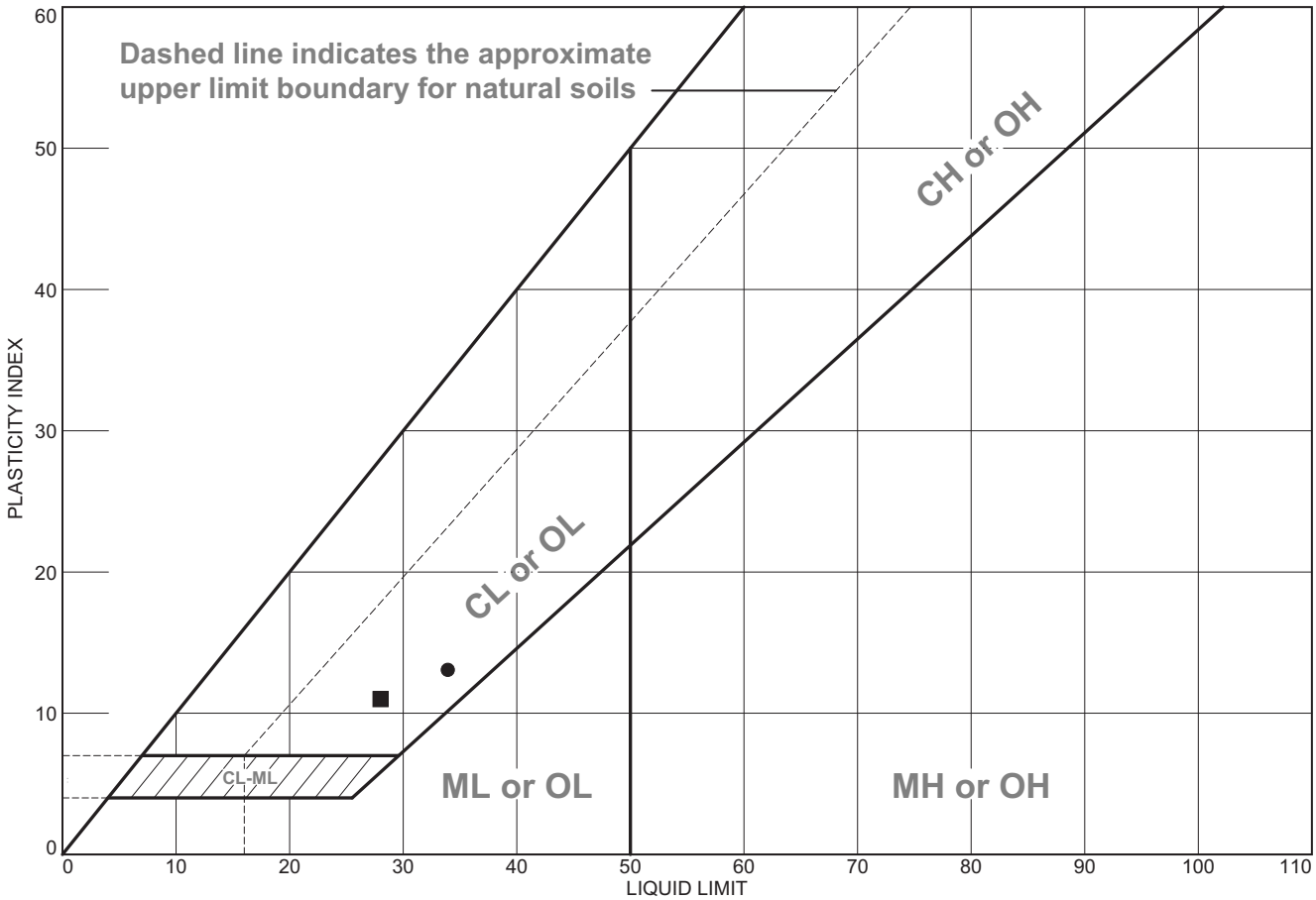
Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean clay	34	21	13			CL
■	Lean clay	28	17	11			CL

Project No. 95618-83529 **Client:** TVA

Project: Watts Bar Fossil Plant CCP Closure

●**Source of Sample:** B-1 **Depth:** 5-7 **Sample Number:** S-4

■**Source of Sample:** B-1 **Depth:** 23-25 **Sample Number:** S-9

Remarks:

●As received moisture content=16.2%

■As received moisture content=23.0%

CDM Smith

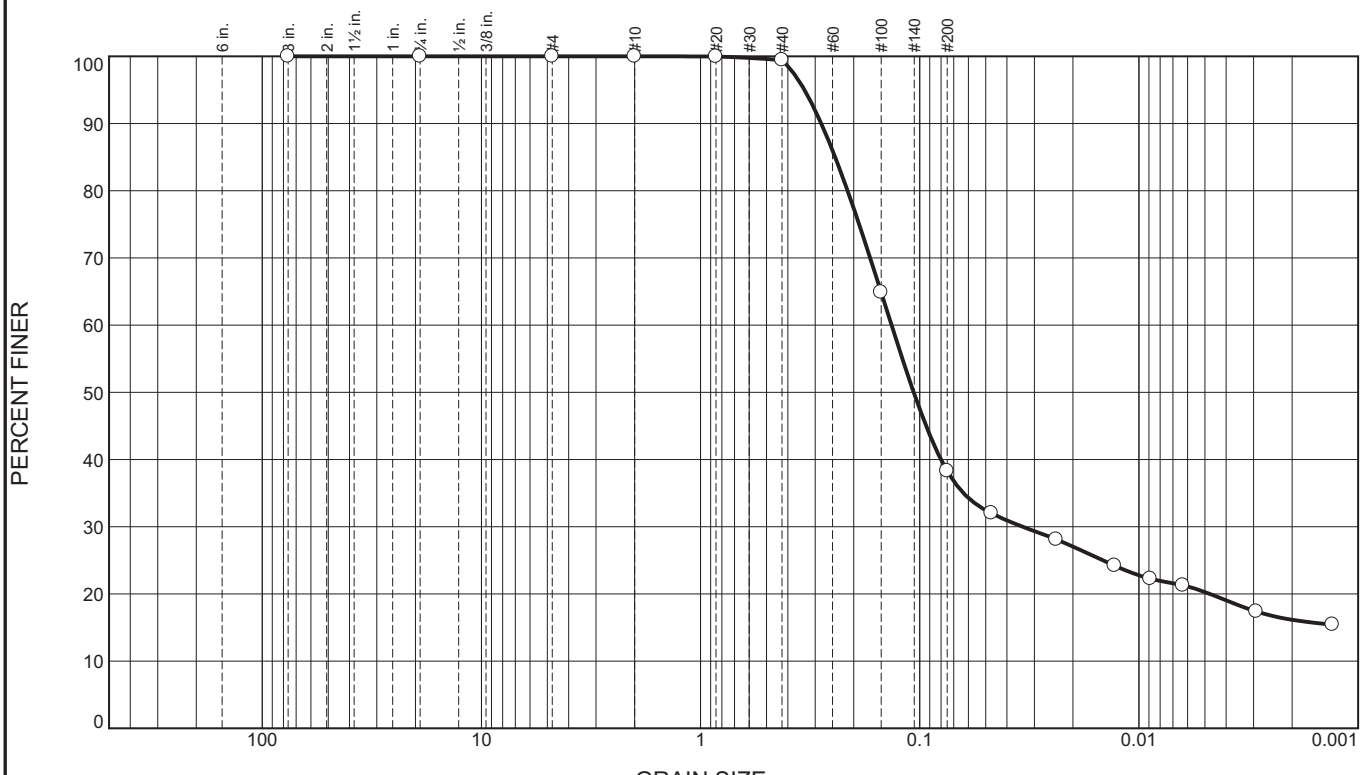
Cambridge, Massachusetts

Figure

Tested By: NE **Checked By:** MR

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	61.1	18.0	20.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
3/4	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.4		
#100	64.9		
#200	38.3		

* (no specification provided)

Material Description

Clayey sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2815 D_{85}= 0.2433 D_{60}= 0.1345
D_{50}= 0.1066 D_{30}= 0.0339 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

As received moisture content=20.2%
Soil classification and description based on
Visual Manual Procedure ASTM D2488

Source of Sample: B-1 **Depth:** 13-15
Sample Number: S-7 **Date:** 11/16/2011

CDM Smith

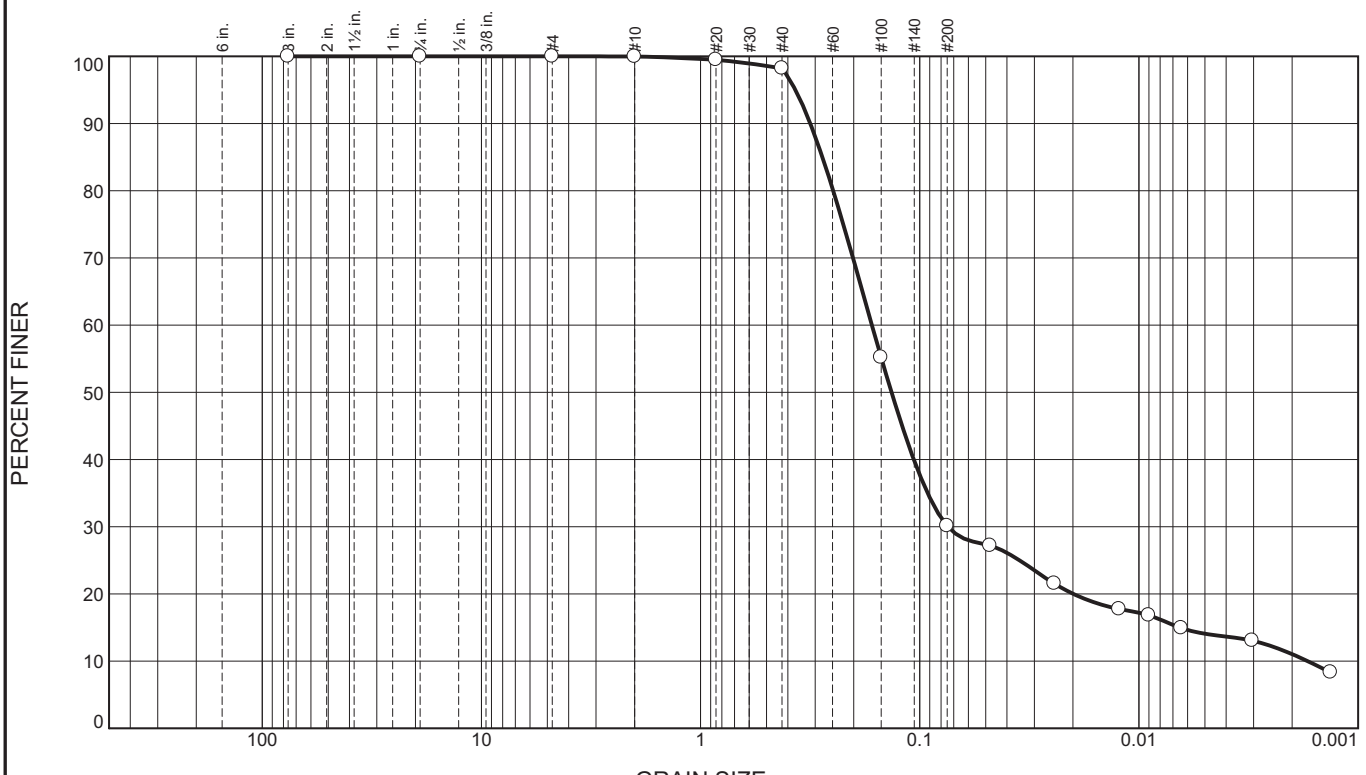
Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.8	68.1	16.0	14.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
3/4	100.0		
#4	100.0		
#10	100.0		
#20	99.5		
#40	98.2		
#100	55.2		
#200	30.1		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3160 D_{85}= 0.2782 D_{60}= 0.1653
D_{50}= 0.1346 D_{30}= 0.0744 D_{15}= 0.0065
D_{10}= 0.0017 C_u= 97.09 C_c= 19.66

Classification

USCS= SM AASHTO=

Remarks

As received moisture content=34.5%
Soil classification and description based on
Visual Manual Procedure ASTM D2488

Source of Sample: B-1 **Depth:** 28-30
Sample Number: S-10 **Date:** 11/16/2012

CDM Smith

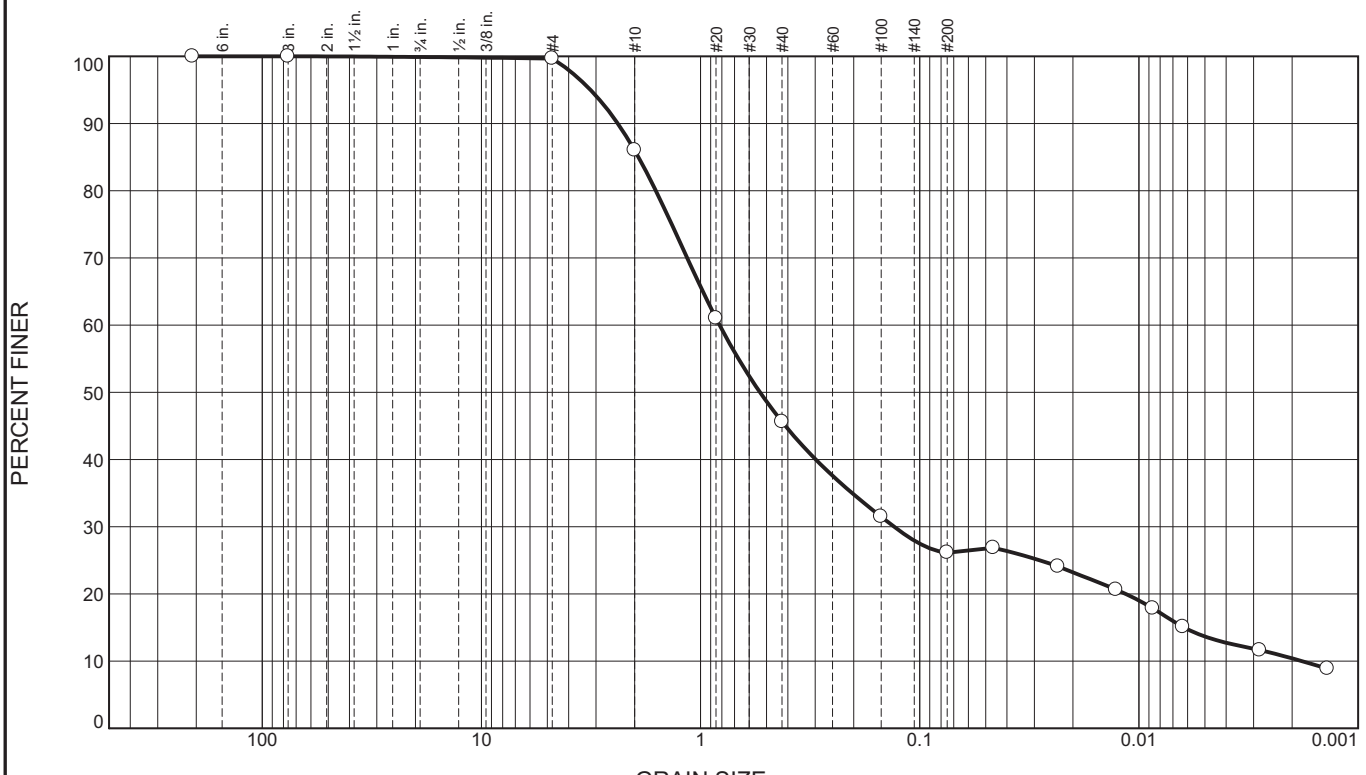
Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.1	0.2	13.7	40.4	19.5	12.4	13.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
8.19	100.0		
3	100.0		
#4	99.7		
#10	86.0		
#20	61.0		
#40	45.6		
#100	31.5		
#200	26.1		

* (no specification provided)

Material Description

Silty sand
Note: Portion of sample soft, weathered rock easily broken into smaller fractions during sample preparation.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.3878 D_{85}= 1.9212 D_{60}= 0.8189
D_{50}= 0.5357 D_{30}= 0.1310 D_{15}= 0.0062
D_{10}= 0.0018 C_u= 453.07 C_c= 11.59

Classification

USCS= SM AASHTO=

Remarks

As received moisture content=7.4%
Soil classification and description based on Visual Manual Procedure ASTM D2488

Source of Sample: B-1 **Depth:** 33-34.5
Sample Number: S-11 **Date:** 11/16/2011

CDM Smith

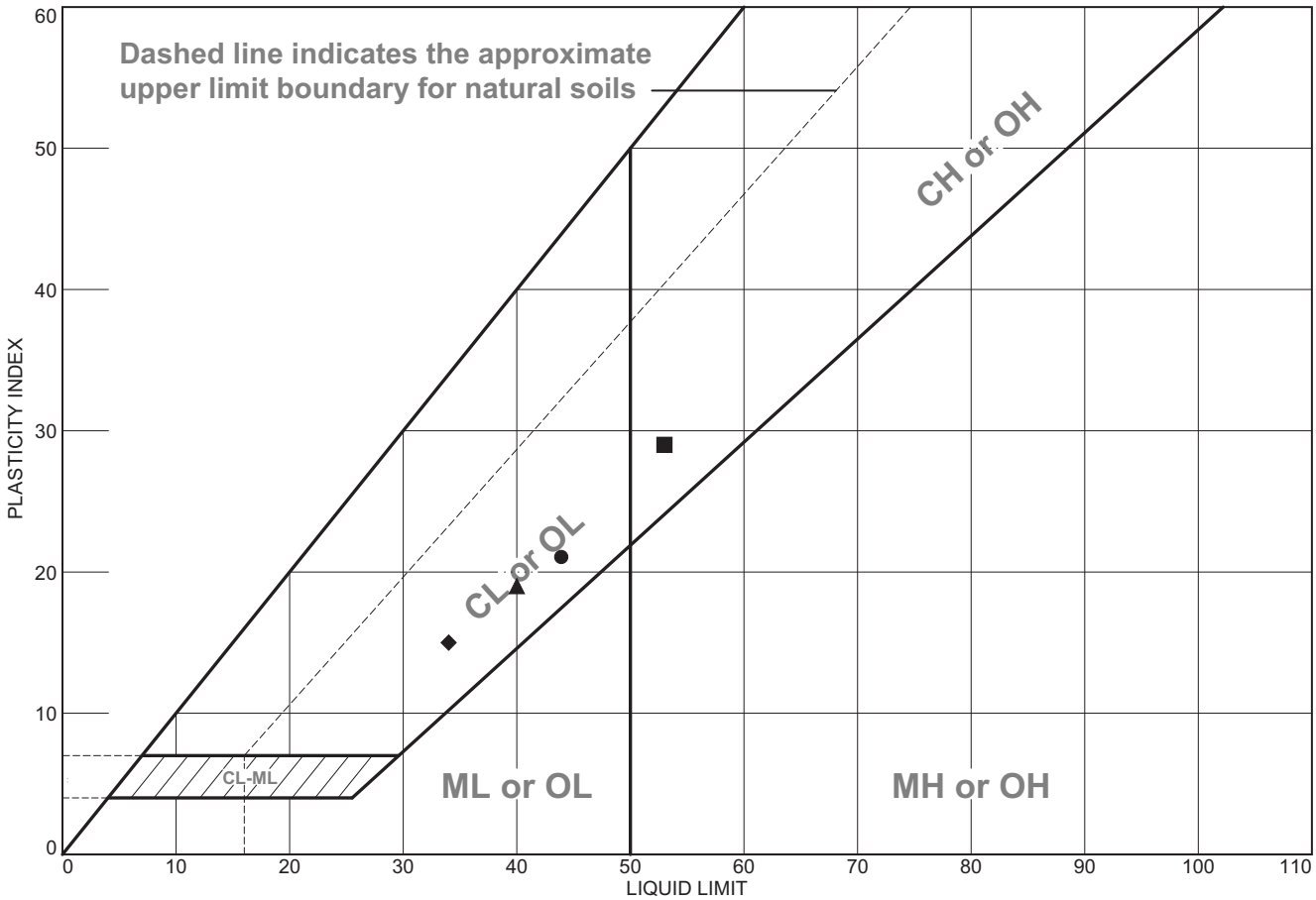
Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean clay	44	23	21			CL
■	Fat clay	53	24	29			CH
▲	Lean clay	40	21	19			CL
◆	Lean clay	34	19	15			CL

Project No. 95618-83529 **Client:** TVA

Project: Watts Bar Fossil Plant CCP Closure

●**Source of Sample:** B-2 **Depth:** 5-7 **Sample Number:** S-3

■**Source of Sample:** B-2 **Depth:** 13.5-15.5 **Sample Number:** S-6

▲**Source of Sample:** B-2 **Depth:** 28.5-30.5 **Sample Number:** S-9

◆**Source of Sample:** B-2 **Depth:** 20.5-22.5 **Sample Number:** U-1

Remarks:

●As received moisture content=21.7%

■As received moisture content=20.6%

▲As received moisture content=27.8%

◆As received moisture content=14.6%

CDM Smith

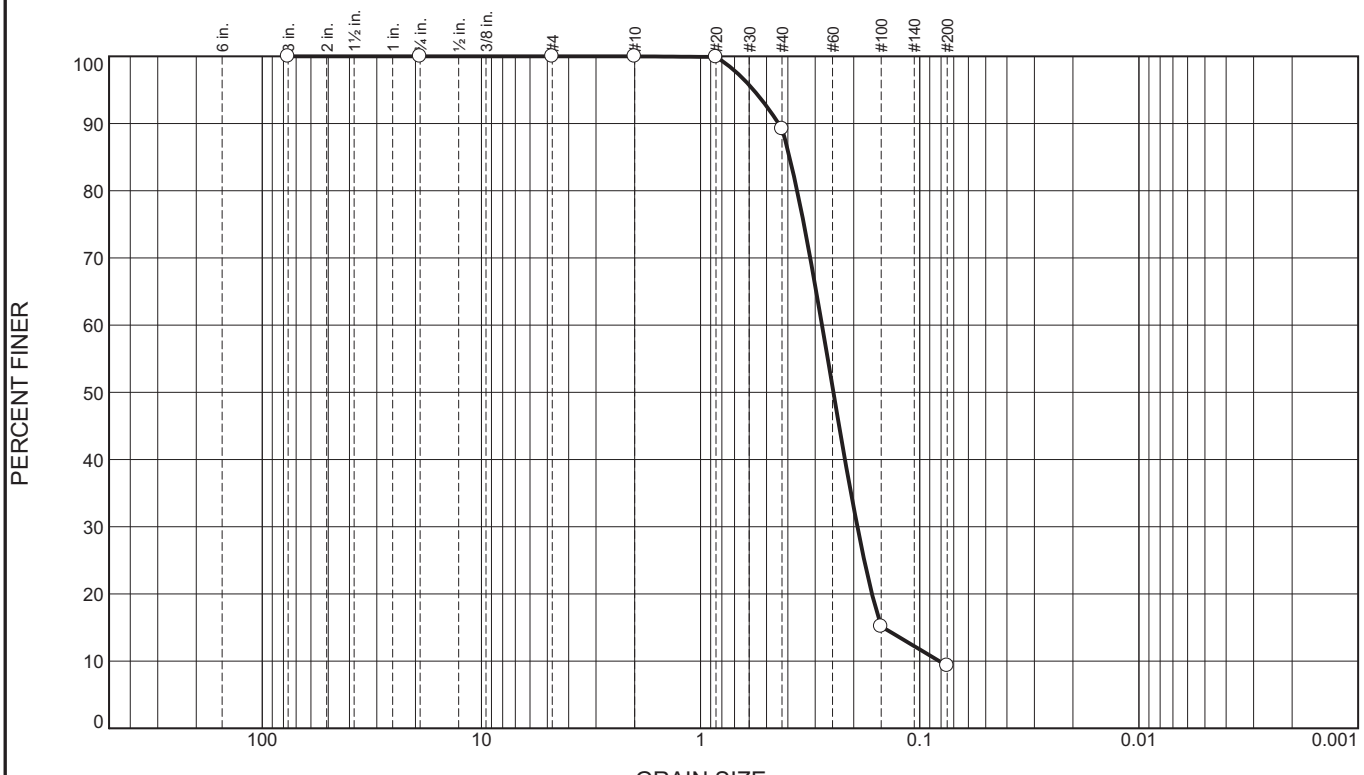
Cambridge, Massachusetts

Figure

Tested By: NE **Checked By:** MR

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	10.8	79.9	9.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
3/4	100.0		
#4	100.0		
#10	100.0		
#20	99.9		
#40	89.2		
#100	15.2		
#200	9.3		

* (no specification provided)

Material Description

Poorly graded sand with silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.4406 D_{85}= 0.3927 D_{60}= 0.2792
D_{50}= 0.2477 D_{30}= 0.1926 D_{15}= 0.1470
D_{10}= 0.0814 C_u= 3.43 C_c= 1.63

Classification

USCS= SP-SM AASHTO=

Remarks

As received moisture content=27.6%
Soil classification and description based on
Visual Manual Procedure ASTM D 2488

Source of Sample: B-2 **Depth:** 38.5-40.5
Sample Number: S-11 **Date:** 1/10/2012

CDM Smith

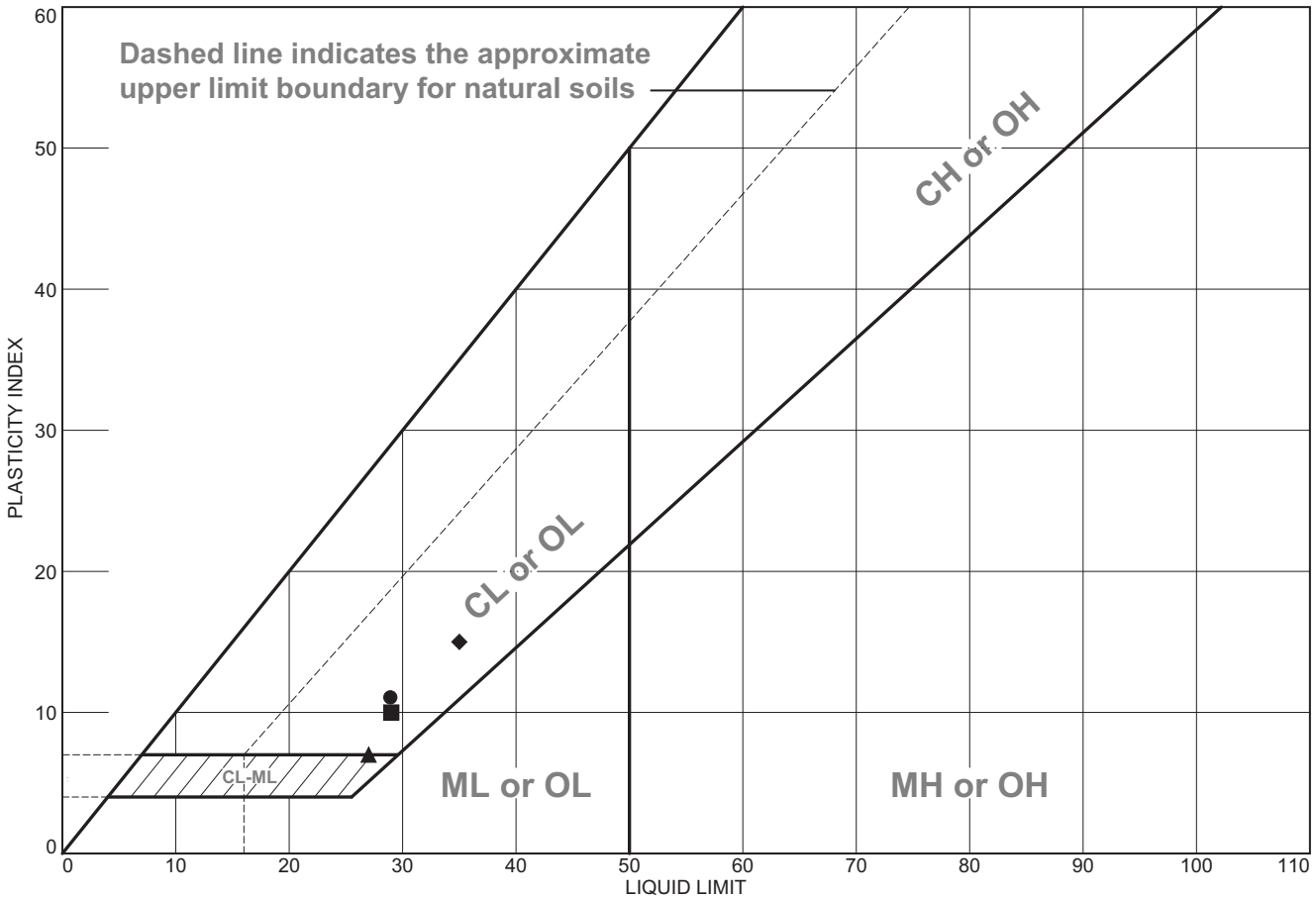
Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Lean clay	29	18	11			CL
■	Lean clay	29	19	10			CL
▲	Lean clay-low plasticity silt	27	20	7			CL-ML
◆	Lean clay	35	20	15			CL

Project No. 95618-83529 **Client:** TVA

Project: Watts Bar Fossil Plant CCP Closure

●**Source of Sample:** B-3 **Depth:** 2-4 **Sample Number:** S-2

■**Source of Sample:** B-3 **Depth:** 13-15 **Sample Number:** S-6

▲**Source of Sample:** B-3 **Depth:** 18-20 **Sample Number:** S-7

◆**Source of Sample:** B-3 **Depth:** 23-25 **Sample Number:** S-8

Remarks:

●As received moisture content=14.5%

■As received moisture content=21.3%

▲As received moisture content=28.1%

◆As received moisture content=31.9%

CDM Smith

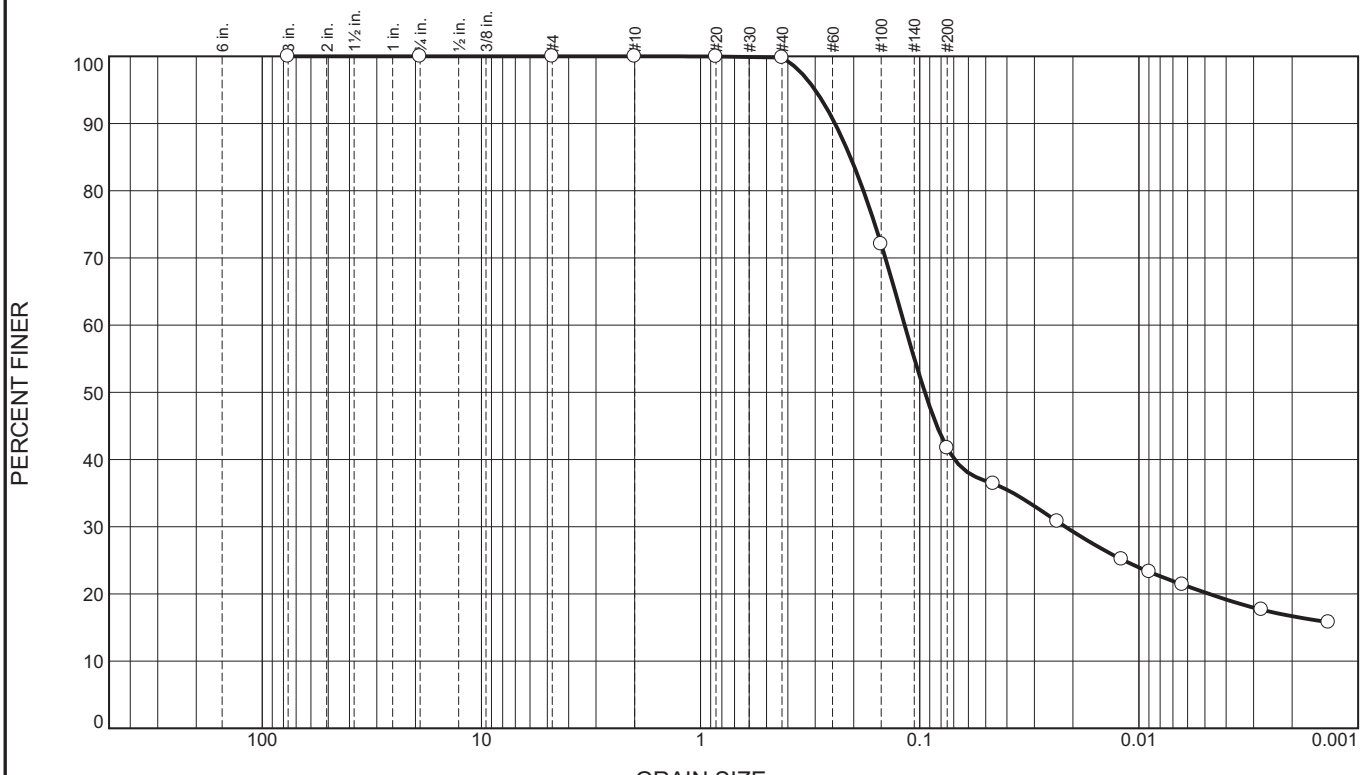
Cambridge, Massachusetts

Figure

Tested By: NE **Checked By:** MR

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	58.1	21.5	20.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
3/4	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#100	72.1		
#200	41.7		

* (no specification provided)

Material Description

Clayey sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2437 D_{85}= 0.2072 D_{60}= 0.1172
D_{50}= 0.0948 D_{30}= 0.0217 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

As received moisture content=14.5%
Soil classification and description based on
Visual Manual Procedure ASTM D 2488

Source of Sample: B-3 **Depth:** 8-10
Sample Number: S-5 **Date:** 11/15/2011

CDM Smith

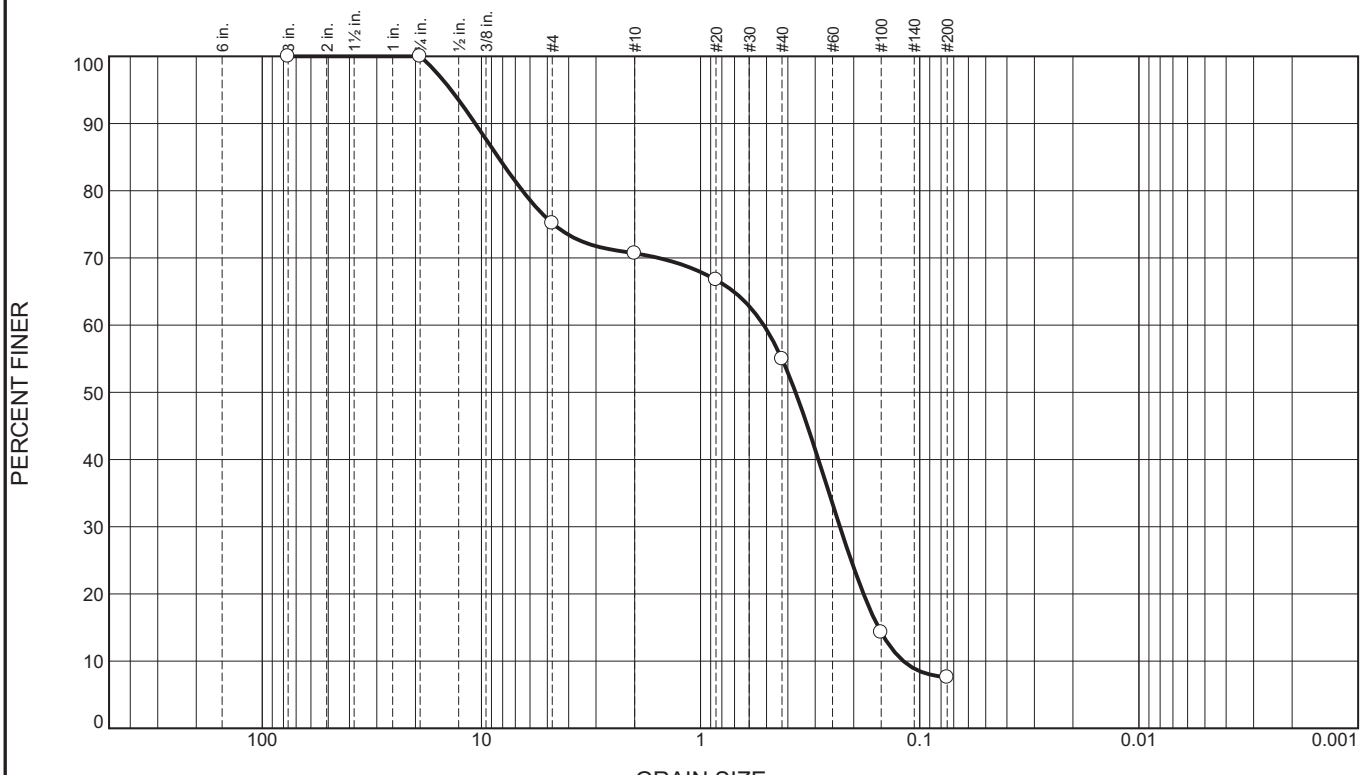
Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	24.8	4.5	15.8	47.3	7.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
3/4	100.0		
#4	75.2		
#10	70.7		
#20	66.7		
#40	54.9		
#100	14.3		
#200	7.6		

* (no specification provided)

Material Description

Poorly graded sand with silt and gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.6723 D_{85}= 8.3878 D_{60}= 0.5154
D_{50}= 0.3688 D_{30}= 0.2314 D_{15}= 0.1542
D_{10}= 0.1187 C_u= 4.34 C_c= 0.88

Classification

USCS= SP-SM AASHTO=

Remarks

As received moisture content=22.0%
Soil classification and description based on
Visual Manual Procedure ASTM D 2488

Source of Sample: B-3 **Depth:** 33-35
Sample Number: S-10 **Date:** 11/15/2011

CDM Smith

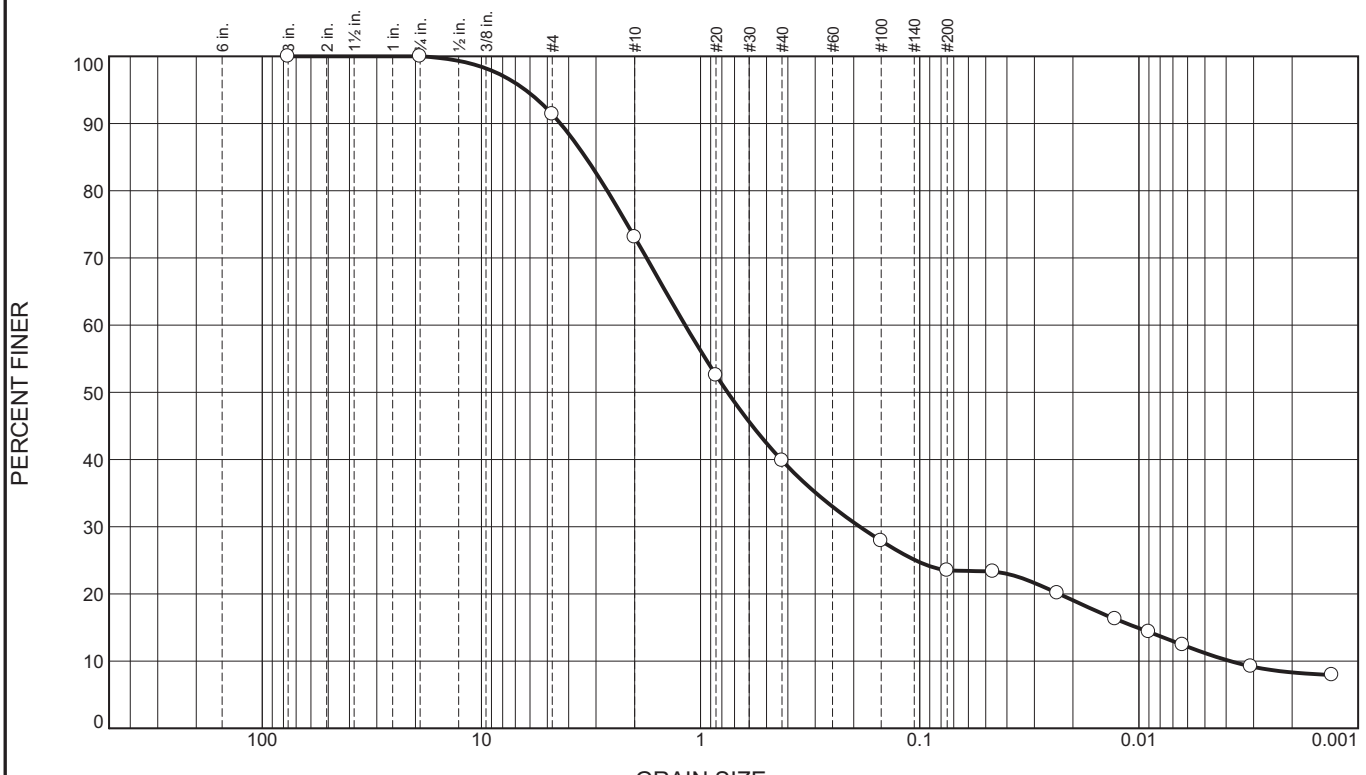
Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.6	18.3	33.3	16.3	12.3	11.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
3/4	100.0		
#4	91.4		
#10	73.1		
#20	52.5		
#40	39.8		
#100	27.9		
#200	23.5		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.3626 D_{85}= 3.3491 D_{60}= 1.1759
D_{50}= 0.7530 D_{30}= 0.1876 D_{15}= 0.0102
D_{10}= 0.0038 C_u= 306.42 C_c= 7.80

Classification

USCS= SM AASHTO=

Remarks

As received moisture content=11.6%
Soil classification and description based on
Visual Manual Procedure ASTM D2488

Source of Sample: B-3 **Depth:** 38-38.7
Sample Number: S-11 **Date:** 11/15/2011

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Cambridge, Massachusetts

Client: TVA
Project: Watts Bar Fossil Plant CCP Closure
Project No: 95618-83529 **Figure**

Tested By: NE **Checked By:** MR

DRAFT

CDM Smith

Geotechnical Engineering Laboratory

ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL TEST SUMMARY - ASTM D4767

Client:	TVA	**Test Date:**	3/14/2012	**LL :**	34
Project:	Watts Bar	**Exploration No:**	B-2	**PL :**	19
Location:	Spring City, TN	**Sample No:**	U-1 Specimen 1	**PI :**	15
Project No:	95618-83529	**Depth (ft):**	21	**USCS:**	CL

Initial

Moisture Content (%):	20.7%
Dry Unit Weight (pcf):	105.9
Diameter (in):	1.407
Height (in):	3.125
Void Ratio (-):	0.59
Saturation (%):	94.7%
Moisture Content (Trim.%):	19.9%
Cross Sectional Area (in^2):	1.555

Final

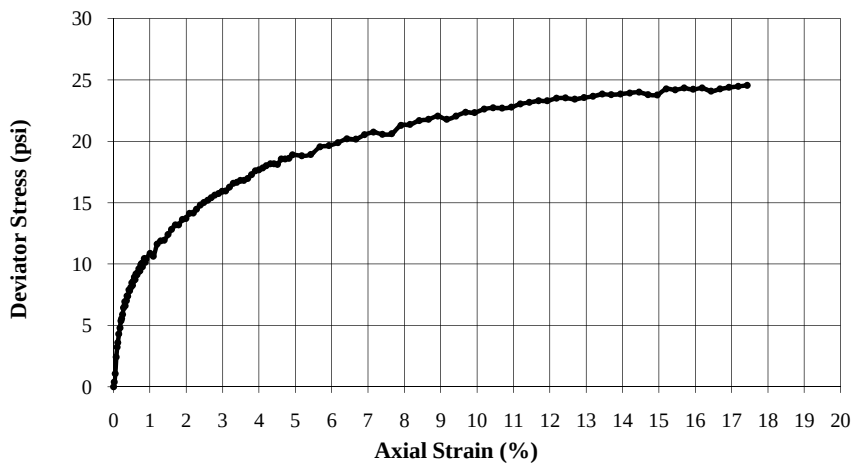
Moisture Content (%):	23.2%
Dry Unit Weight (pcf):	103.3
Height (in):	2.564
Void Ratio (-):	0.63
Saturation (%):	99.4%
Cross Sectional Area (in^2):	1.926

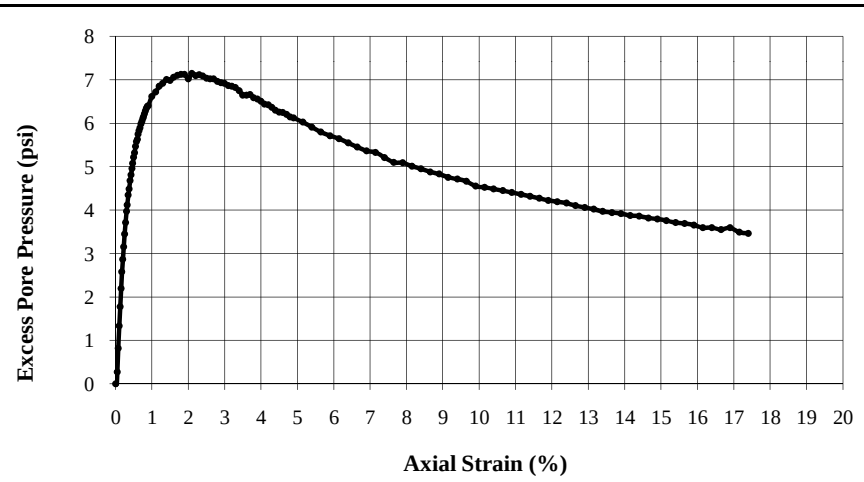
End of Consolidation Data

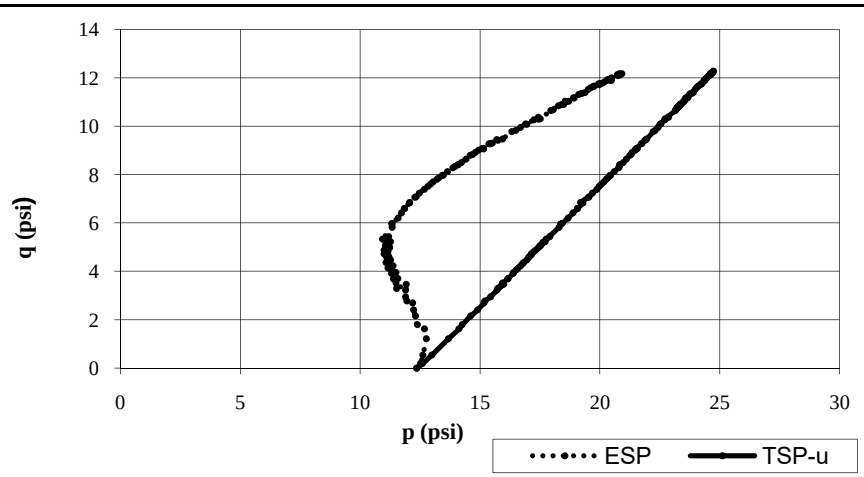
A_c Evaluated using Method	B
Sample Saturated using Method	B
Moisture Content (%):	23.2%
Dry Unit Weight (pcf):	103.3
Height (in):	3.125
Void Ratio (-):	0.63
Saturation (%):	99.4%
Cross Sectional Area (in^2):	1.590
Pore Pressure Parameter B (-):	0.97
Final Back Pressure (psi):	80
Consolidation Pressure (psi):	12.21

Shear Data

Shear Strain Rate (%/hr):	1%
Max. Deviator Stress (psi):	24.56
Strain at Failure (%):	15.00
Minor Eff. Pr. Stress (psi):	8.88
Major Eff. Pr. Stress (psi):	33.44
Undrained Strength Ratio (-):	1.01







Notes:

1. Value of Specific Gravity Gs is assumed
2. Failure criterion: max. deviator stress at strain ≤ 15%

Remarks:

DRAFT

CDM Smith

Geotechnical Engineering Laboratory

ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL TEST SUMMARY - ASTM D4767

Client:	TVA	**Test Date:**	3/14/2012	**LL :**	34
Project:	Watts Bar	**Exploration No:**	B-2	**PL :**	19
Location:	Spring City, TN	**Sample No:**	U-1 Specimen 2	**PI :**	15
Project No:	95618-83529	**Depth (ft):**	21	**USCS:**	CL

Initial

Moisture Content (%):	19.3%
Dry Unit Weight (pcf):	104.4
Diameter (in):	1.385
Height (in):	3.220
Void Ratio (-):	0.61
Saturation (%):	84.8%
Moisture Content (Trim.%):	20.6%
Cross Sectional Area (in^2):	1.507

Final

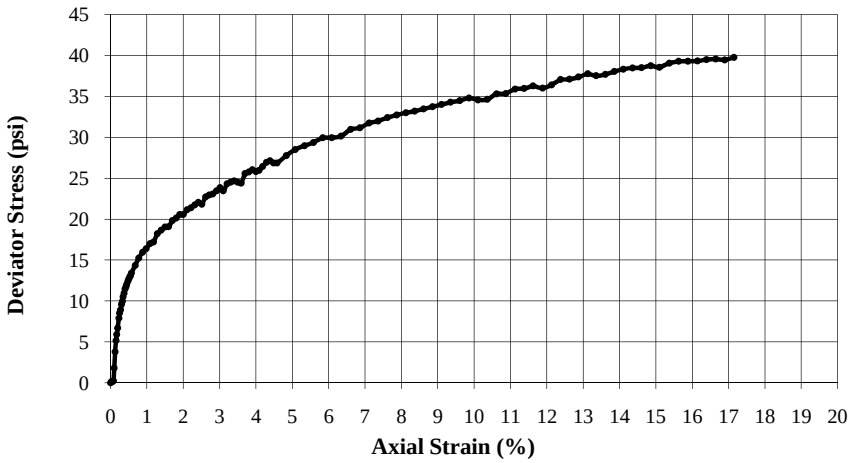
Moisture Content (%):	22.8%
Dry Unit Weight (pcf):	104.0
Height (in):	2.651
Void Ratio (-):	0.62
Saturation (%):	99.4%
Cross Sectional Area (in^2):	1.820

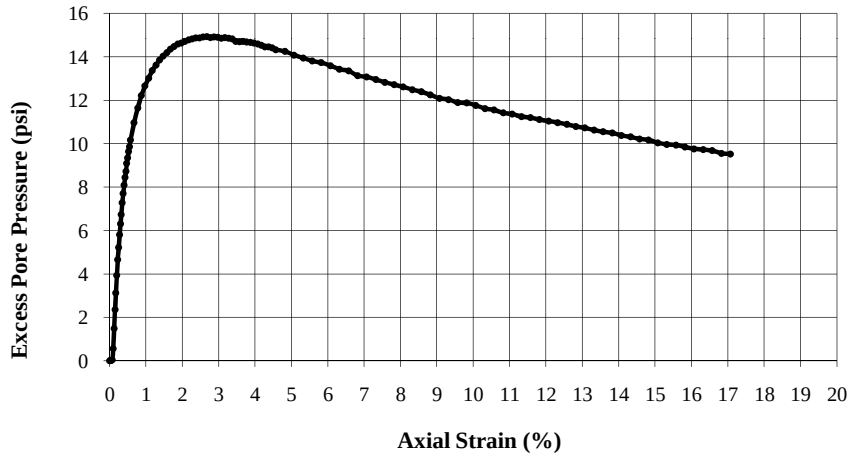
End of Consolidation Data

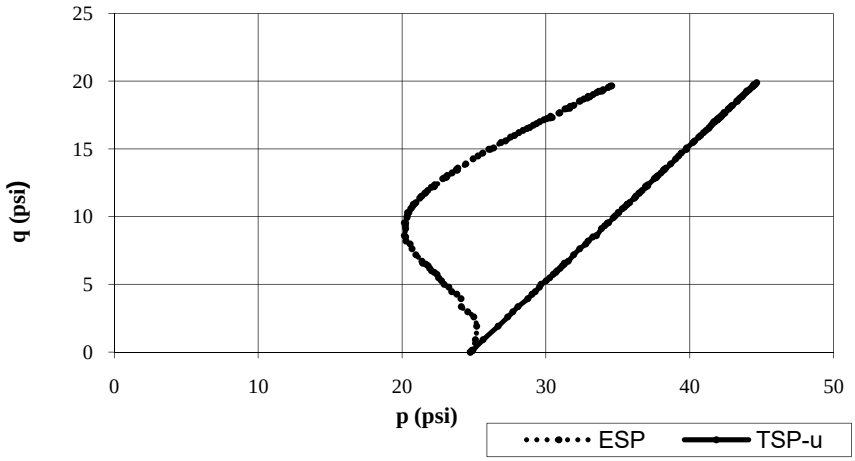
A_c Evaluated using Method	B
Sample Saturated using Method	B
Moisture Content (%):	22.8%
Dry Unit Weight (pcf):	104.0
Height (in):	3.219
Void Ratio (-):	0.62
Saturation (%):	99.4%
Cross Sectional Area (in^2):	1.508
Pore Pressure Parameter B (-):	0.97
Final Back Pressure (psi):	85
Consolidation Pressure (psi):	24.34

Shear Data

Shear Strain Rate (%/hr):	1%
Max. Deviator Stress (psi):	39.77
Strain at Failure (%):	15.00
Minor Eff. Pr. Stress (psi):	15.25
Major Eff. Pr. Stress (psi):	55.02
Undrained Strength Ratio (-):	0.82







Notes:

1. Value of Specific Gravity Gs is assumed
2. Failure criterion: max. deviator stress at strain ≤ 15%

Remarks:

DRAFT

CDM Smith

Geotechnical Engineering Laboratory

ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL TEST SUMMARY - ASTM D4767

Client:	TVA	**Test Date:**	3/14/2012	**LL :**	34
Project:	Watts Bar	**Exploration No:**	B2	**PL :**	19
Location:	Spring City, TN	**Sample No:**	U-1 Specimen 3	**PI :**	15
Project No:	95618-83529	**Depth (ft):**	21	**USCS:**	CL

Initial

Moisture Content (%):	20.8%
Dry Unit Weight (pcf):	104.5
Diameter (in):	1.411
Height (in):	3.085
Void Ratio (-):	0.61
Saturation (%):	91.7%
Moisture Content (Trim.%):	20.2%
Cross Sectional Area (in^2):	1.564

Final

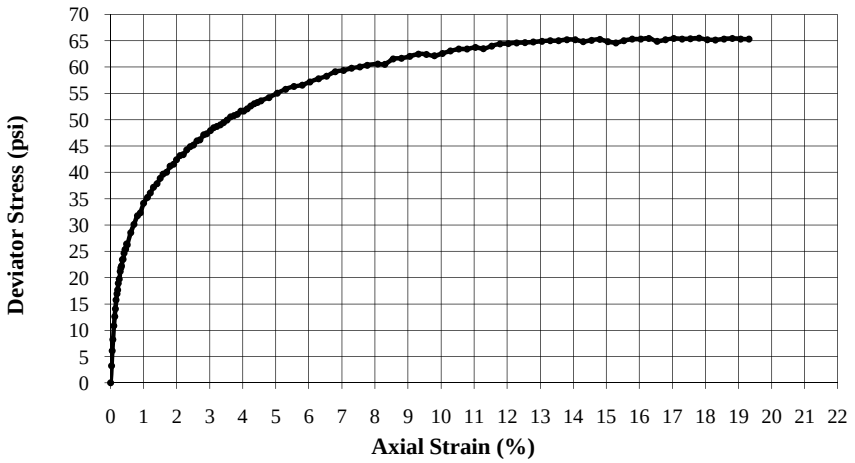
Moisture Content (%):	21.1%
Dry Unit Weight (pcf):	107.1
Height (in):	2.480
Void Ratio (-):	0.57
Saturation (%):	99.4%
Cross Sectional Area (in^2):	1.853

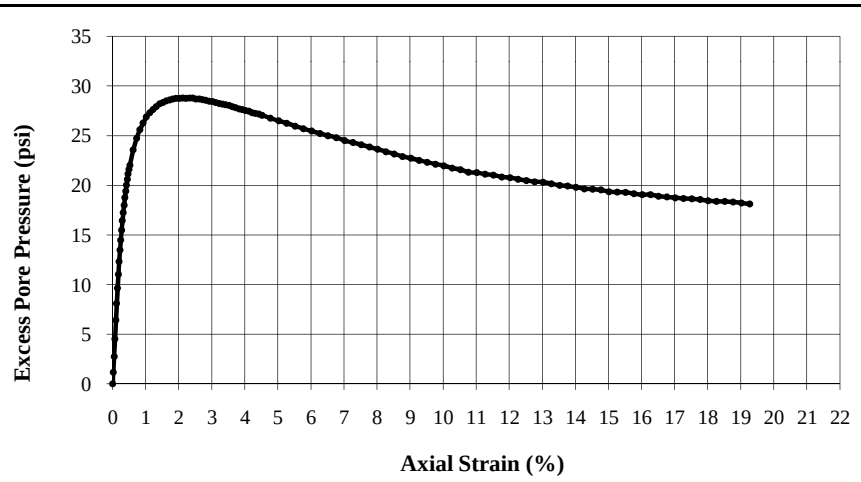
End of Consolidation Data

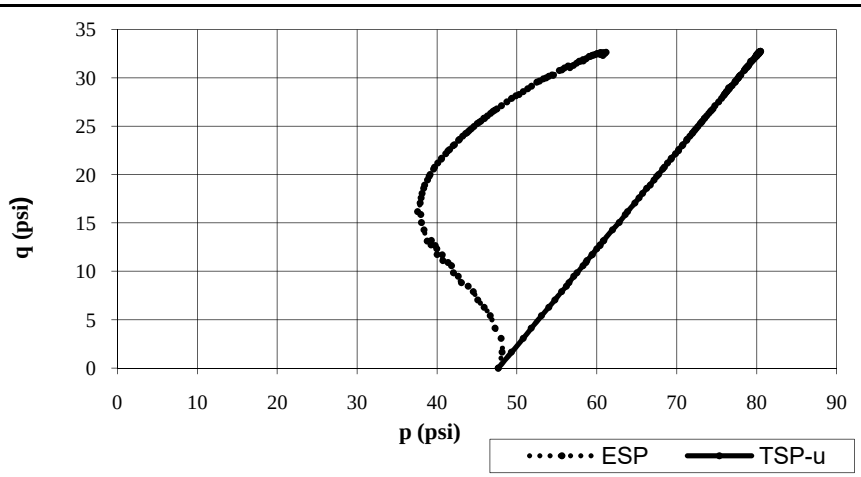
A_c Evaluated using Method	B
Sample Saturated using Method	B
Moisture Content (%):	21.1%
Dry Unit Weight (pcf):	107.1
Height (in):	3.084
Void Ratio (-):	0.57
Saturation (%):	99.4%
Cross Sectional Area (in^2):	1.523
Pore Pressure Parameter B (-):	0.97
Final Back Pressure (psi):	107
Consolidation Pressure (psi):	48.22

Shear Data

Shear Strain Rate (%/hr):	1%
Max. Deviator Stress (psi):	65.49
Strain at Failure (%):	15.00
Minor Eff. Pr. Stress (psi):	29.14
Major Eff. Pr. Stress (psi):	94.62
Undrained Strength Ratio (-):	0.68







Notes:

1. Value of Specific Gravity Gs is assumed
2. Failure criterion: max. deviator stress at strain ≤ 15%

Remarks:

DRAFT

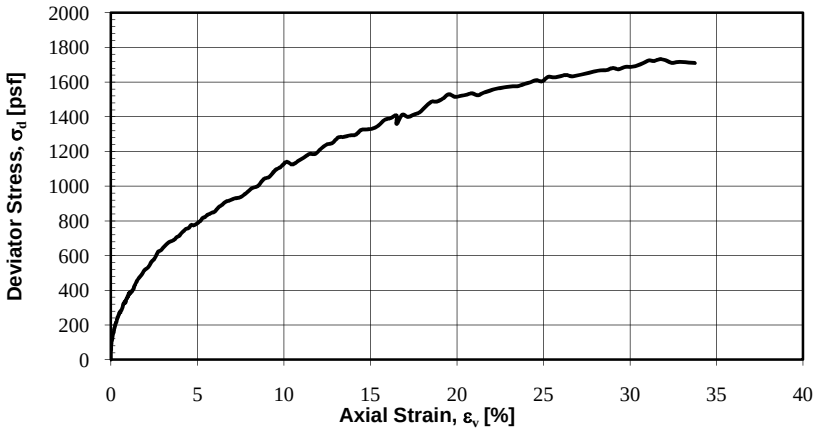
CDM Smith

Geotechnical Engineering Laboratory

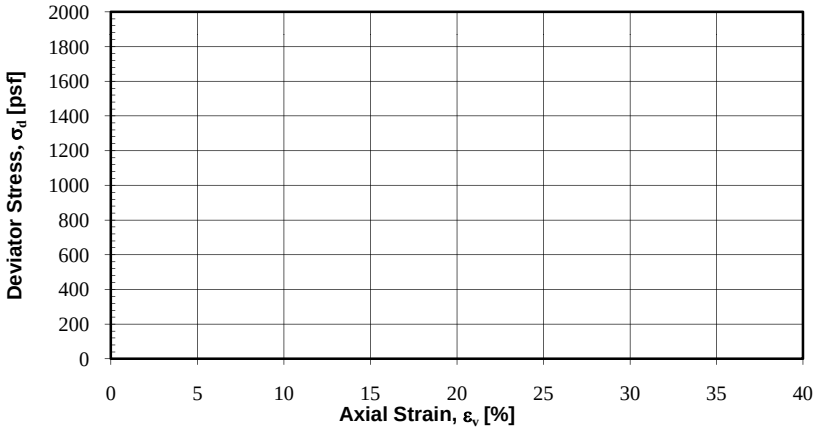
UNCONSOLIDATED-UNDRAINED TRIAXIAL TEST SUMMARY - ASTM D2850

Client:	TVA	**Test Date:**	3/14/2012	**LL :**	34
Project:	Watts Bar	**Exploration No:**	B-2	**PL :**	19
Location:		**Sample No:**	U-1	**PI :**	15
Project No:	95618-83529	**Depth (ft):**	21.5	**USCS:**	CL

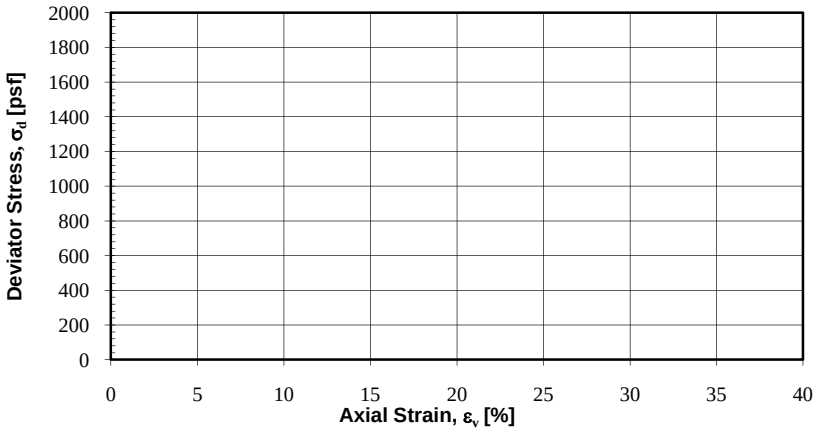
Specimen 1	**Initial**	**Final**
Moisture Content (%):	21.1%	22.0%
Dry Unit Weight (pcf):	126.5	-
Diameter (in):	1.390	-
Height (in):	2.750	-
Void Ratio (-):	0.61	0.61
Saturation (%):	93.3%	97.4%
Specific Gravity (-)(1):	2.70	
Moisture Content (Trim.%):	20.2%	
Strain Rate (%/min):	0.7	
Confining Pressure (psi):	7	
Strain at Failure (%):	15.00	
Compressive Strength (psf)(2)	12.0	



Specimen	**Initial**	**Final**
Moisture Content (%):		
Dry Unit Weight (pcf):		
Diameter (in):		
Height (in):		
Void Ratio (-):		
Saturation (%):		
Specific Gravity (-)(1):		
Moisture Content (Trim.%):		
Strain Rate (%/min):		
Confining Pressure (psi):		
Strain at Failure (%):		
Compressive Strength (psi)(2)		



Specimen	**Initial**	**Final**
Moisture Content (%):		
Dry Unit Weight (pcf):		
Diameter (in):		
Height (in):		
Void Ratio (-):		
Saturation (%):		
Specific Gravity (-)(1):		
Moisture Content (Trim.%):		
Strain Rate (%/min):		
Confining Pressure (psi):		
Strain at Failure (%):		
Compressive Strength (psi)(2)		



Notes:

1. Value of specific gravity is assumed
2. Failure criterion: maximum deviator stress at strain less than or equal to 15%

Test Remarks:

DRAFT

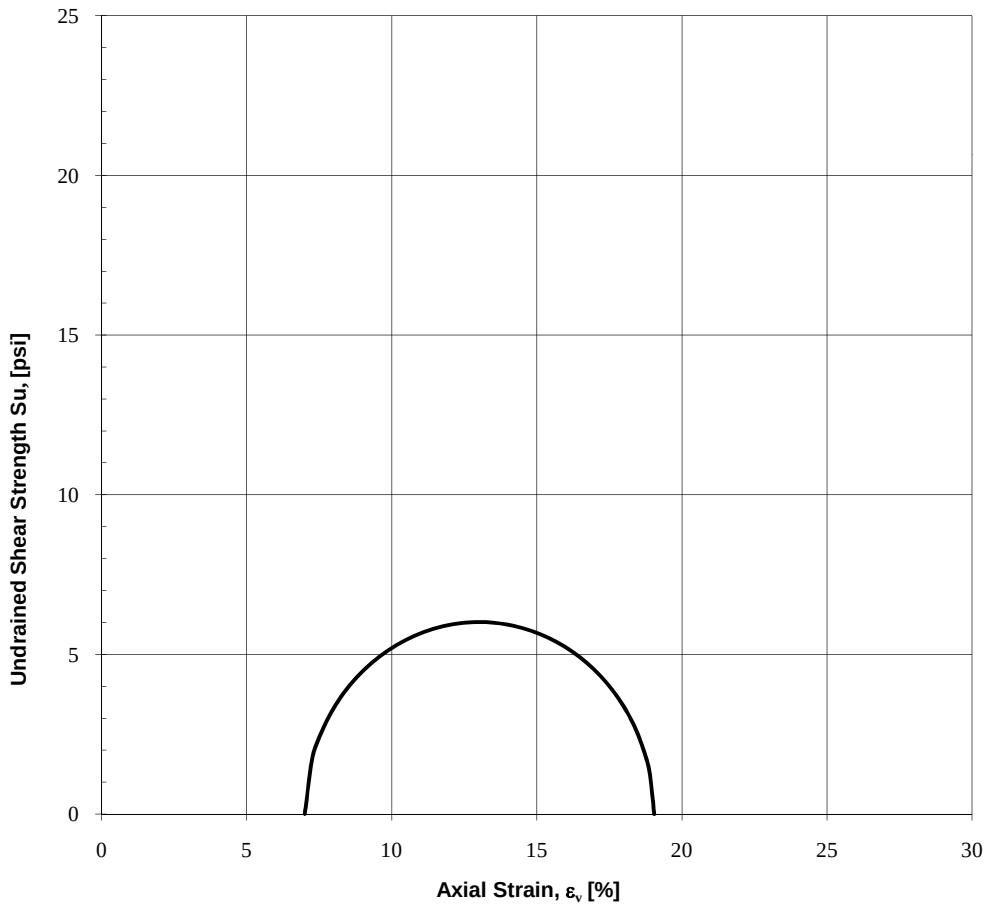
CDM Smith

Geotechnical Engineering Laboratory

UNCONSOLIDATED-UNDRAINED TEST - MOHR CIRCLES

Client:	TVA	**Test Date:**	3/14/2012	**LL :**	34
Project:	Watts Bar	**Exploration No:**	B-2	**PL :**	19
Location:	0	**Sample No:**	U-1	**PI :**	15
Project No:	95618-83529	**Depth (ft):**	21.5	**USCS:**	CL

	Specimen 1	Specimen 2	Specimen 3
Confining Pressure (psi)	7	0	0
Undrained Shear Strength Su (psi)	6.02	0.00	0.00
Strain at Failure (%)	15.00	0.00	0.00
Initial Moisture Content (%)	21.1%	0.0%	0.0%
Initial Saturation (%)	93.3%	0.0%	0.0%
Average Su (psi)			



Notes:

Test Remarks:

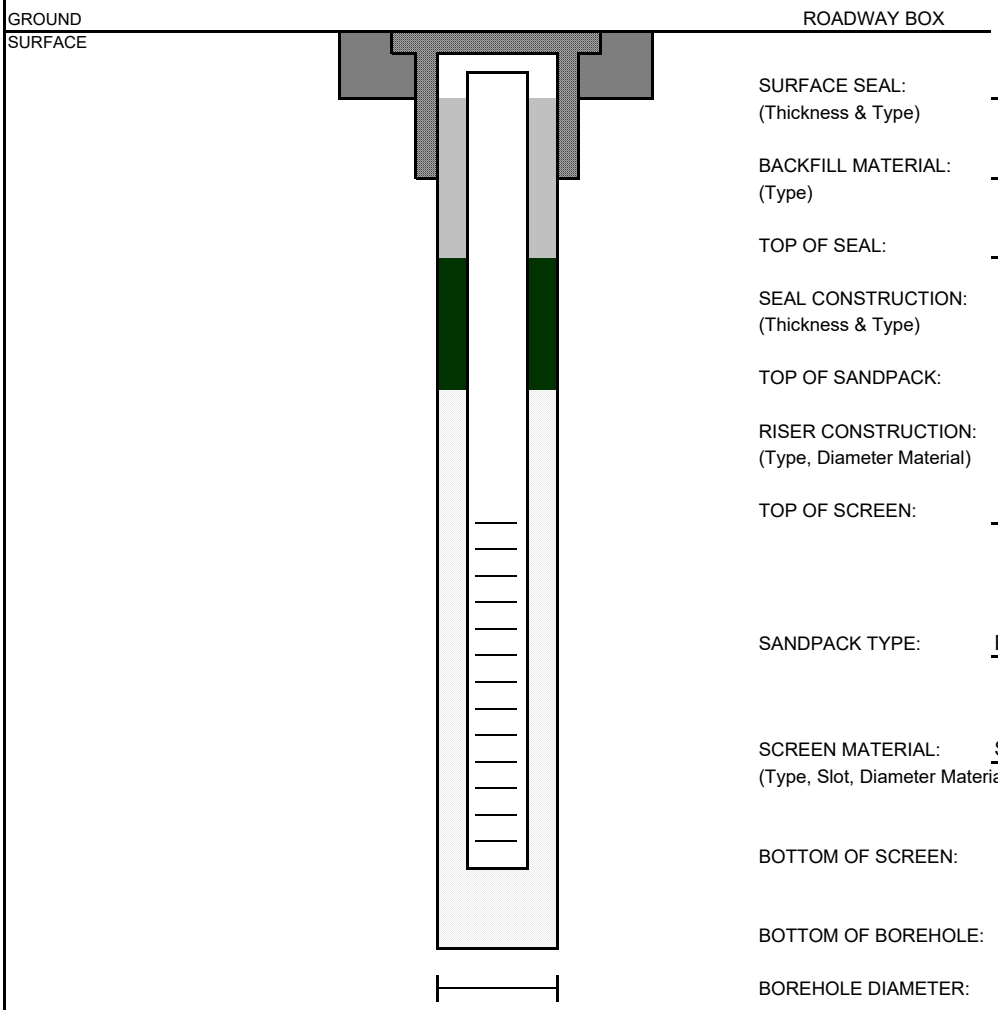
DRAFT

CDM Smith

5400 Glenwood Ave
Suite 300
Raleigh, NC 27612
(919) 787-5620

Monitoring Well Installation Log

Client:	TVA	Contractor:	Total Depth Drilling	Boring/Well No.:	B-1/MW-1
Project Name:	Watts Bar Fossil Plant	Driller:	Tim Hall	Date Installed:	11/17/11 - 01/11/12
Project Location:	Watts Bar (Rhea Co.), TN	Ground EL:	699.0 ft	Logged By:	MRH
Project Number:	83529	Riser EL:		Page:	1 of 1



SURFACE SEAL: (Thickness & Type)	1 ft - Portland Cement
BACKFILL MATERIAL: (Type)	Soil sloughed into hole
TOP OF SEAL:	16 ft
SEAL CONSTRUCTION: (Thickness & Type)	7 ft - Bentonite
TOP OF SANDPACK:	23 ft
RISER CONSTRUCTION: (Type, Diameter Material)	Schedule 40 PVC, 2 - Inch
TOP OF SCREEN:	25 ft
SANDPACK TYPE:	Filter Sand - DSI Well Gravel Pack
SCREEN MATERIAL: (Type, Slot, Diameter Material)	Schedule 40 PVC, 0.10, 2-Inch
BOTTOM OF SCREEN:	35 ft
BOTTOM OF BOREHOLE:	44.6 ft
BOREHOLE DIAMETER:	0.75 ft - soil/0.24 ft - rock

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

DRAFT

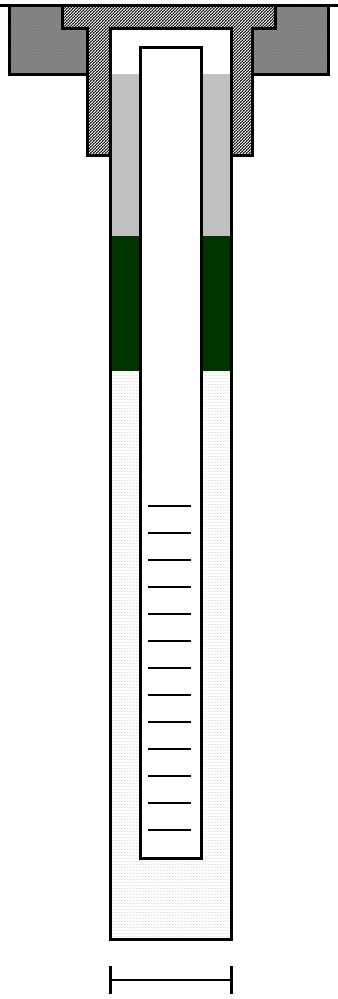
CDM Smith

5400 Glenwood Ave
Suite 300
Raleigh, NC 27612
(919) 787-5620

Monitoring Well Installation Log

Client:	TVA	Contractor:	Total Depth Drilling	Boring/Well No.:	B-3/MW-3
Project Name:	Watts Bar Fossil Plant	Driller:	Tim Hall	Date Installed:	11/16/2011
Project Location:	Watts Bar (Rhea Co.), TN	Ground EL:	701.0 ft	Logged By:	MRH
Project Number:	83529	Riser EL:		Page: 1 of	1

GROUND SURFACE



ROADWAY BOX

SURFACE SEAL: (Thickness & Type)	3 ft - Portland Cement
BACKFILL MATERIAL: (Type)	Filter Sand (DSI gravel pack)
TOP OF SEAL:	24 ft
SEAL CONSTRUCTION: (Thickness & Type)	4 ft - Bentonite
TOP OF SANDPACK:	28 ft
RISER CONSTRUCTION: (Type, Diameter Material)	Schedule 40 PVC, 2-Inch
TOP OF SCREEN:	30 ft
SANDPACK TYPE:	:Filter Sand - DSI Well Gravel Pack
SCREEN MATERIAL: (Type, Slot, Diameter Material)	Schedule 40 PVC, 0.10, 2-Inch
BOTTOM OF SCREEN:	40 ft
BOTTOM OF BOREHOLE:	54.8 ft
BOREHOLE DIAMETER:	0.75 ft - soil/0.24 ft - rock

NOTE: All depths are in feet below ground surface, unless noted otherwise.

Remarks:

Updated On: 04/09/01

DRAFT

Summary of Groundwater Level Readings
TVA WBF CCP Closure
Spring City, TN

Location	Ground Surface Elevation	Groundwater Level Readings		Date	Time (24 hr)
		in feet below ground surface	Elevation, ft		
B-1	699	12.1	686.9	11/16/2011	17:15
		13.1	685.9	11/16/2011	17:40
		9.32	689.7	1/11/2012	10:40
B-2	711	37.1	673.9	1/10/2012	13:05
		27.4	683.6	1/10/2012	14:50
B-3	701	31.15	669.9	11/15/2011	10:20
		15.70	685.3	11/16/2011	11:00
		19.00	682.0	1/10/2012	15:10
		18.11	682.9	1/11/2012	11:10

Note: Elevations & locations based on estimated distance to existing features.

ATTACHMENT B

DRAFT

Client: TVA
Project: WBF CCP CLOSURE

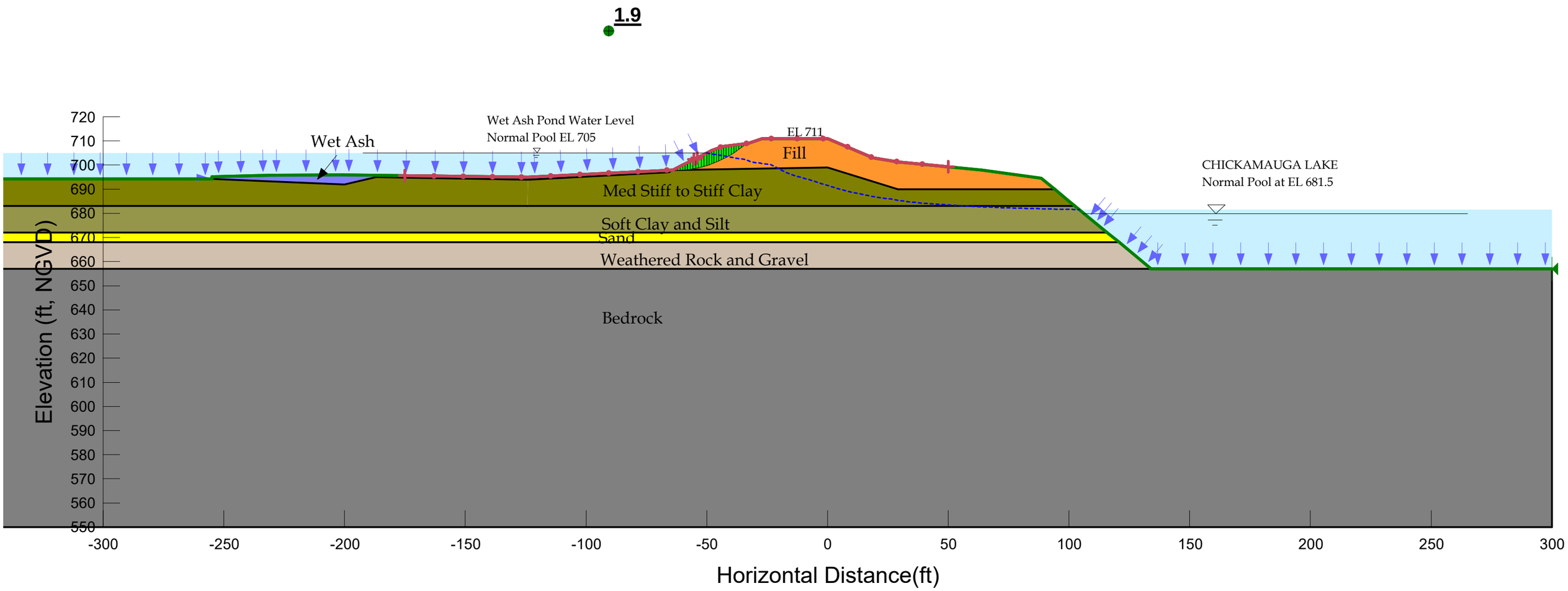
Computed By: Wen, Jintao
Date & Time: 1/20/2012 10:03:52 AM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section A-A' at Wet Ash Pond Area

Case Number: A-1
Location: Section A-A'

Model Scenario:
Existing Conditon at Wet Ash Pond Area
Static Analysis

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 0 psf 29 °
Layer 2B: Soft Clay and Silt 110 pcf 0 psf 28 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

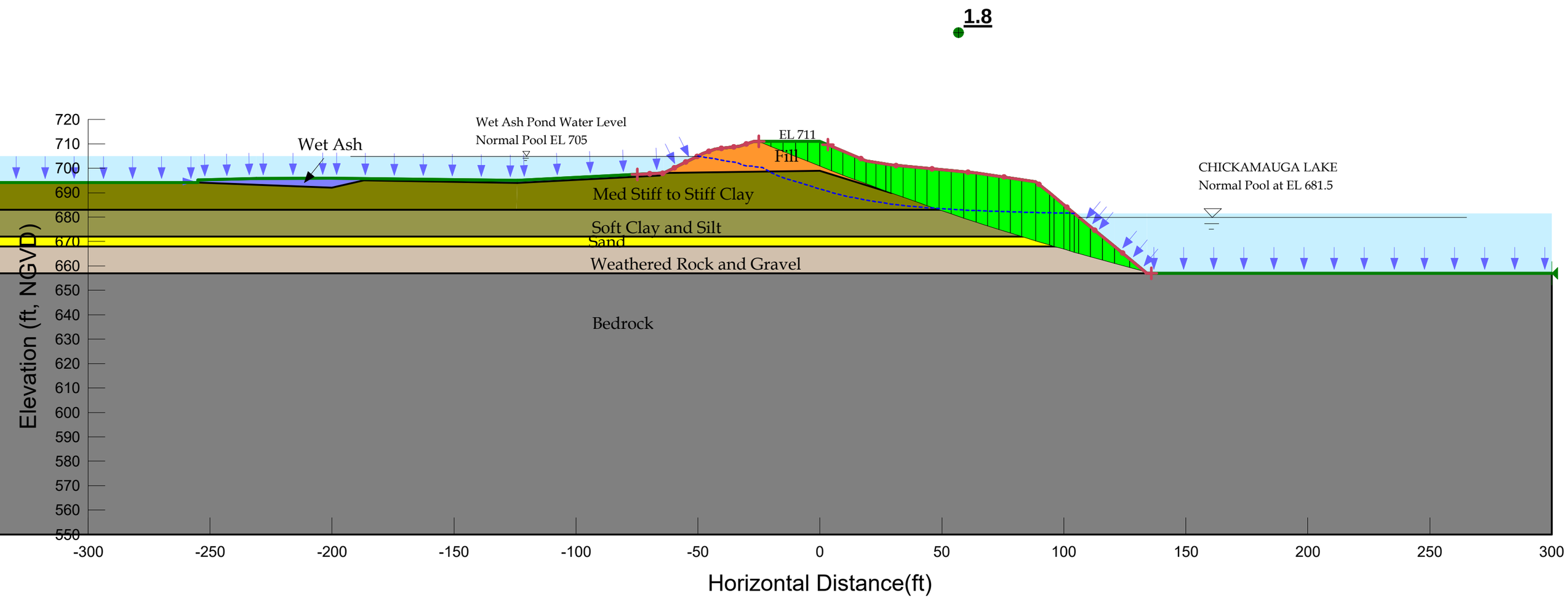
Computed By: Wen, Jintao
Date & Time: 1/20/2012 10:03:52 AM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section A-A' at Wet Ash Pond Area

Case Number: A-1
Location: Section A-A'

Model Scenario:
Existing Conditon at Wet Ash Pond Area
Static Analysis

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 0 psf 29 °
Layer 2B: Soft Clay and Silt 110 pcf 0 psf 28 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

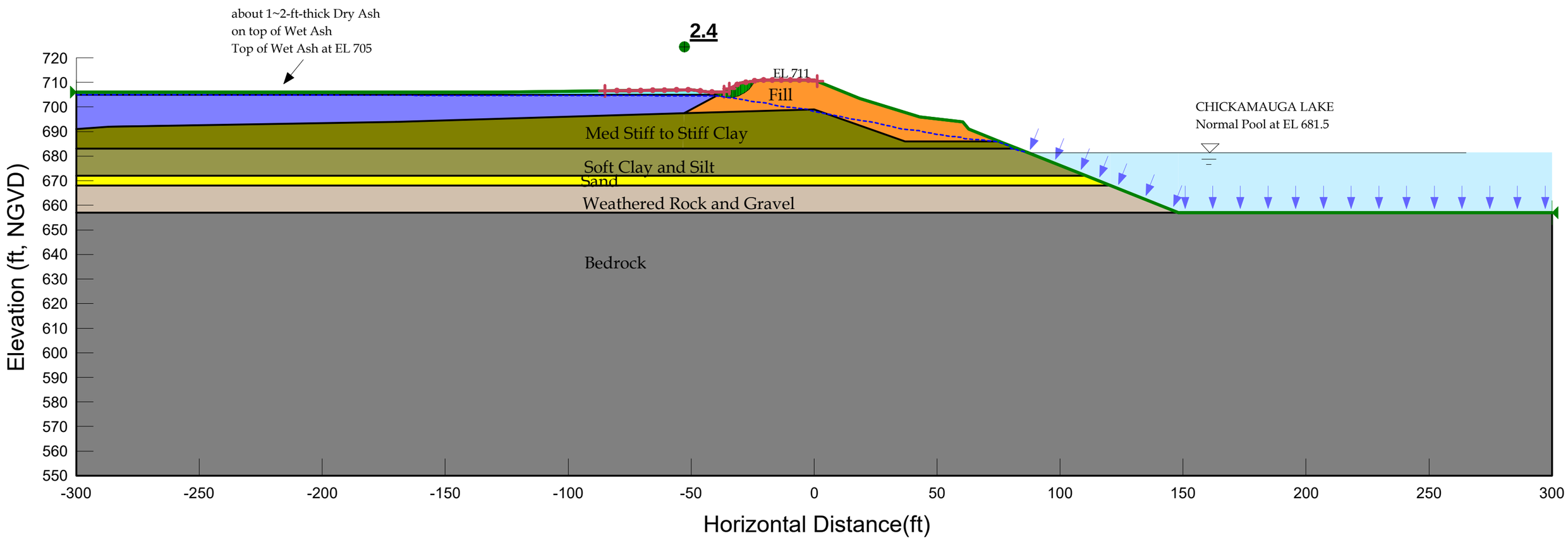
Computed By: Wen, Jintao
Date & Time: 1/20/2012 9:58:09 AM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section B-B' at Dry Ash Area

Case Number: B-1
Location: Section B-B'

Model Scenario:
Existing Conditon at Dry Ash Area.
Static Analsyes

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Dry Ash 85 pcf 0 psf 25 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 0 psf 29 °
Layer 2B: Soft Clay and Silt 110 pcf 0 psf 28 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

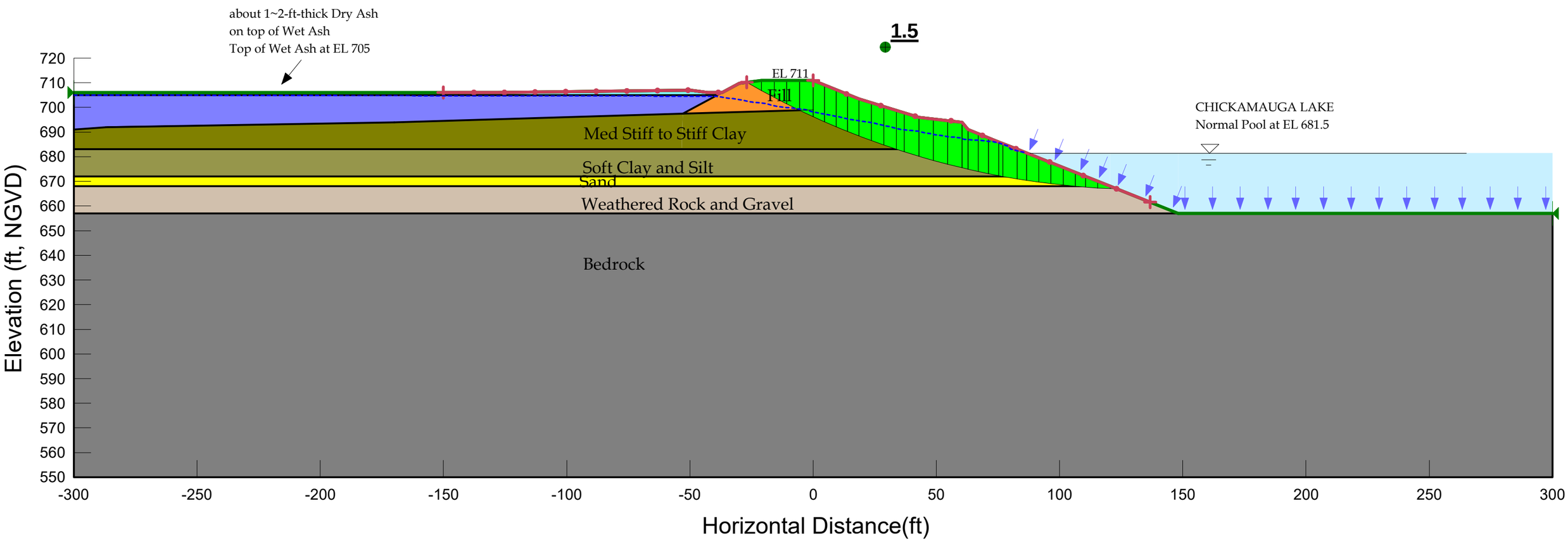
Computed By: Wen, Jintao
Date & Time: 1/20/2012 10:02:17 AM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section B-B' at Dry Ash Area

Case Number: B-1
Location: Section B-B'

Model Scenario:
Existing Conditon at Dry Ash Area.
Static Analsyes

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Dry Ash 85 pcf 0 psf 25 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 0 psf 29 °
Layer 2B: Soft Clay and Silt 110 pcf 0 psf 28 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

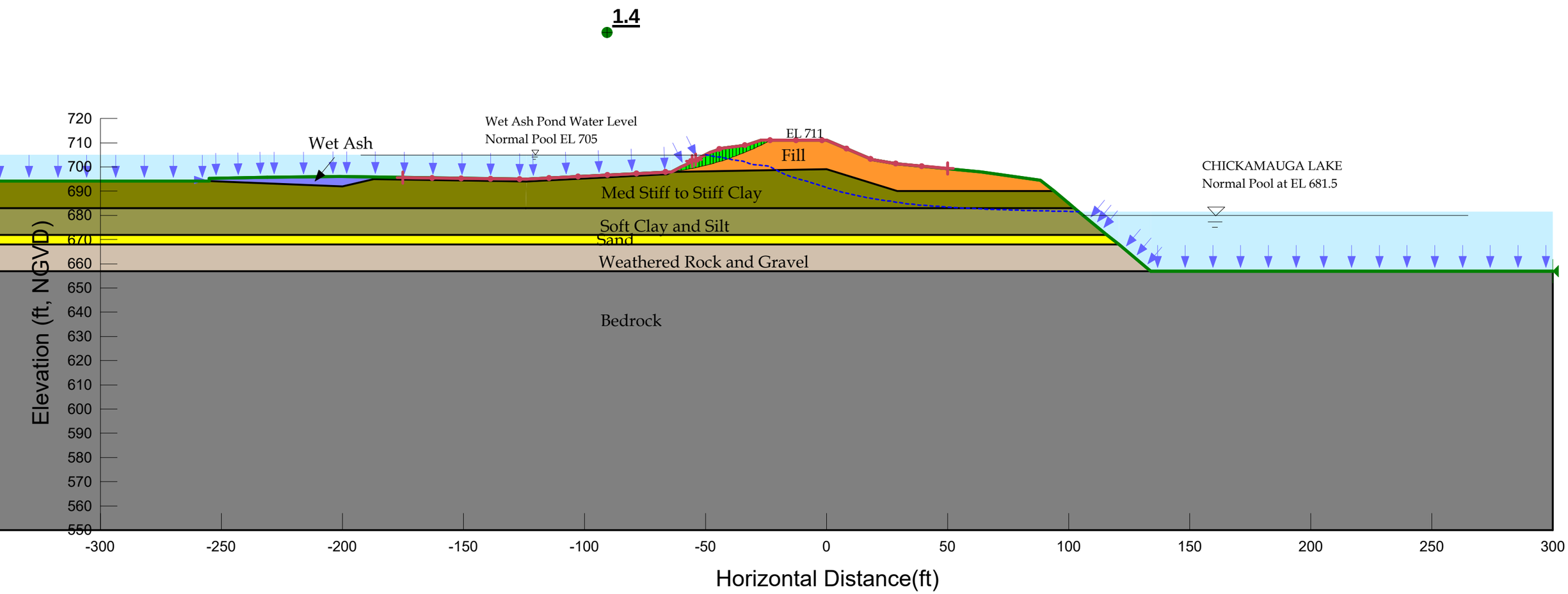
Computed By: Wen, Jintao
Date & Time: 4/25/2012 3:08:18 PM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section A-A' at Wet Ash Pond Area

Case Number: A-2
Location: Section A-A'

Model Scenario:
Existing Conditon at Wet Ash Pond
Seismic Analysis PHA=0.116g

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 1300 psf 0 °
Layer 2B: Soft Clay and Silt 110 pcf 500 psf 0 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

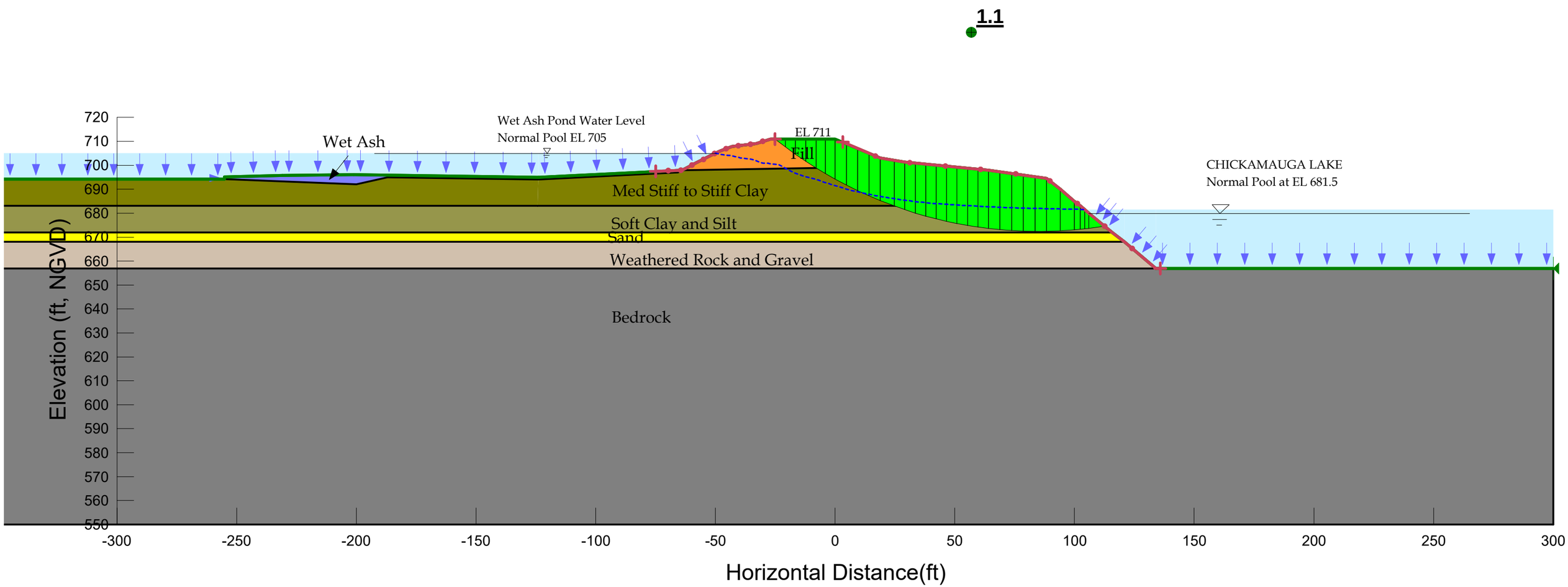
Computed By: Wen, Jintao
Date & Time: 4/25/2012 3:08:18 PM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section A-A' at Wet Ash Pond Area

Case Number: A-2
Location: Section A-A'

Model Scenario:
Existing Conditon at Wet Ash Pond
Seismic Analysis PHA=0.116g

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 1300 psf 0 °
Layer 2B: Soft Clay and Silt 110 pcf 500 psf 0 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

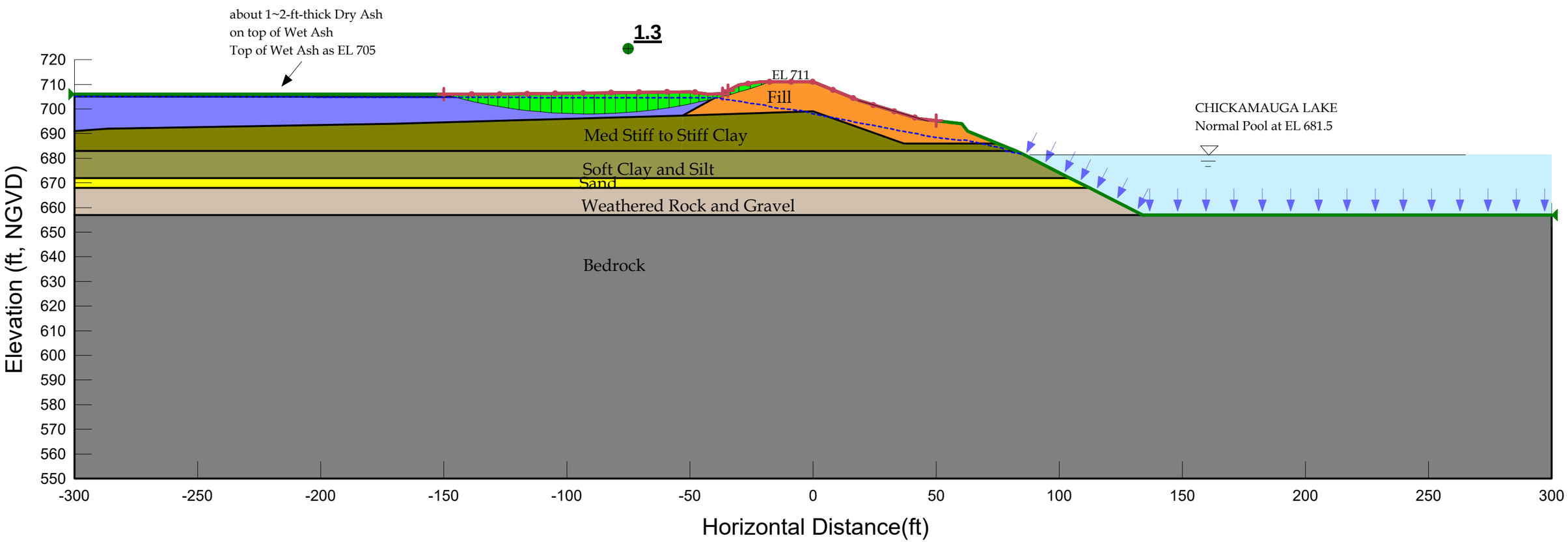
Computed By: Wen, Jintao
Date & Time: 4/25/2012 3:05:46 PM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section B-B' at Dry Ash Area

Case Number: B-2
Location: Section B-B'

Model Scenario:
Existing Conditon at Dry Ash Area.
Seismic Analsyes, PHA=0.116g

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Dry Ash 85 pcf 0 psf 25 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 1300 psf 0 °
Layer 2B: Soft Clay and Silt 110 pcf 500 psf 0 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

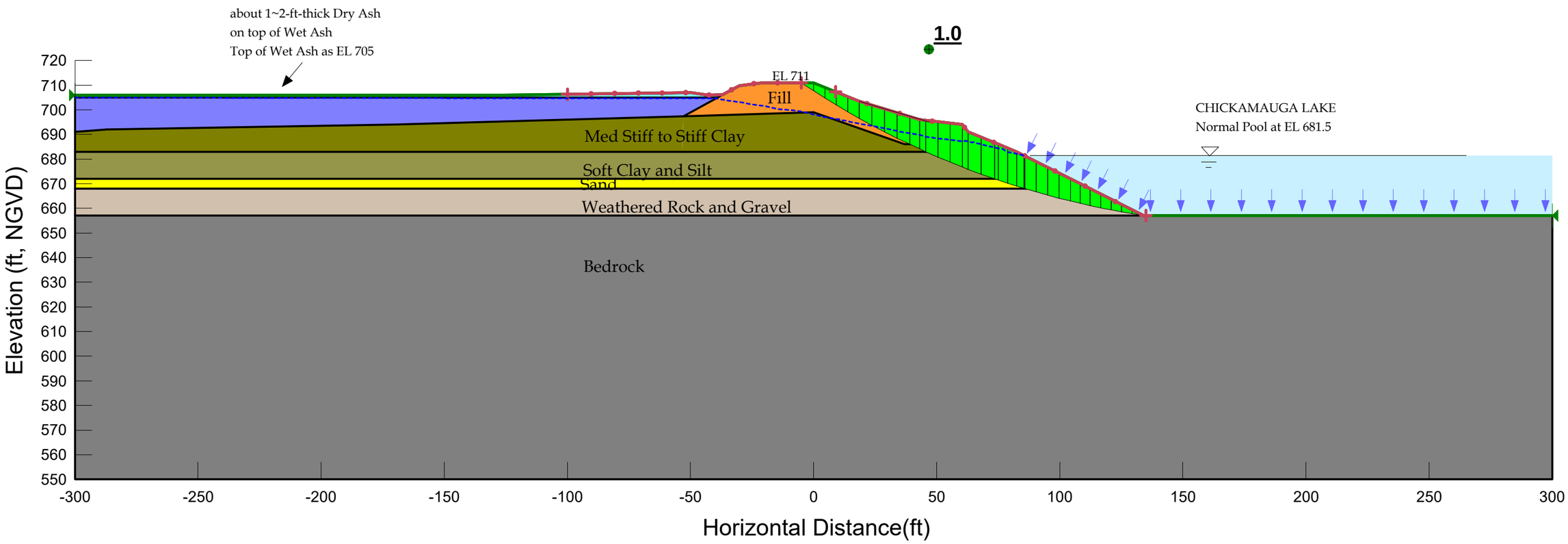
Computed By: Wen, Jintao
Date & Time: 4/25/2012 3:05:46 PM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section B-B' at Dry Ash Area

Case Number: B-2
Location: Section B-B'

Model Scenario:
Existing Conditon at Dry Ash Area.
Seismic Analsyes, PHA=0.116g

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Dry Ash 85 pcf 0 psf 25 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 1300 psf 0 °
Layer 2B: Soft Clay and Silt 110 pcf 500 psf 0 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



DRAFT

Client: TVA
Project: WBF CCP CLOSURE

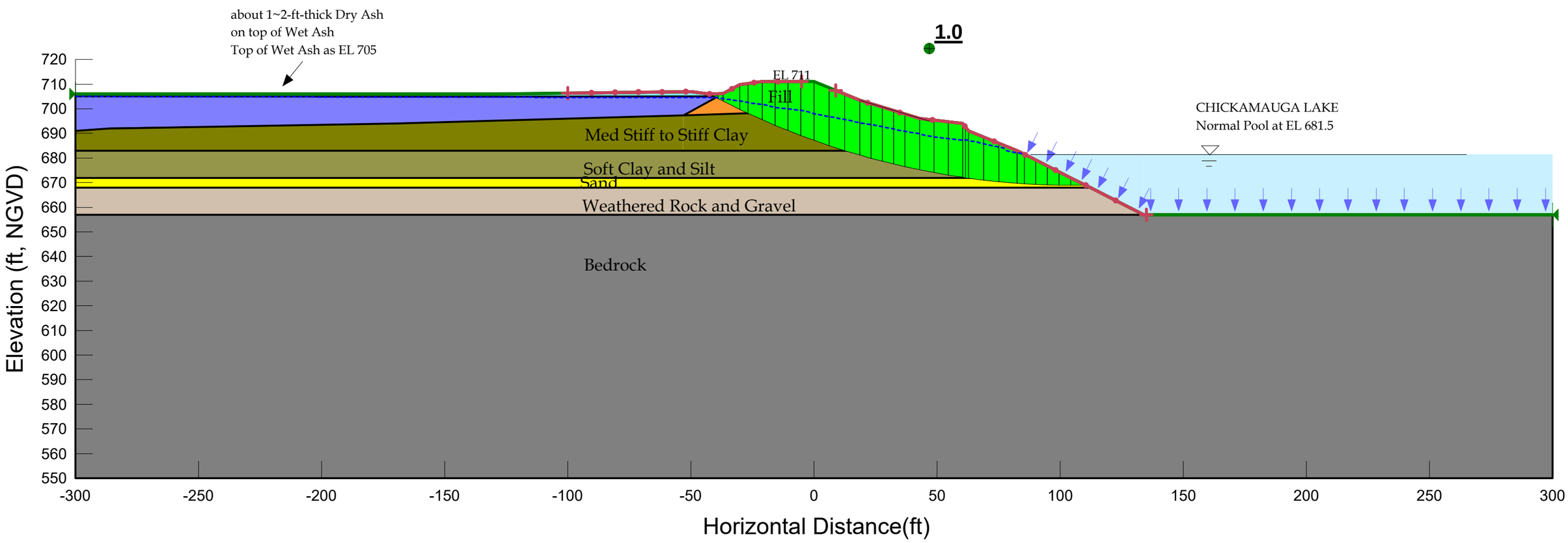
Computed By: Wen, Jintao
Date & Time: 4/20/2012 10:49:51 AM

TVA Watts Bar Fossil Plant, Spring City, TN
Seepage and Slope Stability Analyses
Cross-Section B-B' at Dry Ash Area

Case Number: B-2
Location: Section B-B'

Model Scenario:
Existing Conditon at Dry Ash Area.
Seismic Analsyes, PHA=0.09g

Layer 1: Fill 120 pcf 115 pcf 0 psf 32 °
Dry Ash 85 pcf 0 psf 25 °
Layer 2A: Med Stiff to Stiff Clay 110 pcf 105 pcf 1000 psf 0 °
Layer 2B: Soft Clay and Silt 110 pcf 500 psf 0 °
Layer 3: Sand 120 pcf 0 psf 30 °
Layer 4: Weathered Rock and Gravel 125 pcf 0 psf 40 °
Wet Ash 70 pcf 0 psf 20 °
Layer 5: Bedrock



ATTACHMENT C

Seismic Risk Assessment
Closed CCP Storage Facilities
Tennessee Valley Authority Fossil Plants

Prepared by:

Alan F. Rauch, PhD, P.E.
Senior Associate
Stantec Consulting Services, Inc.

Wayne Quong, M.A.Sc., P.Eng.
Senior Associate
Stantec Consulting Services, Inc.

Jeffrey S. Dingrando, P.G., P.E.
Associate
Stantec Consulting Services, Inc.

Reviewed and Approved by:

Barry S. Snider, P.E.
TVA-CCP Interim Engineering Manager
Tennessee Valley Authority

William H. Walton, P.E.
Vice President, Senior Principal Engineer
AECOM

Thomas L. Cooling, P.E.
Vice President, Geotechnical Services
URS Corporation

Gonzalo Castro
Independent Consultant

Seismic Risk Assessment
Closed CCP Storage Facilities
Tennessee Valley Authority Fossil Plants

This document outlines proposed engineering analyses to estimate seismic failure risks at wet storage facilities for coal combustion products, following closure, at various TVA fossil power plants. The specific details outlined in this document are subject to future discussion and modification by the project team.

OVERVIEW

Tennessee Valley Authority (TVA) operates storage facilities for coal combustion products (CCPs) at eleven fossil power generating stations. As TVA transitions to dry systems for handling these materials, 18 to 25 wet storage facilities (CCP ponds, impoundments, dredge cells, etc.) will be closed (drained and capped). The CCP storage facilities are currently operated in accordance with state and federal regulations, but previously issued permits have not required evaluations for seismic performance. Moreover, the existing permits do not require seismic qualification for the storage facilities in their closed configurations.

TVA recognizes there is a potential for strong earthquakes to occur within the region, and there is a tangible risk for seismic failure at each closed CCP facility. These risks, including both the likelihood of failure and the consequences, must be understood to effectively manage TVA's portfolio of byproduct storage sites. This white paper summarizes the methodology that will be used to estimate these risks at the CCP storage facilities following closure.

Seismicity in the TVA service area is attributed to the New Madrid fault and smaller, less concentrated crustal faults. These two earthquake scenarios generate significantly different seismic hazards at each locality and will be considered independently within the risk assessment. At each closed byproduct facility, potential seismic failure modes will be evaluated in sequence. Instability due to soil liquefaction, slope instability due to inertial loading, and other potential failure mechanisms will be addressed. Seismic performance will be evaluated for differing earthquake return periods until a limiting (lowest return period) event that would cause failure is obtained. The probability of seismic failure will then correspond to the probability of this limiting earthquake event. The assessment of risk will also include estimates of potential consequences, as well as costs to mitigate the risks, that reflects the unique setting of the individual storage facilities after closure.

Following the same general methodology, seismic risks will be estimated in two phases. The near-term "Portfolio Seismic Assessment" will provide a rough estimate of seismic risks. The likely performance of each facility will be evaluated using simplified analyses, empirical methods, and the judgment of experienced engineers. The results will establish a ranking of the relative risks across the closure portfolio and also provide a preliminary picture of overall seismic risk. For the subsequent "Facility Seismic Assessments", seismic performance will be judged on the basis of site-specific data and detailed engineering analyses, which will be completed during the closure design process for individual facilities.

SEISMIC RISKS

This white paper provides an overview of the engineering methods proposed by Stantec for estimating seismic risks at TVA's closed byproduct storage sites. For each facility, four specific questions must be answered quantitatively:

(1) What is the approximate probability that a strong earthquake will occur?

Several seismic source zones could produce earthquakes large enough to impact these TVA sites. Very large magnitude earthquakes have occurred within the New Madrid seismic zone, which is located along the western boundaries of Tennessee and Kentucky. Because of their observed large magnitude and frequency of occurrence, New Madrid events contribute substantially to the seismic risks at all TVA sites. Ground motions from a New Madrid earthquake would attenuate with distance toward the east, such that local area sources also contribute significantly to site-specific seismic hazards.

Seismicity across the Tennessee Valley was previously characterized by AMEC/Geomatrix (2004), in a probabilistic study that focused on TVA dam sites. The same seismogenic model can be applied in evaluating earthquakes that would impact other TVA sites. Accordingly, probabilistic seismic hazards obtained from the 2004 AMEC/Geomatrix model will be used in the seismic risk assessment of the closed CCP storage facilities.

(2) Will a given earthquake cause failure in the closed facility?

Many of the TVA byproduct storage facilities are underlain by a substantial thickness of loose, saturated, alluvial soils (silts and sands). Some facilities will have layers of ash or other uncemented CCPs that remain saturated following closure. These materials, especially sluiced fly ash, are prone to liquefaction in a strong earthquake, as cyclic motions cause a build up of pore water pressure and a consequent loss of effective stress and shearing resistance. Extensive liquefaction in a foundation or CCP deposit under a storage facility would be expected, in most cases, to result in lateral spreading and massive slope movements (failure). Even without liquefaction, large slope deformations or failures may be triggered by lateral inertial loads during an earthquake. Liquefaction and dynamic loading of slopes are the most likely failure mechanisms, but other seismic failure modes, which may be unique to a particular closed storage facility, must also be evaluated.

(3) What are the potential consequences of a failure?

In addition to understanding the probability of failure, a risk assessment should consider the potential consequences. A failure is likely to have economic costs associated with clean-up and restoration of the site. Depending on the local site conditions, failure of a closed CCP facility may or may not cause significant impacts on the environment, waterways, transportation routes, buried or overhead utilities, or other infrastructure. Substantial economic costs would result if power generation is interrupted. Failure consequences may also include the potential loss of human life at some sites.

In this proposed seismic risk assessment, the definition of "failure" will be constrained to

mean the displacement of stored materials to a distance beyond the permitted boundary of the facility. While smaller deformations in a closed storage facility could cause economic damages, the resulting consequences for TVA should be manageable. Hence, this risk assessment will focus on potential "failures" where stored materials could move past the permitted boundary.

(4) What are the approximate costs to mitigate the risks of a seismic failure?

With an understanding of the probability and consequences of failure, the potential risks can be quantified and understood, possibly leading to decisions to mitigate seismic risks in the closure of certain facilities. Mitigation measures might include ground improvement to reduce liquefaction potential (stone columns, deep soil mixing, jet grouting, or other appropriate technology), stabilization of slopes by flattening or buttressing, enhanced drainage features, or some other engineered solution. The potential cost of these risk mitigation strategies are needed to make appropriate management decisions.

PORTFOLIO AND FACILITY ASSESSMENTS

Seismic evaluations will be completed for each of the CCP storage facilities that TVA has slated for closure; a tentative list is given in Table 1. The assessment of seismic risks will be accomplished in two phases:

A. Portfolio Seismic Assessment

In this first phase, the seismic risk assessment will be carried out using general site information, simplified analyses, empirical methods, and the judgment of experienced engineers. A team of four to five engineers will complete this evaluation for the entire portfolio, with assistance from the engineering teams currently working on each facility. After the probabilistic seismic hazards are defined, this phase of the work can be completed in a relatively short timeframe.

Given the level of effort and the simplified engineering analyses to be employed, the seismic risk estimates from the Phase A assessment will be approximate. Rather than attempting to compute precise risk numbers, Phase A will focus on capturing the relative risks between the different closed facilities. The key to successfully meeting this objective will be the consistent application of the assessment process across the portfolio.

This effort will result in a ranked list of sites that can be used to illustrate where seismic risks are greatest within the portfolio. The results will also provide some insight for understanding and communicating the magnitude of potential risks associated with seismic loading of the closed CCP facilities.

As a secondary objective, the Phase A assessment team will also consider the potential for failure of the active storage facilities, due to an earthquake occurring prior to closure. The seismic risks associated with the operating facility will not be estimated, but the Phase A assessment process provides an opportunity to identify potential failure mechanisms that should be addressed in the short term. This information may suggest the need to re-prioritize the closure schedule. Prior to closure, many of the wet CCP storage facilities retain large pools of water and are thus more susceptible to uncontrolled

releases in an earthquake. TVA has already made the decision to close these wet storage facilities to manage these risks, so the effort in Phase A will focus on identifying sites that may have unusually high seismic risks and deserve more study or higher priority in the closure program.

B. Facility Seismic Assessment

In this subsequent phase of work, more detailed engineering analyses will be carried out using site-specific geometry, subsurface conditions, material parameters, and results from static slope stability analyses. Simplified, state-of-the-practice methods of engineering analysis will be used; more complex analytical methods will be generally impractical for this risk assessment.

This phase of the work will be accomplished for individual facilities as part of the closure design, after the completion of other engineering analyses. The risks will be quantified by the design team, with assistance from the portfolio seismic assessment team. Significant, detailed effort will be required to assess each closed facility.

Compared to Phase A, the risk estimates obtained at this stage will be more reliable and better represent the actual risks for seismic failure. While it will be impossible to know how accurately the risks have been characterized at the completion of Phase B, the objective is to obtain results that are within perhaps ± 30% of the “actual” risk numbers. TVA expects to use the Phase B results to decide if the risks are acceptable, or if the closure design should be modified to mitigate risks for a seismic failure.

The engineering methodology (described below) to be followed in the Phase A and B evaluations will not characterize all of the uncertainties with respect to seismic performance. The uncertainties in the soil parameters and in the liquefaction, stability, and deformation analyses will not be quantified and carried through the risk assessment. Consequently, the estimated risk numbers will be approximate, but the results will be sufficiently accurate to support TVA decisions regarding prioritization for closure or the need for seismic mitigation. At most sites, the risks are expected to be high enough or low enough that further refinement in the risk numbers would not change these decisions. More detailed analysis beyond Phase B would be unjustified in these cases.

This assessment plan does not preclude the possibility that more detailed risk evaluations could be undertaken in subsequent phases of work. The Phase B results might reveal a subset of closed facilities with marginal risks, where a more rigorous and complete calculation of the risks would be needed to support a management decision. Hence, at the conclusion of the Phase B assessments, a “Phase C” evaluation may be needed for select sites and facilities, wherein uncertainties in the soil parameters and performance analyses would be quantified and carried through the risk assessment.

RESULTS AND APPLICATION

The results from the Phase A Portfolio Assessment will be presented in a table, like Table 1. For each facility evaluated, the estimated annual probability of failure due to a seismic event, the expected consequences (economic costs and potential loss of life), and the mitigation costs (design features to reduce risks) will be tabulated. The same parameters, but more

accurate numbers, will be reported from the more in-depth Phase B assessments. A qualitative description of the data quality (based on the number of borings, test data on key soil properties, etc.) will also be included, to indicate how well the site conditions were characterized at the time of the Phase A or B assessment.

In both Phase A and B, the evaluation teams will prepare a discussion of significant issues driving the seismic risks at each site. This summary will include knowledge gaps, likely failure mechanisms, unique consequences, suggested approaches for risk mitigation, and other key information. The Phase A evaluation of a facility may point out the need for additional data to support later seismic analyses in Phase B; needed field or laboratory testing could then be accomplished and documented as part of the facility closure design effort.

In the short term, TVA will utilize the Phase A results to better plan budgets and schedules for managing the closure process over the next several years. The Phase A assessment will also be used as an opportunity to identify operating facilities with especially high seismic risks. While these risks will not be quantified for conditions prior to closure, the consideration of potential seismic failure modes may prompt additional study and reconsideration of priorities. Where justified, the priorities for closure may be changed to more quickly address sites with higher seismic risks.

More accurate risk estimates will be obtained from the Phase B assessments, which will be completed as part of the closure design process. Those results will be used, within TVA's existing decision making framework, to judge if seismic mitigation is needed. For context, the criteria in Tables 2 and 3 represent the risk-based framework TVA uses to guide enterprise-level decisions. This framework relies upon broad, qualitative scoring of consequences and risks for the organization. For managing the seismic risks at the closed CCP facilities, complete probabilistic calculations of risk are not needed; approximate estimates of seismic risk will be sufficient to support TVA decisions.

The risks computed in Phase A and B will not be compared to a prescribed threshold or design risk level. Criteria for tolerable seismic risk in these closed CCP storage facilities has not been defined in the existing permits, in TVA policy, or in TVA design guidance.

METHODOLOGY

The same general methodology, outlined in ten steps below and in Figures 1 through 4, will be used to evaluate seismic risk in both the Phase A Portfolio Assessments and the Phase B Facility Assessments. While advanced engineering analyses may be required to demonstrate acceptable seismic performance in a design situation, simplified analyses will be used here, consistent with the goal of estimating the probability of failure.

In Step 1, seismic hazard parameters will be defined for each site; the results will be used as inputs for both the Phase A and Phase B assessments. Then, the evaluation of a particular facility will begin with a review of existing site information (Step 2), followed by engineering analyses for seismic performance. As described in Steps 3 through 7 below, the engineering analyses in Phase B will be more detailed than the simplified estimates in Phase A. The analyses will commence with an initial selection of an earthquake return period and evaluation for seismic performance. Steps 3 through 7 will be repeated until the limiting (lowest) earthquake return period expected to cause failure is obtained. Flowcharts

summarizing Steps 1 through 7 in the Phase A and B seismic performance assessments are given in Figures 3 and 4, respectively. The earthquake event with the lowest return period that causes failure will then be used to compute the probability of failure in Step 8. The potential consequences and mitigation costs will be estimated in Steps 9 and 10.

Step 1 – Define Seismic Input Parameters

Seismic hazards at TVA dam sites were quantified in a 2004 study by AMEC/Geomatrix. The New Madrid fault zone and several area source zones contribute to the seismicity of the region, as represented schematically in Figure 1. The New Madrid seismic zone is characterized by a large linear, combined reverse/strike-slip fault. Earthquakes in the area source zones are more diffuse (less concentrated in clusters) and tend to occur in zones of weakness of large crustal extent rather than along narrow, well-defined faults. Earthquakes occurring within the New Madrid Seismic Zone and in area sources outside of it will be considered in developing seismic input parameters for each CCP facility. However, only seismic source zones that contribute significantly to the ground motion hazard at a particular site will be used to develop seismic input parameters.

The national USGS seismic hazard model will not be used in these seismic risk assessments; instead, TVA will ask AMEC/Geomatrix to compute the site-specific seismic hazards for each closed CCP facility. The needed information can be obtained from the existing seismogenic model, but will need to separately consider the hazards associated with the New Madrid events and all other seismic sources (Figure 2), hereafter referred to in this white paper as the “earthquake scenarios”. The following parameters are needed for each earthquake scenario:

- Uniform hazard spectra for frequencies from 0.25 to 100 Hz (100 Hz value is equivalent to peak ground acceleration, PGA) at the top of rock for a range of return periods from 100 to 2,500 years.
- De-aggregation for relevant ground motion frequencies (one or more of the following: 0.5, 1.0, 2.5, 5.0, and 100 Hz) at each return period. The de-aggregation results will be used to select appropriate, representative earthquake parameters (magnitude and distance from the site), from which inputs needed for liquefaction analyses can be developed.

In the Phase A effort, the project team (including seismologists designated by TVA) will meet to consider the earthquake hazard data produced by the AMEC/Geomatrix model for each site. The team will reach consensus on the appropriate parameters (return period, earthquake magnitude, and peak ground acceleration) to be used in evaluating each facility, before proceeding with work on subsequent steps of the analysis. The seismic parameters to be tabulated (Table 4) will then be used in both the Phase A and Phase B assessments.

Ground motion time histories will be needed for the detailed Phase B calculations, and TVA will need to ask AMEC/Geomatrix to provide:

- Representative acceleration time histories (two orthogonal components), representing ground motions at the top of the rock profile for the specified earthquake return periods.

Given the results of the Phase A assessment, the Phase B analyses will focus on a narrower range of possible earthquakes. Hence, acceleration time histories will not be needed for every seismic event listed in Table 4.

Step 2 – Review Site and Facility Information

To meet the requirements for closure of TVA ash storage facilities, the closed condition may involve placement of compacted ash behind a strengthened dike, drainage of pond water to the levels of the surrounding groundwater table, and capping of the area with native soils. The collection of available site information for each facility will be reviewed from a seismic performance perspective. For the Phase B assessment, this information will be augmented with new data that becomes available during the closure design process.

The project information needed for each storage facility includes:

- Planned geometry of the closed storage facility, as needed to meet current design criteria and regulatory requirements.
- Geologic mapping and related information about the site geology.
- Historical records and other information related to site development.
- Boring logs, SPT data, CPT data, shear wave velocities, etc. from field explorations.
- Laboratory data from testing of site materials, including classification, Atterberg limits, moisture content, particle size, specific gravity, unit weight, compaction tests, and other relevant test data.
- Laboratory data on measured strength properties, for both drained and undrained conditions.
- Previously completed slope stability analyses, where available, will be modified for calculations in the risk assessments.

Step 3 - Evaluate Potential for Soil Liquefaction

The potential for soil liquefaction may be the greatest contributor to failure risk at many of the TVA storage sites. Liquefaction will thus be considered first in the assessment of seismic performance at each closed facility (Figures 3 and 4).

The Phase A assessment will utilize empirical charts and back-of-the-envelope calculations to judge if liquefaction would be likely for a given earthquake scenario. For example, Ambraseys (1988) compiled magnitude, epicentral distance, and whether or not liquefaction was observed in past earthquakes, and then suggested a threshold boundary (in terms of magnitude and epicentral distance) where liquefaction might occur in natural soil deposits. Selected, parametric calculations with the simplified procedure outlined by Youd et al (2001) will also be useful in judging what earthquakes would cause liquefaction in the Phase A Portfolio Assessments. These empirical methods may be unconservative for evaluating saturated CCPs, which are often more prone to liquefaction than a sandy soil, but the results will still provide useful guidance in the Phase A assessment.

For the Phase B liquefaction evaluations, detailed engineering analyses will be undertaken to obtain estimates of cyclic loading, soil resistance, and factor of safety as described below. Potentially liquefiable soils include saturated alluvial soils, loose granular fills, and sluiced ash. The detailed analyses will focus on critical cross sections of the closed facilities; liquefaction safety factors will not be computed for all boring locations at a site.

(a) Soil Loading from Earthquake Motions

The magnitude of the cyclic shear stresses induced by an earthquake are represented by the cyclic stress ratio (CSR). The simplified method proposed by Seed and Idriss (1971) will be used to estimate CSR in the Phase A parametric analyses (ground response analyses will not be completed in Phase A).

In Phase B, the CSR at specific locations (borings and depths where in situ penetration resistance are measured) will be computed using one-dimensional, equivalent-linear elastic methods as implemented in the ProSHAKE software. Using an acceleration time history at the top of rock (obtained from the seismic hazards study in Step 1), the computer program will model the upward propagation of the ground motions through a one-dimensional soil profile. For cases where the one-dimensional assumption is inadequate, the calculations can be accomplished using QUAKE, a two-dimensional finite element program that implements the same dynamic modulus reduction curves and damping relationships as used in ProSHAKE.

The cyclic stresses imparted to the soil will be estimated from the earthquake parameters described in Step 1, representing earthquakes on the New Madrid fault and local crustal events.

(b) Soil Resistance from Correlations with Penetration Resistance

The resistance to soil liquefaction, expressed in terms of the cyclic resistance ratio (CRR), will be assessed using the NCEER empirical methodology (Youd et al. 2001). Updates to the procedure from recently published research will be used where warranted. The analyses will be based on the blowcount value (N) measured in the Standard Penetration Test (SPT) or the tip resistance (q_c) measured in the Cone Penetration Test (CPT). In Phase A, typical or representative values will be used in parametric hand calculations; detailed data from site-specific explorations will be analyzed in Phase B.

The NCEER procedure involves a large number of correction factors. Based on the site-specific conditions and soil characteristics, engineering judgment will be used to select appropriate correction factors consistent with the consensus recommendations of the NCEER panel (Youd et al. 2001). To avoid inappropriately inflating the CRR, the NCEER fines content adjustment will not be applied where zero blowcounts (“weight of hammer” or “weight of rod”) are recorded. The magnitude scaling factor (MSF) is used in the empirical liquefaction procedure to normalize the representative earthquake magnitude to a baseline 7.5M earthquake. The earthquake magnitude (M) considered to be most representative of the liquefaction risk will be determined by applying the MSF to the de-aggregation data (from Step 1) for each selected earthquake return period.

Saturated fly ash, where it remains following closure, is likely to be more susceptible to liquefaction than indicated by these empirical methods. Values of CRR determined via the NCEER procedure are related to the observation of liquefaction in natural soils, mostly silty sands. Given the spherical particle shape and uniform, small grain size of fly ash, the NCEER procedure may give CRR values that are too high for saturated fly ash.

Lacking better methods of analysis, the lower-bound, "clean sand" base curve (Youd et al. 2001) will be assumed to apply for fly ash in the Phase A assessment. Within the liquefaction calculations, this will be accomplished for these materials by neglecting the fines content adjustment to the normalized penetration resistance. For Phase B, published and unpublished data from cyclic laboratory testing on similar materials will be sought to augment the indications of liquefaction resistance obtained from in situ penetration tests.

(c) Factor of Safety Against Liquefaction

The factor of safety against liquefaction (FS_{liq}) is defined as the ratio of the liquefaction resistance (CRR) over the earthquake load (CSR). Following TVA design guidance and the precedent set by Seed and Harder (1990), FS_{liq} is interpreted as follows:

- Soil will liquefy where $FS_{liq} \leq 1.1$.
- Expect substantial soil softening where $1.1 < FS_{liq} \leq 1.4$.
- Soil does not liquefy where $FS_{liq} > 1.4$.

Using this criteria for guidance, values of FS_{liq} computed throughout a soil deposit or cross section (at specific CPT-q_c and SPT-N locations) will be reviewed in aggregate. Occasional pockets of liquefied material in isolated locations are unlikely to induce a larger failure, and are typically considered tolerable. Instead, problems associated with soil liquefaction are indicated where continuous zones of significant lateral extent exhibit low values of FS_{liq}. Engineering judgment, including consideration for the likely performance in critical areas, will be used for the overall assessment of each facility. A determination of "extensive" or "insignificant" liquefaction will then lead to the appropriate stability analyses in the next stage of the evaluation, as indicated in Figures 3 and 4.

Step 4 – Characterize Post-Earthquake Soil Strengths

The post-earthquake shearing resistance of each soil and CCP will be estimated, with consideration for the specific characteristics of that material. The full, static shear strength will be assigned to unsaturated soils. Excess pore pressures will not develop in an unsaturated soil during seismic loading, so drained strength parameters can be used. The undrained strengths of saturated soils will be decreased to account for the softening effects of pore pressure buildup during the earthquake. Specifically:

- In saturated clays and soils with $FS_{liq} > 1.4$, 80% of the static undrained strength will be assumed.
- In saturated, low-plasticity, granular soils with $1.1 < FS_{liq} \leq 1.4$, a reduced strength will be assigned, based on the excess pore pressure ratio, r_u (Seed and Harder 1990).

Typical relationships between FS_{liq} and r_u have been published by Marcuson and Hynes (1989).

- In saturated, low-plasticity, granular soils with $FS_{liq} \leq 1.1$, a residual (steady state) strength (S_{us}) will be estimated for the liquefied soil. Values of S_{us} can be obtained from the empirical correlations published by Seed and Harder (1990), Castro (1995), Olson and Stark (2002), Seed et al. (2003), and Idriss and Boulanger (2008).

Subsequent stability and deformation analyses will be accomplished using these reduced strength parameters. No attempt will be made to model the cyclic reduction in soil shear strength during an earthquake. In the deformation analyses, the fully reduced strengths will be assumed at the start of cyclic loading, which will yield conservative estimates of slope displacements.

Step 5 – Analyze Slope Stability

The next step in the performance evaluation (Figures 3 and 4) will consider slope stability, for conditions with or without significant liquefaction. Slope stability will be evaluated using two-dimensional, limit equilibrium, slope stability methods. Reduced soil strengths (from Step 4), conservatively representing the loss of shearing resistance due to cyclic pore pressure generation during the earthquake, will be used in the stability calculations. The analyses will be accomplished using Spencer's method of analysis, as implemented in the SLOPE/W software, considering both circular and translational slip mechanisms.

Input files for static stability calculations, where previously completed for a particular facility, will be updated to represent seismic conditions. These stability analyses may be not available, or the closure geometry may be undefined, for the Phase A assessment of some sites. In those cases, simplified or approximate geometries will be developed for approximate analysis in Phase A. Engineering experience will also be useful in judging likely seismic stability. For example, a complete failure is likely if liquefaction undermines the foundation of the outslope. In the absence of liquefaction, a slope that exhibits adequate safety factors under static conditions is unlikely to fail in an earthquake. Back-of-the-envelope hand calculations can be useful in assessing stability where extensive liquefaction occurs in the saturated materials within or below CCPs retained by a stable perimeter dike. Detailed slope stability calculations, which accurately represent the planned closure geometry, will be used in the Phase B facility assessments.

(a) Slope Stability if Extensive Liquefaction

If extensive liquefaction is indicated, stability will be evaluated for the static conditions immediately following the cessation of the earthquake motions. Residual or steady state strengths will be assigned in zones of liquefied soil, with reduced strengths that account for cyclic softening and pore pressure build up assumed in non-liquefied soil. In both Phase A and B, complete failure (large, unacceptable displacements) will be assumed if the safety factor (FS_{slope}) computed in this step is less than one (Figures 3 and 4).

For slopes where the post-earthquake $FS_{slope} \geq 1$, deformations will be estimated in the Phase B assessment (Step 6 and Figure 4). Slope deformations will not be estimated in the Phase A portfolio assessment, where ground motion time histories will not be available. In Phase A, slopes exhibiting $FS_{slope} \geq 1$ with liquefaction will be assumed

stable with tolerable deformations; this condition may exist, for example, where liquefied ash at the base of a closed storage facility is contained within a stable perimeter dike.

Note that pseudostatic stability analyses are not useful for evaluating a factor of safety where extensive liquefaction is expected, because appropriate pseudostatic coefficients can not be defined.

(b) Slope Stability if No Significant Liquefaction

If no significant liquefaction is expected, seismic stability will be analyzed in Phase A using approximate, pseudostatic stability methods (Figure 3). The added inertial loads from the earthquake will be represented with a simple, horizontal pseudostatic coefficient (k_h), which provides an approximate representation of the dynamic loads imposed by an earthquake. The horizontal pseudostatic coefficient will be set to one-tenth of the peak ground acceleration in rock ($k_h = 0.1 \cdot PGA_{rock}$). In Phase A, tolerable deformations (less than about 5 meters) will be assumed if the pseudostatic $FS_{slope} \geq 1$, and failure will be assumed if the pseudostatic $FS_{slope} < 1$.

This approach and criteria are based on the work of Hynes-Griffin and Franklin (1984). They performed Newmark deformation analyses, integrated over 350 ground motion time histories, used an amplification factor of three to represent peak accelerations at the base of an earth embankment, and assumed a displacement of 1 meter would be tolerable for an embankment dam. For a typical CCP facility, assuming no pool is retained following closure, “failure” would imply displacements significantly greater than 1 meter. A tolerable displacement of about 5 meters will be assumed here, for the Phase A risk assessments. From the upper bound curve plotted by Hynes-Griffin and Franklin (1984), a displacement of 5 meters would correspond to a yield acceleration of about 0.03 times the peak acceleration along the slip surface. Then, assuming an amplification factor of 3 for the ground motions at the base of the embankment, this suggests $k_h = 0.1 \cdot PGA_{rock}$ can be used conservatively in the pseudostatic analysis to judge failure, as described above.

Pseudostatic factors of safety will not be computed in the Phase B assessment. Instead, where a liquefaction failure is not predicted, potential slope displacements will be computed as described in Step 6.

Step 6 – Predict Deformations

In the Phase A Portfolio Assessment, closed facilities that are expected to remain stable (pseudostatic $FS_{slope} \geq 1$ with no liquefaction, or post-earthquake $FS_{slope} \geq 1$ with liquefaction) will be assumed to have tolerable displacements. Dynamic slope deformations are difficult to estimate without detailed analysis; the available empirical or approximate methods do not represent the conditions of interest, or the level of effort is not consistent with the goals of the first phase of risk assessments. In addition, earthquake ground motion time histories will not be available for the Phase A analyses.

In the Phase B Facility Assessments, the potential deformation of stable slopes will be evaluated as indicated in Figure 4. Conventional methods of analysis will be implemented to estimate potential slope displacements that accumulate during earthquake shaking; movements are assumed to stop when the earthquake ends, consistent with a post-

earthquake safety factor greater than one. The acceleration time histories obtained from the ground response analyses in Step 3a will be used as inputs for computing deformations with one of the following simplified methods:

- Newmark's (1965) method involves double integration of accelerations greater than the yield acceleration (k_y), which will be determined from a succession of pseudostatic slope stability analyses in which k_h is varied. The value of k_h where the pseudostatic FS_{slope} = 1.0 corresponds to the yield acceleration.
- The Makdisi-Seed (1978, 1979) procedure, which better accounts for the dynamic response of embankments. This procedure was developed based on parametric numerical simulations for earthen dams. The procedure is iterative, considers the fundamental periods of the embankment response, and can be completed in steps using published charts. Results from QUAKE can also be used as input in this procedure.

The slope deformations predicted in Phase B will be conservative, because the yield acceleration will be computed based on reduced, post-earthquake soil strengths. In reality, the yield acceleration declines in successive cycles of seismic loading, as pore pressures accumulate and saturated soils become weaker. The analysis outlined in Figure 4 assumes reduced strengths and, where liquefaction is predicted, residual strengths at the start of the earthquake. Detailed numerical simulations can be used to track the progressive softening and liquefaction of soil within an embankment during an earthquake; such analyses are expensive and time consuming. Rigorous analyses of this type will not be justified except in a "Phase C" analysis, or where performance in a given seismic design event must be demonstrated. Note that the logic in Figure 4 might appear to assume a slope will be stable if there is no significant liquefaction; however, the deformation analysis will indicate unlimited deformations and certain failure if $FS_{slope} < 1$ for static, post-earthquake conditions.

Step 7 – Consider Other Potential Failure Modes

For most of the closed facilities, soil liquefaction, slope instability, and slope deformations will be the most likely seismic failure modes. However, depending on the unique configuration of each CCP facility, other potential failure modes may contribute significantly to the seismic risks. For example, the loss of critical drainage structures or retaining walls could lead to a failure condition. Other potential failure modes will be identified and evaluated quantitatively in this step.

As a secondary objective of the Phase A effort, the assessment team will consider the potential for failure of the active storage facilities, due to an earthquake occurring prior to closure. Many of the wet CCP storage facilities retain large pools of water, so this assessment will need to consider additional failure modes such as seepage and embankment cracking. The objective here will be to identify operating facilities that may have unusually high seismic risks, and might deserve more study or higher priority in the closure program.

Step 8 – Estimate Annual Probability of Seismic Failure

As indicated in the flowcharts in Figures 3 and 4, the assessments of seismic performance (in both the Phase A and Phase B efforts) will consider a range of potential earthquakes with differing return periods. The analyses will be repeated until the limiting (lowest) earthquake return period (from the candidate events defined in Step 1) that predicts failure of a particular CCP storage facility is obtained. Interpolation may be used, as appropriate, to narrow the definition of the limiting earthquake.

The return period for each earthquake scenario (Table 4) represents the annual probability of exceedance for the associated ground motion parameter. Hence, for each earthquake scenario, the event with the smallest return period that causes failure represents a limiting case, where all events having longer return periods would also cause failure. The inverse of the limiting return period thus represents the annual probability of seismic failure due to that earthquake scenario.

Step 9 – Estimate Potential Consequences of Failure

The potential consequences of a failure at each closed facility will be estimated in this step. The potential consequences will be unique to each site, but may include any of the following:

- restoration of the site and storage facility,
- clean-up to address environmental impacts,
- off-site disposal of released materials,
- damages and loss of use for transportation routes, including buried or overhead utilities,
- damages to buildings and other infrastructure,
- economic losses from the possible shutdown of power generation, and
- loss of human life (expected to be unlikely at most sites following closure).

Except for the potential loss of life, the failure consequences will be expressed in terms of present day costs. Detailed cost estimates of the potential consequences of failure will not be attempted in the Phase A assessments; instead, the potential magnitude of total consequence costs will be estimated using broad categories (< $100K, < $500K, < $1M, < $5M, < $10M, < $50M, < $100M). Cost estimates that better reflect the local site conditions will be produced by the closure design teams during the Phase B assessments.

Step 10 – Estimate Possible Mitigation Costs

The final step in the process will involve estimating the costs to mitigate seismic risks, perhaps by altering the closure design to withstand stronger earthquakes. Examples of possible mitigation measures include:

- ground improvements to reduce liquefaction potential (stone columns, deep soil mixing, jet grouting, or other appropriate technology),
- altering the geometry of outslopes (setbacks, benches, or flatter slopes) to improve

stability,

- adding buttresses or other supporting structures at the toe of slopes,
- enhanced drainage features, and
- relocation of infrastructure or people away from potential impact zones.

These mitigation approaches generally involve higher construction costs, which can be quantified in terms of present dollars. As with the consequence costs, detailed estimates of mitigation costs will not be attempted in the Phase A assessments. The potential magnitude of mitigation will be estimated in categories (< $100K, < $500K, < $1M, < $5M, < $10M, < $50M, < $100M). Mitigation cost estimates that better reflect the local conditions and facility layout will be developed by the closure design teams during the Phase B assessments.

Table 1. Expected Results from the Phase A and B Seismic Risk Assessments

TVA Facility	Prob. Failure	Econ. Costs	Loss of Life	Mitigat. Costs	Data Quality
ALF East Ash Disposal					
ALF East Stilling Pond					
BRF Dry Fly Ash Disposal					
BRF Fly Ash Pond And Stilling Basin Area 2					
BRF Bottom Ash Disposal Area 1					
BRF Gypsum Disposal Area 2a					
COF Disposal Area 5					
COF Ash Pond 4					
CUF Dry Ash Stack					
CUF Ash Pond					
CUF Gypsum Storage Area					
GAF Fly Ash Pond E					
GAF Bottom Ash Pond A					
GAF Stilling Pond B, C & D					
JSF Dry Fly Ash Stack					
JSF Bottom Ash Disposal Area 2					
JOF Ash Disposal Area 2					
KIF Dike C					
PAF Scrubber Sludge Complex					
PAF Peabody Ash Pond					
PAF Slag Areas 2a & 2b					
SHF Consolidated Waste Dry Stack					
SHF Ash Pond					
WCF Ash Pond Complex					
WCF Gypsum Stack					

Prob Failure = Annual probability of failure due to earthquakes
Econ. Costs = Economic costs resulting from a failure
Loss of Life = Potential loss of life resulting from a failure
Mitigat. Costs = Costs to mitigate seismic risks in closure design
Data Quality = Qualitative indication of how well conditions in the facility are characterized

Table 2. Risk Severity Scoring (Draft) used by TVA

as of 4/22/2009

TVA Risk Event Consequence Rating Scale (Work-In-Progress)						
Strategic Objective	Success Factor	5 Worst Case	4 Severe	3 Major	2 Moderate	1 Minor
Customer	Public Image	International media attention; nearly unanimous public criticism	National media attention; federal, state officials, and customers publicly critical	Regional / local media attention; customers voice concern	Minimal media attention; letters / emails to executive leadership voicing concern	No media attention; sparse criticism
	Rate Impact	Average total retail rate increases by 15%, relative to peers	Average total retail rate increases by 10%-15%, relative to peers	Average total retail rate increases by 5%-10%, relative to peers	Average total retail rate increases by 2%-5%, relative to peers	Average total retail rate increases by 0-2%, relative to peers
People	Safety	Fatalities	Wide spread injuries	Major injuries	Significant injuries	Minor injuries
	Employee Confidence	Widespread departures of key staff with scarce skills or knowledge	Sharp, sustained drop in CHI results; departures of key staff with scarce skills or knowledge	Sharp decline in CHI results	Modest decline in CHI results	No effect on CHI results
Financial	Cash Flow Impact	>$500M	$100M - $500M	$25M - $100M	$5M - $25M	<$5M
	Credit Worthiness	Credit rating downgrade to below investment grade	Credit Rating Downgrade	TVA put on credit watch	TVA put on negative outlook	Credit rating agencies and bondholders express concern
Assets and Operations	LNS (Load not served)*	10% of System Daily Sales (48,000 MWhrs)	1% of System Daily Sales (4,800 MWhrs)	0.1% of System Daily Sales (480 MWhrs)	0.05% of System Daily Sales (240 MWhrs)	140 MWhrs
	CPI (Connection Point Interruptions)	10% of CPs are down simultaneously	5% of CPs are down simultaneously	CPI totaling 10% of current CP count (124 for FY09)	CPI totaling 7.5% of current CP count (93 for FY09)	CPI totaling 5% of current CP count (62 for FY09)
	Duration (in Hours) of Service Interruption	3,000 cumulative hours for CPs	1,000 cumulative hours for CPs	500 cumulative hours for CPs	150 cumulative hours for CPs	50 cumulative hours for CPs
	Delivered Cost of Power	Sustained increase in delivered cost of power >1 year	Increase in delivered cost of power <1 year	Increase in delivered cost of power <1 month	Increase in delivered cost of power <1 week	Delivered cost of power not effected
	Damage to environment; type and magnitude of contamination / discharge	Major coal, nuclear plant accident or dam failure	Significant hazardous waste discharged; nuclear plant accident; dam integrity failure resulting in drawdown of pool elevation	Hazardous materials / waste discharge; clean up / remediation time takes approximately two weeks	Localized environmental damage, no impact to wildlife, clean up / remediation time less than two weeks	Minimal environmental damage, no hazardous discharge; clean up time takes a few days

Table 3. Risk Likelihood Scoring used by TVA

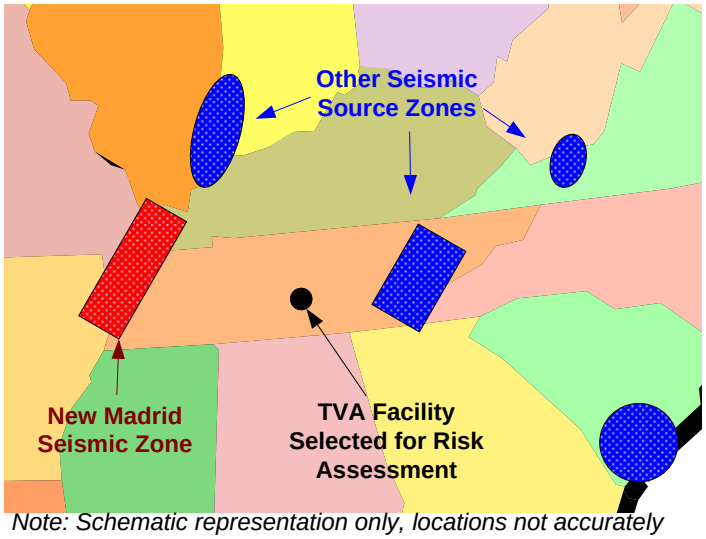
TVA Risk Event Probability Rating Scale		
Score	Rating	Description
5	Virtually Certain	95% probability that the event will occur in the next 3 years /10 years
4	Very Likely	75% probability that the event will occur in the next 3 years/10 years
3	Even Odds	50% probability that the event will occur in the next 3 years/10 years
2	Unlikely	25% probability that the event will occur in the next 3 years/10 years
1	Remote	5% probability that the event will occur in the next 3 years/10 years

- *The 3-year timeframe will be the primary focus for the business unit risk maps*
- *The 10-year risks will be collected by the ERM organization and charted separately for the enterprise*

Table 4. Seismic Hazard Input Data for Probabilistic Assessment of TVA Facilities

Seismic Sources	Return Period (years)	Annual Probability of Exceedance	Peak Ground Acceleration (g)	Earthquake Magnitude
New Madrid Seismic Zone	2,500 1,000 500 250 100	0.0004 0.001 0.002 0.004 0.01	*Values to be determined from the seismic hazard curves*	*Values to be determined from the hazard de-aggregation data**
All Other Seismic Sources	2,500 1,000 500 250 100	0.0004 0.001 0.002 0.004 0.01		

** Representative magnitude corresponding to the maximum contribution to the seismic hazard for liquefaction, as determined from the de-aggregation data weighted by the magnitude scaling factor (maximum PGA / MSF)*



Note: Schematic representation only, locations not accurately depicted, some sources omitted.

Figure 1. Schematic Representation of Seismic Source Model for TVA Facilities

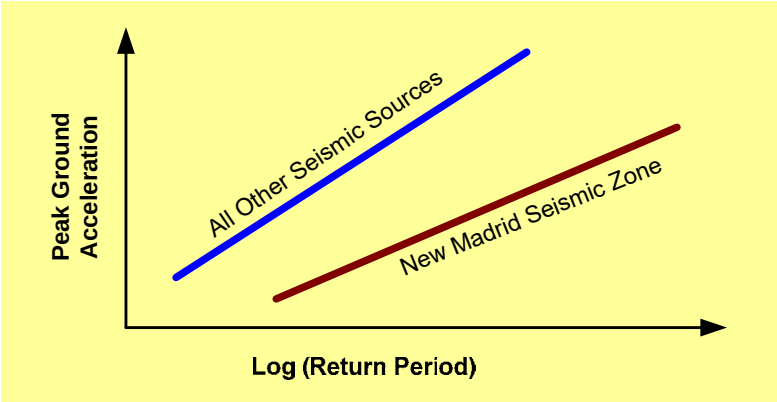


Figure 2. Typical Seismic Hazard Curves for Proposed Probabilistic Assessment of TVA Facilities

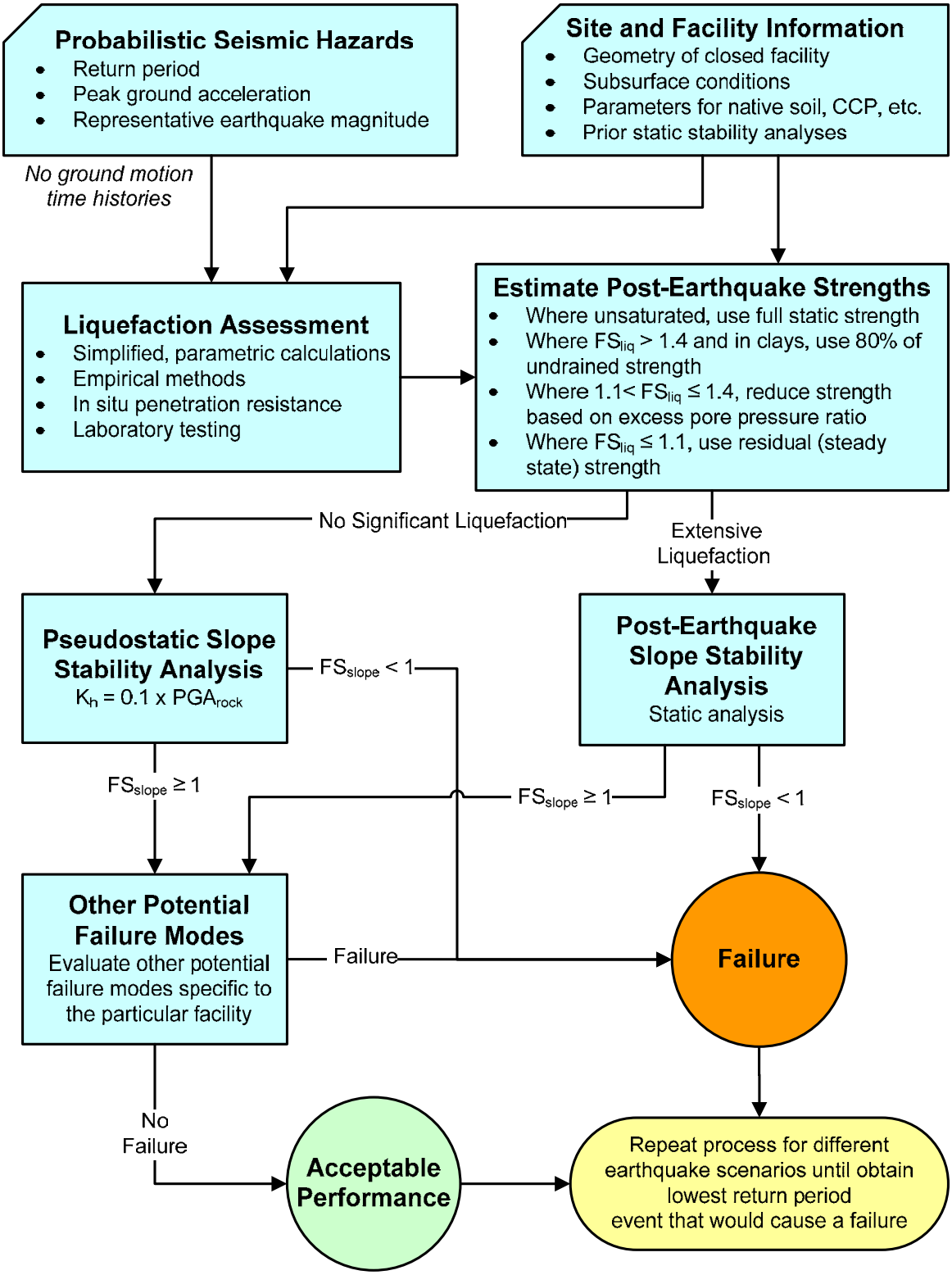


Figure 3. Simplified Flowchart for Assessing Facility Performance During a Probabilistic Seismic Event in Phase A

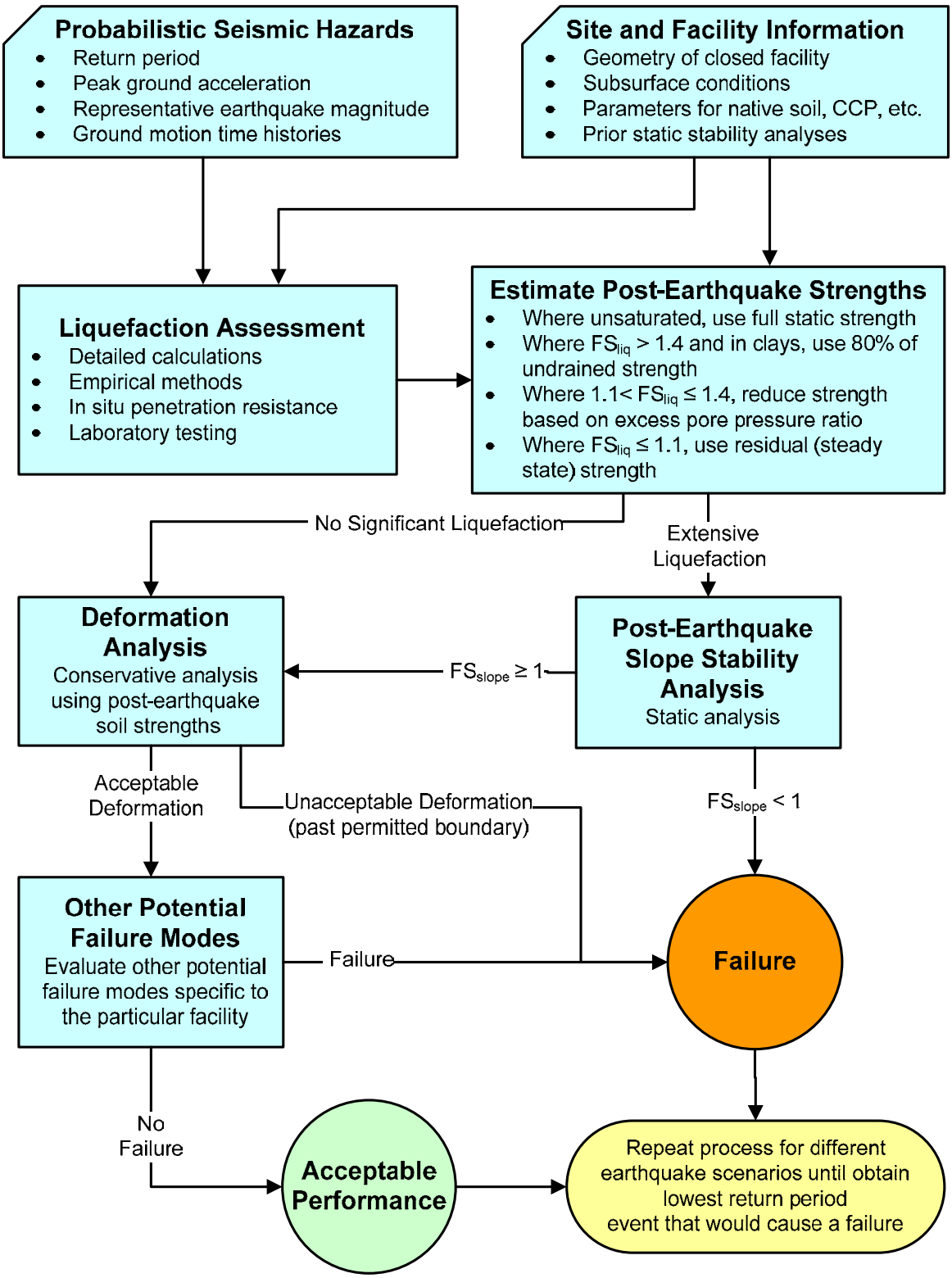


Figure 4. Simplified Flowchart for Assessing Facility Performance During a Probabilistic Seismic Event in Phase B

Appendix F.2 – DRAFT Supplemental Closure/Post-Closure Plan Slag Disposal Area

TDEC Commissioner's Order
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, TN 37402

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal to TDEC	December 5, 2025

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Attachment 1 – Closure and Post-Closure Plan, Slag Disposal Area

Abbreviations

CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
CH	Fat Clay
CL	Lean Clay
CL- ML	Silty Clay
MH	Elastic Slit
ML	Silt
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order No. OGC15-0177
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

This document provides the Supplemental Closure/Post-Closure Plan that will be used to perform closure and post-closure care activities in fulfillment of the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order, TDEC 2015) and the Tennessee Solid Waste Disposal Act. The TDEC Order applies to specifically identified coal combustion residual (CCR) units located at seven current or former fossil power generation plants. The scope of this document pertains to closure and post-closure care activities for the Slag Disposal Area located at the Tennessee Valley Authority (TVA) Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

1.1 SITE LOCATION AND BACKGROUND

The WBF Plant is located on the west bank of the Tennessee River (also referred to as Chickamauga Lake or Chickamauga Reservoir) approximately one mile downstream of TVA Watts Bar Dam in Rhea County Tennessee (Exhibit 1). TVA constructed the WBF Plant between 1940 and 1945, commencing power generation in 1942. It is located entirely on TVA-owned property.

The Slag Disposal Area is a closed CCR unit. The Slag Disposal Area was closed in 2009 under TDEC Permit TNR190741 in accordance with State regulations applicable at the time of closure. The closure included the construction of a soil cover system consisting of 12 inches of compacted clay and 12 inches of vegetative cover soil (Attachment 1).

A separate drainage improvements project was completed in 2015 at the Drainage Improvements Area to place fill, improve drainage, and remove water around the Slag Disposal Area (AECOM 2016). The Drainage Improvements Area is located immediately adjacent to, and upgradient of, the Slag Disposal Area as shown in Exhibit 1.

1.2 REGULATORY FRAMEWORK

1.2.1 TDEC Division of Solid Waste Management

The Slag Disposal Area was closed under Tennessee Solid Waste Disposal Act, TCA 68-211-101, et seq. Permit No. TNR190741, which is inactive. TVA developed and implemented a closure plan for the Slag Disposal Area (Attachment 1). Post-closure care activities include vegetative cover monitoring and maintenance, maintaining the final contours, drainage systems maintenance, and post-closure inspections.

1.2.2 TDEC Order

The TDEC Order was issued under the authority of the Tennessee Solid Waste Disposal Act to establish a process for investigating, assessing, and remediating unacceptable risks from management of CCR material at TVA coal-fired plants in the state of Tennessee. TDEC Order requirements for unit closure and

remediation of unacceptable risks were applied to the two TDEC Order CCR units at the WBF Plant in the Corrective Action/Risk Assessment (CARA) Plan. The CARA Plan also specifies the basis and actions TVA plans to take related to closure and groundwater corrective action for TDEC Order CCR units at the WBF Plant. This Supplemental Closure/Post-Closure Plan applies to the Slag Disposal Area.

1.2.3 New Regulations

TVA will continue to comply with new regulations promulgated in the future (both State and Federal) governing CCR management in the state of Tennessee. Updates to this Supplemental Closure/Post-Closure Plan will be made as necessary based on new regulatory requirements.

1.3 PLANNED ADDITIONAL CLOSURE ACTIONS

As described above, the Slag Disposal Area was closed in 2009 by leaving the CCR material in place with a soil cover system. The planned additional closure actions at the Slag Disposal Area include modifying the existing cover system at this CCR unit with a geosynthetic cover system and implementing drainage modifications. This includes extending the cover system across the majority of the footprint of the Drainage Improvements Area as well as across an existing ponded area directly west of the CCR unit once it has been filled with excavated CCR material, alluvial material, or borrow soils and regraded. Areas within the proposed limits of the cover system extension will be regraded to promote site drainage using existing site material or borrow material.

Prior to installing the cover system, CCR material behind the former unloading dock sheet pile wall, located in the northeast corner of the Slag Disposal Area, will be excavated to accommodate installation of the toe berm buttress as described below. Excavated CCR material will be consolidated in the drainage modifications area (southwest corner) of the Slag Disposal Area and Drainage Improvements Area. If additional CCR material is exposed during regrading operations, the material will be placed within the proposed limits of capping.

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

Design drawings for the planned additional closure actions are provided in the CARA Plan. The CARA Plan provides the basis for closing the Slag Disposal Area by leaving the CCR material in place with the

planned additional closure actions. The planned additional closure activities to be conducted at the Slag Disposal Area described above will be initiated following TDEC approval of the CARA Plan.

1.4 PURPOSE AND OBJECTIVES

This Supplemental Closure/Post-Closure Plan documents the closure and post-closure requirements for the planned additional closure activities at the Slag Disposal Area. The previous closure plan document is provided as Attachment 1.

1.5 CLOSURE SCHEDULE

TVA will implement this supplemental closure and post-closure plan once the CARA Plan is approved. Implementation activities will commence with the detailed design of the planned actions with permitting (if needed) generally proceeding simultaneously. Once the detailed design phase is complete, procurement and then construction will proceed. Following construction completion, TVA will implement post-closure care activities and the planned actions for the CCR unit, and conduct groundwater corrective action monitoring.

1.6 FACILITY CONTACT INFORMATION

The party listed below was involved with the permitting, design, operation, maintenance, quality control/quality assurance of the Slag Disposal Area at the WBF Plant.

Owner: Tennessee Valley Authority (TVA)

Contact: Civil Projects & CCP Management, Strategy and Engineering
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402

2.0 CLOSURE PLAN

2.1 CLOSURE REQUIREMENTS

The existing soil cover system at the Slag Disposal Area will be modified with the final cover system described in Section 2.2. This includes extending the cover system across the majority of the footprint of the Drainage Improvements Area as well as across an existing ponded area directly west of the CCR unit. Stormwater drainage modifications will be implemented to further control and minimize infiltration consistent with applicable regulations. The modifications will include design and implementation of a site grading plan, construction of a final cover system, and the construction of a stormwater management system in accordance with accepted engineering practices. These actions will limit infiltration through the final cover system to lower the hydraulic head, in conjunction with the existing low permeability perimeter dikes and foundation soils.

TVA will mitigate against the need for further maintenance of the CCR unit through compliance with post-closure care activities, in addition to the final cover system that will be installed. Regularly scheduled inspections to evaluate post-closure conditions and to verify preventive maintenance activities of the unit will reduce the need for additional maintenance. Post-closure care activities are addressed below.

The final cover system will control the infiltration of precipitation into the closed CCR unit. The final cover system will also act to cover, control, and prevent the release of CCR material from the closed CCR unit, into surface waters and the atmosphere. The grading plan and stormwater management system will promote positive drainage and control infiltration into the CCR material. The final cover system is designed to prevent the exposure of CCR material to the atmosphere.

Sections 2.2 through 2.6 describe the additional closure activities intended to minimize the need for further maintenance as well as control, minimize, or eliminate threats to public health and the environment post-closure.

Section 3.2 describes the measures planned during the post-closure care period established in Section 3.1. These measures are intended to ensure the performance objective of actions completed during closure are continuously met.

TVA will initiate and complete additional closure activities and conduct post-closure care activities in accordance with the approved Supplemental Closure/Post-Closure Plan.

The CARA Plan, as and when approved by TDEC, provides the notification to the TDEC Division Director of the intent to perform the additional closure actions.

The Commissioner's approval of the schedule in the CARA Plan provides approval of a time period to complete the planned additional closure actions.

2.2 FINAL COVER AND ALTERNATIVE FINAL COVER SYSTEMS

The installation of the final cover system will be completed in the shortest amount of time practicable, consistent with recognized and generally accepted good engineering and safety practices. The Commissioner's approval of the schedule in the CARA Plan provides approval of a time period to complete the planned additional closure actions.

An alternative final cover system consisting of either a geosynthetic-soil cover system or a geosynthetic-engineered turf cover system, as described below, is planned to be installed over the CCR unit.

The geosynthetic-engineered turf cover system includes the following components (from bottom to top):

- Structured geomembrane
- Engineered turf
- Sand infill (1/2-inch minimum).

The geosynthetic-soil cover system includes the following components (from bottom to top):

- Flexible membrane or geomembrane liner
- Geocomposite drainage layer
- Protective cover soil (18-inch minimum)
- Vegetative cover soil (six-inch minimum).

Typical permeability values for geomembrane range from 10^{-13} to 10^{-14} centimeters per second.

The planned additional closure actions at the Slag Disposal Area include installing a geosynthetic cover system over the CCR material and extending the cover system across the majority of the footprint of the Drainage Improvements Area as well as across an existing ponded area directly west of the CCR unit. The existing soil cover system will be removed during closure activities to prepare the subgrade for the geosynthetic cover system installation. Areas within the limits of the cover system will be regraded to promote site drainage. If CCR material is exposed during regrading operations, the material will be placed within the final cover system limits. Once final grades are achieved, a geosynthetic-soil cover system or a geosynthetic-engineered turf cover system will be installed.

2.2.1 Geosynthetic Materials

Excavation of the existing vegetative cover, where present, to establish a subgrade surface within the limits of the final cover system will be performed in a manner to leave existing cover soils over CCR material and mitigate exposure of CCR materials to the extent practicable. The geomembrane will be placed directly on the subgrade surface within the limits of the final cover system. The geocomposite drainage layer will be placed above the geomembrane and drain surface water that infiltrates through the overlying soil materials. The geosynthetic materials will be installed and tested as required by the manufacturer.

2.2.2 Cover Soils

If a geosynthetic-soil cover system is selected, protective and vegetative cover soil layers will be placed overtop the geocomposite drainage layer within the final cover system. This soil material will consist primarily of fine-grained materials that are suitable for fill and final cover soil and classify as fat clay (CH), lean clay (CL), silty clay (CL- ML), elastic silt (MH), or silt (ML) as determined by the Unified Soil Classification System, ASTM D2487. TVA will complete investigations to confirm soil material that meets this requirement is readily available. If the engineered turf cover system is selected, cover soil will not be used.

2.3 DRAINAGE SYSTEM

Prior to installation of the final cover system, grading of existing ditches will be completed. Stormwater drainage modifications will include replacement of existing stormwater culverts disturbed during construction and installation of new stormwater culverts as necessary. Following completion of the

regrading and final cover system, exposed areas will be stabilized with seed or sod, and gravel roadways will be repaired or replaced as necessary.

Proper establishment of vegetation or engineered turf will be the primary method to minimize erosion.

The surface grading will be designed to properly convey precipitation run-off from the CCR unit, thus preventing ponded water, and all the conveyance features will be designed to promote positive drainage to prevent ponding of water.

The surface water drainage system will be designed to be consistent with the surrounding area and will not adversely affect proper drainage from the adjacent lands.

2.4 VEGETATIVE COVER

TVA will take necessary steps to establish a protective cover over disturbed areas of the CCR unit as soon as practicable after final grading to minimize erosion, consistent with recognized and generally accepted good engineering practices. Most surfaces are and will be protected against surface erosion by either vegetative cover, engineered turf, riprap, or other erosion protective measures. No nuisance or invasive species will be used as vegetative cover. If an engineered turf system is used, seeding or sodding will not be required.

2.5 OTHER EROSION AND SEDIMENT CONTROL MEASURES

Other erosion and sediment control measures may be implemented to minimize and control erosion and sedimentation at the site. Additional erosion control problems will be addressed with appropriate structural and nonstructural sediment and erosion control practices as prescribed within the plans or the most recent edition of the *Tennessee Erosion Prevention and Sediment Control Handbook* (TDEC 2024).

2.6 CLOSURE CERTIFICATION AND NOTIFICATION

TVA will continue to comply with new regulations promulgated in the future (both State and Federal) governing CCR management in the state of Tennessee. Updates to this Supplemental Closure/Post-Closure Plan will be made as necessary based on new regulatory requirements.

3.0 POST-CLOSURE PLAN

3.1 POST-CLOSURE CARE PERIOD

Post-closure activities will be conducted in accordance with the Slag Disposal Area closure and post-closure plan (Attachment 1) and the CARA Plan.

3.2 POST-CLOSURE CARE ACTIVITIES

3.2.1 Final Contours, Drainage System, and Vegetative Cover

TVA will maintain the integrity and effectiveness of the final cover system and establish and maintain the vegetative cover as described in Sections 3.2.1 and 3.2.2 of the Slag Disposal Area closure and post-closure plan (Attachment 1).

Maintaining drainage facilities, sediment ponds, and other erosion/sedimentation control measures will be conducted in accordance with Section 3.2.2 of the Slag Disposal Area closure and post-closure plan (Attachment 1).

3.2.2 Groundwater Monitoring Plan

Routine groundwater sampling and analysis are currently being conducted for the Slag Disposal Area. Groundwater monitoring will continue during closure and post-closure activities in accordance with Appendix E – Groundwater Monitoring Plan of the CARA Plan.

3.2.3 Inspections

TVA will implement post-closure inspection and maintenance activities in accordance with Section 3.2.6 of the Slag Disposal Area closure and post-closure plan (Attachment 1).

3.2.4 Post-Closure Certification

Following the completion of the post-closure care period, TVA will submit a certification verifying that post-closure has been completed in accordance with Section 3.2 of the Slag Disposal Area closure and post closure plan (Attachment 1) and the CARA Plan.

3.3 POST-CLOSURE USE

TVA currently has no plans for future use of the remaining property during the post-closure care period.

3.4 AMENDMENT OF PLAN

Any amendments to this Supplemental Closure/Post-Closure Plan initiated by TVA will include evidence demonstrating that the requirements for approved modifications are met.

4.0 REFERENCES

AECOM. (2016). Slag Disposal Area Maintenance, TVA Project 90160, Construction Record Documentation Report (Rev. 0). Watts Bar Fossil Plant. January 18, 2016.

Tennessee Department of Environment and Conservation (TDEC). (2015). *Commissioner's Order No. OGC15- 177*. August 6, 2015.

TDEC. (2024). *Tennessee Erosion Prevention and Sediment Control Handbook*. Revised November 18, 2024.

EXHIBITS

Exhibit No.
1

DRAFT

Title
WBF Plant Overview

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-09-24
Technical Review by BL on 2025-09-24

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

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

CCR: Coal combustion residuals

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

Stantec TVA

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ATTACHMENT 1

Closure Plan and Post Closure Plan
Slag Disposal Area

DRAFT

Tennessee Valley Authority
Watts Bar Fossil Plant

CLOSURE AND POST-CLOSURE PLAN

SLAG PROCESSING AND POND AREA

Prepared By:

Tennessee Valley Authority
Fossil Engineering Services
1101 Market Street
Chattanooga, TN 37401-2801

April 2007

DRAFT

Title: CLOSURE AND POST-CLOSURE PLAN SLAG PROCESSING AND POND AREA.			DCN#
			Plant/Unit: Watts Bar Fossil Plant
Vendor	Contract No.	Key Nouns:	

Applicable Design Documents	REV	EDMS NUMBER	DESCRIPTION
	R0		
References	R1		
	R2		

TENNESSEE VALLEY AUTHORITY
FOSSIL POWER GROUP
FOSSIL ENGINEERING SERVICES
SITE AND ENVIRONMENTAL ENGINEERING

HAROLD L. PETTY
REGISTERED ENGINEER
No. 015576
STATE OF TENNESSEE

4.25.07

	Revision 0	R1	R3
Date	April 2007		
Prepared	Kelly Evans		
Checked	John Dizer Amos Smith		
Supervised	Harold L. Petty		

DRAFT

CLOSURE AND POST-CLOSURE PLAN
SLAG PROCESSING AND POND AREA

Prepared By:
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37401-2801

Revision 0

April 2007

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1.0 INTRODUCTION

1.1 Purpose

The following Closure and Post-Closure Plan (C/PC Plan) has been developed for the Slag Processing and Pond Area located at Tennessee Valley Authority's (TVA's) Watts Bar Fossil Plant (WBF). Closure and post closure activities will be conducted in accordance to the current standards adopted by the Tennessee Department of Environment and Conservation (TDEC). The purpose of this document is to: (i) describe necessary activities associated with the closure of the disposal facility; and (ii) describe the monitoring and maintenance activities for the facility during the post-closure period. A copy of this C/PC Plan will be kept at the facility, or another approved location.

1.2 Site Location and Description and History

1.2.1 Location The slag processing and pond area is located on land currently owned by TVA at the Watts Bar Fossil Plant (WBF). WBF is located on the west bank of the Tennessee River near Spring City in Rhea County, TN (see Appendix A). Access to the Site is via a shared access road to Watts Bar Nuclear Plant. The intersection of the access road is located approximately 1 mile west of Watts Bar Dam off Highway 68.

1.2.2 History The Watts Bar Fossil Plant was built with four operating units rated at 60,000 kilowatts of rated capacity. Major operations of the plant began when the first unit went into commercial operations on February 15th, 1942 with the final unit beginning commercial operations on April 8th, 1945. The plant played a key role as a part of the World War II emergency program. The Watts Bar Fossil Plant ceased operation in 1982.

The slag processing and pond area is located as shown in Figure 1 in Appendix A, and covers an area of approximately 27 acres. Within this area is the original ash pond which received sluiced fly ash. Bottom ash in the form of slag was also disposed of in this area. (In 1978 the ash pond extension to the south was added via a series of culverts underneath the road to the south of this area. It is noted that this extended

portion of the ash pond is not being closed.) In 1978 a chemical treatment pond (1.1 acres) was added in the northwest corner of this area. This pond was designed to receive the output of periodic acidic boiler cleaning treatments; the planned output being neutralized before discharging into the ash pond. It is unknown if this pond was ever used for that purpose as four years later the Watts Bar Fossil Plant ceased operation in 1982.

While the plant was in deactivated status no ash was discharged into this area however raw water continued to be discharged into the bottom ash area for various reasons. During a portion of this period TVA used part of the dry area for storage of heavy construction equipment. US Minerals reclaimed slag from this area from March 1996 until December 2005. This recovered aggregate material was used in the manufacture of products as varied as roofing shingles and toothpaste. Those operations ceased when all the usable material was recovered. Since the area is no longer being used as a processing pond and no more material can be reclaimed for other use, it is to be closed.

1.3 Expected Year of Closure

TVA expects to complete the closure of the slag area in 2008.

1.4 Facility Contact Information

The following is a list of responsible parties involved in the permitting, design, operation, maintenance, quality control and quality assurance of the slag disposal facility at TVA's Watts Bar Fossil Plant.

1. Owner: Tennessee Valley Authority (TVA)
   Contact: Facilities Manager
   Tennessee Valley Authority
   400 W. Summit Hill Drive, WT 3B-K
   Knoxville, TN 37902

As of the date of this revision, the plant is unmanned. TVA's facilities' management contact for this project is Mr. Larry Graves, (865)632-8924

Please direct any correspondence in regards to this document to the designated Solid Waste Specialist. The Solid Waste Specialist for Watts Bar Fossil Plant is:

John Dizer
1101 Market Street, LP 5D-C
Chattanooga, Tennessee 37402-2801
Phone: (423)751-7636
Fax: (423)751-7011

2. State: Tennessee Department of Environment and Conservation
Division of Solid Waste Management
Tennessee Department of Environment and Conservation
540 McCallie Avenue
Suite 550- State Office Bldg
Chattanooga, TN 37402
Phone: (423) 634-5745
Fax: (423) 634-6389

Contact as of the date of this manual is Mr. Guy Moose, Management of Solid (Trash) & Hazardous Wastes

Tennessee Department of Conservation
Division of Solid Waste Management
Central Office
401 Church Street
5th Floor, L&C Tower
Nashville, TN 37243-1533
Phone: (615) 532-0780
Fax: (615) 532-0886

Contact as of the date of this manual is Mr. Mike Apple, Division Director.

2.0 CLOSURE PLAN

Though the slag processing and pond area was not subject to a solid waste disposal operating permit, closure and post closure information presented in this document has been organized and presented consistent with the permit application standards presented in Rule 1200-1-7-.04 (8) (d) and Rule 1200-1-7-.03 (2). Sections within this document have been titled and enumerated consistent with the regulations to facilitate the review process. The regulatory requirements are cited in italics at the start of each section followed by a text description indicating how the specific requirement has been or will be addressed.

2.1 Closure Requirements (ref. 1200-1-7-.04 (8))

Regulatory requirement:

(a) General Performance Standard

1. *The operator must close the disposal facility or disposal facility parcel in a manner that:*

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

2. *The operator must care for a disposal facility or disposal facility parcel for the period of time after closure, specified in subparagraph (d) of this Rule, in a manner that assures that the performance objectives of part 1 of this subparagraph are continuously met.*

This Closure Plan provides direction to close the slag processing and pond facility in a manner that will minimize the need for further maintenance of the facility. It further specifies measures to control, minimize, or eliminate threats to public health and the environment.

(a) Adherence to plan - The operator must initiate and complete closure activities and conduct post-closure care activities in accordance with the approved closure/post-closure care plan, if such plan has been prepared and approved for the disposal facility or disposal facility parcel being closed.

The operator will initiate and complete closure activities and conduct post-closure activities in accordance with the approved closure and post-closure plan at the time of closure of the facility.

(b) Closure Requirements - The following requirements apply to active portions of the facility:

1. *The operator must notify the Division Director of his intent to close at least 60 days prior to the date he expects to begin final closure of the disposal facility or disposal facility parcel.*

2. *The operator must complete closure activities including grading and establishing vegetative cover in the shortest practicable time, not to exceed 180 days, after any fill areas or any portion of the fill areas have achieved final grade, unless the Commissioner allows otherwise in the permit. Permits may provide, or be modified to provide, minimum areas for closure which will be shown in closure plans. Such modifications of closure plans, for the sole purpose of identifying minimum closure areas, shall be deemed minor modifications. When these complete closure areas reach final grade, these areas shall be closed as otherwise provided in this part and within the 180 day time frame provided herein.*

By the submission of this plan TVA hereby notifies the Director of the Tennessee Division of Solid Waste Management of its intent to close the facility. The closure activities (including final cover placement, grading, drainage) will be completed within

180 days following the beginning of closure activities, except where an extension is requested and approved by the Tennessee Division of Solid Waste Management. It should be noted that the native grasses require they be planted in the early spring. Therefore the total closure will not be complete until summer of 2008.

2.2 Final Cover and Alternative Final Cover Systems (ref. 1200-1-7-.04 (8) (c))

Regulatory requirement:

3. *Unless otherwise noted in the permit a depth of compacted final cover material (e.g., soil) shall be placed on the disposal facility or disposal facility parcel in the shortest practicable time, not to exceed 90 days, after achieving final grade of any fill area or any portion of a fill area. At least the top twelve inches of this cover material shall be soil which will support the growth of suitable vegetation (e.g., topsoil).*

   (i) *At Class I and Class II facilities the depth of final cover system shall be at least 36 inches of soil of which a minimum of 12 inches shall be for the support of vegetative cover.*

   The design of the final cover system shall be such that the infiltration volume of water will be equal to or less than the percolation volume through the bottom liner system or a design which includes a compacted soil layer of at least 24 inches which has a permeability no greater than 1×10^{-7} *cm/sec, whichever is less. This design shall be supported by the use of the HELP model or other equivalent method approved by the Commissioner.*

   An alternate final cover system may be used provided that it is demonstrated to the satisfaction of the Commissioner that the final cover system provides equivalent or superior performance to the minimum performance standard in this subpart.

(ii) At Class III and Class IV facilities, unless the Commissioner determines that a greater depth is needed to achieve the general performance standard of subparagraph (a) of this paragraph, the depth of final cover shall be at least 30 inches of compacted soil. The final cover consists of an 18 inch low permeability layer overlain by a 12 inch protective layer.

(iii) At Class I, II, III, and IV facilities, with approval of the Commissioner any other low permeability layer construction techniques or materials may be used to provide the final cover, provided that it provides equivalent or superior performance to the requirements of this part.

One final cover system is proposed for the primary slag processing and pond area. Another final cover system is proposed for the former Chemical Pond Area.

2.2.1 Final Cover for the Slag Processing and Pond Area.

Details of the final cover system for this area are illustrated on Drawing No. 10W425-06 (Slag Disposal Details I). As shown in the drawing, the final cover system will consist of the following profile, from top to bottom:

- a 12-inch thick protective cover soil (vegetative cover) that is capable of sustaining native plant growth;
- a 12-inch thick compacted soil layer. The soil source is to be a soil that has shown to be capable of achieving a hydraulic conductivity of less than or equal to 1×10^{-6} cm/sec. See Appendix E (QA/QC) section 6.4 for testing requirements.

The proposed final cover with a compacted layer achieving the specified hydraulic conductivity exceeds the performance requirements stated in DSWM Policy Memorandum #93 (see Appendix B) for a coal ash disposal facility. This area has been open for more than 60 years. The chemical testing of the various waste materials in this area, included in Appendix G, shows these materials to be of relatively low hazard. The regrading and addition of the proposed final cover will greatly reduce infiltration thru the waste material in this area.

- The final cover grading plan for this area is presented in Drawing No. 10W425-03 (Site Grading Plan (Slag Area)). As shown in this drawing, the final cover will be graded to a minimum slope of 2 percent and a maximum slope of 20 percent.

2.2.2 Final Cover for the Chemical Pond Area.

Details of the final cover system for this area are illustrated on Drawing No. 10W425-07 (Slag Disposal Details II). As shown in the drawing, the final cover system will consist of the following profile, from top to bottom:

- a 12-inch thick protective cover soil (vegetative cover) that is capable of sustaining native plant growth;

In TVA's records there is no indication that the chemical pond was ever used. This is quite conceivable in light of the fact that the plant was decommissioned approximately four years after the Chemical Treatment pond was constructed. Boiler cleanings at our other fossil plants are more typically on 5 year or even greater intervals. In the final years of operation the plant was only intermittently operated. Furthermore, the sediment was tested and no significant contamination was found. The results of that testing is included in Appendix G.

- The final cover grading plan for this area is presented in Drawing No. 10W425-03 (Site Grading Plan (Slag Area)). As shown in this drawing, the final cover will be graded to a minimum slope of 2 percent following filling in the pond to grade with select fly ash from the adjacent processing area.

2.3 Drainage System (ref. 1200-1-7-.04 (8) (c))

Regulatory requirement:

4. *The final surface of the disposal facility or disposal facility parcel shall be graded and/or provided with drainage facilities in a manner that:*

   (i) Minimizes precipitation run-on from adjacent areas onto the disposal facility or disposal facility parcel;
   (ii) Minimizes erosion of cover material (e.g., no steep slopes);
   (iii) Optimizes drainage of precipitation falling on the disposal facility or disposal facility parcel (e.g., prevent pooling); and
   (iv) Provides a surface drainage system which is consistent with the surrounding area and in no way significantly adversely affects proper drainage from these adjacent lands.

The proposed grading plan of the drainage system (surface water management system) for the TVA Watts Bar Slag Processing and Pond Area is provided in Drawing No. 10W425-3. Runoff from primarily undisturbed areas to the north of the disposal area (referred to as "run-on") will be intercepted by a system of pre-existing drainage channels to prevent from "running-on" to the active portion of the disposal area. The run-on from the parking area adjacent to the former powerhouse will be re-directed into a ditch west of the slag processing area. This system of drainage channels will collect and convey run-on to the Tennessee River to the south of the disposal area, through the remaining ash pond which will serve as a retention pond.

Once closed, the majority of the former slag area will continue to drain to the south through the ash pond and will outlet thru the existing weirs into the Tennessee River thru an existing NPDES discharge point. Approximately 3.4 acres of the northernmost portion of the area will be directed to a new sedimentation/retention basin and will be directed into the Tennessee River through a new NPDES permitted discharge. Approximately 3.2 acres located on the eastern side of the final closed area will sheet flow directly to the Tennessee River.

Erosion of soil material on the final cover system will be minimized through slope stabilization techniques. The majority of the final cover slope will be graded at 2%. A portion of the final cover side slopes will be graded not to exceed a 20 percent (i.e., 5 horizontal: 1 vertical) slope. The maximum slope length of the steepest slope (between drainage benches) is 75 feet. (Only a small portion of a run-on diversion ditch side

slope is set at 33% (3:1) at a location that does not receive final cover) The cover system optimizes drainage and precipitation run-off by maintaining minimum top slopes of 2 percent to prevent ponding of water on top of the cover. The new stormwater pond at the north of the closed area has been designed to accommodate at least a 25-year, 24-hour storm event. Calculations for the new stormwater pond are included in Appendix F. Calculations verify that existing spillway structures for the existing ash pond south of the area are sufficient for a 25-year 24-hour storm event. The surface water management system has been designed to be consistent with the surrounding area and does not significantly affect proper drainage from or to adjacent lands.

In addition, vegetation will be established on the final cover system surface as the construction progresses to prevent erosion of final cover material.

2.4 Vegetative Cover (ref. 1200-1-7-.04 (8) (c))

Regulatory requirement:

5. *In order to minimize soil erosion, as soon as practicable after final grading, the operator shall take steps as necessary to establish a protective vegetative cover of acceptable grasses over disturbed areas of the site. These steps shall include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding of steeper slopes and drainage ways if such are necessary.*

As soon as practical after final grading, the operator will take necessary steps to establish a protective vegetative cover of acceptable grasses over disturbed areas of the site. These steps shall include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding of steeper slopes and drainage ways if necessary. Application rates for seeding and fertilizing of indigenous grass/vegetation are provided in the Specifications included as Appendix C in this closure plan. Temporary erosion control blankets may be used if necessary to provide seedbed protection and prevent wash-out of seed and fertilizer during vegetation establishment. A temporary cover of a grass seeding such as annual ryegrass may be used as necessary during the construction period to prevent erosion until the final native grass is established.

2.5 Other Erosion and Sediment Control Measures (ref. 1200-1-7-.04 (8) (c))

Regulatory requirement:

6. *In addition to the drainage and grading requirements and vegetative cover requirements, the operator shall take other measures as may be necessary to minimize and control erosion and sedimentation (e.g., soil stabilization, sediment ponds) at the site.*

In addition to the drainage, grading, and vegetative cover requirements, other measures such as soil stabilization through riprap protection, and sediment ponds will be implemented to minimize and control erosion and sedimentation at the site. Additional erosion control problems will be addressed with appropriate structural and non-structural sediment and erosion control practices as prescribed within the plans or the most recent edition of the Tennessee Erosion and Sediment Control Handbook.

2.6 Leachate Collection System (ref. 1200-1-7-.04 (8) (c))

Regulatory requirement:

7. *As required in his permit, or as otherwise necessary to prevent threats to human health and the environment, the operator shall establish and/or complete a system for collecting, removing, and treating leachate generated by the disposal facility or disposal facility parcel.*

This facility is a slag processing area that does not have a leachate collection system. Leachate collection for ash disposal facilities is not applicable as so stated in DSWM Policy memorandum SW-93 (A copy of this Policy Memorandum is included in Appendix B).

2.7 Gas Collection System (ref. 1200-1-7-.04 (8) (c))

Regulatory requirement:

> 8. *As required in his permit, or as otherwise necessary to prevent threats to human health and the environment, the operator shall establish and/or complete a system for collecting and venting or otherwise controlling the vertical and horizontal escape of gases generated in the disposal facility or disposal facility parcel.*

This facility processed only slag and ash produced from burning coal. Gas collection for ash disposal facilities is not applicable as so stated in DSWM Policy memorandum SW-93 (A copy of this Policy Memorandum is included in Appendix B). Ash produced from the combustion of coal is the primary waste material processed in the facility. Ash is completely composed of noncombustible mineral components. Ash is basically inert, noncombustible, nonputrescible, and will not decompose to produce gases. Rule 1200-1-7-.04 (8) (c) 8 is not applicable to this facility.

2.8 Borrow Area Reclamation

Borrow areas which are used for excavation and construction of final cover soil will be reclaimed by regrading, stabilizing, and establishing permanent vegetation, within 30 days of ceasing borrow activities. Borrow and stockpile areas will be graded to allow positive drainage off-site. Additional erosion controls will be addressed with appropriate structural and non-structural sediment and erosion control practices as prescribed within the plans or the most recent edition of the Tennessee Erosion and Sediment Control Handbook.

2.9 Closure Sequence

Upon achieving the appropriate final grades for the closure, the facility will be closed in the following sequence:

1) An on-site borrow source for soil material has been identified and laboratory tests have been performed to ensure that the properties of that soil satisfy the needs for this project. Portions of the soils report are reproduced in Appendix H. The entire report is available upon request.

2) Closure will then begin by installing the compacted soil layer in a controlled manner in lifts using materials from the designated borrow source. The QA/QC plan will be followed to monitor the consistency and thickness of the compacted soil layer as it is placed.

3) The vegetative soil cover will be installed on top of the compacted soil layer under the supervision of the TVA site construction manager and a professional engineer registered in the State of Tennessee. To aid in root development, this layer will be moderately compacted.

4) Finally, the surface of the cover will be seeded and/or vegetated, and fertilizer will be added to promote germination and growth. Native grasses will be used for the final vegetative cover. Application rates for seeding and fertilizing are provided in the specification for native grasses reproduced in Appendix C.

2.10 Closure Certification and Notification (ref. 1200-1-7-.04 (8) (c))

Regulatory requirement:

9. *The operator must notify the Division Director in writing within 60 days of his completion of closure of the disposal facility or disposal facility parcel. Such notification must include a certification by the operator that the disposal facility or disposal facility parcel has been closed in accordance with the approved closure/post-closure care plan. Within 21 days of the receipt of such notice the Division Director shall inspect the facility to verify that closure has been completed and in accordance with the approved plan. Within 10 days of such verification, the Commissioner shall approve*

the closure in writing to the operator. Closure shall not be considered final and complete until such approval has been made.

TVA will close the Watts Bar Fossil Plant Disposal Facility in accordance with the closure plan approved by TDEC Division of Solid Waste Management. Upon completing all the requirements outlined in the closure plan, TVA will provide the Division of Solid Waste Management with certification, signed by a professional engineer registered in the State of Tennessee, verifying compliance with closure requirements within 60 days after completing the closure requirements.

3.0 POST-CLOSURE PLAN

3.1 Post-Closure Care Period (ref. 1200-1-7-.04 (8) (a) and (d))

Regulatory requirement:

(a) General Performance Standard

(ii) The operator must care for a disposal facility or disposal facility parcel for the period of time after closure, specified in subparagraph (d) of this Rule, in a manner that assures that the performance objectives of part 1 of this subparagraph are continuously met.

(d) Post-Closure Care Period - For Class I and Class II disposal facilities, post-closure care must continue for 30 years after the date of final completion of closure of the disposal facility or disposal facility or parcel unless a shorter period is established in the approved closure/post-closure care plan. For Class III and IV disposal facilities, post-closure care must continue for 2 years after the date of final completion of closure of the facility or facility parcel. The postclosure care period may be reduced or extended based on cause by amendment of the approved closure/post-closure care plan as provided in rule 1200-1-7-.03(2)(e).

TVA will provide post-closure care for the disposal facility for a period of thirty (30) years after completion of disposal facility closure activities, in accordance with this Post-Closure Plan.

3.2 Post-Closure Care Activities

3.2.1 Final Contours and Drainage System (ref. 1200-1-7-.04 (8) (e))

Regulatory requirement:

(e) Post-Closure Care Activities - During the post-closure care period, the operator must, at a minimum, perform the following activities on closed portions of his facility:

1. Maintain the approved final contours and drainage system of the site such that the objectives of part (c) 4 of this paragraph are continuously met;

The approved final contours and drainage system will be maintained at the site. The effectiveness of the final cover will be maintained by making repairs to the cover as necessary to correct the effects of subsidence and erosion, as well as preventing run-on and run-off from eroding/damaging the final cover system. If settlement or other structural problems occur in the final cover system, the cover will be regraded. The problem area will be stripped of the vegetation layer and fill dirt will be applied to the area. The disturbed area will be covered with soil and reseeded as specified in the design. If excessive surface cracks appear on the soil cover, the cracks will be properly graded with suitable soil and appropriate vegetative cover will be re-established to prevent the infiltration of surface water.

The disposal area final cover has been designed to provide for positive, non-erosive drainage of run-off.

The outlet and inlet structures of the stormwater ponds will be maintained by the operator throughout the life of the disposal facility and during the post-closure period.

3.2.2 Vegetative Cover (ref. 1200-1-7-.04 (8) (e))

Regulatory requirement:

2. Ensure that a healthy vegetative cover is established and maintained over the site.

The vegetative cover will be inspected on a regular basis so as to maintain a healthy stand of vegetation. Areas containing distressed vegetation will be reseeded. The vegetative cover over the site will be maintained by mowing or selective herbicide use

on a regular schedule. If an area has less than 25 percent coverage by grass, the area will be reworked and reseeded. Fertilizer may be applied to promote the re-establishment of a self-sustaining vegetative cover. Significant depressions or gullies that develop will be promptly repaired by filling with soil and seeding. The details of the vegetative cover are provided in the QA/QC plan.

Regulatory requirement:

> 3. *Maintain the drainage facilities, sediment ponds, and other erosion/sedimentation control measures (if such are present at the landfill), at least until the vegetative cover is established sufficiently enough to render such maintenance unnecessary.*

Until vegetation of the final cover is fully established, sediment transport will be retarded by temporary silt fences. Sediment transported from the cover before vegetation is fully established will be conveyed to the stormwater pond. Should excessive cleaning and maintenance of the stormwater pond be needed due to erosion of soil from the cover, temporary sediment control measures will be installed to reduce the sediment load until the vegetative cover is fully established. Stormwater channels will be lined to prevent erosion. Until vegetation is fully established, the channels will be inspected monthly and after major storm events for structural and erosion problems. If damage to the channel is discovered, it will be repaired as appropriate.

3.2.3 Leachate Collection System (ref. 1200-1-7-.04 (8) (e))

Regulatory requirement:

> 4. *Maintain and monitor the leachate collection, removal, and treatment system (if such is present at the facility);*

No leachate system exists at this site. Rule 1200-1-7-.04 (8) (e) 4 is not applicable to this facility.

3.2.4 Gas Collection System (ref. 1200-7-.04 (8) (e))

Regulatory requirement:

> 5. *Maintain and monitor the gas collection and control system (if such is present at the facility);*

Since this facility processed only coal ash as waste, and no gas is expected to be generated from the waste, Rule 1200-1-7-.04 (8) (e) 5 is not applicable to this facility.

3.2.5 Groundwater Monitoring Plan (ref. 1200-1-7-.04 (8) (e))

Regulatory requirement:

> 6. *Maintain and monitor the ground and/or surface water monitoring system (if such is present at the facility). The monitoring system and sampling and analysis program established in the permit shall be continued during the post-closure care period, unless the permit is modified to establish a different system or program. Monitoring data must be reported in writing to the Division Director within 30 days after the completion of the analyses.*

Since this facility was never permitted as a disposal facility, groundwater monitoring has not been required. The slag has been stored and processed uncovered in this area since the 1950's. TVA has sampled all waste material to be left in-place and the material poses a low risk of groundwater contamination. The installation of the cap will significantly reduce the infiltration of water thru the waste material and will greatly reduce any potential for impacts to groundwater.

3.2.6 Inspections

Personnel from TVA will make visual inspections of the site on a regular basis for the duration of the post-closure care period. Maintenance or other corrective measures

needed to prevent the deterioration of the closure system will be identified during the inspections.

Features to be inspected include the disposal site, surface-water and security devices, and storm-water control features. Each inspection will be documented and will include, at a minimum, the following information: date and time of inspection, name of inspector, notation of observations made, nature of any remedial actions to be taken, and recommendation for corrective measures.

3.2.7 Post-Closure Certification (ref. 1200-1-7-.04 (8) (e))

Regulatory requirement:

> 7. *Following completion of the post-closure care period for each SWLF unit, the owner or operator must file with the Department a certification verifying that post-closure has been completed in accordance with the post-closure plan.*

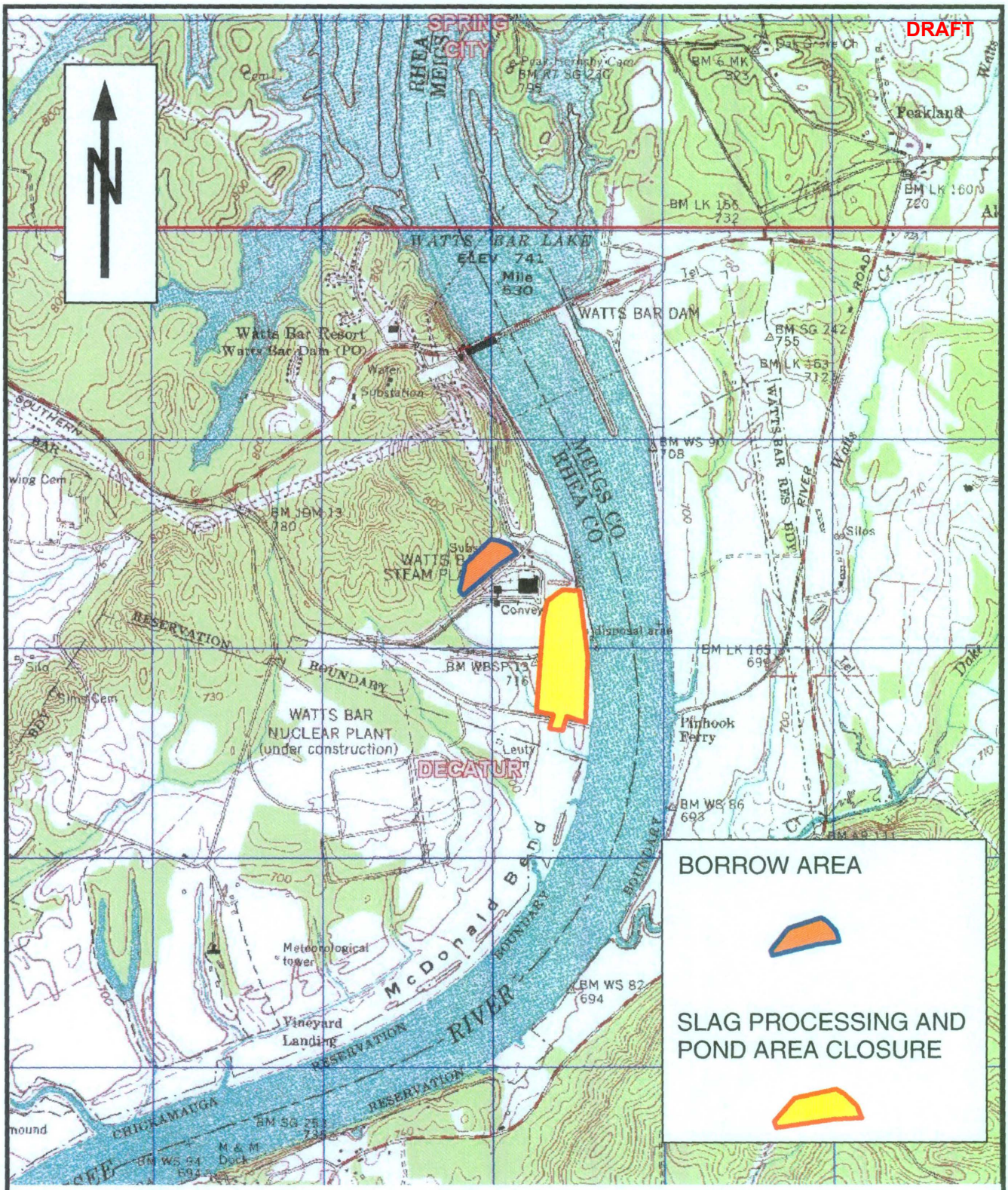
The operator will notify the Division Director in writing of its completion of the post-closure care period of the disposal facility within 60 days of completion of the post-closure care period. A professional engineer in the State of Tennessee will certify that the post-closure activities were completed in accordance with the post-closure care plan.

4.0 NOTICE IN DEED TO PROPERTY (ref. 1200-1-7-.04 (8) (f))

Regulatory requirement:

(f) Notice in Deed to Property - the operator must ensure that, within 90 days of completion of final closure of the facility and prior to sale or lease of the property on which the facility is located, there is recorded, in accordance with State law, a notation on the deed of property or on some other instrument which is normally examined during a title search that will in perpetuity notify any person conducting a title search that the land has been used as a disposal facility and its use is restricted in accordance with the approved closure/post-closure plan.

Within 90 days of completion of final closure activities of the facility and prior to final sale or lease of the property on which the facility is located, TVA will ensure that there is recorded, in accordance with State law, a notation on the deed to the property or some other instrument, which is normally examined during a title search that will in perpetuity notify any person conducting a title search that the land has been used as a disposal facility, and the use of the property is restricted in accordance with the approved closure/post-closure plan.



SOURCE: USGS TOPGRAPHIC MAPS OF DECATUR AND SPRING CITY, TENNESSEE

TVA

FIGURE 1 - LOCATION MAP
SLAG PROCESSING AND POND AREA CLOSURE
TVA—WATTS BAR FOSSIL PLANT

SCALE 1" = 2000 FT

APRIL 2007

DRAFT

TENNESSEE DEPARTMENT OF EVIRONMENT AND CONSERVATION

Division of Solid Waste Management

FOSSIL FUEL FLY ASH AND BOTTOM ASH DISPOSAL WITHIN A CLASS II FACILITY

POLICY

The purpose of this policy is to establish the criteria by which fossil fuel fly and bottom ash may be disposed of in a Class II facility:

1. The geologic buffer required will be 3 feet in total thickness with a maximum hydraulic conductivity of 1×10^{-6} cm/sec. The thickness will be measured from the base of the fill to the seasonal high water table of the uppermost unconfined aquifer, or the top of the formation aquifer;

2. No leachate migration control system will be required;

3. No gas migration control system will be required;

4. The final cover shall be 24 inches of compacted soil with a minimum of 6 inches which shall support vegetative cover; and

5. No random inspection program will be required.

Any variance to the Class II facility permit criteria will require the Commissioner's approval.

(Signature on File)
Mike Apple, Director
Division of Solid Waste Management

9-7-01
Date

policy/notebook/pn093
Revision 1: September 2001

VEGETATION SPECIFICATIONS

NATIVE GRASSESS - SEEDING AND MULCHING

(SPECIAL FOR WASTE AREAS)

SECTION 582 - Mulching

Refer to FP-96 Section 625. FP-96 Standard Specification for Construction of Roads and Bridges on Federal Highway Projects (US DOT - FHWA)

SECTION 583 - Native Grasses Seeding

583.1 – Description

This specification consists of furnishing and placing native warm season grass seed on waste disposal areas when specified by the plans or the Engineer. The use of these grasses for landfill cover crops is being encouraged by the Tennessee Department of Environment and Conservation Division of Solid Waste Management.

583.2 – Materials

1. Seeds

Seeds shall meet the requirements of applicable seed laws and shall be tested in accordance with the most current edition of the U.S. Department of Agriculture Handbook No. 30, Testing Agricultural and Vegetable Seed. Seeds shall be from the last preceding crop and comply with the requirements outlined below for purity and germination. Each variety of seed shall be furnished in separate, strong bags with each bag being fully tagged or labeled to show the variety, weight, purity, germination, and test data prescribed by law. All test

results shall be fully certified by the vendor or by a recognized seed testing agency. TVA reserves the right to require that samples be furnished, and to inspect and test the seeds after delivery. Seeds found not to comply with specification requirements shall be subject to rejection.

When mixing or forming seed mixtures, the seeds shall be carefully and uniformly mixed. Seeds shall not be mixed until each variety of seed to be used in the mix has been inspected and/or tested separately and approved.

583.2 – Materials (Continued)

Seed Varieties	Purity, Minimum %	Germination Minimum %
Sideoasts Gramma (*Bouteloua curtipendula*)	95	85
Little Bluestem (Schizachyrium scoparium)	95	85
Sand Lovegrass (*Eragrostis trichodes*)	95	85
Annual Rye (lolium multiflorum)	90	90

Seeding materials shall be free from seeds or bulbets of Wild Onion (Allium vineale), Canada Thistle (Cirsium arvense), and Johnson Grass (Sorghum halepense).

Continued next page.....

Seed species shall not contain more than six seeds per ounce of the seed of any of the following noxious weeds or the seeds of any other weed specifically listed as noxious:

Bindweed (Convolvulus arvensis)
Buckthorn (Plantago lanceolata)
Corncockle (Agrostemmo githago)
Dodder (Cuscuta species)
Oxeyedaisy (Chrysanthemum leucantheumum)
Quackgrass (Agropyron repens)
Sorrel (Rumex acetosella)

Seed species shall not contain an excess of 2 percent by weight of weed seeds, noxious or otherwise.

2. Seed or seed mixtures, rates, and seasons

Seeding mixtures, rates, and seasons shall be those specified herein. The types to be used for each area or project will be specified by the drawing or by memorandum. Mixtures or rates of application other than those specified shall be used only when specified by the plans or the Engineer. Seeding shall be planted during the season and between the dates specified. Note that the pound rates are PLS (pure live seed).

Type 1: Winter seeding ((Plant between November 1 and December 31)

(1) Sideoats Grama	4 pounds per acre
(2) Little Bluestem	5 pounds per acre
(3) Sand Lovegrass	1 pounds per acre
(4) Annual Rye	60 pounds per acre
	70 pounds per acre

Type 2: Spring seeding (Plant between April 15 and July 1).

Mixture:

(1) Sideoats Grama	4 pounds per acre
(2) Little Bluestem	5 pounds per acre
(3) Sand Lovegrass	1 pounds per acre
	10 pounds per acres

Note: All slopes 3:1 or greater shall be seeded with the winter mixture

e. Temporary Cover

Type 3: Temporary winter seeding (Plant between October 15 and March 15).

Annual Ryegrass	80 pounds per acre

583.3– Soil Chemistry Requirements

Soil pH range: 5.0 - 7.8 S.U.

Soil Fertility: Low-Medium for phosphorous and potassium.

583.4 -- Soil Preparation

Areas to be seeded shall have approved cross sections and grades. Objects such as large roots, stones, stumps, coarse vegetation, debris, or any other items that might impede mechanical mowing shall be removed and disposed of satisfactorily.

Seedbeds shall be plowed, disked, harrowed, scarified, or cultivated to the approved depth. In areas where it is practical, this work shall be done with farm-type equipment. On steep slopes, preparation of seedbeds shall be done with the tools and methods specified by the Engineer. It is strongly recommended that scarifying and preparation on cut and fill slopes be accomplished with tools or equipment specially designed for this purpose. Small furrows or grooves formed in the slopes shall be horizontal or as nearly horizontal as practical. The work shall be performed only when the ground is in a workable and tillable condition as determined by good farming practices.

583.5 -- Special Hydroseeding Equipment

Equipment to be used for the hydraulic application of planting materials shall be a Finn Hydro-Seeder, Bowie Hydro Mulcher, Toro Environmental Control Unit, or an approved equal. The equipment shall have mixing tanks with built-in agitators having operating capacities sufficient to agitate, suspend, and homogeneously mix slurries of water and planting materials. The slurry distribution lines shall be large enough to prevent clogging or stoppage. Discharge lines shall be equipped with sets of different sized hydraulic spray nozzles capable of providing for even distribution of varying slurry mixtures on areas to be seeded.

583.6 -- Seeding Methods

Seeds shall be sown with approved hydroseeding equipment. Rates specified in Section 583.2 shall be maintained in a manner that will guarantee uniform coverage. Seeding operations shall not be performed when drought, high winds, and excessive moisture or other factors may defer satisfactory results. The carrier mix shall be 0-13-13. The area shall be cultipacked immediately after seeding.

583.7 -- Maintenance

Seeded areas shall be maintained until a satisfactory cover of plant material is secured, unless stipulated otherwise. All areas shall be preserved, repaired, and protected as specified for this purpose. Areas having poor stands of plant material shall be seeded again and fertilized at the proper rates.

Watering shall be accomplished during the maintenance period to the extent necessary.

583.8 -- Method of Measurement

Seeded areas will be measured in square yard units and include the seeded areas along slopes.

Appendix D - List of Drawings

The following is a list of the drawings for this closure project. By their reference they are included as a part of this closure plan.

10W245-01	Title Sheet
10W245-02	Existing Site Conditions Surveys
10W245-03	Site Grading Plan (Slag Area)
10W245-04	Existing Transmission Line Profile
10W245-05	Cross Sections
10W245-06	Slag Disposal Details I
10W245-07	Slag Disposal Details II
10W245-08	Sediment and Erosion Control Plan (Slag Area)

APPENDIX E

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PLAN

1.0 INTRODUCTION

This Material Specifications and Construction Quality Assurance/Quality Control Plan (QA/QC Plan) is prepared for the proposed closure of the Watts Bar Fossil Plant Slag Processing and Pond Area. The purpose of this QA/QC Plan is to outline procedures for verifying that proper materials, construction techniques, and installation procedures are used by the Constructor, and that the design intent is met. This QA/QC plan has been developed to satisfy the requirements of rule 1200-1-7-.04(9)(c)19. In addition, this QA/QC Plan is intended to define problems that may occur during construction and to provide a mechanism for resolving these problems as they occur.

The elements of construction of the closure of this facility requiring field monitoring and documentation under this plan include: final grading of the site, and final cover system construction.

The program described by this Plan is independent of the quality control (QC) program conducted by the Constructor. This QA/QC Plan is intended to provide verification that the Constructor has met his obligation in the supply and installation of the specified materials. This plan does not replace the contract documents (design drawings and documents) regarding the selection and installation of materials.

2.0 DEFINITIONS AND USE OF TERMS

This section provides definitions for terms used in the QA/QC Plan.

Owner – Tennessee Valley Authority

Constructor – the individual or firm, responsible for construction activities. This definition applied to any party performing work defined in the construction documents. At this time TVA plans to use their own construction organization, Heavy Equipment Division (HED), for construction activities. Other TVA organizations may be used to support this portions of the work activities described herein. TVA reserves the right to subcontract construction at it's discretion.

Construction Manager – the official representative of the Owner responsible for overseeing construction of the project. If TVA uses the HED for construction the Construction Manager and Constructor are one in the same.

Conformance Testing - includes testing that is performed by the Certification Engineer to conform and qualify material prior to their use.

Certification Engineer – individual appointed by the Owner who is responsible for performing tasks outlined in this QA/QC Plan. The Certification Engineer will be

selected by TVA FES and shall be a registered Professional Engineer in the state of Tennessee.

Design Engineer – the individual(s) or firm(s) responsible for the preparation of design documents and significant design changes during construction as determined by the Certification Engineer. The design engineer shall be a registered Professional Engineer in the state of Tennessee. TVA Fossil Engineering Services (FES) is the responsible engineering organization for design and certification of this facility.

Earthwork – an activity involving the use of soil or rock materials. It also includes activities involving the use of byproducts in the construction of waste disposal facilities.

Performance Testing – includes those activities that occur during and following material installation including dike raising activities during facility operation.

Project Design Drawings and Documents – all project related drawings and documents, including design modifications and record drawings.

Project Documents – includes Constructor submittals, construction drawings, record drawings, specifications, shop drawings, field inspection reports, and project schedule.

Quality Control (QC) – functions performed by the Constructor and material supplier to verify that work performed conforms to project design drawings and documents.

Quality Assurance (QA) – provides verification that QC functions have been performed in substantial compliance with the project design drawings and documents, this function will normally be provided by a Certification Engineer chosen by TVA.

Testing Laboratory – one or more laboratories capable of conducting the required conformance and performance laboratory testing of soils and geosynthetics required by this QA/QC Plan.

3.0 CERTIFICATION ENGINEER

The Certification Engineer (or personnel under his direct supervision) will closely monitor construction of the various components of the closure plan which includes: soil placement and compaction, a protective cover soil to support native plant growth to make up the final cover system. The Certification Engineer will be a Professional Engineer licensed to practice in the state of Tennessee, who is knowledgeable in the field of soil mechanics, and will have a good working knowledge of the equipment and procedures generally used in the construction of landfills.

The Certification Engineer has the following duties:

- provide written, certified documentation attesting to conformance with the design requirements and the QA/QC Plan with respect to conditions of the construction of the final cover system;
- be present at appropriate intervals during construction of the soil components, perform appropriate tests, and obtain samples for laboratory analyses;
- observe material delivery and unloading;
- use the results of tests and laboratory analyses to document conformance with project requirements;
- provide to TVA and the Constructor the results of observations and test as the work progresses. Coordinate with Constructor when modifications to the plans are necessary to ensure compliance with the design drawings, specifications, and QA/QC Plan;
- schedule and coordinate inspection and testing activities; and
- reject defective work and verify that corrective measures have been implemented.

The Certification Engineer may utilize qualified field technicians to perform testing described and to provide as necessary additional oversight during construction.

4.0 PROJECT MEETINGS

4.1 Design Review Meeting (Optional)

Following the completion of the design of the closure plan and after review and approval by the State of Tennessee Department of Environment and Conservation (TDEC), Division of Solid Waste Management (DSWM), a design review meeting will be held. The purpose of this meeting, which the Owner, Construction Manager, and the Certification Engineer shall attend, is to accomplish the following activities:

- identify key personnel;
- provide all parties with relevant documents;
- review the project design drawings, documents, and QA/QC Plan;
- confirm responsibilities of each party;
- review reporting and documenting procedures;
- define lines of communication;
- establish work area procedures; and
- review sampling and testing procedures.

The meeting will be documented by the Certification Engineer or person designated by the Construction Manager. Copies of the minutes and relevant documents will be provided to all parties.

4.2 Pre-construction Meeting

A pre-construction meeting will be held at the site prior to the start of construction. The Owner, Construction Manager, Certification Engineer, Constructor, and others designated by the Owner will attend this meeting. In certain cases, many, if not most of these functions may be performed directly by the Owner. The purpose of the meeting is to accomplish the following activities:

- review the construction drawings and documents, QA/QC Plan, work area procedures, construction procedures, and other related issues;
- define lines of communication and authority;

- review the project schedule;
- review best management practices for erosion and sediment control and construction stormwater management during each phase of construction;
- review testing procedures and procedures for correcting and documenting; construction deficiencies, repairs, and retesting;
- review testing and record drawing documentation procedures; and
- conduct a site inspection to discuss work areas, work plans, stockpiling, equipment and material laydown areas, access roads, and related items.

This meeting will be documented by the Construction Manager or authorized representative, and copies of the documentation will be distributed to all parties.

4.3 Progress Meetings

A progress meeting may be held daily just prior to commencement or just following the completion of work. This meeting should be attended by the Construction Manager, and the Constructor's on-site superintendent and the Certification Engineer. The following activities should be discussed during this meeting:

- review the previous days activities and accomplishments;
- review work locations and scheduled work;
- discuss problems; and
- review test data.

This meeting should be documented by the Certification Engineer, and copies of the documentation will be distributed to the Owner, Construction Manager, and Constructor.

4.4 Deficiency Meetings

As required, meetings will be held to discuss problems or deficiencies. At a minimum, these meetings will be attended by the Construction Manager, Certification Engineer, and the Constructor's on-site superintendent. If the problem requires a design

modification, the Design Engineer and Constructor's project manager should also be present. The meeting will be documented by the Certification Engineer.

5.0 Potential Problems And Deficiencies

During construction, the frequency of testing may be increased at the discretion of Certification Engineer or the Construction Manager when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- excessive pumping or cracking of material occurs;
- under adverse weather conditions;
- work is conducted in difficult areas; and
- high frequency of failing tests is observed.

If a defect is discovered in the earthwork product, the Certification Engineer shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the Certification Engineer shall determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means and notify the Constructor and Construction Manager.

The Certification Engineer shall schedule appropriate retests after the work deficiency has been corrected. Retests recommended by the Certification Engineer must verify that the defect has been corrected before any additional work is performed in the area of the deficiency

6.0 FINAL COVER SYSTEM SOIL COMPONENT CONSTRUCTION

6.1 Introduction

This section addresses material specifications and CQA activities associated with the construction of the soil components for the final cover system. Details of the soil components of the final cover system are provided in the Design Drawings. These components include:

- compacted soil layer; and
- vegetative soil layer

The soil components of the final cover system shall meet requirements related to material specification and construction quality provided in this QA/QC Plan. Field tests shall be performed during construction to evaluate if the characteristics of soil from proposed sources meet the material acceptance requirements.

6.2 Compacted Soil Layer

Soils for the compacted soil layer shall consist of relatively homogenous, silty, and clayey soils which are substantially free of debris, rock, plant materials, frozen materials, foreign objects, and organics

A borrow area for the compacted soil layer has been identified. Testing of the material in that borrow area has been completed. Selected tables from the soil report of that area are reproduced in Appendix H. Based on the results of these laboratory tests, material to meet the requirements of the compacted soil layer material have been identified. The range of moisture/density values which results in the required permeability has been determined based on the laboratory testing data. This range will then be used as the acceptable range of moisture/density values for field compaction control.

The compacted soil layer material shall be placed in 8 to 10 in. loose (6 to 8 in. compacted) lifts. The lift depth shall be verified by a manual method (i.e., hand auguring). Soil clods shall be broken down, and moisture conditioning shall be conducted to preserve the homogeneity of the soil and to obtain relatively uniform moisture content through the layer. The moisture content and in-place density of the compacted soil layer will be field tested during processing and placement when requested by the Constructor for verification purposes. The action of heavy equipment shall be observed for penetration, pumping, and cracking of the compacted soil layer surface.

The finished surface shall be firm, uniform, and relatively smooth. Perforations in the compacted soil layer created by nuclear density probes, stakes, or any other methods shall be filled with compacted soil.

Soil thickness verification will be performed by manual methods (i.e., hand auguring and/or thickness markers) due to possible settlement of the underlying layers during final cover construction activities.

6.3 Vegetative Soil Layer

The soil to be utilized for establishing the vegetative cover shall be capable of sustaining a healthy stand of vegetation, and shall consist of soil reasonably free from subsoil, noxious weeds, stones larger than two inches in diameter, or other deleterious matter that would prevent the formation of a suitable seed bed.

Low ground-pressure equipment shall be used to place the material for the vegetative soil layer over the compacted soil layer. The equipment shall be operated over the full depth of the layer. Care should be exercised when material is being placed around pipes and other appurtenances to prevent damage to these components. The material shall be placed by pushing the material upslope only. Vegetative soil layer material should not be placed from the top of the slope. The finished surface of the vegetative soil layer shall be roughened to help prevent erosion from occurring, seeded as described in the Vegetation Specification included in Appendix C of the closure plan.

Soil thickness verification will be performed by manual methods (i.e., hand auguring and/or thickness markers) due to possible settlement of the underlying layers during final cover construction activities.

6.4 Test Methods and Sampling Requirements

The following Table presents the field test methods which shall be used to evaluate construction quality for the soil components of the final cover system. The tests shall be conducted in accordance with the current versions of the corresponding standard methods given.

COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Compacted Soil Layer	Visual	As Required	Substantially free of debris, large rocks, plant material, or other deleterious substances
Compacted Soil Layer	Nuclear Density In place Density & Moisture	1 per 5000 CY placed or 1 each day soil is placed	*Plots of the dry density and moisture content shall be in the acceptable zones of hydraulic conductivity as provided in figures 5 and 6 in Appendix H

COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	ACCEPTANCE CRITERIA
Compacted Soil Layer	Moisture Content	1 per 10 Nuclear Densometer tests	Check nuclear Densometer measurements to verify moisture correction
Compacted Soil Layer	Hand Auger - Check completed lift thickness	30 locations evenly distributed across the project area (1 ea representing approx 1 Acre)	12" minimum depth
Compacted Soil Layer	Std Proctor	1 every 15,000 CY of material placed	Verify borrow source consistency with initial soil report (Table C-2 in App. H) and adjust as needed
Vegetative Layer	Visual	As Required	Substantially free of debris, large rocks, or other deleterious substances
Vegetative Layer	Hand Auger - Check completed lift thickness	30 locations evenly distributed across the project area (1 ea representing approx 1 Acre)	12" minimum depth

* In order to implement the use of the graphical plots in the field, the soil technicians must first classify the soil types. Classification based on visual observations may not be conclusive, therefore one-point standard Proctor compaction tests will be occasionally performed in the field to aid in identification of questionable materials. After the materials have been placed and compacted in lifts, the technicians then measure the dry density and moisture content in the field. The field dry density-moisture content point is then plotted on the appropriate graphical plot (Figure 5 or 6 - Acceptable Zone of Hydraulic Conductivity - in Appendix H). If the field measured dry density and

moisture content values fall within the acceptable zone, then no further action is needed. If the field measured values fall outside the acceptable zone, then additional compaction and/or moisture conditioning is required to ensure the compacted fill is brought within the acceptable zone.

7.0 Potential Problems And Deficiencies

During construction, the frequency of testing may be increased at the discretion of the Certification Engineer or the Construction Manager when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- excessive pumping or cracking of material occurs;
- under adverse weather conditions;
- work is conducted in difficult areas; and
- high frequency of failing tests is observed.

If a defect is discovered in the earthwork product, the Certification Engineer shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the Certification Engineer shall determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means. All deficiencies shall be corrected by the Constructor.

The Certification Engineer shall schedule appropriate retests after the work deficiency has been corrected. Retests recommended by the Certification Engineer must verify that the defect has been corrected before any additional work is performed by the Constructor in the area of the deficiency.

8.0 REPORTING AND DOCUMENTATION

8.1 Deficiencies

When deficiencies are discovered, the Certification Engineer shall immediately determine the nature and extent of the problem, notify the Constructor, and complete required documentation. In all cases, the Certification Engineer will notify the Constructor within one-half hour of discovering the deficiency. If the deficiency will cause construction delays of more than four hours or will necessitate substantial rework, the Certification Engineer shall also notify the Construction Manager.

The Constructor shall correct the deficiency to the satisfaction of the Certification Engineer. If the Constructor is unable to correct the problem, the Certification Engineer will prepare a nonconformance report and will develop and present suggested solutions to the Construction Manager for approval.

The corrected deficiency shall be re-tested before additional work is performed. All retests, and the steps taken to correct the problem, will be documented by the Certification Engineer.

8.2 Documentation

The QA/QC Plan depends on through monitoring and documentation of construction activities. Therefore, the Certification Engineer shall document that Quality Assurance requirements have been addressed and satisfied. Documentation shall consist of daily record keeping, construction problem resolutions, photographic records, design revisions, weekly progress reports, and a certification and summary report.

8.2.1 Daily Record Keeping

At a minimum, daily records shall consist of field notes, summaries of the daily meetings with the Constructor, observations and data sheets, and construction problems and resolution reports. This information shall be submitted to the Construction Manager for review and approval.

A Daily Meeting Report will be prepared each day, summarizing discussions held with a Constructor. This report will include the following items:

a. date, project name, and location;

b. names of parties involved in discussions;

c. data on weather conditions;

d. listing and location of construction activities underway during the time frame of the Daily Summary Report;

e. equipment present on-site;

f. descriptions of areas and/or activities being inspected and/or tested, and related documentation;

g. description of off-site materials received;

h. scheduled activities;

i. items discussed;

j. signature of the Certification Engineer.

8.2.2 Observation and Test Sheets

Observation and test data sheets shall include the following information:

a. date, project name, and location;

b. weather data;

c. reduced-scale site plan showing work areas, including sample and test locations;

d. description of ongoing construction;

e. summary of test results identified as passing, failing, or in the event of a failed test, retest;

f. calibration of test equipment;

g. summary of decisions regarding acceptance of the work and/or corrective actions taken;

h. signature of the Certification Engineer.

8.2.3 Construction Problem Reports

This report identifies and documents construction problems and resolutions. It is intended to document problems involving significant rework and is not intended to document items easily corrected unless the problems are recurring. At a minimum, this report shall include the following items:

a. detailed description of the problem;

b. location and cause of the problem;

c. how the problem was identified;

d. resolution of the problem;

e. personnel involved;

f. signature of the Certification Engineer and Construction Manager.

8.2.4 Certified Construction

- The Certification Engineer will certify that the components meet the requirements in the Design Drawings and will submit approval to the Construction Manager.

8.2.5 Design Changes

Design changes may be required during construction. In such cases, the Certification Engineer shall notify the Construction Manager, who will then notify the responsible State Agencies. Design changes shall only be made with written agreement of the Construction Manager.

9.2.6 Weekly Progress Reports

The Certification Engineer will prepare weekly progress reports summarizing construction and quality control activities. At a minimum this report, submitted to the Construction Manager, shall contain the following information:

a. date, project name, and location;

b. summary of work activities;

c. summary of deficiencies and/or defects and resolutions;

d. signature of Certification Engineer.

8.2.7 Certification Reports

The Certification Engineer will be required to submit the following certification report. A certification report will also be required for final cover system construction.

This report will cover the capping phase of construction and will be required after closure of the facility. This report will address the final compacted soil layer, and vegetative layer.

At completion of construction, the Certification Engineer shall submit a certification report to the Construction Manager. This report shall certify that the work has been performed in substantial compliance with the approved Design Plans. At a minimum, this report shall contain the following information:

a. summary of all construction activities;

b. test results;

c. observation and test data sheets;

d. sampling and testing location plan;

e. description of significant construction problems and their resolution;

f. list of changes from the approved plans and the justification for these changes;

g. a certification statement signed and sealed by the Certification Engineer.

HYDRAULIC CALCULATIONS

The hydraulic Calculations are attached. These calculations utilize the TR-55 methodology as computed by the storm water modeling software HYDROCAD. Calculations are based on a 25 year 24 hour storm event. A 100 year 24 hour storm event was used for the emergency spillway for the new detention pond located at the North end of the closure site.

There are four HYDROCAD calculations attached. This was necessary due to the large watershed that discharges through the existing NPDES outfall 002. This is the same outfall that storm water runoff from the slag cap will discharge to. Also, a small portion of the Slag Processing Area Cap will drain to a new detention pond at the north end. This pond will discharge to a new NPDES outfall. This area required a separate model. The sequence of each calculation is provided below:

1. Drainage for Remaining 002 Watershed (102 Acres) - This discharge links to the Slag Process Cap Model. 24 year 24 hour storm event

2. Drainage for the Slag Processing Area Cap (Except for the far northern portion). This includes verification that the existing fly ash pond and spillway structures will handle the flow. 24 year 24 hour storm event

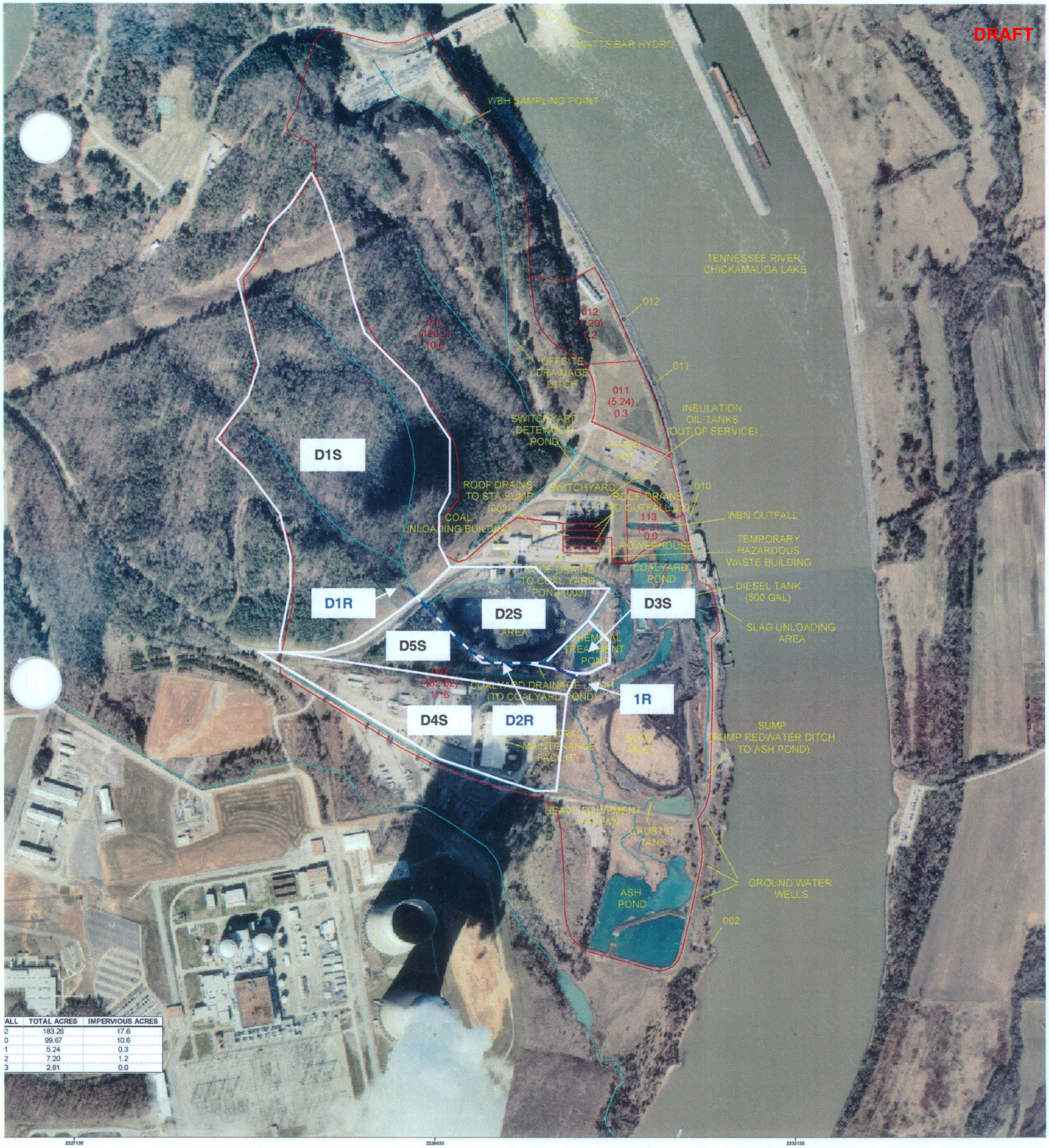
3. Drainage for the upper north end of the Slag Processing Area Cap and the new Detention Pond. 24 year 24 hour storm event

4. Drainage for the upper north end of the Slag Processing Area Cap and the new Stromwater Pond. Calculation summary is for Emergency Spillway Only. 100 year 24 hour storm event

Calculations have an area map that shows locations of sub-catchments (drainage areas), reaches (distinct drainage flow paths such as ditches, culverts, etc.), ponds, and links (discharges from other programs or processes). This is then followed by a Node Diagram showing how sub-catchments, reaches, ponds, and links are tied. Following this is a summary of the total acres associated with Runoff Curve Numbers (CN). Next is a summary for each item in the model. This summary provides data associated with Storm Peak Discharge and includes: areas, runoff depth, flow lengths, time of concentration (Tc), CN, Inflow rate, Outflow rate, average depth, velocities, etc.. This is arranged with sub-catchments first, followed by reaches, ponds, and links. After the summary pages are detailed sheets for each item that includes the hydrograph.

The detention pond in effect will serve as a sediment trap until final seeding and vegetative cover becomes established. This pond has been sized to exceed the minimum requirements for a sediment trap as specified in the Tennessee Erosion and Sediment Control Handbook.

These calculations verify that the completed ditches, culverts and ponds are designed to properly control runoff from a 25 year 24 hour storm event. These calculations show that the emergency spillway for the new stormwater pond will properly discharge runoff from a 100 year 24 hour storm event. Also, these calculations show that the existing spillway structures for NPDES outfall 002 can discharge the runoff from a 25 year 24 hour storm event.



ALL	TOTAL ACRES	IMPERVIOUS ACRES
2	183.26	17.6
0	99.67	10.6
1	5.24	0.3
2	7.20	1.2
3	2.81	0.0

Watts Bar Fossil Plant

January 31, 1998
Acreage Noted With Parentheses.
Previous Acreage Noted Without Parentheses.
Projection: Tennessee Stateplane
Fipszone: 4100
Units: Feet, Datum: NAD83

1:4500
0 240 480 960 1,440 1,920 Feet

Legend

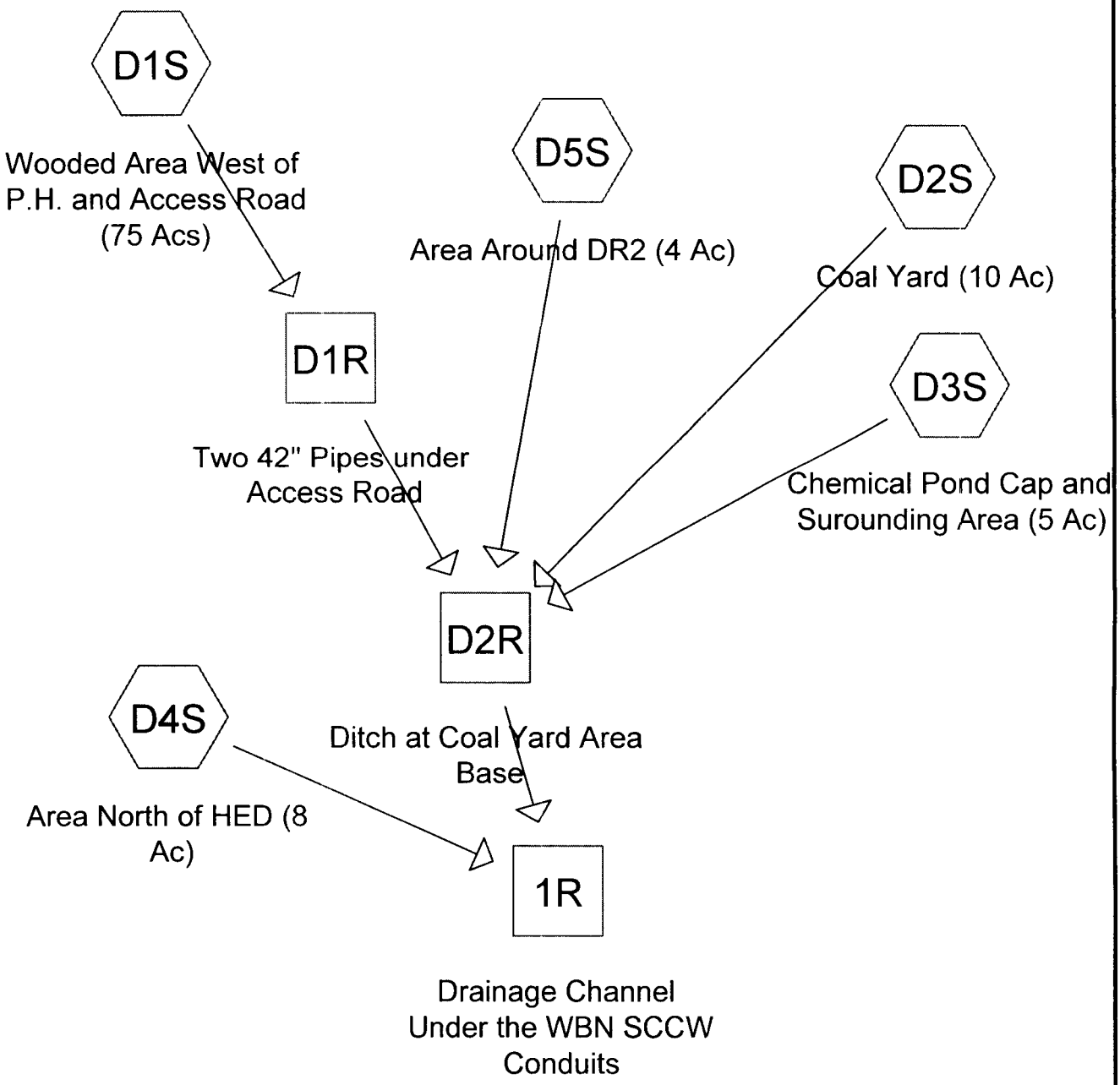
- Sample Sites
- Drainway/Water
- Drainage Boundaries
- Pond

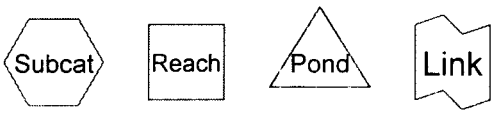
Revision By:	Date:	Revision Number:	
RJHALE 6409	4/5/2002	REV-1	
RJHALE 6409	4/19/2002	REV-2	Pe
albowen 751-2087	5/6/2003	REV-3	

Produced by TVA RSOE&ERTA's Geographic Information and Engineering

n of Sub-catchments and Reaches for Hydro-
del – Remaining Watershed

DRAFT





Drainage Diagram for Remaining 002 Watershed (102 Acs)
Prepared by {enter your company name here} 06/15/2009
HydroCAD® 8.00 s/n 002910 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
10.000	50	Coal Material (D2S)
4.200	65	Brush, Good, HSG C (D3S)
83.000	70	Woods, Good, HSG C (D1S,D4S)
4.000	73	Woods, Fair, HSG C (D5S)
0.800	74	>75% Grass cover, Good, HSG C (D3S)
102.000		

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment D1S: Wooded Area West of P.H. and Access R Runoff Area=75.000 ac Runoff Depth>2.52"
Flow Length=3,000' Tc=106.1 min CN=70 Runoff=66.66 cfs 15.775 af

Subcatchment D2S: Coal Yard (10 Ac) Runoff Area=10.000 ac Runoff Depth>1.01"
Flow Length=650' Slope=0.0050 '/' Tc=24.5 min CN=50 Runoff=7.61 cfs 0.843 af

Subcatchment D3S: Chemical Pond Cap and Surounding Area Runoff Area=5.000 ac Runoff Depth>2.23"
Flow Length=600' Tc=37.3 min CN=66 Runoff=8.13 cfs 0.929 af

Subcatchment D4S: Area North of HED (8 Ac) Runoff Area=8.000 ac Runoff Depth>2.55"
Flow Length=2,005' Slope=0.0130 '/' Tc=75.3 min CN=70 Runoff=9.18 cfs 1.700 af

Subcatchment D5S: Area Around DR2 (4 Ac) Runoff Area=4.000 ac Runoff Depth>2.82"
Flow Length=700' Slope=0.0110 '/' Tc=75.5 min CN=73 Runoff=5.14 cfs 0.940 af

Reach 1R: Drainage Channel Under the W Avg. Depth=2.64' Max Vel=3.04 fps Inflow=80.34 cfs 20.092 af
n=0.040 L=31.0' S=0.0032 '/' Capacity=194.33 cfs Outflow=80.34 cfs 20.088 af

Reach D1R: Two 42" Pipes under Access Avg. Depth=1.09' Max Vel=13.05 fps Inflow=66.66 cfs 15.775 af
D=42.0" n=0.011 L=112.5' S=0.0178 '/' Capacity=317.07 cfs Outflow=66.64 cfs 15.773 af

Reach D2R: Ditch at Coal Yard Area Base Avg. Depth=1.94' Max Vel=4.78 fps Inflow=73.67 cfs 18.485 af
n=0.040 L=1,160.0' S=0.0112 '/' Capacity=1,594.27 cfs Outflow=73.49 cfs 18.393 af

Total Runoff Area = 102.000 ac Runoff Volume = 20.187 af Average Runoff Depth = 2.37"
100.00% Pervious Area = 102.000 ac 0.00% Impervious Area = 0.000 ac

Subcatchment D1S: Wooded Area West of P.H. and Access Road (75 Acs)

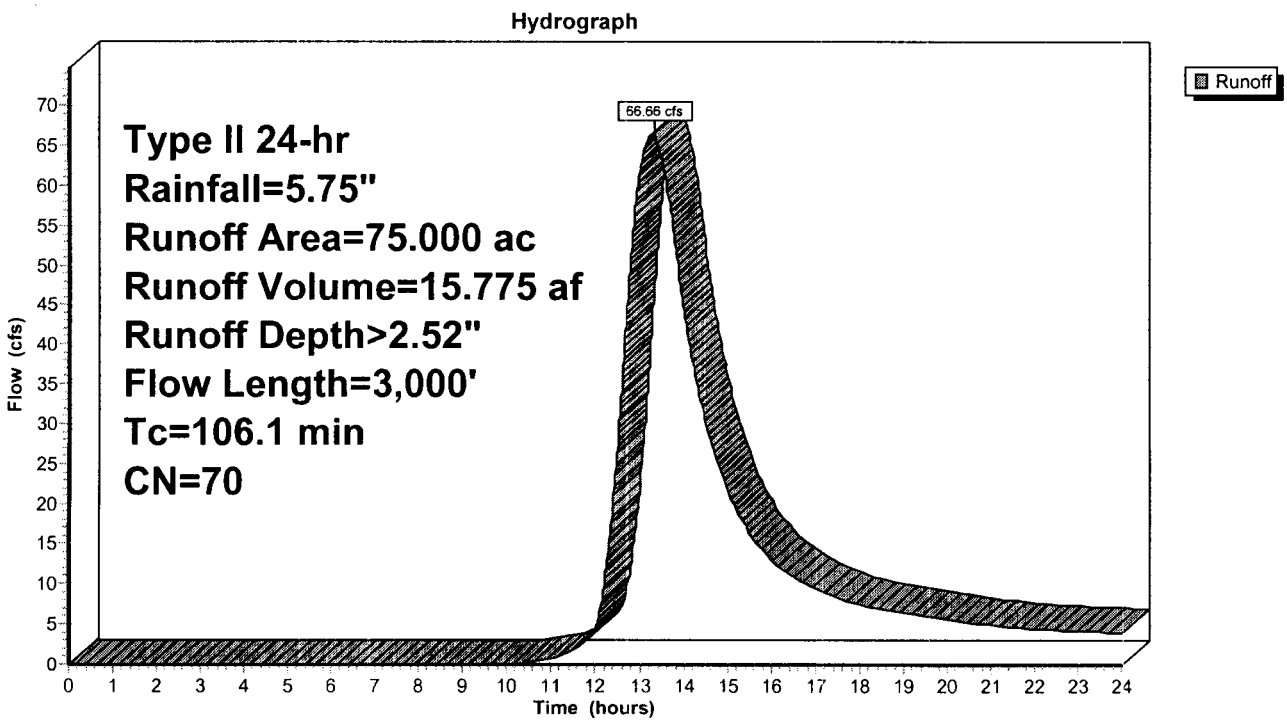
Runoff = 66.66 cfs @ 13.32 hrs, Volume= 15.775 af, Depth> 2.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
75.000	70	Woods, Good, HSG C
75.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.0	300	0.0700	0.17		**Sheet Flow, Upper Portion** Woods: Light underbrush n= 0.400 P2= 3.50"
76.1	2,700	0.0140	0.59		**Shallow Concentrated Flow, Rest of Watershed** Woodland Kv= 5.0 fps
106.1	3,000	Total			

Subcatchment D1S: Wooded Area West of P.H. and Access Road (75 Acs)



Subcatchment D2S: Coal Yard (10 Ac)

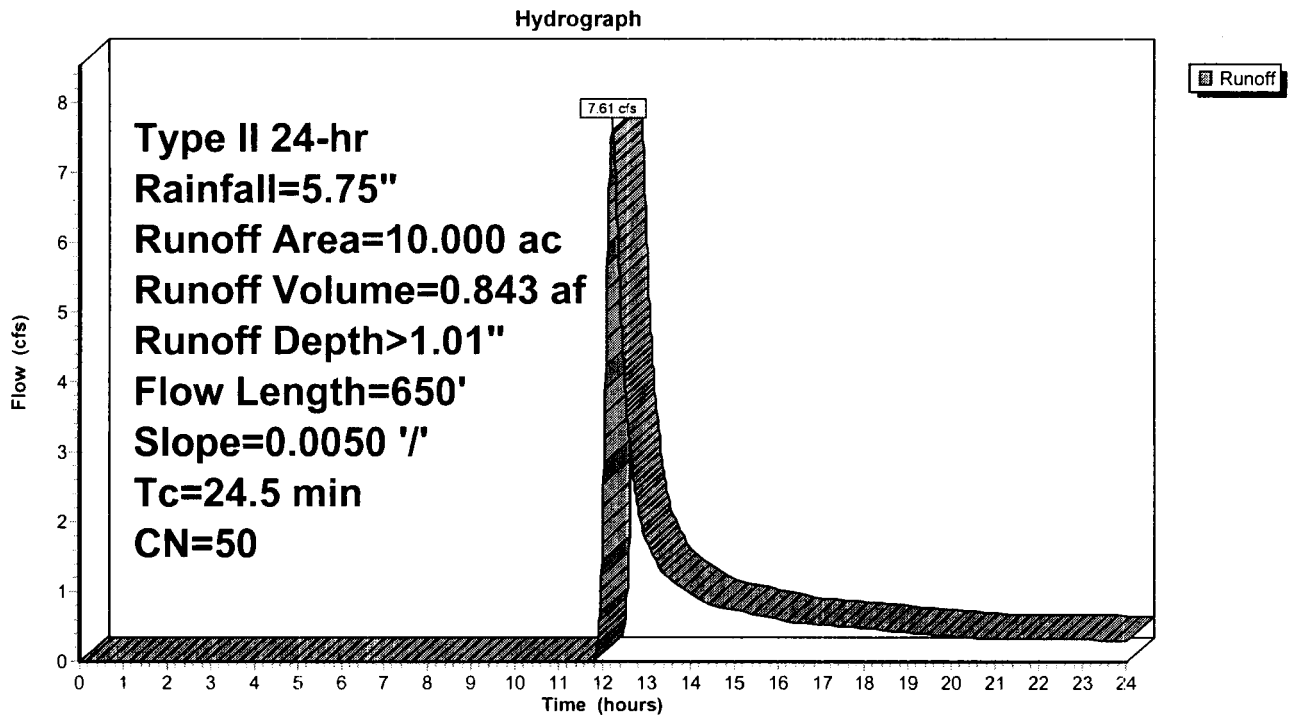
Runoff = 7.61 cfs @ 12.22 hrs, Volume= 0.843 af, Depth> 1.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
10.000	50	Coal Material
10.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	300	0.0050	0.31		**Sheet Flow, Upper Portion** Fallow n= 0.050 P2= 3.50"
8.2	350	0.0050	0.71		**Shallow Concentrated Flow, Lower Portion** Nearly Bare & Untilled Kv= 10.0 fps
24.5	650	Total			

Subcatchment D2S: Coal Yard (10 Ac)



Subcatchment D3S: Chemical Pond Cap and Surounding Area (5 Ac)

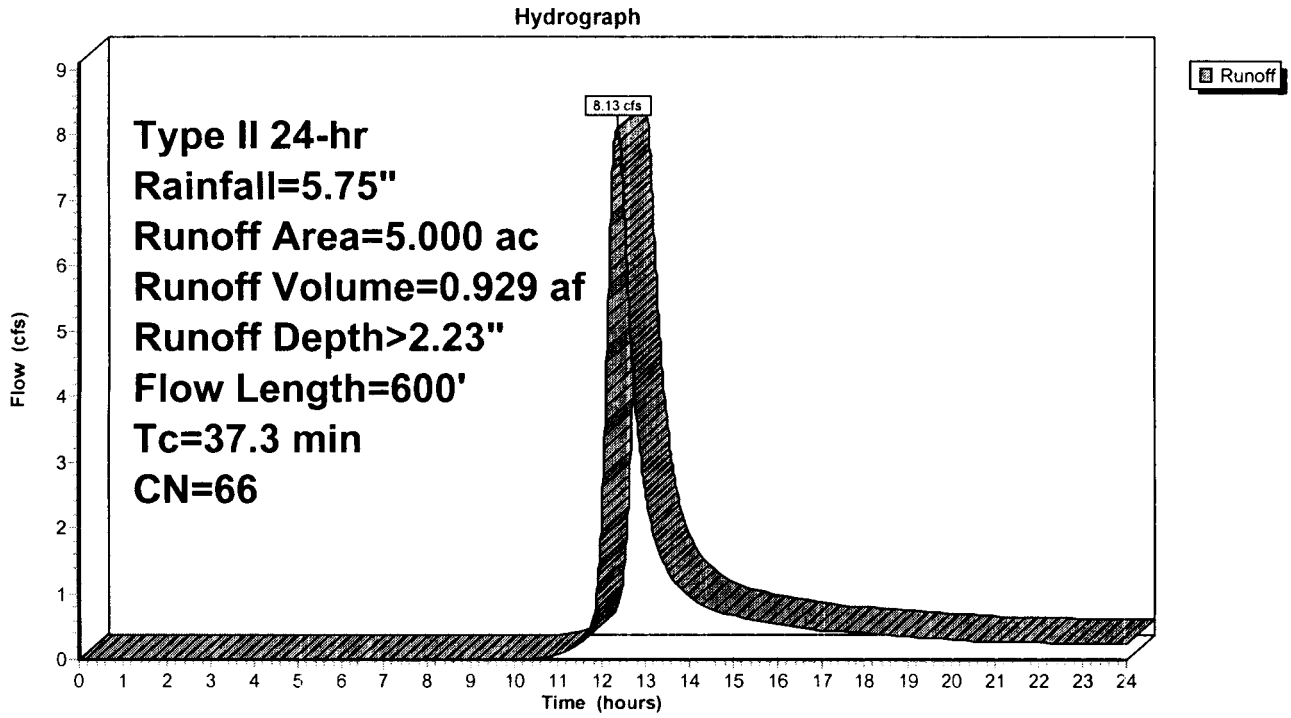
Runoff = 8.13 cfs @ 12.35 hrs, Volume= 0.929 af, Depth> 2.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.800	74	>75% Grass cover, Good, HSG C
4.200	65	Brush, Good, HSG C
5.000	66	Weighted Average
5.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.3	300	0.0070	0.15		**Sheet Flow, Upper Portion** Grass: Short n= 0.150 P2= 3.50"
3.0	300	0.0570	1.67		**Shallow Concentrated Flow, Lower Portion** Short Grass Pasture Kv= 7.0 fps
37.3	600	Total			

Subcatchment D3S: Chemical Pond Cap and Surounding Area (5 Ac)



Subcatchment D4S: Area North of HED (8 Ac)

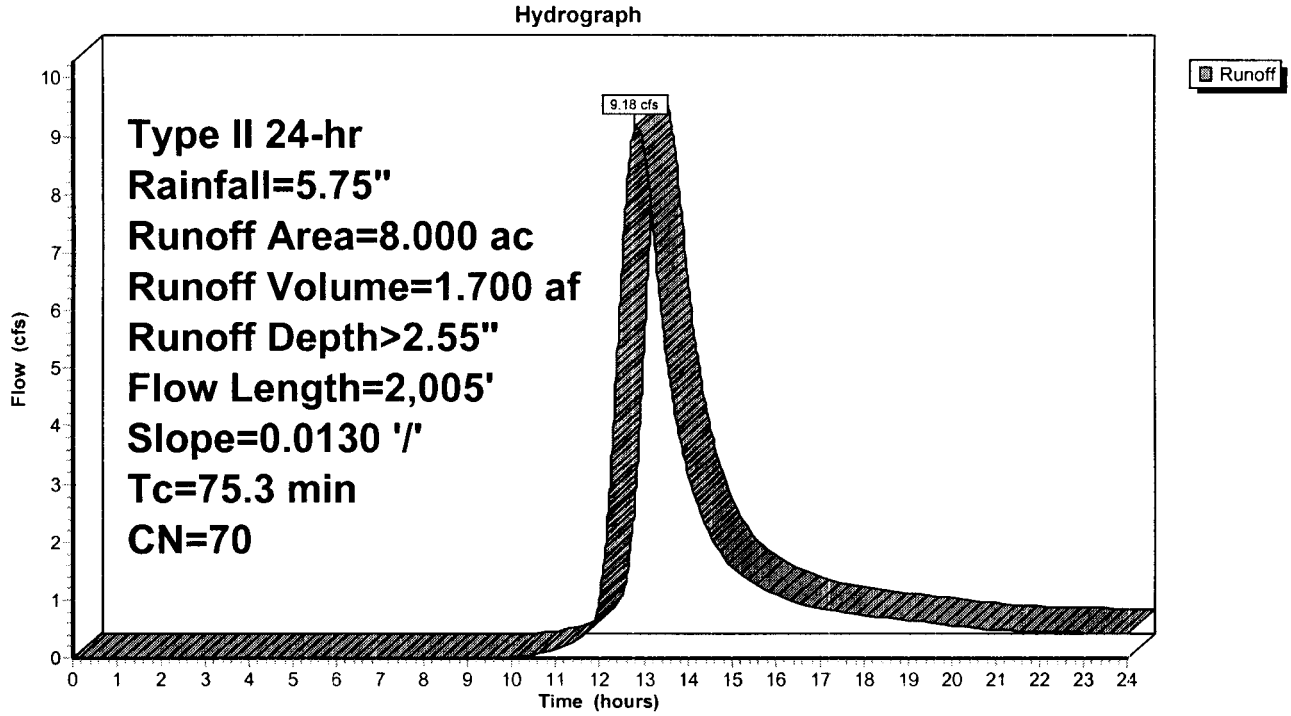
Runoff = 9.18 cfs @ 12.81 hrs, Volume= 1.700 af, Depth> 2.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
8.000	70	Woods, Good, HSG C
8.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
58.7	300	0.0130	0.09		**Sheet Flow, Upper portion** Woods: Light underbrush n= 0.400 P2= 3.50"
16.6	1,705	0.0130	1.71		**Shallow Concentrated Flow, Lower Portion** Grassed Waterway Kv= 15.0 fps
75.3	2,005	Total			

Subcatchment D4S: Area North of HED (8 Ac)



Subcatchment D5S: Area Around DR2 (4 Ac)

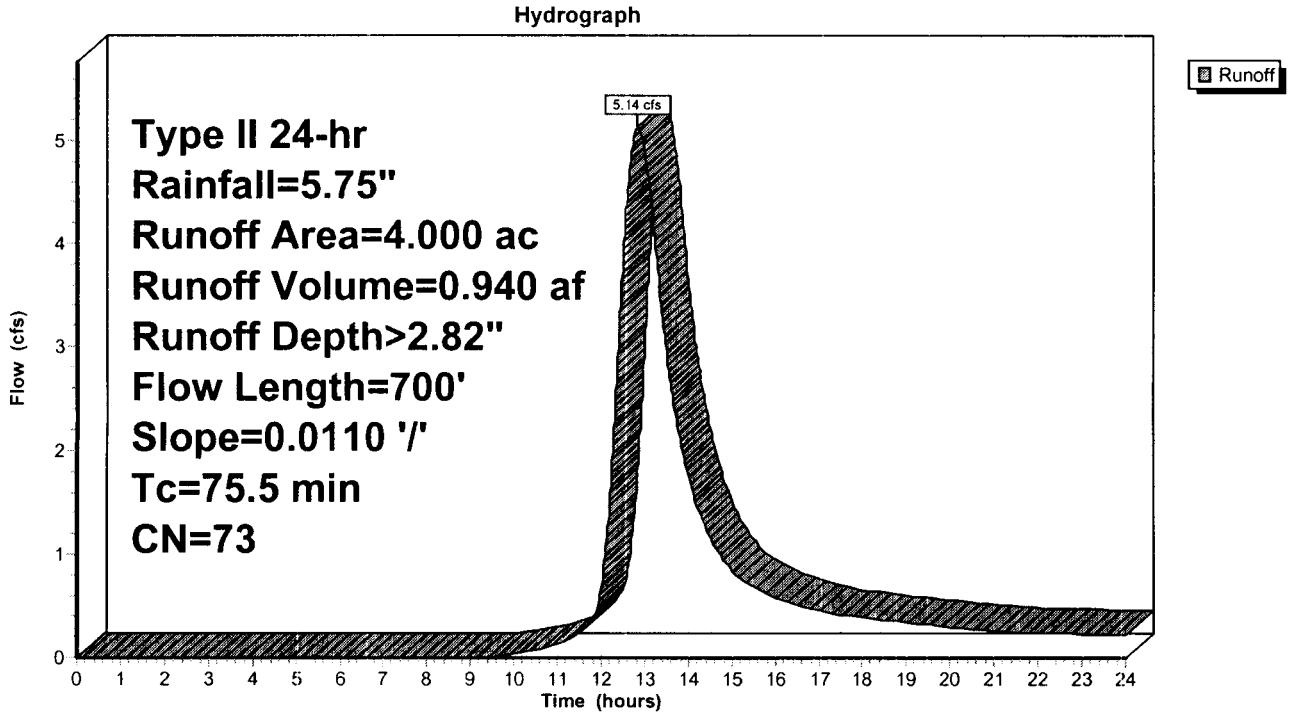
Runoff = 5.14 cfs @ 12.84 hrs, Volume= 0.940 af, Depth> 2.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
4.000	73	Woods, Fair, HSG C
4.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8	300	0.0110	0.08		**Sheet Flow, upper portion** Woods: Light underbrush n= 0.400 P2= 3.50"
12.7	400	0.0110	0.52		**Shallow Concentrated Flow, Lower Portion** Woodland Kv= 5.0 fps
75.5	700	Total			

Subcatchment D5S: Area Around DR2 (4 Ac)



Reach 1R: Drainage Channel Under the WBN SCCW Conduits

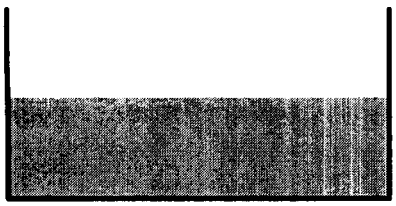
[61] Hint: Submerged 21% of Reach D2R bottom

Inflow Area = 102.000 ac, Inflow Depth > 2.36"
Inflow = 80.34 cfs @ 13.25 hrs, Volume= 20.092 af
Outflow = 80.34 cfs @ 13.26 hrs, Volume= 20.088 af, Atten= 0%, Lag= 0.3 min

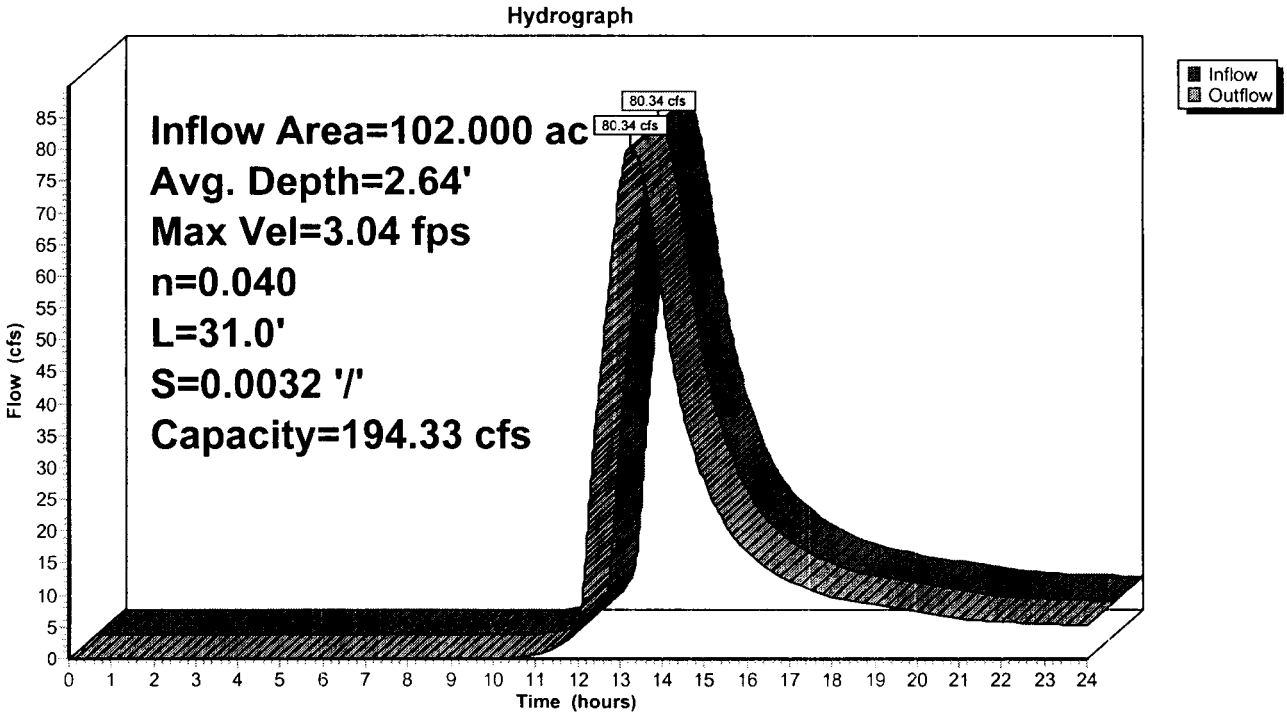
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.04 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.46 fps, Avg. Travel Time= 0.4 min

Peak Storage= 819 cf @ 13.26 hrs, Average Depth at Peak Storage= 2.64'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 194.33 cfs

10.00' x 5.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Length= 31.0' Slope= 0.0032 '/'
Inlet Invert= 707.10', Outlet Invert= 707.00'



Reach 1R: Drainage Channel Under the WBN SCCW Conduits



Reach D1R: Two 42" Pipes under Access Road

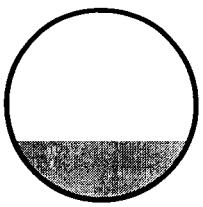
[52] Hint: Inlet conditions not evaluated

Inflow Area =	75.000 ac,	Inflow Depth > 2.52"		
Inflow =	66.66 cfs @	13.32 hrs, Volume=	15.775 af	
Outflow =	66.64 cfs @	13.32 hrs, Volume=	15.773 af,	Atten= 0%, Lag= 0.1 min

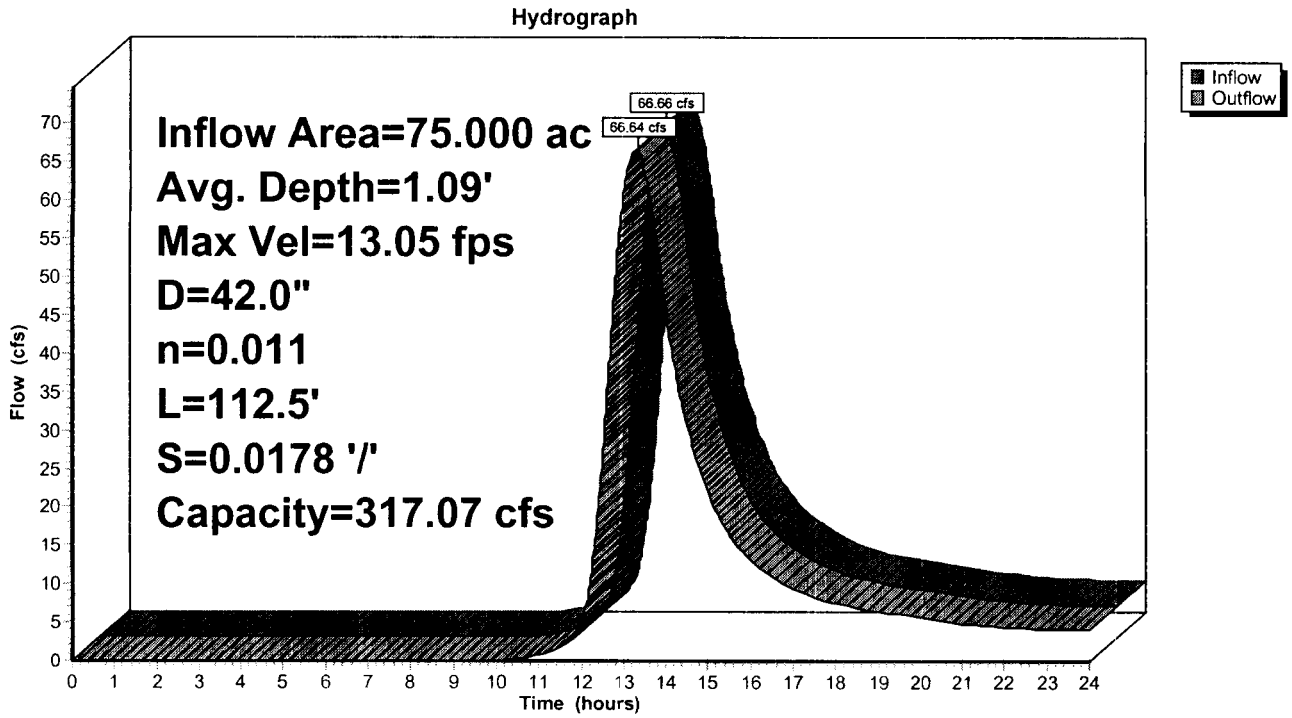
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 13.05 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 6.89 fps, Avg. Travel Time= 0.3 min

Peak Storage= 575 cf @ 13.32 hrs, Average Depth at Peak Storage= 1.09'
Bank-Full Depth= 3.50', Capacity at Bank-Full= 317.07 cfs

A factor of 2.00 has been applied to the storage and discharge capacity
42.0" Diameter Pipe, n= 0.011 Concrete pipe, straight & clean
Length= 112.5' Slope= 0.0178 '/'
Inlet Invert= 722.60', Outlet Invert= 720.60'



Reach D1R: Two 42" Pipes under Access Road



Reach D2R: Ditch at Coal Yard Area Base

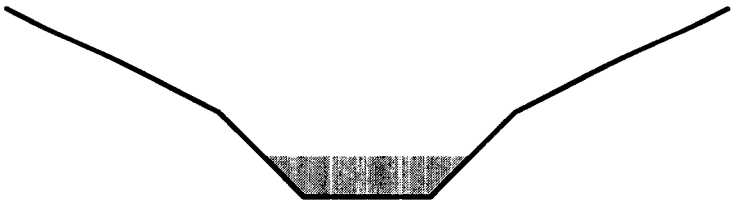
[61] Hint: Submerged 67% of Reach D1R bottom

Inflow Area = 94.000 ac, Inflow Depth > 2.36"
Inflow = 73.67 cfs @ 13.21 hrs, Volume= 18.485 af
Outflow = 73.49 cfs @ 13.32 hrs, Volume= 18.393 af, Atten= 0%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.78 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 2.41 fps, Avg. Travel Time= 8.0 min

Peak Storage= 17,835 cf @ 13.25 hrs, Average Depth at Peak Storage= 1.94'
Bank-Full Depth= 9.00', Capacity at Bank-Full= 1,594.27 cfs

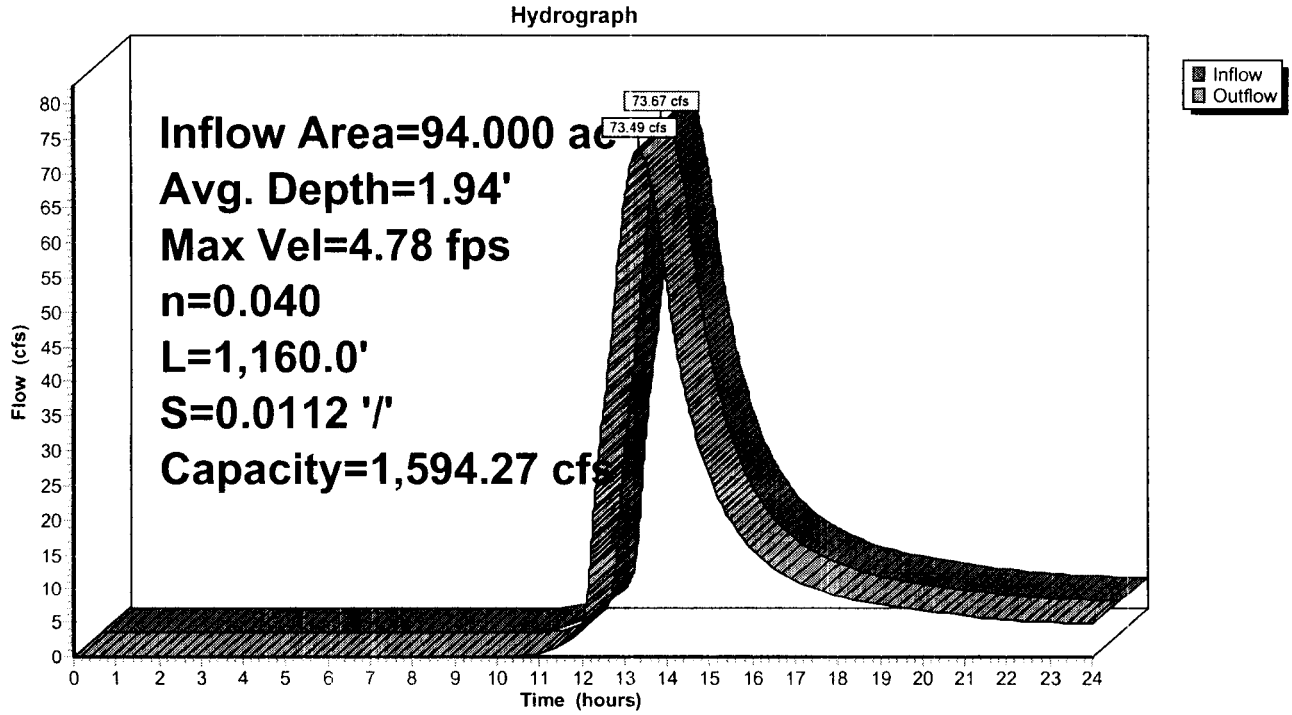
Custom cross-section, Length= 1,160.0' Slope= 0.0112 '/' (101 Elevation Intervals)
Constant n= 0.040 Earth, cobble bottom, clean sides
Inlet Invert= 720.00', Outlet Invert= 707.00'

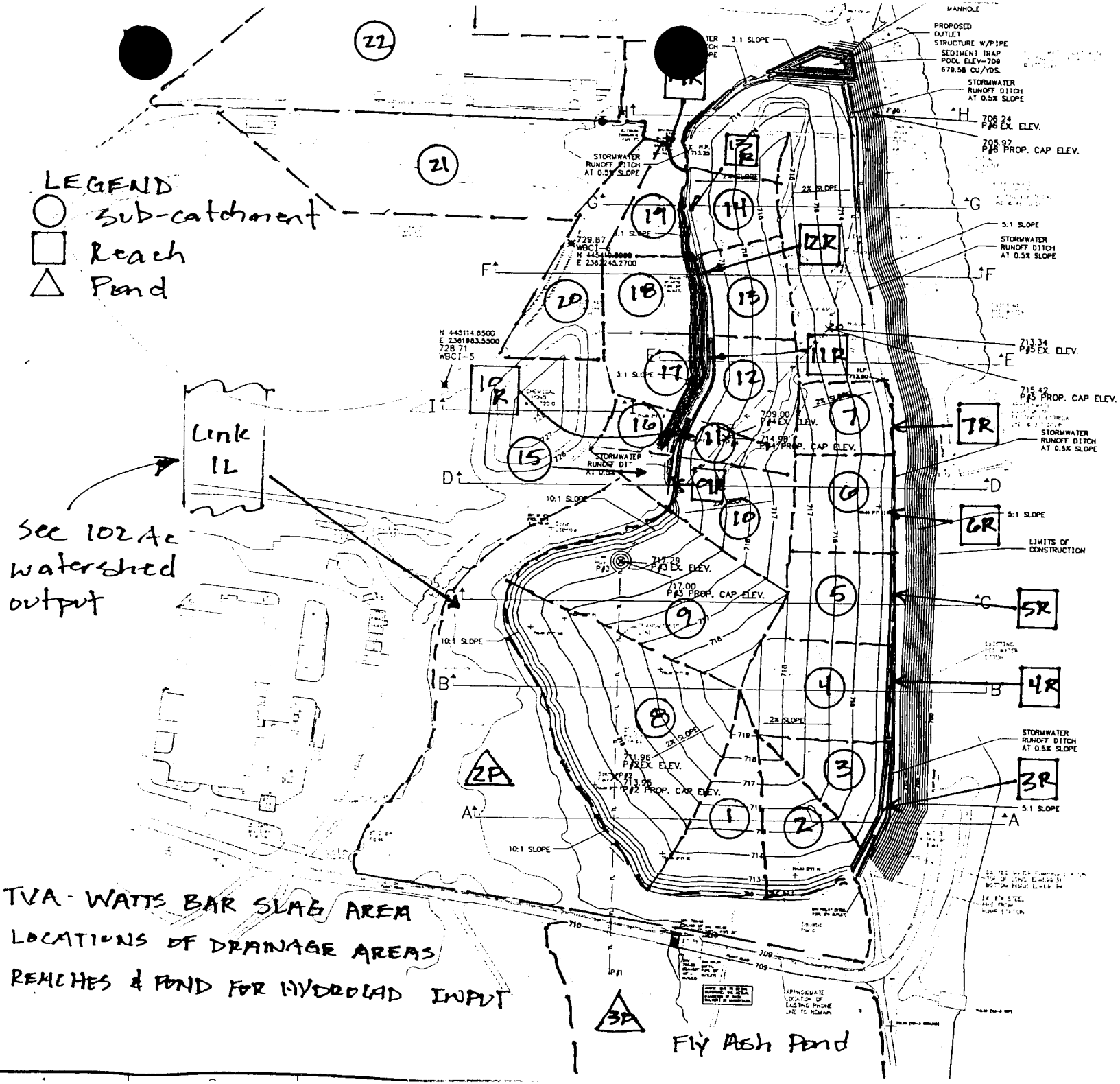


Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	9.00	0.00
10.00	4.00	5.00
14.00	0.00	9.00
20.00	0.00	9.00
24.00	4.00	5.00
34.00	9.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	6.0	0	0.00
4.00	40.0	17.3	46,400	274.92
9.00	160.0	39.7	185,600	1,594.27

Reach D2R: Ditch at Coal Yard Area Base





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GENERAL NOTES:

1. ALL WORK SHALL B
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2922) SHALL BE CHEC
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THE REQUIRED COMPA
PERCENT MAXIMUM A
ADDITIONAL DETAILS

3. COMPACTED SOIL C
TO 10 INCHES PRIOR

3. RIPRAP SHALL BE
WEIGHT, OF THE STON
WITH SECTION 575.

4. PIPE SHALL BE 24
PIPEAS NEEDED SHALL

5. EXCAVATION AND
TO SECTION 125.

6. TEMPORARY SEEDIN
SECTION 583.

7. MULCHING SHALL M

8. FINAL SPRING SEED
PARTRID
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ON AREA
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9. THE SEEDS ARE TO
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MINIMUM OF 30 DAYS
CIRCULATE UNDER THE

10. SEEDS SHOULD BE
DRILL" FIELD TO INC
ROSS SKULURD (615) 7
PLANTING IS TO BE BE

11. THE SEED ARE NOT
COOL STORAGE AREA B
USED OVER THE AREA

12. SEEDED AREA TO B
OF PLANT MATERIAL I
AND PROTECTED AND R
AREAS HAVING A POOR
FERTILIZED AT THE PR

13. BORROW AREA AND
(TYPE B MIXTURE 1, F
SPRING SEEDING), FER
SECTION 580 AND 582

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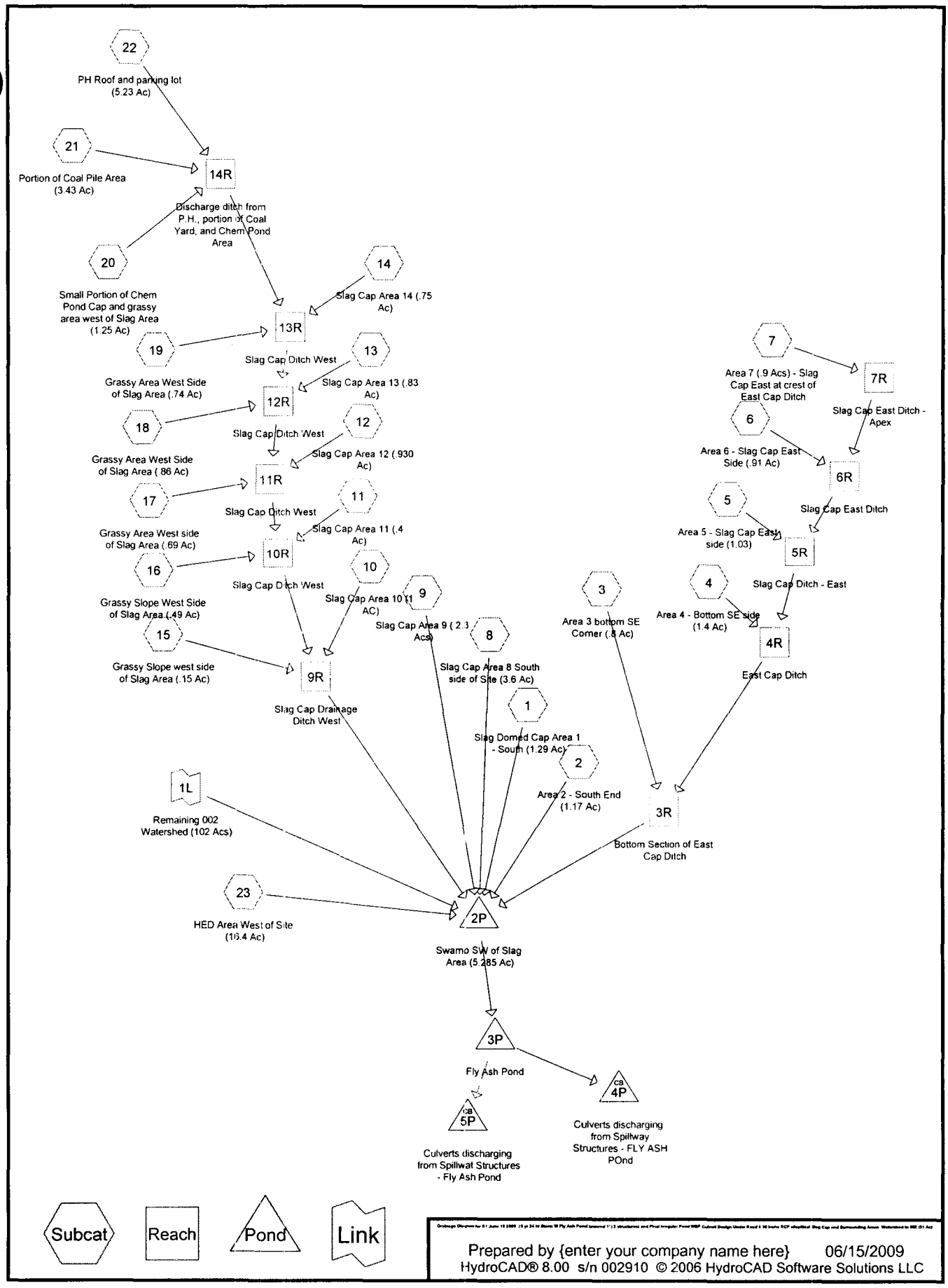

Prepared by {enter your company name here} 06/15/2009
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Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
0.950	50	Coal Material (21)
3.180	65	Brush, Good, HSG C (15,16,17,18,19,20)
2.480	70	Brush, Fair, HSG C (21)
18.313	74	>75% Grass cover, Good, HSG C (1,2,3,4,5,6,7,8,9,10,11,12,13,14,20)
16.400	89	Gravel roads, HSG C (23)
5.230	91	Urban industrial, 72% imp, HSG C (22)
46.553		

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1: Slag Domed Cap Area 1 - South (1.29 Ac) Runoff Area=1.290 ac Runoff Depth>2.95"
Flow Length=530' Tc=35.3 min CN=74 Runoff=2.97 cfs 0.317 af

Subcatchment 2: Area 2 - South End (1.17 Ac) Runoff Area=1.170 ac Runoff Depth>2.95"
Flow Length=350' Tc=33.3 min CN=74 Runoff=2.81 cfs 0.287 af

Subcatchment 3: Area 3 bottom SE Corner (.8 Ac) Runoff Area=0.800 ac Runoff Depth>2.95"
Flow Length=300' Slope=0.0200 '/' Tc=32.9 min CN=74 Runoff=1.94 cfs 0.197 af

Subcatchment 4: Area 4 - Bottom SE side (1.4 Ac) Runoff Area=1.400 ac Runoff Depth>2.95"
Flow Length=340' Slope=0.0200 '/' Tc=33.6 min CN=74 Runoff=3.34 cfs 0.344 af

Subcatchment 5: Area 5 - Slag Cap East side (1.03) Runoff Area=1.030 ac Runoff Depth>2.95"
Flow Length=280' Slope=0.0200 '/' Tc=31.1 min CN=74 Runoff=2.59 cfs 0.253 af

Subcatchment 6: Area 6 - Slag Cap East Side (.91 Ac) Runoff Area=0.913 ac Runoff Depth>2.96"
Flow Length=220' Slope=0.0200 '/' Tc=25.6 min CN=74 Runoff=2.61 cfs 0.225 af

Subcatchment 7: Area 7 (.9 Acs) - Slag Cap East at crest of E Runoff Area=0.900 ac Runoff Depth>2.96"
Flow Length=220' Slope=0.0200 '/' Tc=25.6 min CN=74 Runoff=2.57 cfs 0.222 af

Subcatchment 8: Slag Cap Area 8 South side of Site (3.6 Ac) Runoff Area=3.600 ac Runoff Depth>2.95"
Flow Length=530' Tc=36.1 min CN=74 Runoff=8.19 cfs 0.884 af

Subcatchment 9: Slag Cap Area 9 (2.3 Acs) Runoff Area=2.300 ac Runoff Depth>2.95"
Flow Length=550' Tc=34.9 min CN=74 Runoff=5.35 cfs 0.565 af

Subcatchment 10: Slag Cap Area 10 (1 AC) Runoff Area=1.000 ac Runoff Depth>2.95"
Flow Length=300' Slope=0.0200 '/' Tc=32.9 min CN=74 Runoff=2.42 cfs 0.246 af

Subcatchment 11: Slag Cap Area 11 (.4 Ac) Runoff Area=0.400 ac Runoff Depth>2.95"
Flow Length=250' Slope=0.0200 '/' Tc=28.4 min CN=74 Runoff=1.07 cfs 0.098 af

Subcatchment 12: Slag Cap Area 12 (.930 Ac) Runoff Area=0.930 ac Runoff Depth>2.95"
Flow Length=280' Slope=0.0200 '/' Tc=31.1 min CN=74 Runoff=2.34 cfs 0.229 af

Subcatchment 13: Slag Cap Area 13 (.83 Ac) Runoff Area=0.830 ac Runoff Depth>2.96"
Flow Length=190' Slope=0.0200 '/' Tc=22.8 min CN=74 Runoff=2.54 cfs 0.205 af

Subcatchment 14: Slag Cap Area 14 (.75 Ac) Runoff Area=0.750 ac Runoff Depth>2.96"
Flow Length=190' Slope=0.0200 '/' Tc=22.8 min CN=74 Runoff=2.29 cfs 0.185 af

Subcatchment 15: Grassy Slope west side of Slag Area (.15 A Runoff Area=0.150 ac Runoff Depth>2.16"
Flow Length=170' Slope=0.0290 '/' Tc=18.0 min CN=65 Runoff=0.37 cfs 0.027 af

Subcatchment 16: Grassy Slope West Side of Slag Area (.49 A Runoff Area=0.490 ac Runoff Depth>2.16"
Flow Length=210' Slope=0.0710 '/' Tc=14.9 min CN=65 Runoff=1.36 cfs 0.088 af

Subcatchment 17: Grassy Area West side of Slag Area (.69 AC) Runoff Area=0.690 ac Runoff Depth>2.16"
Flow Length=260' Slope=0.0650 '/' Tc=18.3 min CN=65 Runoff=1.71 cfs 0.124 af

Subcatchment 18: Grassy Area West Side of Slag Area (.86 AC Runoff Area=0.860 ac Runoff Depth>2.16"
Flow Length=210' Slope=0.0760 '/' Tc=14.5 min CN=65 Runoff=2.42 cfs 0.155 af

Subcatchment 19: Grassy Area West Side of Slag Area (.74 AC Runoff Area=0.740 ac Runoff Depth>2.16"
Flow Length=280' Slope=0.0460 '/' Tc=22.3 min CN=65 Runoff=1.63 cfs 0.133 af

Subcatchment 20: Small Portion of Chem Pond Cap and grass Runoff Area=1.250 ac Runoff Depth>2.75"
Flow Length=520' Tc=53.2 min CN=72 Runoff=2.00 cfs 0.286 af

Subcatchment 21: Portion of Coal Pile Area (3.43 Ac) Runoff Area=3.430 ac Runoff Depth>2.07"
Flow Length=860' Tc=24.4 min CN=64 Runoff=6.80 cfs 0.592 af

Subcatchment 22: PH Roof and parking lot (5.23 Ac) Runoff Area=5.230 ac Runoff Depth>4.70"
Flow Length=1,030' Tc=12.1 min CN=91 Runoff=32.99 cfs 2.049 af

Subcatchment 23: HED Area West of Site (16.4 Ac) Runoff Area=16.400 ac Runoff Depth>4.47"
Flow Length=2,225' Tc=23.9 min CN=89 Runoff=71.64 cfs 6.110 af

Reach 3R: Bottom Section of East Cap Ditc Avg. Depth=0.61' Max Vel=3.63 fps Inflow=12.84 cfs 1.237 af
n=0.022 L=240.0' S=0.0083 '/' Capacity=342.21 cfs Outflow=12.82 cfs 1.235 af

Reach 4R: East Cap Ditch Avg. Depth=0.64' Max Vel=2.89 fps Inflow=10.93 cfs 1.041 af
n=0.022 L=200.0' S=0.0050 '/' Capacity=265.07 cfs Outflow=10.91 cfs 1.040 af

Reach 5R: Slag Cap Ditch - East Avg. Depth=0.53' Max Vel=2.60 fps Inflow=7.67 cfs 0.698 af
n=0.022 L=200.0' S=0.0050 '/' Capacity=25.80 cfs Outflow=7.65 cfs 0.697 af

Reach 6R: Slag Cap East Ditch Avg. Depth=0.42' Max Vel=2.30 fps Inflow=5.16 cfs 0.446 af
n=0.022 L=200.0' S=0.0050 '/' Capacity=25.80 cfs Outflow=5.13 cfs 0.445 af

Reach 7R: Slag Cap East Ditch - Apex Avg. Depth=0.29' Max Vel=1.84 fps Inflow=2.57 cfs 0.222 af
n=0.022 L=160.0' S=0.0050 '/' Capacity=6.94 cfs Outflow=2.55 cfs 0.221 af

Reach 9R: Slag Cap Drainage Ditch West Avg. Depth=0.44' Max Vel=2.84 fps Inflow=51.25 cfs 4.403 af
n=0.022 L=90.0' S=0.0056 '/' Capacity=1,786.48 cfs Outflow=51.21 cfs 4.400 af

Reach 10R: Slag Cap Ditch West Avg. Depth=0.98' Max Vel=4.22 fps Inflow=49.16 cfs 4.132 af
n=0.022 L=90.0' S=0.0056 '/' Capacity=675.08 cfs Outflow=49.14 cfs 4.130 af

Reach 11R: Slag Cap Ditch West Avg. Depth=0.95' Max Vel=4.16 fps Inflow=47.09 cfs 3.949 af
n=0.022 L=180.0' S=0.0056 '/' Capacity=390.36 cfs Outflow=46.99 cfs 3.945 af

Reach 12R: Slag Cap Ditch West Avg. Depth=1.20' Max Vel=3.03 fps Inflow=44.52 cfs 3.600 af
n=0.030 L=190.0' S=0.0053 '/' Capacity=152.93 cfs Outflow=43.72 cfs 3.596 af

Reach 13R: Slag Cap Ditch West Avg. Depth=1.47' Max Vel=2.82 fps Inflow=40.62 cfs 3.244 af
n=0.030 L=225.0' S=0.0056 '/' Capacity=113.10 cfs Outflow=39.93 cfs 3.240 af

Reach 14R: Discharge ditch from P.H., port Avg. Depth=0.55' Max Vel=7.49 fps Inflow=37.68 cfs 2.927 af
n=0.030 L=115.0' S=0.0609 '/' Capacity=369.91 cfs Outflow=37.68 cfs 2.926 af

Pond 2P: Swamp SW of Slag Area (5.285 Peak Elev=707.90' Storage=0.670 af Inflow=161.07 cfs 33.886 af
30.0" x 35.0' Culvert Outflow=146.97 cfs 33.886 af

Pond 3P: Fly Ash Pond Peak Elev=705.80' Storage=6.734 af Inflow=146.97 cfs 33.886 af
Primary=93.22 cfs 32.442 af Secondary=0.00 cfs 0.000 af Outflow=93.22 cfs 32.442 af

Pond 4P: Culverts discharging from Spillway Structures - Peak Elev=692.22' Inflow=93.22 cfs 32.442 af
36.0" x 124.0' Culvert Outflow=93.22 cfs 32.442 af

Pond 5P: Culverts discharging from Spillwat Structures - Fly Peak Elev=688.00' Inflow=0.00 cfs 0.000 af
36.0" x 124.0' Culvert Outflow=0.00 cfs 0.000 af

Link 1L: Outflow Imported from Remaining 002 Watershed (102 Acs)~Reach 1R Inflow=80.34 cfs 20.088 af
Primary=80.34 cfs 20.088 af

Total Runoff Area = 46.553 ac Runoff Volume = 13.820 af Average Runoff Depth = 3.56"
91.91% Pervious Area = 42.787 ac 8.09% Impervious Area = 3.766 ac

Subcatchment 1: Slag Domed Cap Area 1 - South (1.29 Ac)

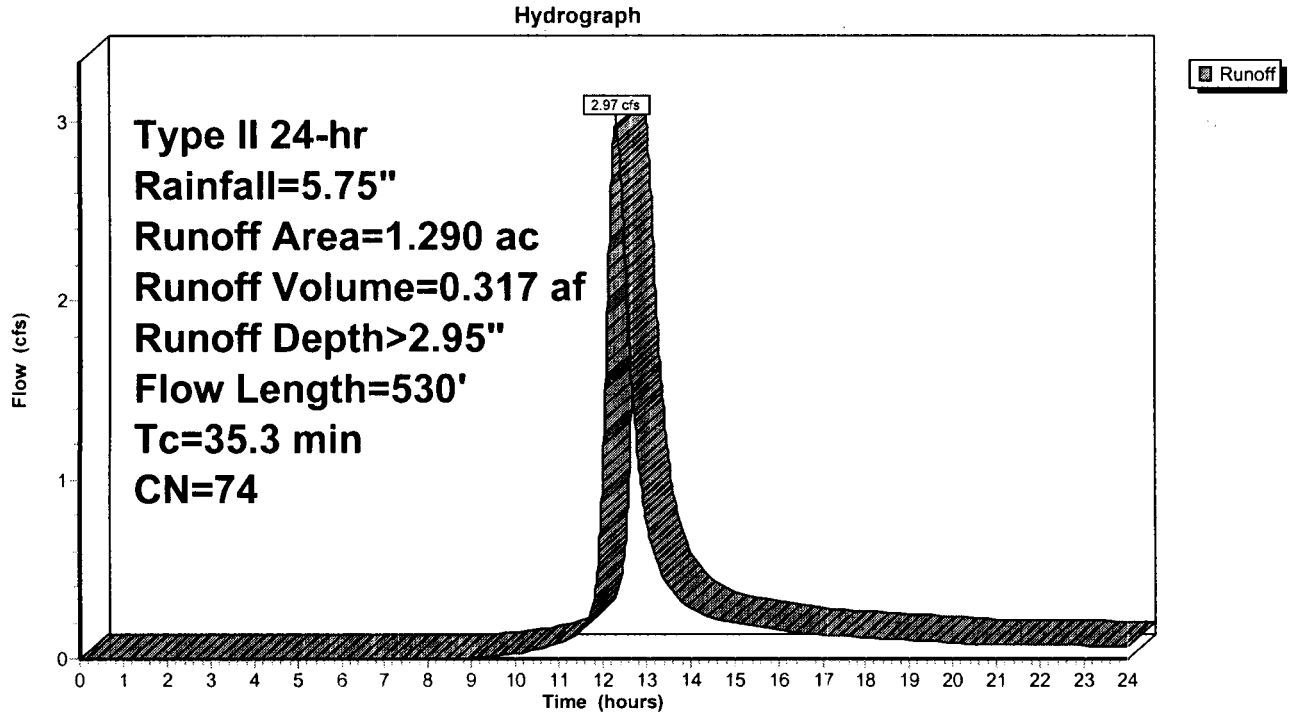
Runoff = 2.97 cfs @ 12.31 hrs, Volume= 0.317 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
1.290	74	>75% Grass cover, Good, HSG C
1.290		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.9	300	0.0200	0.15		**Sheet Flow, 2% Cap Slope w/ 2% slope** Grass: Dense n= 0.240 P2= 3.50"
2.4	230	0.0500	1.57		**Shallow Concentrated Flow, Bottom portion of Area 1** Short Grass Pasture Kv= 7.0 fps
35.3	530	Total			

Subcatchment 1: Slag Domed Cap Area 1 - South (1.29 Ac)



Subcatchment 2: Area 2 - South End (1.17 Ac)

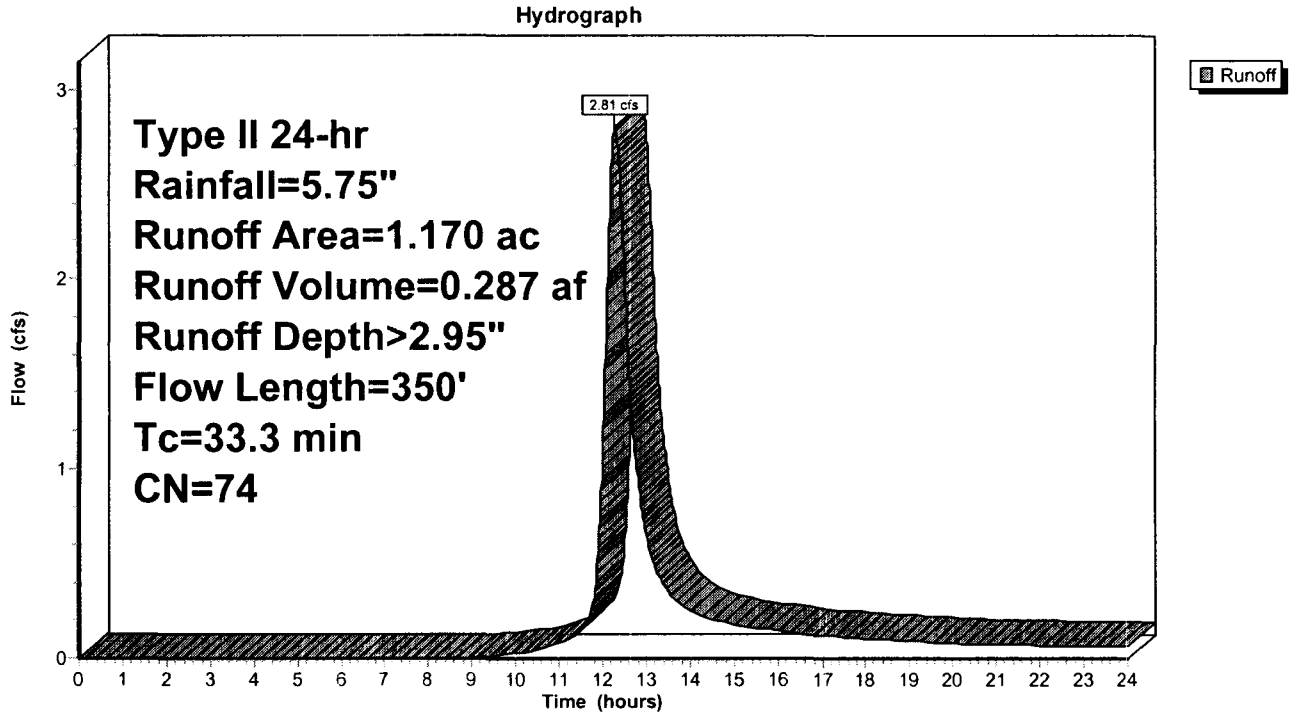
Runoff = 2.81 cfs @ 12.28 hrs, Volume= 0.287 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
1.170	74	>75% Grass cover, Good, HSG C
1.170		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.9	300	0.0200	0.15		**Sheet Flow, Top Half of subcatchment** Grass: Dense n= 0.240 P2= 3.50"
0.4	50	0.1000	2.21		**Shallow Concentrated Flow, Bottom half of subcatchment** Short Grass Pasture Kv= 7.0 fps
33.3	350	Total			

Subcatchment 2: Area 2 - South End (1.17 Ac)



Subcatchment 3: Area 3 bottom SE Corner (.8 Ac)

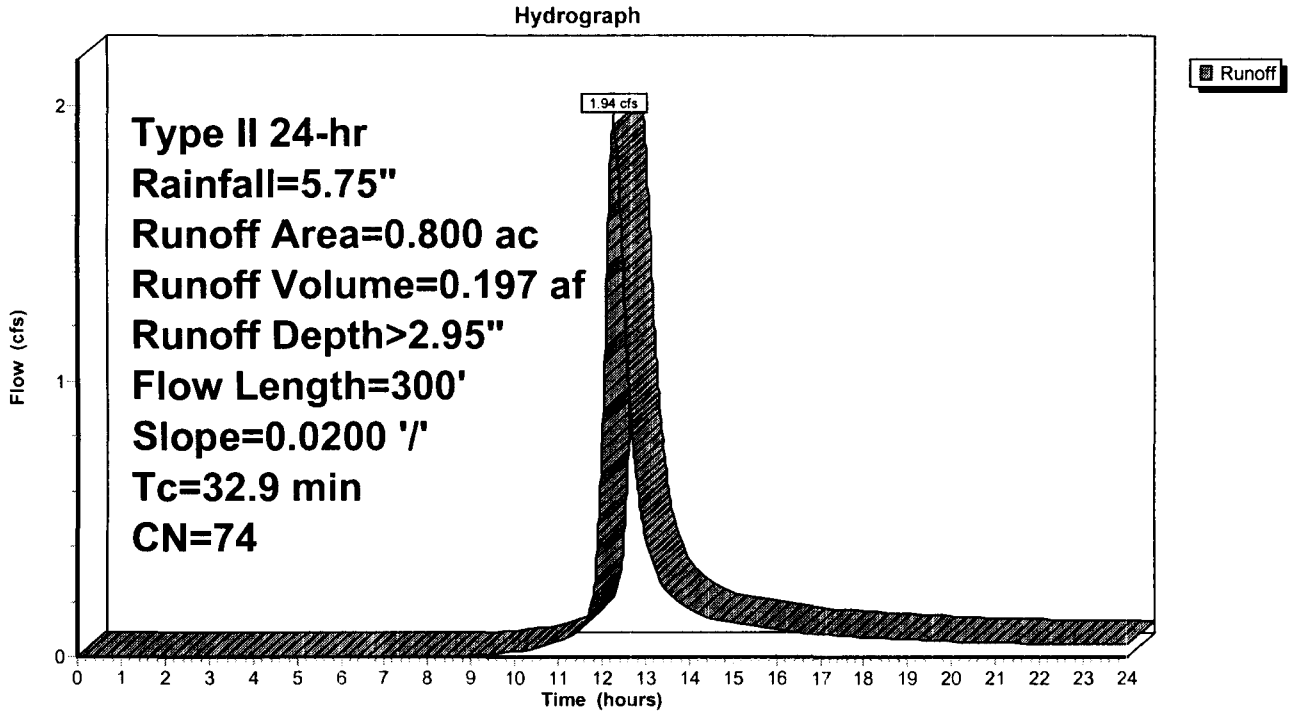
Runoff = 1.94 cfs @ 12.28 hrs, Volume= 0.197 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.800	74	>75% Grass cover, Good, HSG C
0.800		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.9	300	0.0200	0.15		**Sheet Flow, Flow on Cap to perimeter ditch** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 3: Area 3 bottom SE Corner (.8 Ac)



Subcatchment 4: Area 4 - Bottom SE side (1.4 Ac)

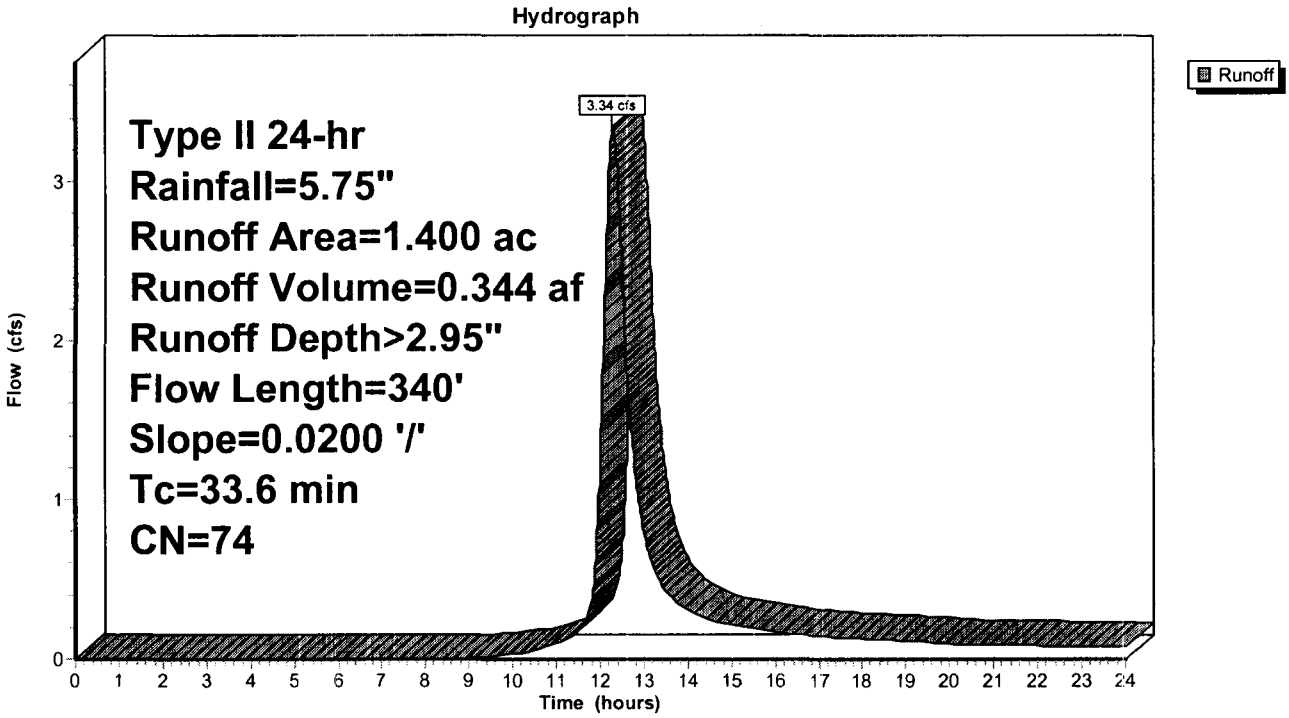
Runoff = 3.34 cfs @ 12.28 hrs, Volume= 0.344 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
1.400	74	>75% Grass cover, Good, HSG C
1.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.9	300	0.0200	0.15		**Sheet Flow, Top portion of Area** Grass: Dense n= 0.240 P2= 3.50"
0.7	40	0.0200	0.99		**Shallow Concentrated Flow, Bottom portion** Short Grass Pasture Kv= 7.0 fps
33.6	340	Total			

Subcatchment 4: Area 4 - Bottom SE side (1.4 Ac)



Subcatchment 5: Area 5 - Slag Cap East side (1.03)

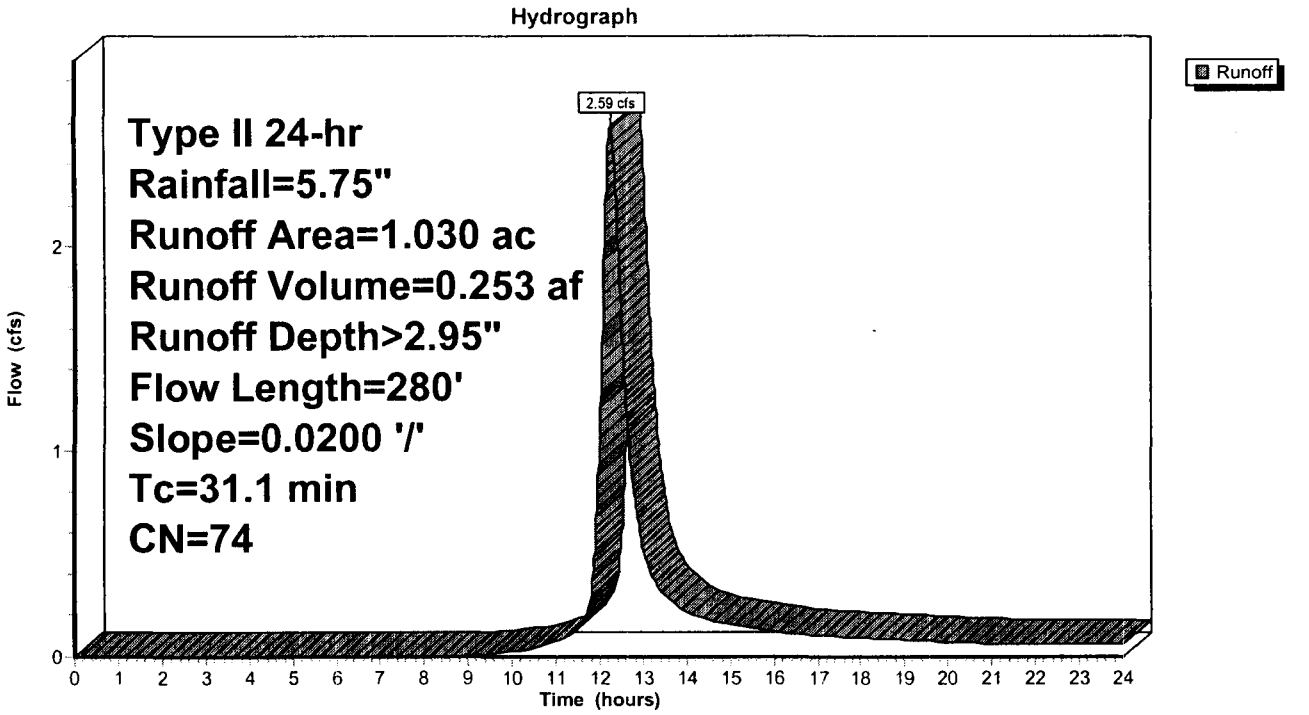
Runoff = 2.59 cfs @ 12.27 hrs, Volume= 0.253 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
1.030	74	>75% Grass cover, Good, HSG C
1.030		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.1	280	0.0200	0.15		**Sheet Flow, Cap surface grassed** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 5: Area 5 - Slag Cap East side (1.03)



Subcatchment 6: Area 6 - Slag Cap East Side (.91 Ac)

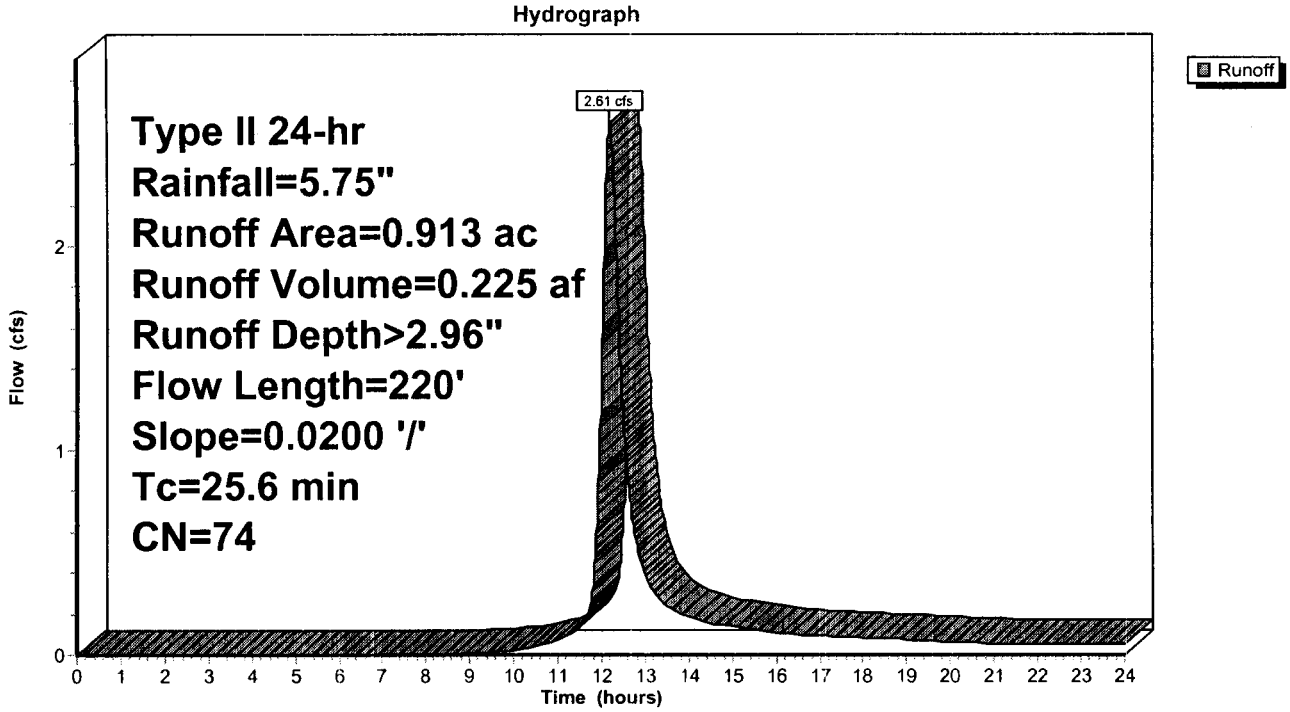
Runoff = 2.61 cfs @ 12.20 hrs, Volume= 0.225 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.913	74	>75% Grass cover, Good, HSG C
0.913		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	220	0.0200	0.14		**Sheet Flow, Slag Cap grassed** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 6: Area 6 - Slag Cap East Side (.91 Ac)



Subcatchment 7: Area 7 (.9 Acs) - Slag Cap East at crest of East Cap Ditch

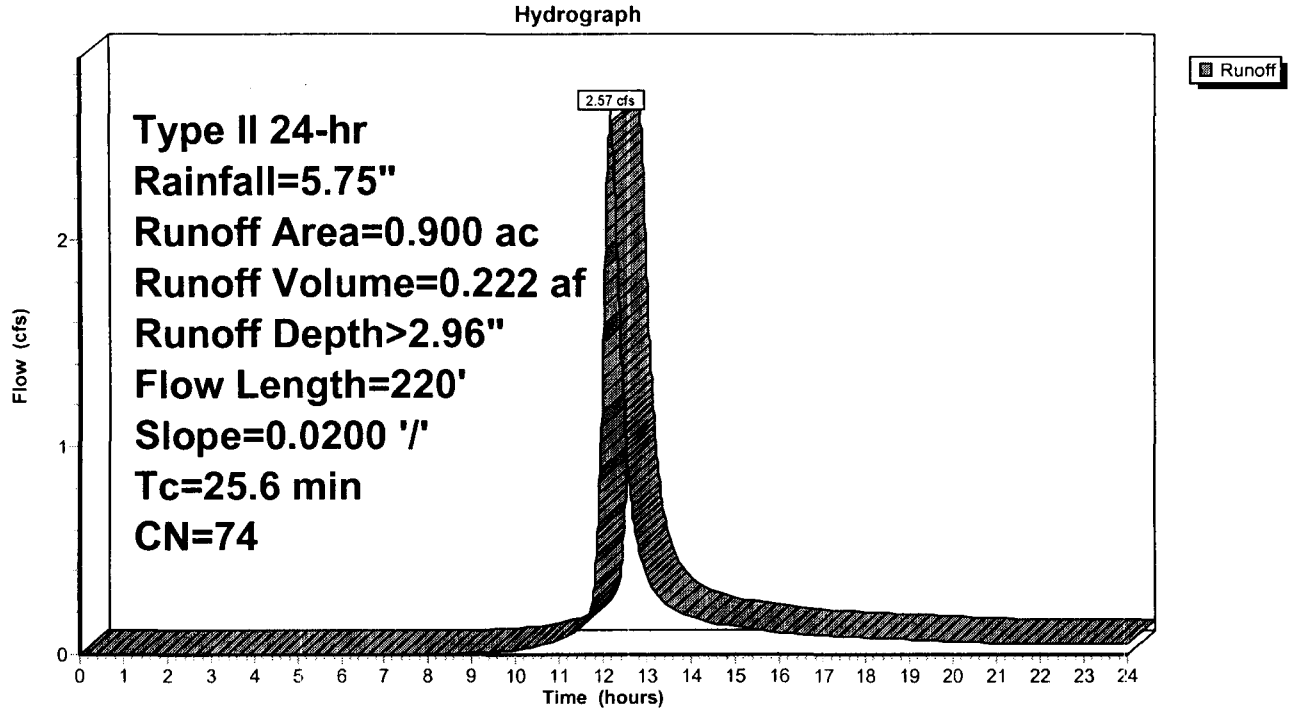
Runoff = 2.57 cfs @ 12.20 hrs, Volume= 0.222 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.900	74	>75% Grass cover, Good, HSG C
0.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	220	0.0200	0.14		**Sheet Flow, Slag Cap Run-off** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 7: Area 7 (.9 Acs) - Slag Cap East at crest of East Cap Ditch



Subcatchment 8: Slag Cap Area 8 South side of Site (3.6 Ac)

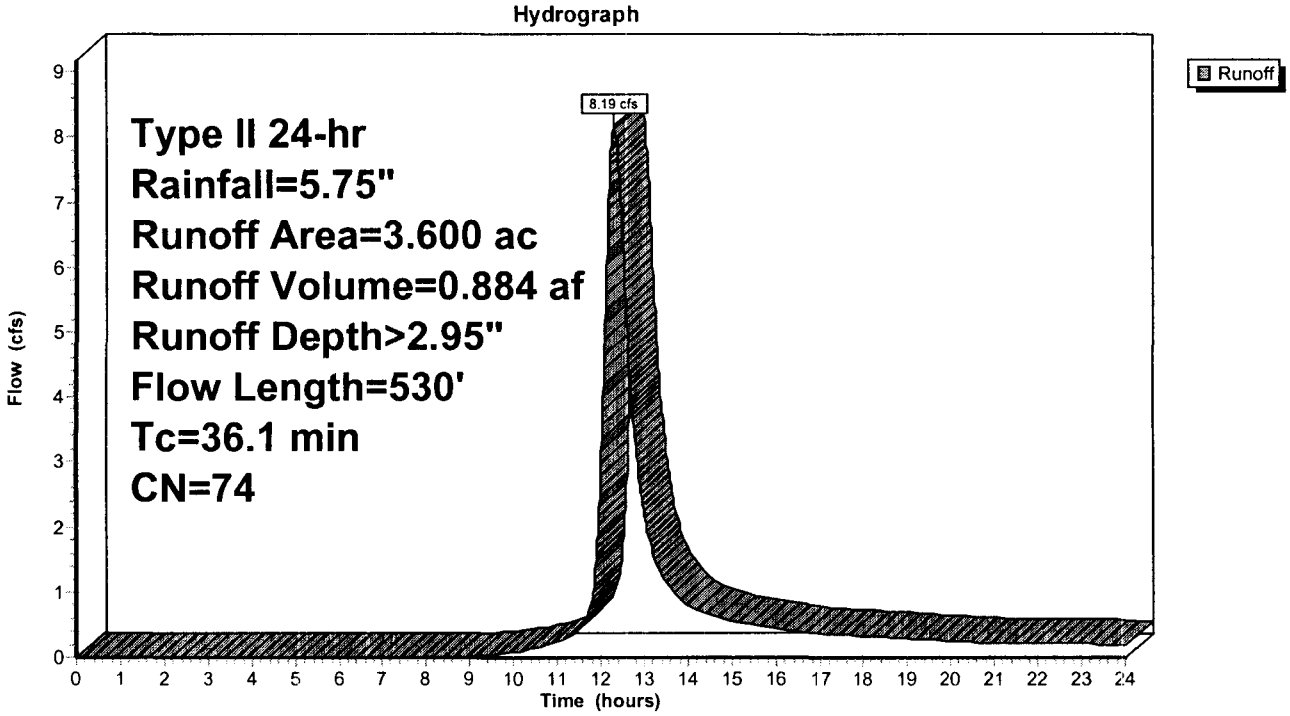
Runoff = 8.19 cfs @ 12.32 hrs, Volume= 0.884 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
3.600	74	>75% Grass cover, Good, HSG C
3.600		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.9	300	0.0200	0.15		**Sheet Flow, Top portion of cap** Grass: Dense n= 0.240 P2= 3.50"
3.2	230	0.0300	1.21		**Shallow Concentrated Flow, Lower portion** Short Grass Pasture Kv= 7.0 fps
36.1	530	Total			

Subcatchment 8: Slag Cap Area 8 South side of Site (3.6 Ac)



Subcatchment 9: Slag Cap Area 9 (2.3 Acs)

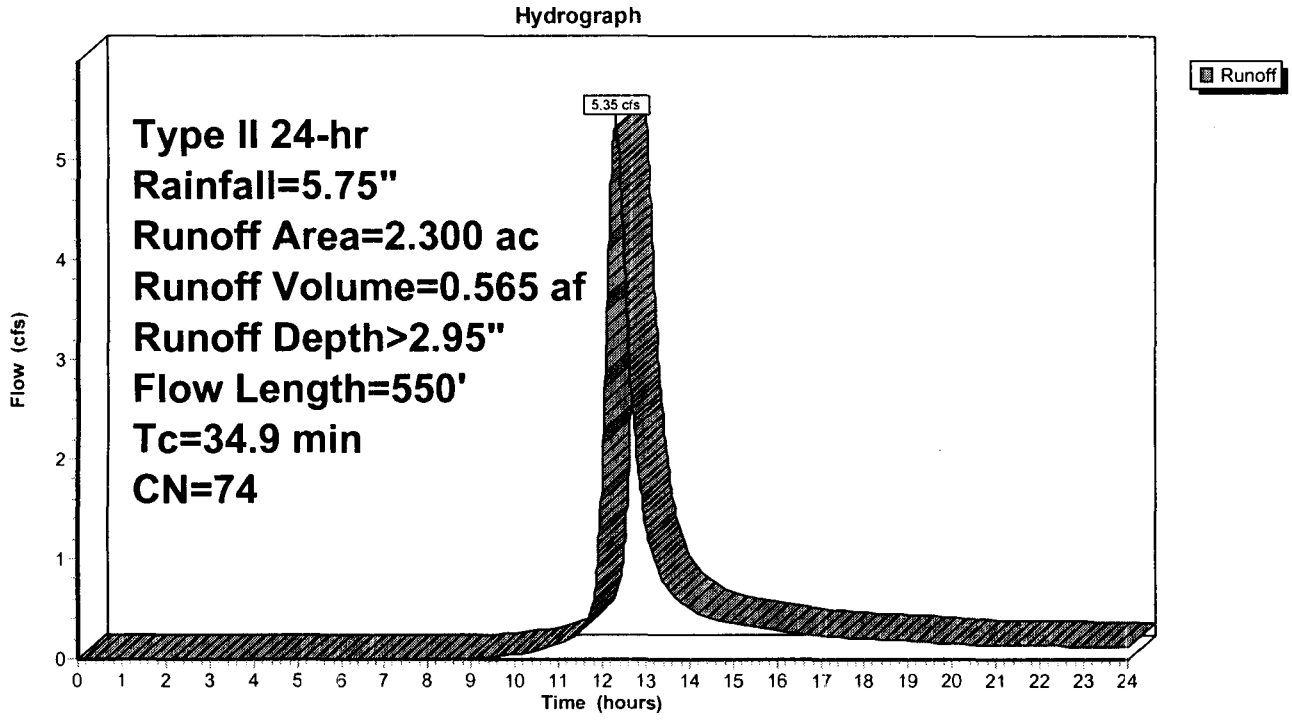
Runoff = 5.35 cfs @ 12.30 hrs, Volume= 0.565 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
2.300	74	>75% Grass cover, Good, HSG C
2.300		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.9	300	0.0200	0.15		**Sheet Flow, top portion of cap** Grass: Dense n= 0.240 P2= 3.50"
2.0	250	0.0900	2.10		**Shallow Concentrated Flow, bottom portion** Short Grass Pasture Kv= 7.0 fps
34.9	550	Total			

Subcatchment 9: Slag Cap Area 9 (2.3 Acs)



Subcatchment 10: Slag Cap Area 10 (1 AC)

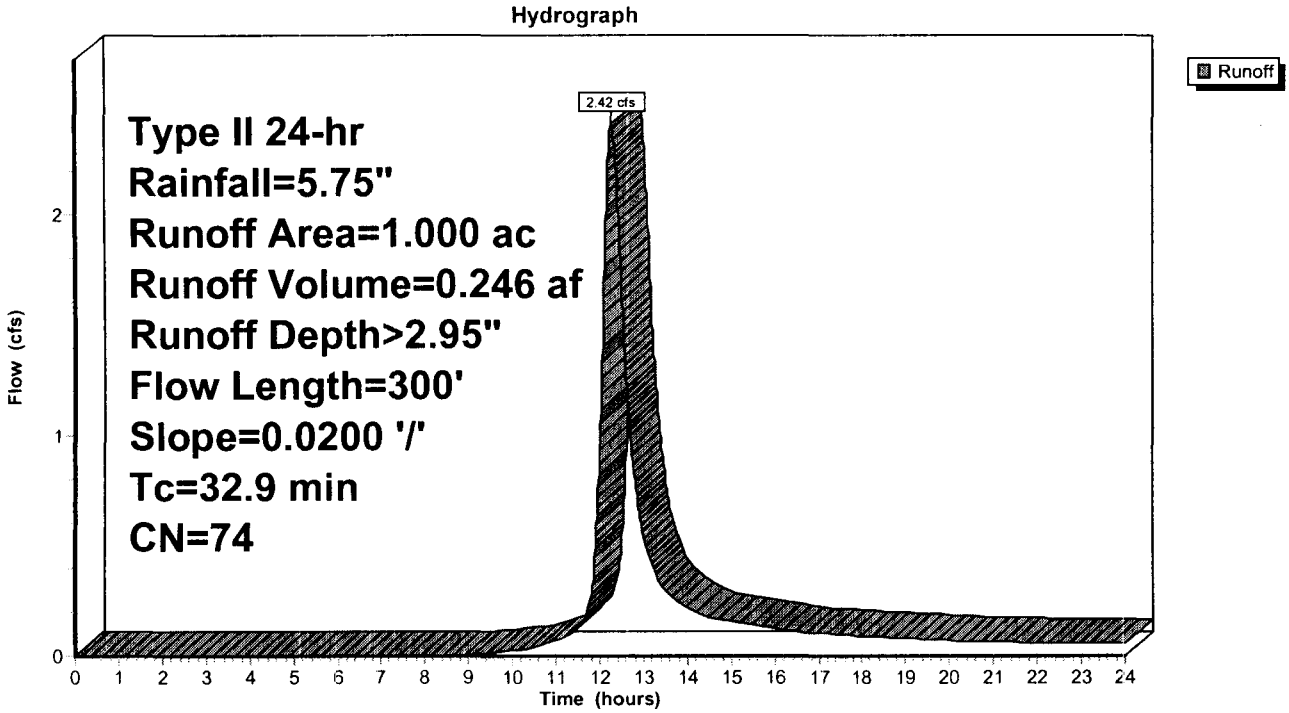
Runoff = 2.42 cfs @ 12.28 hrs, Volume= 0.246 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
1.000	74	>75% Grass cover, Good, HSG C
1.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.9	300	0.0200	0.15		**Sheet Flow, Slag Cap** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 10: Slag Cap Area 10 (1 AC)



Subcatchment 11: Slag Cap Area 11 (.4 Ac)

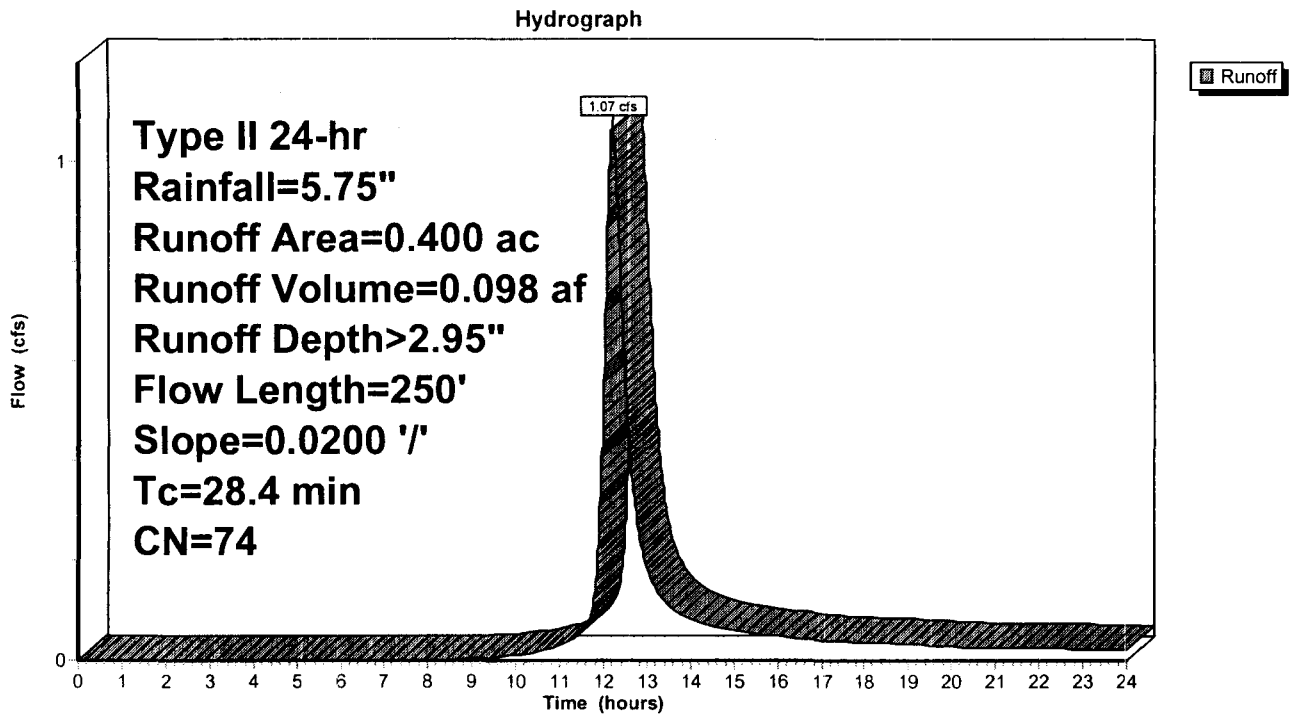
Runoff = 1.07 cfs @ 12.22 hrs, Volume= 0.098 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.400	74	>75% Grass cover, Good, HSG C
0.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.4	250	0.0200	0.15		**Sheet Flow, Drainage on cap** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 11: Slag Cap Area 11 (.4 Ac)



Subcatchment 12: Slag Cap Area 12 (.930 Ac)

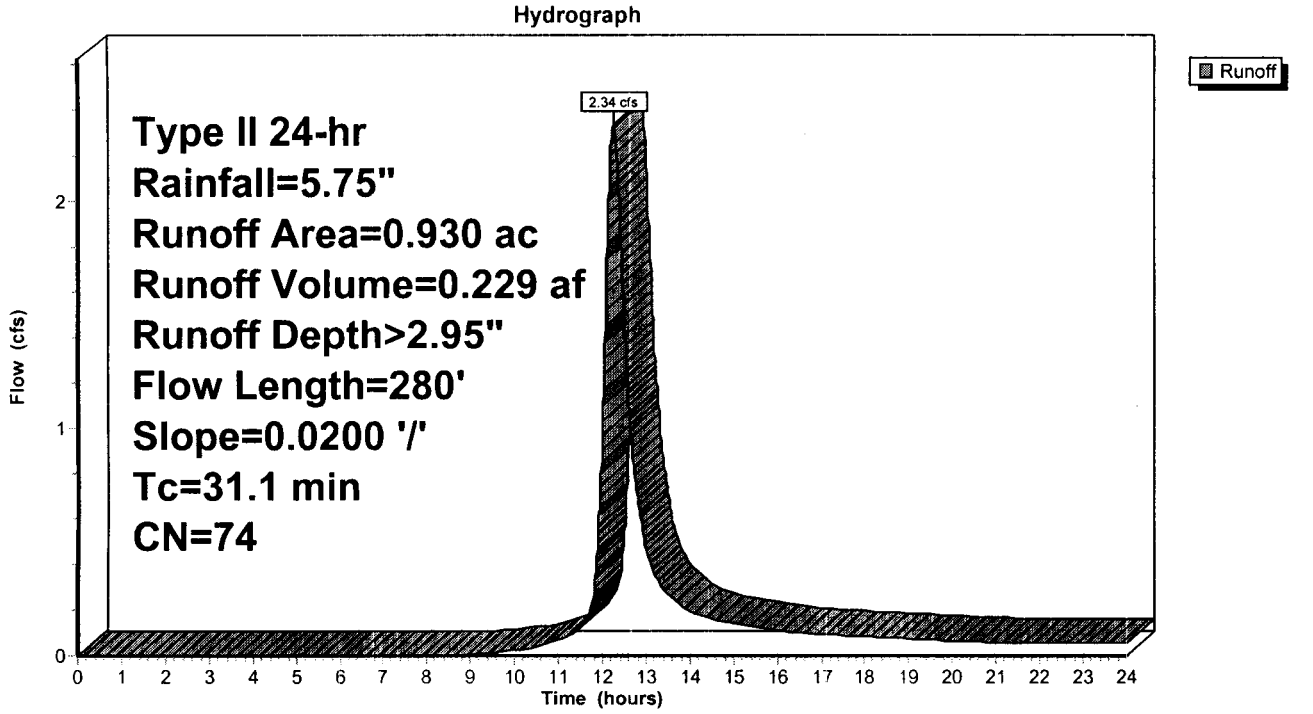
Runoff = 2.34 cfs @ 12.27 hrs, Volume= 0.229 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.930	74	>75% Grass cover, Good, HSG C
0.930		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.1	280	0.0200	0.15		**Sheet Flow, Slag Cap** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 12: Slag Cap Area 12 (.930 Ac)



Subcatchment 13: Slag Cap Area 13 (.83 Ac)

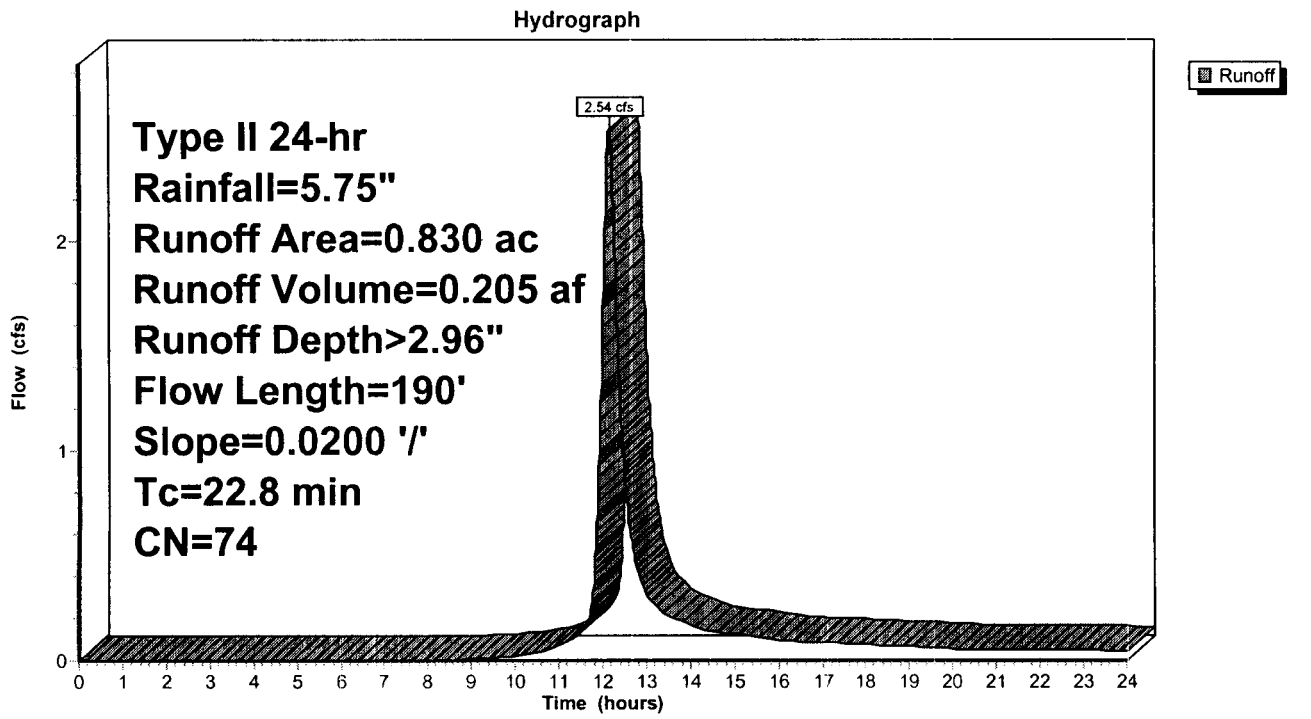
Runoff = 2.54 cfs @ 12.16 hrs, Volume= 0.205 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.830	74	>75% Grass cover, Good, HSG C
0.830		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	190	0.0200	0.14		**Sheet Flow, Slag Cap runoff** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 13: Slag Cap Area 13 (.83 Ac)



Subcatchment 14: Slag Cap Area 14 (.75 Ac)

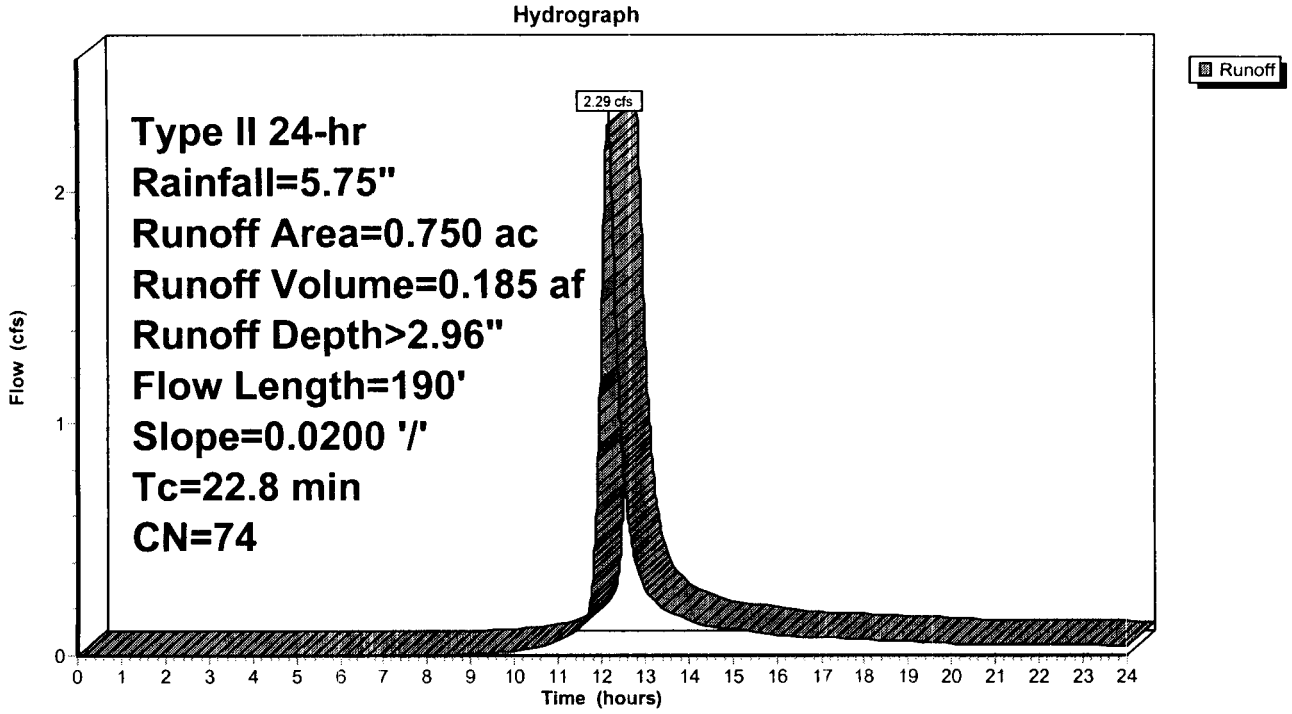
Runoff = 2.29 cfs @ 12.16 hrs, Volume= 0.185 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.750	74	>75% Grass cover, Good, HSG C
0.750		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	190	0.0200	0.14		**Sheet Flow, Slag Cap Drainage** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 14: Slag Cap Area 14 (.75 Ac)



Subcatchment 15: Grassy Slope west side of Slag Area (.15 Ac)

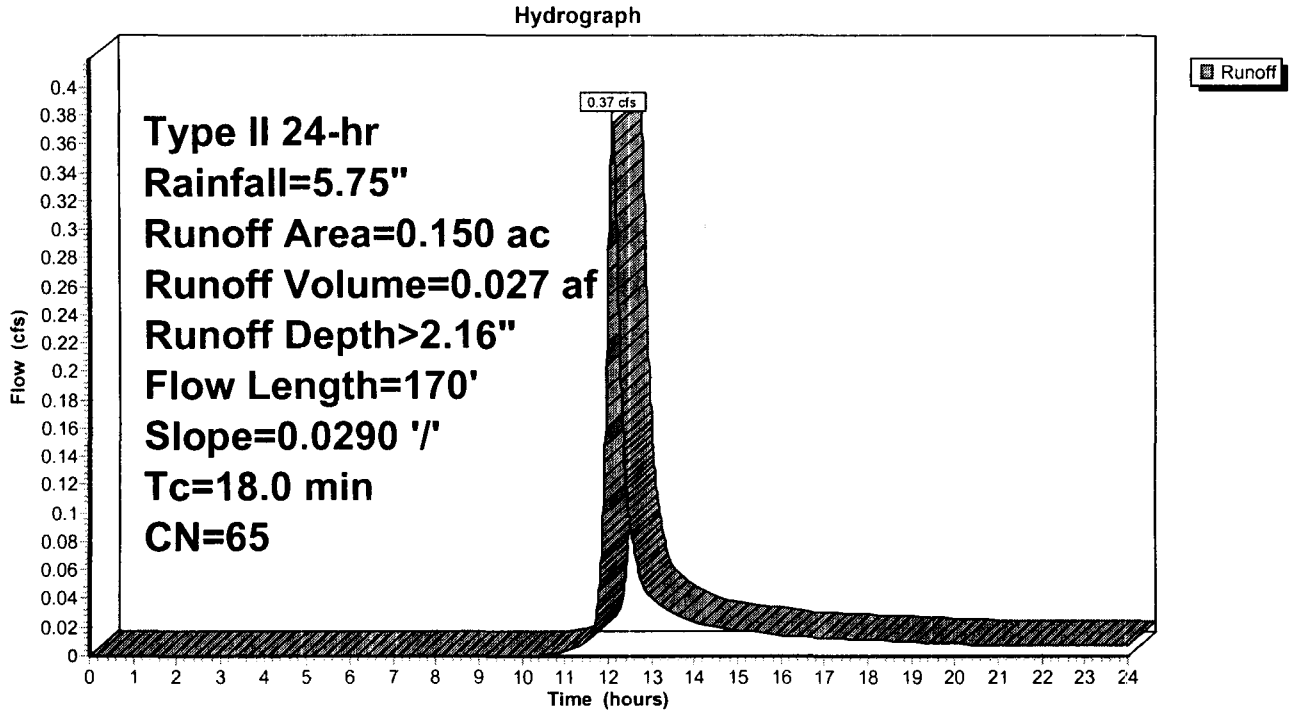
Runoff = 0.37 cfs @ 12.11 hrs, Volume= 0.027 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.150	65	Brush, Good, HSG C
0.150		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0	170	0.0290	0.16		**Sheet Flow, Undisturbed Slope west of Slag Area** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 15: Grassy Slope west side of Slag Area (.15 Ac)



Subcatchment 16: Grassy Slope West Side of Slag Area (.49 Ac)

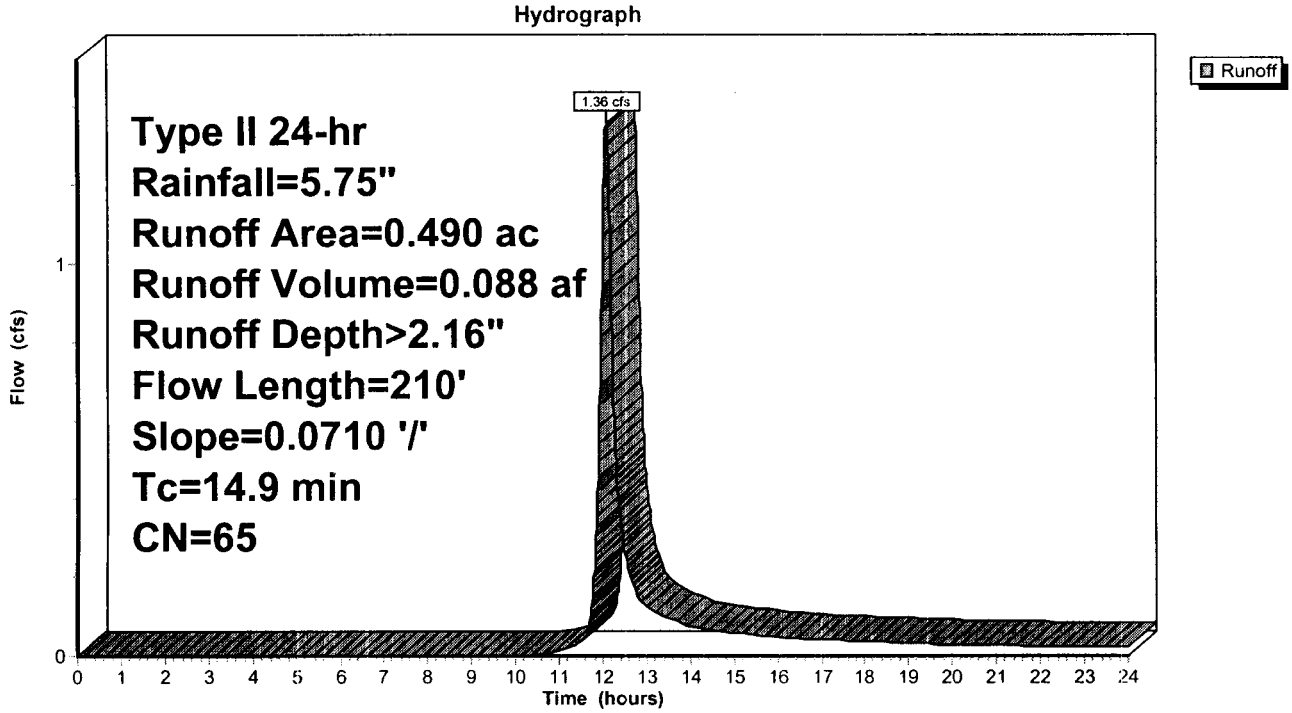
Runoff = 1.36 cfs @ 12.07 hrs, Volume= 0.088 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.490	65	Brush, Good, HSG C
0.490		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	210	0.0710	0.24		**Sheet Flow, Grassy Area next to Slag Cap west ditch** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 16: Grassy Slope West Side of Slag Area (.49 Ac)



Subcatchment 17: Grassy Area West side of Slag Area (.69 Ac)

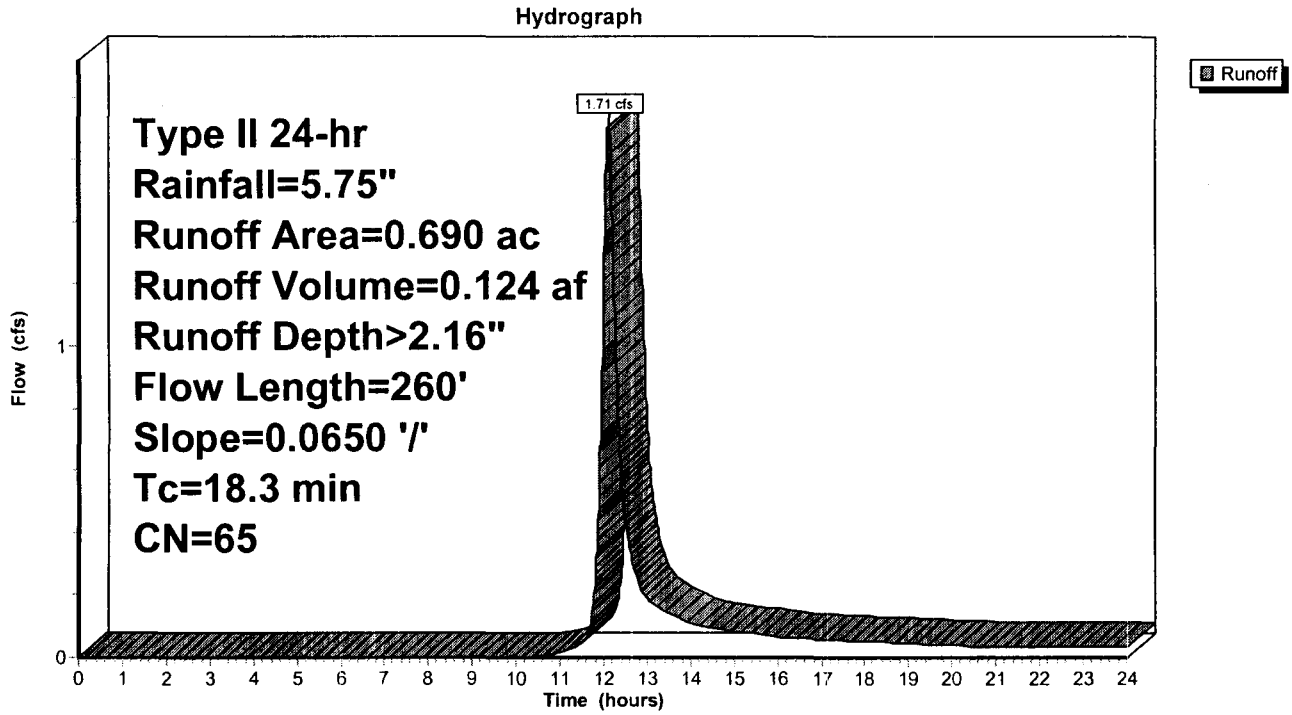
Runoff = 1.71 cfs @ 12.12 hrs, Volume= 0.124 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.690	65	Brush, Good, HSG C
0.690		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.3	260	0.0650	0.24		**Sheet Flow, Grassy Area West of Slag Area** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 17: Grassy Area West side of Slag Area (.69 Ac)



Subcatchment 18: Grassy Area West Side of Slag Area (.86 Ac)

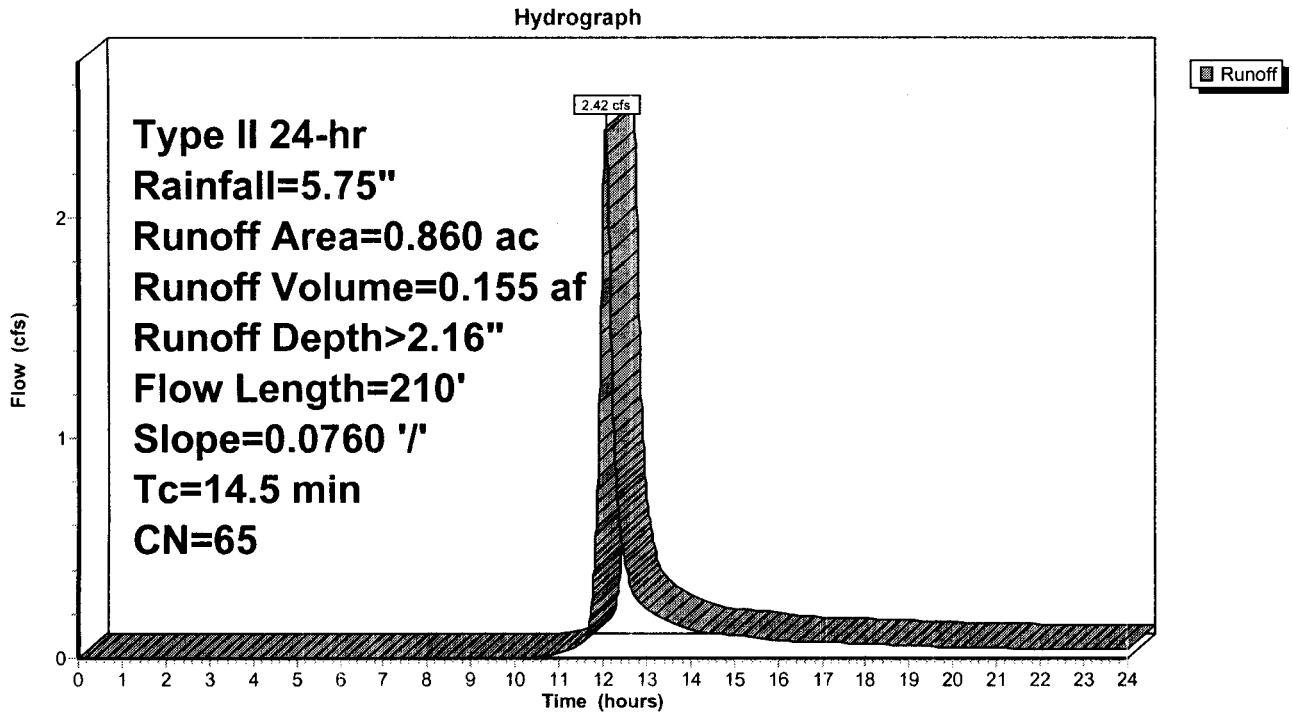
Runoff = 2.42 cfs @ 12.07 hrs, Volume= 0.155 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.860	65	Brush, Good, HSG C
0.860		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	210	0.0760	0.24		**Sheet Flow, Grassy Area West of Slag Area** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 18: Grassy Area West Side of Slag Area (.86 Ac)



Subcatchment 19: Grassy Area West Side of Slag Area (.74 Ac)

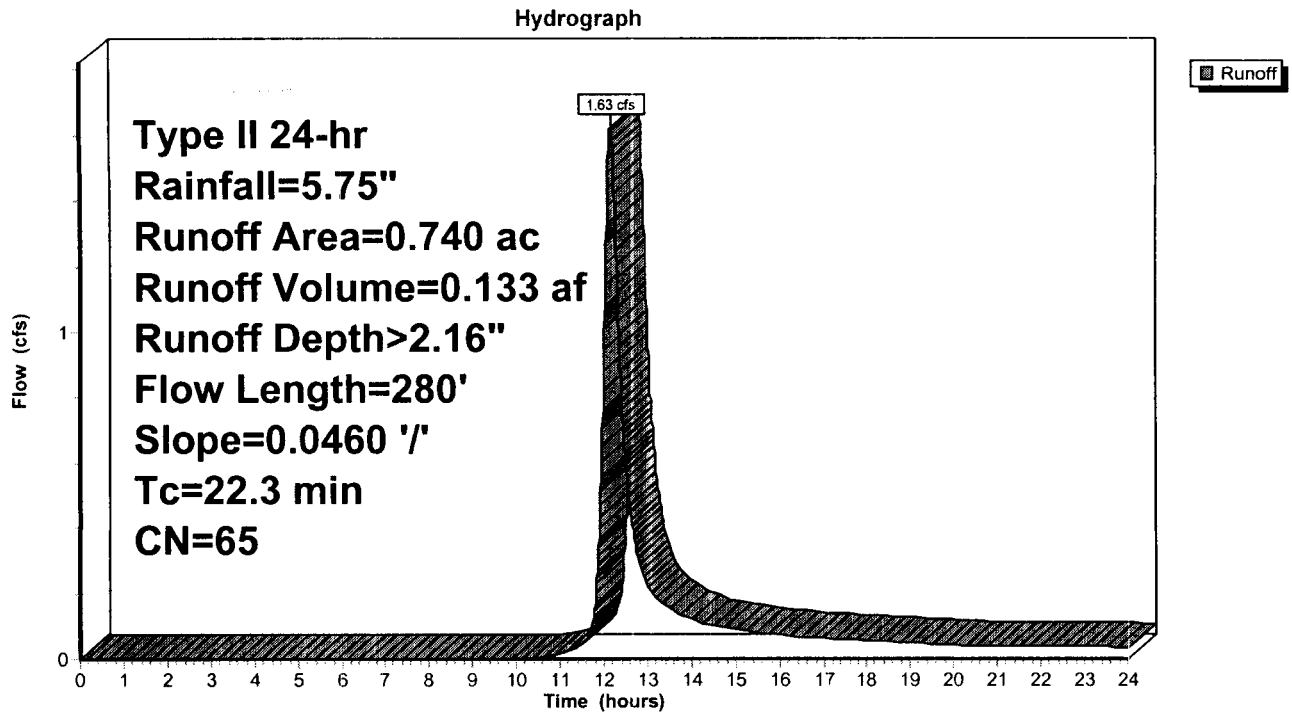
Runoff = 1.63 cfs @ 12.16 hrs, Volume= 0.133 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.740	65	Brush, Good, HSG C
0.740		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.3	280	0.0460	0.21		**Sheet Flow, Grassy Area West of Slag Area** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment 19: Grassy Area West Side of Slag Area (.74 Ac)



Subcatchment 20: Small Portion of Chem Pond Cap and grassy area west of Slag Area (1.25 Ac

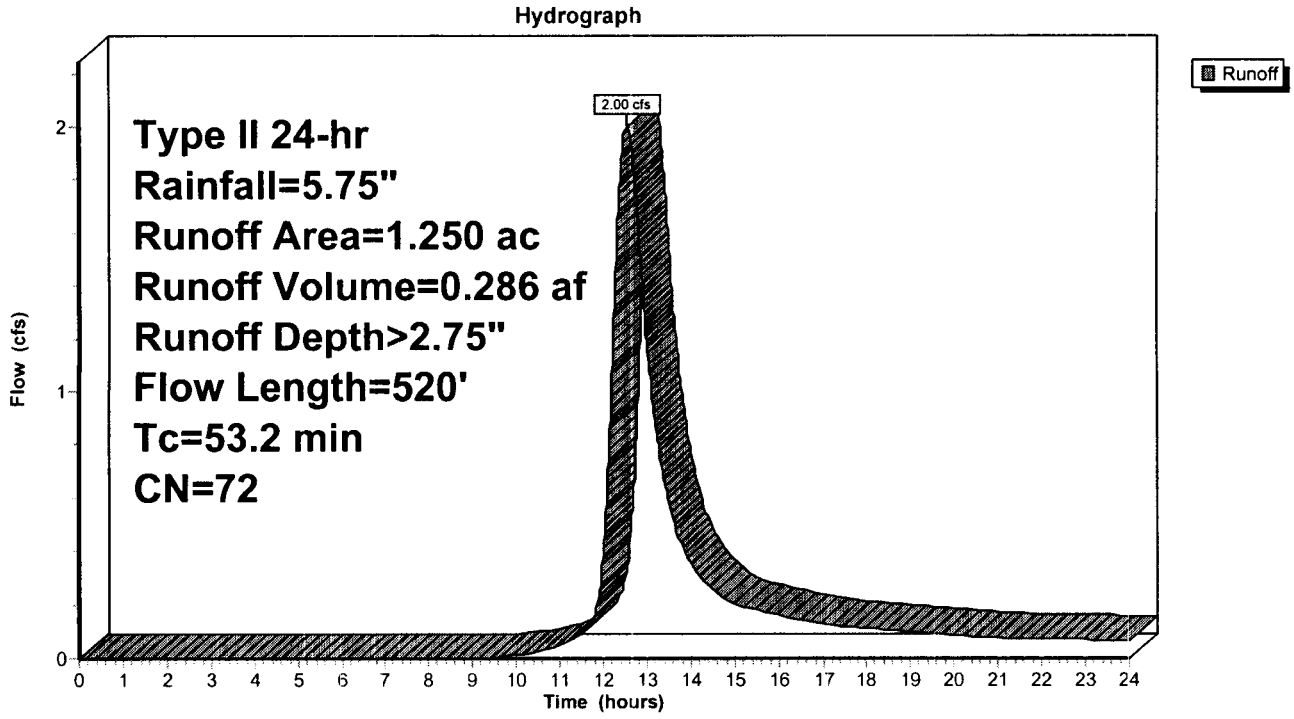
Runoff = 2.00 cfs @ 12.54 hrs, Volume= 0.286 af, Depth> 2.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
1.000	74	>75% Grass cover, Good, HSG C
0.250	65	Brush, Good, HSG C
1.250	72	Weighted Average
1.250		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.0	300	0.0070	0.10		**Sheet Flow, Upper portion - chem pond cap plus grassy area** Grass: Dense n= 0.240 P2= 3.50"
3.2	220	0.0270	1.15		**Shallow Concentrated Flow, Lower portion of area** Short Grass Pasture Kv= 7.0 fps
53.2	520	Total			

Subcatchment 20: Small Portion of Chem Pond Cap and grassy area west of Slag Area (1.25 Ac



Subcatchment 21: Portion of Coal Pile Area (3.43 Ac)

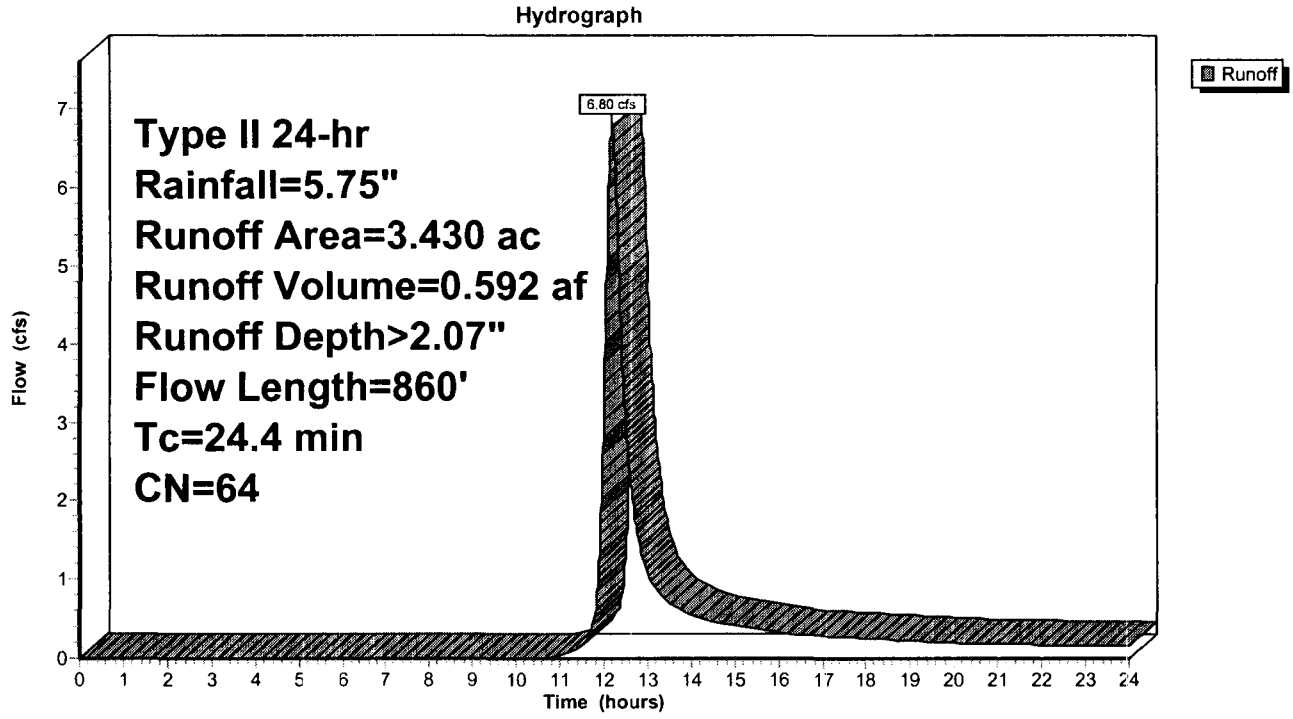
Runoff = 6.80 cfs @ 12.18 hrs, Volume= 0.592 af, Depth> 2.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.950	50	Coal Material
2.480	70	Brush, Fair, HSG C
3.430	64	Weighted Average
3.430		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	300	0.0030	0.25		**Sheet Flow, Upper Portion of Area - Mostly Coal Yard** Fallow n= 0.050 P2= 3.50"
4.4	560	0.0200	2.12		**Shallow Concentrated Flow, Lower Portion of Area** Grassed Waterway Kv= 15.0 fps
24.4	860	Total			

Subcatchment 21: Portion of Coal Pile Area (3.43 Ac)



Subcatchment 22: PH Roof and parking lot (5.23 Ac)

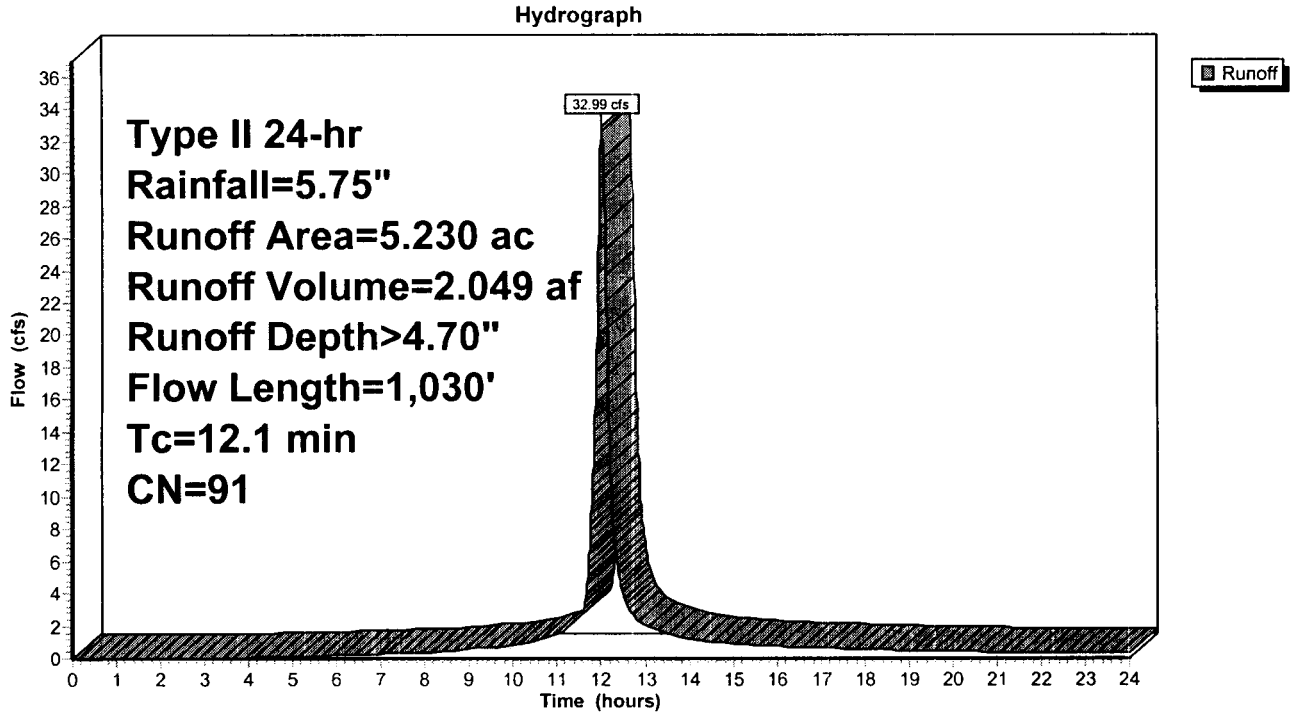
Runoff = 32.99 cfs @ 12.03 hrs, Volume= 2.049 af, Depth> 4.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
5.230	91	Urban industrial, 72% imp, HSG C
1.464		Pervious Area
3.766		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	300	0.0020	0.71		**Sheet Flow, Upper Portion of Area** Smooth surfaces n= 0.011 P2= 3.50"
5.1	730	0.0140	2.40		**Shallow Concentrated Flow, Lower Portion** Paved Kv= 20.3 fps
12.1	1,030	Total			

Subcatchment 22: PH Roof and parking lot (5.23 Ac)



Subcatchment 23: HED Area West of Site (16.4 Ac)

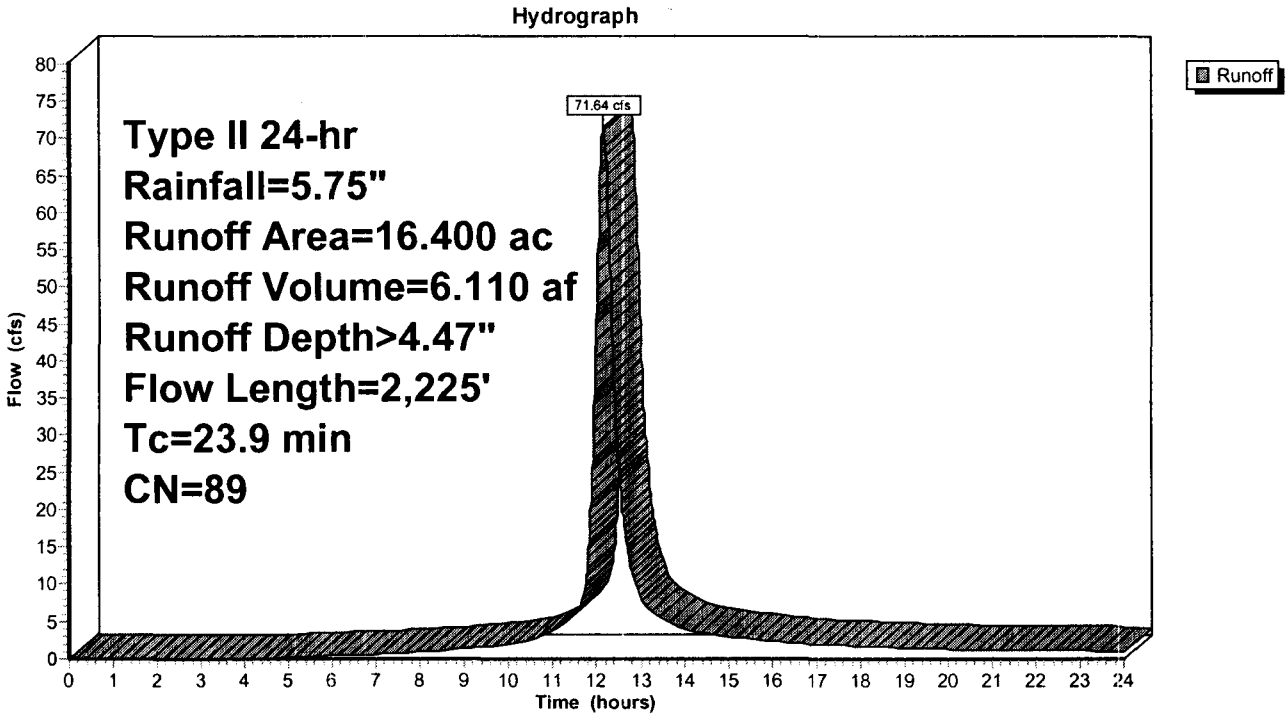
Runoff = 71.64 cfs @ 12.16 hrs, Volume= 6.110 af, Depth> 4.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
16.400	89	Gravel roads, HSG C
16.400		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	300	0.0050	1.03		**Sheet Flow, beginning portion** n= 0.011 P2= 3.50"
19.0	1,925	0.0110	1.69		**Shallow Concentrated Flow, Lower Portion** Unpaved Kv= 16.1 fps
23.9	2,225	Total			

Subcatchment 23: HED Area West of Site (16.4 Ac)



Reach 3R: Bottom Section of East Cap Ditch

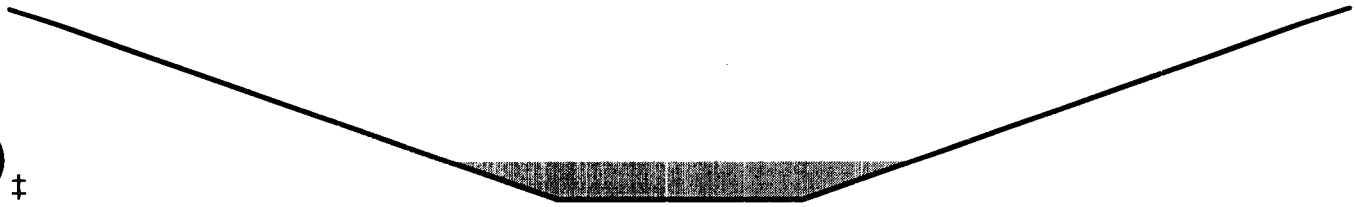
[61] Hint: Submerged 61% of Reach 4R bottom

Inflow Area =	5.043 ac,	Inflow Depth > 2.94"		
Inflow =	12.84 cfs @	12.27 hrs, Volume=	1.237 af	
Outflow =	12.82 cfs @	12.29 hrs, Volume=	1.235 af,	Atten= 0%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.63 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.28 fps, Avg. Travel Time= 3.1 min

Peak Storage= 848 cf @ 12.29 hrs, Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 342.21 cfs

4.00' x 3.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 22.00'
Length= 240.0' Slope= 0.0083 '/'
Inlet Invert= 710.00', Outlet Invert= 708.00'



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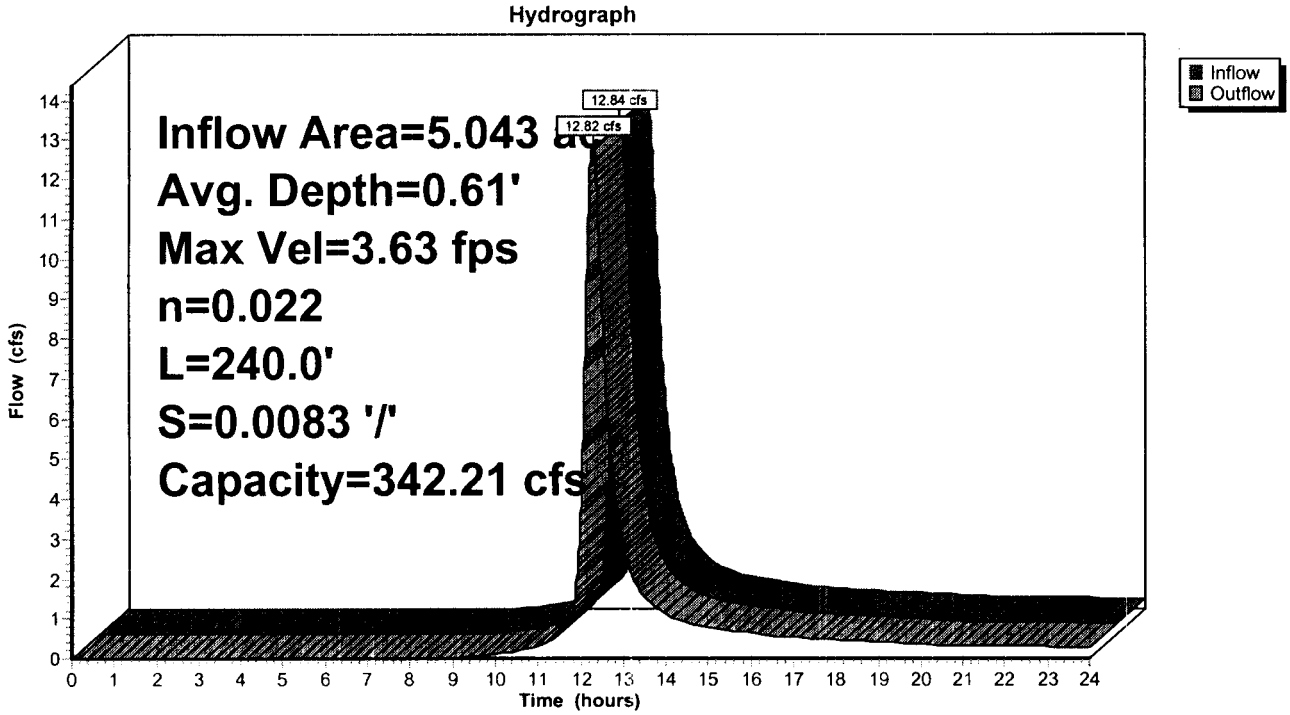
Reach 3R: Bottom Section of East Cap Ditch



Reach 4R: East Cap Ditch

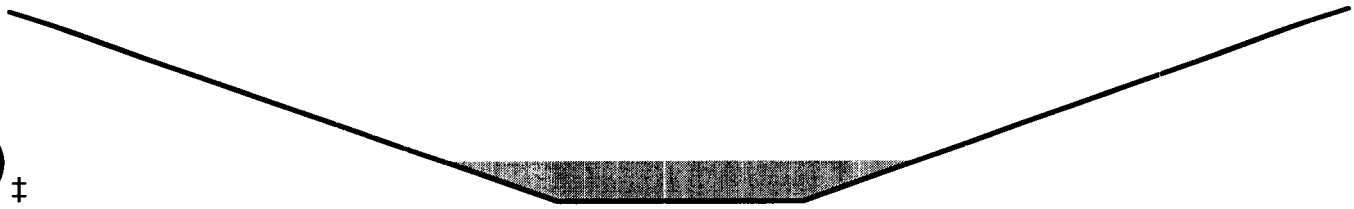
[61] Hint: Submerged 64% of Reach 5R bottom

Inflow Area =	4.243 ac,	Inflow Depth > 2.95"		
Inflow =	10.93 cfs @	12.26 hrs, Volume=	1.041 af	
Outflow =	10.91 cfs @	12.27 hrs, Volume=	1.040 af,	Atten= 0%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.89 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.02 fps, Avg. Travel Time= 3.3 min

Peak Storage= 756 cf @ 12.27 hrs, Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 265.07 cfs

4.00' x 3.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 22.00'
Length= 200.0' Slope= 0.0050 '/'
Inlet Invert= 711.00', Outlet Invert= 710.00'



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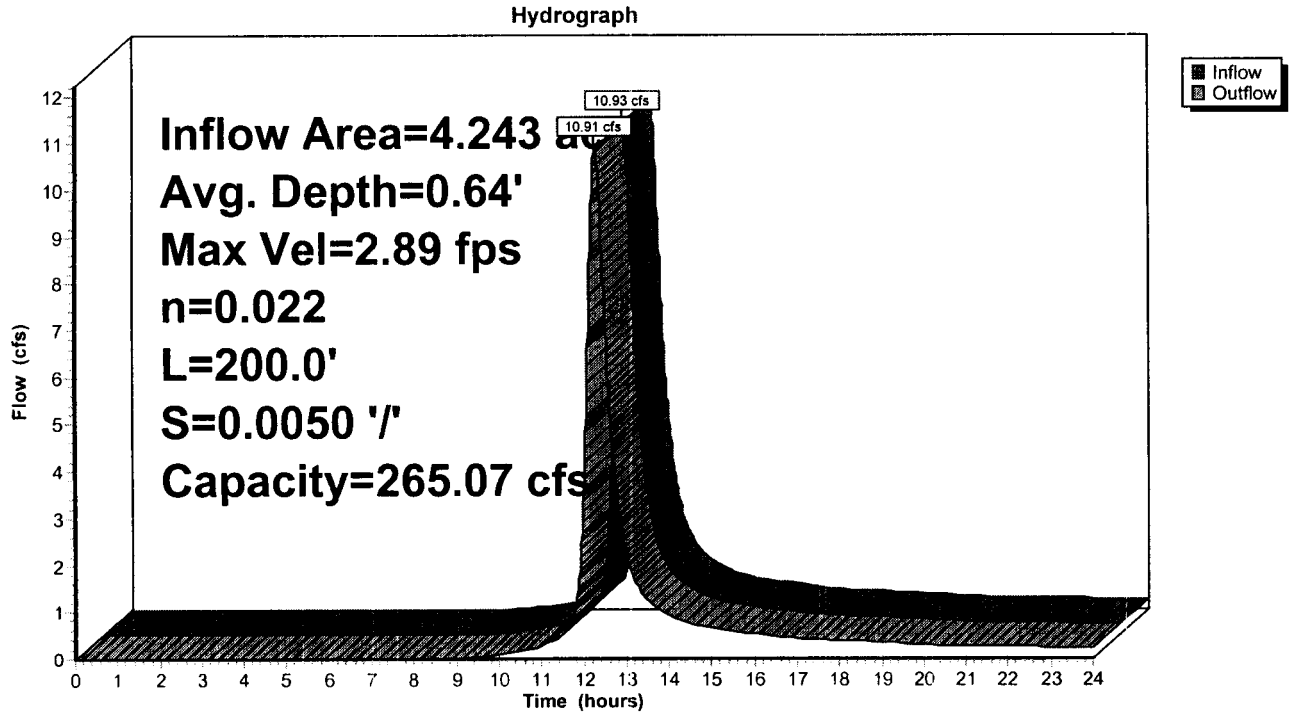
Reach 4R: East Cap Ditch



Reach 5R: Slag Cap Ditch - East

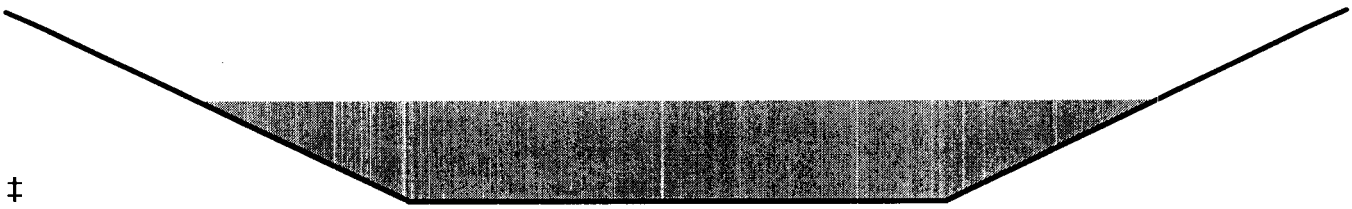
[61] Hint: Submerged 53% of Reach 6R bottom

Inflow Area =	2.843 ac,	Inflow Depth > 2.95"		
Inflow =	7.67 cfs @	12.23 hrs, Volume=	0.698 af	
Outflow =	7.65 cfs @	12.24 hrs, Volume=	0.697 af, Atten= 0%, Lag= 0.9 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.60 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.86 fps, Avg. Travel Time= 3.9 min

Peak Storage= 589 cf @ 12.24 hrs, Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 25.80 cfs

4.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 200.0' Slope= 0.0050 '/'
Inlet Invert= 712.00', Outlet Invert= 711.00'



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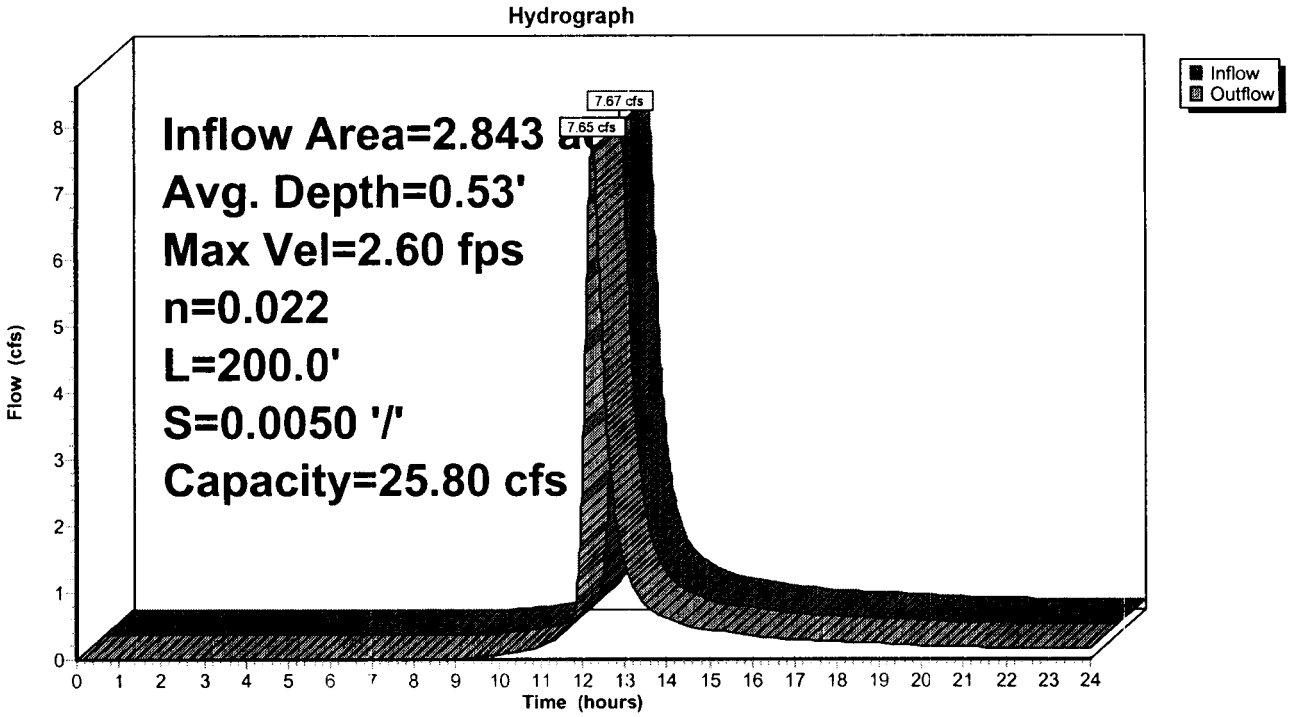
Reach 5R: Slag Cap Ditch - East



Reach 6R: Slag Cap East Ditch

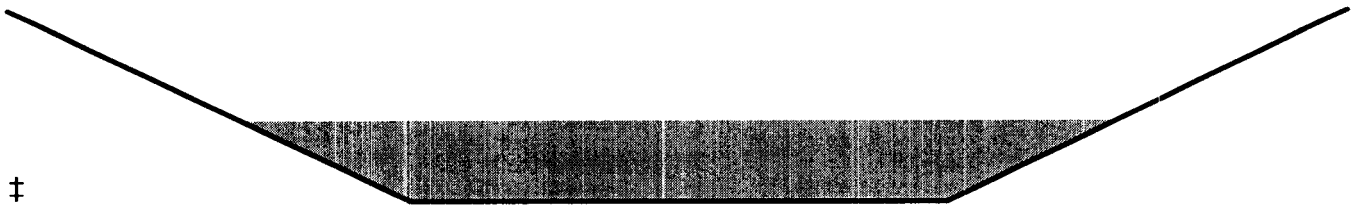
[61] Hint: Submerged 53% of Reach 7R bottom

Inflow Area =	1.813 ac,	Inflow Depth > 2.95"		
Inflow =	5.16 cfs @	12.20 hrs, Volume=	0.446 af	
Outflow =	5.13 cfs @	12.22 hrs, Volume=	0.445 af,	Atten= 1%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.30 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.73 fps, Avg. Travel Time= 4.5 min

Peak Storage= 446 cf @ 12.22 hrs, Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 25.80 cfs

4.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 200.0' Slope= 0.0050 '/'
Inlet Invert= 713.00', Outlet Invert= 712.00'



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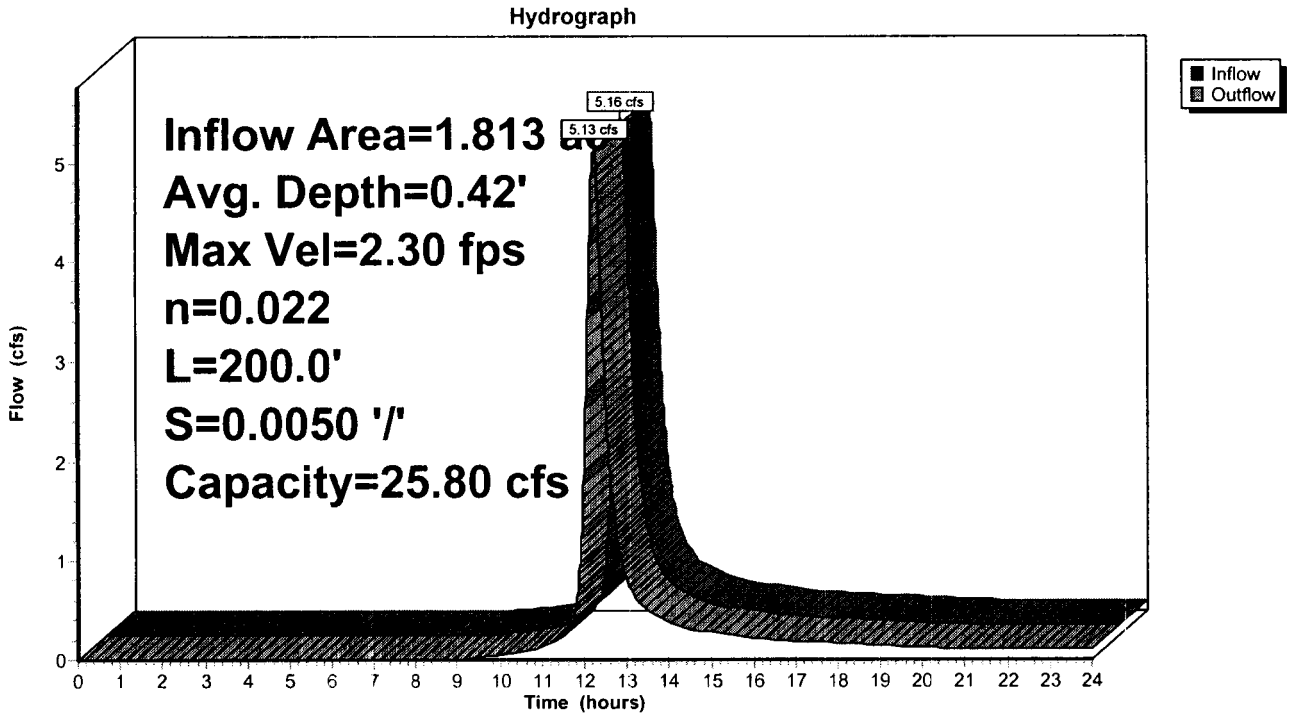
Reach 6R: Slag Cap East Ditch



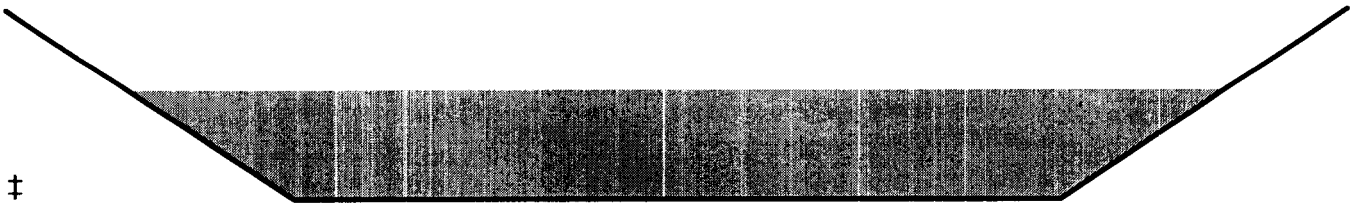
Reach 7R: Slag Cap East Ditch - Apex

Inflow Area = 0.900 ac, Inflow Depth > 2.96"
Inflow = 2.57 cfs @ 12.20 hrs, Volume= 0.222 af
Outflow = 2.55 cfs @ 12.21 hrs, Volume= 0.221 af, Atten= 1%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.84 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 4.7 min

Peak Storage= 222 cf @ 12.21 hrs, Average Depth at Peak Storage= 0.29'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 6.94 cfs

4.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 7.00'
Length= 160.0' Slope= 0.0050 '/'
Inlet Invert= 713.80', Outlet Invert= 713.00'



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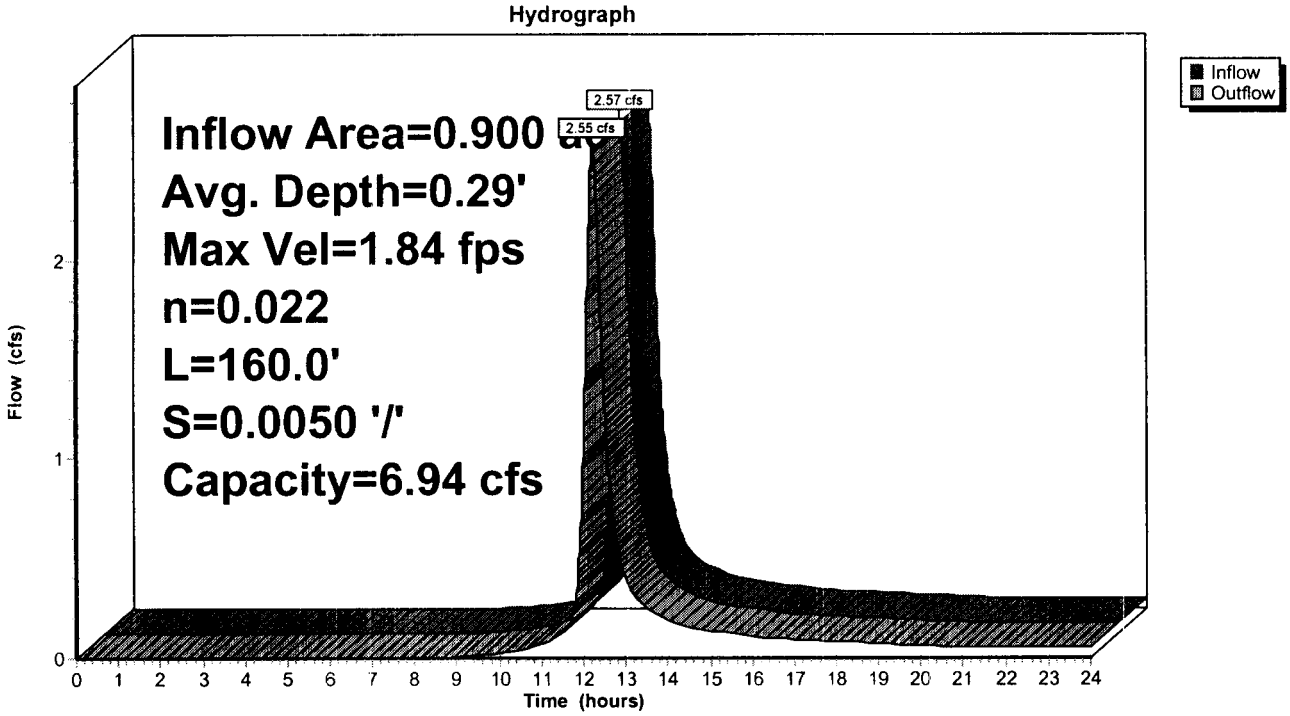
Reach 7R: Slag Cap East Ditch - Apex



Reach 9R: Slag Cap Drainage Ditch West

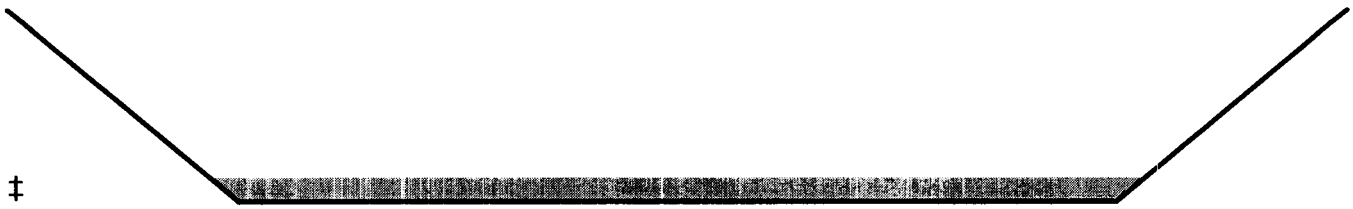
[61] Hint: Submerged 87% of Reach 10R bottom

Inflow Area = 16.750 ac, Inflow Depth > 3.15"
Inflow = 51.25 cfs @ 12.12 hrs, Volume= 4.403 af
Outflow = 51.21 cfs @ 12.12 hrs, Volume= 4.400 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.84 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.76 fps, Avg. Travel Time= 2.0 min

Peak Storage= 1,625 cf @ 12.12 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 3.50', Capacity at Bank-Full= 1,786.48 cfs

40.00' x 3.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 61.00'
Length= 90.0' Slope= 0.0056 '/'
Inlet Invert= 709.50', Outlet Invert= 709.00'



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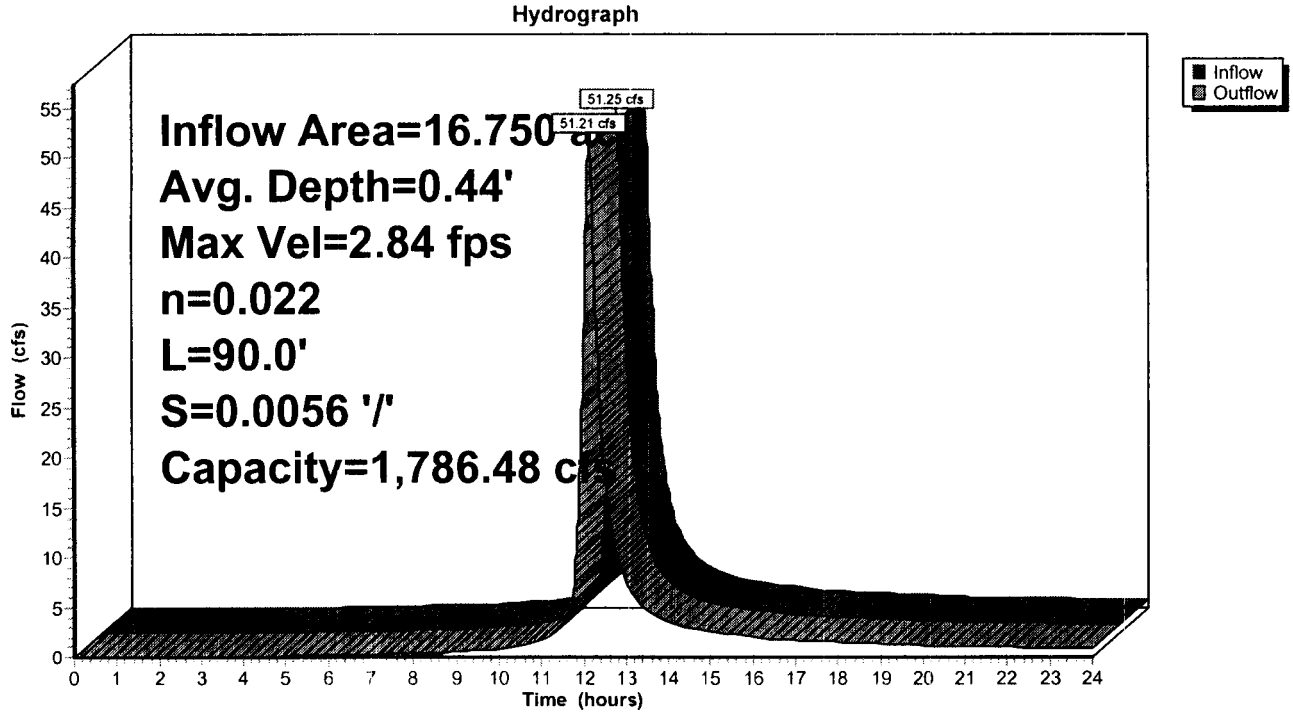
Reach 9R: Slag Cap Drainage Ditch West



Reach 10R: Slag Cap Ditch West

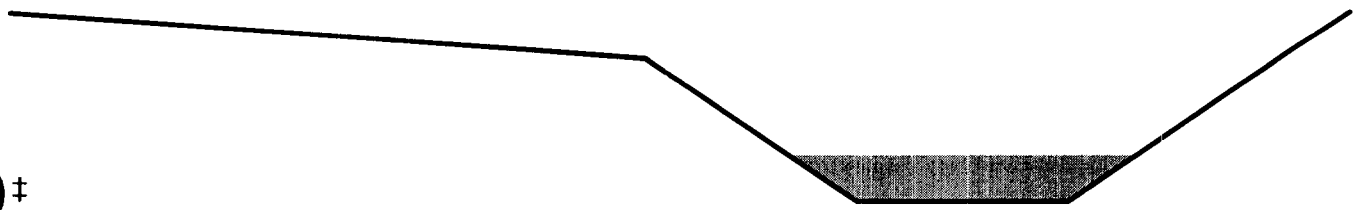
[61] Hint: Submerged 98% of Reach 11R bottom

Inflow Area = 15.600 ac, Inflow Depth > 3.18"
Inflow = 49.16 cfs @ 12.11 hrs, Volume= 4.132 af
Outflow = 49.14 cfs @ 12.11 hrs, Volume= 4.130 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.22 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 1.3 min

Peak Storage= 1,048 cf @ 12.11 hrs, Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 675.08 cfs

Custom cross-section, Length= 90.0' Slope= 0.0056 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 710.00', Outlet Invert= 709.50'



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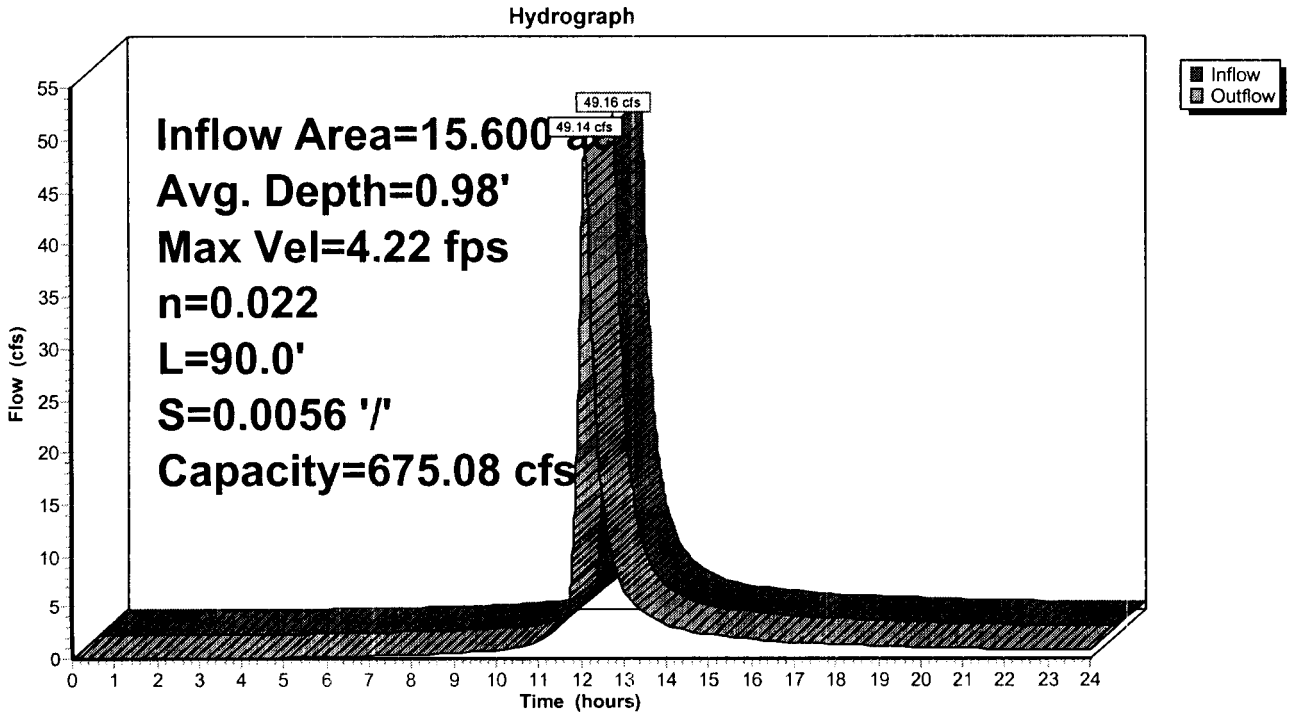
Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	4.00	0.00
27.00	3.00	1.00
36.00	0.00	4.00
45.00	0.00	4.00
57.00	4.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	9.0	0	0.00
3.00	54.0	28.0	4,860	421.49
4.00	96.0	58.2	8,640	675.08

Reach 10R: Slag Cap Ditch West



Reach 11R: Slag Cap Ditch West

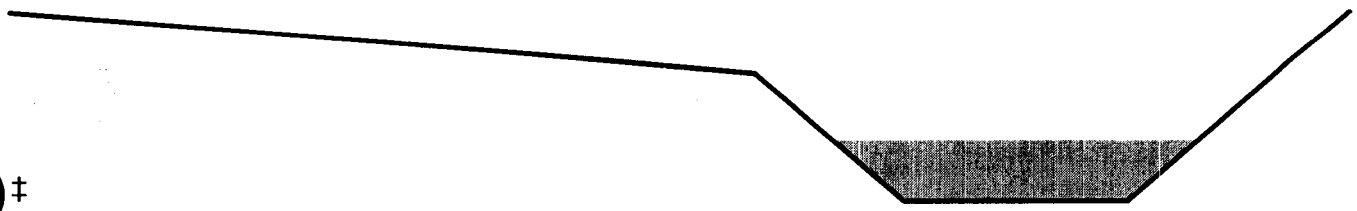
[61] Hint: Submerged 95% of Reach 12R bottom

Inflow Area = 14.710 ac, Inflow Depth > 3.22"
Inflow = 47.09 cfs @ 12.10 hrs, Volume= 3.949 af
Outflow = 46.99 cfs @ 12.11 hrs, Volume= 3.945 af, Atten= 0%, Lag= 0.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.16 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.15 fps, Avg. Travel Time= 2.6 min

Peak Storage= 2,032 cf @ 12.11 hrs, Average Depth at Peak Storage= 0.95'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 390.36 cfs

Custom cross-section, Length= 180.0' Slope= 0.0056 '/' (101 Elevation Intervals)
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 711.00', Outlet Invert= 710.00'



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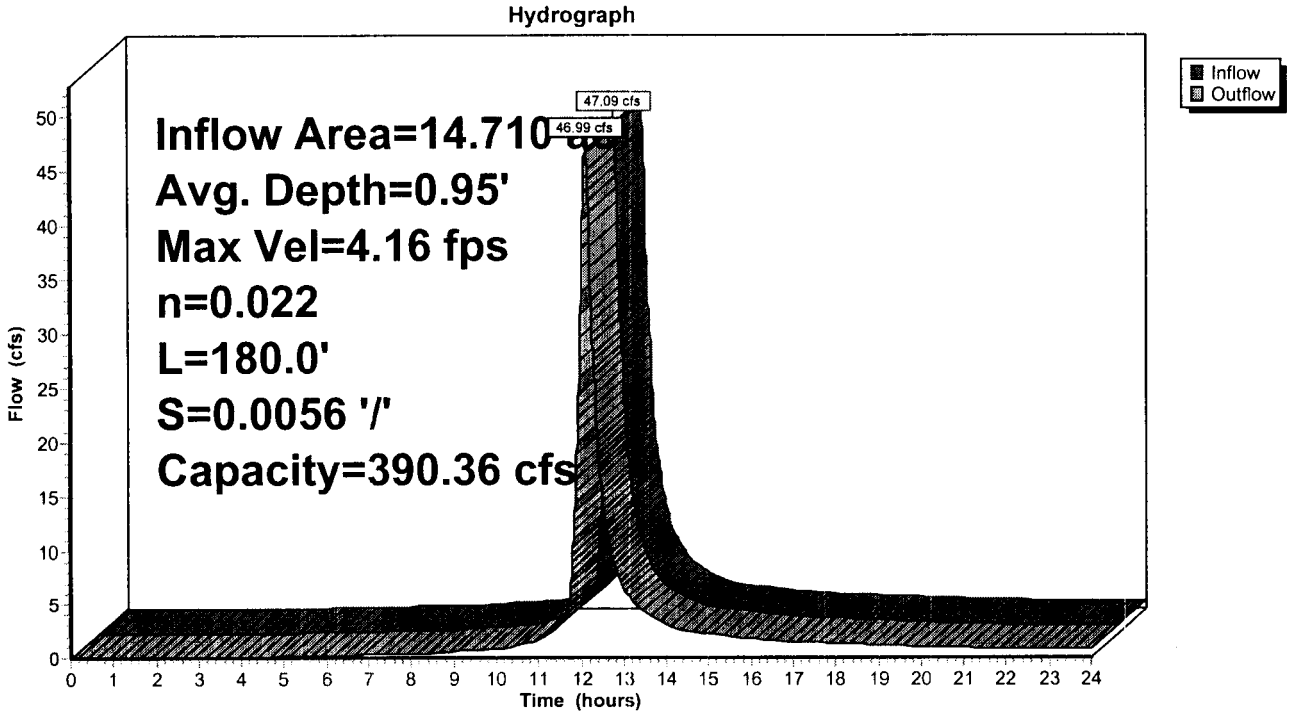
Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	3.00	0.00
30.00	2.00	1.00
36.00	0.00	3.00
45.00	0.00	3.00
54.00	3.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	9.0	0	0.00
2.00	30.0	21.6	5,400	187.73
3.00	67.5	54.8	12,150	390.36

Reach 11R: Slag Cap Ditch West



Reach 12R: Slag Cap Ditch West

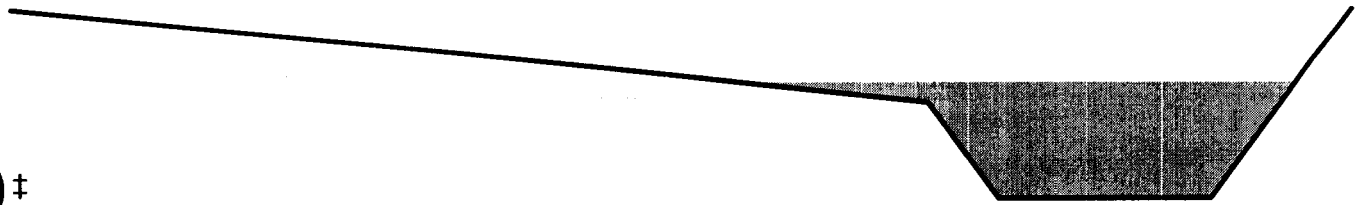
[61] Hint: Submerged 96% of Reach 13R bottom

Inflow Area = 13.090 ac, Inflow Depth > 3.30"
Inflow = 44.52 cfs @ 12.08 hrs, Volume= 3.600 af
Outflow = 43.72 cfs @ 12.10 hrs, Volume= 3.596 af, Atten= 2%, Lag= 1.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.03 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 3.6 min

Peak Storage= 3,032 cf @ 12.10 hrs, Average Depth at Peak Storage= 1.20'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 152.93 cfs

Custom cross-section, Length= 190.0' Slope= 0.0053 '/'
Constant n= 0.030 Earth, grassed & winding
Inlet Invert= 712.00', Outlet Invert= 711.00'



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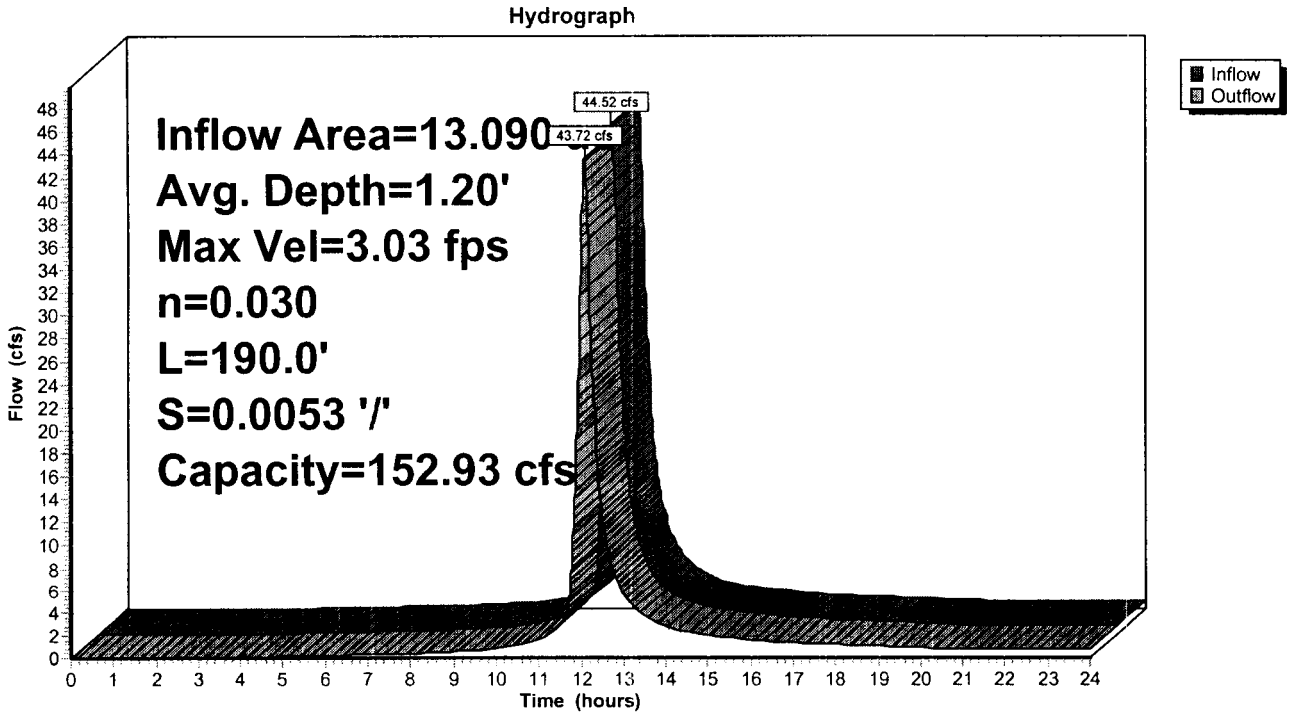
Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	2.00	0.00
39.00	1.00	1.00
42.00	0.00	2.00
51.00	0.00	2.00
57.00	2.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	9.0	0	0.00
1.00	12.0	15.3	2,280	36.64
2.00	48.0	57.5	9,120	152.93

Reach 12R: Slag Cap Ditch West



Reach 13R: Slag Cap Ditch West

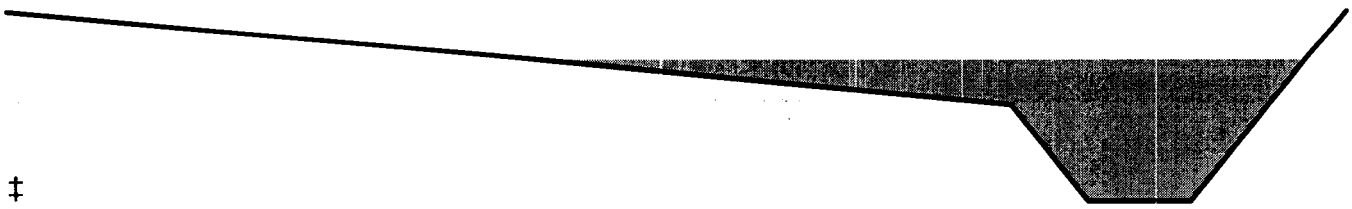
[61] Hint: Submerged 25% of Reach 14R bottom

Inflow Area = 11.400 ac, Inflow Depth > 3.41"
Inflow = 40.62 cfs @ 12.05 hrs, Volume= 3.244 af
Outflow = 39.93 cfs @ 12.07 hrs, Volume= 3.240 af, Atten= 2%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.82 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.09 fps, Avg. Travel Time= 3.5 min

Peak Storage= 3,663 cf @ 12.07 hrs, Average Depth at Peak Storage= 1.47'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 113.10 cfs

Custom cross-section, Length= 225.0' Slope= 0.0056 '/'
Constant n= 0.030 Earth, grassed & winding
Inlet Invert= 713.25', Outlet Invert= 712.00'



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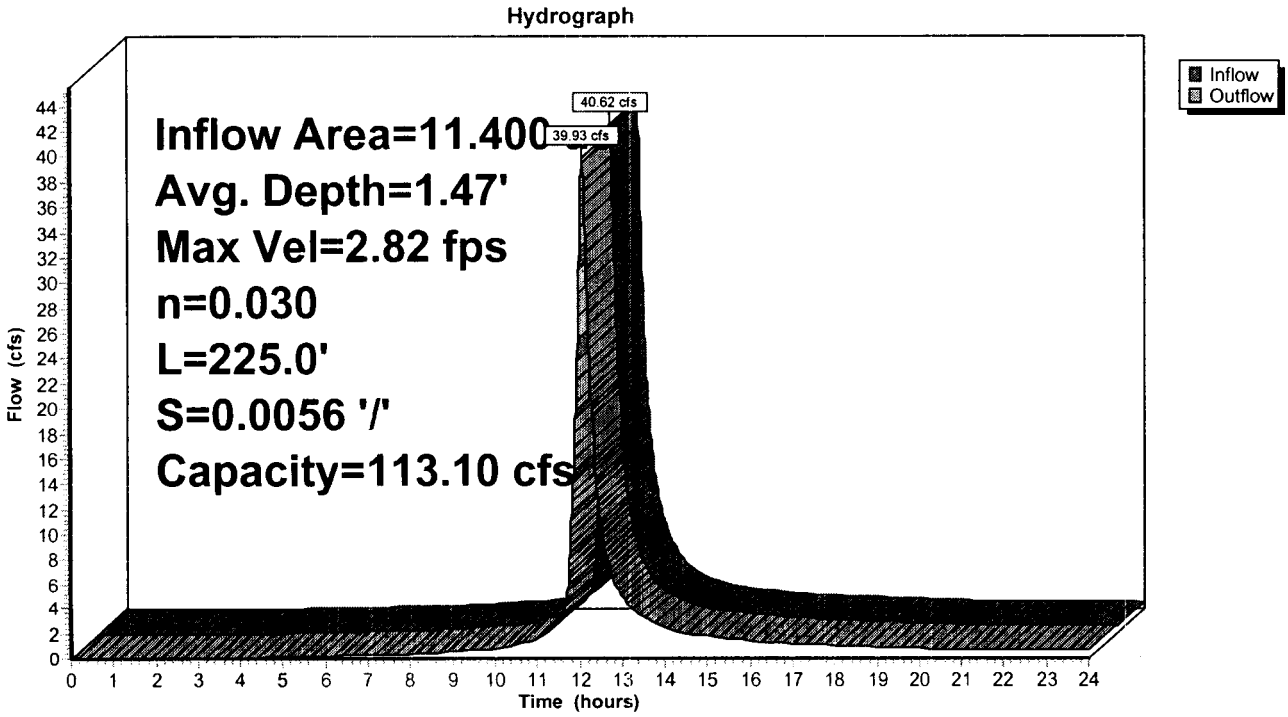
Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	2.00	0.00
39.00	1.00	1.00
42.00	0.00	2.00
46.00	0.00	2.00
52.00	2.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	4.0	0	0.00
1.00	7.0	10.3	1,575	19.95
2.00	38.0	52.5	8,550	113.10

Reach 13R: Slag Cap Ditch West



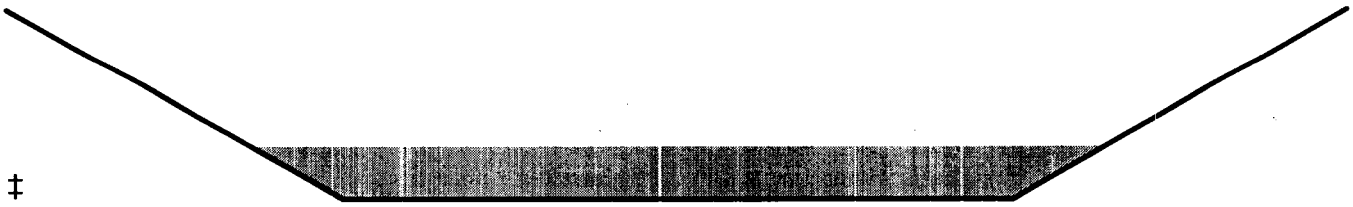
Reach 14R: Discharge ditch from P.H., portion of Coal Yard, and Chem Pond Area

Inflow Area = 9.910 ac, Inflow Depth > 3.54"
Inflow = 37.68 cfs @ 12.04 hrs, Volume= 2.927 af
Outflow = 37.68 cfs @ 12.04 hrs, Volume= 2.926 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.49 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.91 fps, Avg. Travel Time= 1.0 min

Peak Storage= 578 cf @ 12.04 hrs, Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 369.91 cfs

8.00' x 2.00' deep channel, n= 0.030 Rubble masonry, cemented
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 115.0' Slope= 0.0609 '/'
Inlet Invert= 720.00', Outlet Invert= 713.00'



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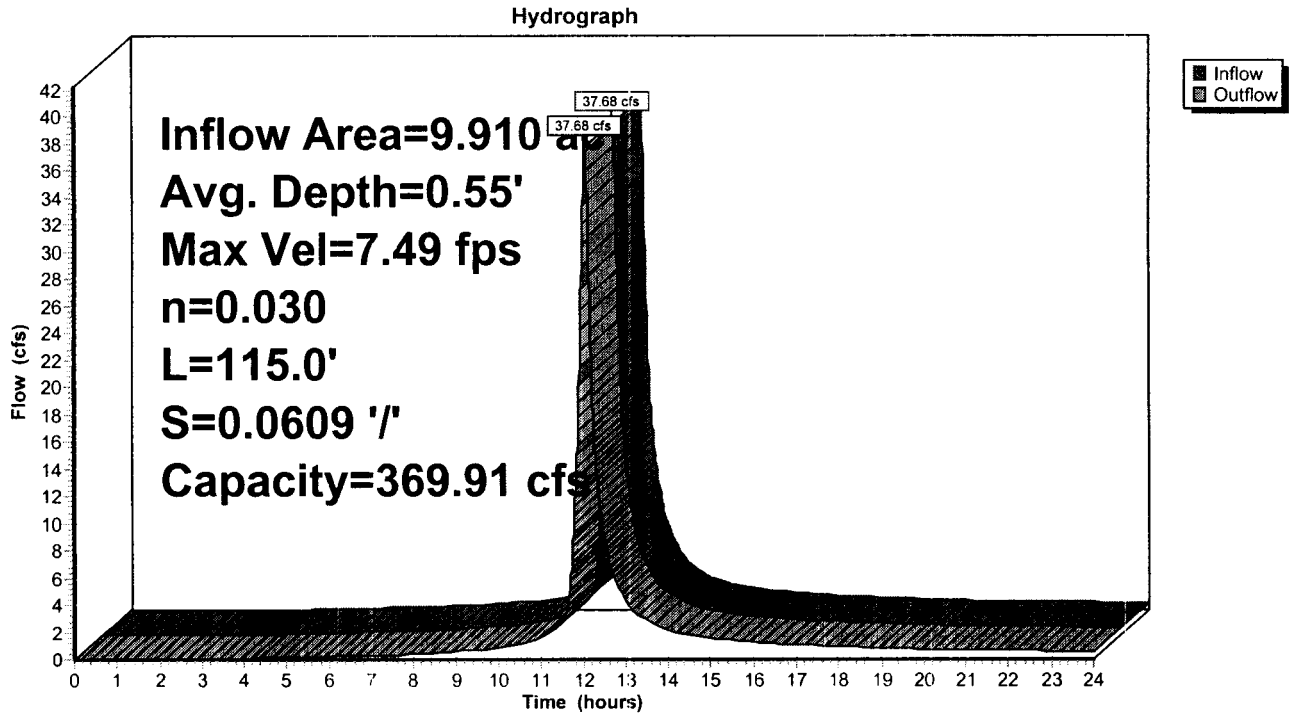
Reach 14R: Discharge ditch from P.H., portion of Coal Yard, and Chem Pond Area



Pond 2P: Swamp SW of Slag Area (5.285 Ac)

Inflow Area = 148.553 ac, Inflow Depth > 2.74"
Inflow = 161.07 cfs @ 12.19 hrs, Volume= 33.886 af
Outflow = 146.97 cfs @ 12.29 hrs, Volume= 33.886 af, Atten= 9%, Lag= 6.1 min
Primary = 146.97 cfs @ 12.29 hrs, Volume= 33.886 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 707.90' @ 12.29 hrs Surf.Area= 0.805 ac Storage= 0.670 af
Flood Elev= 710.00' Surf.Area= 5.910 ac Storage= 7.291 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 1.1 min (876.0 - 874.9)

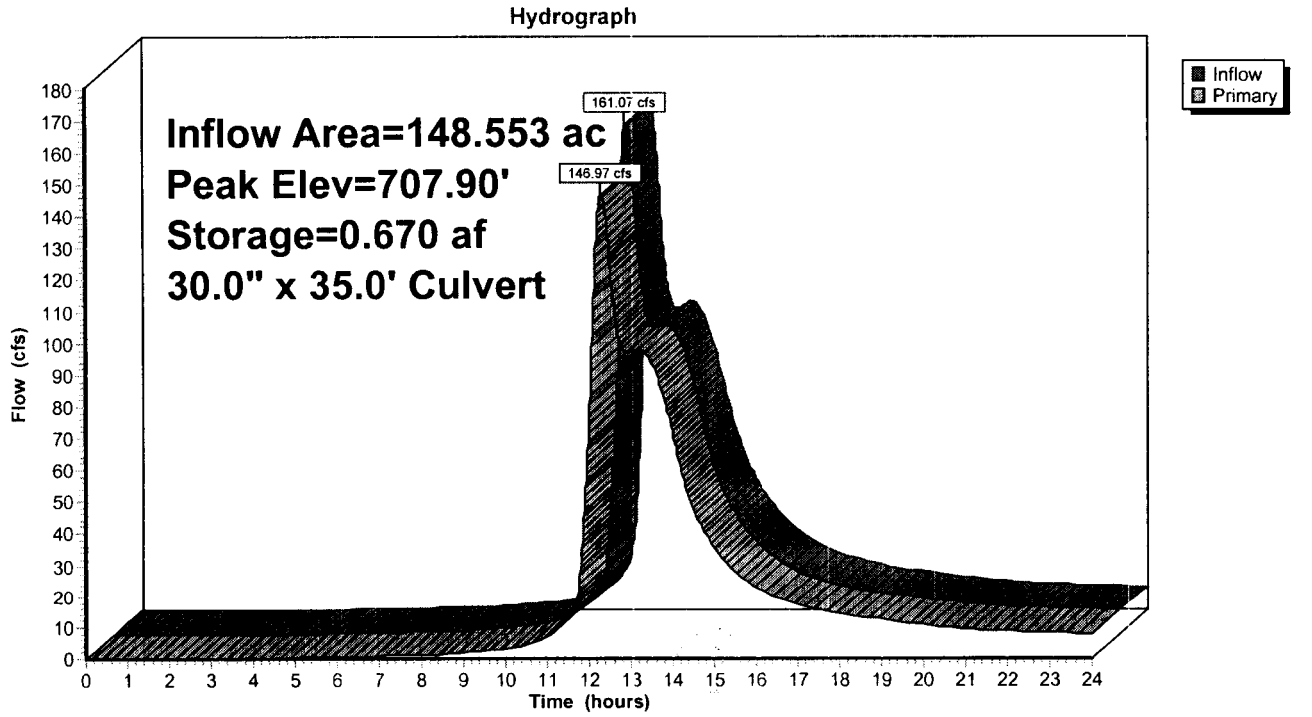
Volume	Invert	Avail.Storage	Storage Description
#1	706.40'	7.291 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
706.40	0.000	0.0	0.000	0.000	0.000
707.00	0.482	615.0	0.096	0.096	0.691
708.00	0.846	1,550.0	0.656	0.752	4.389
709.00	3.360	3,076.0	1.964	2.716	17.285
710.00	5.910	4,162.0	4.575	7.291	31.646

Device	Routing	Invert	Outlet Devices
#1	Primary	705.30'	**30.0" x 35.0' long Culvert X 6.00** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 705.15' S= 0.0043 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections

Primary OutFlow Max=146.96 cfs @ 12.29 hrs HW=707.90' TW=705.48' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 146.96 cfs @ 5.96 fps)

Pond 2P: Swamp SW of Slag Area (5.285 Ac)



Pond 3P: Fly Ash Pond

Inflow Area =	148.553 ac,	Inflow Depth >	2.74"		
Inflow =	146.97 cfs @	12.29 hrs,	Volume=	33.886 af	
Outflow =	93.22 cfs @	13.52 hrs,	Volume=	32.442 af,	Atten= 37%, Lag= 73.6 min
Primary =	93.22 cfs @	13.52 hrs,	Volume=	32.442 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 705.80' @ 13.52 hrs Surf.Area= 8.035 ac Storage= 6.734 af

Plug-Flow detention time= 71.0 min calculated for 32.442 af (96% of inflow)
Center-of-Mass det. time= 48.8 min (924.8 - 876.0)

Volume	Invert	Avail.Storage	Storage Description
#1	704.92'	48.768 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

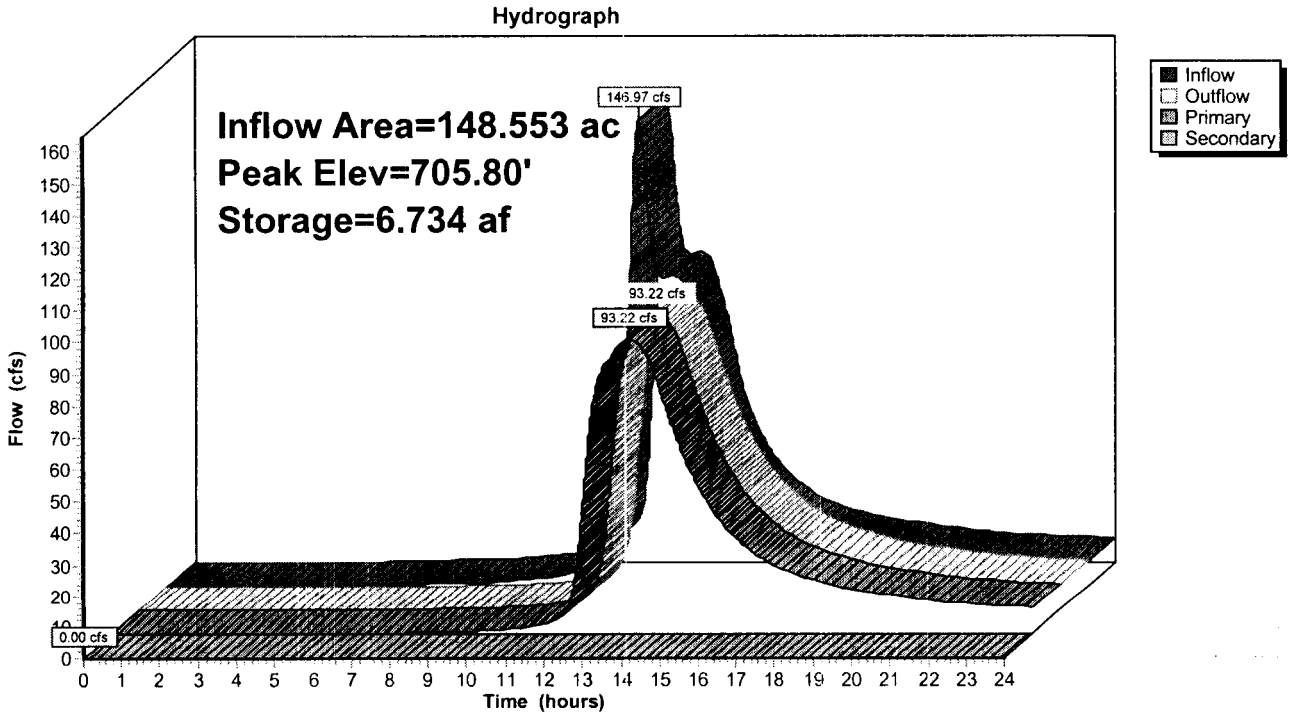
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
704.92	7.200	0.000	0.000
710.00	12.000	48.768	48.768

Device	Routing	Invert	Outlet Devices
#1	Primary	704.92'	**14.1' long Sharp-Crested Rectangular Weir X 2.00** 0 End Contraction(s) 0.5' Crest Height
#2	Secondary	705.82'	**14.1' long Sharp-Crested Rectangular Weir X 2.00** 0 End Contraction(s) 0.5' Crest Height

Primary OutFlow Max=93.22 cfs @ 13.52 hrs HW=705.80' TW=692.22' (Dynamic Tailwater)
↑—**1=Sharp-Crested Rectangular Weir**(Weir Controls 93.22 cfs @ 3.74 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=704.92' TW=688.00' (Dynamic Tailwater)
↑—**2=Sharp-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 3P: Fly Ash Pond



Pond 4P: Culverts discharging from Spillway Structures - FLY ASH POnd

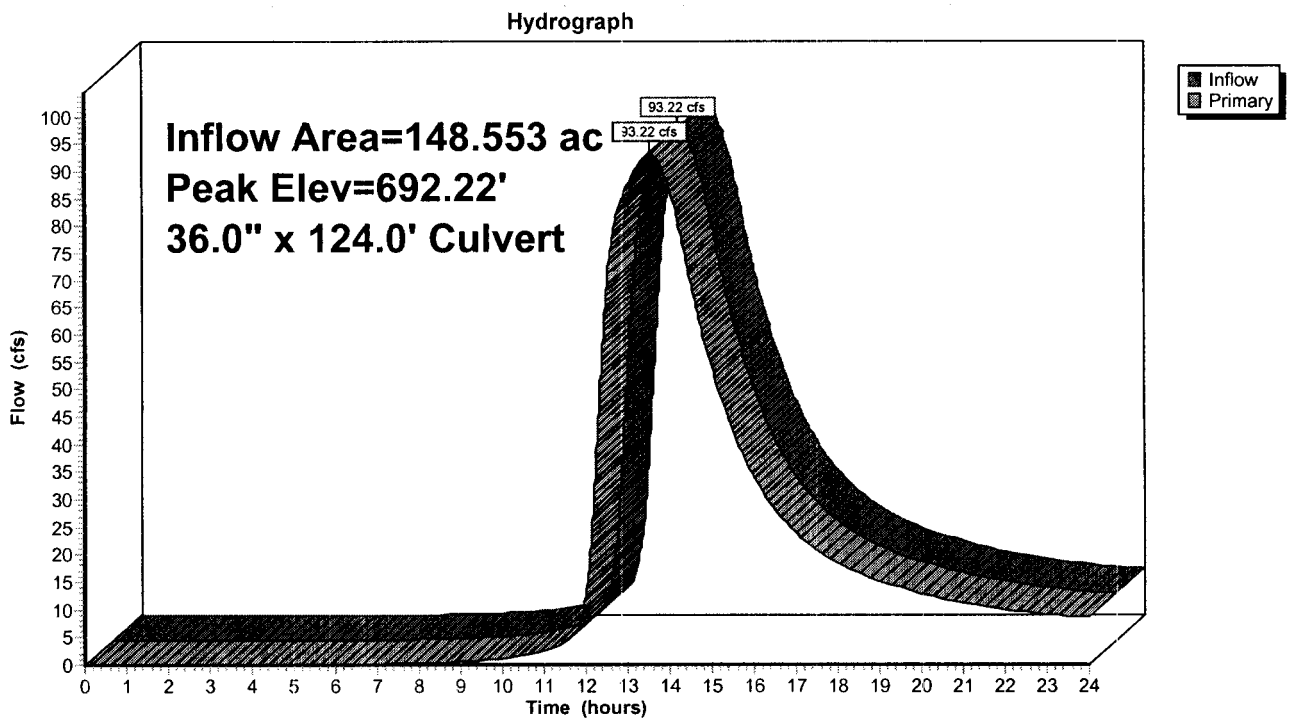
Inflow Area =	148.553 ac,	Inflow Depth > 2.62"		
Inflow =	93.22 cfs @	13.52 hrs, Volume=	32.442 af	
Outflow =	93.22 cfs @	13.52 hrs, Volume=	32.442 af,	Atten= 0%, Lag= 0.0 min
Primary =	93.22 cfs @	13.52 hrs, Volume=	32.442 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 692.22' @ 13.52 hrs
Flood Elev= 705.82'

Device	Routing	Invert	Outlet Devices
#1	Primary	688.00'	**36.0" x 124.0' long Culvert X 2.00** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 687.40' S= 0.0048 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets

Primary OutFlow Max=93.22 cfs @ 13.52 hrs HW=692.22' (Free Discharge)
└**1=Culvert** (Barrel Controls 93.22 cfs @ 6.59 fps)

Pond 4P: Culverts discharging from Spillway Structures - FLY ASH POnd



Pond 5P: Culverts discharging from Spillwat Structures - Fly Ash Pond

[57] Hint: Peaked at 688.00' (Flood elevation advised)

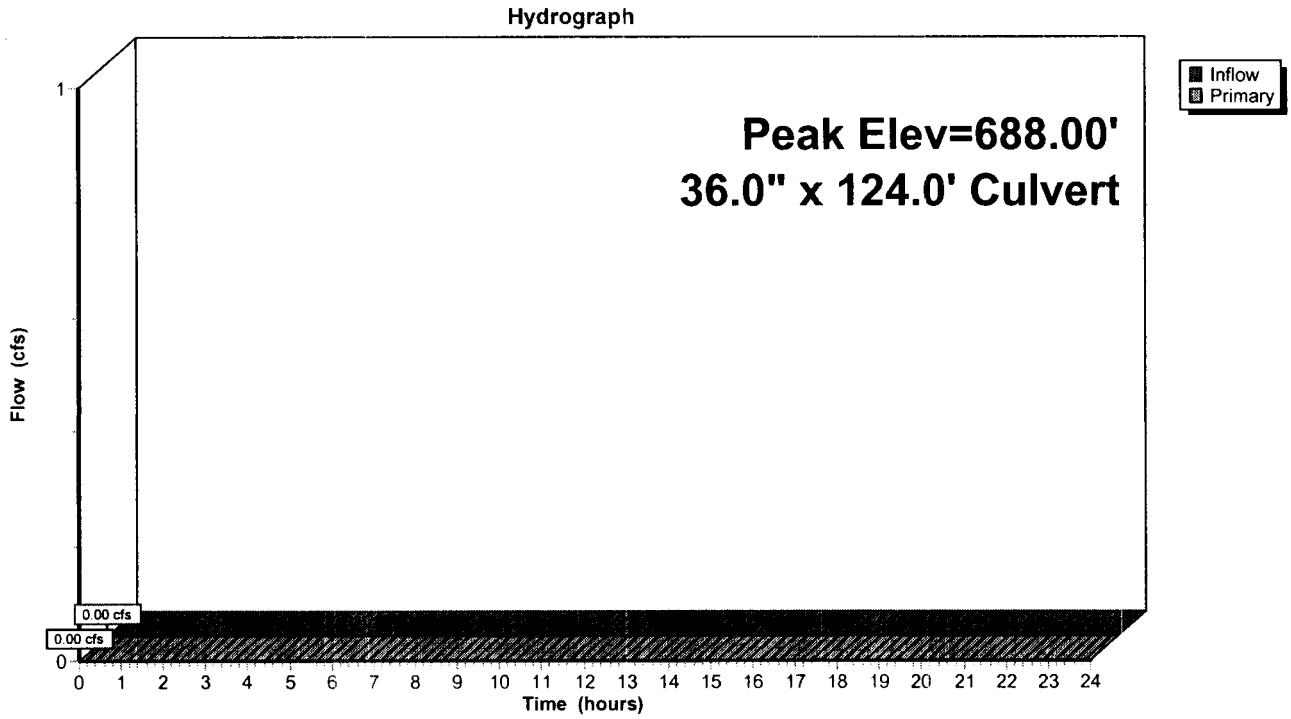
Inflow	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 688.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	688.00'	**36.0" x 124.0' long Culvert X 2.00** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 687.40' S= 0.0048 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=688.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)

Pond 5P: Culverts discharging from Spillwat Structures - Fly Ash Pond



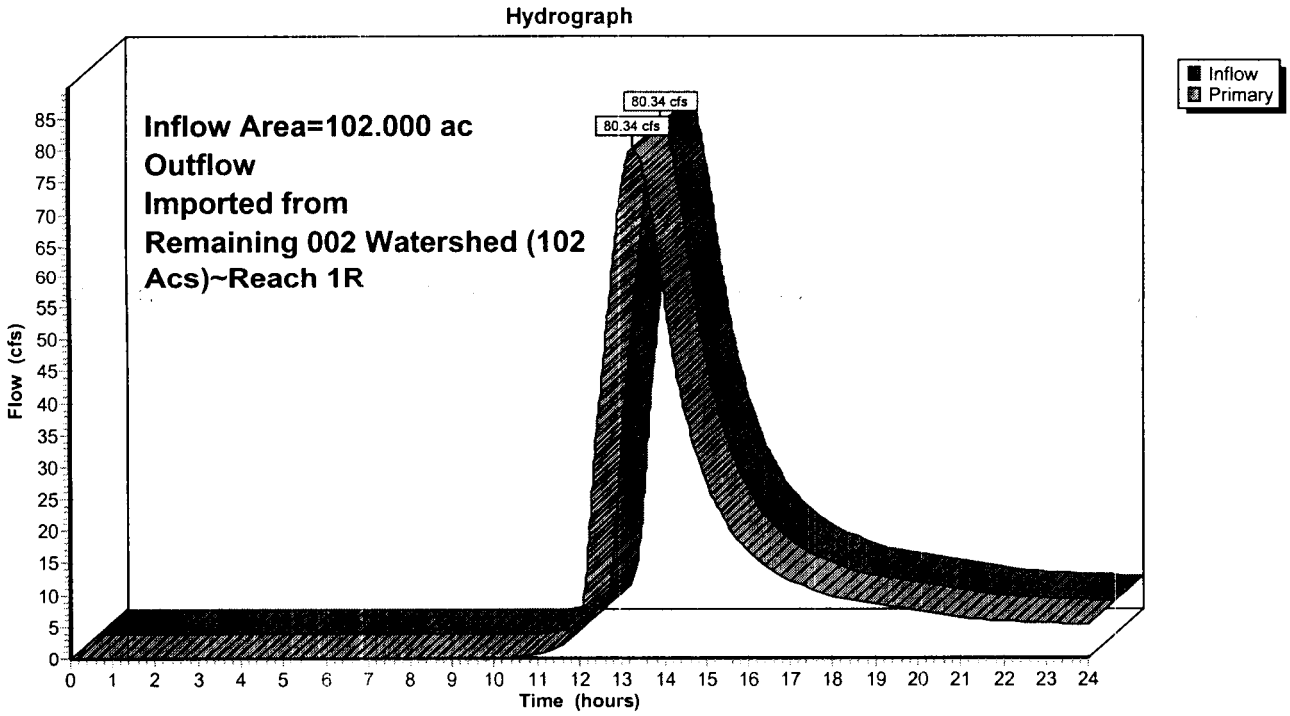
Link 1L: Remaining 002 Watershed (102 Acs)

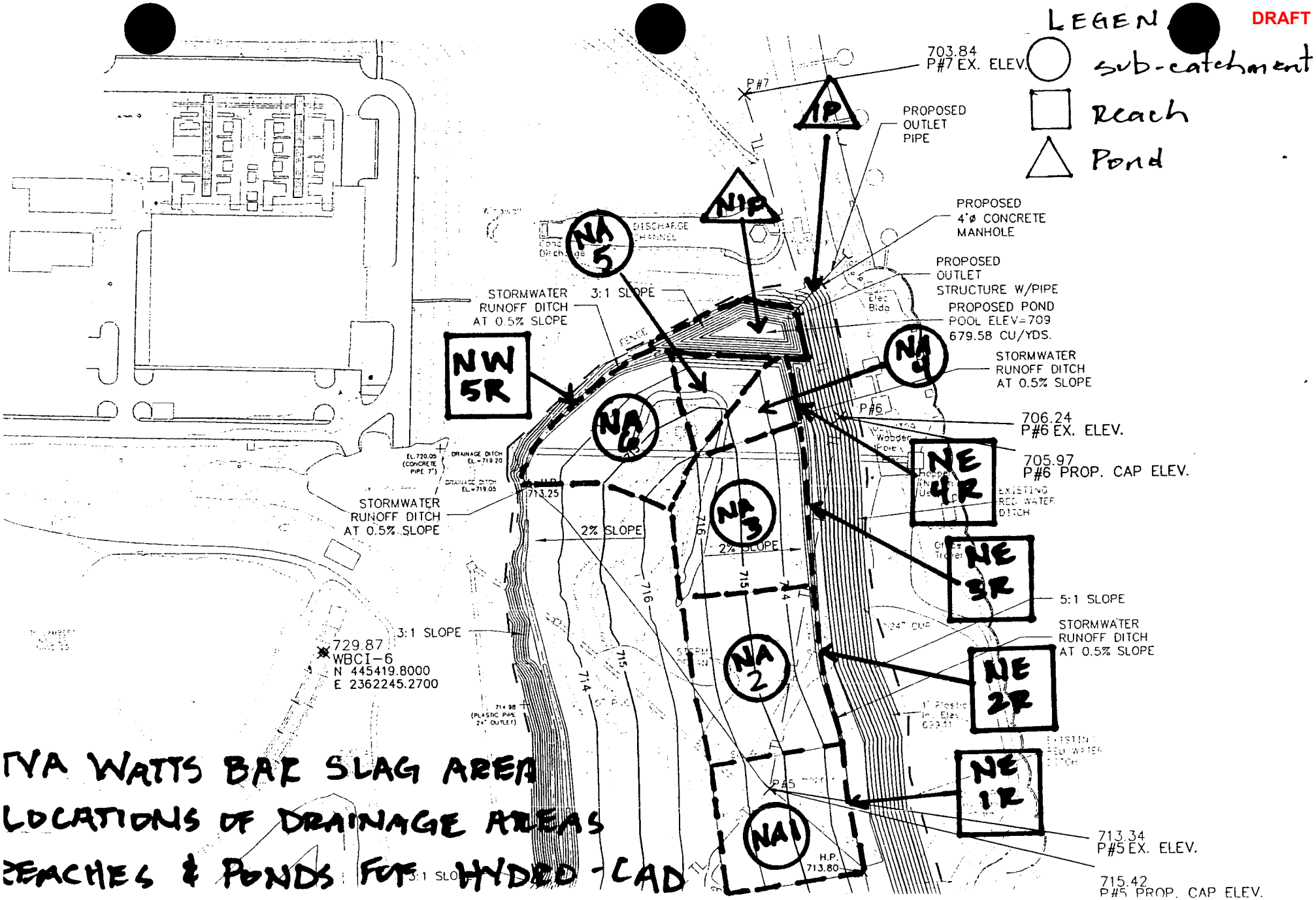
Inflow Area = 102.000 ac, Inflow Depth > 2.36"
Inflow = 80.34 cfs @ 13.26 hrs, Volume= 20.088 af
Primary = 80.34 cfs @ 13.26 hrs, Volume= 20.088 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Outflow Imported from Remaining 002 Watershed (102 Acs)~Reach 1R

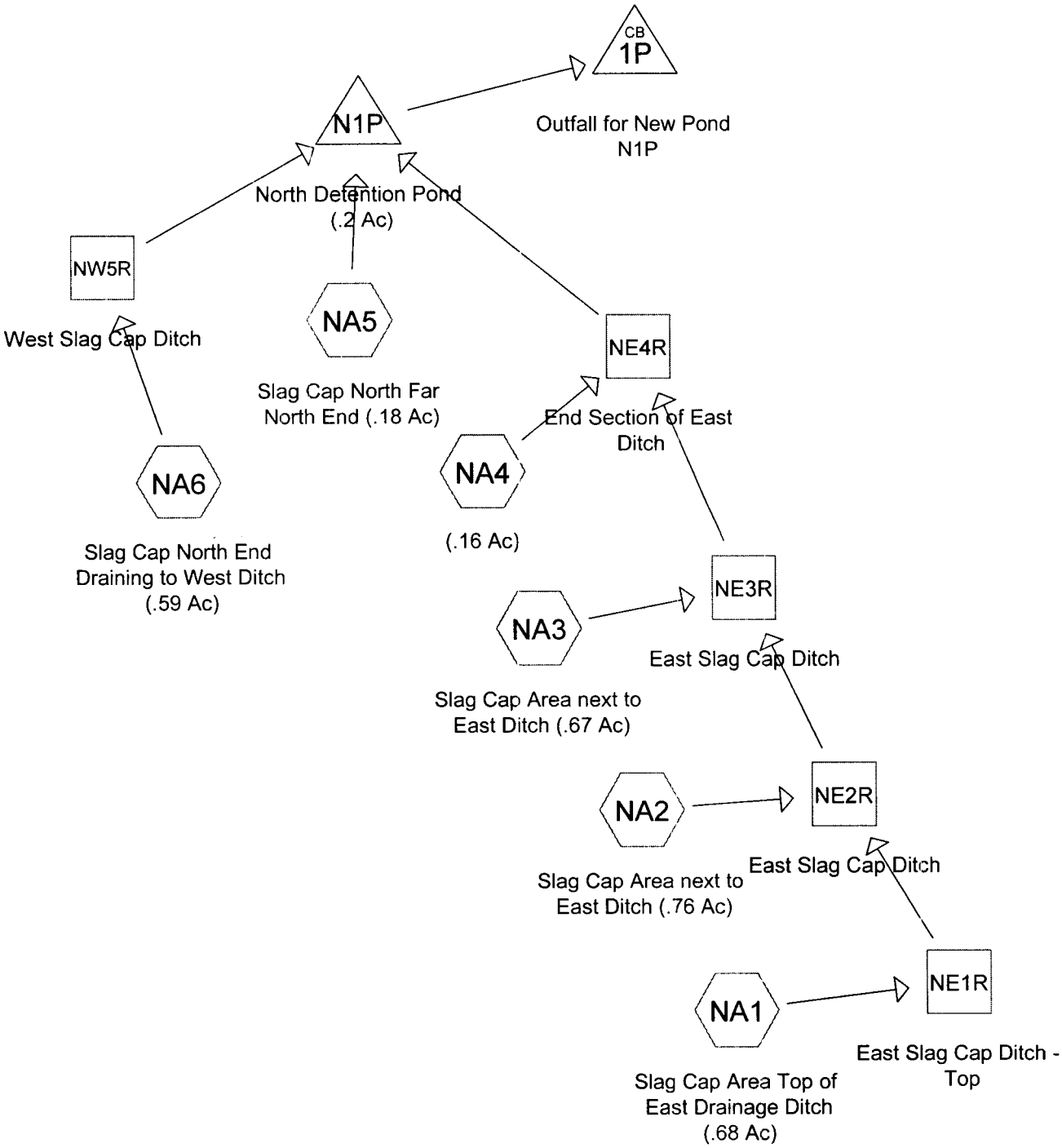
Link 1L: Remaining 002 Watershed (102 Acs)

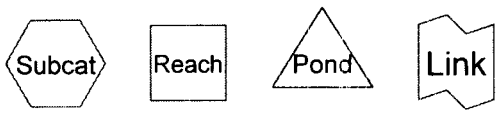




TVA WATTS BAR SLAG AREA
LOCATIONS OF DRAINAGE AREAS
REACHES & PONDS FOR HYDRO-CAD
INPUT - NORTH END

DRAFT





Drainage Diagram for Mar 10 2008 Redesign 25 yr Event Slag Cap North Retention Pond (3.24 Ac)

Prepared by {enter your company name here} 06/15/2009

HydroCAD® 8.00 s/n 002910 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
3.040	74	>75% Grass cover, Good, HSG C (NA1,NA2,NA3,NA4,NA5,NA6)
3.040		

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment NA1: Slag Cap Area Top of East Drainage Ditch Runoff Area=0.680 ac Runoff Depth>2.95"
Flow Length=254' Slope=0.0200 '/' Tc=28.8 min CN=74 Runoff=1.79 cfs 0.167 af

Subcatchment NA2: Slag Cap Area next to East Ditch (.76 Ac) Runoff Area=0.760 ac Runoff Depth>2.95"
Flow Length=254' Slope=0.0200 '/' Tc=28.8 min CN=74 Runoff=2.00 cfs 0.187 af

Subcatchment NA3: Slag Cap Area next to East Ditch (.67 Ac) Runoff Area=0.670 ac Runoff Depth>2.95"
Flow Length=263' Slope=0.0200 '/' Tc=29.6 min CN=74 Runoff=1.73 cfs 0.165 af

Subcatchment NA4: (.16 Ac) Runoff Area=0.160 ac Runoff Depth>2.96"
Flow Length=159' Slope=0.0200 '/' Tc=19.8 min CN=74 Runoff=0.53 cfs 0.039 af

Subcatchment NA5: Slag Cap North Far North End (.18 Ac) Runoff Area=0.180 ac Runoff Depth>2.96"
Flow Length=150' Slope=0.0330 '/' Tc=15.4 min CN=74 Runoff=0.68 cfs 0.044 af

Subcatchment NA6: Slag Cap North End Draining to West Ditc Runoff Area=0.590 ac Runoff Depth>2.96"
Flow Length=200' Slope=0.0200 '/' Tc=23.8 min CN=74 Runoff=1.75 cfs 0.145 af

Reach NE1R: East Slag Cap Ditch - Top Avg. Depth=0.28' Max Vel=1.33 fps Inflow=1.79 cfs 0.167 af
n=0.030 L=160.0' S=0.0050 '/' Capacity=12.26 cfs Outflow=1.77 cfs 0.167 af

Reach NE2R: East Slag Cap Ditch Avg. Depth=0.42' Max Vel=1.68 fps Inflow=3.73 cfs 0.354 af
n=0.030 L=200.0' S=0.0050 '/' Capacity=18.92 cfs Outflow=3.68 cfs 0.353 af

Reach NE3R: East Slag Cap Ditch Avg. Depth=0.51' Max Vel=1.87 fps Inflow=5.34 cfs 0.518 af
n=0.030 L=200.0' S=0.0050 '/' Capacity=18.92 cfs Outflow=5.28 cfs 0.516 af

Reach NE4R: End Section of East Ditch Avg. Depth=0.40' Max Vel=2.66 fps Inflow=5.53 cfs 0.556 af
n=0.030 L=75.0' S=0.0133 '/' Capacity=129.27 cfs Outflow=5.51 cfs 0.555 af

Reach NW5R: West Slag Cap Ditch Avg. Depth=0.25' Max Vel=1.42 fps Inflow=1.75 cfs 0.145 af
n=0.035 L=262.0' S=0.0086 '/' Capacity=88.92 cfs Outflow=1.71 cfs 0.145 af

Pond 1P: Outfall for New Pond N1P Peak Elev=706.40' Inflow=0.96 cfs 0.360 af
24.0" x 110.0' Culvert Outflow=0.96 cfs 0.360 af

Pond N1P: North Detention Pond (.2 Ac) Peak Elev=708.87' Storage=0.432 af Inflow=7.30 cfs 0.745 af
Primary=0.96 cfs 0.360 af Secondary=0.00 cfs 0.000 af Outflow=0.96 cfs 0.360 af

Total Runoff Area = 3.040 ac Runoff Volume = 0.749 af Average Runoff Depth = 2.96"
100.00% Pervious Area = 3.040 ac 0.00% Impervious Area = 0.000 ac

Subcatchment NA1: Slag Cap Area Top of East Drainage Ditch (.68 Ac)

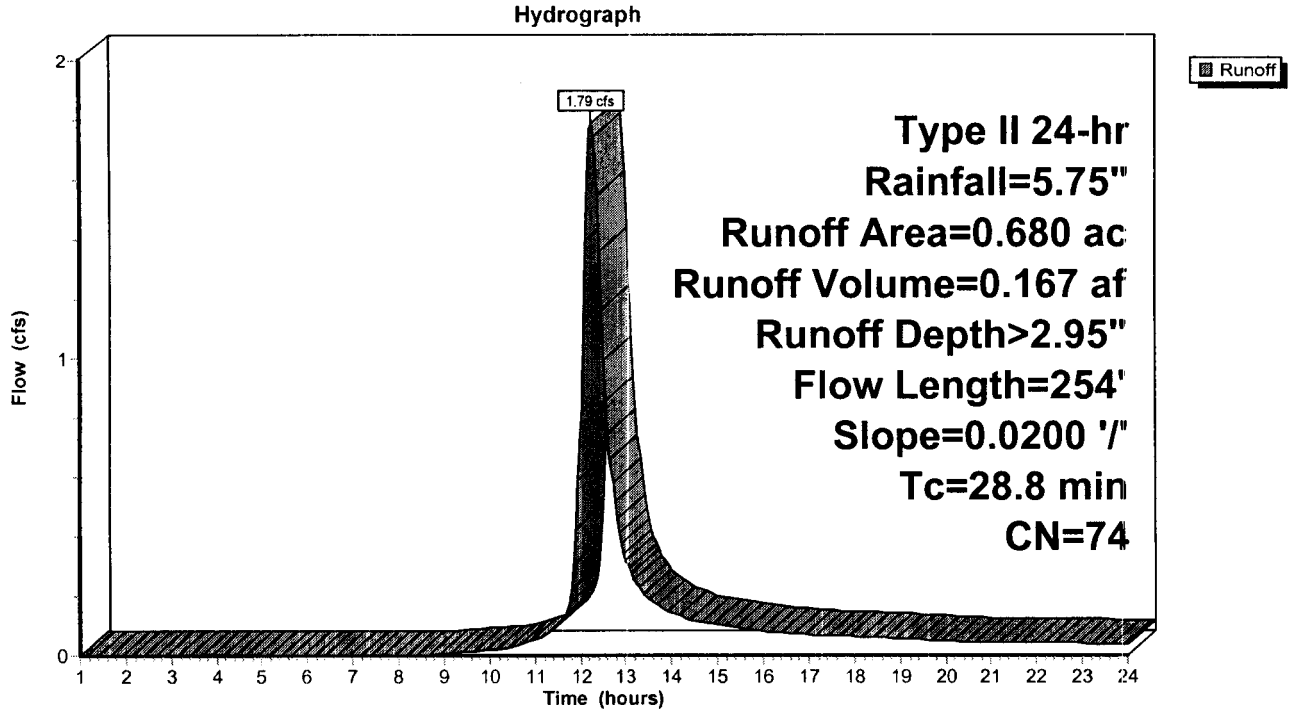
Runoff = 1.79 cfs @ 12.23 hrs, Volume= 0.167 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.680	74	>75% Grass cover, Good, HSG C
0.680		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	254	0.0200	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment NA1: Slag Cap Area Top of East Drainage Ditch (.68 Ac)



Subcatchment NA2: Slag Cap Area next to East Ditch (.76 Ac)

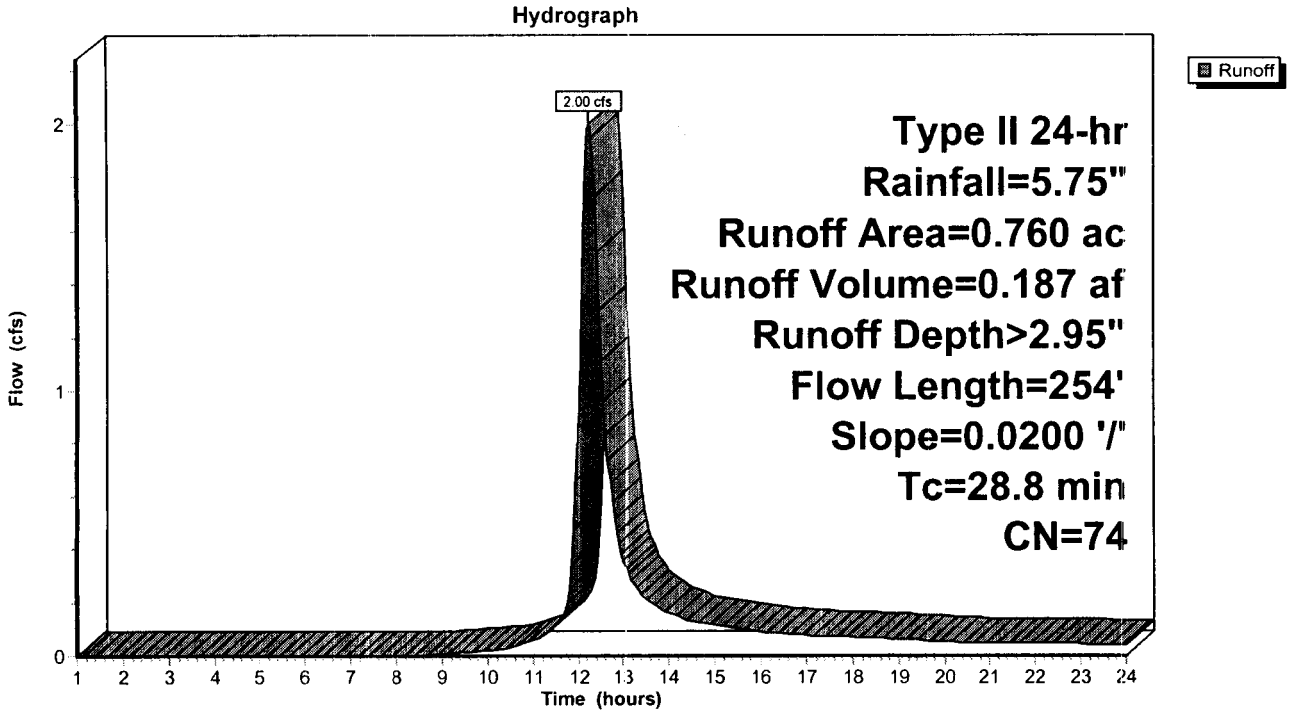
Runoff = 2.00 cfs @ 12.23 hrs, Volume= 0.187 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.760	74	>75% Grass cover, Good, HSG C
0.760		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	254	0.0200	0.15		**Sheet Flow, Slag Cap portion next to NA1** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment NA2: Slag Cap Area next to East Ditch (.76 Ac)



Subcatchment NA3: Slag Cap Area next to East Ditch (.67 Ac)

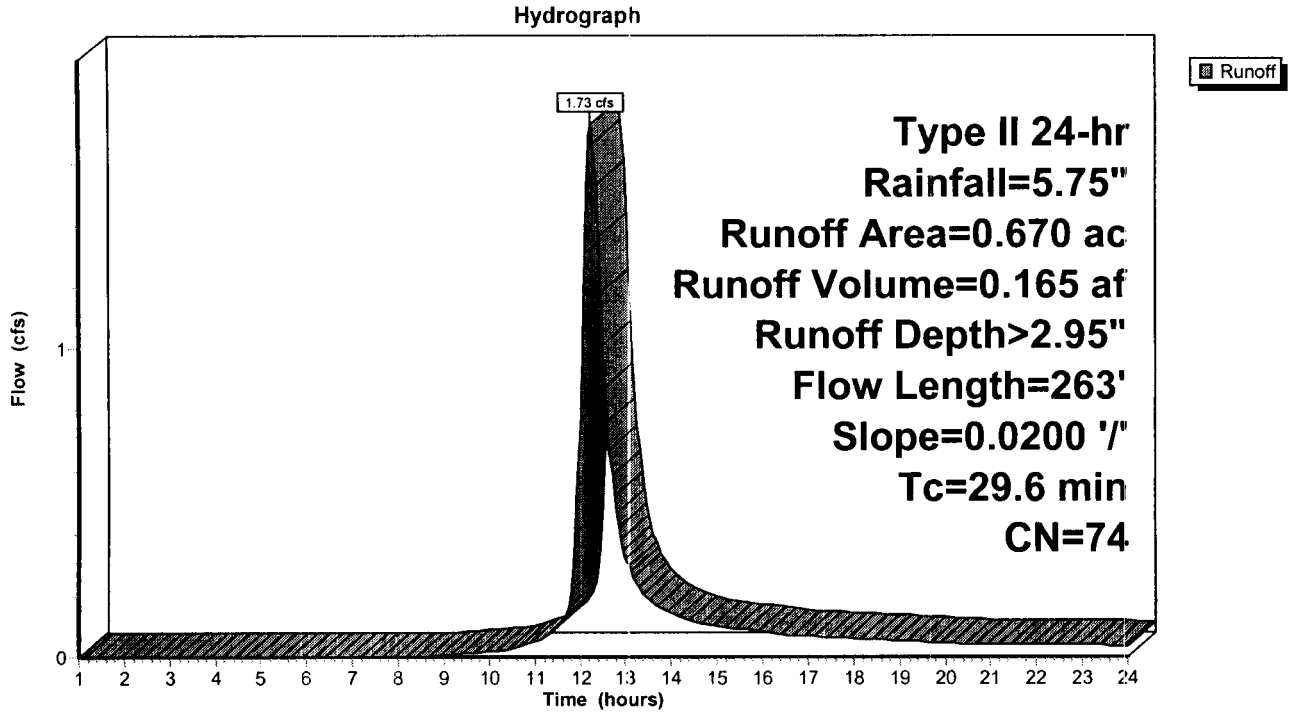
Runoff = 1.73 cfs @ 12.24 hrs, Volume= 0.165 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.670	74	>75% Grass cover, Good, HSG C
0.670		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.6	263	0.0200	0.15		**Sheet Flow, Slag Cap** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment NA3: Slag Cap Area next to East Ditch (.67 Ac)



Subcatchment NA4: (.16 Ac)

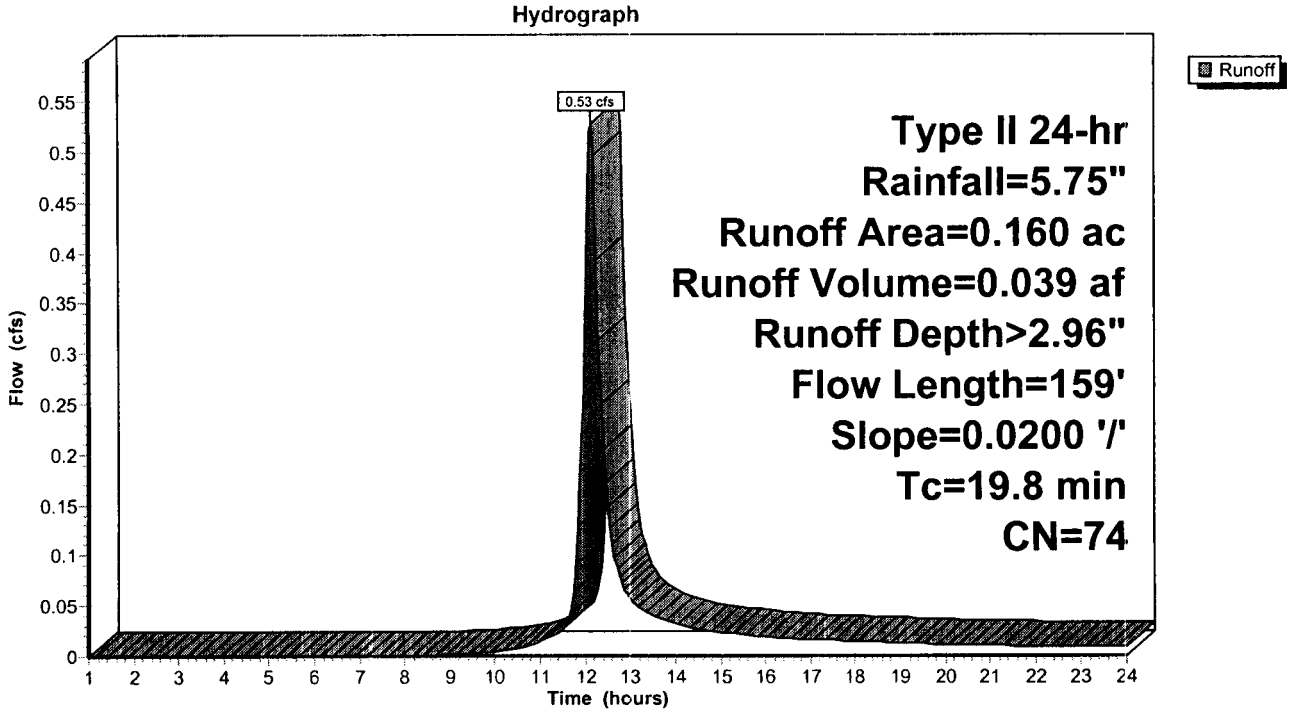
Runoff = 0.53 cfs @ 12.13 hrs, Volume= 0.039 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.160	74	>75% Grass cover, Good, HSG C
0.160		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.8	159	0.0200	0.13		**Sheet Flow, Last Area to Drain into East Ditch before Pond** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment NA4: (.16 Ac)



Subcatchment NA5: Slag Cap North Far North End (.18 Ac)

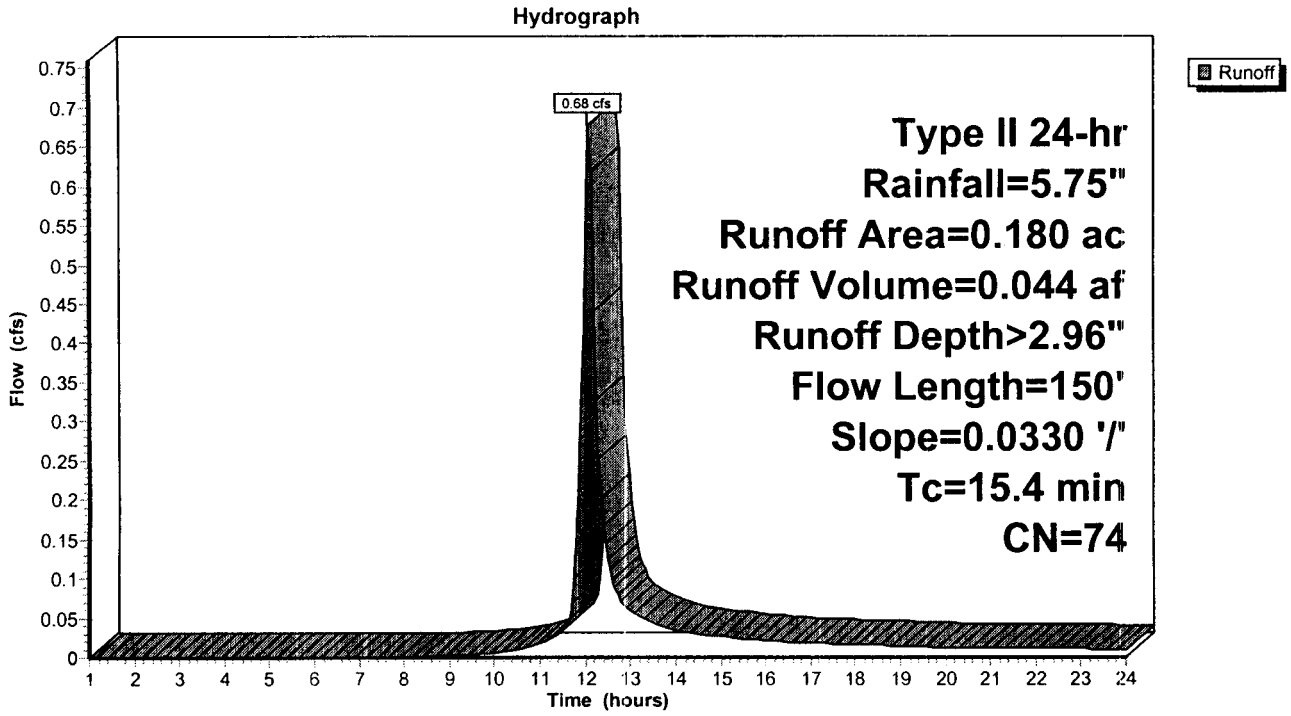
Runoff = 0.68 cfs @ 12.08 hrs, Volume= 0.044 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.180	74	>75% Grass cover, Good, HSG C
0.180		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	150	0.0330	0.16		**Sheet Flow, Slag Cap Flowing Directly into North Retention P** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment NA5: Slag Cap North Far North End (.18 Ac)



Subcatchment NA6: Slag Cap North End Draining to West Ditch (.59 Ac)

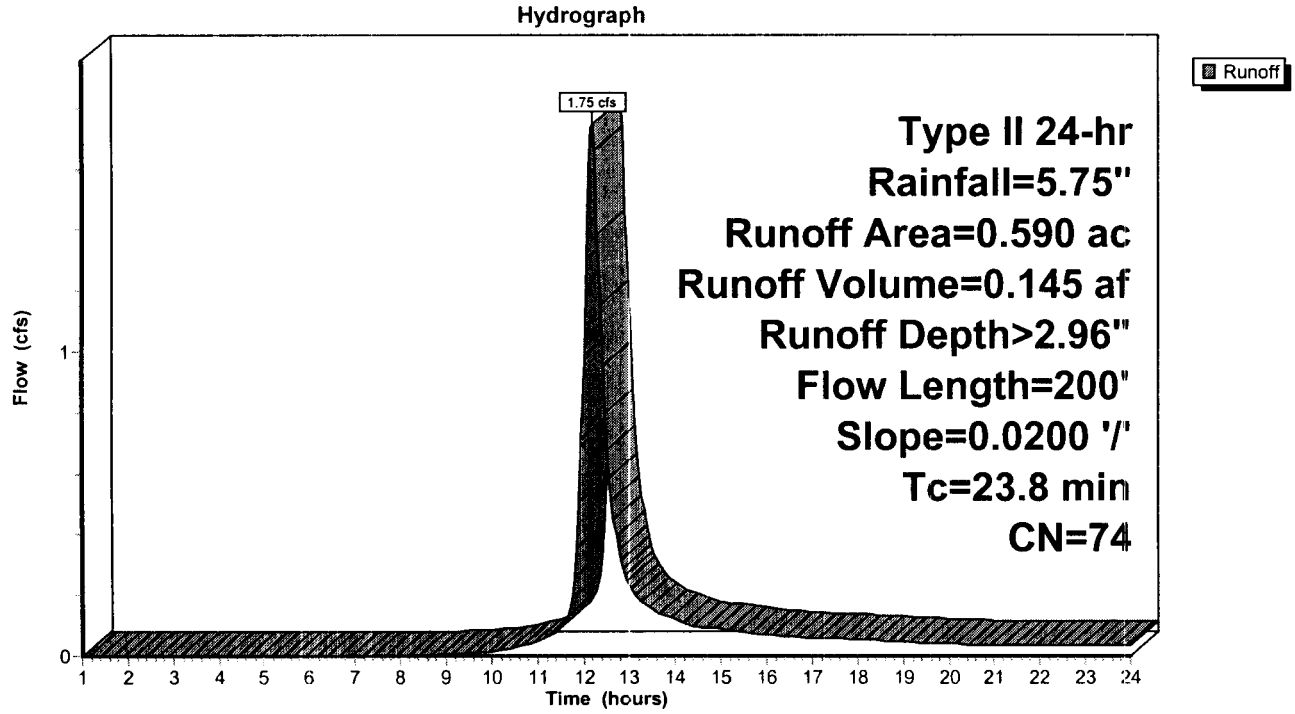
Runoff = 1.75 cfs @ 12.17 hrs, Volume= 0.145 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.75"

Area (ac)	CN	Description
0.590	74	>75% Grass cover, Good, HSG C
0.590		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.8	200	0.0200	0.14		**Sheet Flow, Typical Flow** Grass: Dense n= 0.240 P2= 3.50"

Subcatchment NA6: Slag Cap North End Draining to West Ditch (.59 Ac)



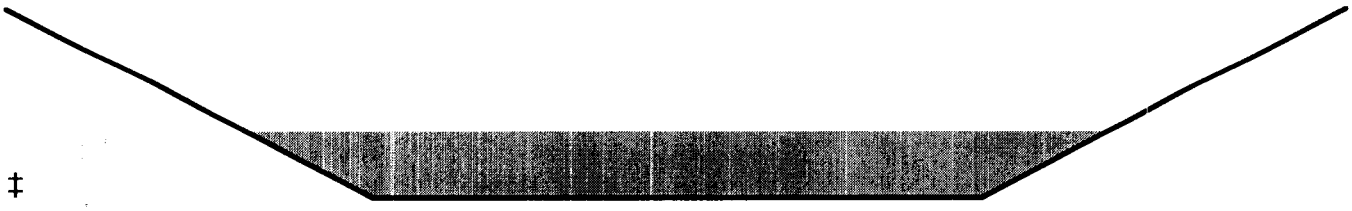
Reach NE1R: East Slag Cap Ditch - Top

Inflow Area = 0.680 ac, Inflow Depth > 2.95"
Inflow = 1.79 cfs @ 12.23 hrs, Volume= 0.167 af
Outflow = 1.77 cfs @ 12.29 hrs, Volume= 0.167 af, Atten= 1%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.33 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 0.42 fps, Avg. Travel Time= 6.3 min

Peak Storage= 215 cf @ 12.26 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 0.80', Capacity at Bank-Full= 12.26 cfs

4.00' x 0.80' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 8.80'
Length= 160.0' Slope= 0.0050 '/'
Inlet Invert= 713.80', Outlet Invert= 713.00'



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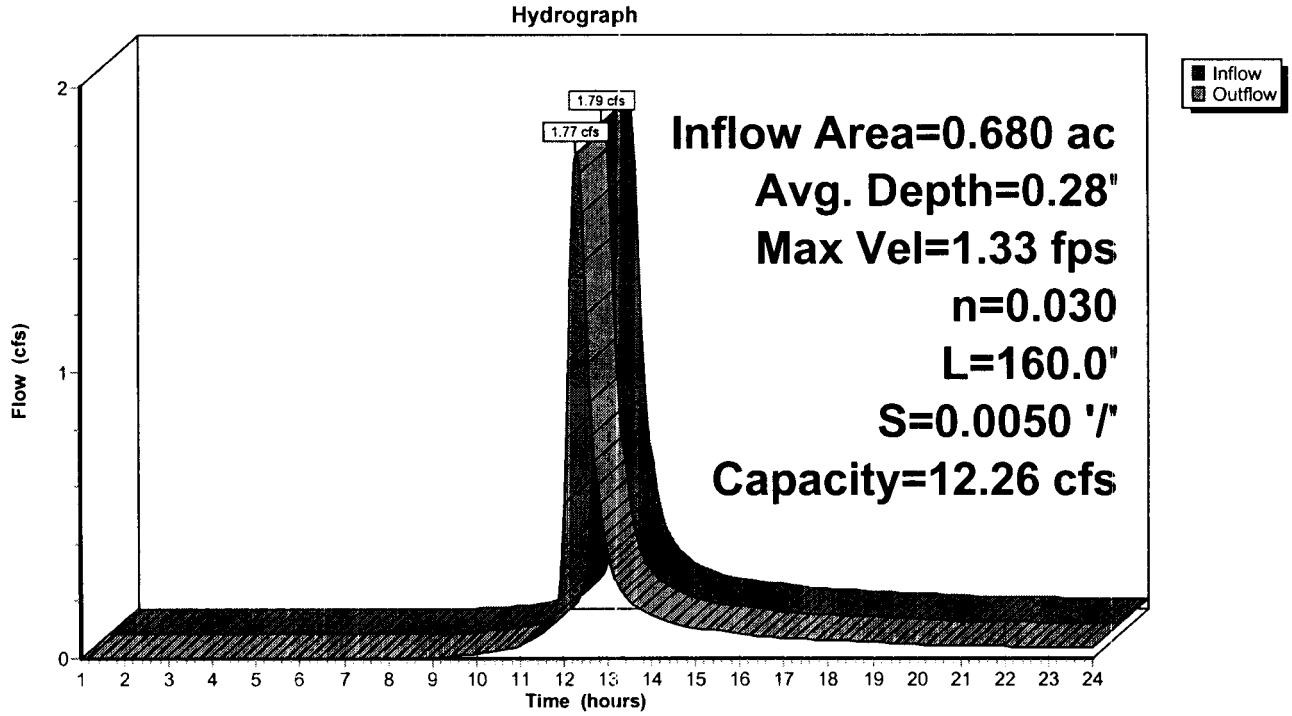
Reach NE1R: East Slag Cap Ditch - Top



Reach NE2R: East Slag Cap Ditch

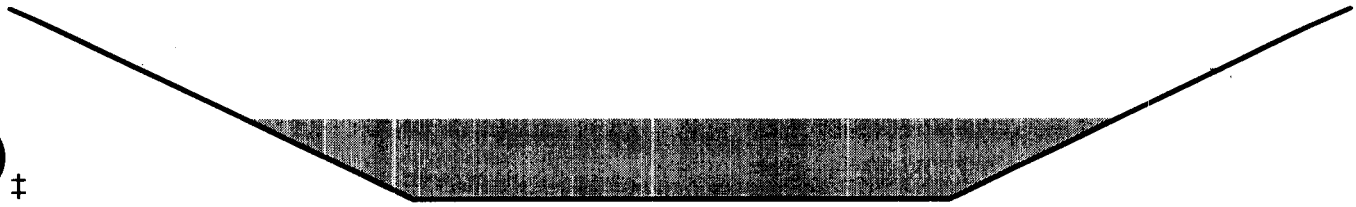
[61] Hint: Submerged 52% of Reach NE1R bottom

Inflow Area =	1.440 ac,	Inflow Depth >	2.95"	
Inflow =	3.73 cfs @	12.26 hrs,	Volume=	0.354 af
Outflow =	3.68 cfs @	12.32 hrs,	Volume=	0.353 af, Atten= 1%, Lag= 3.5 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.68 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 6.0 min

Peak Storage= 441 cf @ 12.29 hrs, Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 18.92 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 200.0' Slope= 0.0050 '/'
Inlet Invert= 713.00', Outlet Invert= 712.00'



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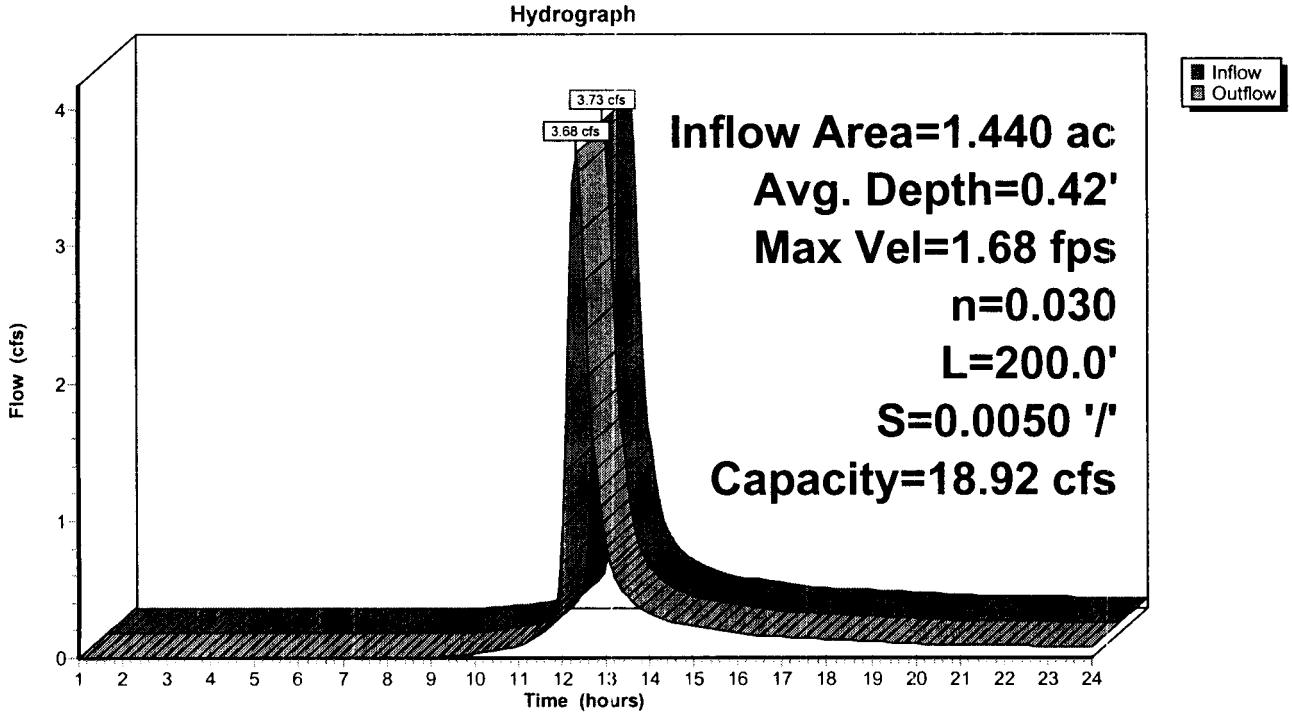
Reach NE2R: East Slag Cap Ditch



Reach NE3R: East Slag Cap Ditch

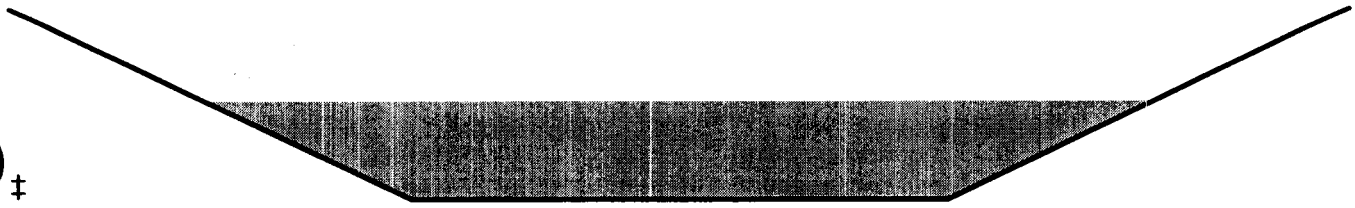
[61] Hint: Submerged 51% of Reach NE2R bottom

Inflow Area =	2.110 ac,	Inflow Depth > 2.94"		
Inflow =	5.34 cfs @	12.30 hrs,	Volume=	0.518 af
Outflow =	5.28 cfs @	12.35 hrs,	Volume=	0.516 af, Atten= 1%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.87 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 5.2 min

Peak Storage= 567 cf @ 12.32 hrs, Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 18.92 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 200.0' Slope= 0.0050 '/'
Inlet Invert= 712.00', Outlet Invert= 711.00'



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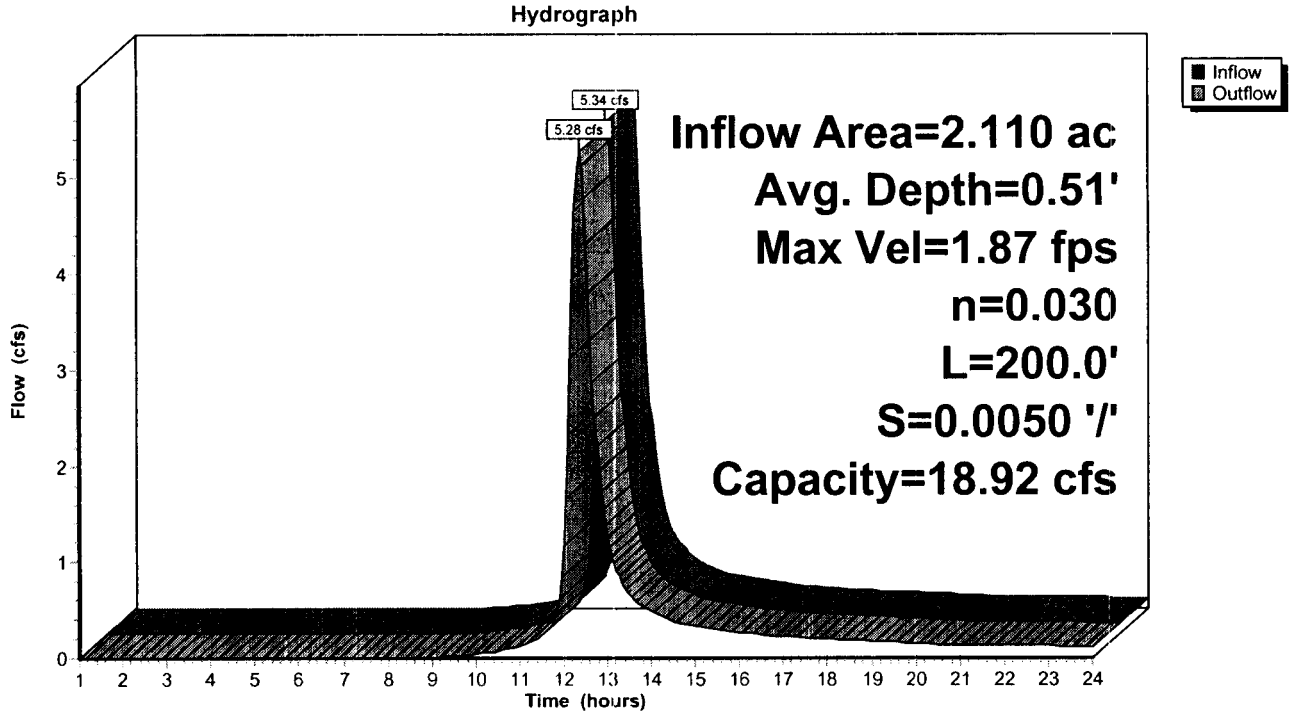
Reach NE3R: East Slag Cap Ditch



Reach NE4R: End Section of East Ditch

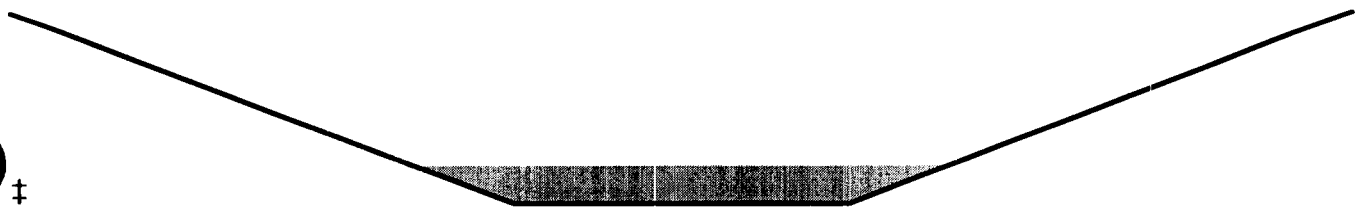
[61] Hint: Submerged 40% of Reach NE3R bottom

Inflow Area =	2.270 ac,	Inflow Depth > 2.94"		
Inflow =	5.53 cfs @	12.34 hrs, Volume=	0.556 af	
Outflow =	5.51 cfs @	12.36 hrs, Volume=	0.555 af, Atten= 0%, Lag= 0.8 min	

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.66 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 1.4 min

Peak Storage= 156 cf @ 12.35 hrs, Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 129.27 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 75.0' Slope= 0.0133 '/'
Inlet Invert= 711.00', Outlet Invert= 710.00'



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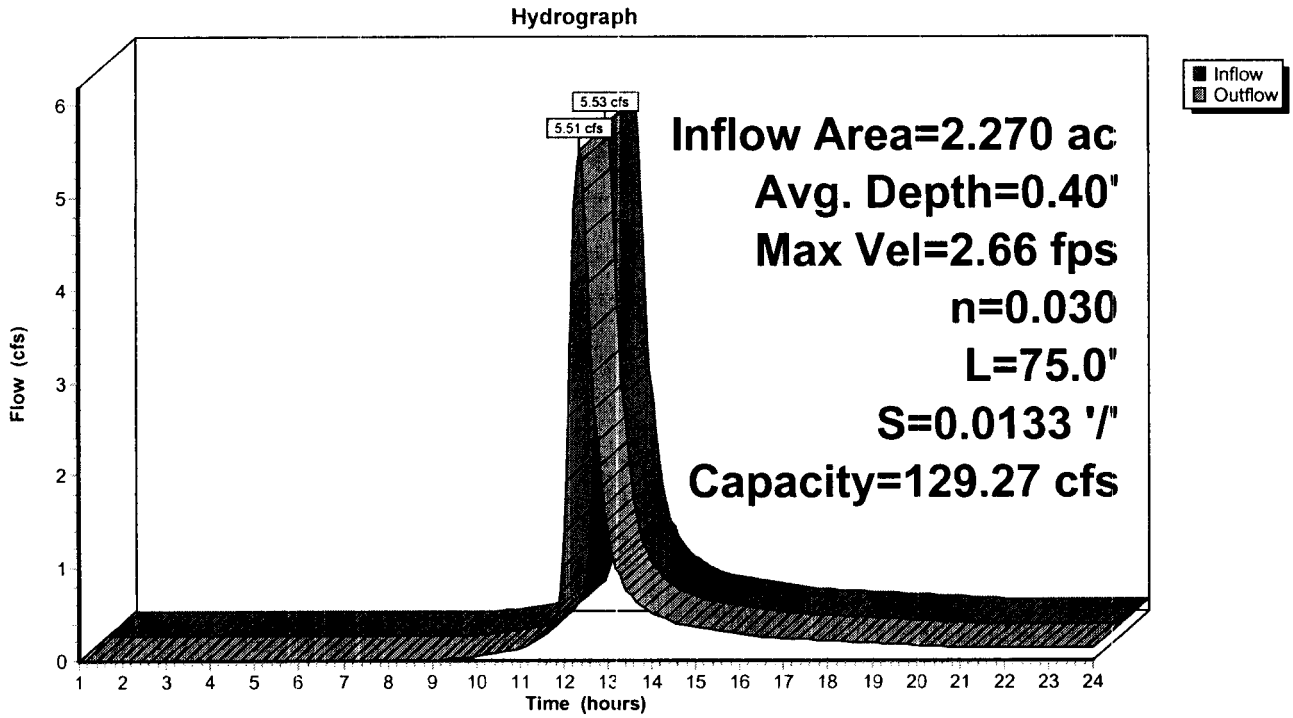
Reach NE4R: End Section of East Ditch



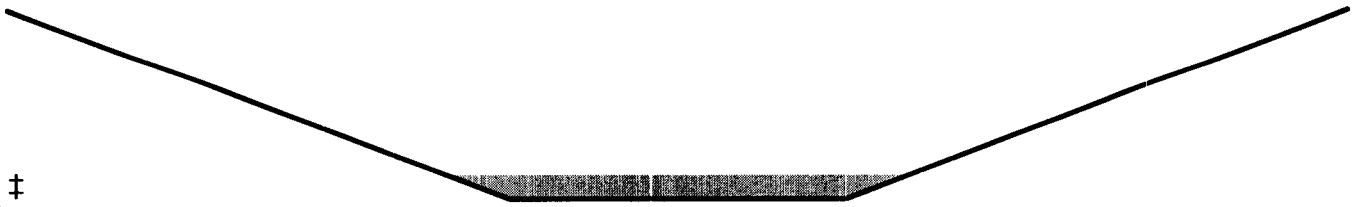
Reach NW5R: West Slag Cap Ditch

Inflow Area = 0.590 ac, Inflow Depth > 2.96"
Inflow = 1.75 cfs @ 12.17 hrs, Volume= 0.145 af
Outflow = 1.71 cfs @ 12.26 hrs, Volume= 0.145 af, Atten= 2%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.42 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 9.8 min

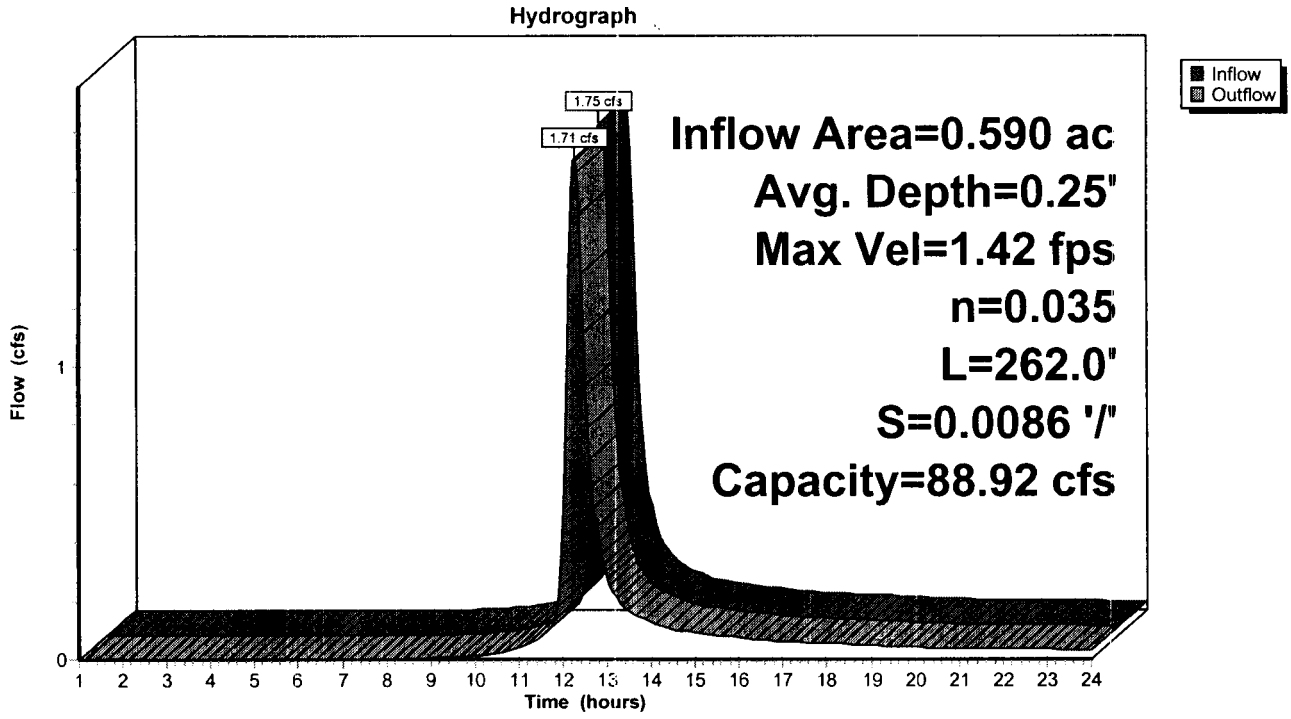
Peak Storage= 317 cf @ 12.21 hrs, Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 88.92 cfs

4.00' x 2.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 16.00'
Length= 262.0' Slope= 0.0086 '/'
Inlet Invert= 713.25', Outlet Invert= 711.00'



‡

Reach NW5R: West Slag Cap Ditch



Pond 1P: Outfall for New Pond N1P

[57] Hint: Peaked at 706.40' (Flood elevation advised)

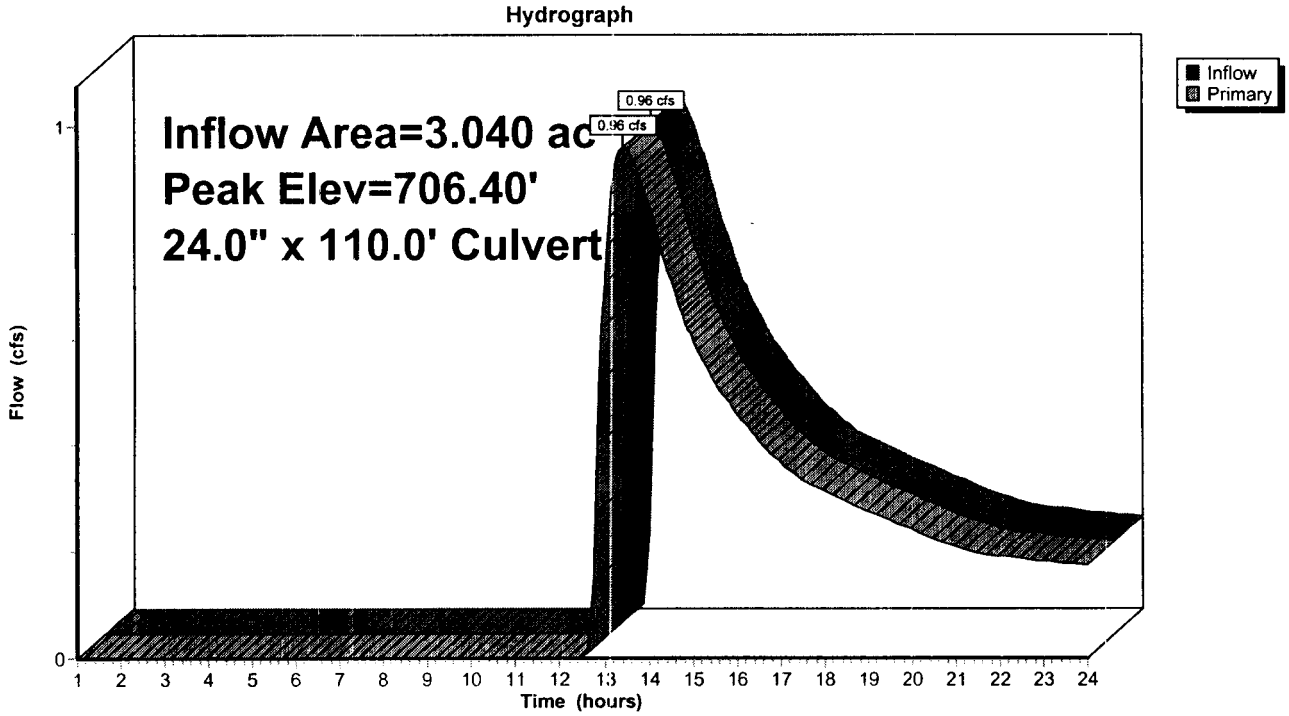
Inflow Area =	3.040 ac,	Inflow Depth > 1.42"		
Inflow =	0.96 cfs @	13.45 hrs, Volume=	0.360 af	
Outflow =	0.96 cfs @	13.45 hrs, Volume=	0.360 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.96 cfs @	13.45 hrs, Volume=	0.360 af	

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 706.40' @ 13.45 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	706.00'	**24.0" x 110.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 695.00' S= 0.1000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Primary OutFlow Max=0.96 cfs @ 13.45 hrs HW=706.40' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.96 cfs @ 2.15 fps)

Pond 1P: Outfall for New Pond N1P



Pond N1P: North Detention Pond (.2 Ac)

Inflow Area =	3.040 ac,	Inflow Depth >	2.94"		
Inflow =	7.30 cfs @	12.32 hrs,	Volume=	0.745 af	
Outflow =	0.96 cfs @	13.45 hrs,	Volume=	0.360 af,	Atten= 87%, Lag= 67.8 min
Primary =	0.96 cfs @	13.45 hrs,	Volume=	0.360 af	
Secondary =	0.00 cfs @	1.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 708.87' @ 13.45 hrs Surf.Area= 0.212 ac Storage= 0.432 af

Plug-Flow detention time= 268.7 min calculated for 0.359 af (48% of inflow)
Center-of-Mass det. time= 151.4 min (1,001.5 - 850.1)

Volume	Invert	Avail.Storage	Storage Description
#1	706.00'	0.946 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

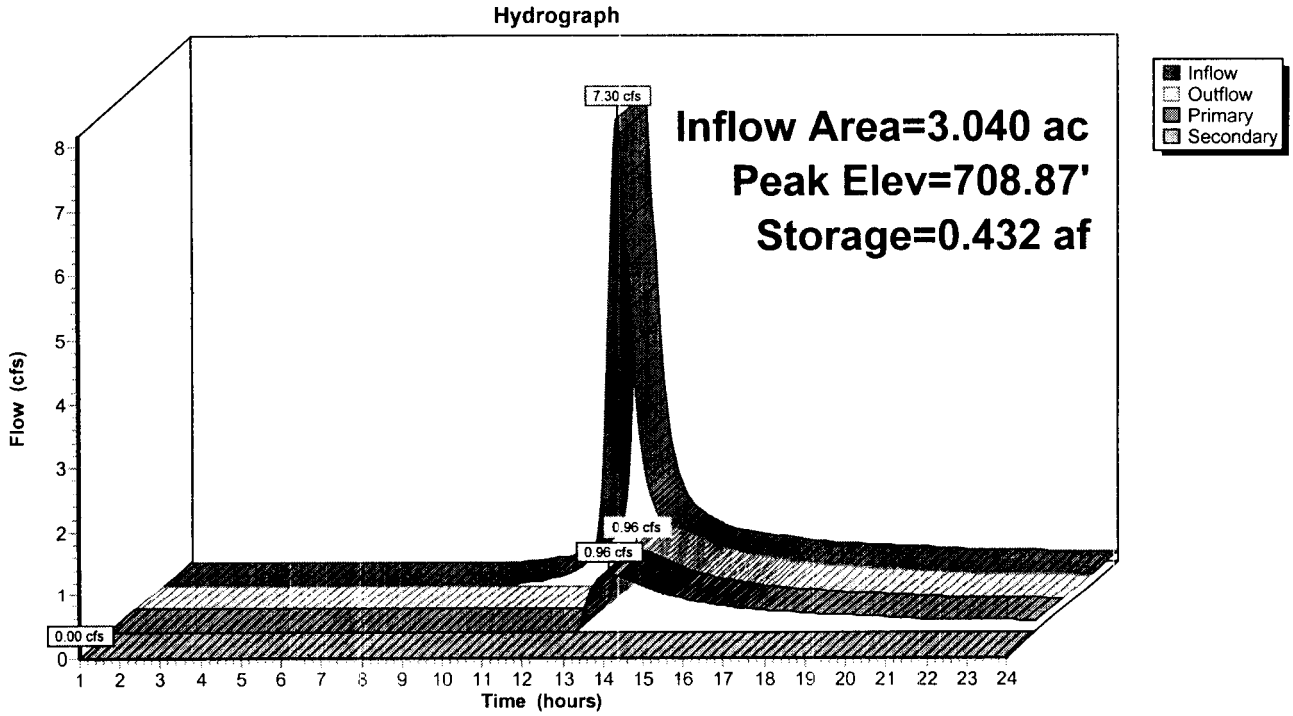
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
706.00	0.054	0.000	0.000
707.00	0.148	0.101	0.101
708.00	0.177	0.162	0.263
709.00	0.217	0.197	0.460
710.00	0.240	0.228	0.689
711.00	0.274	0.257	0.946

Device	Routing	Invert	Outlet Devices
#1	Primary	708.50'	**6.0" Vert. Orifice/Grate X 3.00** C= 0.600
#2	Primary	709.50'	**12.6' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) 3.0' Crest Height
#3	Secondary	710.50'	**Custom Weir/Orifice, C= 2.62** Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50 Width (feet) 29.00 29.20 29.40 29.60 29.80 30.00

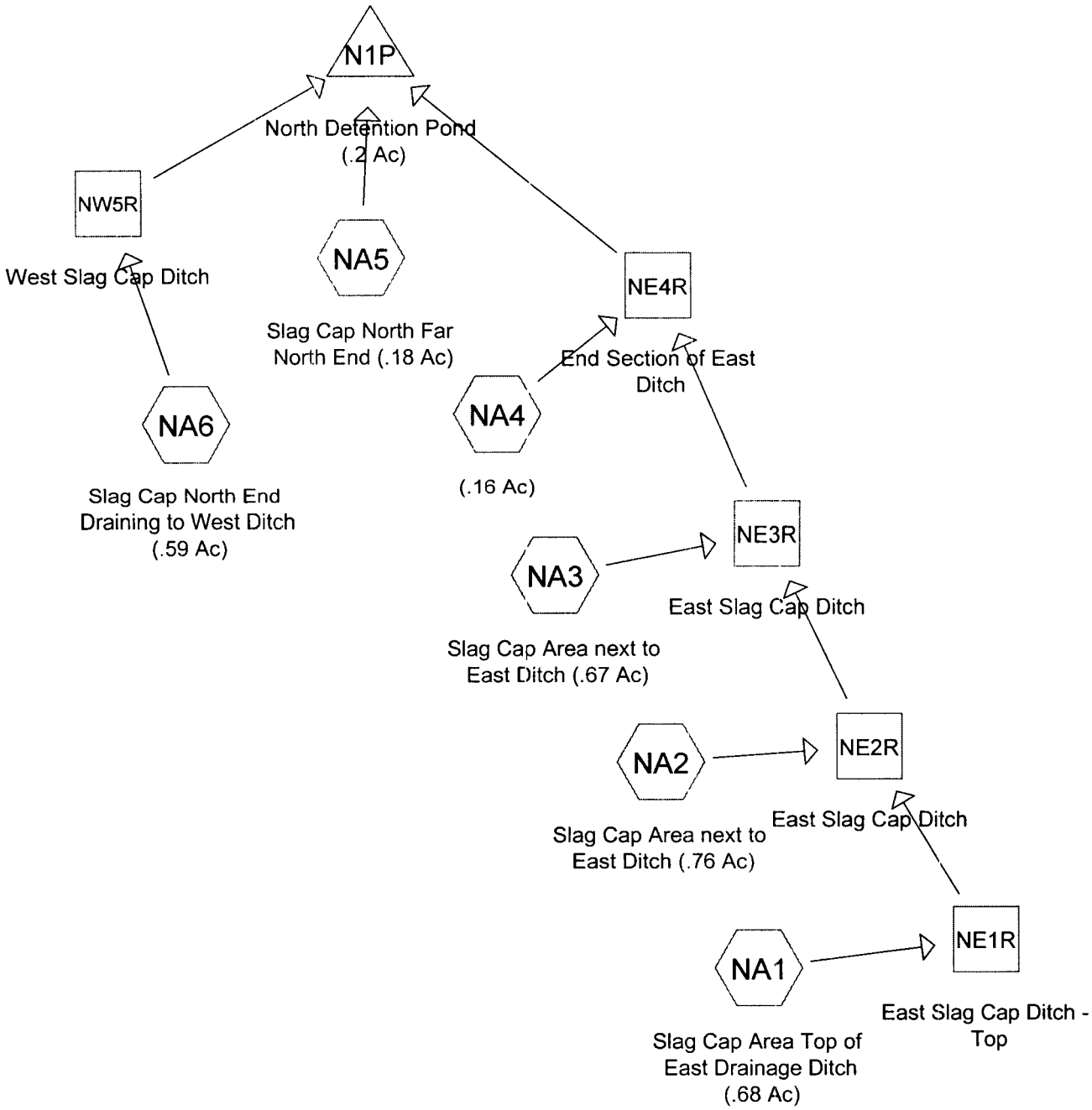
Primary OutFlow Max=0.96 cfs @ 13.45 hrs HW=708.87' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.96 cfs @ 2.07 fps)
└─**2=Sharp-Crested Rectangular Weir**(Controls 0.00 cfs)

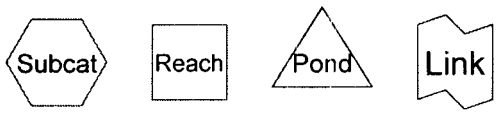
Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=706.00' (Free Discharge)
└─**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond N1P: North Detention Pond (.2 Ac)



DRAFT





Drainage Diagram for Mar 10 2208 Redesign 100 yr Event Slag Cap North Retention Pond (3.24 Ac)

Prepared by {enter your company name here} 06/15/2009

HydroCAD® 8.00 s/n 002910 © 2006 HydroCAD Software Solutions LLC

Pond N1P: North Detention Pond (.2 Ac)

[61] Hint: Submerged 52% of Reach NE4R bottom

Inflow Area =	3.040 ac,	Inflow Depth >	4.21"		
Inflow =	10.60 cfs @	12.30 hrs,	Volume=	1.068 af	
Outflow =	0.47 cfs @	16.32 hrs,	Volume=	0.210 af,	Atten= 96%, Lag= 240.8 min
Primary =	0.47 cfs @	16.32 hrs,	Volume=	0.210 af	

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 710.52' @ 16.32 hrs Surf.Area= 0.266 ac Storage= 0.861 af

Plug-Flow detention time= 463.8 min calculated for 0.209 af (20% of inflow)
Center-of-Mass det. time= 323.6 min (1,163.1 - 839.5)

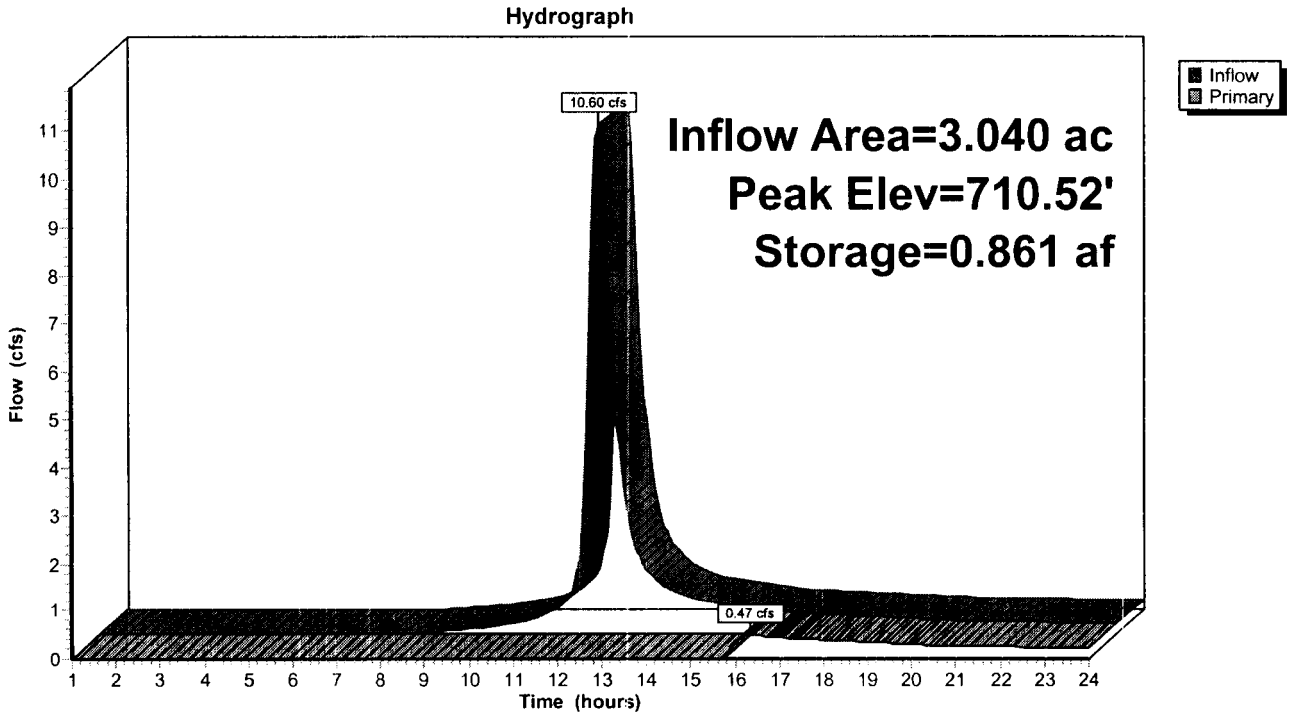
Volume	Invert	Avail.Storage	Storage Description
#1	706.00'	0.991 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
706.00	0.000	0.000	0.000
707.00	0.174	0.087	0.087
708.00	0.200	0.187	0.274
709.00	0.226	0.213	0.487
710.00	0.252	0.239	0.726
711.00	0.278	0.265	0.991

Device	Routing	Invert	Outlet Devices
#1	Primary	710.50'	**Custom Weir/Orifice, C= 2.62** Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50 Width (feet) 29.00 29.20 29.40 29.60 29.80 30.00

Primary OutFlow Max=0.31 cfs @ 16.32 hrs HW=710.52' (Free Discharge)
↑—**1=Custom Weir/Orifice** (Weir Controls 0.31 cfs @ 0.49 fps)

Pond N1P: North Detention Pond (.2 Ac)



DRAFT

Watts Bar Fossil Plant

Slag Processing Area
Ash Sampling and Lab Testing

DRAFT

Watts Bar Fossil Plant
Ash Pile Sampling

August 1, 2006

Ash pile samples were collected during the months of June and July of this year, by Environmental Engineering Services East (EESE) personnel. A truck mounted Geoprobe® Model 5400 was used for the collection of samples. Continuous sampling was conducted from the surface to the interface with natural soils. Each sample was logged and described, then placed in jars for shipment to TVA's Environmental Chemistry Laboratory. The samples will be analyzed for TCLP, Total Metals, and Sulfates.

A total of seven locations were bored with the Geoprobe®. Each location was assigned a number starting with GP-1 through GP-7. Locations GP-1, GP-2, and GP-3 were combined into one sample and labeled WBF-Slag. Sample locations GP-4, GP-5, and GP-7 were stand alone, and sampled individually, location GP-6 was for depth to natural soil only and no analysis was requested. The sample labeled WBF-Surface was collected from various location of ash pile and combined for a representative of pyretic material on the surface. The boring logs and a field site map showing approximate location of these borings is attached.

If you have any questions or concerns, please contact Jim Overton at 673-2363.

Prepared by: J.A. Overton

DRAFT

Watts Bar FP Ash Pile Sampling	Well ID: GP-1

Depth Ft.	Description	Well Construction
		TC_____ SE _____ _____Stickup
0 to 2.1	Slag,coarse, black/brown, dry	NO WELL INSTALLED
2.1 to 6.7	Ash, fine,gray with some coarse black slag, dry	
6.7 to 9.1	Ash, fine, black, soft, moist	_____
9.1 to 10.7	Slag, coarse, black, wet	
10.7 to 12.0	Clay, sandy/silty, tan with gray, moist	_____ _____
	TD = 12 feet	

Project: Watts Bar Ash Pile
Company: TVA
Location: Ash Pile

Drill Date: 6-22-06
Drilled by: TVA
Drill Method: Geoprobe

North _____
West _____
Top Casing ft. _____

DRAFT

Watts Bar FP Ash Pile Sampling	Well ID: GP-2

Depth Ft.	Description	Well Construction
		TC_____ SE _____ _____Stickup
0 to 1.7	Slag,coarse, black/brown, dry	**NO WELL INSTALLED**
1.7 to 4.1	Slag mixed with ash, gray/black, dry	
4.1 to 8.5	Ash, fine, black, soft, moist	_____
8.5 to 9.1	Slag mixed with ash, black, wet	
9.1 to 10.0	Clay, sandy/silty, tan	_____ _____
	TD = 10 feet	

Project: Watts Bar Ash Pile
Company: TVA
Location: Ash Pile

Drill Date: 6-22-06
Drilled by: TVA
Drill Method: Geoprobe

North _____
West _____
Top Casing ft. _____

DRAFT

Watts Bar FP Ash Pile Sampling	Well ID: GP-3

Depth Ft.	Description	Well Construction
		TC_____ SE_____ _____Stickup
0 to 1.8	Slag,coarse, black/brown, dry	NO WELL INSTALLED
1.8 to 2.3	Ash, fine,gray, dry	
2.3 to 2.6	Ash/clay mix, fine, black, soft, moist	
2.6 to 5.1	Slag, coarse,black, moist	_____
5.1 to 8.8	Ash, fine, black, moist	
8.8 to 9.6	Slag,coarse, black, moist	_____ _____
9.6 to 12.0	Clay, sandy, tan with gray,firm	
	TD = 12 feet	

Project: Watts Bar Ash Pile
Company: TVA
Location: Ash Pile

Drill Date: 6-22-06
Drilled by: TVA
Drill Method: Geoprobe

North _____
West _____
Top Casing ft. _____

DRAFT

Watts Bar FP Ash Pile Sampling	Well ID: GP-4

Depth Ft.	Description	Well Construction
		TC_____ SE _____ _____Stickup
0 to 3.2	Ash/clay, sandy/silty, brown black, dry	NO WELL INSTALLED
3.2 to 5.7	Ash, fine, black ,moist	
5.7 to 11.7	Ash, fine, gray, soft, moist	_____
11.7 to 14.2	Slag and ash, coarse black/brown, moist	
14.2 to 16	Clay, sandy/silty, tan with gray ,firm TD = 16 feet	_____ _____

Project: Watts Bar Ash Pile
Company: TVA
Location: Ash Pile

Drill Date: 6-22-06
Drilled by: TVA
Drill Method: Geoprobe

North _____
West _____
Top Casing ft. _____

DRAFT

Watts Bar FP Ash Pile Sampling	Well ID: GP-5

Depth Ft.	Description	Well Construction
		TC_____ SE _____ _____Stickup
0 to 3.6	Slag, medium/fine, brown/black, dry	**NO WELL INSTALLED**
3.6 to 5.1	Slag, coarse, brown/black, dry	
5.1 to 5.8	Slag, medium/fine, black, moist	
5.8 to 21.5	Ash, fine black, moist	
21.5 to 22.0	Clay, sandy/silty, tan with gray ,firm, moist TD = 22 feet	

Project: Watts Bar Ash Pile
Company: TVA
Location: Ash Pile

Drill Date: 7-17-06
Drilled by: TVA
Drill Method: Geoprobe

North _____
West _____
Top Casing ft. _____

DRAFT

Watts Bar FP Ash Pile Sampling	Well ID: GP-6

Depth Ft.	Description	Well Construction	
		TC_____ SE _____	_____Stickup
0 to 7.1	Ash mix	**NO SAMPLE TAKEN**	**NO WELL INSTALLED**
7.1 TO 8.0	Clay, sandy/silty, tan, firm	**Confirm Clay Depth**	
	TD= 8.0		
			_____
			_____
		_____	

Project: Watts Bar Ash Pile
Company: TVA
Location: Ash Pile

Drill Date: 7-24-06
Drilled by: TVA
Drill Method: Geoprobe

North _____
West _____
Top Casing ft. _____

DRAFT

Watts Bar FP Ash Pile Sampling **Well ID: GP-7**

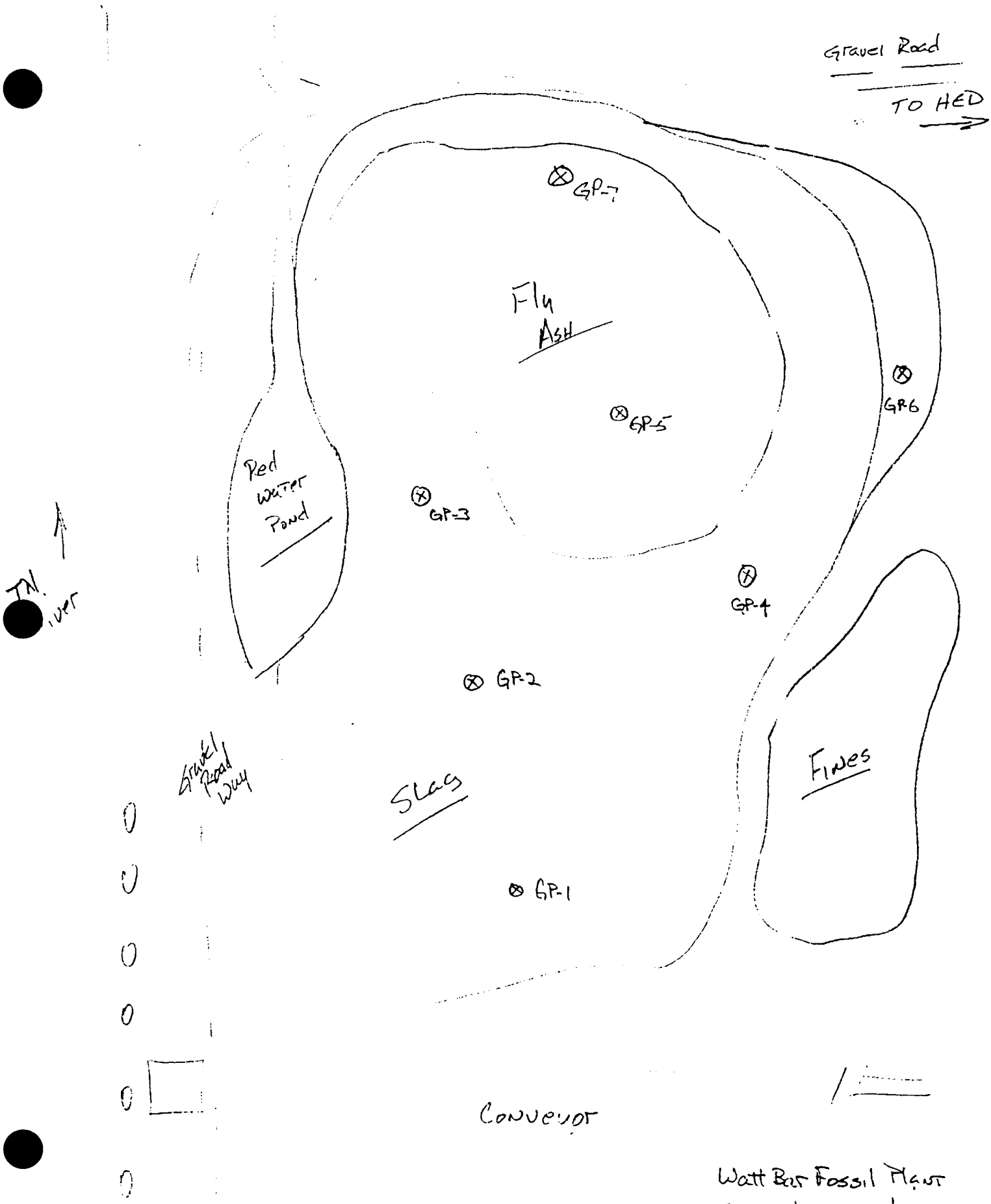
Depth Ft.	Description	Well Construction
		TC_____ SE _____ _____Stickup
0 to 4.0	Ash/clay mix, fine, brown.black/tan, dry	**NO WELL INSTALLED**
4.0 to 14.8	Ash, medium/fine, gray/black,dry	
14.8 to 17.2	Ash, fine, gray, moist	
17.2 to 18.0	Ash, fine black, moist	
	TD = 18.0 feet	

Project: Watts Bar Ash Pile
Company: TVA
Location: Ash Pile

Drill Date: 7-24-06
Drilled by: TVA
Drill Method: Geoprobe

North _____
West _____
Top Casing ft. _____

DRAFT



Watt Bar Fossil Plant
Geoprobe Locations
Ash Pile Area
June - July 2006

DRAFT

Data Report Number: 060828-92857
Report of Results: Environmental

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801

Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: Jim Overton
GRN 2F-K
Phone: Not Available
Fax : Not Available
E-Mail: jaoverton@tva.gov; EDM

Location Code: WBF

Field ID: WBF-SLAG

Sample Description: WBF-SLAG

Sample ID: AG47628 **LRF ID:** 06080013

Matrix: Solids

Date Collected: 06/22/2006

Time Collected: 0:00 EST

Date Received: 08/01/2006

Time Received: 10:11

Project Manager: Ricardo I. Gilbert

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Arsenic, TCLP Extract	7440-38-2	< MDL	mg/L	0.1	08/08/2006	13:07	LMJ	EPA 6010
Barium, TCLP Extract	7440-39-3	0.18	mg/L	0.01	08/08/2006	13:07	LMJ	EPA 6010
Cadmium, TCLP Extract	7440-43-9	< MDL	mg/L	0.005	08/08/2006	13:07	LMJ	EPA 6010
Chromium, TCLP Extract	7440-47-3	< MDL	mg/L	0.05	08/08/2006	13:07	LMJ	EPA 6010
Lead, TCLP Extract	7439-92-1	< MDL	mg/L	0.05	08/08/2006	13:07	LMJ	EPA 6010
Selenium, TCLP Extract	7782-49-2	< MDL	mg/L	0.1	08/08/2006	13:07	LMJ	EPA 6010
Silver, TCLP Extract	7440-22-4	< MDL	mg/L	0.01	08/08/2006	13:07	LMJ	EPA 6010
ercury , TCLP Extract	7439-97-6	< MDL	mg/L	0.002	08/04/2006	10:14	WMG	EPA 7470
senic, RCRA Total	7440-38-2	11	mg/Kg	5	08/22/2006	19:37	LMJ	EPA 6010
Barium, RCRA Total	7440-39-3	180	mg/Kg	0.5	08/22/2006	19:37	LMJ	EPA 6010
Cadmium, RCRA Total	7440-43-9	< MDL	mg/Kg	0.25	08/22/2006	19:37	LMJ	EPA 6010
Chromium, RCRA Total	7440-47-3	46	mg/Kg	2.5	08/22/2006	19:37	LMJ	EPA 6010
Lead, RCRA Total	7439-92-1	30	mg/Kg	2.5	08/22/2006	19:37	LMJ	EPA 6010
Selenium, RCRA Total	7782-49-2	< MDL	mg/Kg	5	08/22/2006	19:37	LMJ	EPA 6010
Silver, RCRA Total	7440-22-4	< MDL	mg/Kg	0.5	08/22/2006	19:37	LMJ	EPA 6010
Mercury, RCRA Total	7439-97-6	< MDL	mg/Kg	0.1	08/06/2006	11:56	WMG	EPA 7470
Sulfate, Total	14808-79-8	5800	mg/Kg	40	08/14/2006	9:17	GMP	ASTM D 516

Sample Comments: Sample was brought in , past the holding time.

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

Data Report Number: 060828-92857
Report of Results: Environmental

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801

Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: Jim Overton
GRN 2F-K
Phone: Not Available
Fax : Not Available
E-Mail: jaoverton@tva.gov; EDM

Location Code: WBF

Field ID: WBF-GP4

Sample Description: WBF-GP4

Sample ID: AG47629 **LRF ID:** 06080013
Matrix: Solids
Date Collected: 06/22/2006
Time Collected: 0:00 EST
Date Received: 08/01/2006
Time Received: 10:11
Project Manager: Ricardo I. Gilbert

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Arsenic, TCLP Extract	7440-38-2	< MDL	mg/L	0.1	08/08/2006	13:14	LMJ	EPA 6010
Barium, TCLP Extract	7440-39-3	0.26	mg/L	0.01	08/08/2006	13:14	LMJ	EPA 6010
Cadmium, TCLP Extract	7440-43-9	0.041	mg/L	0.005	08/08/2006	13:14	LMJ	EPA 6010
Chromium, TCLP Extract	7440-47-3	< MDL	mg/L	0.05	08/08/2006	13:14	LMJ	EPA 6010
Lead, TCLP Extract	7439-92-1	< MDL	mg/L	0.05	08/08/2006	13:14	LMJ	EPA 6010
Selenium, TCLP Extract	7782-49-2	< MDL	mg/L	0.1	08/08/2006	13:14	LMJ	EPA 6010
Silver, TCLP Extract	7440-22-4	< MDL	mg/L	0.01	08/08/2006	13:14	LMJ	EPA 6010
ercury , TCLP Extract	7439-97-6	< MDL	mg/L	0.002	08/04/2006	10:16	WMG	EPA 7470
rsenic, RCRA Total	7440-38-2	86	mg/Kg	5	08/22/2006	19:41	LMJ	EPA 6010
Barium, RCRA Total	7440-39-3	240	mg/Kg	0.5	08/22/2006	19:41	LMJ	EPA 6010
Cadmium, RCRA Total	7440-43-9	4.8	mg/Kg	0.25	08/22/2006	19:41	LMJ	EPA 6010
Chromium, RCRA Total	7440-47-3	73	mg/Kg	2.5	08/22/2006	19:41	LMJ	EPA 6010
Lead, RCRA Total	7439-92-1	67	mg/Kg	2.5	08/22/2006	19:41	LMJ	EPA 6010
Selenium, RCRA Total	7782-49-2	< MDL	mg/Kg	5	08/22/2006	19:41	LMJ	EPA 6010
Silver, RCRA Total	7440-22-4	< MDL	mg/Kg	0.5	08/22/2006	19:41	LMJ	EPA 6010
Mercury, RCRA Total	7439-97-6	0.3	mg/Kg	0.1	08/06/2006	12:02	WMG	EPA 7470
Sulfate, Total	14808-79-8	6100	mg/Kg	40	08/14/2006	9:29	GMP	ASTM D 516

Sample Comments: Sample was brought in, past the holding time.

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

Data Report Number: 060828-92857
Report of Results: Environmental

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801

Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: Jim Overton
GRN 2F-K
Phone: Not Available
Fax : Not Available
E-Mail: jaoverton@tva.gov; EDM

Location Code: WBF

Field ID: WBF-GP5

Sample Description: WBF-GP5

Sample ID: AG47630 **LRF ID:** 06080013
Matrix: Solids
Date Collected: 07/17/2006
Time Collected: 0:00 EST
Date Received: 08/01/2006
Time Received: 10:11
Project Manager: Ricardo I. Gilbert

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Arsenic, TCLP Extract	7440-38-2	< MDL	mg/L	0.1	08/08/2006	13:20	LMJ	EPA 6010
Barium, TCLP Extract	7440-39-3	0.23	mg/L	0.01	08/08/2006	13:20	LMJ	EPA 6010
Cadmium, TCLP Extract	7440-43-9	0.045	mg/L	0.005	08/08/2006	13:20	LMJ	EPA 6010
Chromium, TCLP Extract	7440-47-3	< MDL	mg/L	0.05	08/08/2006	13:20	LMJ	EPA 6010
Lead, TCLP Extract	7439-92-1	< MDL	mg/L	0.05	08/08/2006	13:20	LMJ	EPA 6010
Selenium, TCLP Extract	7782-49-2	< MDL	mg/L	0.1	08/08/2006	13:20	LMJ	EPA 6010
Silver, TCLP Extract	7440-22-4	< MDL	mg/L	0.01	08/08/2006	13:20	LMJ	EPA 6010
Mercury , TCLP Extract	7439-97-6	< MDL	mg/L	0.002	08/04/2006	10:18	WMG	EPA 7470
Arsenic, RCRA Total	7440-38-2	38	mg/Kg	5	08/22/2006	19:44	LMJ	EPA 6010
Barium, RCRA Total	7440-39-3	330	mg/Kg	0.5	08/22/2006	19:44	LMJ	EPA 6010
Cadmium, RCRA Total	7440-43-9	2.2	mg/Kg	0.25	08/22/2006	19:44	LMJ	EPA 6010
Chromium, RCRA Total	7440-47-3	50	mg/Kg	2.5	08/22/2006	19:44	LMJ	EPA 6010
Lead, RCRA Total	7439-92-1	25	mg/Kg	2.5	08/22/2006	19:44	LMJ	EPA 6010
Selenium, RCRA Total	7782-49-2	< MDL	mg/Kg	5	08/22/2006	19:44	LMJ	EPA 6010
Silver, RCRA Total	7440-22-4	< MDL	mg/Kg	0.5	08/22/2006	19:44	LMJ	EPA 6010
Mercury, RCRA Total	7439-97-6	<MDL	mg/Kg	0.1	08/14/2006	10:22	CLS	EPA 7470
Sulfate, Total	14808-79-8	3100	mg/Kg	40	08/14/2006	9:55	GMP	ASTM D 516

Sample Comments: None

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

Data Report Number: 060828-92857
Report of Results: Environmental

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801

Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: Jim Overton
GRN 2F-K
Phone: Not Available
Fax : Not Available
E-Mail: jaoverton@tva.gov; EDM

Location Code: WBF

Field ID: WBF-GP7

Sample Description: WBF-GP7

Sample ID: AG47631 **LRF ID:** 06080013
Matrix: Solids
Date Collected: 07/24/2006
Time Collected: 0:00 EST
Date Received: 08/01/2006
Time Received: 10:11
Project Manager: Ricardo I. Gilbert

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Arsenic, TCLP Extract	7440-38-2	< MDL	mg/L	0.1	08/08/2006	11:38	LMJ	EPA 6010
Barium, TCLP Extract	7440-39-3	0.17	mg/L	0.01	08/08/2006	11:38	LMJ	EPA 6010
Cadmium, TCLP Extract	7440-43-9	0.063	mg/L	0.005	08/08/2006	11:38	LMJ	EPA 6010
Chromium, TCLP Extract	7440-47-3	< MDL	mg/L	0.05	08/08/2006	11:38	LMJ	EPA 6010
Lead, TCLP Extract	7439-92-1	< MDL	mg/L	0.05	08/08/2006	11:38	LMJ	EPA 6010
Selenium, TCLP Extract	7782-49-2	< MDL	mg/L	0.1	08/08/2006	11:38	LMJ	EPA 6010
Silver, TCLP Extract	7440-22-4	< MDL	mg/L	0.01	08/08/2006	11:38	LMJ	EPA 6010
Mercury , TCLP Extract	7439-97-6	< MDL	mg/L	0.002	08/06/2006	13:32	WMG	EPA 7470
Arsenic, RCRA Total	7440-38-2	91	mg/Kg	5	08/22/2006	19:47	LMJ	EPA 6010
Barium, RCRA Total	7440-39-3	190	mg/Kg	0.5	08/22/2006	19:47	LMJ	EPA 6010
Cadmium, RCRA Total	7440-43-9	3.7	mg/Kg	0.25	08/22/2006	19:47	LMJ	EPA 6010
Chromium, RCRA Total	7440-47-3	57	mg/Kg	2.5	08/22/2006	19:47	LMJ	EPA 6010
Lead, RCRA Total	7439-92-1	49	mg/Kg	2.5	08/22/2006	19:47	LMJ	EPA 6010
Selenium, RCRA Total	7782-49-2	< MDL	mg/Kg	5	08/22/2006	19:47	LMJ	EPA 6010
Silver, RCRA Total	7440-22-4	< MDL	mg/Kg	0.5	08/22/2006	19:47	LMJ	EPA 6010
Mercury, RCRA Total	7439-97-6	1.3	mg/Kg	0.1	08/14/2006	10:28	CLS	EPA 7470
Sulfate, Total	14808-79-8	7900	mg/Kg	40	08/15/2006	17:13	GMP	ASTM D 516

Sample Comments: None

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

Data Report Number: 060828-92857
Report of Results: Environmental

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801

Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: Jim Overton
GRN 2F-K
Phone: Not Available
Fax : Not Available
E-Mail: jaoverton@tva.gov; EDM

Location Code: WBF

Field ID: WBF-SURFACE

Sample Description: WBF-SURFACE

Sample ID: AG47632 **LRF ID:** 06080013
Matrix: Solids
Date Collected: 07/24/2006
Time Collected: 0:00 EST
Date Received: 08/01/2006
Time Received: 10:11
Project Manager: Ricardo I. Gilbert

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Arsenic, TCLP Extract	7440-38-2	< MDL	mg/L	0.1	08/08/2006	13:25	LMJ	EPA 6010
Barium, TCLP Extract	7440-39-3	0.17	mg/L	0.01	08/08/2006	13:25	LMJ	EPA 6010
Cadmium, TCLP Extract	7440-43-9	< MDL	mg/L	0.005	08/08/2006	13:25	LMJ	EPA 6010
Chromium, TCLP Extract	7440-47-3	< MDL	mg/L	0.05	08/08/2006	13:25	LMJ	EPA 6010
Lead, TCLP Extract	7439-92-1	< MDL	mg/L	0.05	08/08/2006	13:25	LMJ	EPA 6010
Selenium, TCLP Extract	7782-49-2	< MDL	mg/L	0.1	08/08/2006	13:25	LMJ	EPA 6010
Silver, TCLP Extract	7440-22-4	< MDL	mg/L	0.01	08/08/2006	13:25	LMJ	EPA 6010
Mercury , TCLP Extract	7439-97-6	< MDL	mg/L	0.002	08/04/2006	10:20	WMG	EPA 7470
Arsenic, RCRA Total	7440-38-2	28	mg/Kg	5	08/22/2006	19:51	LMJ	EPA 6010
Barium, RCRA Total	7440-39-3	280	mg/Kg	0.5	08/22/2006	19:51	LMJ	EPA 6010
Cadmium, RCRA Total	7440-43-9	0.56	mg/Kg	0.25	08/22/2006	19:51	LMJ	EPA 6010
Chromium, RCRA Total	7440-47-3	39	mg/Kg	2.5	08/22/2006	19:51	LMJ	EPA 6010
Lead, RCRA Total	7439-92-1	17	mg/Kg	2.5	08/22/2006	19:51	LMJ	EPA 6010
Selenium, RCRA Total	7782-49-2	< MDL	mg/Kg	5	08/22/2006	19:51	LMJ	EPA 6010
Silver, RCRA Total	7440-22-4	< MDL	mg/Kg	0.5	08/22/2006	19:51	LMJ	EPA 6010
Mercury, RCRA Total	7439-97-6	0.6	mg/Kg	0.1	08/14/2006	10:34	CLS	EPA 7470
Sulfate, Total	14808-79-8	8400	mg/Kg	40	08/15/2006	17:37	GMP	ASTM D 516

Sample Comments: None

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

Central Laboratories Services data report number 060828-92857 was electronically approved using Labworks Enterprise Version 5.7, Build 255 on **08/25/2006 at 2:28:00 PM by Ricardo I. Gilbert**

Vanessa L. Ramey, Lab Director
Lisa D. Ortiz, Department Manager
James W. Dillard, Product Manager
Ricardo I. Gilbert, Senior Analytical Chemist

This report contains sample results for the following samples, Login Reference File number: 06080013

Sample ID	Field ID
AG47628	WBF-SLAG
AG47629	WBF-GP4
AG47630	WBF-GP5
AG47631	WBF-GP7
AG47632	WBF-SURFACE

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

Watts Bar Fossil Plant

Chemical Pond Sediment Lab Testing

DRAFT

Data Report Number: 060713-170215
Report of Results: Environmental

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801

Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: S.C. Williams
WBF 1A-WBN
Phone: 423-365-8157
Fax : Not Available
E-Mail: WBF Environmental; EDM

Location Code: WBF

Field ID: WBFCP-1-06

Sample Description: CHEM POND SEDIMENT COMPOSITE

Sample ID: AG41667 **LRF ID:** 06070018
Matrix: Waste
Date Collected: 06/30/2006
Time Collected: 9:00 EST
Date Received: 06/30/2006
Time Received: 13:33
Project Manager: Ricardo I. Gilbert

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Arsenic, TCLP Extract	7440-38-2	< MDL	mg/L	0.1	07/12/2006	13:47	LMJ	EPA 6010B
Barium, TCLP Extract	7440-39-3	0.92	mg/L	0.01	07/12/2006	13:47	LMJ	EPA 6010B
Cadmium, TCLP Extract	7440-43-9	< MDL	mg/L	0.005	07/12/2006	13:47	LMJ	EPA 6010B
Chromium, TCLP Extract	7440-47-3	< MDL	mg/L	0.05	07/12/2006	13:47	LMJ	EPA 6010B
Lead, TCLP Extract	7439-92-1	< MDL	mg/L	0.05	07/12/2006	13:47	LMJ	EPA 6010B
Selenium, TCLP Extract	7782-49-2	< MDL	mg/L	0.1	07/12/2006	13:47	LMJ	EPA 6010B
Silver, TCLP Extract	7440-22-4	< MDL	mg/L	0.01	07/12/2006	13:47	LMJ	EPA 6010B
Mercury , TCLP Extract	7439-97-6	< MDL	mg/L	0.002	07/07/2006	14:46	WMG	EPA 7470

Sample Comments: None

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

Central Laboratories Services data report number 060713-170215 was electronically approved using Labworks Enterprise Version 5.7, Build 255 on **07/13/2006 at 4:51:00 PM by Ricardo I. Gilbert**

Vanessa L. Ramey, Lab Director
Lisa D. Ortiz, Department Manager
James W. Dillard, Product Manager
Ricardo I. Gilbert, Senior Analytical Chemist

This report contains sample results for the following samples, Login Reference File number: 06070018

Sample ID	Field ID
AG41667	WBFCP-1-06

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

DRAFT

TABLE C-2
Index Property and Additional Moisture-Density Test Results of Representative Soils - "MH" and "ML"
TVA Watts Bar Borrow Area - Slag Disposal Area Closure
MACTEC Project 3043061035/01

			Atterberg Limits					Compaction Tests			
Test Location Number	Sample Depth (Feet)	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Percent Finer Than No. 200 Sieve	USCS Classification	Standard Proctor Max. Dry Density, pcf	Optimum Moisture Content, %	Modified Proctor Max. Dry Density, pcf	Optimum Moisture Content, %
OT-1	3.0 - 4.0	32.3	67	41	26	87.5	MH	88.0	30.8	102.0	20.6
OT-1	8.0 - 10.0	18.6	41	31	10	55.5	ML	101.2	20.9	112.0	17.0

Prepared/Date: CTJ 12/14/06
Checked/Date: SDS 3/8/07

DRAFT

T[illegible]C-3
Hydraulic Conductivity Test Results of "MH" Soil obtained from OT-1
TVA Watts Bar Borrow Area - Slag Disposal Area Closure
MACTEC Project 3043061035/01

Proctor	Point	Remolded Moisture (%)	Remolded Dry Density (pcf)	Hydraulic Conductivity (cm/sec)
Modified	1	15.7	100.3	2.8×10^{-7}
	2	18.9	101.9	4.5×10^{-8}
	3	21.0	101.7	4.3×10^{-8}
	4	27.3	97.8	1.5×10^{-8}
	5	28.5	92.8	2.6×10^{-8}
Standard	1	24.2	82.6	8.8×10^{-7}
	2	28.1	86.5	9.5×10^{-8}
	3	30.4	88.5	6.7×10^{-8}
	4	32.9	86.5	2.6×10^{-7}
	5	34.2	86.5	2.8×10^{-8}

Note: "MH" soil samples obtained from OT-1 at depths of 3.0 to 4.0 feet.

Prepared By: CTJ 03/28/06
Checked By: SDS 3/8/07

DRAFT

Table C-4
Hydraulic Conductivity Test Results of "ML" Soil obtained from OT-1
TVA Watts Bar Borrow Area - Slag Disposal Area Closure
MACTEC Project 3043061035/01

Proctor	Point	Remolded Moisture (%)	Remolded Dry Density (pcf)	Hydraulic Conductivity (cm/sec)
Modified	1	10.9	107.2	2.1×10^{-7}
	2	13.9	109.1	2.5×10^{-8}
	3	18.8	111.9	6.0×10^{-8}
	4	18.7	104.6	4.9×10^{-8}
	5	20.2	104.4	7.6×10^{-8}
Standard	1	15.0	92.4	4.7×10^{-8}
	2	18.1	96.9	4.7×10^{-8}
	3	20.3	102.1	2.8×10^{-8}
	4	27.1	93.5	8.4×10^{-8}
	5	38.6	83.2	3.7×10^{-8}

Note: "ML" soil samples obtained from OT-1 at depths of 8.0 to 10 feet

Prepared By: CTJ 03/02/07
Checked By: SDS 03/8/07

DRAFT

Soil Classification Type "MH" - Orange Brown and Yellow Brown elastic SILT

COMPACTION DATA POINTS SHOWING ACCEPTABLE ZONE OF HYDRAULIC CONDUCTIVITY FOR "MH" SOIL FROM OT-1

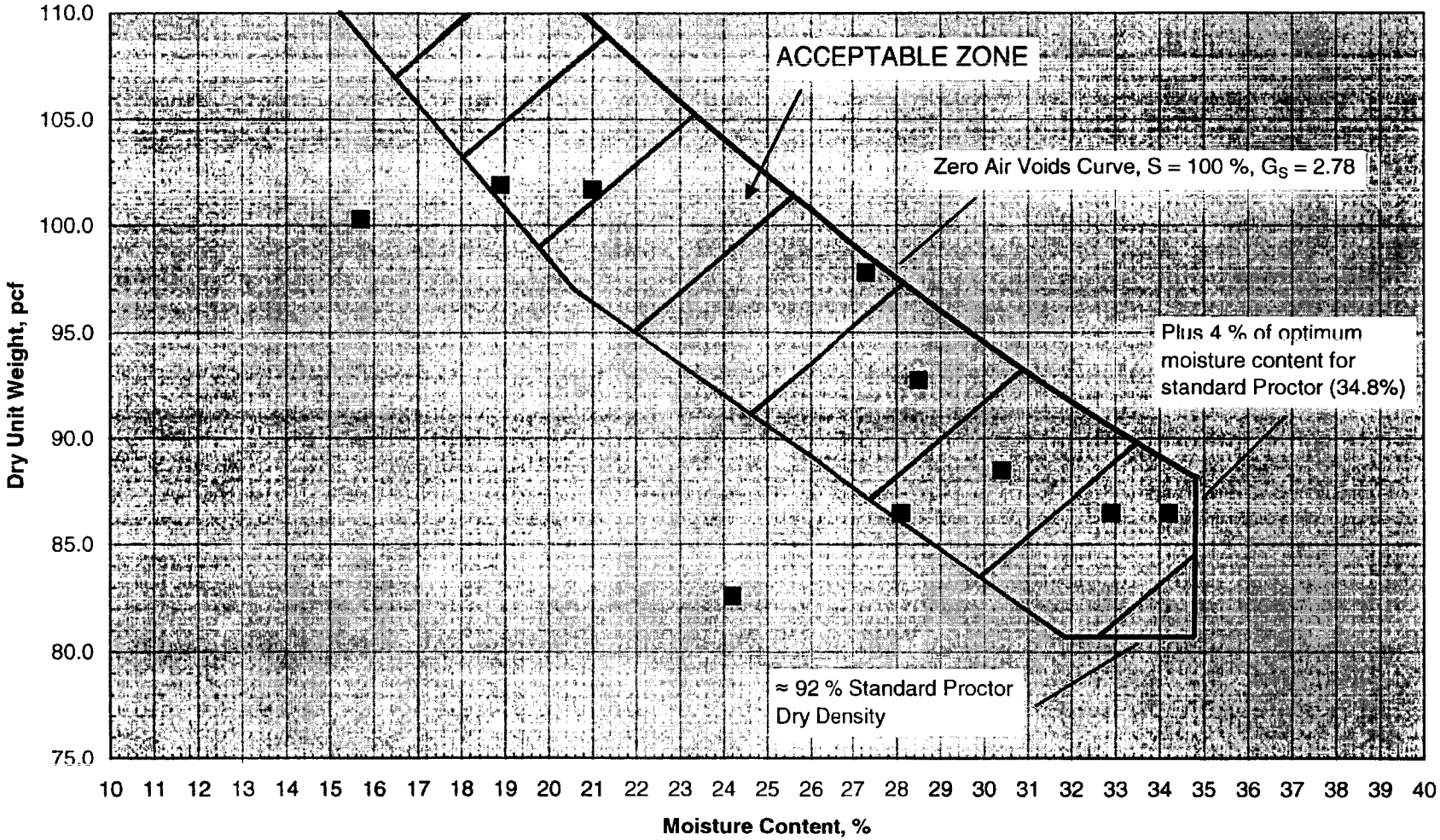


Figure 5- Compaction Data for "MH" Soil from OT-1 - Solid symbols are for compacted specimens with a hydraulic conductivity < 1 x 10^{-6} cm/s and open symbols for specimens with a hydraulic conductivity > 1 x 10^{-6} cm/s.

DRAFT

Soil ClassificationType "ML" - Light Orange Brown and Light Gray Sandy SILT

COMPACTION DATA POINTS SHOWING ACCEPTABLE ZONE OF HYDRAULIC CONDUCTIVITY FOR "ML" SOIL FROM OT-1

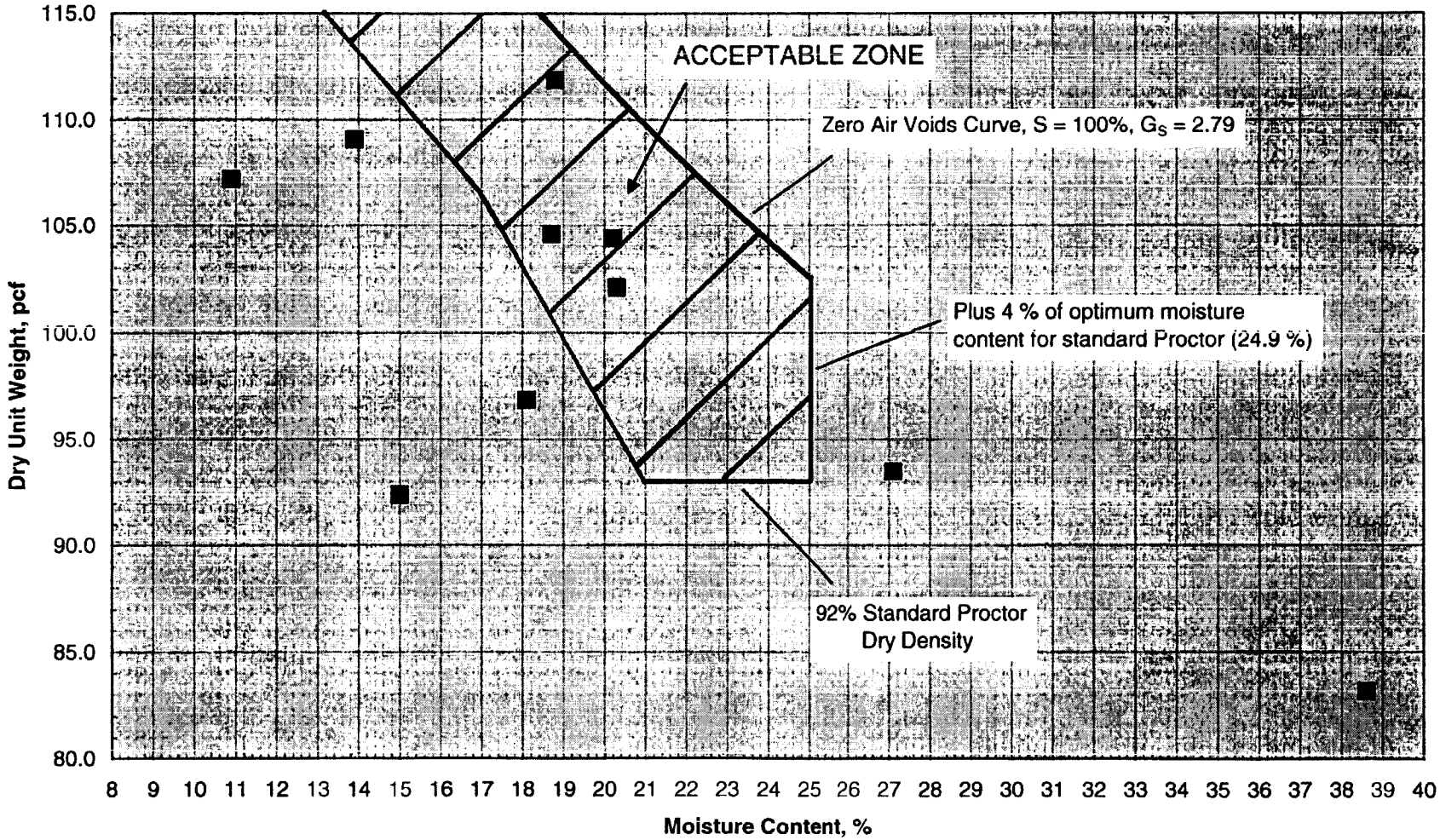


Figure 6- Compaction Data for "ML" Soil from OT-1 - Solid symbols are for compacted specimens with a hydraulic conductivity < 1 x 10^{-6} cm/s and open symbols for specimens with a hydraulic conductivity > 1 x 10^{-6} cm/s.

APPENDIX G –
GROUNDWATER FLOW MODELING

Appendix G - Groundwater Flow Modeling Technical Memorandum - DRAFT

TDEC Commissioner's Order:
Corrective Action/Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Revisions to Align with CARA Plan and Corrective Measure Alternatives	December 5, 2025

Sign-Off Sheet

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

Prepared by _____

Sixue Wang, Water Resources Engineer

Reviewed by _____

Joel Thompson, Principal Hydrogeologist

Approved by _____

John Griggs, Senior Principal, PG

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Abbreviations

amsl	Above Mean Sea Level
ASTM	ASTM International
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
cm/sec	centimeters/second
CSM	Conceptual Site Model
DEM	Digital Elevation Model
EAR	Environmental Assessment Report
EI	Environmental Investigation
EIP	Environmental Investigation Plan
ft/d	Feet per day
GMS	Groundwater Modeling System
gpm	gallons per minute
GWPS	Groundwater protection standards
NOAA	National Oceanic & Atmospheric Administration
%	percent
RMS	Root Mean Square
Stantec	Stantec Consulting Services, Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner’s Order No. OGC15-0177
TM	Technical Memorandum
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant
USGS	United States Geological Survey

1.0 INTRODUCTION AND OBJECTIVES

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this Groundwater Flow Modeling Technical Memorandum (TM) to summarize a groundwater flow model (the "Model") at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

The overall objective of the groundwater modeling activities was to create a quantitative tool capable of predicting groundwater flow under varying conditions and to evaluate groundwater corrective action strategies for the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at the TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan is being prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of coal combustion residuals (CCR) material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA. This TM is included as an appendix in the CARA Plan to support evaluation of potential corrective actions at the WBF Plant CCR units.

The location of the WBF Plant and its surroundings are presented in Exhibit 1. There are two CCR units at the WBF Plant that are included in the TDEC Order: Slag Disposal Area and Ash Pond. An overview of the WBF Plant including the two CCR units and other plant and adjacent features is also presented in Exhibit 1.

The specific objectives of the groundwater modeling activities are summarized as follows:

- Develop and calibrate a numerical groundwater flow model of the WBF Plant using site-specific and regional hydrogeologic and hydrologic properties
- Simulate baseline groundwater flow conditions to reflect the hydrogeologic conceptual site model (CSM) refined through implementation of several years of environmental investigations, the results of which are presented in the Environmental Assessment Report (EAR) (TVA 2024)
- Provide a framework for predictive modeling simulations to support the CARA Plan.

This TM presents the findings and results of groundwater modeling activities performed to meet the specific objectives described above and is based on available data at the time of construction of the Model. Future updates to the Model may be warranted as additional data are obtained, as new project objectives are defined, and as indicated, based on Model results.

2.0 DATA COMPILATION

The WBF Plant has been investigated and monitored to meet multiple hydrogeological, geotechnical, environmental, and engineering objectives. Recent environmental investigations performed under the Environmental Investigation Plan (EIP) during the period, 2018 through 2021, to address the TDEC Order requirements, are documented in the EAR (TVA 2024). Specifically, Appendix H.1 of the EAR includes a summary of historical hydrogeologic investigations. The following datasets were reviewed and incorporated into the development of the hydrogeologic framework that serves as the basis for the construction and calibration of the Model:

- Stratigraphic data from soil borings and lithologic logs associated with installation of geotechnical borings, monitoring wells, piezometers, and other CCR unit instrumentation
- Publications pertaining to hydrogeologic and topographic features and boundaries, including geology and surface water
- Publications pertaining to the WBF Plant features, including engineering records and construction completion reports
- *Geologic Map of the Decatur Quadrangle, Tennessee* (Zurawski 2008)
- Geologic Map of Tennessee (East Central Sheet). Tennessee Division of Geology (Hardeman 1966)
- Geologic Map Databases for the United States: Kentucky, Ohio, Tennessee, and West Virginia (Nicholson, et al. 2007)
- United States Geological Survey (USGS) topographic maps for the Decatur Quadrangle, TN (1935) and Watts Bar Lake, TN (1981)
- Groundwater and pore water level data for piezometers and monitoring wells obtained from manual gauging events or transducer records
- Stage data from TVA's Watts Bar Dam tailwater gauge
- Field and laboratory hydraulic property testing results
- Precipitation data from the Spring City weather station National Oceanic & Atmospheric Administration's (NOAA) stations (ID: USC00408540).

The use of the various datasets is explained in more detail, as necessary, in subsequent sections of this report.

3.0 OVERVIEW OF GROUNDWATER FLOW SYSTEM

This section presents an overview of the hydrogeologic CSM, which has been developed from the history of investigation and monitoring at the WBF Plant, including the recent environmental investigation (EI) performed to address TDEC Order requirements. While this overview provides the framework for the hydrogeologic CSM that is the basis for the Model, the user of this TM is referred to the EAR (TVA 2024) for further details.

3.1 LOCAL GEOLOGIC SETTING

The WBF plant is located approximately seven miles southeast of Spring City, Tennessee, and approximately one mile downstream of Watts Bar Dam, on the west bank of the Tennessee River.

The WBF Plant is located in the Tennessee River valley (Exhibit 1) in the western portion of the Valley and Ridge physiographic province of the Appalachian Highlands physiographic division (Fenneman 1938). The geology, hydrogeology and surface water hydrology of the area are interpreted to be influenced by the belt of northeast / southwest trending ridges and valleys formed by the differential erosion of a thick sequence of folded and faulted Paleozoic sedimentary rocks (Nelms, et al. 1997). The WBF Plant is located within the alluvial valley of the Tennessee River.

The Tennessee River floodplain is lower in elevation than the surrounding area. Floodplain deposits or alluvium from the Tennessee River and tributaries consisting of clay, silt, sand, and gravel ranging in thickness from 0 to approximately 32 feet overlie bedrock (TVA 2024). Where alluvium is absent, residuum derived from the weathering of bedrock overlies bedrock. Artificial fill generally consisting of reworked alluvial sediments is locally encountered. The distribution of major geologic units underlying the WBF Plant is depicted on Exhibit 2.

3.2 HYDROGEOLOGIC FRAMEWORK

Various subsurface investigations have been conducted at the WBF Plant to characterize the geology, evaluate slope stability of dikes, monitor groundwater elevations and quality, and develop corrective actions for groundwater, as needed. Exhibit 3 depicts subsurface investigation soil borings and cone penetrometer test locations. Exhibit 4 depicts the monitoring well and piezometer network. Exhibit 5 depicts the hydraulic property testing locations referenced in the following sections. The hydraulic conductivity results derived from the testing data are presented in Tables H.1-3 in Appendix H.1 and Attachment F.5 of Appendix G.2 of the EAR (TVA 2024) and summarized below by hydrostratigraphic unit.

Representative cross-sections through each CCR unit were developed to support the overall CSM and were presented in Appendix D of the EAR (TVA 2024). Following implementation of the EIP, a three-dimensional plant-wide lithologic model was developed using Leapfrog Works© software (Seequent) to visualize the historical and recent investigation lithologic and hydrogeologic datasets and were also presented in the EAR. The lithologic model also serves as a basis for development of the Model.

Naturally deposited unconsolidated materials at the WBF Plant consist of residuum and alluvium overlying bedrock. The unconsolidated materials are underlain by bedrock formations that primarily consist of shale and varying amounts of limestone. A conceptual cross-section and stratigraphic column illustrating the stratigraphy distribution within the Model layers and a conceptual block model diagram are presented on Exhibit 6.

Based on the geology and hydraulic conductivities of geological materials measured in the vicinity of the CCR units, the alluvial sands and gravels above bedrock are considered to be the uppermost aquifer. The uppermost aquifer is overlain by less permeable clays and silts that act as an aquitard; therefore, the uppermost aquifer is a confined aquifer. Discussion of the uppermost aquifer beneath the CCR units is provided in Appendix H.1 of the EAR (TVA 2024).

The following sub-sections provide an overview of the hydrostratigraphic units that are encountered at the WBF Plant.

3.2.1 Coal Combustion Residuals

The WBF Plant has two CCR units: the Slag Disposal Area (and Drainage Improvements Area) and the Ash Pond. CCR material within the Slag Disposal Area and the Drainage Improvements Area at the WBF Plant is contained by a railroad embankment and a natural knoll to the west, stacked CCR material to the east, and a dike and spillway to the south constructed to discharge process water (TVA 1969). CCR material is interpreted to exhibit variable hydrogeologic properties depending on the type of material, placement method, and post-placement compaction/mixing.

During implementation of the EIP, encountered CCR material predominantly consisted of silty clay- to coarse sand-sized materials. Minor gradational changes, such as silty sand grading to sandy silt, were common throughout the vertical profile of each CCR unit (TVA 2024). Estimated CCR material thickness ranged from 0 to 25 feet (TVA 2024).

The calculated horizontal hydraulic conductivities of the CCR material based on slug testing at the Slag Disposal Area temporary wells (installed and slug tested during implementation of the EIP) ranged from 0.16 feet per day (ft/d) (5.5×10^{-5} centimeters per second [cm/sec]) at WBF-TW04 to 114 ft/d (4.0×10^{-2} cm/sec) at WBF-TW03 (TVA 2024).

Vertical hydraulic conductivity of the CCR material at the WBF Plant ranged from to 2.9×10^{-4} to 3.7×10^{-3} ft/d (1.0×10^{-7} to 1.3×10^{-6} cm/sec). This range includes estimates from recent laboratory testing results associated with samples described as fly ash, bottom ash, or more generally as CCR material (TVA 2024).

3.2.2 Alluvium

Alluvial deposits typically underlie the CCR material and consist of fine-grained unconsolidated materials (e.g, clays and silts) grading downward to coarser-grained sands and gravels.

Unconsolidated material thicknesses range from 0 to 32 feet. The unconsolidated materials on the elevated flood plain are thickest near the Tennessee River and thinner at greater distances from the river.

Where the alluvial deposits approach the elevated topography overlying the more resistant bedrock formations, the alluvial deposits thin out and terminate against the bedrock. The upper fine-grained alluvial layer varies in thickness from approximately 0 to 27 feet and is primarily comprised of clay and silty clays. The lower alluvial layer, ranging in thickness from 0 to 20 feet, is primarily silty sand, sand, and gravel (TVA 2024).

Plant-specific estimates of horizontal hydraulic conductivity of the alluvium range from 0.54 to 20.6 ft/d (1.9×10^{-4} to 7.3×10^{-3} cm/sec), based on hydraulic property testing (TVA 2024). The geometric mean of the horizontal hydraulic conductivities of the alluvium wells listed in Table H.1-3 of the EAR (TVA 2024) is 1.5 ft/d (5.28×10^{-4} cm/sec).

Vertical hydraulic conductivity of the native unconsolidated materials at the WBF Plant, which includes alluvium and potentially residuum, ranges from 9.4×10^{-6} to 3.2×10^{-2} ft/d (3.3×10^{-9} to 1.1×10^{-5} cm/sec). This range includes estimates from recent laboratory testing results associated with samples typically described as unconsolidated fine-grained (silt/clay) and coarse-grained (sand) alluvial materials (TVA 2024).

3.2.3 Residuum

Silty and clayey soils, referred to as residuum, formed from the *in-situ* weathering of bedrock. The thickness of the residuum was generally not investigated at the site but is considered to consist of little to no unconsolidated materials along some nearby ridges to the west and north of the alluvial flood plain where bedrock is at or near the ground surface. In eastern Tennessee, the residuum is commonly characteristic of the individual bedrock formations over which it lies. Much of the generally shallow residuum over shale retains the original bedrock structures, such as bedding planes, but the rock has generally been converted into silty clay. In general, the residuum grades down into the unweathered shale (Rodgers 1953).

As described in the previous section, vertical hydraulic conductivity of the native unconsolidated materials at the WBF Plant, which may include alluvium and residuum, ranges from 9.4×10^{-6} to 3.2×10^{-2} ft/d (3.3×10^{-9} to 1.1×10^{-5} cm/sec). This range includes estimates from recent laboratory testing results associated with samples typically described as fine-grained (silt/clay) (TVA 2024).

3.2.4 Bedrock

Geologic mapping (Exhibit 2) indicates that the floodplain alluvial deposits at the Slag Disposal Area and the Ash Pond are underlain by bedrock comprised of the Conasauga Group Middle and the Nolichucky Shale. The upper bedrock consists of dark gray-green shale, weathered in the upper few feet, with varying amounts of gray limestone based on boring logs reported in the EAR (TVA 2024). Evidence of weathered bedrock has been observed at several boring logs across the EI area. No hydraulic conductivity testing was available within bedrock at the WBF Plant.

3.3 SURFACE WATER AND HYDROGEOLOGIC BOUNDARIES

The most prominent regional surface water drainage feature in proximity to the WBF Plant is the south-flowing Tennessee River, which is also referred to as the Chickamauga Reservoir or Lake Chickamauga. The WBF Plant lays adjacent to a bend in the Tennessee River, which naturally bounds the WBF Plant to the east. The WBF Plant is located approximately one mile downstream of the Watts Bar Dam and 58 miles upstream of TVA Chickamauga Dam. In the vicinity of the WBF Plant, flow within the Tennessee River is primarily controlled by regulated releases at the Watts Bar Dam and to a lesser extent by downstream releases at the Chickamauga Dam. The seasonal influence of the operating reservoir levels is apparent, with the lowest stages generally occurring during the late fall through early winter months and the highest stages generally occurring during the spring and summer months.

TVA reports high-temporal-resolution elevation data for tailwater at the Watts Bar Dam. Exhibit 7 depicts the recorded stage (average daily stage calculated from hourly data) between January 1, 1994, and December 31, 2023, and precipitation recorded at the Spring City NOAA station. The average daily stage elevation ranged between 675.0 and 693.8 feet above mean sea level (amsl). The river stage fluctuations appear to correlate with winter and summer pool changes that are part of the management of water levels in Watts Bar Reservoir. Both the seasonal influence of the operating reservoir levels and influence of large precipitation events are apparent in the stage data (Exhibit 7).

Several small tributaries or intermittent drainages to the Tennessee River are present at the WBF Plant (see Exhibit 8). Prior to the construction of the WBF Plant, a small tributary to the Tennessee River followed an alignment through the Slag Disposal Area (TVA 2024).

Exhibit 9 shows the physiographic setting of the WBF Plant within the floodplain of the Tennessee River. The key characteristics of the setting are that the plant is situated in a low-lying area along the Tennessee River with higher elevation ridges to the northwest of the plant. The ridges to the west and north serve as a topographic divide to groundwater flow.

3.4 SURFACE RUNOFF AND DRAINAGE FEATURES

Surface runoff and drainage generally occur within or in the immediately adjacent land of each CCR unit. These local drainage networks consist of the following elements to convey stormwater runoff from the site:

- Sheet flow from the surface of the units
- Channelized flow by way of drainage ditches and culverts
- Outlets to adjacent water bodies via flumes and/or stormwater ponds.

Drainage networks within the interior of the units (i.e., within the footprint) are typically sloped to convey water without resulting in erosion or degradation of the soil or geosynthetic cover system present. Through this management of erosion, ditches naturally begin ponding of water during larger storm events to reduce the potential for higher runoff velocities and subsequent erosion. In addition to erosion

prevention, ditches, culverts, and ponds are utilized to retain water during larger storm events and to reduce suspension of solids and conveyance of those to the downstream outlets and water bodies.

Surface runoff from the upgradient Drainage Improvements Area including the former Coal Yard Storage Area drains to a series of ditches parallel to the south and north boundaries of the former Coal Yard Storage Area. The north ditch outlets flow into a small stormwater pond located on the north end of the Slag Disposal Area. The south ditch directs flow from the watershed west of the CCR units, as well as the former Coal Yard Storage Area, into a small ponded area west of the Slag Disposal Area. This ponded area directs flow into a culvert and the western perimeter ditch of the Slag Disposal Area. The ponded area is observed to retain water year-round due to sheet pile walls blocking a majority of the flow path.

Surface runoff from the Slag Disposal Area drains to a series of perimeter ditches parallel to the perimeter access road and / or parallel to the unit perimeter boundary that outlet to stormwater ponds on the north end of the unit or in the south to the Stormwater Pond (Former Ash Pond). On the north side of the Slag Disposal Area, the small stormwater pond outlet discharges directly into the Tennessee River. The southern and western perimeter ditches outlets direct flow into a series of culverts under the gravel access road between the Slag Disposal Area and the Ash Pond. These culverts discharge into the perimeter ditch of the Ash Pond prior to discharging into the Stormwater Pond situated south of the Ash Pond.

Surface runoff from the Ash Pond drain to a series of perimeter ditches located parallel to access roads around the unit. The perimeter ditches direct all surface flow into the Stormwater Pond that outlets flow via a concrete spillway system into the Tennessee River.

4.0 MODELING OVERVIEW

4.1 MODELING APPROACH

The modeling approach was to develop a sub-watershed scale groundwater flow model to simulate the hydrogeologic CSM of the WBF Plant and support evaluation of potential groundwater corrective actions. Although hydrogeologic data are primarily available within the limits of WBF Plant, the sub-watershed scale was selected to incorporate naturally occurring boundary conditions located, where possible, at a sufficient distance from the primary areas of concern (i.e., the vicinity of the CCR units). The Model was developed in general accordance with ASTM International (ASTM) *D5447–17 Standard Guide for Application of a Numerical Groundwater Flow Model to a Site-Specific Problem* and was designed to be consistent with the objectives outlined in Section 1.

The Model was initially prepared to support the development of the hydrogeologic CSM for the WBF Plant and subsequently revised to reflect findings of the EI as presented in the EAR (TVA 2024) and to support the CARA Plan process.

4.2 COMPUTER CODE

To accomplish the approach outlined above, the Model was constructed using the three-dimensional finite-difference MODFLOW-NWT computer code developed by the USGS (Niswonger et al 2011). MODFLOW-NWT is a publicly available groundwater flow simulation program developed by the USGS and is designed to simulate three-dimensional groundwater flow using the finite-difference method (Niswonger et al 2011). The program was selected for this study, in part, because it is thoroughly documented, widely used by consultants, government agencies, and researchers; and is consistently accepted by regulators.

In addition to its attributes of widespread use and acceptance, MODFLOW-NWT was also selected because of its versatile simulation features. MODFLOW-NWT can simulate transient or steady-state saturated groundwater flow in one, two, or three dimensions and offers a variety of boundary conditions, including specified hydraulic head, areal recharge, hydraulic barriers, injection or extraction wells, evapotranspiration, drains, and rivers or streams. Aquifers simulated by MODFLOW-NWT can be confined or unconfined, or convertible between confined and unconfined conditions. MODFLOW-NWT's three-dimensional capability and boundary condition versatility are essential for the simulation of groundwater flow conditions given the hydrostratigraphy of the WBF Plant, which consists of a multi-layered geologic system with variable unit thicknesses, and the hydrogeologic framework necessitates the inclusion of a variety of boundary conditions. MODFLOW-NWT also has improved capabilities for solving problems involving drying and rewetting of cells in unconfined aquifer settings.

The Model was constructed using Groundwater Modeling System (GMS) (Aquaveo 2017) as a graphic user interface for model development and post-processing. GMS allows for ease in model input and for viewing model output.

The Model was used in conjunction with the particle-tracking program MODPATH (Pollock 2016) to evaluate simulated advective groundwater flow pathways and potential capture zones. MODPATH is a particle-tracking post processing package that was developed to compute three-dimensional flow paths using output from steady-state or transient groundwater flow simulations by MODFLOW-NWT. MODPATH was used to evaluate the flow paths and travel times of simulated particles moving through the modeled flow system.

5.0 MODEL CONSTRUCTION

5.1 MODEL DOMAIN AND DISCRETIZATION

The Model domain was selected to encompass the CCR units at the WBF Plant and to extend to natural hydrologic and hydrogeologic boundaries (Section 3.3). The entire Model covers an area of approximately 1.4 square miles and the active model area is approximately 0.7 square miles. The CCR units account for approximately 8 percent (%) of the active Model domain. Exhibit 10a depicts the areal extent of the Model domain.

The Model units are in feet and days. The origin of the Model (lower left corner) is positioned at 2287535.0 feet U.S. Easting and 12927160.0 feet U.S. Northing (North American Datum 1983, Universal Transverse Mercator 16N). As depicted on Exhibit 10b, the Model is rotated 324.34 degrees such that the Tennessee River forms the east and south boundary of the Model domain.

The active domain is generally a triangular shaped area bounded as follows:

- At the eastern side of the Model domain by the Tennessee River
- At the northwestern side of the Model domain by the topographic highs that represent the watershed boundaries
- At the southwestern side of the Model domain by a perennial stream north of the Watts Bar Nuclear Plant.

The Model boundary conditions are described in Section 5.3.

5.1.1 Horizontal Discretization

The Model grid consists of 244 rows and 248 columns and a uniform cell size of 25 by 25 feet. The horizontal discretization of the Model was selected based on the necessity to have a fine enough grid to simulate localized patterns of groundwater flow in the vicinity of the CCR units. Exhibit 10b presents the Model grid.

5.1.2 Vertical Discretization

The Model domain was discretized vertically into six layers to simulate the hydrogeologic framework described in Section 3. The Model layers are defined below. Layer elevations and thicknesses are presented on Exhibit 11a and Exhibit 11b, respectively. A cross-section comparison of the groundwater flow Model and lithologic model is presented on Exhibit 12.

The Model layer, associated hydrostratigraphic unit, and the data source(s) used to define the contact surfaces are described below:

- Layer 1 represents the surficial topsoil or fill material. Outside the limits of the fill material, Layer 1 represents native unconsolidated materials (either residuum or alluvium). The top of Layer 1 represents ground surface elevation and is derived from a USGS seamless digital elevation model (DEM).
- Layer 2 represents the CCR units (CCR material when present and dike materials). A surface representing the elevation of the top and bottom of the CCR units was developed during implementation of the EIP to support the CCR material quantity investigation and was imported as the top and bottom of Layer 2 for the CCR unit areas. Outside the CCR units and the Drainage Improvements Area where CCR material is observed, Layer 2 transitions to either topsoil (unconsolidated native soil) or fine alluvium depending on the location.
- Layers 3 and 4 represent a portion of the native unconsolidated materials, either silt and clay (fine-grained unconsolidated materials) or sand and gravel (coarse-grained unconsolidated materials), respectively. Boring logs were reviewed to identify the approximate elevation of the vertical contact between fine-grained materials (Layer 3) and coarse-grained materials (Layer 4), where both lithologies are present. The sands and gravels above bedrock in Layer 4 represent the uppermost aquifer. The less permeable clays and silts in Layer 3 overlying the uppermost aquifer represent an aquitard.
- Layer 5 represents upper bedrock and was assigned a uniform thickness. A bedrock elevation surface beneath the CCR units and immediately adjacent areas was developed during implementation of the EI to support the CCR material quantity investigations presented in the EAR (TVA 2024). The top of Layer 5 reflects this top of bedrock elevation surface in the vicinity of the CCR units. Outside of this area, which is the modeling area of interest, and in the absence of stratigraphic data, the bedrock surface was assumed to roughly mirror surface topography.
- Layer 6 represents lower bedrock and was assigned a uniform bottom elevation of 546 feet amsl.

The selection of zones for representation of different hydraulic properties is described in the following Section 5.2.

5.2 HYDRAULIC PROPERTIES

Hydraulic property zones defining hydraulic conductivity, storage parameters, and porosity were used to simulate the hydrostratigraphic units within the Model. A total of eight zones were applied to the Model. Exhibit 13 presents the hydraulic property zone distribution. The parameter zone number and representative hydrostratigraphic unit are outlined below:

- Zone 1 represents CCR material.
- Zone 2 represents the constructed dike material.
- Zone 3 represents residuum in the uplands portion of the Model domain. The term “uplands” used herein refers to ridges with comparatively higher ground surface elevation relative to the adjacent low-lying areas within the valley.

- Zone 4 represents fine-grained alluvium and residuum.
- Zones 5 and 6 collectively generally represent the coarse-grained alluvium.
    - Zone 5 represents a less permeable sequence of intermixed fine-grained and coarse-grained alluvium that is inferred to have been deposited toward the edges of the channel fill.
    - Zone 6 represents the coarse-grained alluvium deposited within the historical stream channel area.
- Zones 7 and 8 represent upper and lower bedrock, respectively.

Hydraulic conductivity was a primary calibration variable and is discussed more in Section 60. A range of reasonable hydraulic conductivities was defined using the plant-specific hydraulic property testing results presented in Section 3.2. In the absence of plant-specific data, typical ranges of hydraulic conductivity established in literature values were used as the basis for calibration. The final calibrated horizontal and vertical hydraulic conductivities for each zone are presented in Table 1.

Exhibit 14a presents a box and whiskers plot of the range of horizontal hydraulic conductivity values obtained through plant-specific hydraulic property testing compared to the calibrated horizontal hydraulic conductivity for each zone with plant-specific estimates. As shown on Exhibit 14a, the Model-calibrated horizontal hydraulic conductivity values for most of the zones fall within the range of plant-specific estimates based on hydraulic property testing.

Exhibit 14b presents a box and whiskers plot of the range of vertical hydraulic conductivity values obtained through plant-specific hydraulic property testing compared to the calibrated vertical hydraulic conductivity for each zone with plant-specific estimates. As shown on Exhibit 14b, the Model-calibrated vertical hydraulic conductivity values are generally above the range of laboratory testing results. The laboratory results are inferred to be biased towards lower permeability materials (silt and clay).

Storage parameters are required inputs for performing transient model simulations. There are two main types of storativity: unconfined storage (specific yield) and confined storage (specific storage). Unconfined storage is related to the release of water as the phreatic surface lowers (dewatering of the CCR material); thus, it occurs only along the top boundary of the saturated flow system. At the WBF Plant, unconfined storage applies to pore water within the CCR units due to the confined nature of the uppermost aquifer. Confined storage is related to the release of water as the head drops because of expansion of the water itself as the pressure changes and due to changes in the solid framework of the aquifer (no dewatering occurs). At the WBF Plant, confined storage applies to the uppermost aquifer. Literature ranges were generally used as the basis for establishing a reasonable range of storage values. Storage parameter values applied in the Model are included in Table 1. Storage parameters were assigned to each hydraulic property zone based on the soil type from literature. Sensitivity of the model results to specific yield of CCR material is evaluated in Section 8.5.

Effective porosity values are used for calculating groundwater flow velocities. Literature ranges were generally used as the basis for establishing a reasonable range of effective porosity values. Effective porosity values applied in the Model are included in Table 1.

5.3 BOUNDARY CONDITIONS

5.3.1 Recharge

Recharge is derived from infiltrating precipitation and is applied to the top active layer of the Model (Layer 1). Daily precipitation data are recorded at the Spring City weather station (NOAA Station ID USC00408540), which is located approximately seven miles northwest of the WBF Plant. Average annual precipitation at this location, based on an approximately 20-year average using cumulative annual precipitation during May 2003 through December 2022, is 65.3 inches. A review of monthly data from the same 20-year period indicates that December is the wettest month, and October is the driest month. Precipitation at this station was reported to range between 61 to 71 inches per year with an average of 66.2 inches per year during the calibration period (August 2019 to August 2021).

Seven zones of recharge were utilized across the Model to simulate a range of infiltration rates as controlled by topography, the various surface cover materials, and topsoil types.

Because recharge processes are difficult to directly observe or measure, recharge rates were estimated during the calibration process. Recharge is an integral component of the groundwater flow model and estimates of recharge can be generated through calibration to hydraulic heads directly measured at the WBF Plant. The uncertainty associated with this approach is mitigated though independent estimates of hydraulic properties (hydraulic conductivity and storage). Recharge was varied during calibration iterations (see Section 6.0) to identify a reasonable match to observation data (groundwater elevation measurements, gradient, and flow direction).

Applied recharge values used in the Model are described below, displayed in Exhibit 15, and summarized in Table 2.

- Zone 1 is applied to the Tennessee River floodplain outside of the CCR units. The distribution of the recharge zone is defined using a topographic break identified in the DEM to delineate the inferred boundary between residuum and alluvium. Recharge in Zone 1 is set to 3.51 inches per year.
- Zone 2 is applied to the Slag Disposal Area where there is a soil cover. Recharge in Zone 2 is set to 2.19 inches per year.
- Zone 3 is applied to the Ash Pond where there a geosynthetic cap. Zone 3 was assigned a recharge value of 0.09 inches per year consistent with recharge anticipated following capping or capping modifications with a geomembrane (Moo-Young et al. 2003).
- Zone 4 is applied to the facilities area of the plant, which is largely covered by buildings, pavement and an equipment yard. Recharge in Zone 4 is set to one inch per year.

- Zone 5 is applied to the upland residuum areas. This zone mirrors the extent of uplands residuum coverage. Recharge in Zone 5 is set to 0.18 inches per year. The low recharge rate is characteristic of the thin, low permeability residuum covering low permeability bedrock and steeper slopes which result in a greater proportion of overland runoff during precipitation events.
- Zone 6 is applied to ponded water and Tennessee River waterbody. Zone 6 was assigned a recharge value of 0 inches per year.

5.3.2 Tennessee River

Constant head boundaries represent model cells of constant total (hydraulic and pressure) head in the Model where the Tennessee River is present. Constant head boundary conditions were assigned to cells representing the Tennessee River (Exhibit 10b). The boundary head (682.60 feet amsl) was selected based on average stage data recorded at the Watts Bar Dam tailwater gauge from August 2019 to Augst 2021, to align with the steady-state calibration dataset. For the baseline simulation steady state model, the boundary head was reassigned to be 681.62 feet amsl based on average stage data recorded at the Watts Bar tailwater gauge during a 30-year period from January 1994 to December 2023 (see Exhibit 7). Sensitivity of the model results to change in river stage is evaluated in Section 8.5.

5.3.3 Other Surface Water Features

The stormwater ponds at the former Ash Pond and west of the Drainage Improvements Area and the discharge structure north of the Slag Disposal Area are also represented as constant head boundaries within the Model. The assigned cells were digitized using the DEM and recent aerial photography imagery. Stages of the stormwater ponds were estimated from the DEM and, in the case of the discharge north of the Slag Disposal Area, construction diagrams. The location of the boundary conditions representing the storm water ponds is shown on Exhibit 10b.

5.3.4 Drain (Head-Dependent Flux Boundary)

The MODFLOW Drain package was used to simulate drainage features representing small or intermittent streams. In the Model, geographic representations of the drainages were described using National Hydrography Dataset flowlines (USGS 2019).

Conductance is calculated based on the channel area (length and width), thickness, and hydraulic conductivity of streambed sediments. The applied conductance of drains ranges from 48 to 40,000 square feet per day.

5.3.5 Subsurface Structures Horizontal Flow Barrier

The MODFLOW Horizontal Flow Barrier package was used to simulate the hardening to the shoreline of the Tennessee River through installation of bulkheads to be “partial” barriers to groundwater flow within the groundwater system. The location of this feature and the depth of the barriers (at the top of the upper bedrock) are based on pre-construction design drawings provided by TVA (1943).

A stability wall immediately downgradient of the stormwater pond west of the Drainage Improvements Area was similarly simulated as a Horizontal Flow Barrier. The location of this feature was identified using engineering drawings provided by TVA (1999), and an outlet cut was kept to allow water flow and be consistent with the engineering design.

The partial groundwater barriers were simulated in the Model by assigning a lower hydraulic conductivity value to the boundary of the barrier (Exhibit 10b). The boundaries were placed in Model Layers 1 through 5 within the layers representing unconsolidated materials and upper bedrock.

A hydraulic conductivity of 0.00028 feet per day (1×10^{-7} cm/sec) was assigned to the cells which approximately coincide with the location of the sheet pile to represent no flow exchange between the two sides of the wall.

5.3.6 No Flow

No-flow boundaries represent model cells across which groundwater flow does not occur. Application of the no-flow boundary condition restricts cells from holding or transmitting water, thereby rendering them inactive. The construction of the Model places these boundaries in locations that satisfy the no-flow boundary assumption and at sufficient distance from the CCR units to reduce the influence on Model results in the areas of interest. The active Model domain is bounded by inferred natural hydrologic boundaries to lateral groundwater flow, such as surface watershed boundaries indicating a groundwater divide. The surface watershed boundaries were identified using the online USGS StreamStats tool (https://www.usgs.gov/streamstats). The Model cells outside of the active model domain, depicted on Exhibit 10b, are no-flow cells.

No-flow boundaries also represent the concrete lining at the water discharge feature north of the Slag Disposal Area.

A no-flow boundary is also implicitly included at the bottom of the Model.

6.0 MODEL CALIBRATION

Calibration is the process of adjusting model parameters to produce a reasonable match between simulated and observed groundwater system responses. The Model calibration was performed by developing calibration targets, identifying calibration criteria, and finally conducting model calibration. The calibration criteria represent acceptable model performance with respect to predicted versus observed target values. In the process of calibration, model parameters are adjusted (subject to reasonable bounds) to match observed water levels at wells and piezometers. Calibration is critical in evaluating a model's performance. Calibration target residual analysis can reveal potential trends in residuals, indicating a systematic error in a model or the data.

This section describes the procedure for calibrating the Model and discusses the selection of calibration data and target residual analysis.

6.1 MODEL CALIBRATION APPROACH

Calibration data points are a key element to the success or failure of model development. Information about the Model parameters is drawn from measurements of the groundwater system. Model output and measured data are compared at discrete points in space and time. The differences between the measured and the computed system responses at the calibration points are termed residuals. Calibration is the process of minimizing the residuals by modifying model parameters. For the steady-state model, the calibration targets consisted of water levels (i.e., pore water or groundwater elevations), which are described in Section 6.2.1.

Numerous simulations of MODFLOW-NWT were performed with varying model input parameter values. Adjustments of model input parameters were held within reasonable ranges to limit the differences between the observed and simulated water level calibration targets. The range over which the parameters were varied was derived from the hydrogeologic framework. In addition, the principle of parameter parsimony was applied, where appropriate, to achieve an adequate calibration of the Model through adjustment of the fewest number of model parameters. It should be noted that the use of greater numbers of model parameters during model calibration creates a situation in which different combinations of model parameter values produce similar calibration results. In this case, the Model calibration parameters are considered non-unique. Following the principal of parameter parsimony reduces the degree of non-uniqueness and results in more reliable calibrated parameter values.

During the calibration process each model simulation was compared to plant-specific measured head values (pore water or groundwater elevations). The degree of agreement between the Model simulation and the physical hydrogeological system data was then compared to previous simulations to ascertain the success of alterations made to the Model input parameters in response to previous calibration efforts and to identify potentially beneficial directions for further calibration. Qualitative and quantitative comparisons are both essential in the calibration process. Both were used to evaluate the degree of agreement between the Model simulation and plant-specific information.

6.2 SELECTION OF CALIBRATION DATA

6.2.1 Steady State Calibration

The steady-state calibration targets consisted of observed head values (water levels). The head targets were assigned based on the average pore water and groundwater elevations observed during the period August 2019 to August 2021.The calibration period was selected to provide representative recent, average conditions of the groundwater system at the plant. Wells or piezometers within the Model domain with data recorded during the calibration period were used for calibration.

Exhibit 4 depicts the 26 unique locations used to calibrate the steady-state Model.

6.3 CALIBRATION RESULTS

6.3.1 Steady-State Average Conditions

Residual analysis is used to reveal potential trends in residuals, indicating a systematic error in a model or the data, and can point out aspects in a model that need to be modified. The Model calibration process is intended to minimize the residual and the relative error computed for the head targets in the calibration dataset. A quantitative comparison of the Model's fit to observed data is performed using the calibration statistics derived from model residuals. The calibration statistics indicate that the Model sufficiently represents the measured piezometric surface at the WBF Plant and the local groundwater system. The residual mean of 0.1 feet is close to zero and the scaled residual mean is 0.4%. Residual standard deviation is 2.1 and the range of observed heads is 30.1 feet, resulting in a scaled residual standard deviation of 7.0%. Root mean square (RMS) error is 2.1 resulting in a scaled RMS error of 7.0%. A summary of the steady-state target locations and associated residuals is provided in Table 3. As discussed further in this section, the residual statistics are considered reasonable for a representative groundwater flow model used for the stated objectives.

Exhibit 16 presents a graphical representation of the fit of simulated to observed data. In a perfectly calibrated model, the points would fall directly on the 1:1 match line. A poorly calibrated model would show most points falling very far from the match line. Hence, Exhibit 16 demonstrates that the fit is acceptable, with most points falling close to the match line. There does not appear to be an overall bias relative to the number of points falling above or below the line. The differences between observed and simulated heads are the result of assumptions contained in the Model, such as the scale of discretization, application of simplifications in hydrostratigraphy, and potential unidentified elements of the hydrogeologic framework. The Model captures the major features of the flow system. For example, the phreatic surface heads simulated within the CCR material and directly underlying fine unconsolidated materials in the Model are elevated relative to the groundwater piezometric heads simulated in the coarse-grained alluvium and the groundwater flow direction is generally from west to east with a minor component of radial flow that conforms to the shape of the Tennessee River. This is the same relationship that is observed in the pore water and groundwater elevation data collected from the wells and piezometers.

Exhibit 17 depicts the spatial distribution of head target residuals for each layer. The residuals for Layer 4, which represents the uppermost aquifer, are the smallest and therefore demonstrate the best fit of

observed versus simulated heads. The residuals are greater and more variable for Layer 2. This is inferred to be an artifact of the simplifications in the Model relative to the complexities in this layer. For example, CCR material in the Slag Disposal Area is modeled as a single hydraulic conductivity zone, although stratification and heterogeneity are assumed to be present based on CCR material type and placement method. However, the modeling approach was not intended to introduce complexity without sufficient supporting data, particularly when the overall match of flow directions/system responses is achieved with the applied simplifications.

There does not appear to be a large spatial bias in the residuals. Based on the overall favorable calibration statistics and observed qualitative fit to general flow direction and system response, the Model is considered fit for the intended purpose and suitable to meet project objectives.

Based upon review of residuals depicted on Exhibits 16 and 17, the majority of the data reflect the ability of the Model to capture the important groundwater conditions, particularly for Layer 4 which contains the uppermost aquifer. Given the absolute size of the Model and range in heads across it, these values are considered to indicate a satisfactory calibration, and the Model is suitable to use for the identified objectives.

A qualitative evaluation of the calibration was made by comparing the observed water levels for the WBF Plant with the simulated water levels. Exhibits 18a and 18b depict the simulated contours for pore water and groundwater, respectively, compared to the published contour maps (Stantec 2021) for a representative gauging event within the calibration period (August 2019). The overall elevation, shape, gradient, and position of the observed pore water phreatic and groundwater piezometric surfaces are reasonably simulated by the calibrated Model. The major features of the local hydrogeologic flow system (direction and magnitude of flow) appear to be captured by the calibrated steady-state baseline simulation.

6.3.2 Steady-State Model Convergence Criteria

The quality of an iterative solution is measured by convergence statistics. These parameters include the maximum head change for Model cells (residual change) and the percentage discrepancy between the total flow into and out of the Model (volumetric flow budget discrepancy). Generally, the head change should be small, and the volumetric flow budget discrepancy should be less than 0.1% (Konikow 1996).

The convergence statistics for the final calibrated model are as follows: 0.0001 feet head change and less than 0.001% volumetric flow budget discrepancy. The convergence criteria are small, indicating a good approximation of the solution and model mass balance. The steady-state Model water budget terms are discussed in Section 7.

7.0 BASELINE SIMULATIONS

The following is a summary of the Model output and interpretations related to the simulation of baseline groundwater flow conditions at the WBF Plant.

7.1 SIMULATED STEADY STATE GROUNDWATER FLOW

Model-wide recharge and surface water features, excluding the Tennessee River, comprise the volumetric system inflow of 91% and 9%, respectively. The Tennessee River is the primary outflow (96%) for the system, while the remaining 4% of water is groundwater discharge to drainage features represented by the Model drain boundary condition.

Exhibit 19 depicts the simulated piezometric surface for the Model domain within Layer 4 in the vicinity of the WBF Plant. The simulated piezometric surface is representative of recent, average hydrologic conditions incorporating the Watts Bar Dam tailwater gauge during a 30-year period from January 1994 to December 2023 and recharge rates scaled to the approximately 20-year average annual precipitation (65.3 inches) during May 2003 through December 2022.

The Tennessee River is the local hydrologic low of the groundwater flow system in the vicinity of the WBF Plant. Model simulated and measured groundwater elevations indicate that monitoring wells adjacent to the river are influenced by the river stage, with that influence dissipating away from the surface water body. The higher groundwater elevations in the western portion of the Model domain are natural and associated with the topographic and geologic setting.

The simulated direction of groundwater flow for Model Layers 1 through 4 is depicted using the Model flow vectors on Exhibit 20. The flow vectors are on a logarithmic scale to increase visibility and color coded to show if the vertical component of flow is up or down. The Model simulates primarily vertical flow through Layers 1 and 2 and primarily horizontal flow in the coarse-grained alluvium of Layer 4 and partially in Layer 3 where there is higher hydraulic conductivity. Upward flow components are simulated in the vicinity of surface water bodies (local discharge) and in portions of the upper bedrock unit. The simulated groundwater flow direction within the uppermost aquifer unit (Layer 4 coarse-grained alluvium) is primarily horizontal to the east towards the Tennessee River.

Simulated groundwater velocity is variable at the WBF Plant both laterally and with depth. As shown on Exhibit 21, higher groundwater velocity is observed in the coarse-grained material layers with simulated velocities ranging between 100 and over 1,000 feet/year. Upper and lower bedrock (Layers 5 and 6) groundwater flow velocity is simulated as generally less than 1 to 100 feet/year. Flow velocity is simulated as less than 100 feet/year across most of the CCR units and within the directly underlying fine-grained unconsolidated materials.

8.0 CLOSURE AND CORRECTIVE ACTION SIMULATIONS

Modeling simulations were performed to support evaluation of closure approaches and potential groundwater corrective actions considered in the CARA Plan. Section 8.1 provides an introduction to the modeling simulations, including an overview of the Model predictive simulations performed (Section 8.1.1) and a description of the Model simulation result metrics (Section 8.1.2) that are discussed in the text and depicted on the corresponding attachments. Sections 8.2 through 8.4 present a description of the simulation scenario, an overview of the simulation approach, a description of simulation results, and a comparison of simulation results, if appropriate. The simulations were designed to model CCR unit closure (Section 8.2), individual potential technologies that could be implemented separately from or in addition to closure to augment closure or for corrective actions (Section 8.3), as well as combined elements (Section 8.4), as appropriate. Sensitivity analyses are presented in Section 8.5.

The Ash Pond was closed in 2015 under TDEC Permit TN0005461 in accordance with State regulations applicable at the time of closure. As part of the closure project, CCR material was excavated from the southern area of the Ash Pond and consolidated and capped in the northern area of the Ash Pond using a geosynthetic and soil cover system (CDM Smith 2015). Based on the demonstrated effectiveness of the existing geosynthetic cover system at the Ash Pond, TVA is not planning additional closure actions for this CCR unit. Simulations presented herein are focused on evaluating closure and potential corrective actions at the Slag Disposal Area.

8.1 INTRODUCTION TO MODEL SIMULATIONS

8.1.1 Model Predictive Simulations

Model simulations were initially performed to evaluate the two approaches to CCR unit closure (closure in place and closure by removal), without additional technologies that could be incorporated to augment the closure activities or implement potential corrective actions, such as pore water extraction or groundwater control downgradient of the CCR units (see Section 8.2).

Model simulations were also performed to evaluate technologies that could be implemented separately from CCR unit closure, including targeted hydraulic control of groundwater downgradient of the CCR units (see Section 8.3) and pore water extraction. To facilitate the evaluation of the additional technologies, each technology was simulated independently of the closure method or other potential corrective actions.

Steady-state and transient simulations were performed as described in subsequent sections. Steady-state simulation results are interpreted to represent long-term future conditions when the simulated water levels no longer change in response to the modeled closure or corrective action, once the hydrogeologic system has come to an equilibrium. Transient simulations represent the change in pore water and groundwater levels over time. Model results are presented at specific time periods (e.g. 1, 5, or 10 years) following the implementation of closure and corrective actions. Water levels may still change in response to the closure or corrective action after the specific times discussed in this TM.

8.1.2 Model Simulation Result Metrics

The modeling simulations were designed to inform the closure and corrective action evaluations reported in the CARA Plan. The following list of model simulation results were identified as potential key metrics to support the comparison of closure and corrective action model scenarios, where applicable:

- **Simulated groundwater surface within Model Layer 4**

  The sands and gravels above bedrock in Layer 4 represent the uppermost aquifer. This metric provides an overall depiction of how the groundwater system is simulated to respond to different closure types and groundwater corrective actions. The exhibits associated with the discussion of this metric depict the simulated piezometric surface elevation contours. Simulated flow paths are also depicted on select exhibits to support evaluation of targeted hydraulic control.

- **Simulated groundwater velocity within Model Layer 4**

  This metric is used to support geochemical modeling and understanding of simulated time to achieve groundwater protection standards (GWPS), which is presented in Appendix H of the CARA Plan. The exhibits associated with the discussion of this metric are maps depicting simulated groundwater velocity in units of feet per year. The exhibits also include flow vectors to show simulated direction of groundwater flow.

- **Simulated thickness of CCR material below the pore water phreatic surface**

  This metric provides an overall depiction of how the pore water phreatic surface is simulated to respond to the different closure activities. The exhibits associated with the discussion of this metric are maps depicting the simulated thickness of CCR material below the simulated phreatic surface in units of feet. There are two types of thickness maps: one depicts the steady-state simulation results; the other depicts the results through time for a transient simulation. The thickness of CCR material below the phreatic surface is the difference in elevation between the simulated phreatic surface and the base of the CCR material. The flux of pore water is independent of this metric.

- **Simulated groundwater flux within Model Layer 4 at the lateral boundaries of the CCR units**

  This metric provides a measure of groundwater flux through Layer 4 of the Model (the primary model layer simulating the uppermost aquifer) at the lateral boundaries of the CCR units for potential use in evaluating compliance with GWPS. Groundwater flux is a measure of the volume of water that flows across a specified cross-sectional area of porous media per unit time. The units of flux are typically provided in cubic feet per day or gallons per minute (gpm). This metric is also an indirect measure of simulated extraction rates required for hydraulic control and how those simulated rates decrease with time in response to the system changes caused by closure activities. The exhibits associated with the discussion of this metric are graphs of groundwater flux through time that are plotted as a percentage of simulated baseline groundwater flux.

The results presented below describe qualitative and quantitative observations of model simulation results for the identified key comparative metrics, which are depicted on the accompanying exhibits and summarized in Table 4. Other simulation results, such as groundwater and pore water extraction rates, are included, where applicable.

8.2 CLOSURE SIMULATIONS

The following sections present the predictive simulation modeling of potential CCR unit closure methods.

8.2.1 Closure in Place with Cover System

8.2.1.1 Description of Simulated Closure Type

Modeling closure in place conceptually includes simulation of the effect of source control measures implemented as proposed in the CARA Plan. In this model scenario, the remaining CCR material in the Slag Disposal Area and Drainage Improvements Area will be left in place and covered with an engineered geosynthetic cover system. An engineered geosynthetic cover system and related closure elements, if implemented, would be designed to meet the CCR closure in-place performance standards described in the TDEC Rule 0400-11-01-.4 (TDEC Division of Solid Waste Management). It is anticipated that grading and stormwater management would be performed as part of the overall cover system to promote positive drainage, and control and minimize infiltration into the CCR material. To meet slope stability factors of safety, a buttress of riprap is planned to be constructed along the riverbank of the Slag Disposal Area. To further limit infiltration into the Slag Disposal Area and Drainage Improvements Area, TVA plans additional actions at two upgradient locations. At the Former Coal Yard Storage Area, remnant coal will be removed, and the area regraded and revegetated Upgradient from the Drainage Improvements Area, a ponded area will be filled, regraded and a geosynthetic liner will be installed.

8.2.1.2 Description of Model Changes to Simulate Closure Type

The following methods and assumptions were used to simulate the hydrogeologic system following installation of an engineered geosynthetic cover system:

- The Slag Disposal Area and Drainage Improvement Area were assigned a recharge value of 0.09 inches per year consistent with recharge anticipated following installation of an engineered geosynthetic cover system (Moo-Young et al. 2003).
- The cover system would incorporate other stormwater controls in the vicinity of the CCR unit to manage potential recharge as well as ongoing maintenance of the integrity of the cover system. At the Former Coal Yard Storage Area, remnant coal will be removed, and the area regraded and revegetated. Additionally, a geosynthetic liner is simulated to be installed at the ponded area upgradient of the Drainage Improvements Area; the constant head values representing pond stage were removed; and the stormwater pond was assigned a recharge value of 0.09 inches per year, consistent with recharge anticipated following installation of a geosynthetic liner.

- To meet slope stability factors of safety, a buttress of riprap is planned to be constructed along the riverbank of the Slag Disposal Area and the east side of the Ash Pond. Slag Disposal Area regrading and placement of the buttress material are simulated in the Model through change in Layer 1 top elevation and addition of a hydraulic property zone representing the riprap buttress.
- A steady-state simulation was performed to evaluate the changes to the hydrogeologic system at equilibrium following installation of an engineered geosynthetic cover system as compared to the baseline steady-state simulation described in Section 7.
- In addition, a transient simulation was performed to evaluate the changes to the hydrogeologic system over time in response to a simulated cover system. Initial heads were set to the calibrated steady-state baseline Model solution. The transient Model included a single stress period that covered a period of 30 years.

8.2.1.3 Simulation Results

The qualitative and quantitative observations of model simulation results for the identified key comparative metrics are described below and are summarized on Table 4.

In the simulated steady-state cover system scenario, the Model simulates a system with reduced infiltration through the cover system, which covers the stormwater pond upgradient of the Drainage Improvements Area, the Drainage Improvements Area, and the Slag Disposal Area, compared with the baseline model estimate of recharge. The stormwater controls in the vicinity of the CCR unit are simulated with an estimated 30% reduction in recharge from the baseline simulation. A comparison of the simulated piezometric surface within Layer 4 of the Model (the primary model layer simulating the uppermost aquifer) under baseline conditions versus with a cover system is presented in Exhibit 22. Compared to the baseline simulation, the simulated piezometric surface beneath the Slag Disposal Area with the cover system in place is approximately 2.5 feet lower. In addition, the downward vertical gradient that is observed under baseline conditions is simulated to have reduced as a direct result of the reduced recharge.

Exhibit 23a depicts a comparison of simulated steady-state groundwater flow direction and velocity under baseline conditions versus steady-state closure in place with cover system conditions. Model flow velocities are simulated to decrease slightly in response to the subdued hydraulic gradients that are a direct result of the installation of a cover system.

Exhibit 23b depicts a comparison of the simulated steady-state thickness of CCR material below the phreatic surface under baseline conditions versus closure in place with a cover system. Under the steady-state simulation with a cover system in place, the thickness of CCR material below the phreatic surface is simulated to be reduced in comparison with the baseline simulation. The phreatic surface is simulated to drop below the base of CCR material in areas of the unit that are underlain by native unconsolidated materials at higher elevations most notably in the area between the Drainage Improvements Area and the Slag Disposal Area and in the south and east portions of the Slag Disposal Area. The simulated reduction of pore water heads and CCR material thickness below the phreatic surface are indicative of source

control. Qualitative comparisons of the thickness of CCR material below the phreatic surface are summarized in Table 4.

Exhibit 24 presents the progression of simulated thickness of CCR material below the phreatic surface through time in response to the cover system installation based on the transient model simulation during the first 10 years following closure in place. Under the baseline scenario, the thickness of CCR material below the phreatic surface ranges from 0 to 18 feet. At 10 years following installation of the cover system, the thickness of CCR material below the phreatic surface is simulated to be reduced to a range of 0 to 6 feet across the Slag Disposal Area with a large area at less than one foot of CCR material below the phreatic surface. Within the Drainage Improvements Area, reductions in the thickness of CCR material below the phreatic surface were mainly observed on the south side of the area. The reduction in CCR material thickness below the phreatic surface following cover system installation is simulated to continue through time until reaching the steady-state conditions depicted on Exhibit 24.

Exhibit 25 shows the simulated change in horizontal groundwater flux within Model Layer 4 at the lateral boundaries of the CCR unit. The simulated groundwater flux is predicted to decrease to approximately 85% of the baseline modeled flux within 10 years in response to installation of a cover system.

The simulation results are sensitive to the input parameters, and underlying assumptions of the Model. sensitivity is further discussed in Section 8.5.

8.2.2 Closure by Removal

8.2.2.1 Description of Simulated Closure Type

Modeling closure by removal conceptually consists of removal of CCR material and affected areas from the CCR units. In this modeled scenario, the remaining CCR material in the CCR units would be removed. In the closure by removal scenario it is assumed that both the Slag Disposal Area and Ash Pond would be removed.

Closure by removal involves excavation and relocation of the CCR material, underlying impacted soil, if present, and support structures within the CCR unit footprint. Closure by removal would be anticipated to include construction activities to grade and revegetate the CCR unit area.

8.2.2.2 Description of Model Changes to Simulate Closure Type

The following methods and assumptions were used to simulate the hydrogeologic system following implementation of closure-by-removal:

- Within the CCR unit area, the Model layer elevations were modified based on an assumed final grade elevation approximately equal to the pre-existing grade prior to the construction of the CCR units. In addition, a drain boundary condition is simulated to represent restoration of a historic drainage feature.
- The CCR unit area was assigned a recharge value of 1.75 inches per year. This rate is equal to 50% of the background recharge rate that is assigned to the Tennessee River basin floodplain.

The reduced recharge is anticipated to account for anticipated increase in evapotranspiration a result of revegetation and removal of overlying material.

- At the Former Coal Yard Storage Area, remnant coal will be removed and the area regraded and revegetated. Additionally, a geosynthetic liner is simulated to be installed at the ponded area upgradient of the Drainage Improvements Area; the constant head values representing pond stage were removed; and the pond was assigned a recharge value of 0.09 inches per year, consistent with recharge anticipated following installation of a geosynthetic liner.
- For the purposes of this TM, a steady-state simulation was used to predict conditions following implementation of the removal activities.

8.2.2.3 Simulation Results

The simulated piezometric surface within Model Layer 4 (the primary model layer simulating the uppermost aquifer) is presented in Exhibit 26. The incorporated stormwater controls in the vicinity of the CCR unit simulates an estimated 30% reduction in recharge from the baseline simulation. Compared to the baseline simulation, the piezometric surface beneath the former CCR unit following closure by removal is approximately 5 to 10 feet lower than the baseline simulation, which can be attributed to the modified post-closure grade, restoration of drainage features, and reduction in recharge.

Exhibit 27 depicts a comparison of simulated steady-state groundwater flow direction and velocity under baseline and post-CCR removal simulations. Model flow velocities and direction of groundwater flow in response to the closure-by-removal approach are both simulated to be similar to the baseline simulation. The modeled groundwater flux at the lateral boundaries of the former CCR unit is also similar to the baseline scenario.

8.2.3 Comparison of Simulation Results

Closure in place with a cover system is simulated to produce an increase (approximately 12%) in the modeled groundwater flux at the lateral boundaries of the CCR units in comparison with closure by removal, which is simulated to be similar to the baseline simulation.

8.3 POTENTIAL TECHNOLOGY EVALUATION

The following sections present the predictive simulation modeling of potential individual technologies to support a corrective action for groundwater or to be implemented as part of closure activities.

8.3.1 Targeted Hydraulic Control

8.3.1.1 Description of Simulated Component

These simulations were performed to evaluate the conceptual operation of a groundwater extraction hydraulic control system positioned hydraulically downgradient of portions of the Slag Disposal Area and Drainage Improvements Area. The groundwater extraction systems would be designed to target areas requiring corrective action.

8.3.1.2 Description of Model Changes to Simulate Component

The following methods and assumptions were used to simulate a groundwater extraction hydraulic control system at the WBF Plant:

- The MODFLOW drain package was used to simulate groundwater extraction from the simulated well locations. This allowed for setting a targeted groundwater elevation and allowing the Model to calculate the simulated steady-state groundwater extraction rate. The MODFLOW drain package is a specified head boundary type that allows simulation of extraction wells operated to maintain a set head elevation in contrast to the well package which simulates extraction at a set flow rate (specified flux). The drain boundary is anticipated to more closely simulate how the hydraulic control system may be operated. It is anticipated that extraction would be operated to maintain a head elevation that would result in hydraulic control of the targeted zone.

- The simulated extraction wells were placed on the downgradient boundaries of portions of the Slag Disposal Area in Model Layer 4, based on the targeted groundwater elevation.

- A combination of well spacing and groundwater drawdown elevations was utilized to develop a conceptual well layout that would provide hydraulic control while avoiding over-pumping and excessive drawdown. For the presented results, hydraulic control was simulated for the Slag Disposal Area and Drainage Improvements Area using five wells with approximately a 140- to 260-foot variable spacing along the southern segment of the Slag Disposal Area downgradient boundary, and a 300- to 330-foot variable spacing along the northern segment of the Slag Disposal Area downgradient boundary (Exhibit 28). It is anticipated that the detailed design will build upon the conceptual simulations included with this document and that detailed plans and specifications will be prepared. In some cases, additional delineation (installation of additional monitoring wells and subsequent monitoring) or additional pumping tests may be performed during the design phase to refine the design of the extraction systems.

- Actions to further limit infiltration upgradient of the Slag Disposal Area and Drainage Improvements Area are assumed to be completed in conjunction with targeted hydraulic control. At the Former Coal Yard Storage Area, remnant coal will be removed and the area regraded and revegetated. Additionally, a geosynthetic liner is simulated to be installed at the ponded area upgradient of the Drainage Improvements Area, the constant head values representing water levels in the ponded were removed, and the ponded area was assigned a recharge value of 0.09 inches per year consistent with recharge anticipated following installation of a geosynthetic liner.

- To meet slope stability factors of safety, a buttress of riprap is planned to be constructed along the riverbank of the Slag Disposal Area. The Slag Disposal Area regrading and placement of the buttress material are simulated in the Model through change in the Layer 1 top elevation and addition of a hydraulic property zone representing the riprap buttress.

- Forward particle tracing was used to demonstrate groundwater hydraulic control efficacy. Particles were placed in a line upgradient of the groundwater extraction wells and moved forward in time using the simulated steady-state groundwater flow field. The particle traces were

examined to determine if the proposed well layout and target pumping elevations would capture the particles and demonstrate hydraulic control for the targeted areas.

8.3.1.3 Simulation Results

Exhibit 28 shows the targeted zones for groundwater extraction used to develop the conceptual well layouts for this scenario and the simulated piezometric surface within Layer 4 of the Model. The incorporated stormwater controls in the vicinity of the CCR unit simulates an estimated 30% reduction in recharge from the baseline simulation. The particle traces show capture by the proposed groundwater extraction wells and demonstrate hydraulic control for the targeted areas. For the Slag Disposal Area and Drainage Improvements Area, modeled steady-state groundwater extraction rates are approximately 15 gpm for the simulated well spacing with the wells extracting an average of 2.5 gpm for the steady-state simulation.

8.3.2 Pore Water Extraction

8.3.2.1 Description of Simulated Component

These simulations were performed to evaluate the conceptual operation of a pore water extraction system to lower the elevation of the phreatic surface within the Slag Disposal Area and Drainage Improvements Area. Pore water extraction generally refers to the active (e.g., pumping) removal of water within the pore space of CCR material.

8.3.2.2 Description of Model Changes to Simulate Component

Based on an evaluation of extraction methods described in the CARA Plan Appendix K, *Pore Water Extraction Technology Evaluation TM*, horizontal extraction wells were identified as the preferred approach for pore water extraction within the Slag Disposal Area and Drainage Improvements Area, if necessary. The following methods and assumptions were used to simulate pore water extraction:

- The MODFLOW drain package was used to simulate pumping extraction from the Model cells along each proposed horizontal extraction well alignment. This included setting a targeted pore water elevation and allowing the Model to calculate the simulated steady-state extraction rate. Through this modeling approach, it is assumed that flow within the CCR material to the horizontal extraction wells will be controlled by setting a targeted extraction elevation at the base of the unit with an approximately 1% slope to the end of the alignment.

- Heterogeneity and anisotropy are anticipated to influence practicability of this approach but were not explicitly tested in this evaluation. A discussion on the limitations of this pore water extraction technology as applied to the WBF Plant is presented in the CARA Plan, Appendix K.

- At the former Coal Yard Storage Area, remnant coal will be removed and the area regraded and revegetated. Additionally, a geosynthetic liner is simulated to be installed at the ponded area upgradient of the Drainage Improvements Area, the constant head values representing pond stage were removed, and the pond was assigned a recharge value of 0.09 inches per year, consistent with recharge anticipated following installation of a geosynthetic liner.

- To meet slope stability factors of safety, a buttress of riprap is planned to be constructed along the riverbank of the Slag Disposal Area. The Slag Disposal Area regrading and placement of the buttress material are simulated in the Model through change in the Layer 1 top elevation and addition of a hydraulic property zone representing the riprap buttress.
- A steady-state simulation was performed to evaluate the changes to the hydrogeologic system at equilibrium following extraction as compared to the baseline simulation described in Section 7.
- A transient simulation was performed to evaluate the changes to the hydrogeologic system over time in response to simulated extraction. Initial heads were set to the calibrated baseline steady-state Model solution. The transient Model included a single stress period that covered a period of 30 years.

8.3.2.3 Simulation Results

The simulated pore water extraction system wells and the elevation of the bottom of the CCR material (i.e., top of foundation soils) used to decide the extraction well locations are shown on Exhibit 29. As shown in Exhibit 29, two horizontal pore water extraction wells were simulated in the Slag Disposal Area and one horizontal pore water extraction well was simulated in the Drainage Improvements Area.

Exhibit 30 shows the modeled horizontal pore water extraction well locations and compares the baseline and modeled piezometric surfaces in Model Layer 4. Compared to the baseline simulation, the piezometric surface is slightly lower due to the interception of groundwater recharge from the overlying units and lowering of the phreatic surface by pumping of the horizontal pore water extraction wells.

Exhibit 31a depicts a comparison of simulated groundwater flow direction and velocity under baseline and pore water extraction conditions. Model flow velocities in Layer 4 are simulated to increase in magnitude and reverse in vertical flow direction in areas located beneath the horizontal extraction well alignments, most notably in the Drainage Improvements Area. Exhibit 31b shows the steady-state modeled thickness of CCR material below the phreatic surface under baseline and pore water extraction conditions. The thickness of CCR material below the phreatic surface is simulated to decrease in areas near the horizontal extraction well alignments, and the simulated phreatic surface is near (within one foot) the CCR material base or absent in locations proximal to the horizontal pore water extraction wells.

Exhibit 32 presents the progression of simulated thickness of CCR material below the phreatic surface through time in response to pore water extraction based on the transient model simulation during the first 10 years of pore water extraction. As shown in Exhibit 32, noticeable reduction in modeled CCR material thickness below the phreatic surface is shown over the initial period of pore water extraction, but it appears to have reached a stable configuration at approximately 10 years. The reduction in CCR material thickness below the phreatic surface is simulated to continue through time until reaching the steady-state conditions depicted on Exhibit 31b.

The simulated rate of pore water extraction over time from the Slag Disposal Area and Drainage Improvements Area with simulated horizontal extraction wells is shown in Exhibit 33. The early timestep data appear to over-estimate the practical limitations of extraction rates due to the numerical approach

utilized within MODFLOW, which instantaneously removes pore water in the assigned drain boundary cells. Instead, these values should be considered in the context of the total volume of pore water that must be removed initially from the saturated area of the installed wells prior to establishing an equilibrium extraction rate. The horizontal pore water extraction system is simulated to approach an asymptotic combined extraction rate of approximately six gpm within 10 years.

Exhibit 34 shows the simulated change in horizontal groundwater flux within Model Layer 4 at the lateral boundaries of the CCR unit. The modeled groundwater flux is simulated to decrease to approximately 90% of the baseline modeled flux within 10 years of beginning pore water extraction.

The simulation results are sensitive to the input parameters and underlying assumptions of the Model. Sensitivity is further discussed in Section 8.5.

8.4 PLANNED CLOSURE AND CORRECTIVE ACTIONS

Based on the comprehensive investigations and conclusions of the site-specific evaluations, TVA is planning continued closure in place of the WBF Plant CCR units with engineered geosynthetic cover systems. The planned targeted groundwater corrective action is *groundwater extraction*, for which the groundwater flow conditions are represented in the targeted hydraulic control simulation. Detailed modeling components and results are discussed in Section 8.3.1.

8.5 SENSITIVITY ANALYSIS

As described in the preceding sections, the Model is a simplified version of a complex hydrogeologic system and presents a non-unique solution. The simulation results are sensitive to parameters and boundary conditions applied to the Model. The degree of sensitivity is discussed below. The discussion below also describes how important the sensitivity may be for interpreting the Model results.

8.5.1 River Stage

As discussed in Section 3.3, the stage recorded at Watts Bar Dam tailwater ranges between 675 and 694 feet amsl. For the Tennessee River, the seasonal influence of the operating reservoir levels is apparent, with the lowest stages generally occurring during the winter through spring months and the highest stages generally occurring during the summer and fall months. The baseline Model boundary head for Tennessee River was selected based on average river stage data recorded at the Watts Bar Dam tailwater during the two-year calibration period (681.6 feet amsl). The two-year river stage calibration dataset used is consistent with the longer-term data discussed in Section 3.3. To quantify the sensitivity of the baseline Model to surface water stage, the Tennessee River boundary conditions were adjusted to representative high stage (691.5 feet amsl) and low stage (677.1 feet amsl) settings estimated from Watts Bar Dam tailwater elevation records during the same two-year period (July 2019 to July 2021; see Exhibit 7).

The simulated piezometric surface within Layer 4 of the Model for the low and high stage scenarios is presented in Exhibit 35 for comparison to the baseline simulation results. During the low stage season, the simulated piezometric surface beneath the CCR units is lower by approximately 2.5 feet. Conversely,

the simulated piezometric surface beneath the CCR units during the high stage season is approximately five feet higher. For both scenarios, the simulated direction of groundwater flow is consistent with the baseline simulation.

As shown in the table below, the Model simulates greater groundwater flux within Model Layer 4 at the lateral boundaries of the CCR units during a low stage season (7.5 gpm), while the Model simulates less groundwater flux during a high stage season (5.2 gpm). The baseline Model simulates a representative approximation of average piezometric surface conditions.

Steady-State Model Scenario	Boundary Condition Stage Elevation (feet)	Simulated Groundwater Flux (gpm)
Low Water Level Season	677.1	7.5
Baseline [average] Conditions	681.6	6.7
High Water Level Season	691.5	5.2

Lowering of the river stage in the Model simulations by 4.5 feet produced a 0.8 gpm (11%) increase in flux, whereas the raising of the river stage by 9.9 feet produced a 1.5 gpm (23%) decrease in flux.

8.5.2 Specific Yield

As described in Section 5.2, storage parameters are required inputs for performing transient model simulations. At the WBF Plant, unconfined storage (specific yield) applies to pore water within the CCR units and is therefore applicable to the scenarios that specifically simulate flow in the unconfined portion of the system (i.e., installation of a cover system or pore water extraction). To quantify the sensitivity of the Model to specific yield, the steady-state closure-in-place scenario was performed with specific yield ranging from 5% to 15% to bracket the calibrated parameter value (10%).

The range of simulated pore water elevations at an interior location within the Slag Disposal Area is shown through the transient simulation on Exhibit 36. The range of simulated percentages of baseline groundwater flux within Model Layer 4 at the lateral boundaries of the CCR units throughout the transient simulation is depicted on Exhibit 37 and the table below.

Transient Simulation (sensitivity to Specific Yield)	Specific Yield	Baseline	5 Years Following Installation of Cover System	10 Years Following Installation of Cover System	20 Years Following Installation of Cover System	30 Years Following Installation of Cover System
Percentage of Baseline Groundwater Flux (Model Layer 4, lateral boundaries of the CCR Unit)	5%	100%	87.0%	84.3%	83.3%	83.2%
	10%	100%	88.8%	85.2%	83.4%	83.2%
	15%	100%	90.4%	86.3%	83.7%	83.3%

The pore water elevations and groundwater flux are simulated to decline at similar rates with different specific yield settings. These results indicate that rate of response of the pore water phreatic surface to source control measures (e.g., installation of a cover system or pore water extraction) is not sensitive to specific yield.

9.0 MODEL LIMITATIONS

There is uncertainty associated with the numerical simulation of groundwater flow, particularly complex hydrogeologic systems. The Model represents a simplified version of the current understanding of hydrogeologic conditions at the WBF Plant using the data and information available at the time the Model was constructed and this TM was issued. As such, there is a potential that the input parameters and underlying assumptions used to develop the Model may not be fully representative of the complexities of the WBF Plant groundwater system. Based on the Model calibration and the current understanding of the hydrogeologic system, the calibrated Model is considered a reliable tool to meet the objectives of the modeling study. However, because the Model represents a non-unique solution, prudence should be used in interpreting and applying the simulation results.

Although true steady-state conditions generally are not observed in natural systems, steady-state models are widely used to represent long term natural conditions, when appropriate. All groundwater systems fluctuate in response to climatic and boundary condition variations that can be temporal (daily, seasonal, anthropogenic, etc.). For the steady-state Model, the assumption is made that the system can be represented by a state of approximate equilibrium conditions.

It is expected that the Model may be utilized on an ongoing basis to provide continued support for further evaluation of the final groundwater corrective action and closure plans.

Additional data, such as hydraulic conductivity testing data, water level measurements, and time-series groundwater quality data, may be beneficial in further verifying the Model and may be incorporated into the Model, as available and appropriate. The Model may be periodically updated to incorporate relevant changes to the WBF Plant as ongoing projects are completed, if warranted based on project objectives.

10.0 REFERENCES

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TABLES

Table 1 - Summary of Hydraulic Property Values Applied to the Model
Watts Bar Fossil Plant

Zone	Description	Kh (ft/d)	Kv (ft/d)	Specific Storage	Specific Yield	Porosity
1	CCR material in Slag Disposal Area, Drainage Improvement Area, and Ash Pond	0.07	1.78E-03	2.0E-05	0.10	0.45
2	Constructed Dikes (clay fill)	0.02	6.67E-03	2.0E-05	0.10	0.40
3	Upland Residuum (primarily clay)	0.20	6.67E-02	2.0E-04	0.10	0.35
4	Fine-Grained Alluvium/Residuum (silt/clay)	0.06	1.63E-02	1.0E-03	0.10	0.40
5	Coarse-Grained Alluvium (silty sand)	2.84	1.61E+00	1.0E-03	0.10	0.30
6	Coarse-Grained Alluvium (sand and gravel)	15	5.00E+00	2.9E-05	0.25	0.30
7	Upper Bedrock	0.125	4.17E-02	2.0E-04	0.05	0.10
8	Lower Bedrock	0.0125	4.17E-03	1.0E-05	0.01	0.05

Abbreviations:

CCR	coal combustion residuals
ft/d	feet per day
Kh	Horizontal hydraulic conductivity
Kv	Vertical hydraulic conductivity

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Table 2 - Summary of Model-Applied Recharge
Watts Bar Fossil Plant

Zone	Description	Recharge (ft/d)	Recharge (in/yr)
1	Tennessee River Floodplain	8.0E-04	3.51
2	Slag Disposal Area (Soil Cover)	5.0E-04	2.19
3	Ash Pond (Geosynthetic Cap)	2.1E-05	0.09
4	Facility area of the Plant	2.3E-04	1.00
5	Upland Residuum	4.1E-05	0.18
6	Ponded Water and Tennessee River Waterbody	0.0E+00	0.00

Abbreviations:

CCR	coal combustion residuals
ft/d	feet per day
in/yr	inches per year

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Table 3 - Summary of Steady-State Head Calibration Targets
Cumberland Fossil Plant

Target Name	X[1]	Y[1]	Area	Location Type	Layer	Observed Head (feet amsl)	Computed Head (feet amsl)	Residual (feet)
MW-1	2,299,799	12,934,552	Ash Pond	Monitoring Well	4	704.5	704.8	-0.3
MW-2	2,300,430	12,933,719	Ash Pond	Monitoring Well	3	686.5	685.5	1.0
MW-3	2,300,519	12,934,060	Ash Pond	Monitoring Well	3	681.1	684.5	-3.3
WBF-100	2,299,660	12,933,936	Ash Pond	Monitoring Well	3	699.3	700.9	-1.6
WBF-101	2,300,489	12,934,460	Ash Pond	Monitoring Well	4	687.9	687.7	0.1
WBF-102	2,299,741	12,934,320	Ash Pond	Monitoring Well	3	702.6	703.9	-1.2
WBF-103	2,299,172	12,935,334	-	Monitoring Well	3	710.3	712.7	-2.4
WBF-104	2,300,601	12,934,920	Slag Disposal Area	Monitoring Well	4	683.6	686.1	-2.6
WBF-105	2,300,532	12,935,634	Slag Disposal Area	Monitoring Well	4	691.6	692.9	-1.3
WBF-106	2,300,344	12,936,454	Slag Disposal Area	Monitoring Well	4	692.8	695.8	-3.1
WBF-B02A	2,299,940	12,935,134	Slag Disposal Area	Vibrating Wire Piezometer	2	709.8	706.8	3.0
WBF-B02C	2,299,940	12,935,134	Slag Disposal Area	Vibrating Wire Piezometer	4	707.4	705.5	1.9
WBF-B03B	2,300,542	12,935,195	Slag Disposal Area	Vibrating Wire Piezometer	4	696.1	695.4	0.8
WBF-B04A	2,300,415	12,935,403	Slag Disposal Area	Vibrating Wire Piezometer	2	704.1	701.4	2.7
WBF-B04C	2,300,415	12,935,403	Slag Disposal Area	Vibrating Wire Piezometer	4	700.2	698.5	1.7
WBF-B05A	2,300,202	12,935,410	Slag Disposal Area	Vibrating Wire Piezometer	2	704.6	704.1	0.5
WBF-B05C	2,300,202	12,935,410	Slag Disposal Area	Vibrating Wire Piezometer	4	705.1	702.0	3.1
WBF-B12B	2,300,551	12,935,089	Slag Disposal Area	Vibrating Wire Piezometer	4	694.3	692.8	1.5
WBF-B13B	2,300,550	12,935,420	Slag Disposal Area	Vibrating Wire Piezometer	4	689.5	691.3	-1.8
WBF-B15A	2,299,526	12,935,257	Drainage Improvements Area	Vibrating Wire Piezometer	2	711.2	712.0	-0.8
WBF-B15B	2,299,526	12,935,257	Drainage Improvements Area	Vibrating Wire Piezometer	4	710.7	711.5	-0.8
WBF-B16B	2,299,642	12,935,247	Slag Disposal Area	Vibrating Wire Piezometer	4	710.1	710.4	-0.3
WBF-TW02	2,300,328	12,934,266	Ash Pond	Monitoring Well	2	695.3	690.0	5.2
WBF-TW03	2,300,272	12,934,870	Slag Disposal Area	Monitoring Well	2	704.5	702.2	2.3
WBF-TW04	2,300,019	12,935,313	Slag Disposal Area	Monitoring Well	2	707.0	708.5	-1.5
WBF-TW05	2,300,361	12,935,837	Slag Disposal Area	Monitoring Well	2	704.2	703.5	0.7

Notes:
1. Horizontal coordinates provided in UTM 16N (NAD83, U.S. feet).

Summary Statistics:

Residual Mean	0.1
Absolute Residual Mean	1.8
Residual Standard Deviation	2.1
Sum of Squares	114.7
RMS Error	2.1
Minimum Residual	-3.3 feet
Maximum Residual	5.2 feet
Number of Observations	26
Range in Observations	30.1 feet
Scaled Residual Standard Deviation	7.0%
Scaled Absolute Residual Mean	5.8%
Scaled RMS Error	7.0%
Scaled Residual Mean	0.4%

Table 4
Summary of Key Metrics for Evaluation of Simulation Modeling Results
Groundwater Flow Modeling Technical Memorandum
Watts Bar Fossil Plant, Spring City, Tennessee

			Closure Simulations *Section 8.2*		**Potential Technology Evaluation** *Section 8.3*	
Model Simulation Results		**Baseline**	**Closure in Place with Cover System**	**Closure by Removal**	**Targeted Hydraulic Control**	**Pore Water Extraction**
Simulated Thickness of CCR Material below Phreatic Surface (Transient Simulation, Year 30)		*Baseline*	Reduced	None Remaining	No Change	Reduced
Groundwater Flux at Lateral Boundaries of the CCR Units (gpm)	*Steady-State*	*6.7*	5.5	6.0	8.6	6.0
	10 Years	*No Change*	5.7	No Change	No Change	6.0
	20 Years		5.6			6.0
	30 Years		5.5			6.0
Pore Water Extraction Rate (gpm)	*Steady-State*	*0.0*	0.0	0.0	0.0	5.9
	10 Years					6.0
	20 Years					5.9
	30 Years					5.9
Groundwater Extraction Rate (gpm)	*Steady-State*	*0.0*	0.0	0.0	14.8	0.0
	10 Years				No Change	
	20 Years					
	30 Years					

Notes

1. Baseline refers to the calibrated steady-state model simulation output.
2. The simulated values presented above should be considered approximate.

Abbreviations:

CCR	coal combustion residuals
gpm	gallons per minute

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EXHIBITS

Exhibit No.
1

DRAFT

Title
WBF Plant Overview

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

Project Location
Spring City, Tennessee

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

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

Legend

- National Pollutant Discharge Elimination System (NPDES) Outfalls (Historical)
- Historical Stream Alignment
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

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

Stantec TVA

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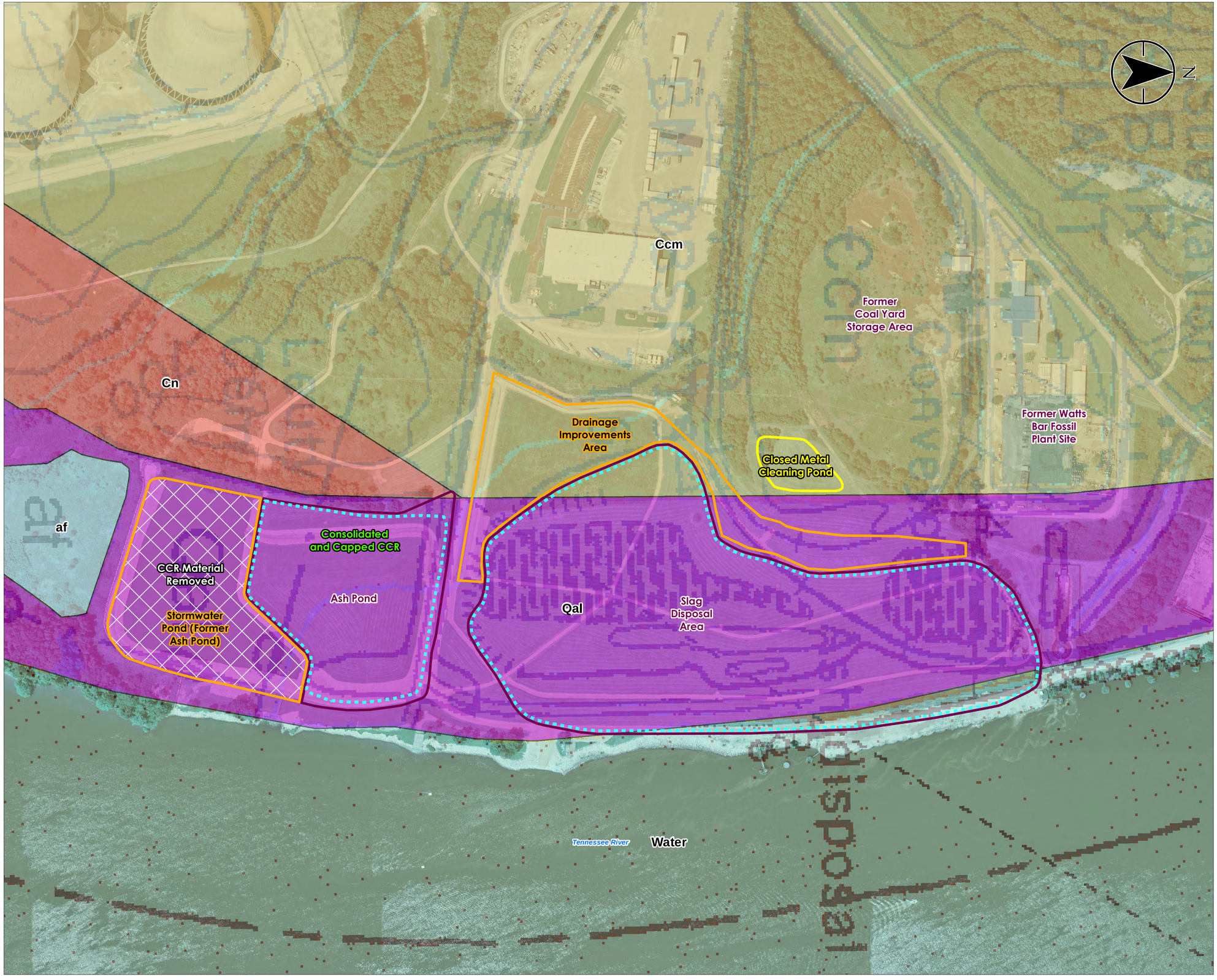

Exhibit No.
2

DRAFT

Title
Geologic Map

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

Project Location
Spring City, Tennessee

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

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

Legend

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

Geologic Formation

- Af - Artificial Fill
- Qal - Surficial Deposits
- Ccm - Conasauga Group Middle
- Cn - Nolichucky Shale

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)
3. Geologic Map: USGS TVA, Decatur Quadrangle, 1973

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Exhibit No.
3

DRAFT

Title
Subsurface Investigation Locations

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

Project Location
Spring City, Tennessee

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

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

Legend

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

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023) and Esri World Imagery
   Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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Exhibit No.
4

DRAFT

Title

Monitoring Well and Piezometer Network

Client/Project

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

Project Location

Spring City, Tennessee

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

0 150 300 450 600 Feet

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

Legend

- TDEC Order Groundwater Monitoring Well
- Existing Groundwater Monitoring Well
- TDEC Order Vibrating Wire Piezometer Measuring Groundwater
- TDEC Order Temporary Well Screened in CCR Material
- TDEC Order Vibrating Wire Piezometer Measuring Pore water in CCR Material
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

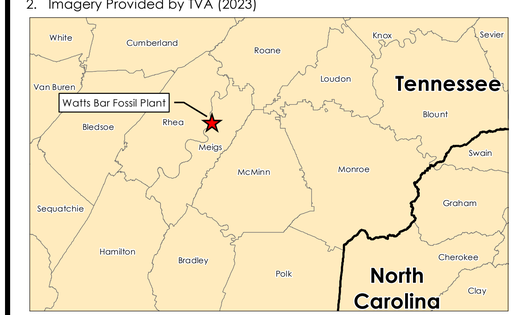

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Exhibit No.
5

DRAFT

Title
Hydraulic Property Testing Locations

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

Project Location
Spring City, Tennessee

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

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

Legend

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

Slug Tests	Laboratory Tests
WBF-101	WBF-B01
WBF-103	WBF-B03
WBF-104	WBF-B05
WBF-105	WBF-B06
WBF-106	WBF-B07
WBF-TW03	WBF-B08
WBF-TW04	WBF-TW01
WBF-TW05	WBF-TW02
	WBF-TW03
	WBF-TW04
	WBF-TW05

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

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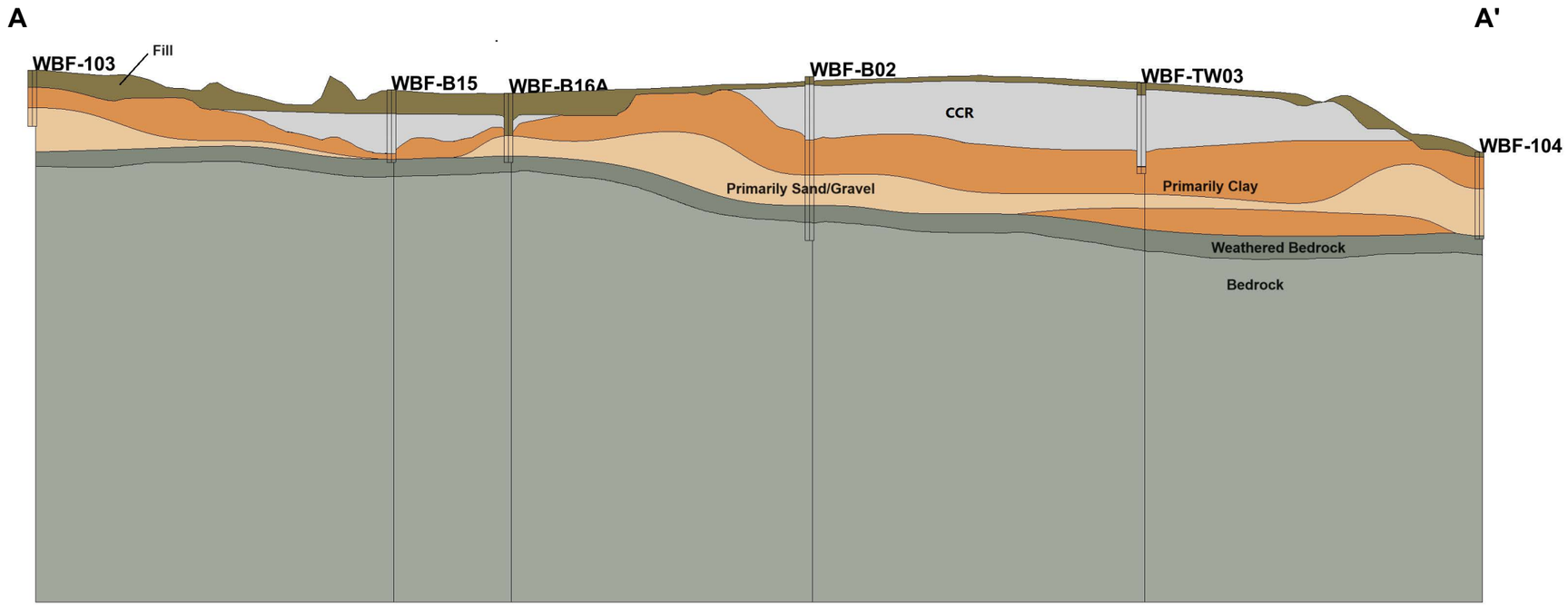

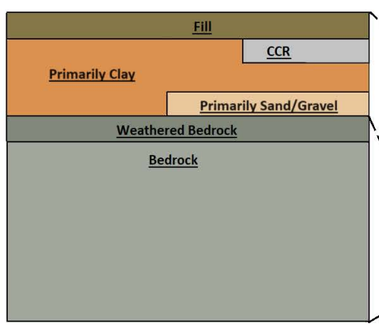

Artificial Fill: stiff silty and/or sandy clay containing rock fragments.

CCR: ash, gypsum, and other non-native fill materials.

Primarily Clay: fine alluvium deposits consisting of clay and silty clays that coarsen with depth; and/or silty/clay residual soils.

Primarily Sand/Gravel: silty sand, sand, and gravel with variable clay.

Bedrock: weathered bedrock and bedrock

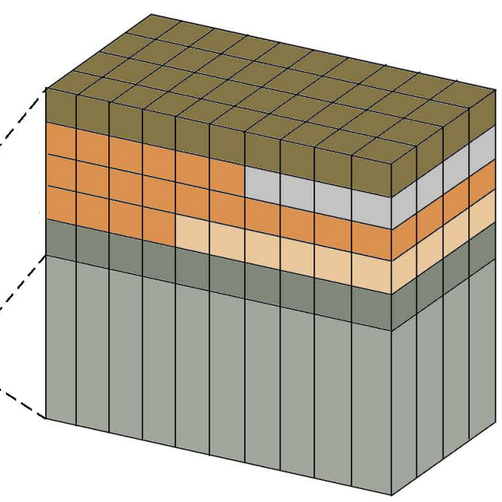

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Exhibit No.

6

Title

Conceptual Cross-Section and Hydrostratigraphic Column

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-08
TR by SW on 2024-07-08
IR Review by RB on 2024-07-08

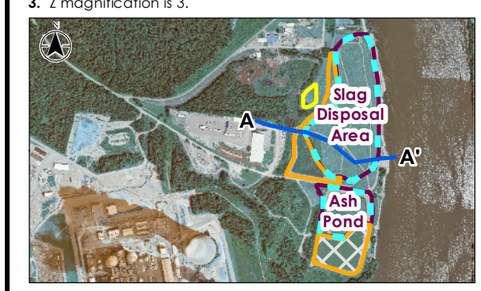
Legend

- Conceptual Cross-Section Transect
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Background: TVA (2023)
3. Z magnification is 3.



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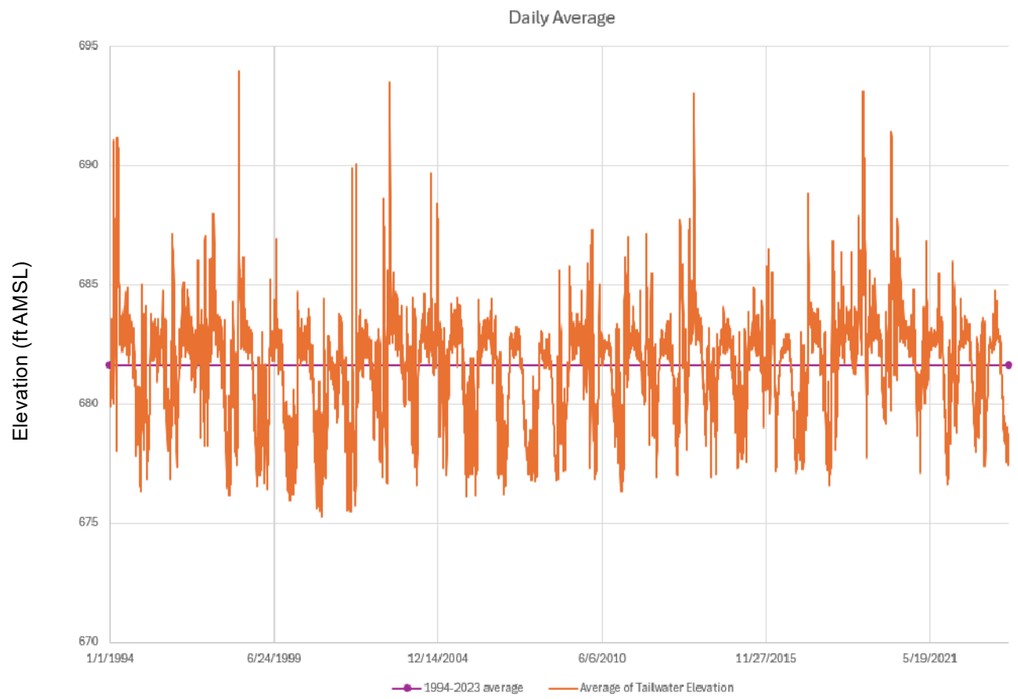

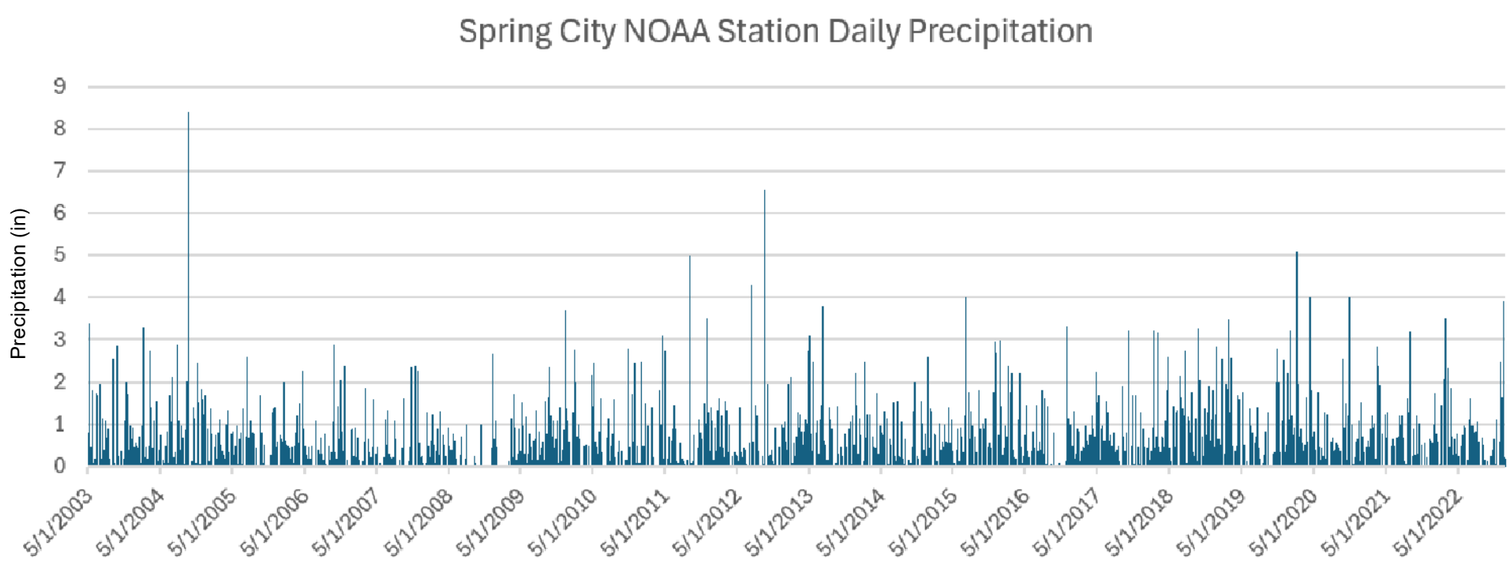

DRAFT

Exhibit No.

7

Title

Watts Bar Dam Tailwater Hydrograph

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-03-13
TR by SW on 2024-03-13
IR Review by RB on 2024-03-13

Notes

1. ft AMSL - feet above mean sea level
2. in - inches
3. NOAA - National Oceanic and Atmospheric Administration

Stantec

TVA

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Exhibit No.
8

DRAFT

Title
Historical Stream Alignment

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-02-10
Technical Review by SW on 2025-02-10

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

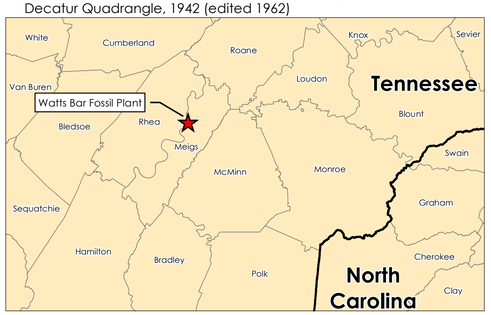
Legend

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

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Historical stream alignments digitized from Topographic Map USGS, Decatur Quadrangle, 1942 (edited 1962)



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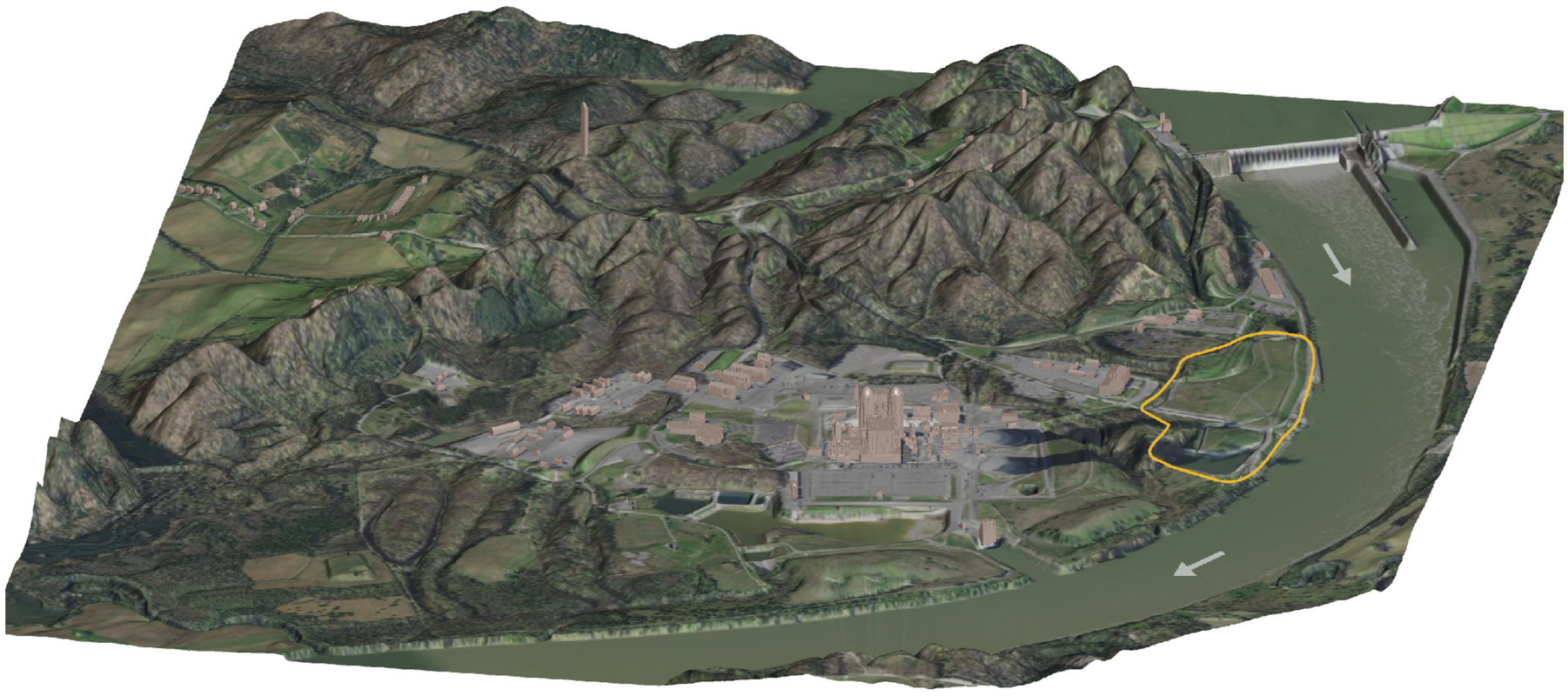

DRAFT

Exhibit No.

9

Title

Physiographic Setting

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-08
TR by SW on 2024-07-08
IR Review by RB on 2024-07-08

Legend

Typical Surface Stream Flow Direction

Study Area

Stantec

TVA

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Exhibit No.
10a

DRAFT

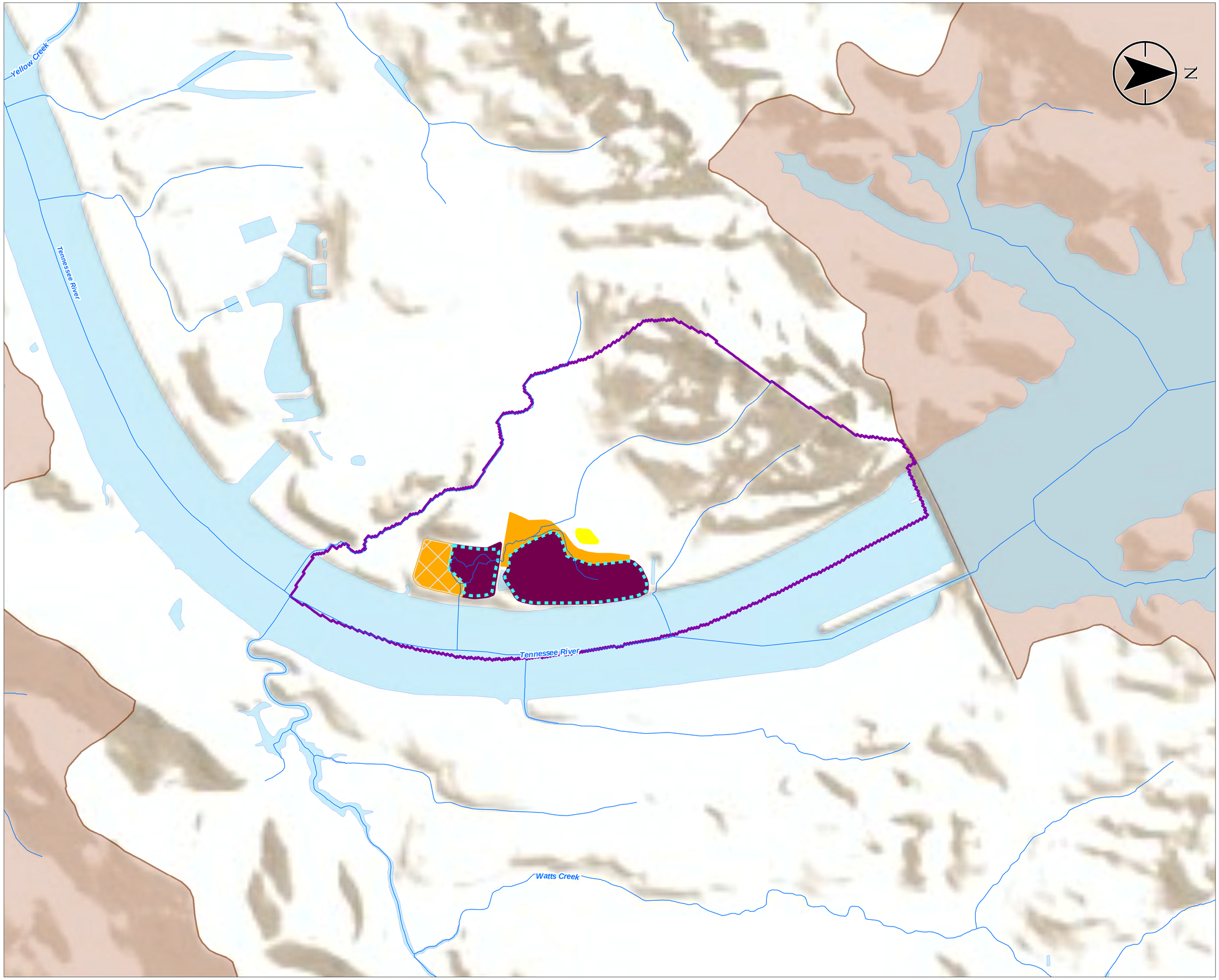
Title
Model Domain

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-07-08
Technical Review by SW on 2024-07-08

0 600 1,200 1,800 2,400 Feet
1:7,200 (At original document size of 22x34)



Legend

- Limit of Existing Cover System (Approximate – 2023)
- River or Stream Flow Line (USGS National Hydrography Dataset [NHD])
- Active Model Domain
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)
- NHD Watershed Boundary (HUC10)
- Water Body or River Area (NHD)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Data Sources: National Hydrography Dataset; Esri ArcGIS World Terrain Base basemap

Stantec TVA

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Exhibit No.
10b

DRAFT

Title
Boundary Conditions

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-07-08
Technical Review by SW on 2024-07-08

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

Legend

- Horizontal Flow Barrier
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)
- Model Boundary
- Model Grid Line

Model Grid

- No Boundary Condition
- Constant Head Boundary
- Drain Boundary

CCR: Coal combustion residuals

Notes

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

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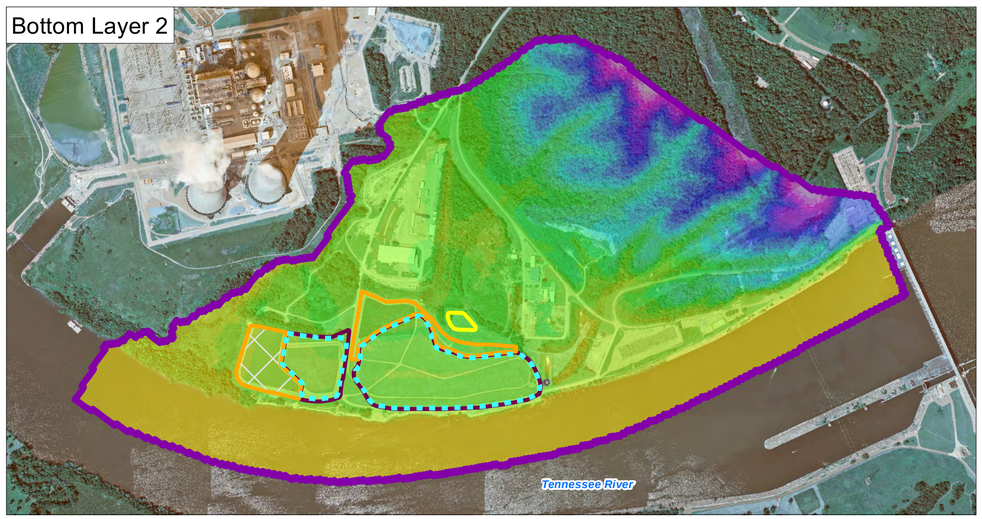


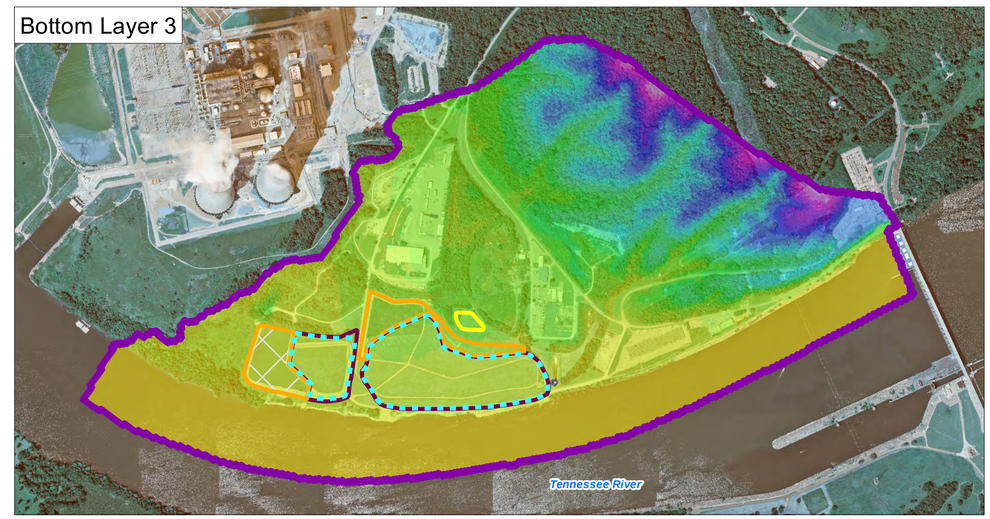


Exhibit No.
11a

DRAFT

Title
WBF Plant Area Model Layer Elevations

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-03-13
Technical Review by SW on 2024-03-13

0 750 1,500 2,250 3,000 Feet
1:9,000 (At original document size of 22x34)

Legend

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

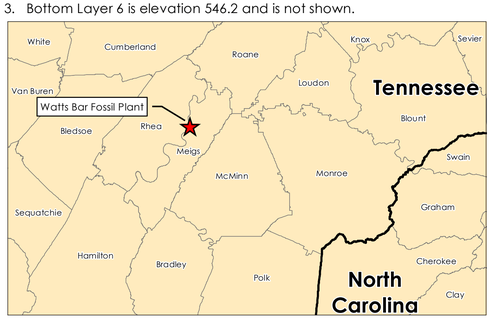
Elevation (feet above mean sea level)

546 - 560	695 - 710	830 - 845
560 - 575	710 - 725	845 - 860
575 - 590	725 - 740	860 - 875
590 - 605	740 - 755	875 - 890
605 - 620	755 - 770	890 - 905
620 - 635	770 - 785	905 - 920
635 - 650	785 - 800	920 - 935
650 - 665	800 - 815	935 - 950
665 - 680	815 - 830	> 950
680 - 695		

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Bottom Layer 6 is elevation 546.2 and is not shown.



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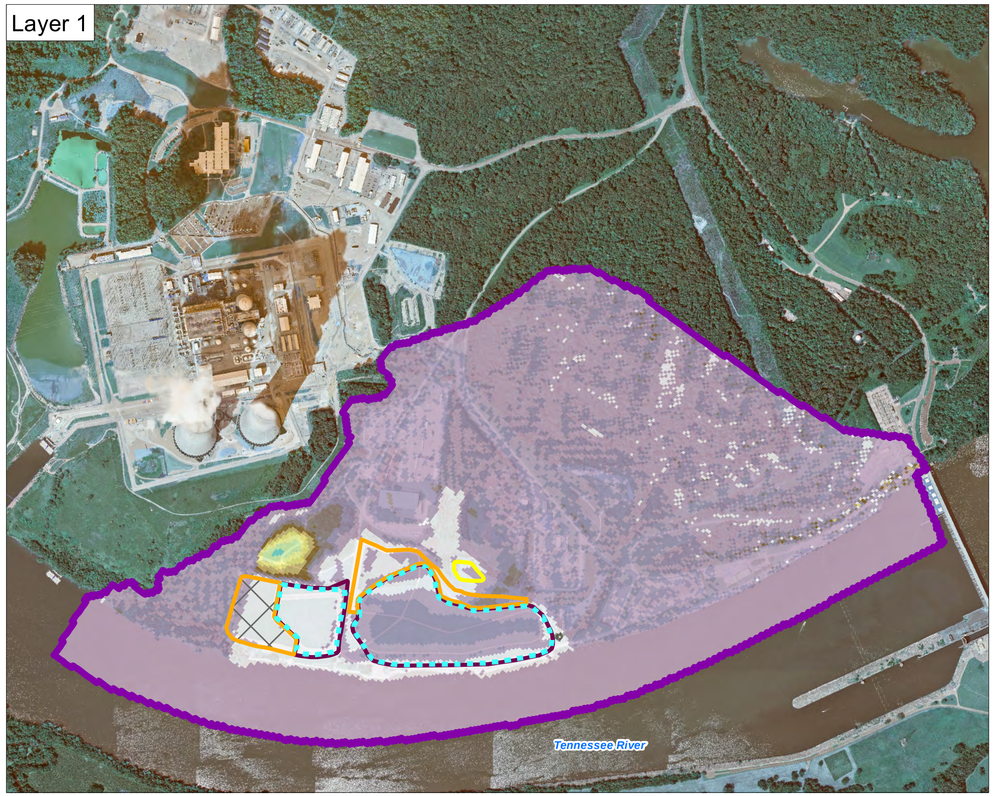

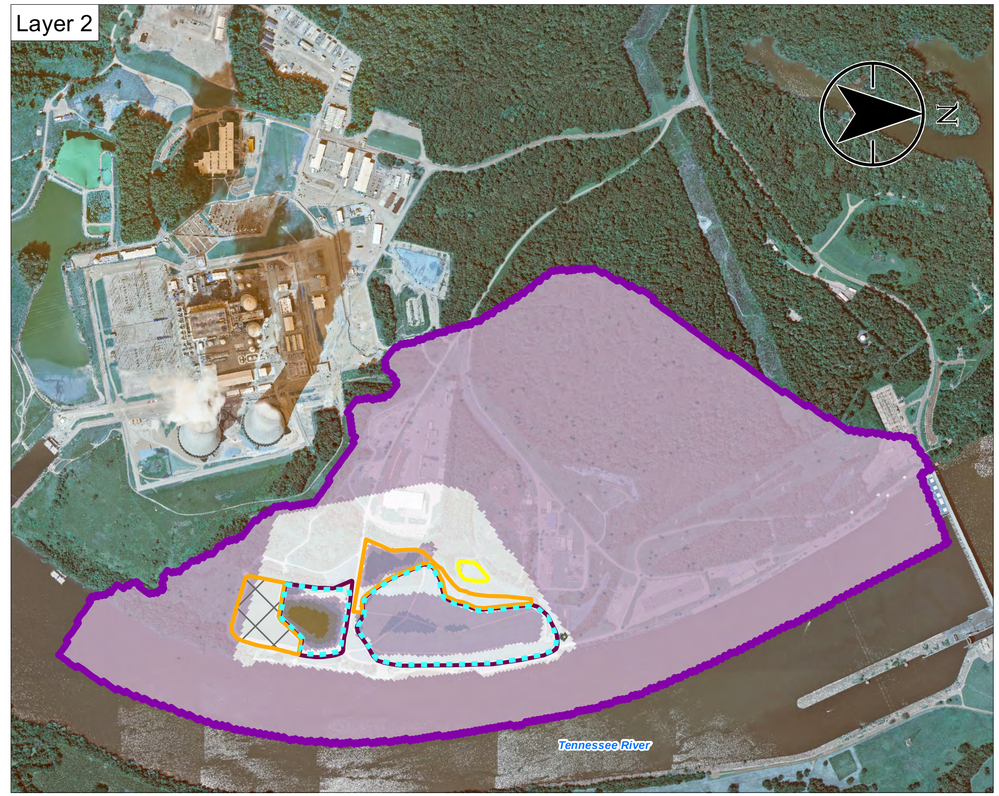

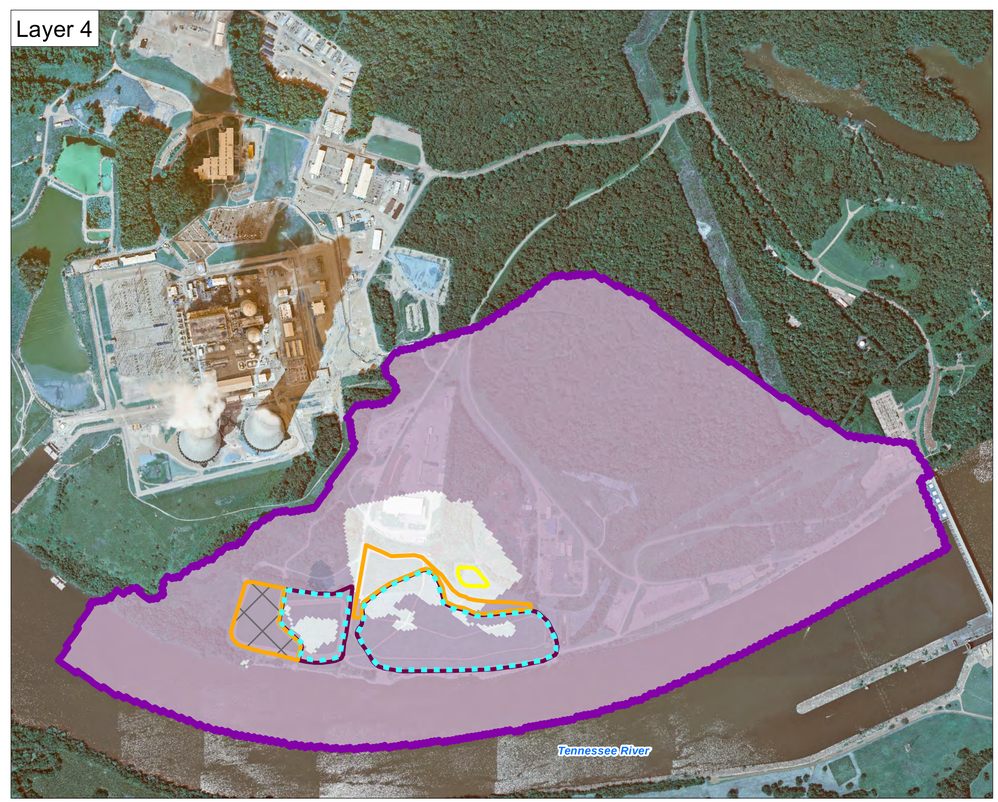

Exhibit No.
11b

DRAFT

Title

WBF Plant Area Model Layer Thickness for Layers 1 through 4

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-03-13
Technical Review by SW on 2024-03-13

0 700 1,400 2,100 2,800 Feet
1:8,400 (At original document size of 22x34)

Legend

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

Model Layer Thickness (feet)

- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- > 45

CCR: Coal combustion residuals

Notes

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

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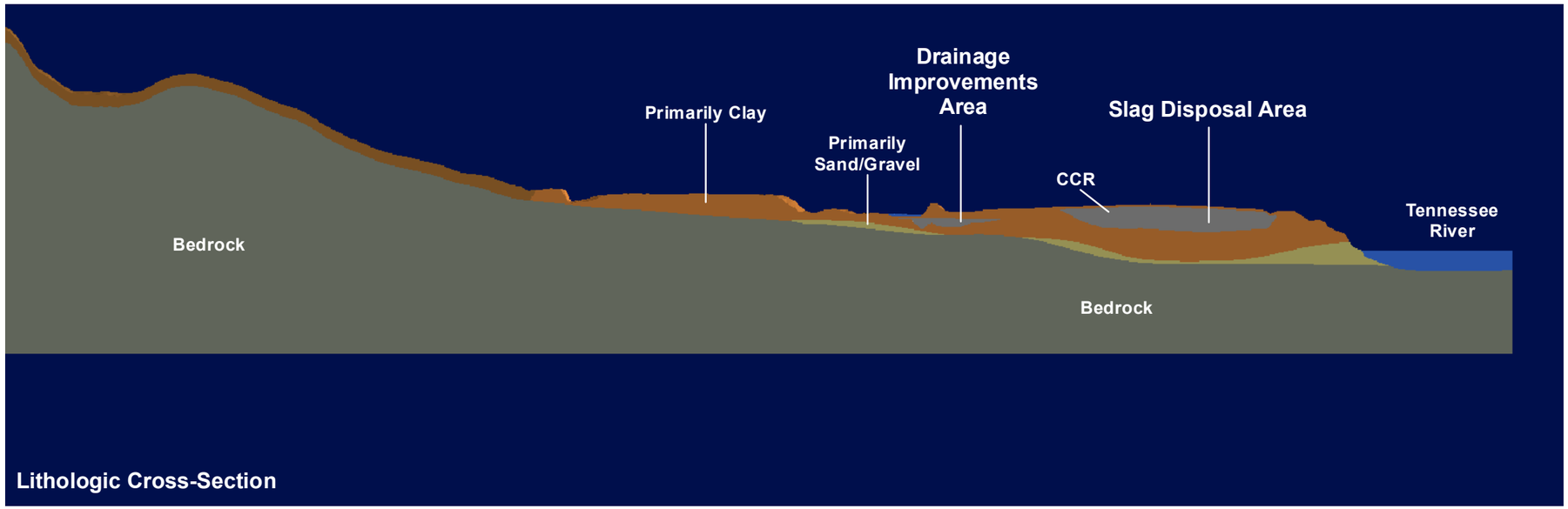

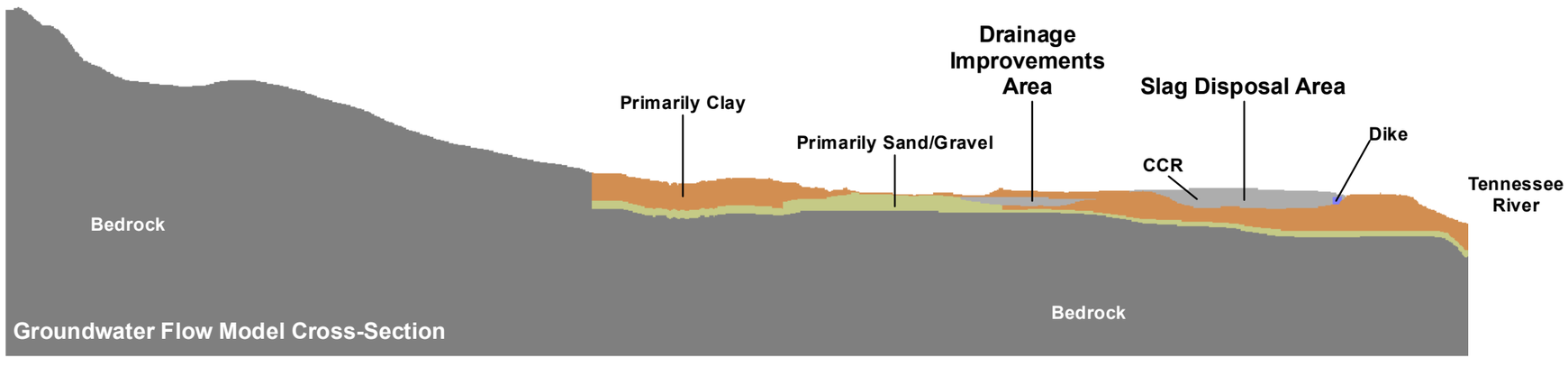

DRAFT

Exhibit No.

12

Title

Lithologic and Groundwater Flow Model Cross-Section Comparison

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-08
TR by SW on 2024-07-08
IR Review by RB on 2024-07-08

Legend

- Cross-Section Transect
- Limit of Existing Cover System (Approximate – 2023)
- CCR
- Primarily Sand/Gravel
- Primarily Clay
- Bedrock
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Background: TVA (2023)

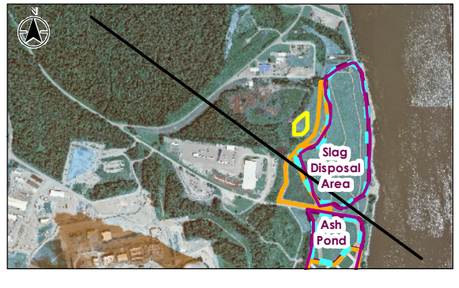

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Exhibit No.
13

DRAFT

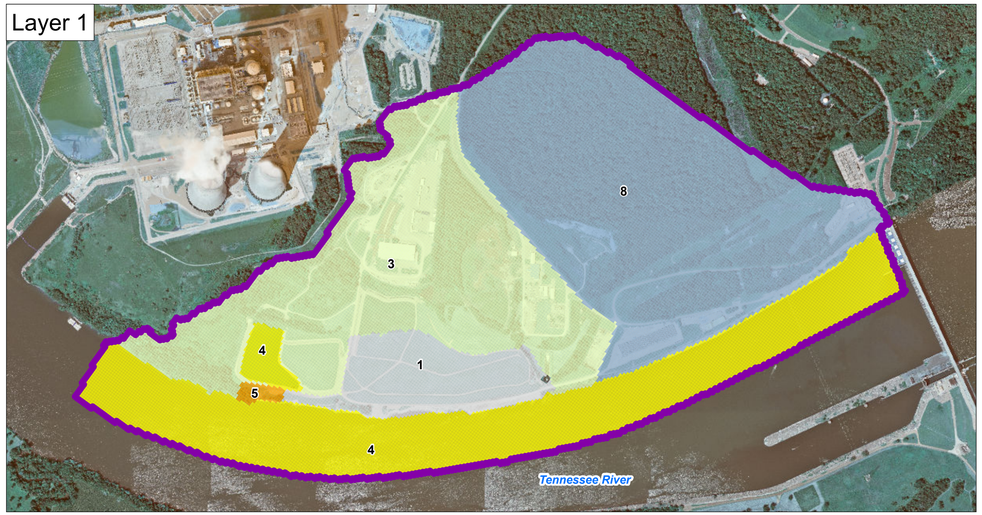
Title
Model Hydraulic Property Zones

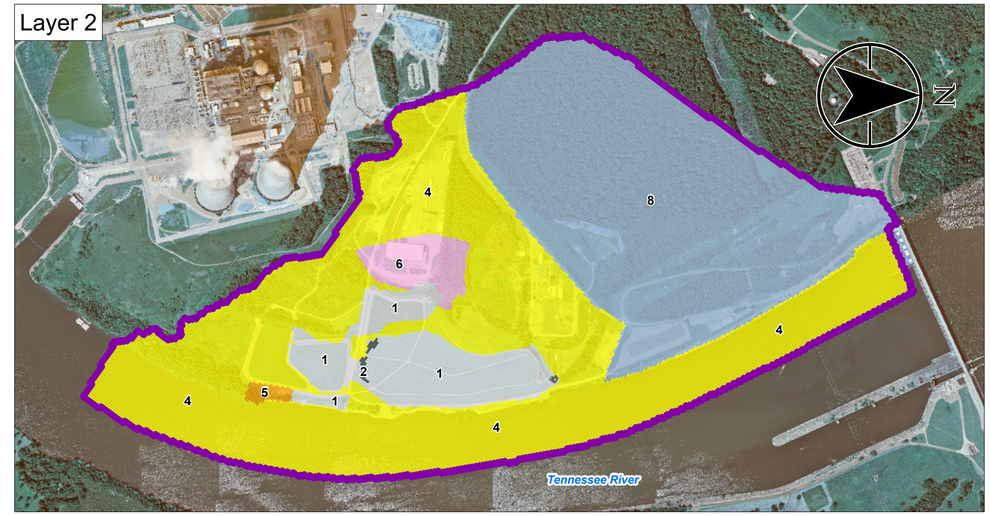
Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

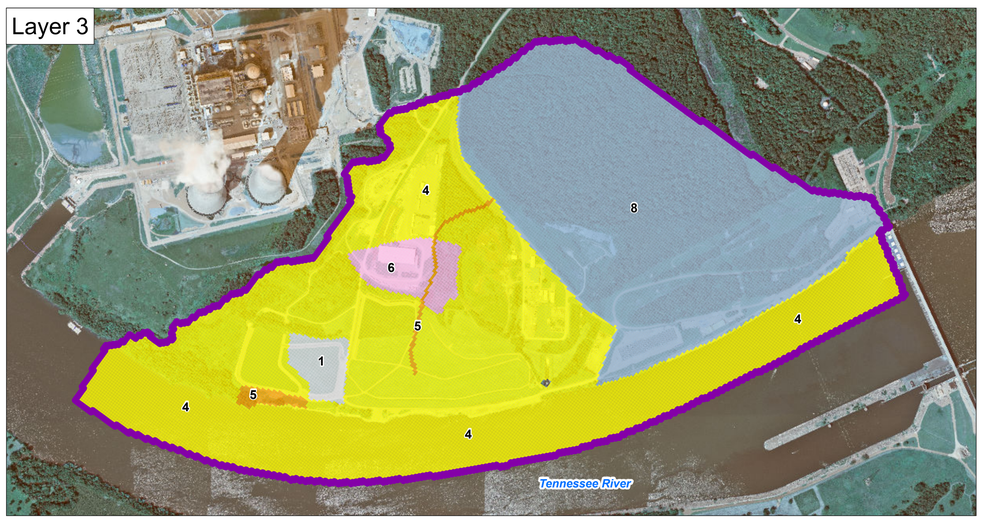
Project Location
Spring City, Tennessee

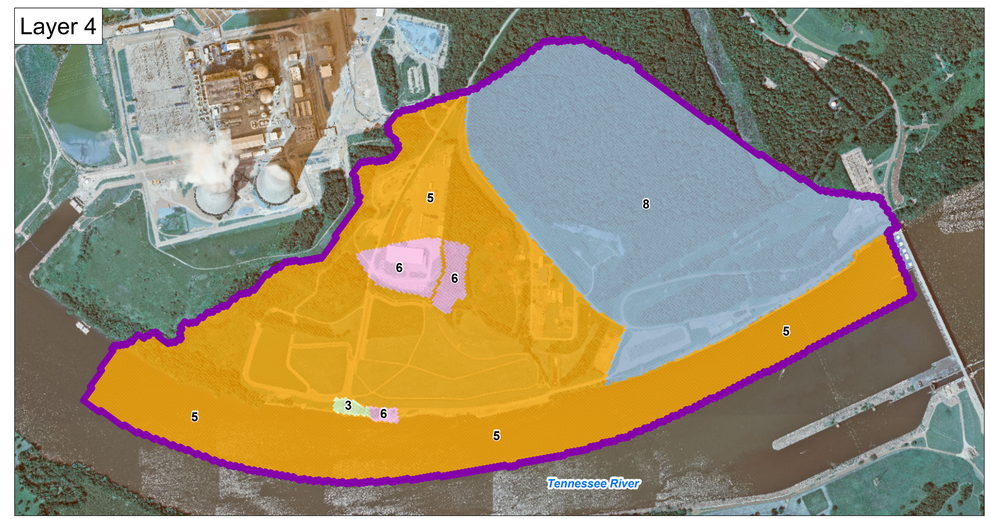
175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

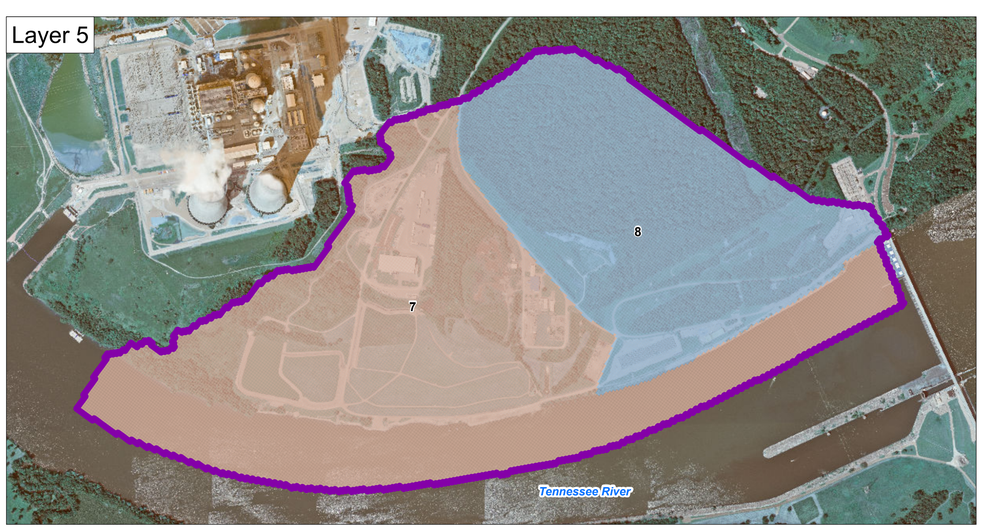
0 750 1,500 2,250 3,000 Feet
1:9,000 (At original document size of 22x34)

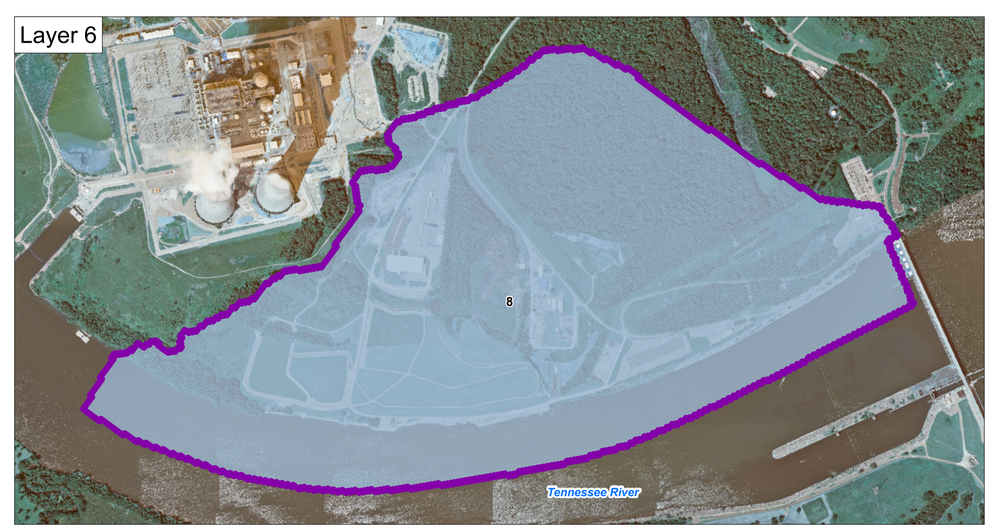












Legend

- Active Model Domain

Hydraulic Property Zones

- Zone 1 represents CCR material
- Zone 2 represents Constructed Dikes (clay fill)
- Zone 3 represents Upland Residuum (primarily clay)
- Zone 4 represents Fine-Grained Alluvium/Residuum (silt/clay)
- Zone 5 represents Coarse-Grained Alluvium (silty sand)
- Zone 6 represents Coarse-Grained Alluvium (sand and gravel)
- Zone 7 represents Upper Bedrock
- Zone 8 represents Lower Bedrock

CCR: Coal combustion residuals

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

Stantec TVA

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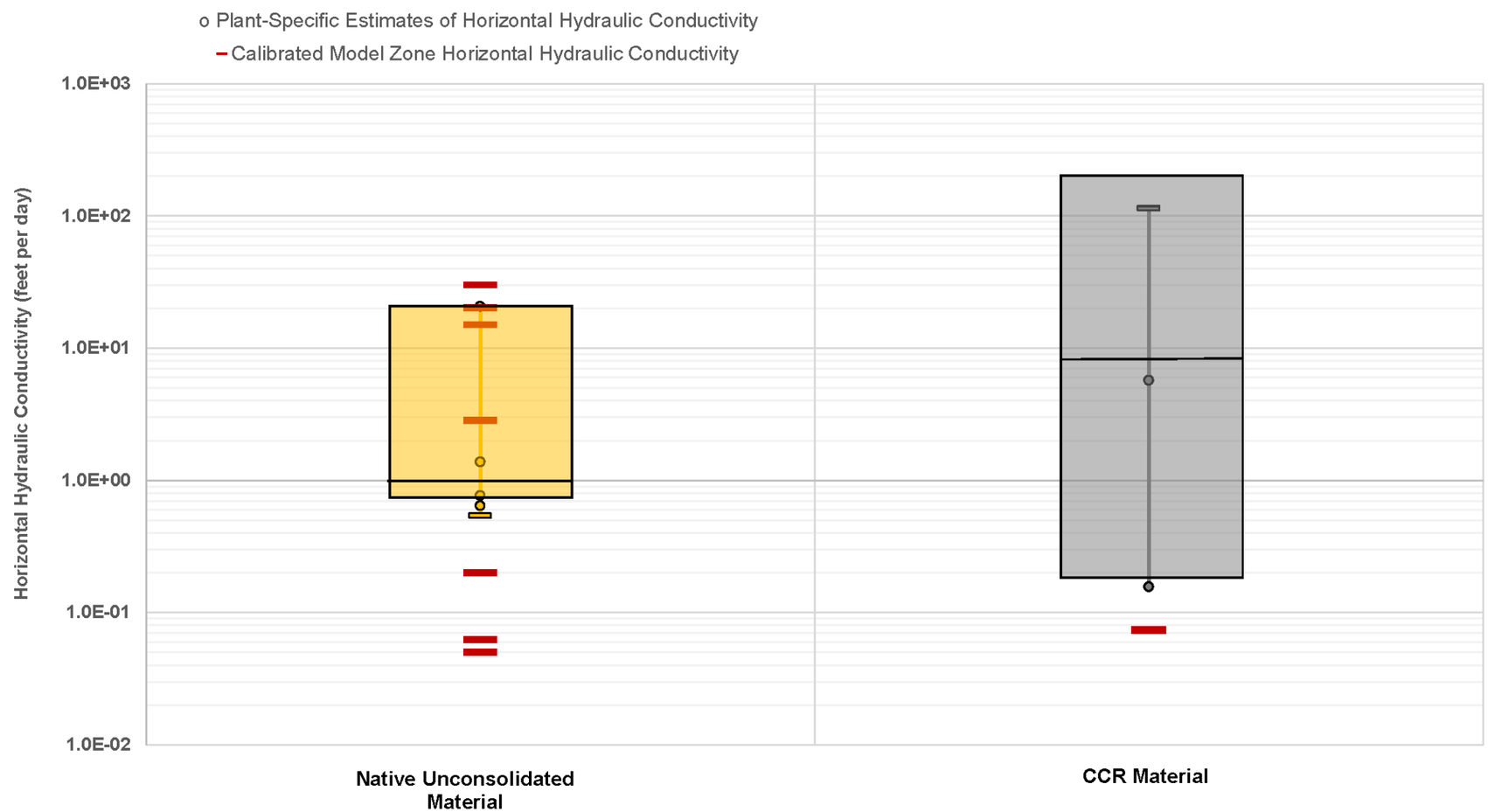

DRAFT

Exhibit No.

14a

Title

Box and Whiskers Plot of Calibrated and Plant-Specific Estimates of Horizontal Hydraulic Conductivity

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-01-23
TR by SW on 2025-01-23
IR Review by RB on 2025-01-23

Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 14a_Box_WhiskersPlot_Calibrated_PlantSpecificEstimates_HorizHydrCondictivity Revised: 2025-01-23 By: mbough

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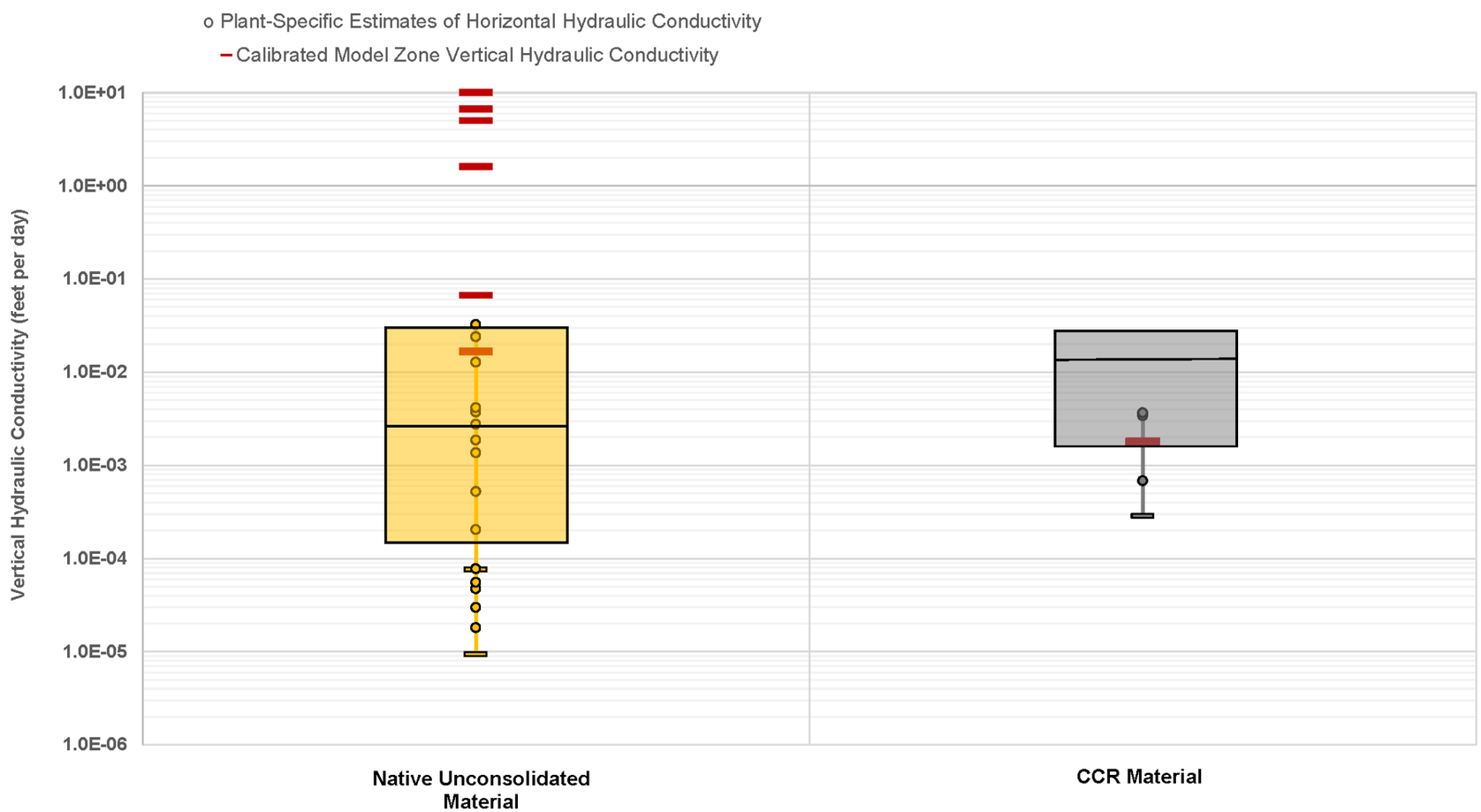

DRAFT

Exhibit No.

14b

Title

Box and Whiskers Plot of Calibrated and Plant-Specific Estimates of Vertical Hydraulic Conductivity

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-01-23
TR by SW on 2025-01-23
IR Review by RB on 2025-01-23

Stantec

TVA

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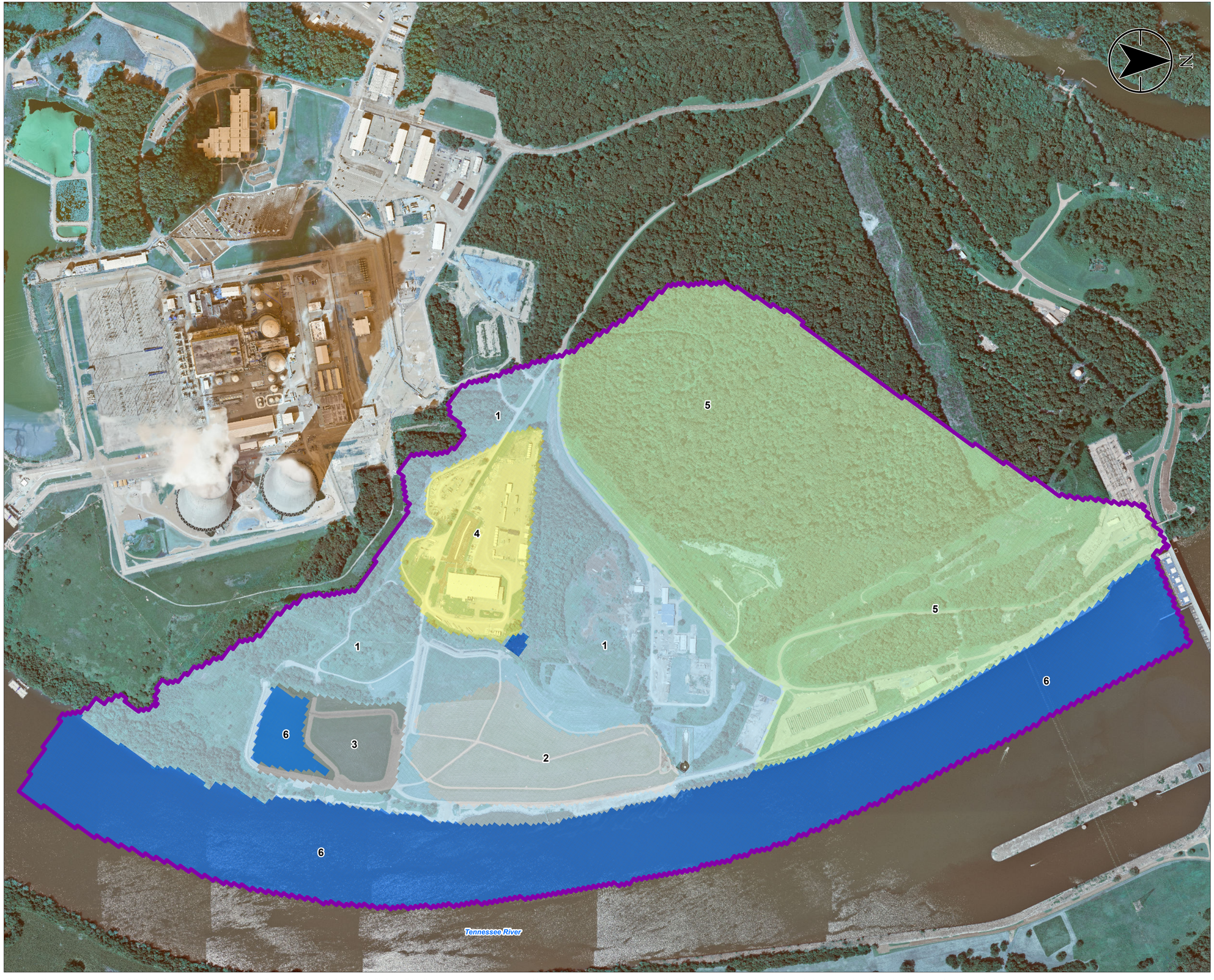

Exhibit No.
15

DRAFT

Title
Model Recharge Zones

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

0 325 650 975 1,300 Feet
1:3,900 (At original document size of 22x34)

Legend

Active Model Domain

Recharge Zone and Rate (inches per year (in/yr))

- Zone 1 - Tennessee River Floodplain (3.51 in/yr)
- Zone 2 - Slag Disposal Area (Soil Cover) (2.19 in/yr)
- Zone 3 - Ash Pond (Geosynthetic Cap) (0.09 in/yr)
- Zone 4 - Facility area of the Plant (1.00 in/yr)
- Zone 5 - Upland Residuum (0.18 in/yr)
- Zone 6 - Ponded Water and Tennessee River Waterbody (0.00 in/yr)

CCR: Coal combustion residuals

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

Stantec TVA

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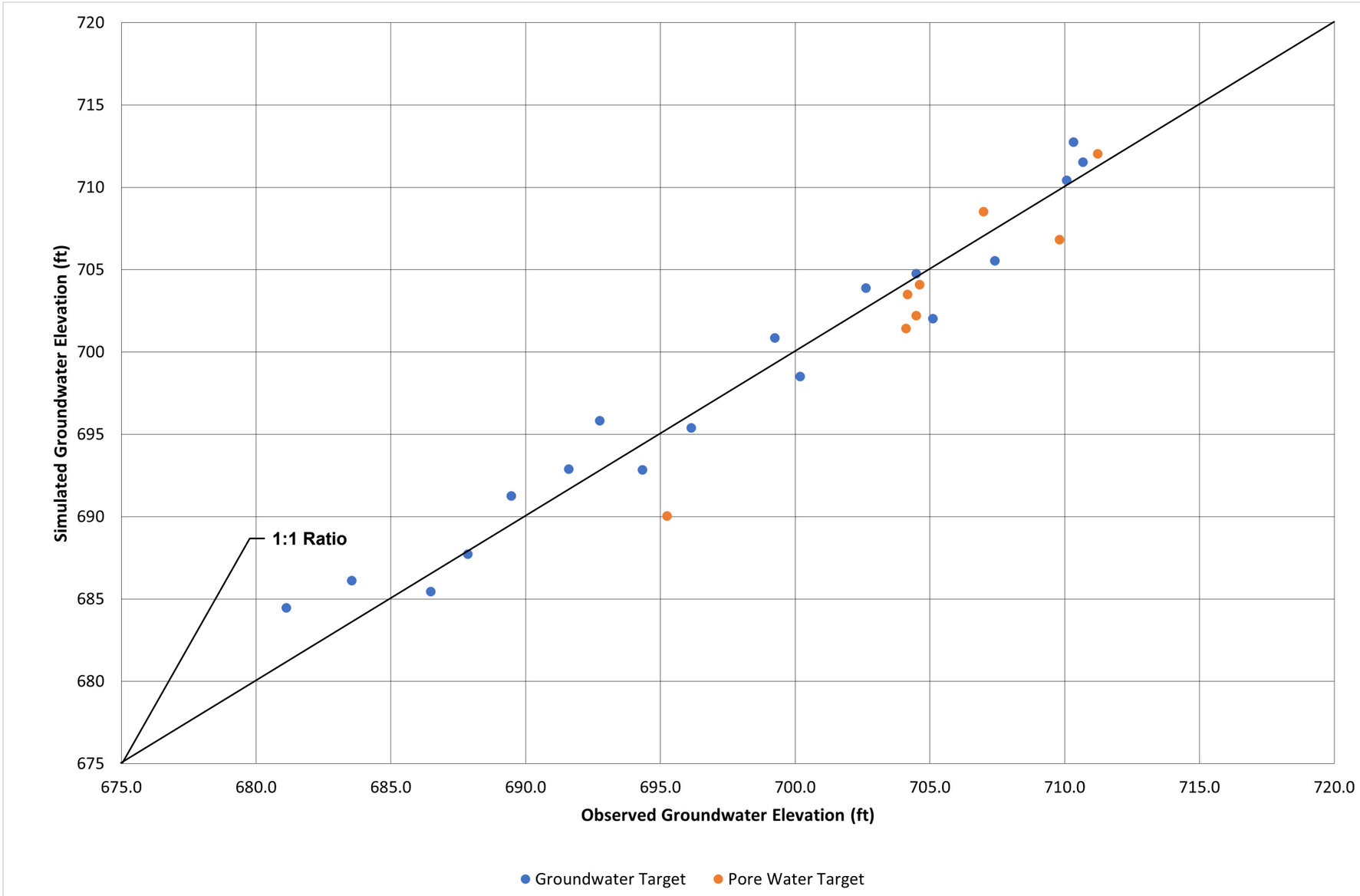
U:\TVA-EIP\175668050_WBF WorkPlans\gis\mxd\CARA\GW Flow TM\WBF_GWFlow Exh\WBF_GWFlow Exh.aprx 15_RCH_lyt Revised: 2024-08-06 By: mbough



DRAFT

Exhibit No.

16

Title

Observed vs. Simulated Steady-State Calibration Results

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2024-08-07
TR by SW on 2024-08-07
IR Review by RB on 2024-08-07

Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 16_ObservedvsSS_CalibrationResults Revised: 2024-08-07 By: mbough

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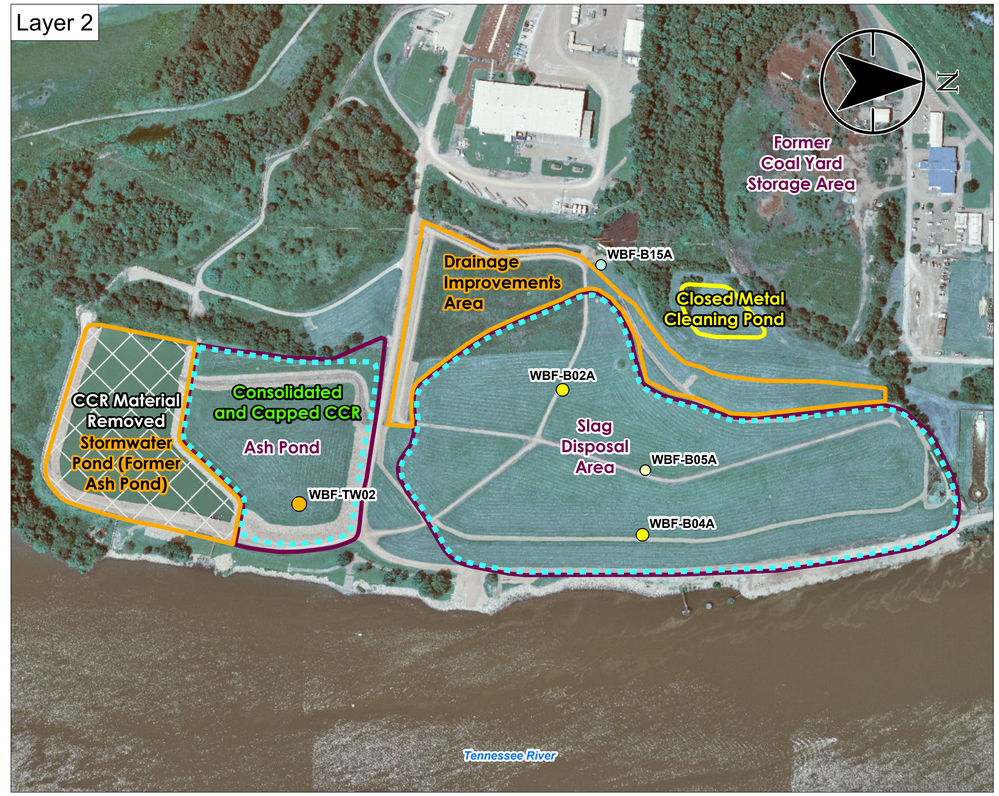

Exhibit No.
17

DRAFT

Title
Steady-State Head Target Residuals

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

0 250 500 750 1,000 Feet
1:3,000 (At original document size of 22x34)

Legend

Calculated Head Residual (feet)

- < -4
- -4 - -2
- -2 - 0
- 0 - 2
- 2 - 4
- > 4

Limit of Existing Cover System (Approximate – 2023)

CCR Unit Area (Approximate)

Closed Metal Cleaning Pond (Approximate)

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

CCR Material Removed (Approximate)

CCR: Coal combustion residuals

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

Stantec TVA

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J:\TVA-EPI\175668050_WBF_WardPlants\gis\mxd\CA-RA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 17_SS_Calibrated_residuals Revised: 2024-08-06 By: mbough

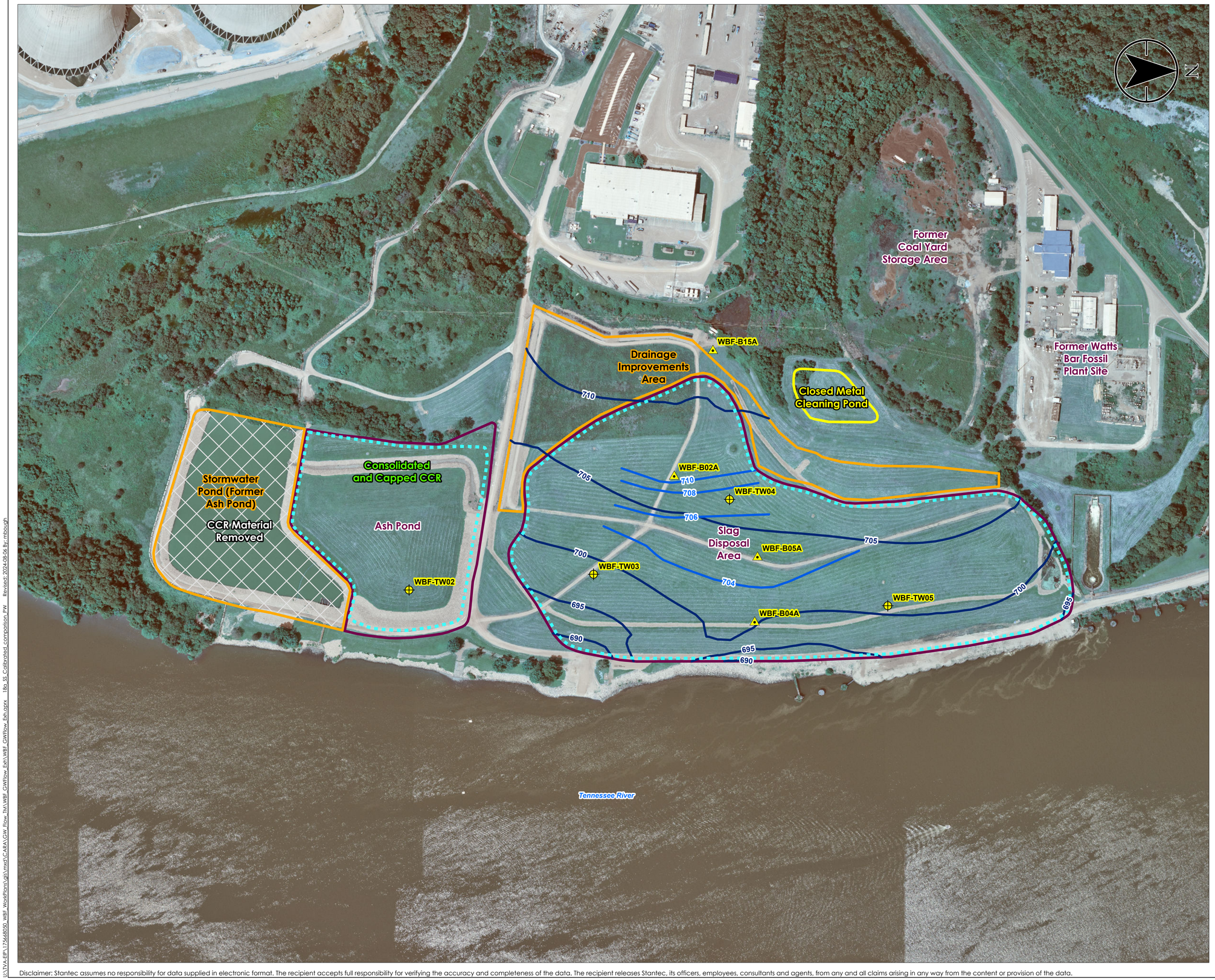

Exhibit No.
18a

DRAFT

Title

Comparison of Simulated and Observed Pore Water Contours (August 26, 2019)

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

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

Legend

- Layer 2 (well)
- Layer 2 (piezometer)
- Limit of Existing Cover System (Approximate – 2023)
- Observed Pore Water Elevation Contours: August 26, 2019 Gauging Event (2 foot interval; elevations are in feet above mean sea level)
- Simulated Pore Water Elevation Contour, Layer 2 (5 foot interval; elevations are in feet above mean sea level)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Groundwater measurements were on August 26, 2019.

Stantec TVA

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U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Eph\WBF_GWFlow_Eph.aprx 18a_SS_Calibrated_comparison_PW Revised: 2024-08-06 By: mbough

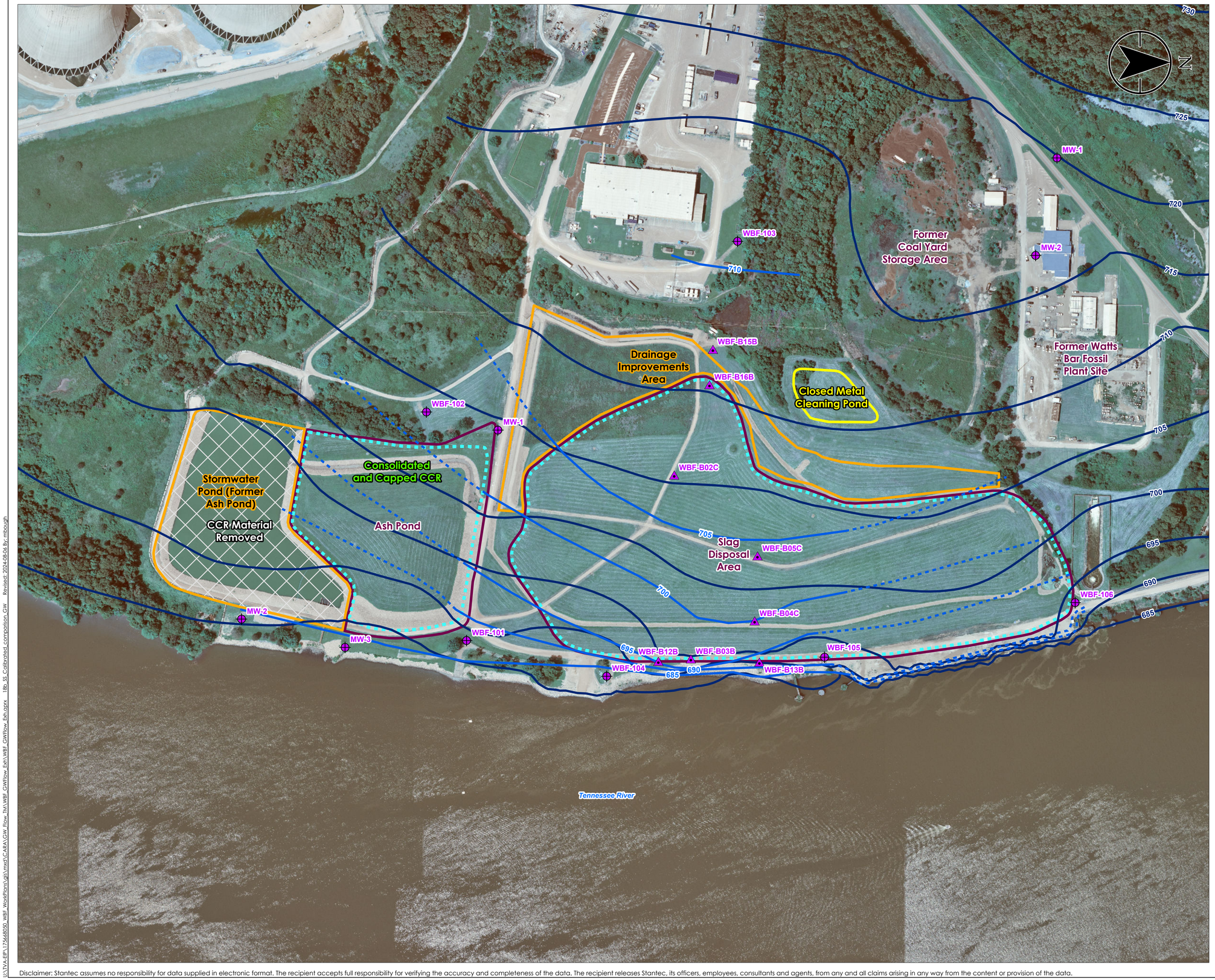

Exhibit No.
18b

DRAFT

Title

Comparison of Simulated and Observed Groundwater Contours (August 26, 2019)

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

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

Legend

- Layer 4 (well)
- Layer 4 (piezometer)
- Limit of Existing Cover System (Approximate – 2023)
- Observed Groundwater Elevation Contours: August 26, 2019 Gauging Event (5 foot interval; elevations are in feet above mean sea level)
- Inferred Groundwater Contours: August 26, 2019 Gauging Event (5 foot interval; elevations are in feet above mean sea level)
- Simulated Groundwater Elevation Contours, Layer 4 (5 foot interval; elevations are in feet above mean sea level)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Groundwater measurements were on August 26, 2019.

Stantec TVA

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J:\TVA-EPI\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 18b_SS_Calibrated_comparison_GW Revised: 2024-08-06 By: mbough

Exhibit No.
19

DRAFT

Title
Simulated Baseline Groundwater Piezometric Surface

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

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

Legend

- Limit of Existing Cover System (Approximate – 2023)
- Simulated Groundwater Elevation Contours (5 foot interval; elevations are in feet above mean sea level)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

Stantec TVA

U:\TVA.EPK\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_Tx\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 19_SimulatedBaselineGWPiezometricSurface Revised: 2024-08-06 By: mbough

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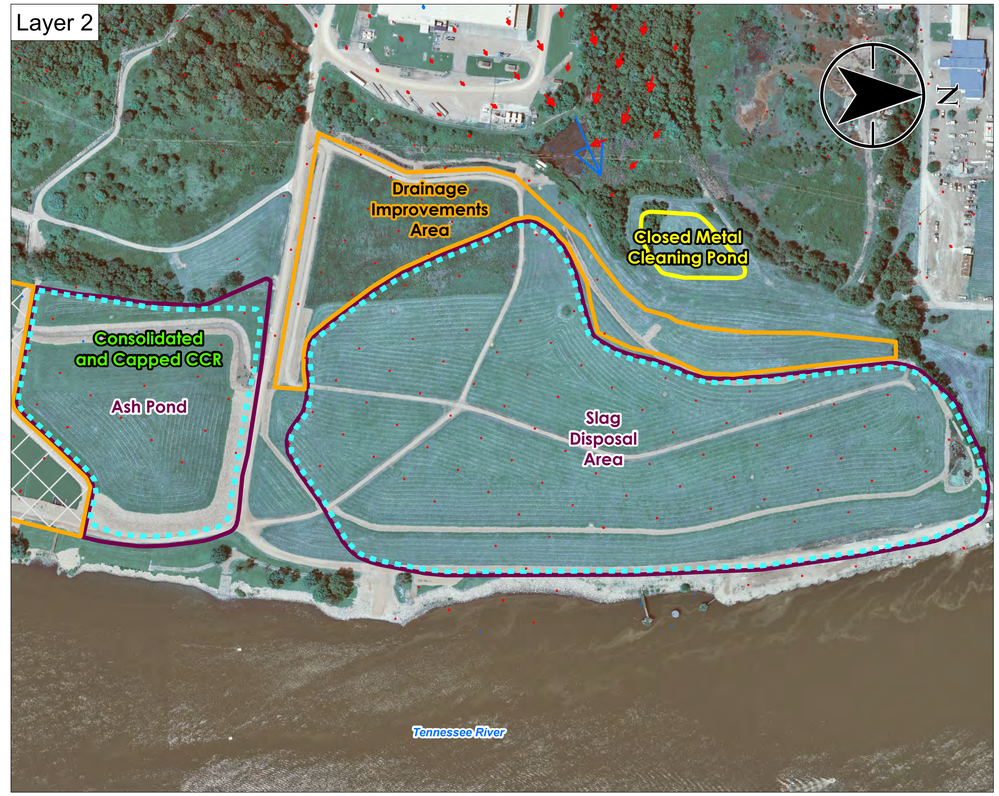


Exhibit No.
20

DRAFT

Title
Simulated Baseline Groundwater Flow Direction

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-09-03
Technical Review by SW on 2024-09-03

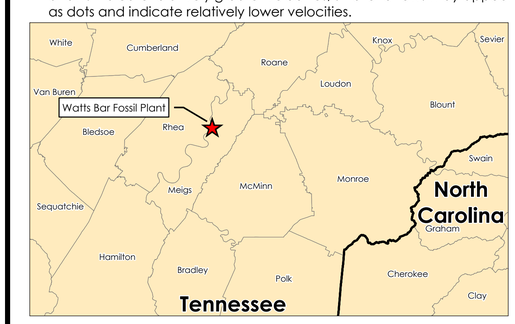
0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- Simulated Direction of Flow (upward flow component)
- Simulated Direction of Flow (downward flow component)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. The flow vectors are scaled to Model-simulated flow velocity. Larger arrows indicate relatively greater velocities; smaller arrows may appear as dots and indicate relatively lower velocities.



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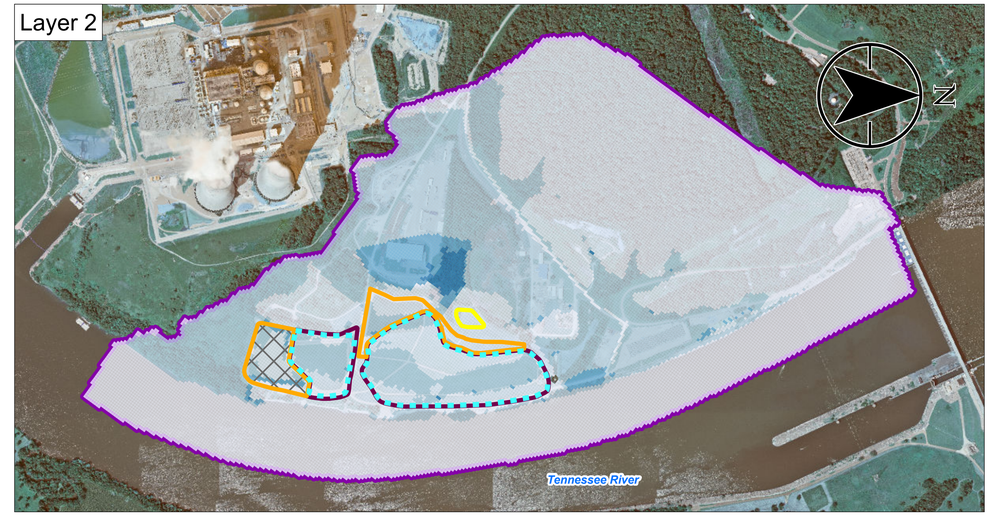
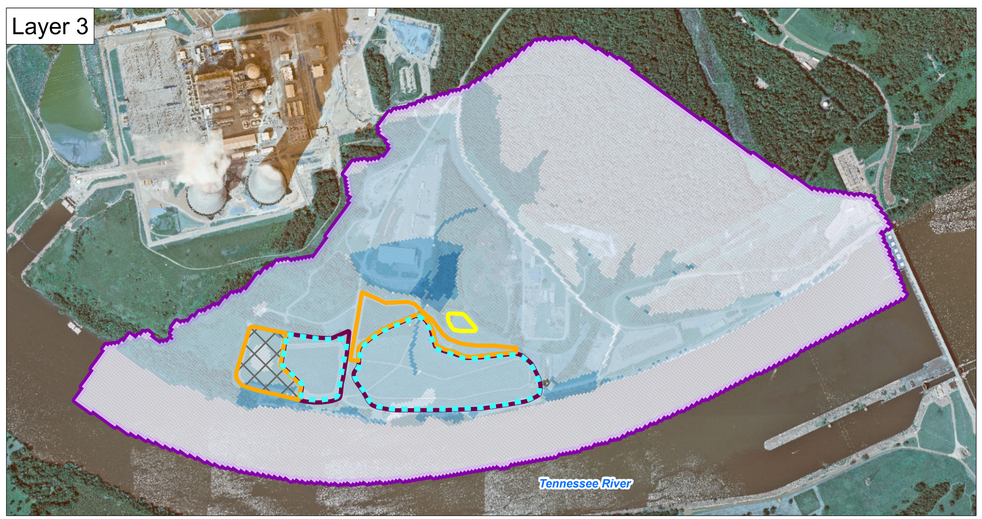
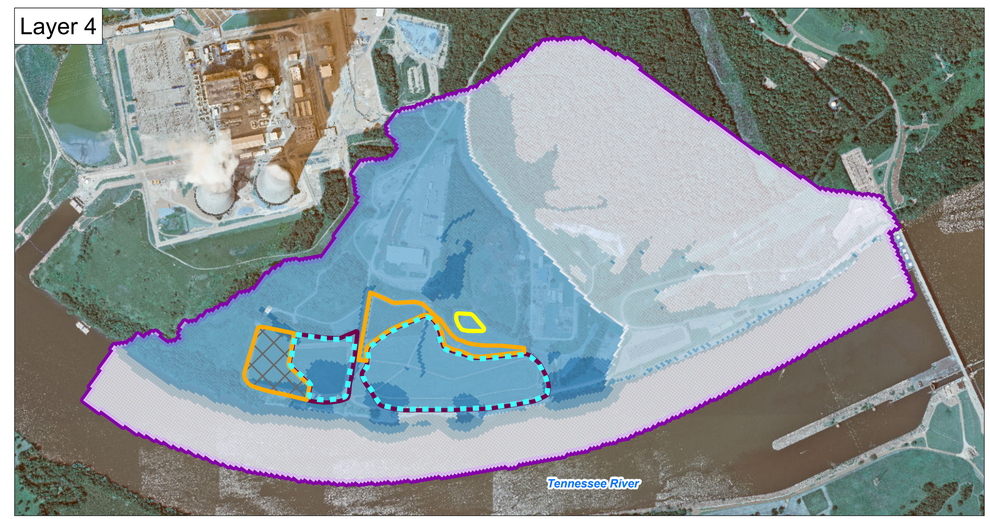
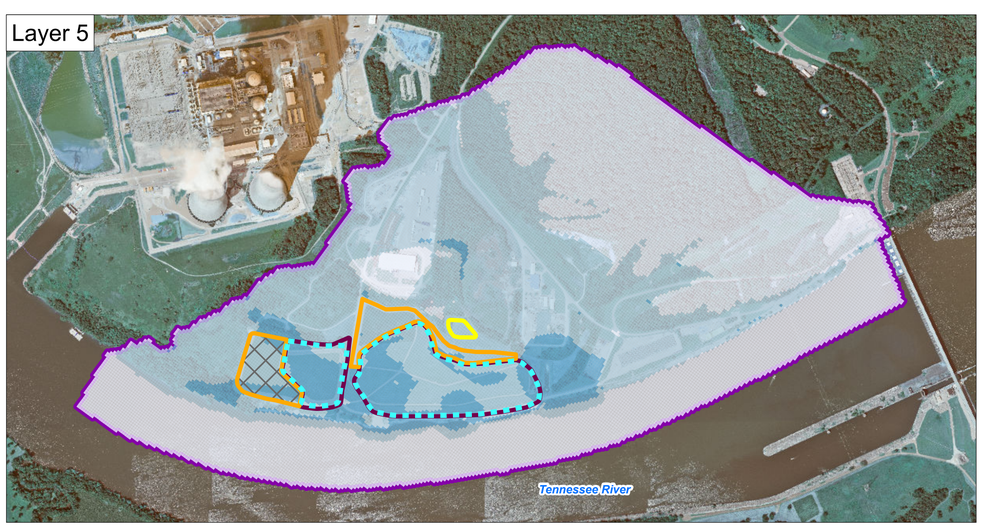
J:\TVA-EPI\175668050_WBF_KnoxPlants\gis\mxd\CA-RAI\GW_Flow_TMX\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 20_SimulatedBaselineGWFlowDirection Revised: 2024-09-03 By: mbough









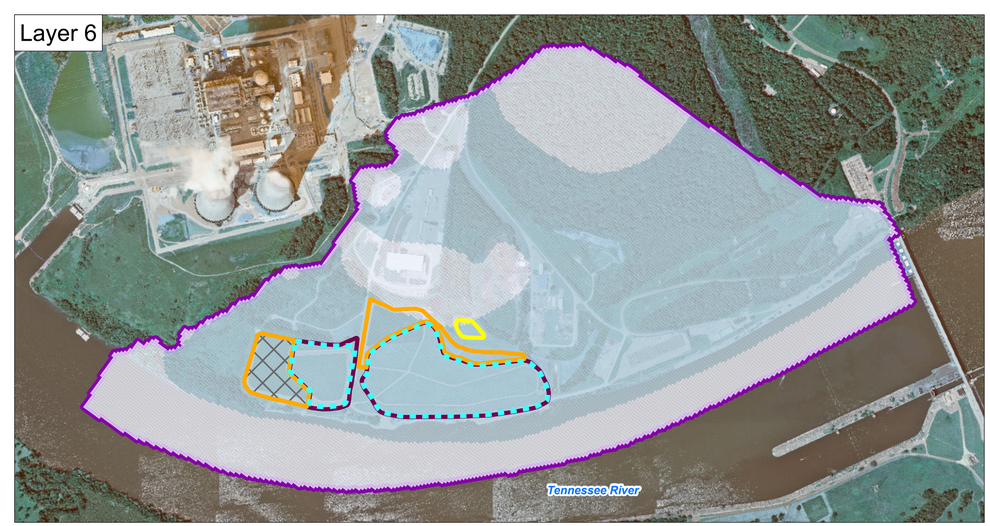


Exhibit No.
21

DRAFT

Title
Simulated Baseline Groundwater Flow Velocity

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

0 750 1,500 2,250 3,000 Feet
1:9,000 (At original document size of 22x34)

Legend

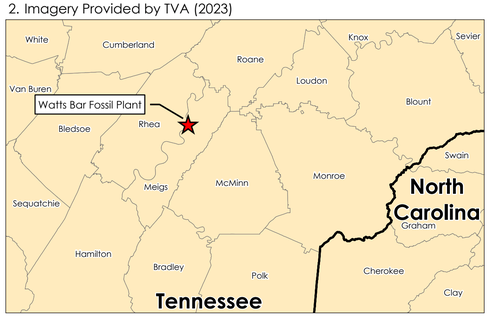
- Limit of Existing Cover System (Approximate – 2023)
- Active Model Domain
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

Simulated Groundwater Flow Velocity (feet/year)

- < 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CCR: Coal combustion residuals

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



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U:\TVA-EPA\175668050_WBF_WorkPlans\gis\mxd\CCARA\GW_Flow_TAI\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 21_Simulated_Baseline_HorizontalGWFlowVelocity Revised: 2024-08-06 By: mbcough

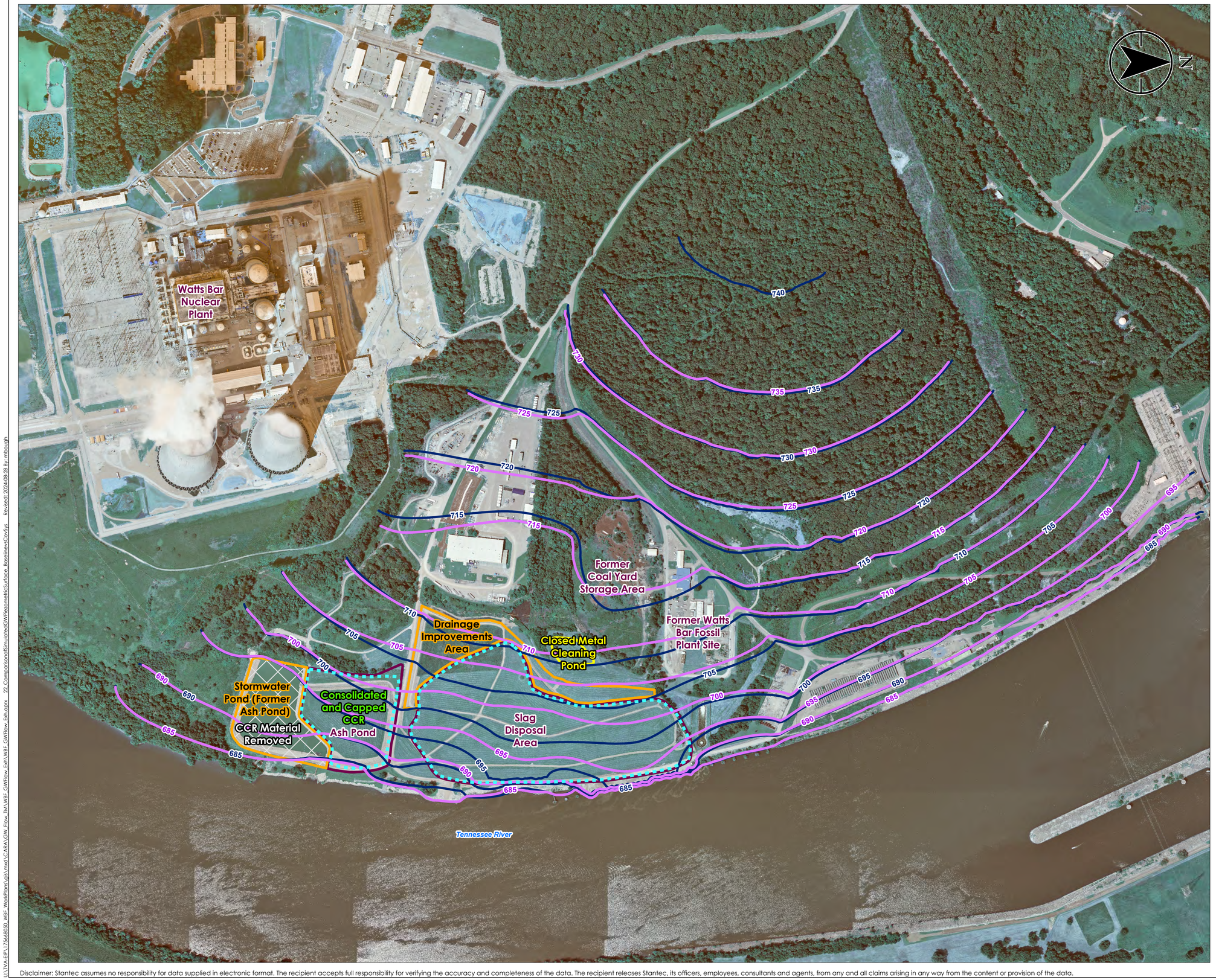

Exhibit No.
22

DRAFT

Title
Comparison of Simulated Groundwater Piezometric Surface: Baseline vs. Closure in Place with Cover System

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-28
Technical Review by SW on 2024-08-28

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

Legend

- Limit of Existing Cover System (Approximate – 2023)
- Simulated Steady-State Groundwater Elevation Contours with Cover System (5 foot interval; elevations are in feet above mean sea level)
- Simulated Baseline Groundwater Elevation Contours (5 foot interval; elevations are in feet above mean sea level)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

Stantec TVA

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Exhibit No.
23a

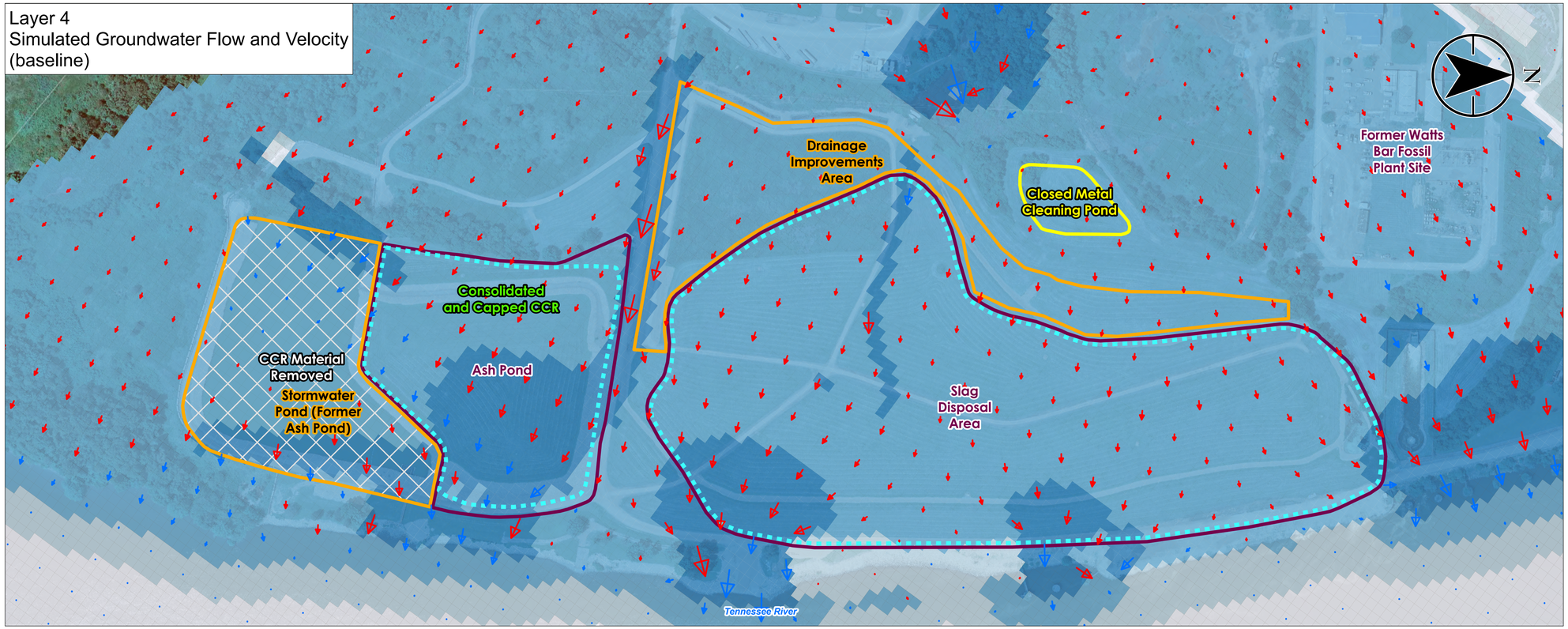
DRAFT

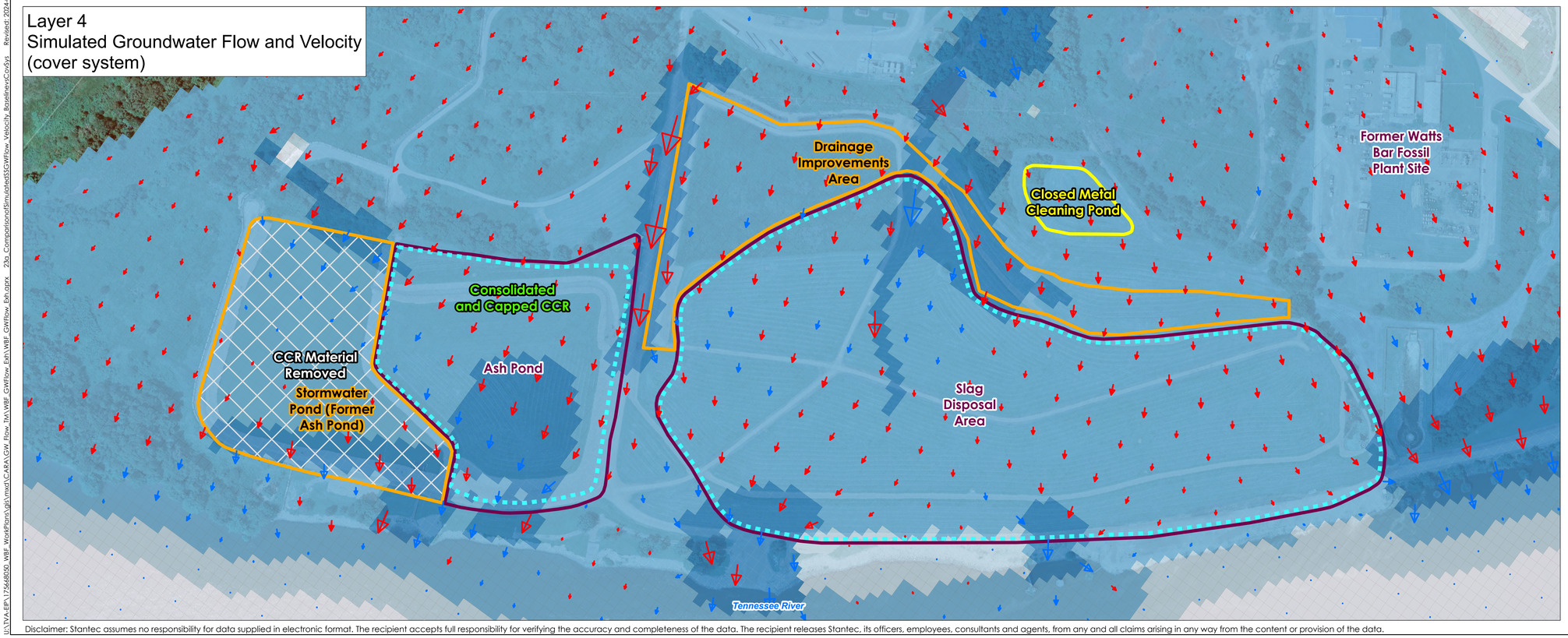
Title
Comparison of Simulated Steady-State Groundwater Flow & Velocity: Baseline vs. Closure in Place with Cover System

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-09-03
Technical Review by SW on 2024-09-03





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

Legend

- Simulated Direction of Flow (upward flow component)
- Simulated Direction of Flow (downward flow component)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

Simulated Groundwater Flow Velocity (feet/year)

- < 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. The flow vectors are scaled to Model-simulated flow velocity. Larger arrows indicate relatively greater velocities; smaller arrows may appear as dots and indicate relatively lower velocities.

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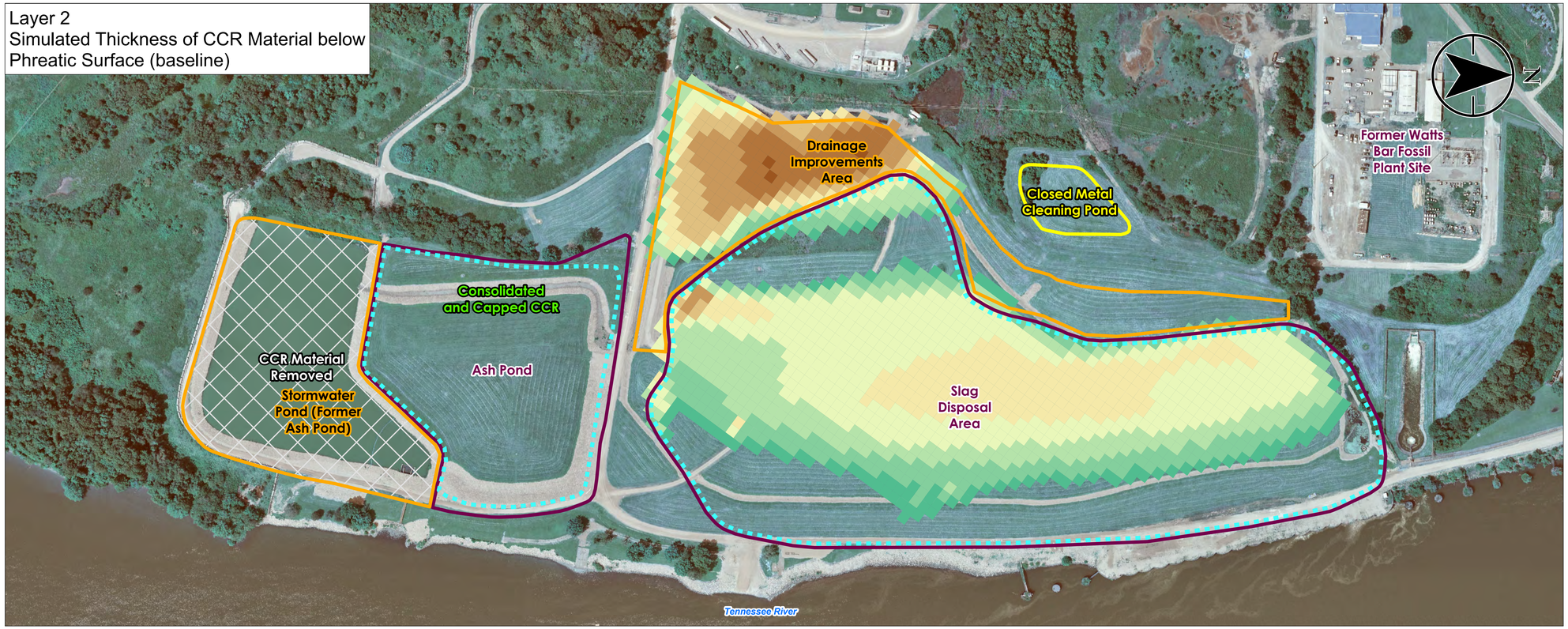

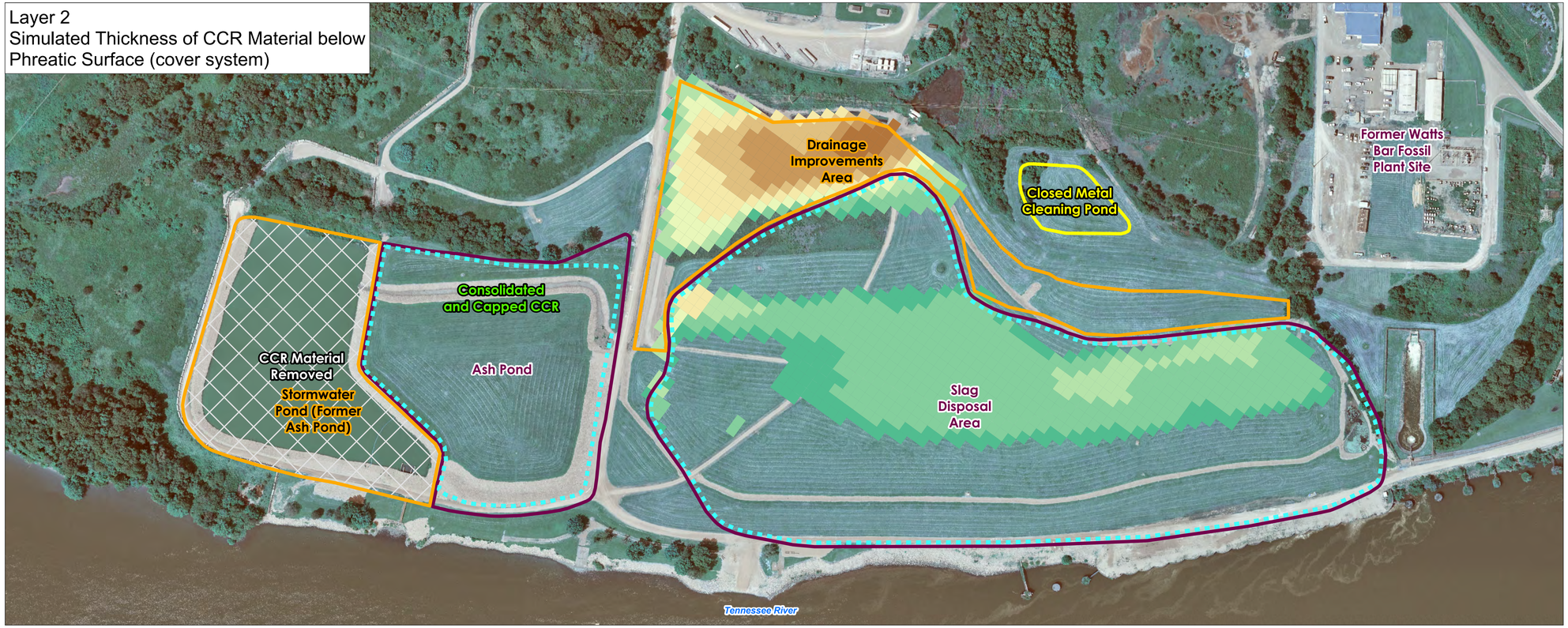

Exhibit No.
23b

DRAFT

Title

Comparison of Simulated Steady-State Thickness of CCR Material below the Phreatic Surface: Baseline vs. Closure in Place with Cover System

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-28
Technical Review by SW on 2024-08-28

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

Legend

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

MODFLOW-Simulated Thickness of CCR Material below Phreatic Surface in feet

- < 1 (transparent)
- 1 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- 14 - 16
- 16 - 18

CCR: Coal combustion residuals

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

Stantec TVA

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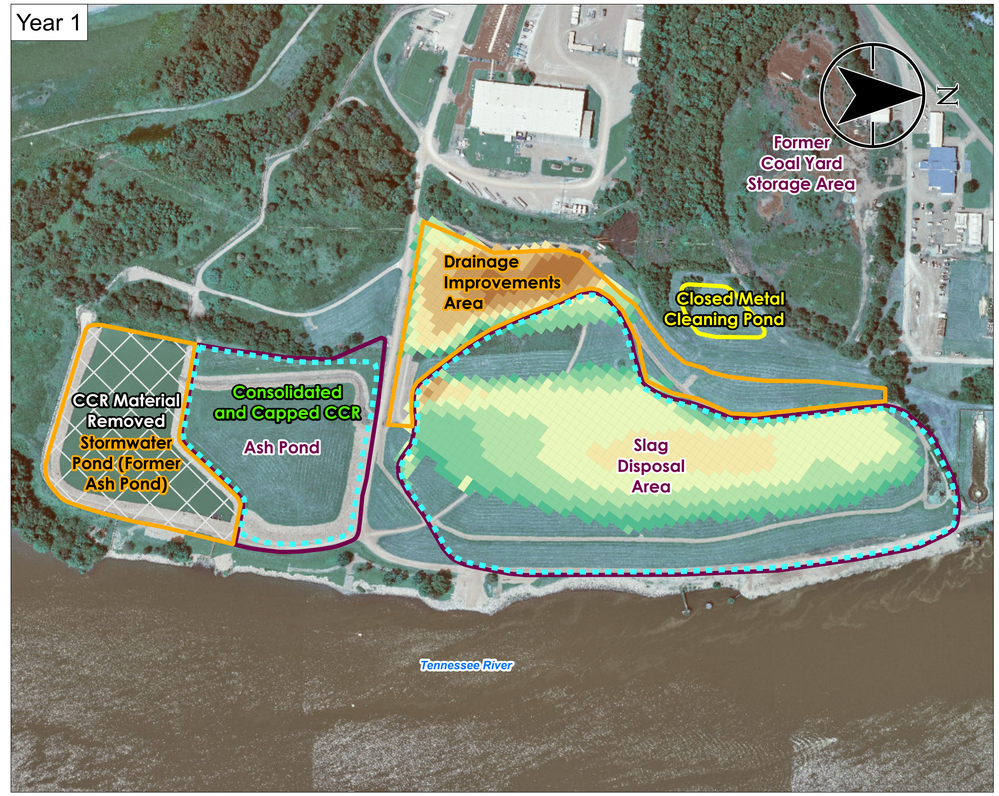

Exhibit No.
24

DRAFT

Title

Simulated Change Over Time in the Thickness of CCR Material below the Phreatic Surface with Cover System

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

0 250 500 750 1,000 Feet
1:3,000 (At original document size of 22x34)

Legend

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

MODFLOW-Simulated Thickness of CCR Material below Phreatic Surface in feet

- < 1 (transparent)
- 1 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- 14 - 16
- 16 - 18

CCR: Coal combustion residuals

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

Stantec TVA

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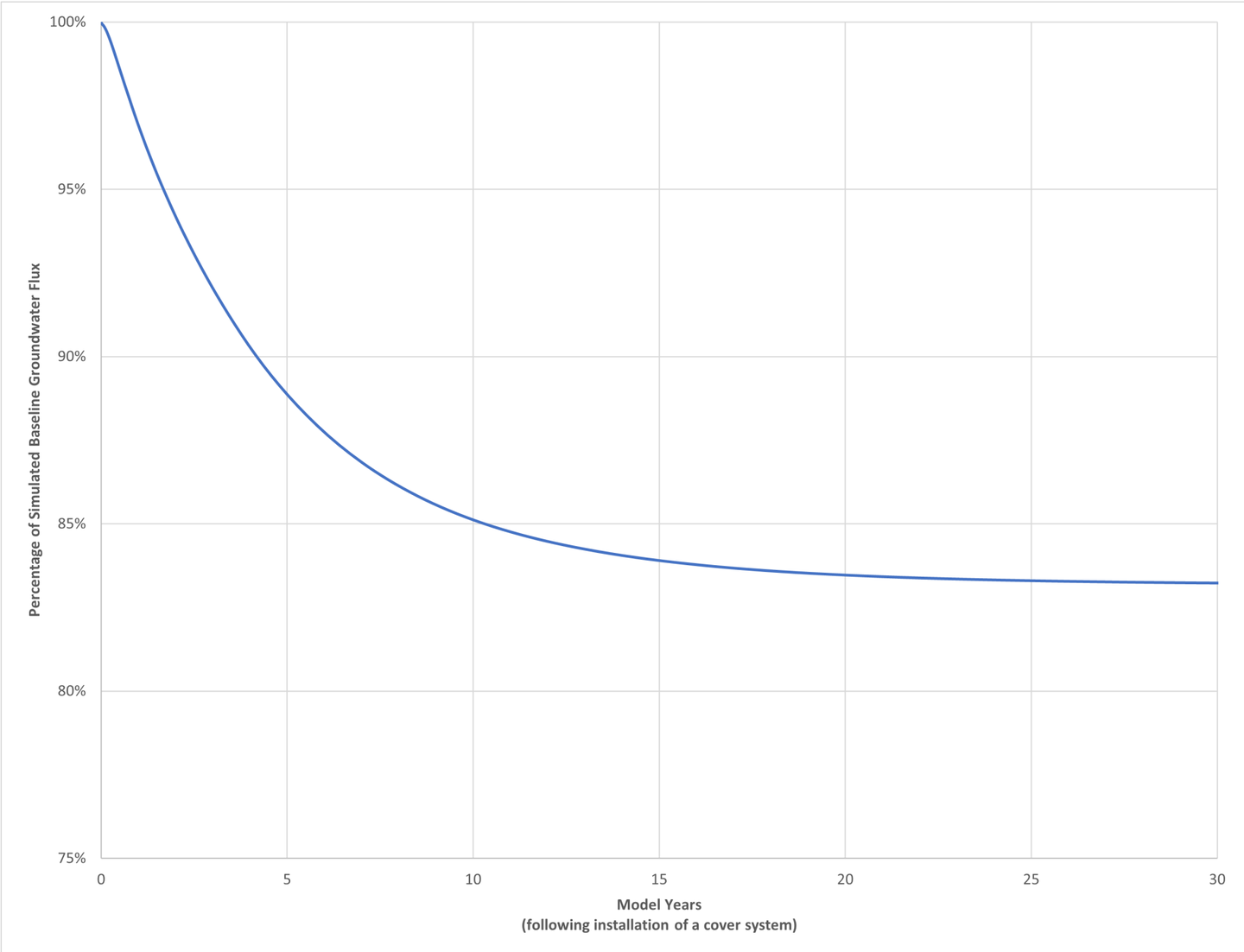
J:\TVA.EPI\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 24_SimulatedChangeOverTimeinThicknessCCR_wCoverSystem Revised: 2024-08-06 By: mbough



DRAFT

Exhibit No.

25

Title

Simulated Reduction in Groundwater Flux Following Installation of a Cover System

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2024-08-06
TR by SW on 2024-08-06
IR Review by RB on 2024-08-06

Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\CAPA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 25_SimulatedReductioninGWFluxFollowinginstallCoverSystem Revised: 2024-08-06 By: mbough

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Exhibit No.
26

DRAFT

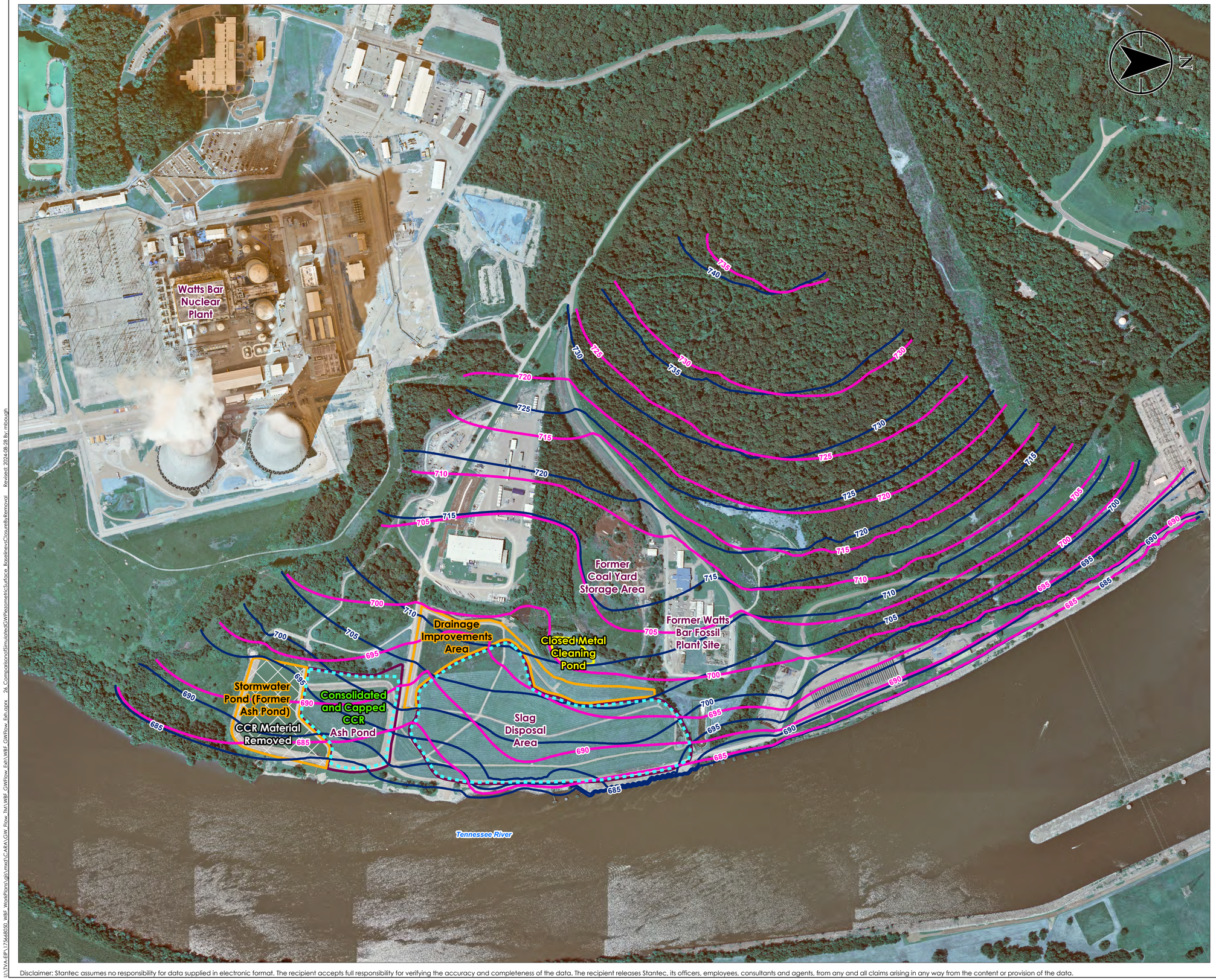
Title
Comparison of Simulated Groundwater Piezometric Surface: Baseline vs. Closure By Removal

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-28
Technical Review by SW on 2024-08-28

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



Legend

- Limit of Existing Cover System (Approximate – 2023)
- Simulated Baseline Groundwater Elevation Contours (5 foot interval; elevations are in feet above mean sea level)
- Simulated Steady-State Post-Closure by Removal Groundwater Elevation Contours (5 foot interval; elevations are in feet above mean sea level)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

Stantec TVA

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\\VA.EIPI\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 26_ComparisonofSimulatedGWPiezometricSurface_BaselinevsClosureByRemoval Revised: 2024-08-28 By: mbclough

Exhibit No.
27

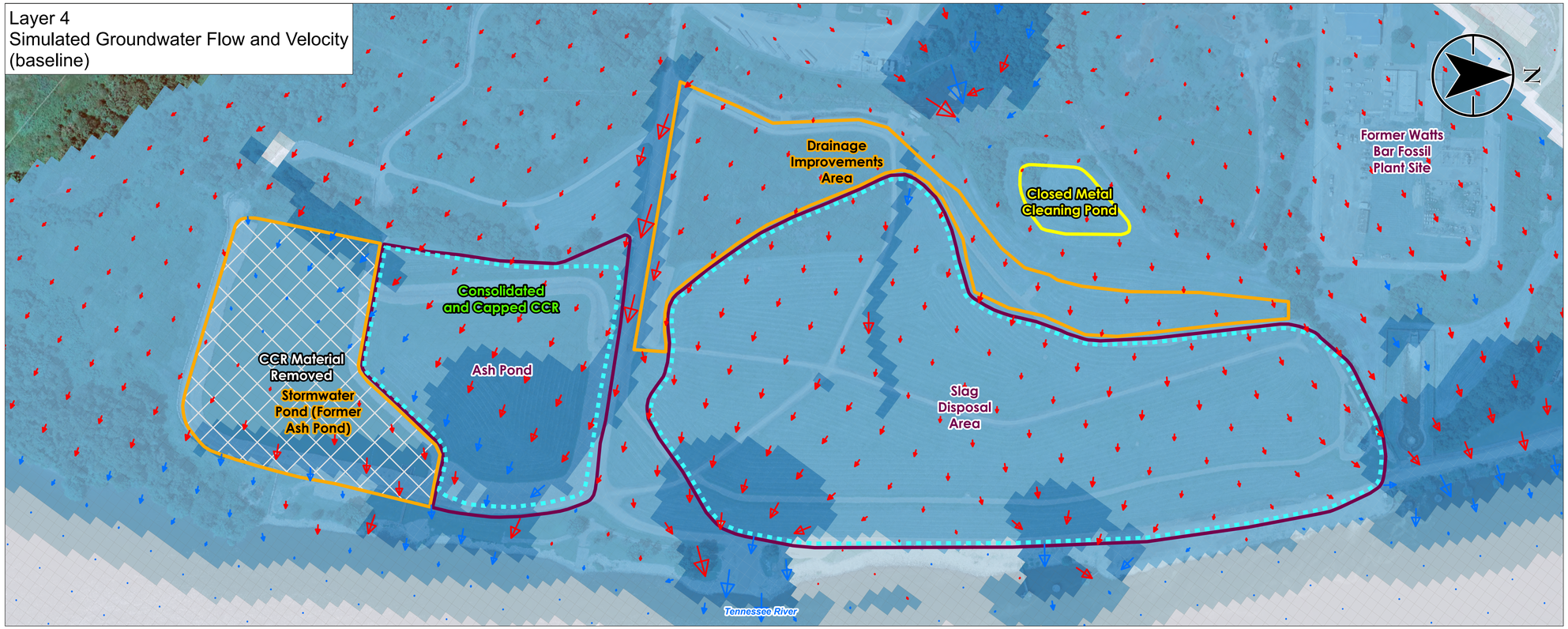
DRAFT

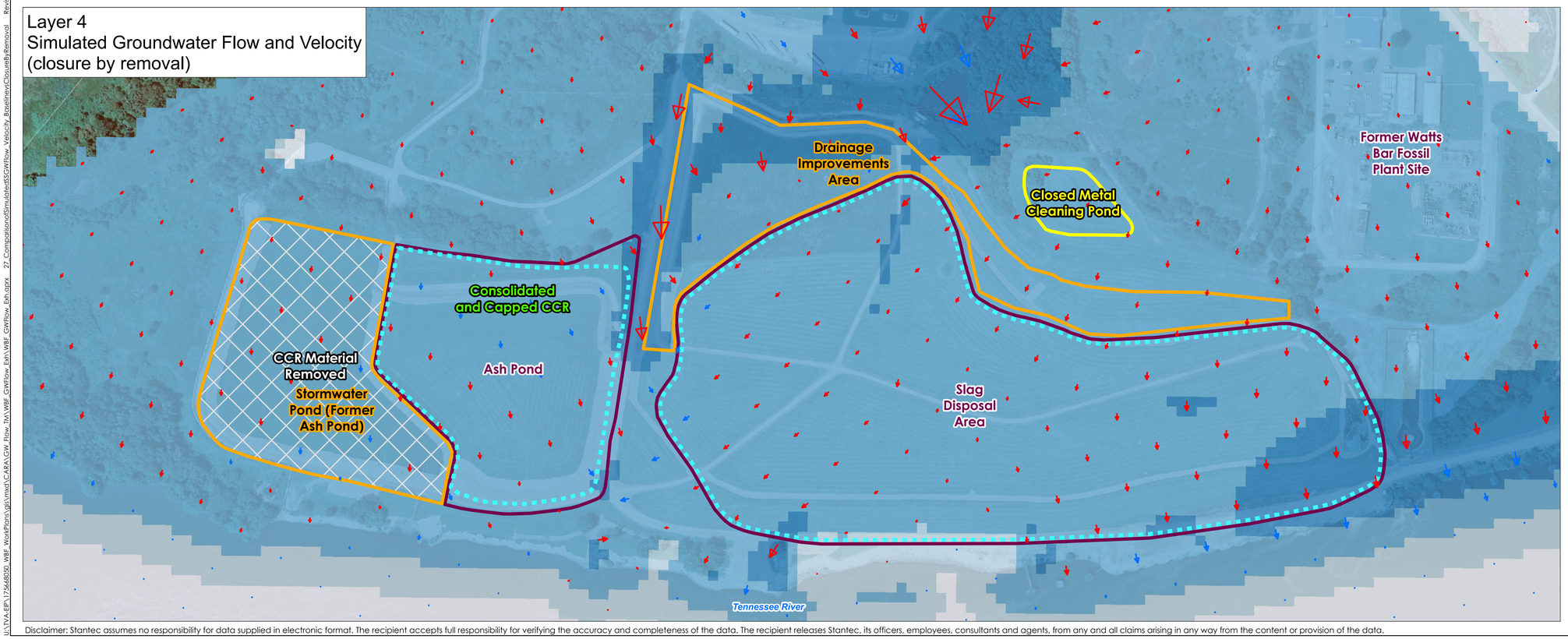
Title
Comparison of Simulated Steady-State Groundwater Flow & Velocity: Baseline vs. Closure by Removal

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-09-03
Technical Review by SW on 2024-09-03





0 150 300 450 600 Feet

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

Legend

- Simulated Direction of Flow (upward flow component)
- Simulated Direction of Flow (downward flow component)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

Simulated Groundwater Flow Velocity (feet/year)

- < 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. The flow vectors are scaled to Model-simulated flow velocity. Larger arrows indicate relatively greater velocities; smaller arrows may appear as dots and indicate relatively lower velocities.

Stantec TVA

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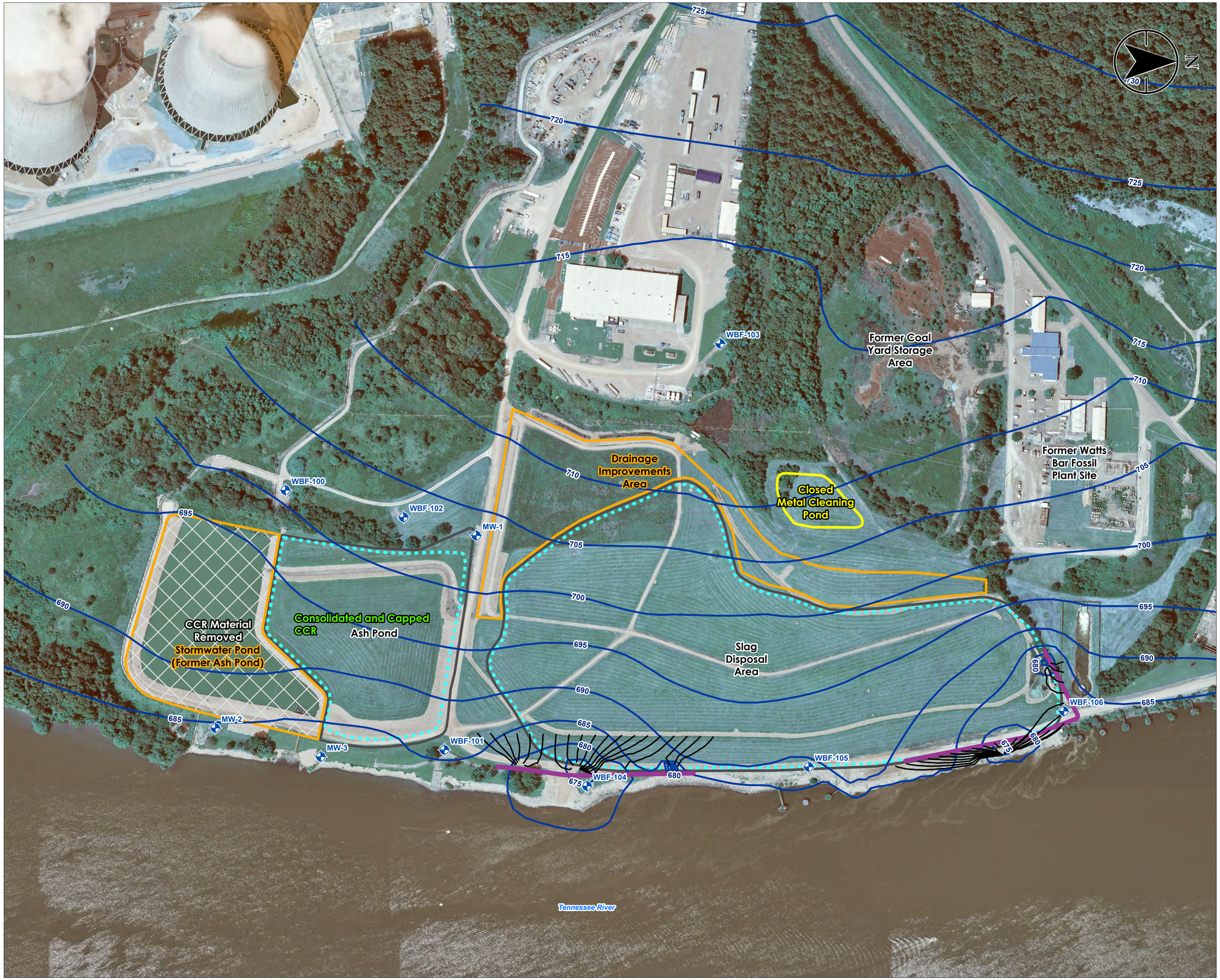

Exhibit No.
28

DRAFT

Title

Simulated Extraction Well Layout for Targeted Hydraulic Control Scenario

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2025-10-06
Technical Review by SW on 2025-10-06

0 150 300 450 600 Feet

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

Legend

- Groundwater Monitoring Well
- Approximate Location of Groundwater Extraction System
- Particle Traces
- Simulated Steady-State Groundwater Elevation Contours with Targeted Groundwater Extraction, Layer 4 (5 foot interval; elevations are in feet above mean sea level)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Groundwater conditions at well MW-1 are evaluated and discussed in Chapter 6.5 and Appendix D of the CARA Plan.

Notes

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

Stantec TVA

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U:\TVA-EPI-175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_Tech\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 28_SimulatedExtractionWellLayoutforTargetedControl Revised: 2025-10-06 By: mbough

Exhibit No.
29

DRAFT

Title
Modeled Pore Water Extraction System Alignments and Bottom of CCR Material Elevation

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-01-23
Technical Review by PD on 2025-01-23

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

Legend

- Approximate Pore Water Horizontal Extraction Well Alignment
- Bottom of CCR Material Elevation Contour (2 ft interval)
- Bottom of CCR Material Elevation Contour Contour (10 ft interval)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)
3. Model input and confirmation data used to model and evaluate the bottom of CCR surfaces shown herein are summarized in Table C.2 (Appendix C).

Stantec TVA

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U:\TVA-EIP\175668050_WBF_MonePlants\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 29_ModeledPWExtractionAlignments_BottomofCCRElevations Revised: 2025-01-23 By: mbough

Exhibit No.
30

DRAFT

Title
Comparison of Simulated Groundwater Piezometric Surface: Baseline vs. Pore Water Extraction

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

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

Legend

- Approximate Pore Water Horizontal Extraction Well Alignment
- Limit of Existing Cover System (Approximate – 2023)
- Simulated Steady-State Groundwater Elevation Contours with Pore Water Extraction (5 foot interval; elevations are in feet above mean sea level)
- Simulated Baseline Groundwater Elevation Contours (5 foot interval; elevations are in feet above mean sea level)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

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J:\TVA\EIP\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_Tn\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 30_CompositionofSimulatedGWPiezometricSurface_BaselinevsPWExtraction Revised: 2024-08-06 By: mbough

Exhibit No.
31a

DRAFT

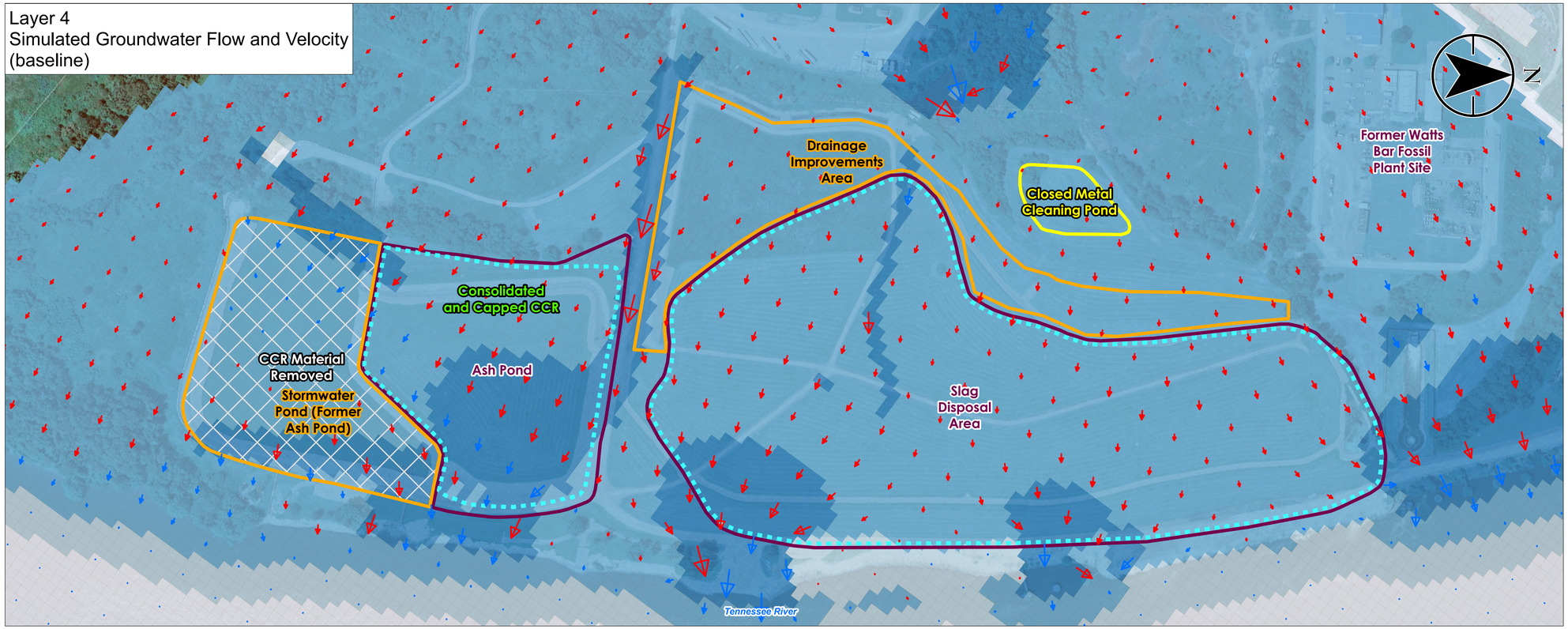
Title
Comparison of Simulated Steady-State Groundwater Flow & Velocity: Baseline vs. Pore Water Extraction

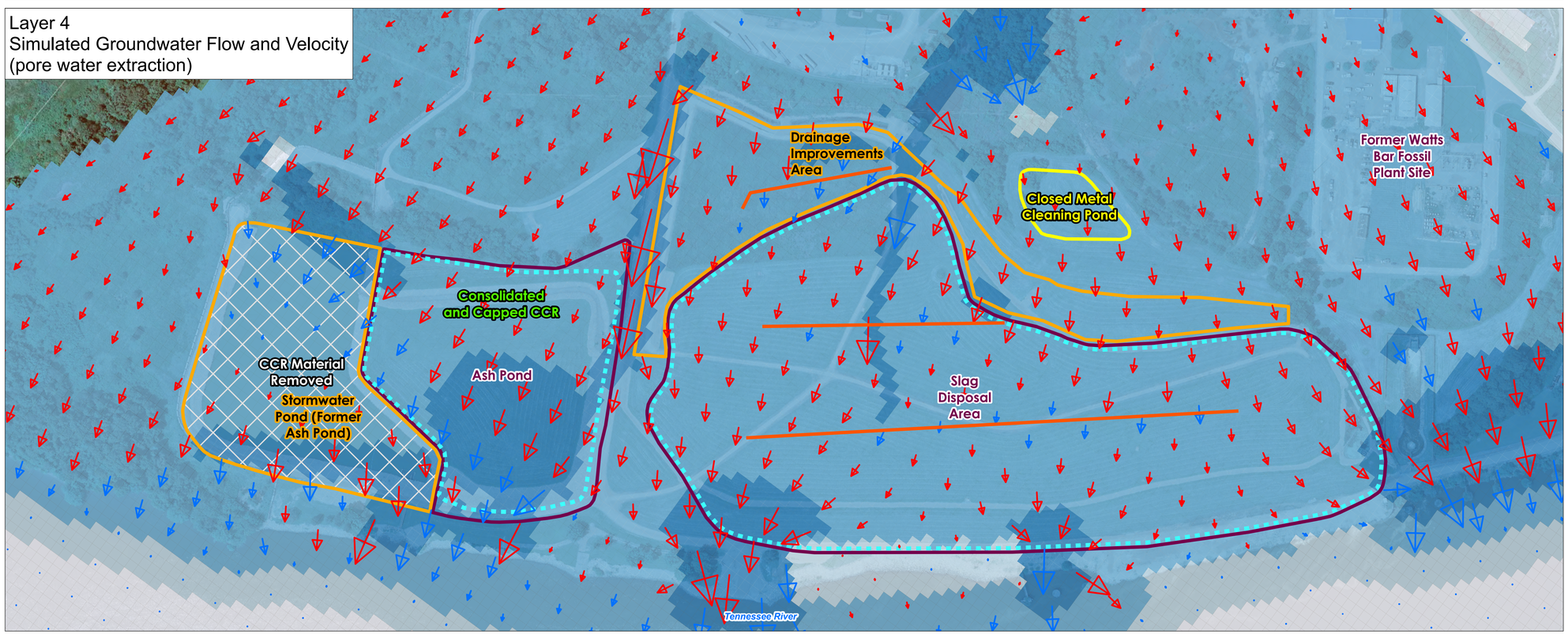
Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-09-03
Technical Review by SW on 2024-09-03

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





Legend

- Approximate Pore Water Horizontal Extraction Well Alignment
- Simulated Direction of Flow (upward flow component)
- Simulated Direction of Flow (downward flow component)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

Simulated Groundwater Flow Velocity (feet/year)

- < 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. The flow vectors are scaled to Model-simulated flow velocity. Larger arrows indicate relatively greater velocities; smaller arrows may appear as dots and indicate relatively lower velocities.

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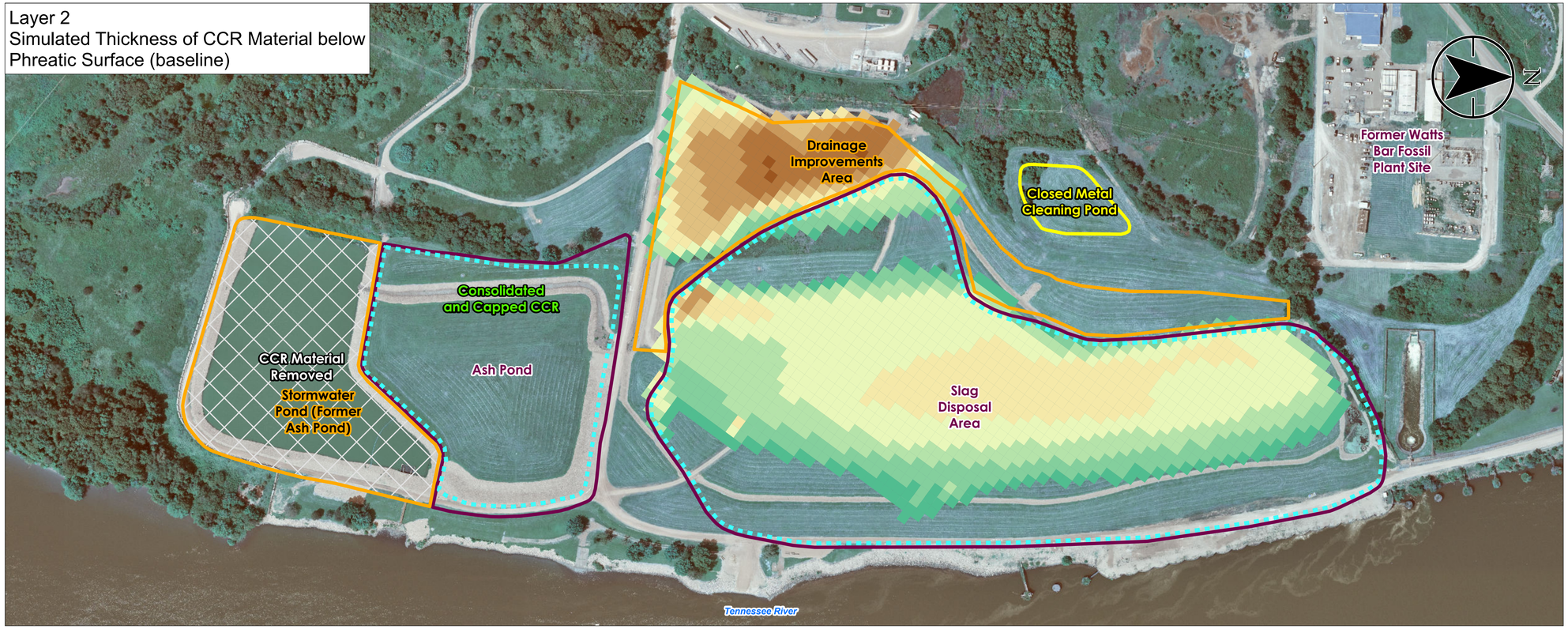
J:\TVA-EPI\175668050_WBF_KnoxPlants\gis\mxd\CA-RAI\GW_Flow_TMI\WBF_GWFlow_Exh\WBF_GWFlow_Exh.aprx 31a_ComparisonofSimulatedSSGWFlow_Velocity_BaselinevsPWExtraction Revised: 2024-09-03 By: mbough



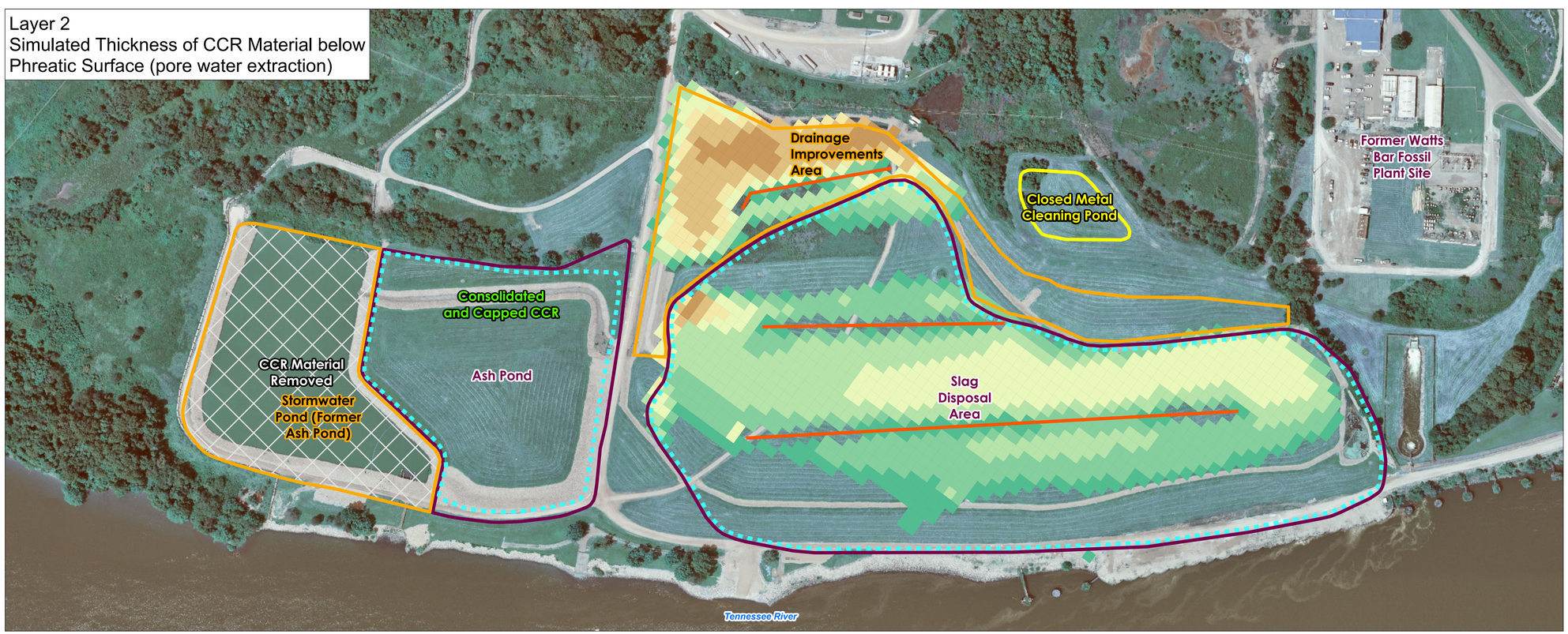


Exhibit No.
31b

DRAFT

Title

Comparison of Simulated Steady-State Thickness of CCR Material below the Phreatic Surface: Baseline vs. Pore Water Extraction

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

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

Legend

- Approximate Pore Water Horizontal Extraction Well Alignment
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

MODFLOW-Simulated Thickness of CCR Material below Phreatic Surface in feet

- < 1 (transparent)
- 1 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- 14 - 16
- 16 - 18

CCR: Coal combustion residuals

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

Stantec TVA

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Exhibit No.
32

DRAFT

Title

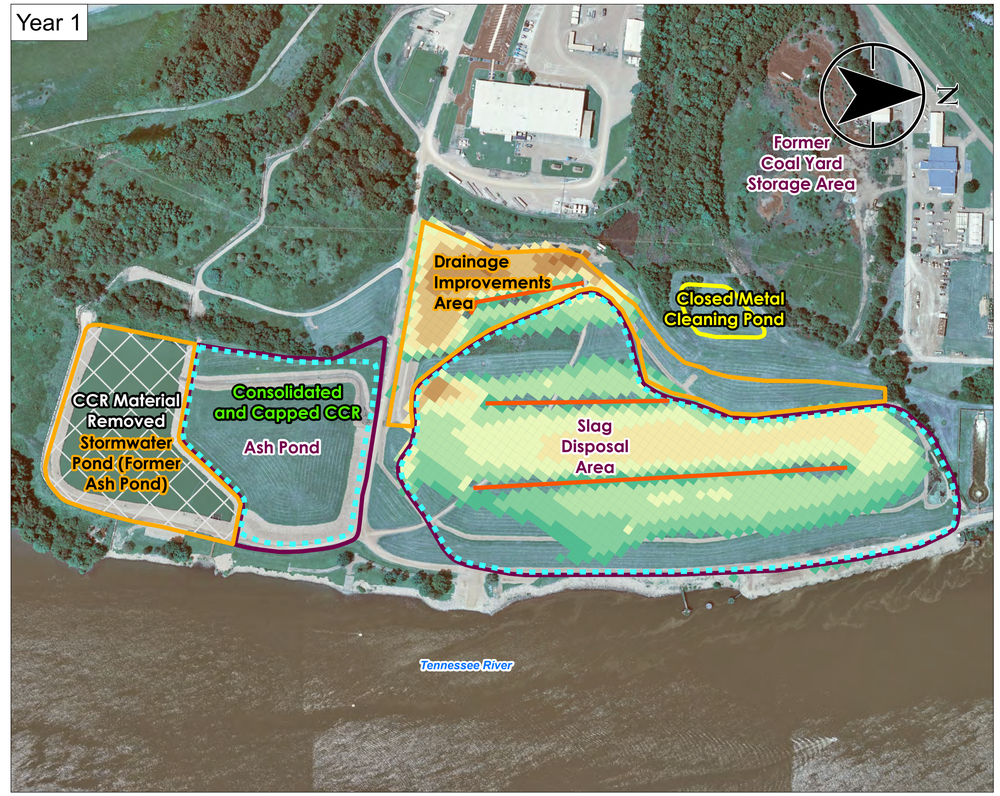
Simulated Change Over Time in the Thickness of CCR Material below the Phreatic Surface with Pore Water Extraction

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-07
Technical Review by SW on 2024-08-07



0 250 500 750 1,000 Feet

1:3,000 (At original document size of 22x34)

Legend

- Approximate Pore Water Horizontal Extraction Well Alignment
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

MODFLOW-Simulated Thickness of CCR Material below Phreatic Surface in feet

- < 1 (transparent)
- 1 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- 14 - 16
- 16 - 18

CCR: Coal combustion residuals

Notes

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

Stantec TVA

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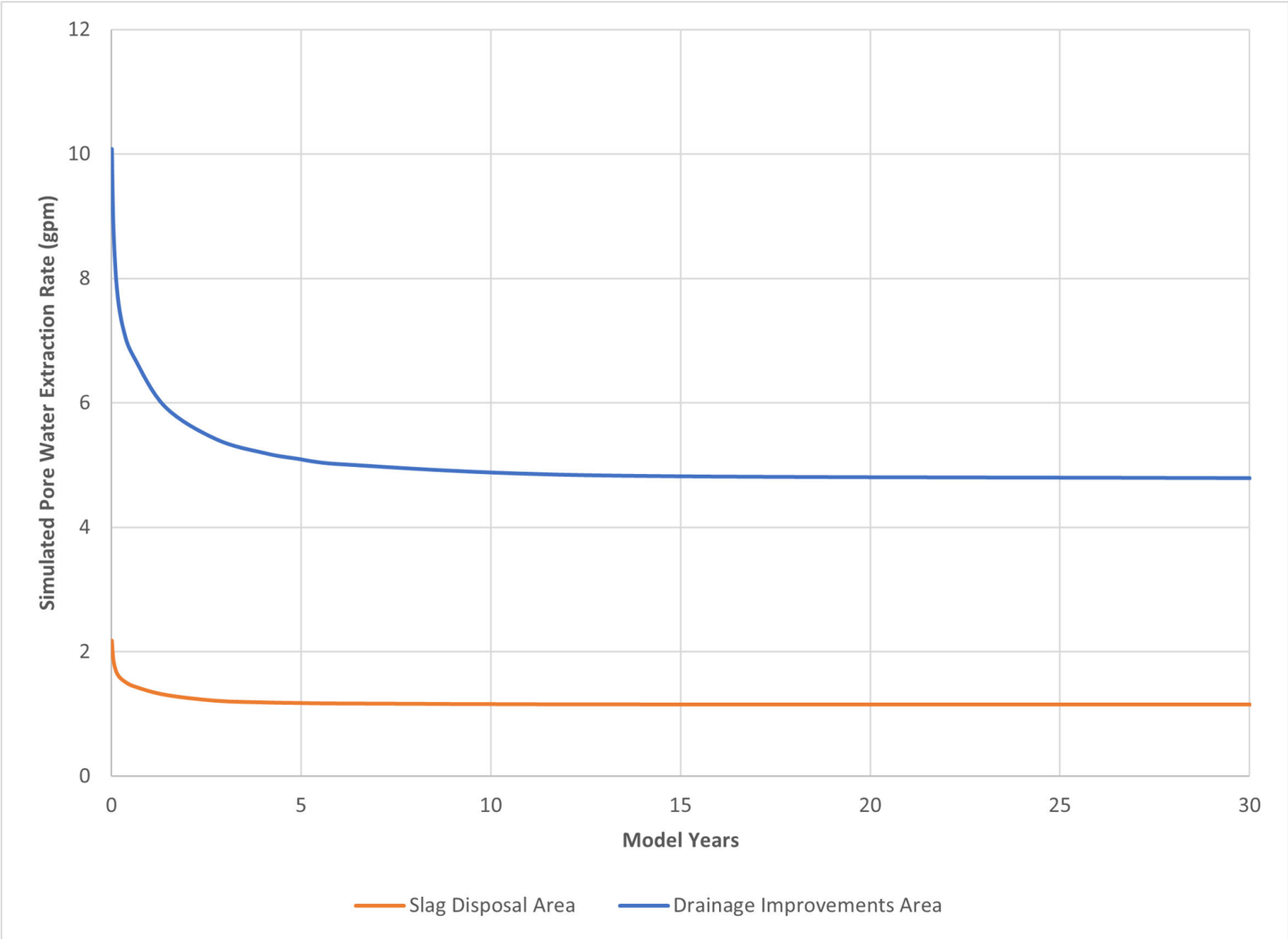
J:\TVA-EPI\175668050_WBF_WorkPlans\gis\mxd\CARA\GW_Flow_TM\WBF_GWFlow_Exh.aprx 32_SimulatedChangeOverTimeinThicknessCCR_wPWExtraction Revised: 2024-08-07 By: mbough



DRAFT

Exhibit No.

33

Title

Simulated Pore Water Extraction Rate over Time

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2024-08-07
TR by SW on 2024-08-07
IR Review by RB on 2024-08-07

Notes

gpm: gallons per minute

Stantec

TVA

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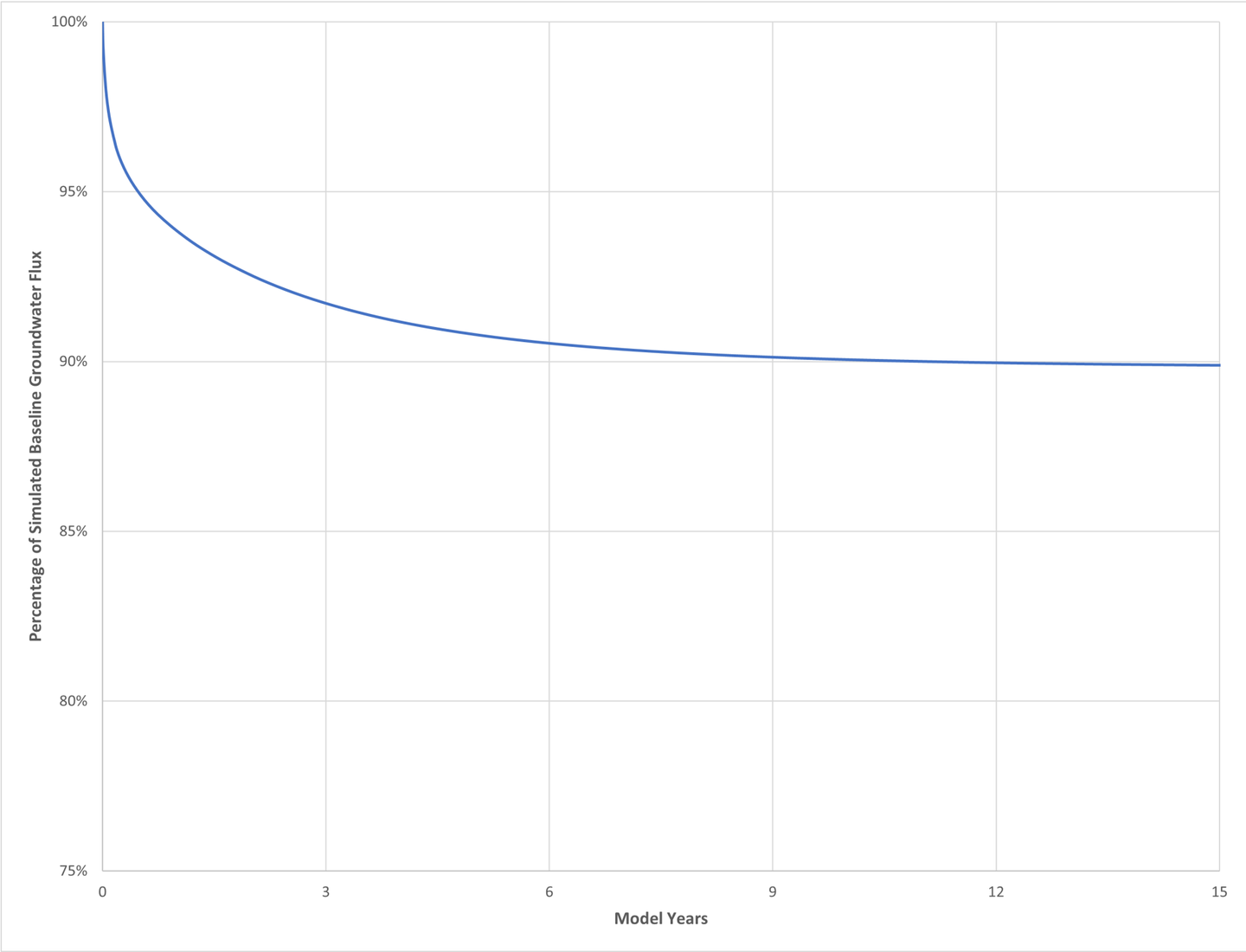

DRAFT

Exhibit No.

34

Title

Simulated Reduction in Groundwater Flux with Pore Water Extraction

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2024-08-06
TR by SW on 2024-08-06
IR Review by RB on 2024-08-06

Stantec

TVA

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Exhibit No.
35

DRAFT

Title

Sensitivity of Simulated Groundwater Piezometric Surface to River Stage

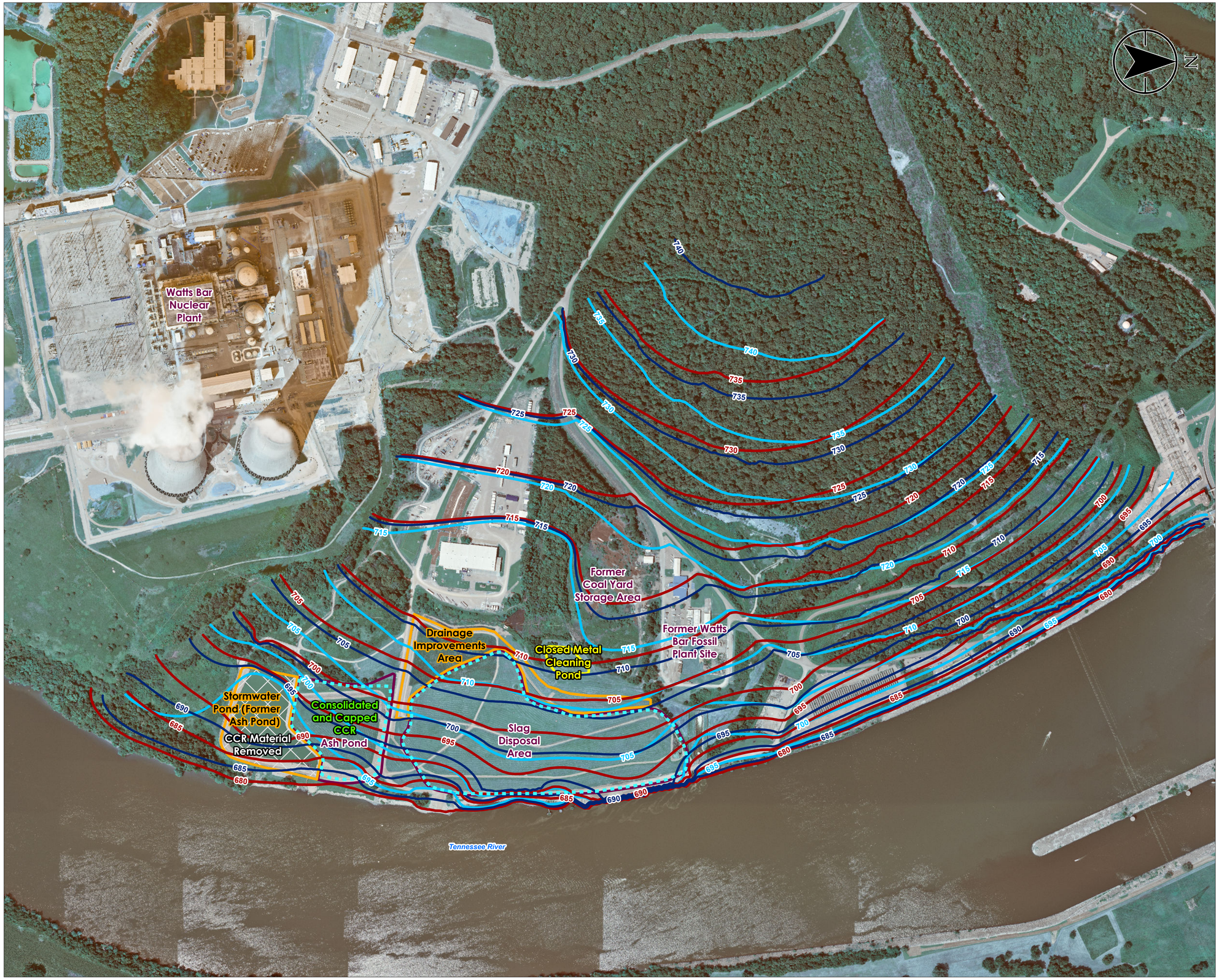
Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-06
Technical Review by SW on 2024-08-06

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



Legend

- Limit of Existing Cover System (Approximate – 2023)
- Simulated Groundwater Elevation Contours (5 foot interval; elevations are in feet above mean sea level)
- Simulated Low Stage Groundwater Elevation Contours, Layer 4 (5 foot interval; elevations are in feet above mean sea level)
- Simulated High Stage Groundwater Elevation Contours, Layer 4 (5 foot interval; elevations are in feet above mean sea level)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

Stantec TVA

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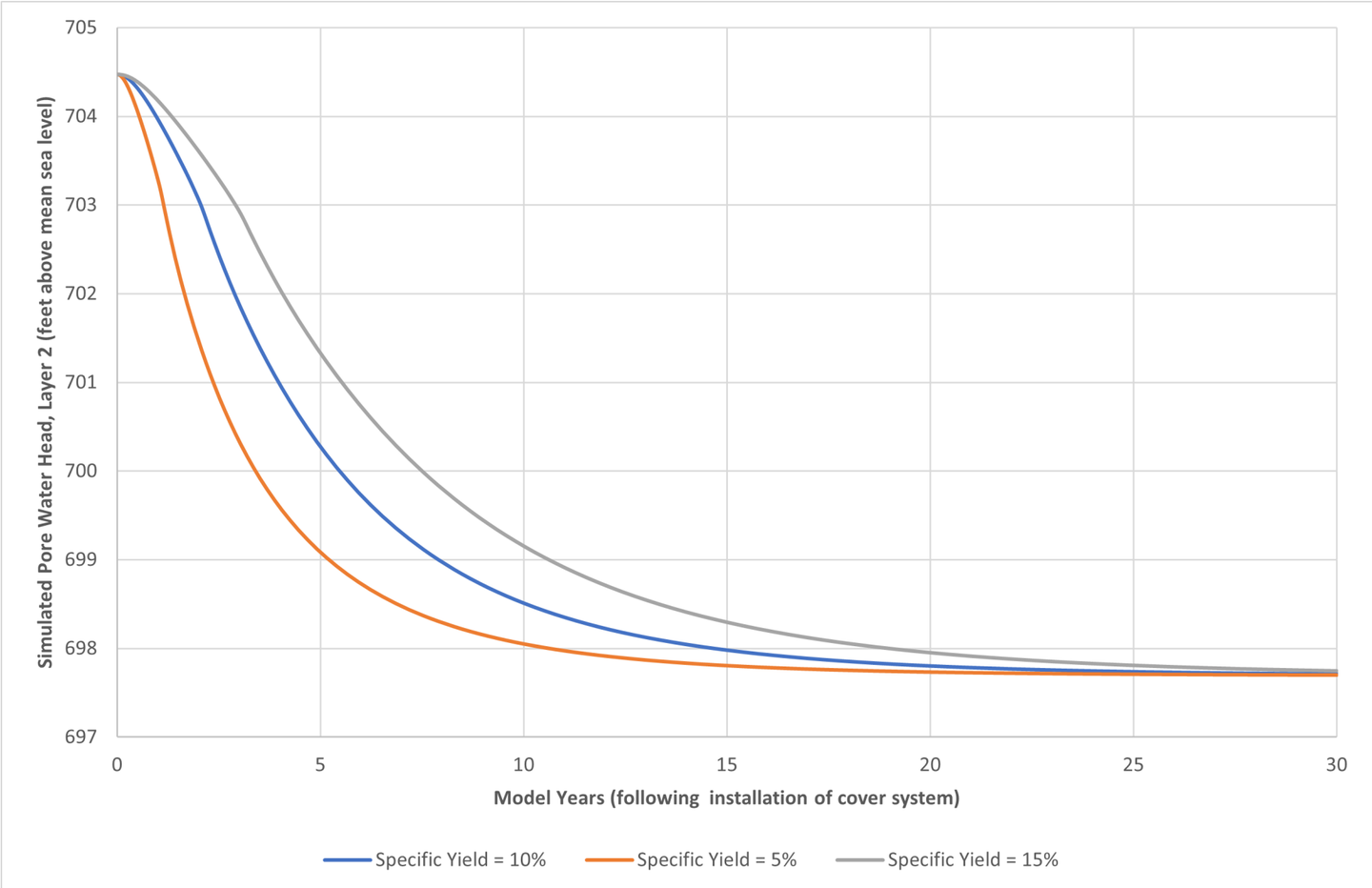

DRAFT

Exhibit No.

36

Title

Sensitivity of Simulated Cover System Response (Pore Water Heads) to Specific Yield

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2024-08-06
TR by SW on 2024-08-06
IR Review by RB on 2024-08-06

Stantec

TVA

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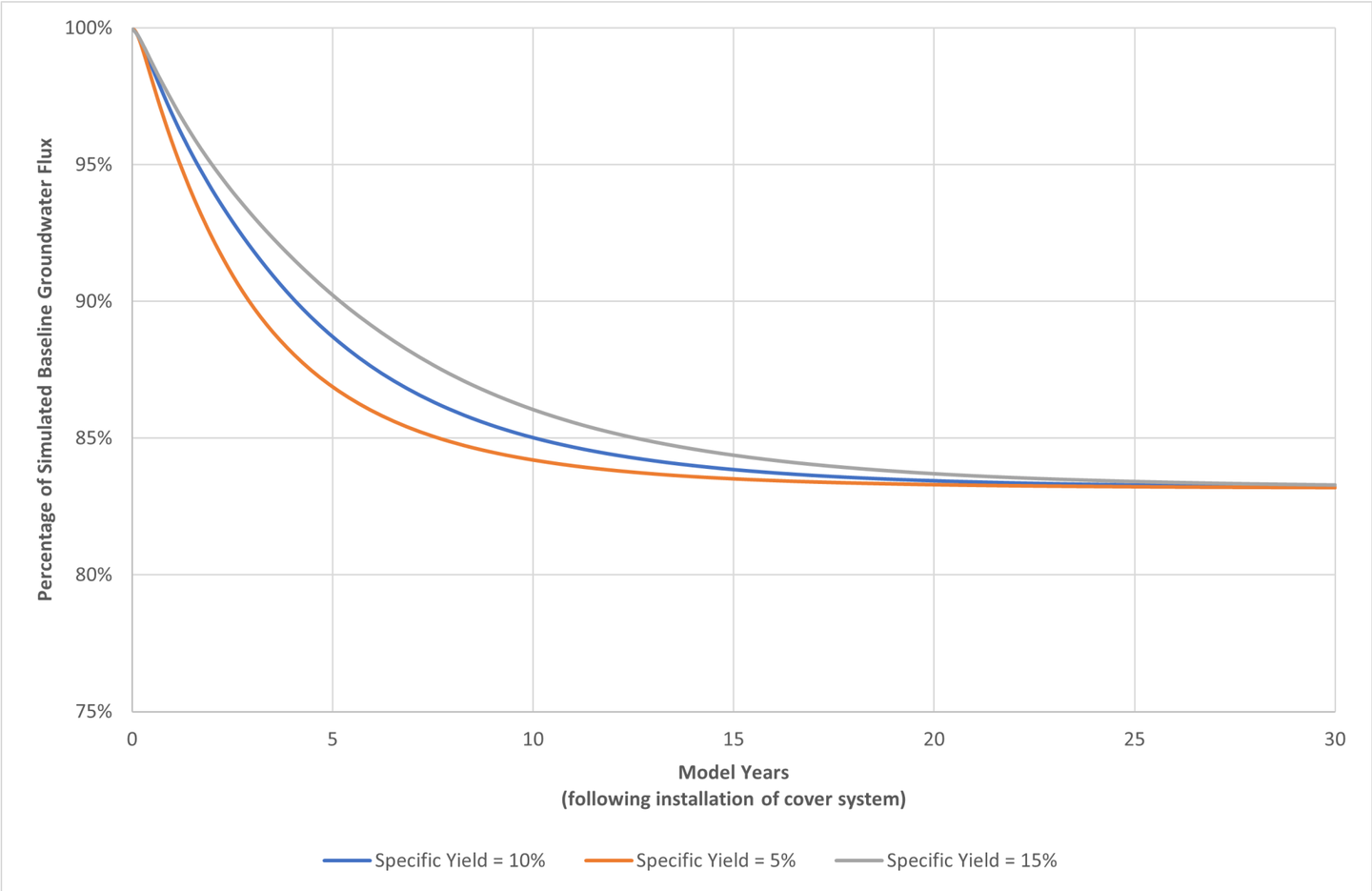

DRAFT

Exhibit No.

37

Title

Sensitivity of Simulated Cover System Response (Groundwater Flux) to Specific Yield

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-08-06
TR by SW on 2024-08-06
IR Review by RB on 2024-08-06

Stantec

TVA

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APPENDIX H –
GEOCHEMICAL MODELING

APPENDIX H.1

GEOCHEMICAL MODELING TECHNICAL MEMORANDUM

Appendix H.1 - Geochemical Modeling Technical Memorandum - DRAFT

TDEC Commissioner's Order:
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal for TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Date Revised for Reissuance. No other changes made to this Appendix	December 5, 2025

Sign-off Sheet

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Prepared by _____

Thai Phan, PhD, Geochemist

Reviewed by _____

Jim B Finley, PhD, PG, Principal Geochemist

Approved by _____

John Griggs, PG, Senior Principal

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Abbreviations

CARA	Corrective Action/Risk Assessment
CBR	Closure-by-removal
CCR	Coal Combustion Residuals
CIP	Closure-in-place
EAR	Environmental Assessment Report
Eh	Oxidation-reduction potential as per the standard hydrogen electrode
EI	Environmental Investigation
g/mol	Grams per mole
GWPS	Groundwater Protection Standard
Hao	Hydrous aluminum oxide or gibbsite
Hfo	Hydrous ferric hydroxide or ferrihydrite
mg/kg	Milligrams per kilogram
Mol	Moles
ORP	Oxidation Reduction Potential
PHREEQC	pH, REdox, EQuilibrium
SEP	Sequential Extraction Procedure
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Tennessee Department of Environment and Conservation's Order No. OGC15-0177
TM	Technical Memorandum
TVA	Tennessee Valley Authority
WBF	Watts Bar Fossil Plant

1.0 INTRODUCTION AND OBJECTIVES

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this Geochemical Modeling Technical Memorandum (TM) to summarize the geochemical modeling and data evaluation at TVA's Watts Bar Fossil (WBF) Plant in Spring City, Tennessee.

The objective of the geochemical modeling activities was to develop and calibrate a site-specific groundwater geochemical model for the WBF Plant coal combustion residuals (CCR) units in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015).

The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan has been prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA.

To achieve the objective of the geochemical modeling activities, supplemental geochemical investigations were conducted as part of other WBF Plant investigative activities to supplement the dataset collected during the Environmental Investigation (EI). The scope of work for the geochemical investigation and modeling activities consisted of the following tasks:

- Collect soil samples for geochemical characterization and use in treatability studies
- Collect groundwater samples for analysis of geochemical constituents and parameters
- Collect pore water samples for analysis of geochemical constituents and parameters
- Evaluate the geochemical data and use the data for input into the WBF Plant geochemical conceptual site model.

A summary of the fieldwork and activities to collect soil, groundwater, and pore water, and a summary of the analytical results with data evaluation are included as Appendix H.2. Details on the geochemical modeling and calibration are discussed in this document.

This geochemical modeling TM presents the findings and results of geochemical modeling activities performed to meet the specific objectives described above and is based on available data at the time of model development. Future updates may be warranted as additional data are obtained, as new project objectives are defined, and as indicated, based on geochemical model results.

2.0 BACKGROUND AND APPROACH

Inspection of the groundwater and pore water chemistry data suggested that the differences in chemistry between pore water and groundwater could not be explained solely by physical processes (e.g., mixing, dispersion). Recognizing that the geochemical properties of unconsolidated materials influence constituent concentrations led to development of a geochemical evaluation program for unconsolidated materials. The geochemical evaluation program was implemented in conjunction with other ongoing drilling programs such as seismic investigations and installation of piezometers. Sampling and analysis plans were developed for collecting soil samples for geochemical evaluation. The purpose of the geochemical evaluation was to establish and quantify the geochemical properties of unconsolidated materials to demonstrate that well understood geochemical reactions (e.g., adsorption to metal hydroxide minerals, cation exchange by clay minerals) contribute to the observed changes in groundwater chemistry downgradient of CCR units.

The information generated from the geochemical evaluation is considered sufficient for purposes of integrating geochemical modeling into the CARA Plan process. Basic questions related to the presence of geochemically reactive minerals, such as iron hydroxide or ferrihydrite, aluminum hydroxide or gibbsite, and clays (such as smectite, illite/smectite, and kaolinite) are of primary importance because measurable amounts of iron hydroxide, aluminum hydroxide, or clay minerals support the inclusion of adsorption and cation exchange processes in the geochemical model. That is, the range in geochemical properties measured from the collected samples of unconsolidated materials demonstrates that geochemically reactive minerals are present in sufficient amounts for known geochemical reactions to occur between groundwater and unconsolidated materials at the WBF Plant. The amount of minerals, as measured by the geochemical testing, can be used as input values in the geochemical model; however, allowing values to vary within the measured range was the approach applied during calibration. For purposes of developing a site-specific geochemical model, the geochemical sampling program provided a sufficient dataset to develop and calibrate a site-specific model for the WBF Plant that can be used to compare the effects of implementing various corrective measures on the geochemical processes affecting groundwater chemistry.

3.0 OVERVIEW OF GEOCHEMICAL SYSTEM

An overview of the geochemical system in this section provides the information used to develop a geochemical conceptual site model, that, in turn, was used to build the geochemical models.

Groundwater quality is affected by numerous geochemical processes during groundwater flow through geological materials, and this is true for groundwater flowing through unconsolidated materials at the WBF Plant. Pore water within the CCR material has specific chemical characteristics that are different from the characteristics of groundwater downgradient of the CCR units. Certain CCR constituents that have been detected in pore water within the CCR material are affected by geochemical processes during groundwater transport through unconsolidated materials surrounding the CCR units. The effects of these geochemical processes help explain the observed differences between the characteristics of pore water and groundwater. The nature and extent of the interactions between dissolved constituents in groundwater, unconsolidated materials, and bedrock range from limited interaction for constituents such as boron, chloride, and sulfate, to strong interaction for constituents such as arsenic and cobalt. Descriptions of the interactions between unconsolidated materials and groundwater constituents are provided in many textbooks (e.g., Appelo and Postma 1996), and these interactions fall under the broad umbrella of geochemical reactions or processes. These include:

- Adsorption/desorption on the surfaces of metal hydroxides – an interaction between dissolved constituents and the surface of certain metal hydroxide minerals (most often iron, but also manganese and aluminum), whereby constituents adsorb onto metal hydroxides that are often coating soil mineral surfaces, or constituents desorb (i.e., reaction is reversible) and become dissolved in groundwater; controlled primarily by the pH of groundwater
- Cation exchange with clay minerals – primarily affects positively charged constituents by interacting with the clay minerals; varies by clay mineral, competition among constituents, and concentrations of other constituents; cation exchange reactions are reversible
- Mineral precipitation or dissolution – a process where constituents in groundwater combine to form a soil mineral; minerals are also subject to dissolution (i.e., reaction is reversible) under certain conditions of groundwater pH and oxidation-reduction potential.

While each of the geochemical processes listed are reversible, the implementation of CCR unit closure and groundwater corrective measures are expected to produce conditions that would limit the potential for reversal of geochemical attenuation.

Understanding the geochemistry of unconsolidated materials is important in interpreting the processes influencing current conditions of groundwater chemistry at the WBF Plant and evaluating effects of activities, such as a cover system installation or groundwater corrective action, on the evolution of groundwater quality.

3.1 STUDY AREA DESCRIPTION

For consideration of geochemistry that influences observed groundwater quality in the vicinity of the WBF Plant, the pertinent study area is the footprint of the CCR units. That is, groundwater quality at groundwater monitoring wells located on the downgradient edge of the CCR units is influenced primarily by near-field hydrologic and geochemical processes rather than by regional conditions. While the geologic history of the area beneath the WBF Plant is complex, most geochemical processes influencing groundwater quality occur in the unconsolidated materials above bedrock, which includes residuum and alluvial deposits associated with the geomorphic history of the Tennessee River. The current location of this waterbody is shown on Exhibit 1.

3.2 GEOCHEMICAL FRAMEWORK

The geochemical properties of unconsolidated materials at the WBF Plant reflect the geologic history of chemical and mechanical weathering of local bedrock and the complex sequence of alluvial deposits that formed in the floodplain of the Tennessee River. Alluvial deposits reflect typical floodplain depositional sequences, with deposits sorted primarily by grain size as a function of changes in the sediment transport capacity of surface water. Depending on a given location in the floodplain, the vertical sequence of sediment grain sizes can vary from coarsening upwards to coarsening downwards. Secondary geochemical modification of the alluvial sediments can occur in response to chemical weathering of unconsolidated materials. Residuum derives by the in-place weathering of bedrock. Geochemical modification of residuum in the presence of groundwater occurs in the same way as in alluvial deposits. The following sub-sections discuss the general geochemical properties of the hydrostratigraphic units found at the WBF Plant that contribute to the observed groundwater quality downgradient of the CCR units.

3.2.1 Coal Combustion Residuals

The WBF Plant has two CCR units: the Slag Disposal Area (and Drainage Improvements Area) and the Ash Pond. The Slag Disposal Area is contained by a railroad embankment and a natural knoll to the west, stacked CCR material to the east, and a dike with a spillway to the south that was constructed to discharge process water (TVA 1969). As part of the Ash Pond closure activities in 2015, the CCR material from the southern area of the Ash Pond (currently the Stormwater Pond) was excavated, consolidated, and capped in the Ash Pond (CDM Smith 2015).

During the EI, temporary wells were installed in the CCR material with samples of CCR material and pore water collected for laboratory analysis. Results of the geochemical testing of CCR material are presented and discussed in the *WBF Plant Environmental Assessment Report* (EAR) (TVA 2024). Pore water chemistry is discussed in Appendix G.1 of the EAR.

3.2.2 Alluvium

The alluvial deposits of the Tennessee River are the primary unconsolidated materials through which groundwater flows. The alluvial materials are thickest near the Tennessee River and thinner at greater distances from the river. Based on historical geotechnical and hydrogeologic investigations, the upper

fine-grained material is primarily comprised of clays and silts that grade downward to coarser-grained sands and gravels where much of the groundwater flows. Most groundwater flow and geochemical reactions between groundwater and unconsolidated materials occur within the unconsolidated alluvium.

3.2.3 Residuum

Silty and clayey unconsolidated materials formed from the weathering of bedrock that was historically above the Tennessee River floodplain and not subjected to alluvial deposition. The thickness of the residuum ranges from little to no unconsolidated materials along some nearby ridges to the west and north sides of the alluvial flood plain where bedrock is at or near the ground surface. For purposes of geochemical modeling, the geochemical properties of residuum are assumed to fall within the range represented by the unconsolidated material samples analyzed.

3.2.4 Bedrock

Bedrock lies beneath the unconsolidated materials. Because groundwater flow occurs primarily in the unconsolidated alluvial materials and geochemical processes in bedrock are limited, bedrock is not considered further in geochemical model development.

3.3 GEOCHEMISTRY OF CCR CONSTITUENTS

Cobalt and cadmium are the two CCR constituents identified as requiring further evaluation in the CARA Plan. The geochemical properties of cobalt and cadmium influence the degree to which constituents interact with the unconsolidated materials, which further influence the types of corrective measures that could attenuate each constituent to achieve the respective groundwater protection standards (GWPS). This section presents a brief discussion of the geochemistry for each constituent as relevant to the conditions at the WBF Plant.

3.3.1 Cobalt

Cobalt is stable as the positively charged ion Co (II) (i.e., cation) over a wide range of pH and oxidation-reduction potential (Eh) conditions and would be more stable as a sulfide mineral only at low Eh conditions (Exhibit 2). Cobalt is not subject to oxidation-reduction conditions over typical pH/Eh conditions present in groundwater at the WBF Plant. The chemical system in Exhibit 2 shows the distribution of stable minerals and aqueous species for cobalt-sulfur-water. The dashed red rectangle shown on Exhibit 2 corresponds to the range of pH and Eh measured in groundwater at the WBF Plant, which indicates that cobalt in groundwater is the aqueous cobalt cation.

For purposes of interpreting and modeling the geochemistry of cobalt, the focus is on geochemical reactions that would involve the cobalt aqueous species that has a plus two positive charge. Given the relative stability of aqueous cobalt over typical pH/Eh conditions in groundwater at the WBF Plant, adsorption to iron (aluminum) hydroxide minerals is the primary geochemical process that might influence aqueous concentrations. While there could be adsorption of cobalt to manganese hydroxide minerals, there are currently no thermodynamic databases with the necessary information to include sorption (adsorption and desorption) reactions between cobalt in groundwater and manganese hydroxide

minerals. The extent to which manganese hydroxide adsorbs cobalt in the current groundwater system is considered covered by iron hydroxide adsorption in the calibrated model.

3.3.2 Cadmium

Cadmium is stable as the positively charged ion Cd (II) (i.e., cation) over a wide range of pH and Eh and would be more stable as a sulfide mineral only at low Eh conditions (Exhibit 3). Cadmium is not subject to oxidation-reduction conditions over typical pH/Eh conditions present in the groundwater at WBF Plant. For purposes of interpreting and modeling the geochemistry of cadmium, the focus is on geochemical reactions that would involve the cadmium aqueous species that has a plus two positive charge. Given the relative stability of aqueous cadmium over typical pH/Eh conditions in groundwater at the WBF Plant, adsorption to iron (aluminum) hydroxide minerals is the primary geochemical process that might influence aqueous concentrations. While there could be adsorption of cadmium to manganese hydroxide minerals, there are currently no thermodynamic databases with the necessary information to include sorption (adsorption and desorption) reactions between cadmium in groundwater and manganese hydroxide minerals. The extent to which manganese hydroxide adsorbs cadmium in the current groundwater system is considered covered by iron hydroxide adsorption in the calibrated model.

3.4 GEOCHEMICAL BOUNDARIES

Geochemical boundaries of the geochemical conceptual site model correspond to the spatial footprint of the CCR units at the WBF Plant. As described in the *Groundwater Flow Modeling Technical Memorandum* (Appendix G), there is a limited area that constitutes the upgradient portion of the groundwater flow system at the WBF Plant. Thus, groundwater quality measured in upgradient groundwater monitoring wells provides the basis for evaluating effects of CCR material on groundwater chemistry. Furthermore, the upgradient groundwater monitoring well data were used to evaluate the effects and response period for potential corrective action approaches for CCR units on groundwater chemistry.

4.0 MODELING OVERVIEW

4.1 MODELING APPROACH

The combined information from the hydrogeologic evaluation (see *Groundwater Flow Modeling TM*; Appendix G), groundwater chemistry from the groundwater monitoring program, pore water chemistry from the EI, and results of the geochemical testing of unconsolidated materials were used to develop a geochemical conceptual site model for the WBF Plant. The Slag Disposal Area has two separate geochemical model transects that each consist of a one-dimensional groundwater flow path, the contributing sources, and their different water chemistries (upgradient groundwater and pore water), and the geochemical properties of unconsolidated materials. The geochemical models have been calibrated to site-specific conditions and are being used to support the CARA Plan groundwater corrective action evaluation and selection process.

4.2 COMPUTER CODE

Geochemical modeling that incorporates the information described above was completed using the PHREEQC computer code developed and supported by the United States Geological Survey (Parkhurst and Appelo 2013). PHREEQC, which stands for pH, REdox, EQuilibrium, is a public domain computer program that allows aqueous speciation, batch reactions, one-dimensional transport, and inverse geochemical reactions. The geochemical modeling capabilities of PHREEQC extend to simulation of isotopic systems and representation of kinetically controlled chemical reactions. More detail about PHREEQC capabilities is presented in Parkhurst and Appelo (2013). One-dimensional transport modeling requires information about the groundwater flow rate, which is obtained from the groundwater flow model (see *Groundwater Flow Modeling TM;* Appendix G).

One-dimensional transport with geochemical reactions using the computer model PHREEQC was appropriate for the analysis completed herein because the resolution of the model matches the nature of the questions being asked. That is, information from the geochemical modeling was used as part of the larger CARA Plan evaluation, which considers many other factors affecting selection of the final corrective action, to distinguish the relative benefits of different closure and groundwater corrective actions. The model outcomes generated by one-dimensional transport modeling using PHREEQC provide useful input to the overall evaluation of the CARA Plan options.

5.0 MODEL CONSTRUCTION

5.1 MODEL DOMAIN

The model domain for geochemical modeling extends spatially from the upgradient groundwater monitoring well location (WBF-103) to the groundwater monitoring wells (WBF-104 and WBF-106) located on the downgradient side of the Slag Disposal Area. Vertically, the geochemical model extends from the CCR material to the base of the coarse unconsolidated materials. The assumption is that sources contributing to chemical mass and geochemical processes that remove chemical mass are contained within the area described. Exhibit 1 shows an overview of the CCR units at the WBF Plant along with two transects used for geochemical modeling at the Slag Disposal Area described in the following subsections.

Conceptually, pore water from the CCR unit mixes with groundwater originating upgradient of the unit, and the resulting mixture migrates downgradient. During downgradient migration, geochemical reactions occur between the pore water-groundwater mixture and unconsolidated materials. Transects were drawn from the upgradient edge of the CCR unit to the target downgradient groundwater monitoring well. The total contribution of pore water to groundwater was calculated by comparing the concentrations of chemically conservative constituents, such as boron, in sources (i.e., upgradient groundwater and pore water) to the concentrations reported in the downgradient groundwater monitoring well.

Geochemical models were not developed for the consolidated and capped Ash Pond CCR unit because no constituents were detected at statistically significant concentrations above a GWPS in groundwater samples collected from wells downgradient of this CCR unit.

5.1.1 Slag Disposal Area – WBF-104 Transect

The first transect for the geochemical modeling in the Slag Disposal Area extends from the west boundary of the CCR unit to downgradient well WBF-104 (Exhibit 1). Pore water chemistry, represented by an average of pore water concentrations from wells WBF-TW03 and WBF-TW04, was mixed with upgradient groundwater concentrations at well WBF-103 with proportions of pore water and groundwater calculated using chemically conservative constituents (e.g., boron). Cadmium and cobalt were the only constituents detected at statistically significant concentrations greater than the GWPS in groundwater samples collected from well WBF-104, which were both greater than their respective concentrations in pore water. The transect used for this location was approximately 1,100 feet long, with an average annual groundwater flow rate of 18.0 feet per year as generated using the calibrated groundwater flow model described in the *Groundwater Flow Modeling TM* (Appendix G).

5.1.2 Slag Disposal Area – WBF-106 Transect

The second transect for the geochemical modeling in the Slag Disposal Area extends from the west boundary of the CCR unit to downgradient well WBF-106 (Exhibit 1). Pore water chemistry represented by pore water concentrations from well WBF-TW05 was mixed with upgradient groundwater concentrations from well WBF-103 for this transect with proportions of pore water and groundwater

calculated using chemically conservative constituents (e.g., boron). Cobalt is the only constituent detected at statistically significant concentrations greater than the GWPS in groundwater samples collected from well WBF-106, which was greater than the concentrations of cobalt in pore water. The transect used for this location was approximately 300 feet long, with an average annual groundwater flow rate of 16.0 feet per year as generated using the calibrated groundwater flow model described in the *Groundwater Flow Modeling TM* (Appendix G).

5.2 GEOCHEMICAL PROPERTIES

Geochemical modeling for the Slag Disposal Area at the WBF Plant uses the groundwater chemistry from upgradient and downgradient groundwater monitoring wells, CCR unit pore water chemistry, and geochemical metrics of unconsolidated materials. Results presented in Appendix H.2 of the CARA Plan for unconsolidated materials mineralogy were used to incorporate reactive minerals that could influence groundwater chemistry. Additionally, adsorption of CCR constituents by iron and aluminum hydroxides was included in the geochemical model via two-layer surface complexation modeling based on the theoretical description of Davis and Kent (1990). Further information related to association constants required to run the geochemical model were developed by Dzombak and Morel (1990) for iron (hydrous ferric oxide [Hfo]) using iron hydroxide, specifically ferrihydrite, and Karamalidis and Dzombak (2011) for aluminum (hydrous aluminum oxide [Hao]) using gibbsite.

Properties of the iron and aluminum adsorbing surfaces were obtained from select data generated from the Sequential Extraction Procedure (SEP) testing (Appendix H.2 of the CARA Plan) and relationships between the abundance of iron/aluminum mineral surfaces and the abundance of adsorption sites on the mineral surfaces in units of moles of surface sites per mole of iron/aluminum. Surface sites are differentiated between weak and strong sites and refer to the strength of the bond between the surface and a constituent bound to the site. Weak and strong adsorption sites arise from the molecular composition of the iron/aluminum hydroxides. An additional assumption is that the molecular weights of Hfo and Hao are 88.85 grams per mole (g/mol) and 78 g/mol, respectively. Specific information from the SEP testing results used in determining parameters for surface complexation calculations is the sum of iron or aluminum extracted in the non-crystalline and metal hydroxide steps of the SEP.

The resulting parameters applied in geochemical modeling for surface complexation (adsorption) modeling are shown in Table 1. Although specific unconsolidated material samples from various locations at the WBF Plant were tested, the entire dataset was used to determine the minimum, maximum, and mean concentrations to incorporate the variability of the unconsolidated materials throughout the WBF Plant.

Table 1 Surface Complexation Parameters for Geochemical Modeling.

Parameter	Unit	Ferrihydrite			Gibbsite		
		Minimum	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**
Mean of Unconsolidated Materials Composition	mg/kg X[1]	9,520	11,130	13,270	3,067	3,363	3,767
	mol X/kg[2]	0.170	0.199	0.238	0.114	0.125	0.140
Surface Site Concentration	mol weak sites / mol X	0.2	0.2	0.2	0.41	0.41	0.41
	mol strong sites / mol X	0.005	0.005	0.005	---[3]		
Surface Sites	mol weak	0.263	0.308	0.367	0.360	0.395	0.442
	mol strong	0.007	0.008	0.009	---	---	---
Mass Ferrihydrite or Gibbsite	grams	117	137	163	68.5	75.1	84

Notes: 1 – milligrams per kilogram (mg/kg) of X where X is either iron (ferrihydrite) or aluminum (gibbsite)
2 – moles (mol) of X per kilogram (kg)
3 – "---" no strong surface sites defined for gibbsite

6.0 MODEL CALIBRATION

Hydrogeological and geochemical numerical models are mathematical constructs of open, natural systems, which means that the ability to simulate observed field conditions, in this case measured groundwater chemistry at downgradient groundwater monitoring wells, depends on the complexity of the model and the quality/representativeness of the data used to construct the model. Model calibration is a necessary step to adjust model input parameters such that model output groundwater chemistry reasonably represents observed groundwater chemistry.

This section describes the calibration procedure for the geochemical models developed for the Slag Disposal Area at the WBF Plant.

6.1 MODEL CALIBRATION APPROACH

The geochemical models consider four geochemical processes that influence the prediction of groundwater chemistry: (1) mixing of pore water and upgradient groundwater, (2) thermodynamic equilibrium with select geochemically reactive mineral phases, (3) surface complexation or adsorption of CCR constituents in groundwater with iron and aluminum hydroxide minerals, and (4) cation exchange between positively charged ions in groundwater and positively charged ions in clay minerals. Each of the listed categories of information are used and values adjusted within the observed range of measured data in the geochemical model to produce a reasonable comparison between predicted groundwater chemistry and observed groundwater chemistry. The objective of calibration is to create a geochemical model of the system that reasonably matches the measured groundwater chemistry over the period of record considered (2019 to 2023). Equally important is to create a model that will reasonably respond to changes in the hydrology and geochemistry of the system to reflect various corrective action options considered in the CARA Plan.

6.2 SELECTION OF CALIBRATION DATA

Groundwater and pore water chemistry are represented by the full suite of constituents measured in the laboratory, plus the field measurements of pH, oxidation-reduction potential (ORP), and temperature. However, for purposes of calibration of the geochemical models, and determining the mixing fraction for pore water and upgradient groundwater, only those constituents that are least affected by other geochemical reactions are considered for defining the range in mixing. Boron and chloride are considered non-reactive in that there are no other geochemical reactions (e.g., adsorption, cation exchange capacity, and mineral equilibria) that change the concentrations after mixing of pore water and upgradient groundwater. A third constituent, sulfate, is also used to determine the mixing proportions. Although sulfate is somewhat geochemically reactive, concentrations of sulfate can be used for the mixing calculation but are not as reliable as boron and chloride. Mixing calculations using boron, chloride, and sulfate do not produce exact matches. Therefore, geochemical model calibration may not produce matches for all three constituents used to assess the mixing ratio. Boron was assumed to be the primary constituent for assessing the mixing ratio. Additional discussion is provided in Section 9.

Minerals identified in the unconsolidated materials evaluation that could influence groundwater chemistry and the concentrations of select CCR constituents, some of which were chemically conservative and some that were geochemically reactive, are discussed in Appendix H.2 of the CARA Plan. As noted in the discussion of mineralogy, the presence of a given mineral, for example calcite or clay minerals (illite and kaolinite), is determined by the mineralogical analysis. The presence and amount of mineral phases included in the models are calibration parameters.

The ranges in amounts of iron and aluminum hydroxide available for surface complexation reactions (adsorption) are presented in Table 1. The observed ranges serve as the calibration ranges used to establish the probable amount of metal hydroxide present in the groundwater flow system.

Similar to the ranges for available metal hydroxides, the range in cation exchange capacities measured in unconsolidated materials and discussed in Appendix H.2 of the CARA Plan, was also used as a calibration parameter in developing the geochemical models.

6.3 DETERMINATION OF MODEL CALIBRATION

As noted in Section 4.2, the intent of geochemical modeling is to develop a tool that predicts the response of the groundwater chemistry from implementation of various corrective actions. In developing the geochemical model, an effort was made to adjust the geochemical model inputs so that outputs match the current conditions as closely as possible. The primary objective of developing a geochemical model is to identify and incorporate the primary geochemical processes that influence constituent concentrations in groundwater with a focus on those constituents detected at statistically significant concentrations greater than the GWPS. In the process of calibration, the available data for groundwater chemistry, pore water chemistry, and unconsolidated materials geochemistry are varied, ideally within the bounds of measured values, to predict the groundwater chemistry at the target downgradient groundwater monitoring well.

Similar to the calibration of a groundwater flow model that compares measured and simulated groundwater heads, the expectation is not to exactly match groundwater heads at all locations. In the same way, the expectation for the calibrated geochemical model was not to match all constituent concentrations, but to generally match the water chemistry with a focus on target constituents and the master variables that influence target constituent concentrations (i.e., pH and oxidation-reduction conditions). The calibrated geochemical model is not an exact match of actual field conditions; however, the calibrated model produced results (predicted groundwater chemistry) that are consistent with the measured groundwater chemistry. Further discussion of model calibration is included in Section 9.

7.0 BASELINE SIMULATIONS

Calibration of the geochemical models entails determining mixing ratios for pore water and upgradient groundwater and then adjusting other geochemical processes within the bounds established by the available geochemical data, so the model output reasonably matches observed conditions. The results of calibration of the geochemical models for the CCR unit under baseline (current) conditions are presented in this section.

7.1 SIMULATED CURRENT CONDITIONS

7.1.1 Slag Disposal Area – WBF-104 Transect

The transect used for geochemical modeling in the Slag Disposal Area is shown on Exhibit 1. As mentioned previously, cobalt and cadmium in groundwater are the only constituents with concentrations above the GWPS at downgradient well WBF-104, and the focus of the baseline simulation is to create a model simulation that captures the main geochemical processes that influence the downgradient groundwater concentrations of cobalt. However, the geochemical model that predicts the concentrations of cobalt and cadmium at well WBF-104 also needs to consider other characteristics of the groundwater solution, including pH, ORP, major ion concentrations, and concentrations of boron, chloride, and sulfate, as described in Chapter 6.2. The first two groundwater chemistry characteristics, pH and ORP, influence adsorption reactions, the stability and distribution of oxidation-reduction species, the overall strength of the water chemistry (as measured by major ions) and are used to confirm the geochemical conceptual site model.

Exhibit 4 shows the results of both the calibration of the geochemical model and simulation of baseline or current conditions. The graphs show a box plot of the groundwater data for the period 2019 through 2023 at downgradient well WBF-104. The green colored squares are the concentrations predicted using the calibrated geochemical model. Constituents shown provide a reasonable fit for calibration of the geochemical model to current conditions, except for sulfate and chloride. Water chemistry for pore water represents current conditions in contrast to groundwater chemistry that reflects both transport and geochemical reactions with unconsolidated materials. As a result, there are differences among constituents considered reasonably chemically conservative. See Section 9 for more discussion of model variances and limitations therein. For purposes of using geochemical modeling as a tool to assess the impact of applying various options for CCR unit closure and addressing groundwater conditions, the model is considered calibrated.

7.1.2 Slag Disposal Area – WBF-106 Transect

The transect used for geochemical modeling in the Slag Disposal Area is shown on Exhibit 1. As mentioned previously, cobalt in groundwater is the only constituent with concentrations above the GWPS at downgradient well WBF-106, and the focus of the baseline simulation is to create a model simulation that captures the main geochemical processes that influence the downgradient groundwater concentrations of cobalt. However, the geochemical model that predicts the concentrations of cobalt at

well WBF-106 also needs to consider other characteristics of the groundwater solution, including pH, ORP, major ion concentrations, and concentrations of boron, chloride, and sulfate, as described in Chapter 6.2. The first two groundwater chemistry characteristics, pH and ORP, influence adsorption reactions, the stability and distribution of oxidation-reduction species, the overall strength of the water chemistry (as measured by major ions) and are used to confirm the geochemical conceptual model.

Exhibit 5 shows the results of both the calibration of the geochemical model and simulation of baseline, or current conditions. The graphs show a box plot of groundwater data for the period 2019 through 2023 at downgradient well WBF-106. The green colored squares are the concentrations predicted using the calibrated geochemical model. Constituents shown provide a reasonable fit for calibration of the geochemical model to current conditions. Water chemistry for pore water represents current conditions in contrast to groundwater chemistry that reflects both transport and geochemical reactions with unconsolidated materials. As a result, there are differences among constituents considered reasonably chemically conservative. See Section 9 for more discussion of model variances and limitations therein. For purposes of using geochemical modeling as a tool to assess the impact of applying various options for CCR unit closure and addressing groundwater conditions, the model is considered calibrated.

8.0 CORRECTIVE ACTION SCENARIOS

Geochemical modeling was performed to support evaluation of closure approaches and potential future groundwater corrective actions considered in the CARA Plan. The following sections present a description of the corrective action scenarios evaluated, an overview of the approach for each scenario evaluated, and a description of results for each scenario. The simulations were designed to model CCR unit closure alternatives (Section 8.1) and evaluate individual components of potential future groundwater corrective measures (Section 8.2). Model sensitivity analyses are presented in Section 8.3.

How the groundwater chemistry at downgradient monitoring wells responds to different closure and corrective action options is more related to how each option influences pore water contribution to groundwater. That is, the primary metric derived from geochemical modeling of groundwater interaction with unconsolidated materials is the time required for the concentrations of CCR constituents to decrease to values less than the GWPS. The potential groundwater corrective action options would be implemented along the border of the CCR units, meaning in close proximity to the downgradient groundwater monitoring wells. As a result, the groundwater chemistry at the downgradient monitoring wells is expected to meet the GWPS in a few years; whereas additional time is required for upgradient groundwater in unconsolidated materials to meet the GWPS without corrective action. During groundwater migration, both physical and geochemical processes occur such that natural attenuation would also be considered as a process contributing to the reduction of concentration below a particular GWPS.

Thus, while there is much detail needed to evaluate closure and groundwater corrective action options from the perspective of groundwater flow (i.e., modeling), for geochemical modeling the central question is to what extent does a given closure/groundwater corrective action option reduce the contribution of pore water as a percentage of the overall groundwater flux. In some cases, the pore water is the source of the constituent of interest. While in other instances, the pore water influences the overall geochemical conditions of the groundwater, resulting in mobilization of constituents from minerals contained in the unconsolidated sediments (e.g., cobalt). Finally, the analyses presented in this section address the time required to change conditions in the unconsolidated materials upgradient of the specific groundwater monitoring well and beneath the CCR unit. Thus, the question for any given groundwater corrective action is to what extent does the corrective action change the contribution of pore water to groundwater. The current modeling approach considers two sources of water: groundwater and pore water. Removal of the latter leaves upgradient groundwater as the primary source influencing the chemistry of groundwater at the downgradient groundwater monitoring wells. There is potential for other sources of water influencing groundwater chemistry including adjacent surface water, but there is no current evidence that other sources of water have an important influence on groundwater chemistry. Therefore, the simulations presented are reasonably representative of expected changes in downgradient groundwater quality after closure actions provide source control.

8.1 CLOSURE SIMULATIONS

With respect to CCR unit closure, there are two options: (1) closure-in-place (CIP) that typically includes re-grading to promote runoff and placement of an engineered geosynthetic cover system to limit infiltration of precipitation, and (2) closure-by-removal (CBR) wherein the CCR material is excavated and hauled offsite for disposal at an appropriately permitted landfill. A comparison of the effects of the two closure methods is provided in this section in terms of the time required to achieve the GWPS at groundwater monitoring wells downgradient of the CCR units.

Note that the starting point, or time zero, for the model simulations for both closure scenarios is when the effective pore water contribution to groundwater ends. For CIP, both re-grading and geosynthetic cover system installation contribute to a decline in pore water levels, a decrease in the effect of pore water on groundwater chemistry, and a change in the average linear velocity of groundwater. As such, time zero for CIP model simulations is established using these factors for each CCR unit as described in the following sections. For CBR, effective pore water contribution ends when the CCR material is removed. As such, time zero for CBR model simulations is established for each CCR unit at the completion of the removal action.

Geochemical modeling of closure scenarios considers a two-component mixing system that includes pore water and upgradient groundwater. For locations where the proposed groundwater corrective action is groundwater extraction and treatment, groundwater extraction wells would be placed such that capture of pore water influenced groundwater would be achieved. A consequence of groundwater capture could result in surface water being drawn into the extraction well, which would only affect the influent chemistry to the groundwater treatment system. Thus, the potential is small for additional sources of water influencing the groundwater system simulated in the geochemical model.

A comparison of the effects of the two closure methods is provided in this section in terms of the time required to achieve compliance with the GWPS at groundwater monitoring wells downgradient of the CCR units.

8.1.1 Closure-In-Place with Cover System

The following presents the CIP geochemical modeling simulations for the CCR unit at the WBF Plant.

8.1.1.1 Slag Disposal Area

WBF-104

Groundwater at WBF-104 has cobalt and cadmium concentrations above the GWPS. Installing a geosynthetic cover system over the CCR unit, in addition to other closure actions, will ultimately result in limited contribution of pore water to groundwater. Geochemical conditions in the groundwater will then be primarily influenced by the upgradient groundwater quality, taken here as groundwater concentrations at well WBF-103. Cobalt and cadmium concentrations in groundwater at well WBF-104 are assumed to be generated by conditions of the pore water-groundwater mixture because cobalt and cadmium concentrations in pore water are low when compared to upgradient groundwater values. Thus, when pore

water no longer contributes to groundwater, geochemical conditions are primarily controlled by upgradient groundwater such that desorption of the remaining cobalt adsorbed to iron hydroxide mineral surfaces in the unconsolidated materials would continue to occur if under acidic pH conditions. The concentrations of cobalt at well WBF-104 are expected to eventually reach levels below the GWPS primarily due to physical mixing with upgradient groundwater and a decrease in the potential for release of adsorbed cobalt from unconsolidated materials after corrective actions. In contrast with cobalt, the cadmium concentrations reported in groundwater at well WBF-104 are interpreted to be controlled by aqueous complexation with sulfate, which then limits the ability of cadmium to adsorb to iron hydroxide similar to cobalt. The concentration of cadmium continued to gradually increase concurrently with sulfate and then eventually reached levels below the GWPS.

While pore water contribution to groundwater affects the geochemical conditions (mainly pH), and thus, cobalt and cadmium concentrations, the groundwater flow velocity, as described in Appendix G of the CARA Plan, imparts a larger effect on response time of cobalt and cadmium concentrations in groundwater. Exhibit 6 shows two scenarios of the change in cobalt and cadmium concentrations with time under two conditions of groundwater velocity: (1) no change in groundwater velocity following installation of an engineered geosynthetic cover system and (2) a change in groundwater velocity following installation of an engineered geosynthetic cover system. For the first scenario, the groundwater flow velocity following installation of an engineered geosynthetic cover system was 18.0 feet per year, whereas a slightly lower groundwater flow velocity of 17.9 feet per year was used for the change in groundwater velocity scenario. These velocities were provided through analysis using the groundwater flow model (Appendix G of the CARA Plan). Under both scenarios, the time required for the concentrations of cobalt and cadmium to decrease below the GWPS was about 70 and 132 years, respectively (Exhibit 6). In Exhibit 6, because of the similarity in the velocities used, the lines representing the predicted concentrations under both scenarios overlap. The longer time for cadmium than for cobalt is due to a persistent extent of cadmium sulfate complex, meaning the decline of cadmium is governed more by complexation than adsorption as observed for cobalt.

WBF-106

The response of cobalt concentrations to installation of an engineered geosynthetic cover system on the Slag Disposal Area at downgradient well WBF-106 is similar to what was observed at well WBF-104. That is, the pore water contribution to groundwater that caused geochemical conditions in the unconsolidated materials to change and cause mobilization of cobalt, would reverse when pore water no longer contributes to groundwater (Exhibit 7). Groundwater velocities under no change groundwater flow velocity scenario following installation of an engineered geosynthetic cover system was 105 feet per year whereas a groundwater flow velocity of 217 feet per year was used for the change in groundwater velocity scenario. Again, the potential variation in groundwater flow velocity has a strong influence on the time needed for cobalt concentrations to decrease below the GWPS. The increase in groundwater velocity results in a decrease in the time required for the concentration of cobalt to decrease below the GWPS from about 31 years, with no change in groundwater velocity, to about 22 years with the increase in groundwater velocity (Exhibit 7).

8.1.2 Closure-by-Removal

Specific simulations of CBR were not completed because the range in probable groundwater velocities for the transects at the CCR unit are within the respective ranges estimated for CIP with an engineered geosynthetic cover system. Therefore, the predicted times to achieve GWPS would be essentially the same under CBR as for CIP with an engineered geosynthetic cover system.

8.1.3 Time to Achieve the Groundwater Protection Standard

At the Slag Disposal Area, the reduction in groundwater concentrations to below GWPS occurs at well WBF-104 in approximately 70 years for cobalt and 132 years for cadmium and at well WBF-106 in approximately 22 years for cobalt. However, with the cumulative uncertainties of groundwater flow modeling and geochemical modeling, the potential upper range in time to achieve GWPS could be approximately 70 years for cobalt and 132 years for cadmium. The estimated time to achieve the GWPS from geochemical modeling begins after the appropriate reduction in pore water is achieved, which could add 10 or more years.

8.2 POTENTIAL GROUNDWATER CORRECTIVE MEASURES

The geochemical model was used to evaluate several groundwater corrective measures including: (1) targeted hydraulic control, (2) enhanced *in situ* groundwater treatment, and (3) monitored natural attenuation. For each of the groundwater corrective measure options, the infrastructure would be installed immediately upgradient of the groundwater monitoring wells at the downgradient boundaries of the CCR units such that the normal flow of groundwater would either be intercepted, in the case of groundwater extraction, or the groundwater chemistry would be modified *in situ* to change conditions of the groundwater resulting in attenuation of constituents. Because of the proximity of the potential groundwater corrective measures to the groundwater monitoring wells, the time to achieve the GWPS near these wells would be relatively short. However, none of the potential groundwater corrective measures would change the time required for upgradient groundwater to migrate through the unconsolidated materials, meaning the anticipated times to achieve the GWPS without corrective action, as presented in Section 8.1, would hold even with implementation of one of the evaluated groundwater corrective measures. In other words, the corrective actions may decrease downgradient concentrations in a shorter time frame, however any corrective action would need to be implemented over the same time frame as CIP until all upgradient groundwater has migrated through the downgradient monitoring points.

8.3 SENSITIVITY ANALYSIS

8.3.1 Groundwater Velocity

For groundwater in the unconsolidated materials at the WBF Plant, the groundwater velocity used in the PHREEQC 1-D transport modeling has an influence on how the concentrations of constituents change with time. Values of groundwater velocity used in the geochemical modeling presented in this document correspond to average values based on groundwater flow modeling (see *Groundwater Flow Modeling TM*; Appendix G). The mobility of cobalt and cadmium in groundwater at the WBF Plant is influenced by

groundwater velocity and geochemical reactions with unconsolidated materials. Thus, a faster groundwater velocity will result in achieving the GWPS faster. Likewise, a slower groundwater velocity will result in a longer time period required to achieve the GWPS The *Groundwater Flow Modeling TM* (Appendix G) provides a more detailed discussion of the probable range of groundwater velocities for the WBF Plant.

8.3.2 Abundance of Hydroxide Minerals for Adsorption

The capacity for adsorption of cobalt by iron hydroxide minerals in the unconsolidated materials at the WBF Plant, as measured by the total number of adsorption sites, is directly proportional to the amount of iron hydroxide present. A similar argument holds for effectiveness of aluminum hydroxide. However, the effectiveness of the adsorption process is primarily controlled by the pH of groundwater. Attenuation of both cobalt and cadmium by adsorption to iron hydroxide is most effective under circumneutral to basic pH (e.g., pH above 6.5); however, the pH of groundwater upgradient of the Slag Disposal Area CCR unit is typically less than six, which limits the attenuation of cobalt and cadmium in groundwater at the WBF Plant. Therefore, the model is insensitive to the amount of iron hydroxide available to facilitate cobalt and cadmium adsorption if there is not also an increase in the pH of groundwater.

For cobalt, the abundance of surface sites available for adsorption, which is related to the abundance of iron and aluminum hydroxide, was used as a calibration parameter. In the case of cobalt at the WBF Plant, the portion of surface sites actively involved with adsorption of cobalt was determined to be less than the theoretical abundance, which is realistic in that there is a wide range of iron-based compounds that classify as “iron hydroxide” as defined by results of the SEP. As a model calibration parameter, the difference between the estimated abundance of hydroxide mineral present from laboratory measurements versus the model calibrated amount demonstrates the overall sensitivity of geochemical model predictions to the abundance of hydroxide minerals. For cadmium, geochemical modeling indicated that the cadmium concentration reported at well WBF-104 was controlled by aqueous complexation with sulfate. Thus, the amount of iron hydroxide available to facilitate adsorption has minimal effect on cadmium attenuation at the WBF Plant.

9.0 MODEL LIMITATIONS

Development of the geochemical models for the CCR unit at the WBF Plant was based on combining information from the hydrogeologic analysis of groundwater flow, measurement of groundwater chemistry, measurement of pore water chemistry, and analysis of the unconsolidated material geochemistry. The hydrogeologic and geochemical data were incorporated into a geochemical modeling computer program (PHREEQC) constructed to represent the geochemical conceptual site model. There are uncertainties inherent to each step of data collection and analysis with the cumulative uncertainty offset by sensitivity testing of the final geochemical model. Additional discussion of PHREEQC model limitations can be found in Parkhurst and Appelo (2013). The following is taken from the Parkhurst and Appelo (2013) reference and addresses the question of uncertainty in thermodynamic databases:

> *One limitation of the aqueous model is lack of internal consistency in the data in the databases. The database pitzer.dat defines the most consistent aqueous model; however, it includes only a limited number of elements. All of the other databases are compendia of logarithms of equilibrium constants (log Ks) and enthalpies of reaction that have been taken from various literature sources. No systematic attempt has been made to determine the aqueous model that was used to develop the individual log Ks or whether the aqueous models defined by the current database files are consistent with the original experimental data. The database files provided with the program should be considered to be preliminary. Careful selection of aqueous species and thermodynamic data is left to the users of the program.*

Current thermodynamic datasets used in geochemical modeling do not contain information related to metal sorption to manganese hydroxide. While manganese concentrations in the geochemically reactive fraction of unconsolidated materials are measurable, the abundance of manganese relative to iron and aluminum is often orders of magnitude less. The approach taken in the geochemical modeling conducted to date is that while there may be sorption reactions to manganese hydroxide, the extent of the sorption reaction is insufficient to markedly affect the predictions based solely on sorption to iron and aluminum hydroxide. A more formal assessment of sorption to manganese hydroxide will be made and adjustments to the models incorporated, if warranted.

Mixing calculations to estimate proportions of pore water and upgradient groundwater contributing to the chemistry measured at the downgradient groundwater monitoring well are based, as described in this document, on use of constituents that are considered to be chemically conservative. That is, the concentrations of the constituents used in mixing calculations are not affected by geochemical processes that might add or remove chemical mass from the mixed waters. In a perfect system (i.e., at steady-state), both hydrologically and geochemically, the mixing calculations based on different chemically conservative constituents will yield identical results. However, no system is perfect, and the mixing calculations for different constituents may vary as a result. For example, the mixing calculation assumes that concentrations of constituents in source (i.e., upgradient) waters are time-synchronous, but concentrations measured in pore water are not time-synchronous with concentrations measured in groundwater.

The calibrated geochemical model is not an exact match of actual field conditions; however, the calibrated model produces results (predicted groundwater chemistry) that are consistent with the measured groundwater chemistry. Therefore, the geochemical model provides a reasonable basis for evaluating the effects of various CCR unit closure options and potential groundwater corrective actions to support the CARA Plan. While geochemical modeling results allow reasonable comparison of CARA Plan alternatives, the geochemical modeling results are not absolute but are comparative. Comparison of model predictions that extend 30 or more years into the future and that appear to differ by a few years may not be materially different. Actual differences may not be resolvable in time frames of less than 10-year increments.

10.0 REFERENCES

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EXHIBITS

Exhibit No.

1

Title

Overview of CCR Units at WBF Plant and Transects used for Geochemical Modeling

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2024-08-29
Technical Review by MW on 2024-08-29

0 150 300 450 600 Feet

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

Legend

- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary Well within CCR Material
- Limit of Existing Cover System (Approximate – 2023)
- Transect for Geochemical Modeling
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

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

Stantec TVA

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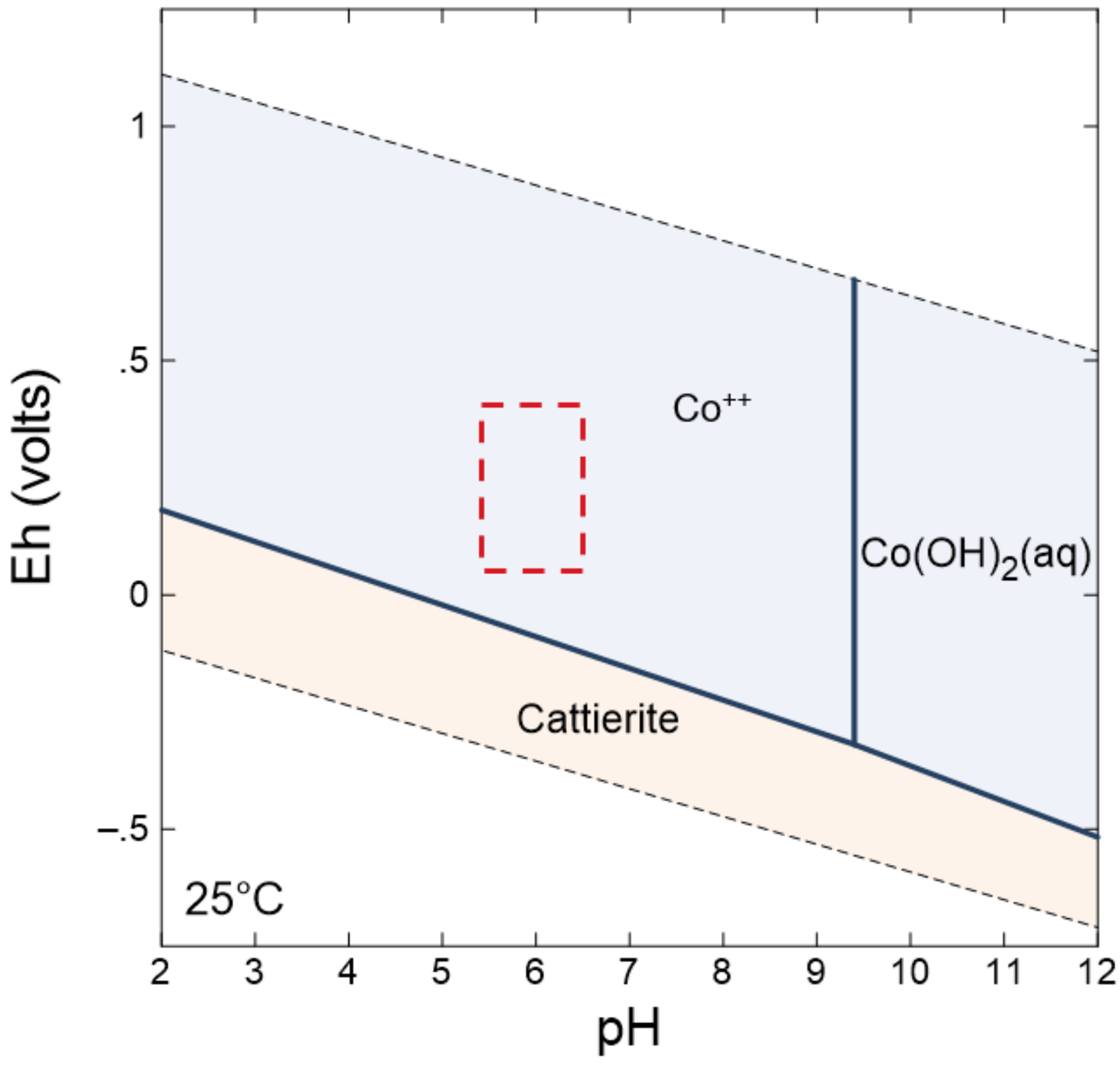

DRAFT

Exhibit No.

2

Title

Pourbaix Diagram Showing the Stability Field for the Primary Form of Aqueous Cobalt

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-30
TR by MW on 2024-07-30

Legend

- Aqueous species
- Mineral
- Range of pH-Eh in groundwater at the WBF Plant

Stantec

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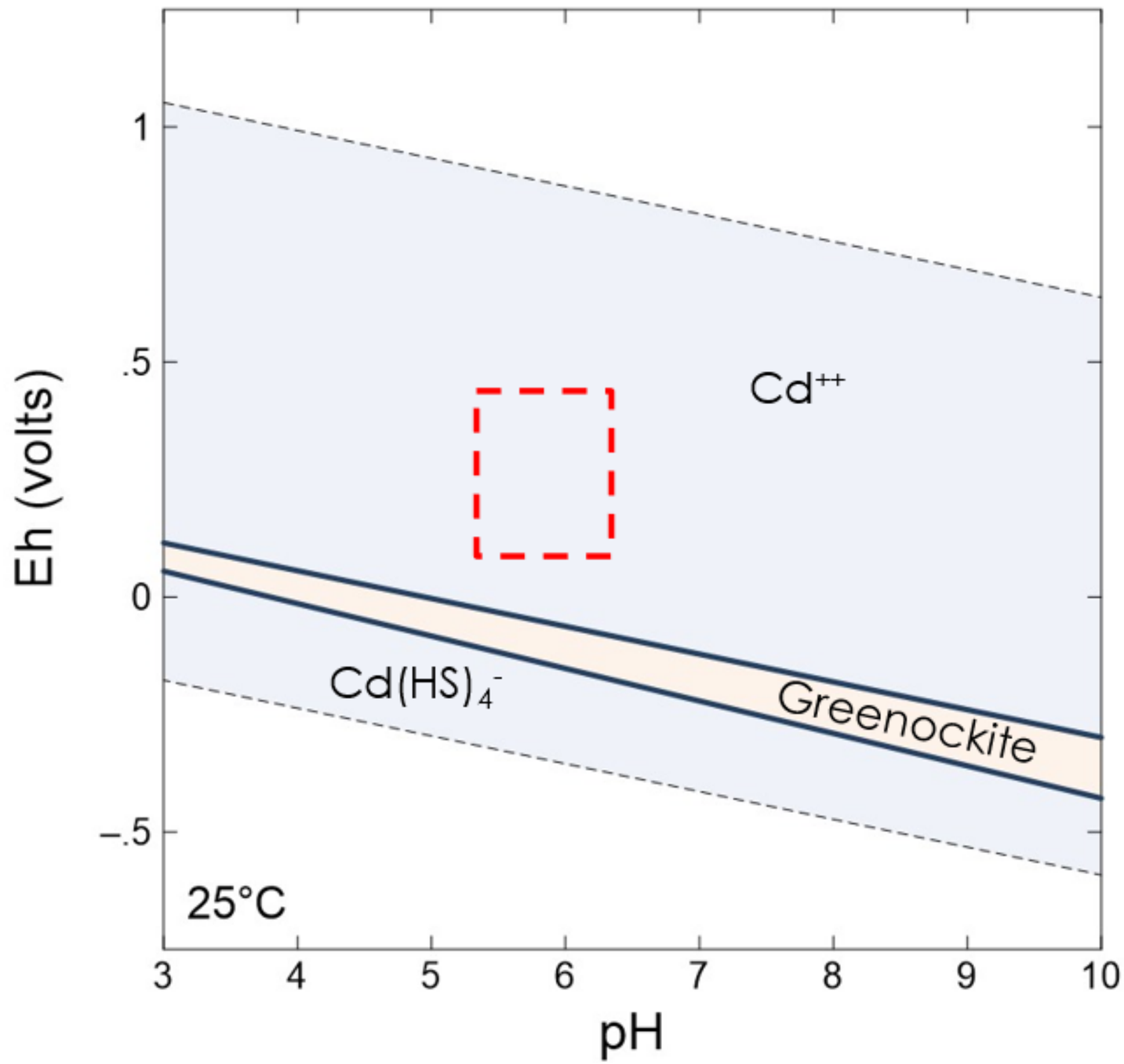

DRAFT

Exhibit No.

3

Title

Pourbaix Diagram Showing the Stability Field for the Primary Form of Aqueous Cadmium

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-30
TR by MW on 2024-07-30

Legend

- Aqueous species
- Mineral
- Range of pH-Eh in groundwater at the WBF Plant

Stantec

TVA

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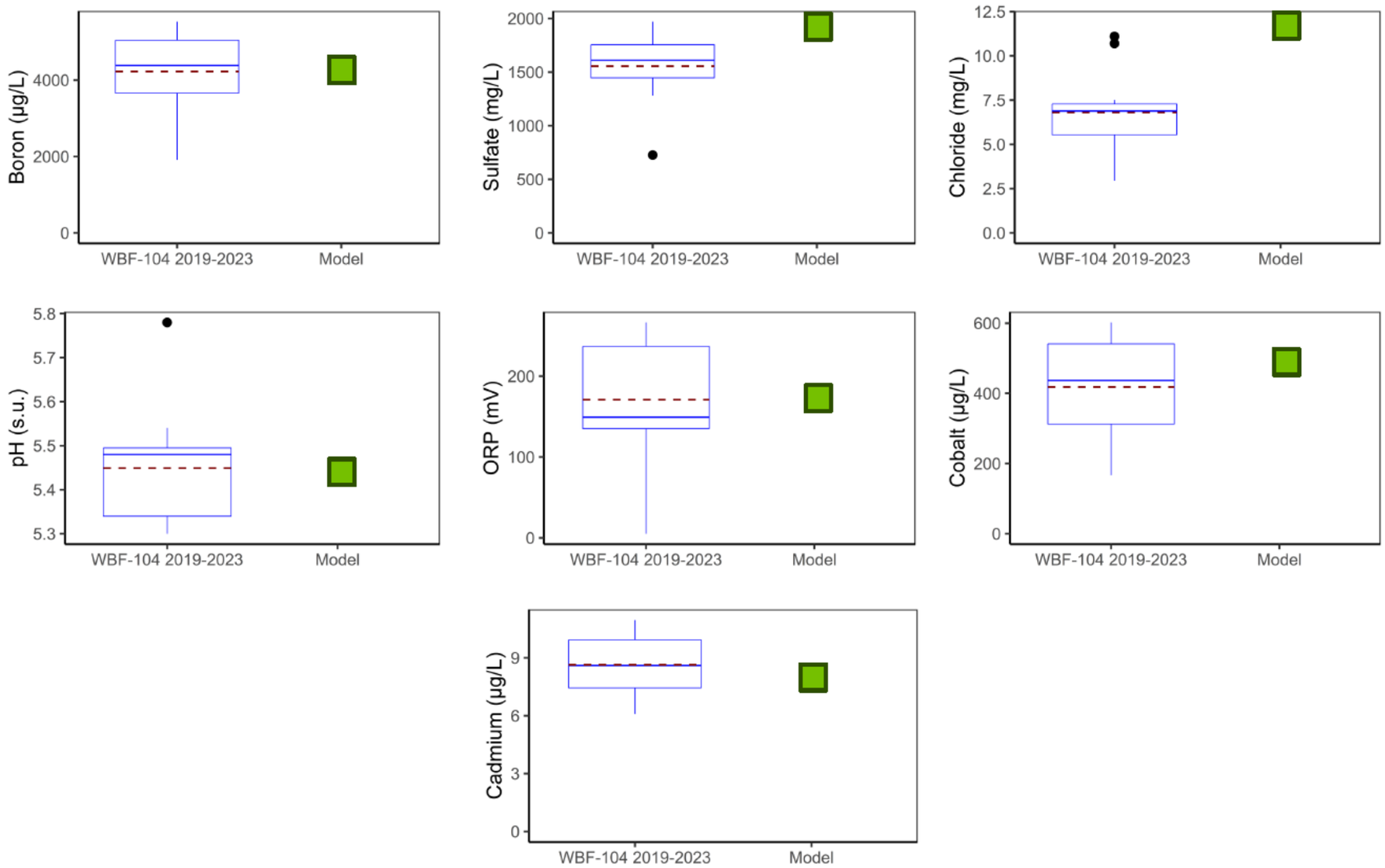

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Exhibit No.

4

Title

Comparison of Measured (N = 11) and Predicted Groundwater Chemistry from the Calibrated Geochemical Model for the Slag Disposal Area Transect at WBF-104

Client/Project 175668050

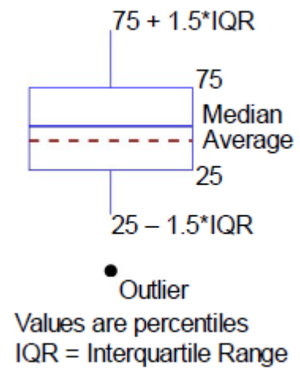
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-30
TR by MW on 2024-07-30

Legend

µg/L – microgram per Liter
mg/L – milligram per Liter
s.u. - standard units
mV - millivolts
ORP - Oxidation Reduction Potential



Values are percentiles
IQR = Interquartile Range

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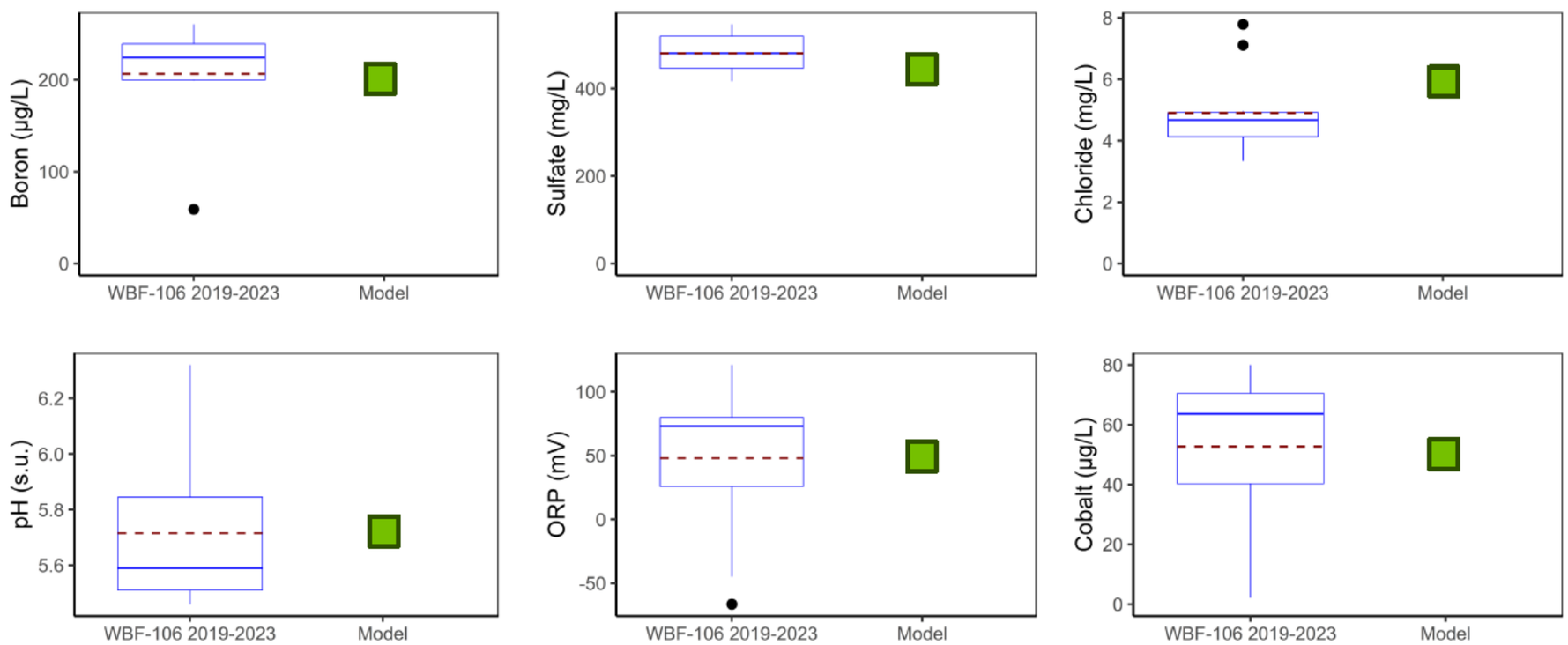

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Exhibit No.

5

Title

Comparison of Measured (N = 11) and Predicted Groundwater Chemistry from the Calibrated Geochemical Model for the Slag Disposal Area Transect at WBF-106

Client/Project 175668050

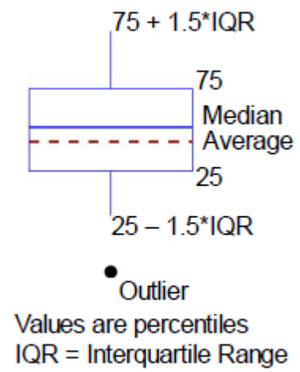
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-30
TR by MW on 2024-07-30

Legend

µg/L – microgram per Liter
mg/L – milligram per Liter
s.u. - standard units
mV - millivolts
ORP - Oxidation Reduction Potential



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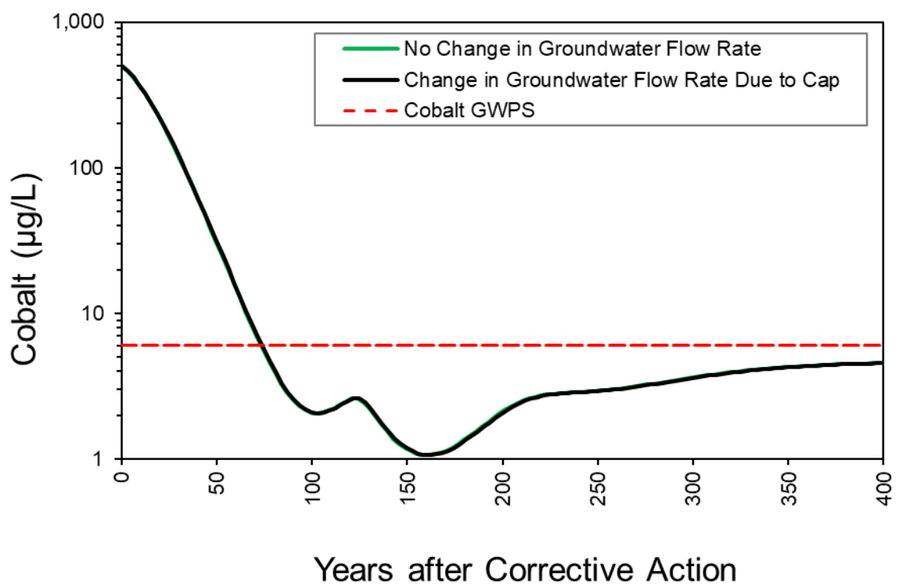

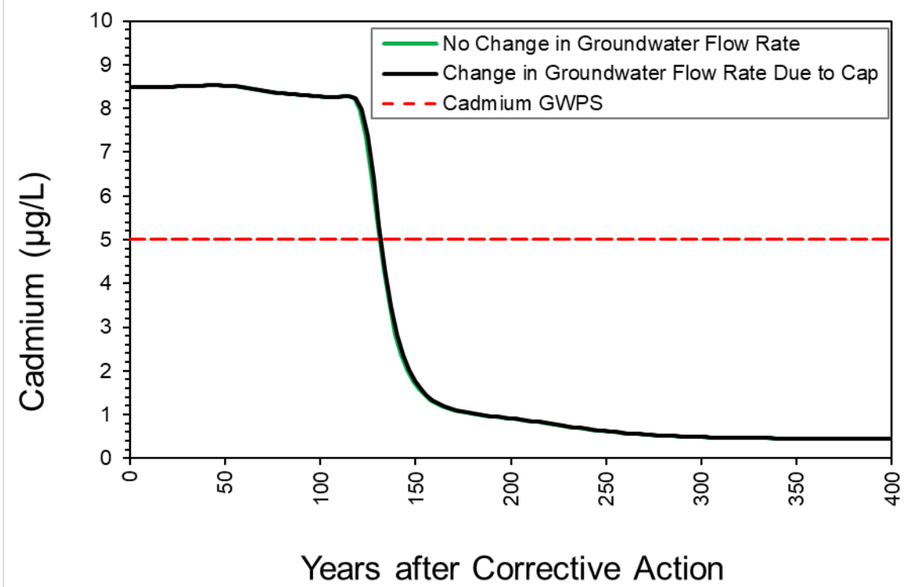

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Exhibit No.

6

Title

Groundwater Response at WBF-104 (Slag Disposal Area) Following Corrective Action

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-07-30
TR by MW on 2024-07-30

Legend

µg/L – microgram per Liter
GWPS - Groundwater Protection Standard

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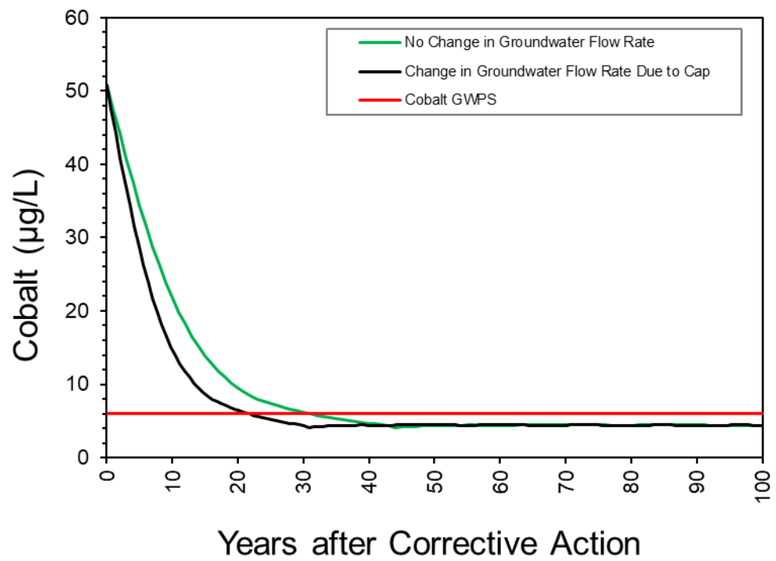

DRAFT

Exhibit No.

7

Title

Groundwater Response at WBF-106 (Slag Disposal Area) Following Corrective Action

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2024-07-30
TR by MW on 2024-07-30

Legend

µg/L – microgram per Liter
GWPS - Groundwater Protection Standard

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APPENDIX H.2

GEOCHEMISTRY INVESTIGATION FIELDWORK SUMMARY AND EVALUATION

Appendix H.2 - Geochemistry Investigation Fieldwork Summary and Evaluation - DRAFT

TDEC Commissioner's Order:
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Date Revised for Reissuance. No other changes made to this Appendix	December 5, 2025

Sign-off Sheet

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Prepared by _____

Andrew Stevens, PG, Geologist

Reviewed by _____

Jamie Snider, PG, Geologist

Approved by _____

Carole Farr, PG, Senior Principal Geologist

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ATTACHMENT

Attachment A Surface Water Investigation Summary

Abbreviations

bgs	Below Ground Surface
$CaCO_3$	Calcite
CARA	Corrective Action/Risk Assessment
Ca-SO_4	Calcium Sulfate
$CaSO_4 \cdot 2H_2O$	Gypsum
CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257, and five metals included in Appendix I of Tennessee Rule 0400-11-01-.04
CCR Rule	Title 40, Code of Federal Regulations, Part 257
CEC	Cation Exchange Capacity
CFR	Code of Federal Regulations
EAR	Environmental Assessment Report
EI	Environmental Investigation
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Eurofins	Eurofins TestAmerica
FeS	Mackinawite
FeS_2	Pyrite
GWPS	Groundwater Protection Standards
IDW	Investigation Derived Waste
µg/L	Micrograms per Liter
meq/100g	Milliequivalents per 100 grams
mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
mV	Millivolts
ORP	Oxidation Reduction Potential
%	Percent
PPE	Personal Protective Equipment
redox	Oxidation-Reduction Condition
QAPP	Quality Assurance Project Plan

QC	Quality Control
SAP	Sampling and Analysis Plan
SEM	Scanning Electron Microscopy
SEP	Sequential Extraction Procedure
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order No. OGC15-0177
TDS	Total Dissolved Solids
TI	Technical Instruction
TVA	Tennessee Valley Authority
TOC	Total Organic Carbon
VWPZ	Vibrating Wire Piezometer
WBF Plant	Watts Bar Fossil Plant
XRD	X-Ray Diffraction

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this *Geochemistry Investigation Fieldwork Summary and Evaluation* to summarize the fieldwork activities conducted to support a geochemical investigation at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

The purpose of the geochemical investigation was to collect additional site-specific data at the WBF Plant to supplement the dataset collected during the environmental investigation (EI). These data will support evaluation of source control measures and inform potential corrective measures at the WBF Plant in support of fulfilling the requirements of the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan is being prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of coal combustion residuals (CCR) material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA.

The geochemical investigation activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order:

- *Sampling and Analysis Plan (SAP) – Opportunistic Sampling of Sediment for Geochemical Analysis, WBF Plant (*Stantec 2021a)
- *Supplemental Investigation SAP, WBF Plant* (Stantec 2021b)
- *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021c)
- *Environmental Investigation Plan, Watts Bar Fossil Plant*. *(EIP)* (Stantec 2018)
- *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation (QAPP)* (Environmental Standards, Inc. [EnvStds] 2018)
- *Coal Combustions Residuals, Groundwater Monitoring and Investigation Quality Assurance Project Plan* (QAPP; EnvStds 2020)
- *Watts Bar Fossil Plant – Seepage Investigation Path Forward (Stantec 2020).*

The SAPs were implemented in accordance with TVA- and TDEC-approved Programmatic and Project-specific changes. Field documentation for work performed under the SAPs was reviewed for variations in scope and procedures, and the findings are provided in Section 3.4.

Quality Assurance oversight on field data acquisition protocols, sampling practices, and data review were performed by EnvStds under direct contract to TVA.

2.0 OBJECTIVE AND SCOPE

The primary objective of the geochemical investigation was to collect soil and surface water samples to support geochemical modeling and an evaluation of the soil-water interactions on the spatial and temporal distributions of CCR constituents in groundwater outside of the CCR units at the WBF Plant. This included a review of groundwater upgradient of the Slag Disposal Area and downgradient groundwater monitoring locations where constituents were identified at statistically significant concentrations greater than a groundwater protection standard (GWPS). Details regarding the groundwater monitoring program and groundwater quality are included in the Environmental Assessment Report (EAR); therefore, this document summarizes groundwater quality details relative to geochemical modeling of the influence of CCR material on groundwater. Similarly, details regarding pore water sampling and chemistry were reported in the EAR, and the influence of pore water on geochemistry and groundwater quality are summarized in this evaluation.

The approach for the geochemical investigation was to collect soil samples from materials saturated with groundwater for geochemical characterization.

Soil samples were analyzed for pH (paste), cation exchange capacity (CEC), total organic carbon (TOC), sulfur speciation, select metals by a sequential extraction procedure (SEP), and mineralogy using x-ray diffraction (XRD) and scanning electron microscopy (SEM).

The scope of work for the geochemical investigation was conducted during various field events outlined below:

- Archive sampling of soil borings under the (Stantec 2020) and *Supplemental Investigation SAP, WBF Plant* (Stantec 2021b)
- Soil sample collection from archive samples in storage at the Stantec Treatability Facility.

Archived soil samples were maintained in the Stantec Treatability Facility in Sylvania, Ohio under project storage and custody protocols until such time the materials were ready for the geochemical testing. Details on each activity are presented in the following sections.

3.0 FIELD ACTIVITIES

Archive sampling of geotechnical soil borings for the seepage investigation was conducted between June 10 and June 16, 2020, and the samples were collected from the archived soil for laboratory analysis on July 12, 2021. Archive sampling of soil borings for the geochemical investigation was conducted on September 28 and 29, 2021, and the samples were collected from the archived soil for laboratory analysis on November 18, 2022. Prior to initiating field activities, TVA conducted environmental reviews, obtained permits, and performed utility clearances as necessary to complete the field work.

Stantec performed the geochemical investigation field activities based on guidance and specifications listed in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, and the QAPPs, except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, oversight of select field activities, field documentation, and centralized data management were performed by EnvStds under direct contract with TVA. EnvStds also provided quality reviews of field documentation.

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

- Collected three archival soil samples at three vibrating wire piezometer (VWPZ) borings and two archival soil samples at two boring locations
- Shipped archival samples via FedEx to the Stantec Treatability Facility in Sylvania, Ohio for storage
- Collected five geochemical soil samples from the archived soil samples in storage for laboratory analysis
- Collected a quality control (QC) sample for laboratory analysis
- Shipped collected samples via FedEx to Eurofins TestAmerica (Eurofins), and RJ Lee Group, Inc (RJ Lee) for analysis.
- Collected seven surface water samples at seven sampling locations. Details of the surface water sampling activities are provided in Attachment A – Surface Water Investigation Summary.

These activities were conducted as part of the WBF Plant TDEC Order supplemental investigation and seepage investigation. Geochemical sampling was performed in general accordance with the SAPs.

Details on each activity are presented in the following sections. The geochemical investigation borings are shown on Exhibit 1. Tabulated information collected during the investigation, including summaries of samples collected and analytical results are provided in Tables 1 through 3.

The surface water sampling conducted as part of the geochemical investigation is summarized in Attachment A.

3.1 SAMPLING

The drilling and sampling methodology, documentation, and field activities for borings sampled as part of the TDEC Order supplemental investigation scope of work are summarized in the *In Situ* Fieldwork Summary (Appendix I.2 of the CARA Plan) and the WBF Plant Exploratory Drilling Sampling and Analysis Report section 3.5 for the seepage investigation scope of work (Stantec 2022). The surface water sampling methodology, documentation, and field activities are summarized in the Surface Water Investigation Summary (Attachment A). The geochemical soil sampling conducted under TDEC Order is described in the following section.

3.1.1 Geochemical Testing

Between June 10 and June 16, 2020, during the installation of three VWPZs (WBF-B12, WBF-B13, and WBF-B14), archive soil samples were collected in general accordance with the Seepage Investigation Path Forward (Stantec 2020). Samples were transferred to the Stantec Geotechnical Laboratory in Lexington, Kentucky to be held until they were submitted to the Stantec Treatability Facility in Sylvania Ohio under project storage and custody protocols until the geochemical sampling and testing was initiated.

On September 28 and September 29, 2021, during drilling activities associated with the TDEC Order, archive soil samples (WBF-SDA-SB02 and WBF-SDA-SB05) were collected per the *Supplemental Investigation SAP* (Stantec 2021b). Samples were submitted to the Stantec Treatability Facility in Sylvania, Ohio under project storage and custody protocols until the geochemical sampling and testing was initiated.

On July 7, 2021, the archived seepage investigation samples (WBF-SB12, WBF-SB13, and WBF-SB14) were pulled from the storage for geochemical sample collection. On November 18, 2022, archived samples (WBF-SB02 and WBF-SB05) were pulled from storage for geochemical sample collection to characterize the geochemical properties of unconsolidated materials in the zone where CCR constituents above GWPS have been measured downgradient in existing perimeter wells at the WBF Plant. The soil samples were typically collected from approximately the first 10 feet below the soil/groundwater interface.

The soil samples were composited and transferred into clean, resealable bags using gloved hands and decontaminated sampling tools. The soil samples were homogenized and then placed into appropriate laboratory-supplied sample jars. Soil samples were collected in accordance with ENV-TI-05.80.50, *Soil and Sediment Sampling*. Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*. Field sampling personnel secured caps on each bottle, labeled the sample jars, and attached a custody seal across the cap before placing the sample container in a cooler with ice (within 15 minutes of sample collection) for transport to the laboratory. QC samples were collected in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control.* Five soil samples, and one duplicate sample, were collected and submitted for laboratory analysis.

Soil samples were analyzed for CCR-related constituents listed in Appendices III and IV of Title 40 of the Code of Federal Regulations (CFR) Part 257 (CCR Rule) based on boring location. In addition, five

inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with the TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents are hereafter referred to as “CCR Parameters.” In addition, TOC, aluminum, manganese, iron, CEC, mineralogy by XRD and SEM, and sulfur speciation (total, sulfide/pyritic, sulfate, and organic/residual sulfur) were added as geochemical parameters of interest to be analyzed per the SAP. Additionally, soil samples were evaluated by SEP per the SAP and CCR Rule QAPP with the extraction solution generated at each step of the sequential extraction analyzed for the CCR Parameters, aluminum, iron, and manganese.

A list of the soil samples collected for geochemical analysis is provided on Table 1. The soil analytical data for geochemical parameters are presented in Tables 2 and 3. The boring locations are shown on Exhibit 1.

3.2 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during the geochemical investigation included:

- Decontamination fluids
- Personal protective equipment (PPE)
- General trash.

IDW was handled in general accordance with TVA ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; the SAP, the WBF Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with WBF Plant facility management. Decontamination fluids were managed as authorized by TVA and in general accordance with the SAP. Used disposable PPE (e.g., nitrile gloves) and general trash were placed in garbage bags and disposed of onsite in a municipal waste dumpster.

3.3 SAMPLE SHIPMENT

Samples were packed and transported under chain-of-custody procedures as specified in TVA ENV-TI-05.80.06, *Handling and Shipping of Samples*. The archival soil samples were initially sent to the Stantec Treatability Facility in Sylvania, Ohio via courier. After the initial evaluation at the Stantec Treatability Facility, the soil samples were then shipped from the Stantec Treatability Facility via FedEx to Eurofins in Pittsburgh, Pennsylvania and then subsequently shipped to the following laboratories for the listed analyses:

- Eurofins in Knoxville, Tennessee for SEP Metals
- Eurofins in Corpus Christi, Texas for CEC

- Eurofins in Tacoma, Washington for TOC.
- ACZ Laboratories Inc. in Steamboat Springs, Colorado for sulfur speciation analysis.
- Soil samples were also shipped at the time they were collected to RJ Lee in Monroeville, Pennsylvania for mineralogy analysis by XRD and SEM.

Eurofins and RJ Lee submitted sample receipt forms to EnvStds for review and confirmation.

3.4 VARIATIONS

The proposed scope and procedures for the investigation were outlined in the SAP, QAPPs, and applicable TVA TIs as detailed in the sections above. Variations in scope or procedures discussed with TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAPs are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this Fieldwork Summary for the investigation at the WBF Plant.

3.4.1 Variations in Scope

No variations in scope were documented during field activities.

3.4.2 Variations in Procedure

No variations in procedures occurred during field activities.

4.0 DATA COMPILATION AND EVALUATION

4.1 PORE WATER AND GROUNDWATER GEOCHEMISTRY

The general water quality properties of pore water and groundwater were presented and discussed in the EAR for the WBF Plant. This section provides a more focused discussion of the water quality of the pore water and groundwater as a foundation for development of the conceptual geochemical model and ultimately geochemical modeling. Pore water and groundwater sampling locations discussed in this section are shown in Exhibit 1. The evaluation focuses on the Slag Disposal Area because the CCR unit has statistically significant concentrations of CCR Parameters above the GWPS in downgradient groundwater monitoring wells.

4.1.1 Pore Water

Pore water is subsurface water that occurs in pore spaces in CCR material, and pore water chemistry develops from the interaction between process water and CCR material with additional water input from infiltration of rain. Pore water samples were collected from the Slag Disposal Area in each of the three temporary wells (WBF-TW03, WBF-TW04, and WBF-TW05) installed during implementation of the EI (Exhibit 1). Samples were collected from each of these locations during sampling events conducted in September 2019, March-April 2021, and May 2021. Analytical results for the pore water samples are useful for evaluating CCR Parameters and the potential for influence of downgradient groundwater. For consideration of bulk chemical composition (i.e., major ions, total dissolved solids, pH, oxidation-reduction potential (ORP), the samples provided the necessary information to describe pore water chemistry. The results of chemical analysis of the pore water samples collected from the temporary wells at the WBF Plant are provided in Table 4 and discussed further in Appendix G.1 of the EAR.

Bulk chemistry of pore water is shown in a Durov plot (Exhibit 2), which captures differences in major ion chemistry, total dissolved solids (TDS), and pH. ORP is not included in a Durov plot. Several parameters in the Durov plot were not analyzed in the September 2019 samples, therefore only 2021 results are presented. As shown in Exhibit 2, the pore water ranges from calcium-sulfate ($Ca\text{-}SO_4$) type to calcium-carbonate ($Ca\text{-}CO_3$) type. The pH ranges from 5.39 to 7.65, while TDS ranges from less than 500 milligrams per liter (mg/L) to 1,800 mg/L. The neutral to high pH can mobilize CCR Parameters, such as cobalt, molybdenum and arsenic, if present.

Exhibit 3 is a series of box plots showing the distribution of concentrations of constituents that are characteristic of pore water that will also be discussed in the groundwater section (Section 4.1.2). Constituents that are typically at higher concentrations in pore water than in groundwater and are not as chemically reactive as most of the CCR Parameters include boron, chloride, and sulfate. As shown in Exhibit 3, the concentrations of boron, chloride, and sulfate vary spatially among the sample locations. Boron is much lower in WBF-TW05 when compared to the other locations, while sulfate is the highest at WBF-TW05. However, the range in concentrations of these parameters are considered representative of the variability in pore water chemistry for the CCR unit.

As shown in the box plots on Exhibit 3, the concentration distributions for cadmium and cobalt vary with the highest concentration for cadmium observed at WBF-TW04 and for cobalt at WBF-TW05. Distributions of ORP values were mostly positive at WBF-TW04 and WBF-TW05 indicating chemically oxidizing conditions in pore water; however, ORP was slightly negative at WBF-TW03 suggesting reducing conditions at that location.

Cobalt is relatively mobile, especially at the conditions represented by pore water in some areas of the CCR unit. The main observation is that cobalt was at or below their respective GWPS in pore water, and pore water pH was 5.7 in WBF-TW05, both of which can influence downgradient groundwater chemistry. However, there are geochemical processes that occur along the groundwater flow path from the CCR units and through the unconsolidated material that limit the influence of pore water chemistry on groundwater chemistry. Geochemical processes acting along hydrogeologic flow paths and the influence of pore water on groundwater concentrations measured at the downgradient edge of the facility are described in more detail in the following sections and in the main text of Appendix H.1.

4.1.2 Groundwater

Groundwater chemistry was measured at the boundary of the CCR units at the WBF Plant between August 2019 and April 2023 and provides information about: (1) baseline concentrations reflecting the interaction of precipitation-induced aquifer recharge and native soils upgradient of the CCR units, and (2) the combination of groundwater interaction with aquifer unconsolidated materials and the extent to which pore water from the CCR units has contributed chemical mass to the uppermost aquifer at downgradient locations.

Observed groundwater chemistry is presented in this section with a focus on CCR Parameters that act as tracers of influence from pore water (i.e., boron, chloride, and sulfate) and CCR Parameters that occur in concentrations above the GWPS. Boron, chloride, and sulfate are considered tracers of CCR Parameters in pore water because boron and chloride are minimally affected by geochemical interactions with unconsolidated materials, and sulfate remains at concentrations higher than upgradient concentrations even when in equilibrium with gypsum ($CaSO_4 \cdot 2H_2O$). CCR Parameters that most commonly occur in concentrations greater than the GWPS include cadmium and cobalt. Groundwater chemistry for the locations discussed in this section is provided in Table 5.

As part of the EI and EAR, groundwater elevation contour maps were developed using several rounds of gauging data. Physiographic features that affect groundwater flow in the vicinity of the WBF Plant include the Tennessee River to the east and ridges that form watershed boundaries to the west. Flows within the unconsolidated material are from the ridges in the west and generally toward the East and Southeast. There are two groundwater wells (WBF-102 and WBF-103) upgradient of the CCR units within the period of record considered (August 2019 to April 2023). The average boron concentration for these two wells is 69 micrograms per liter (µg/L) (Exhibit 4). Boron values less than the reporting limit are plotted at the reporting limit. Chloride ranges from 4.2 to 37.8 mg/L with an average concentration of 9.9 mg/L, and sulfate concentrations range from 32.9 to 664 mg/L with an average concentration of 168 mg/L (Exhibit 4). Chloride and boron concentrations are relatively stable, while sulfate is highly variable at WBF-102.

The two water chemistry parameters that influence geochemical interactions between groundwater and aquifer unconsolidated materials and resulting groundwater concentrations are pH and ORP. The observed pH in groundwater ranged from 5.15 to 7.05 with ORP ranging from 23.9 millivolts (mV) to 349.8 mV (Exhibit 4).

Interpretation of groundwater chemistry requires an understanding of the hydrogeology of the groundwater system, which in this case is the uppermost aquifer or coarse-grained alluvium as described in detail in the WBF Plant EAR. An important assumption for interpreting groundwater chemistry is that groundwater samples collected from groundwater monitoring wells located on the downgradient sides of CCR units represent hydrogeologic and geochemical processes occurring along a flow path from upgradient to downgradient groundwater monitoring locations.

4.1.2.1 Slag Disposal Area

The groundwater monitoring wells downgradient of the Slag Disposal Area are WBF-104, WBF-105, and WBF-106. Two parameters that influence geochemical interactions between parameters in groundwater and aquifer unconsolidated materials are the pH and ORP of groundwater. As shown in Exhibit 5, the pH of groundwater at WBF-104 and WBF-106 ranges between 5.3 and 6.32. When addressing parameter concentrations at low levels, (i.e., concentrations of µg/L) small changes in pH can result in changes in groundwater concentrations that exceed the GWPS. The ORP is positive in groundwater at WBF-104 (ranging from 5.1 to 266.4 mV), but WBF-106 is lower and ranges from -66.5 and 121 mV.

At WBF-104 and WBF-106 boron and sulfate occurred in concentrations that show an influence of pore water on groundwater chemistry (Exhibit 5). However, chloride concentrations are relatively low. The concentrations of boron and chloride are slightly increasing at WBF-104 and relatively stable at WBF-106. Sulfate is relatively stable in WBF-106 and slightly declining in WBF-104 over the period of record. There is a decrease in CCR indicator parameters in January 2020 at WBF-104 and in April 2020 at WBF-106 followed by a return to previous levels.

Cobalt is the CCR Rule Appendix IV parameter above the GWPS in groundwater at WBF-104 and WBF-106, while cadmium also has concentrations above the GWPS at WBF-104. Cobalt in groundwater decreased in January 2020 at WBF-104 and in April 2020 at WBF-106 followed by an increase to above previous levels at WBF-104 and to just below previous levels at WBF-106. The range in cobalt concentrations was 167 to 602 µg/L at WBF 104 and 2.16 to 79.95 µg/L at WBF-106. Cadmium in groundwater also decreased in January 2020 at WBF-104 followed by a return to previous concentrations, ranging from 6.08 to 10.95 µg/L. Over the same time period, the pH of groundwater has been relatively acidic, with higher pH values associated with reduced cobalt concentrations. At WBF-104, cadmium concentrations appear less influenced by pH, but the concentration was lowest when pH was highest (Exhibit 5).

4.2 UNCONSOLIDATED MATERIAL GEOCHEMISTRY

In July 2021 and November 2022, TVA conducted a drilling program at the WBF Plant and geochemical conditions were further investigated. A total of five soil borings adjacent to the Slag Disposal Area were

targeted for soil collection of unconsolidated materials from the upper groundwater zone for analysis of geochemical properties. Laboratory tests were completed for the following geochemical metrics:

- Mineralogy by X-ray Diffraction and Scanning Electron Microscopy
- Sequential Extraction Procedure
- Total Metals
- Total Organic Carbon
- Cation Exchange Capacity.

Soil results of laboratory analysis conducted for the geochemical evaluation are summarized in Tables 2 and 3.

Results of the geochemical testing program were used to describe the geochemical properties of unconsolidated material and to provide input data for geochemical modeling to account for geochemical reactions between constituents in groundwater and unconsolidated materials.

4.2.1 Mineralogy

An evaluation of the soil mineralogy at the borehole locations was completed using two methods: (1) XRD and (2) SEM. For this discussion, results of XRD are presented with SEM providing corroboration of XRD results. The purpose of the mineralogical evaluation was to determine if there are geochemically reactive minerals present in the unconsolidated material. The mineralogical results were combined with results of the SEP to guide development of the geochemical models used to assess the influence of geochemical processes on measured groundwater quality. The geochemical model is discussed in the *Appendix H.1 - Geochemical Modeling Technical Memorandum*.

Given the geological origin of unconsolidated materials that mostly comprise the uppermost aquifer at the WBF Plant, the expectation is that a large proportion of the mineralogy would consist of mineral phases that are not geochemically reactive (e.g., quartz, plagioclase, and chlorite). Of greater interest from the perspective of understanding geochemical conditions and reactions in the subsurface, are the presence of geochemically reactive minerals such as ferrihydrite ($Fe[OH]_3$), and gibbsite ($Al[OH]_3$ (for adsorption); gypsum ($CaSO_4 \cdot 2H_2O$), pyrite (FeS_2), calcite ($CaCO_3$), and mackinawite (FeS) (for precipitation/dissolution); and smectite and other clay minerals (important in cation exchange reactions). The geochemically reactive minerals generally can be grouped based on the type of geochemical reaction that could affect the concentration of constituents in groundwater.

Gypsum and calcite are minerals that could precipitate (i.e., form a mineral) or dissolve, and the occurrence of either or both in the geochemical test results indicates that the groundwater at that location is in equilibrium with the mineral(s). Neither mineral would substantially affect the concentration of CCR constituents (except for CCR Rule Appendix III calcium and sulfate), but the presence of calcite can exert control on the pH of groundwater maintaining groundwater pH of about 8.

The minerals pyrite and mackinawite may form in the subsurface but are not expected to dissolve in the subsurface mainly because the amount of oxygen present is insufficient to cause oxidation of the iron sulfide. However, pyrite and mackinawite do indicate the general oxidation-reduction (redox) condition of the subsurface where the presence of both generally requires chemically reducing conditions.

Ferrihydrite and gibbsite are metal hydroxide minerals that exert control on the concentrations of metals (and metalloids) in groundwater through the geochemical process of adsorption, which is a process by which metals (and metalloids) essentially adhere to the surface of the metal hydroxide. The degree to which a given metal (or metalloid) adheres to a metal hydroxide surface depends on the pH of groundwater. Additionally, the presence of ferrihydrite can be affected by the redox of the groundwater such that at low redox conditions (i.e., chemically reducing) ferrihydrite dissolves, which in turn would release metals adsorbed to the mineral surface.

Smectite is a clay mineral that is commonly referred to as a “swelling” clay because the structure of the mineral is such that water can move into and out of the mineral causing the mineral to swell and shrink. Cations in groundwater (i.e., those ions that carry a positive charge like calcium, magnesium, sodium, and lithium) can also move into or out of the mineral. The geochemical process is called cation exchange, which implies that a cation in the clay mineral is exchanged for another cation in groundwater. Thus, the process is reversible in that a cation in the clay mineral can be exchanged out of the clay mineral.

4.2.1.1 Slag Disposal Area

The bulk mineralogy of unconsolidated materials collected along the eastern levee of the Slag Disposal Area near WBF-104 and WBF 106 is shown as a series of pie charts in Exhibit 6. Soil samples were collected from borings WBF-SS-SB-02 at a depth of 25 to 35 feet below ground surface (bgs) and WBF-SS-SB-05 at a depth of 10 to 30 feet bgs and analyzed for mineralogy by XRD. Quartz is the most abundant mineral at 45 to 60 percent (%) of the total minerals present (Exhibit 6). The XRD results include a general clay category which groups 2:1 clay minerals, which were a minor component (1%) of the unconsolidated materials. Kaolinite, which is a less reactive clay mineral, ranged from 7 to 11% of the minerals present. More reactive minerals, such as ferrihydrite, siderite, calcite, and dolomite were not detected by XRD; however, the SEM analysis indicates the presence of some reactive minerals at less than 0.2% by mass.

4.2.2 Sequential Extraction Procedure

The SEP is designed to sequentially subject a soil sample to more chemically aggressive leaching solutions that are intended to target specific mineral phases that may be present in the soil. At each step of the sequential process, the leachate is analyzed for CCR constituents with the end result allowing identification of the proportional distribution of a CCR constituent among the soil fraction(s) targeted by the SEP. In the first step of the SEP, the soil sample is exposed to the same solution used to determine the cation exchange capacity. Thus, step 1 of the SEP targets the exchangeable fraction of the soil. The second step of the SEP uses a solution that is most sensitive for the carbonate fraction of the soil. Steps 3 and 4 of the SEP effectively target the metal hydroxide fraction of the soil mineralogy; whereas the fifth

step uses a leaching solution intended to dissolve the organic fraction of the soil. The final two steps of the SEP, the “acid sulfide” and “residual” fractions, are the most chemically aggressive and mobilize constituents associated with soil minerals that are not expected to influence groundwater chemistry. Of most interest for geochemical modeling are the first four steps of the SEP, with the third and fourth steps providing essential information about the abundance of metal hydroxides that can be used directly in geochemical modeling. Additionally, the distribution of a given constituent among the SEP mineral categories is also helpful to demonstrate active attenuation as well as address questions regarding the total capacity of aquifer materials to attenuate CCR constituents.

4.2.2.1 Slag Disposal Area

Soil samples were collected from SB-02, SB-05, SB-12, SB-13, and SB-14 along the eastern levee of the Slag Disposal Area and subjected to SEP. Aluminum is generally more abundant than iron and manganese (Exhibit 7). However, the relative portion of aluminum, iron, or manganese that occurs in the geochemical reactive fractions (i.e., non-crystalline and metal hydroxide) is more important than the total amount. A greater proportion of the iron and manganese were extracted in the geochemically reactive fractions whereas most aluminum is in fractions (acid/sulfide and residual) that are not geochemically reactive (Exhibit 7). Enough iron and manganese exist in the geochemically reactive form to act as an adsorption surface for CCR anions in groundwater depending on conditions of pH and ORP.

Cadmium and cobalt are the CCR Parameters that occur in groundwater at WBF-104 in concentrations higher than the GWPS, while only cobalt occurs in groundwater at WBF-106 in concentrations higher than the GWPS. The majority of cadmium is in nonreactive minerals at SB-02, SB-12, SB-13, and SB-14, but at SB-05, which is adjacent to WBF-104, more than half of the cadmium is in reactive phases, particularly exchangeable. At all locations some of the cadmium is in the metal hydroxide phase suggesting a minor amount of adsorption has occurred (Exhibit 7). With the exception of SB-12 and SB-13, most of the cobalt is found in reactive mineral phases. Depending on groundwater conditions of pH and ORP, cadmium and cobalt could either remain attenuated or become mobile.

4.2.3 Cation Exchange Capacity and Total Organic Carbon

CEC is a measure of the total capacity of soil minerals to exchange positively charged ions and is typically reported in units of milliequivalents per 100 grams (meq/100g). A lower range of CEC is about 3 to 15 meq/100g, which is typical of the CEC of the clay mineral kaolinite. On the other end of the spectrum, high CEC for common soil clay minerals such as smectite (or montmorillonite) ranges from 80 to 120 meq/100g (Appelo and Postma, 1996). For the soils tested at the WBF Plant, the maximum CEC measured, 18.1 meq/100g, was for the sample collected at SB-12. The sample from SB-13 had the lowest CEC of 13.1 meq/100g. The overall low CEC of the soil samples indicates that attenuation of CCR constituents, such as cadmium and cobalt, that might be influenced by CEC would likely be limited.

Total Organic Carbon was measured in the unconsolidated material samples. Results range from a low of 1,480 milligrams per kilogram (mg/kg) in SB-13 to a high of 11,000 mg/kg in the field duplicate sample of B-05. The concentration of TOC is sufficient to have influence on ORP values in groundwater.

5.0 SUMMARY

The data presented in this report are from implementation of the geochemical investigation at the WBF Plant. The scope of work for the geochemical investigation included:

- Collected five archival soil samples at five borings for the TDEC Order
- Collected five samples of soil from the archived samples in storage at Stantec's Treatability Facility in Sylvania, Ohio for geochemical analysis
- Collected a QC sample for laboratory analysis
- Shipped collected samples via FedEx to Eurofins and RJ Lee for analysis
- Collected seven surface water samples at seven sampling locations. Details of the surface water sampling activities and results are provided in Attachment A – Surface Water Investigation Summary.
- Evaluated the geochemical data for use in geochemical models for each CCR management unit.

A summary of soil samples and soil analytical results are presented in Tables 1 through 3. Pore water and groundwater analytical results are presented in Tables 4 and 5, respectively.

The data collected during the geochemical investigation are usable for reporting and evaluation in the CARA Plan and meet the objectives of the TDEC Order EIP. The complete dataset from this event will be further evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR programs.

6.0 REFERENCES

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

TABLES

TABLE 1 – Summary of Soil Samples
Watts Bar Fossil Plant

Location ID	Sample ID	Sample Type	SEP Metals	pH (laboratory)	Total Organic Carbon	Cation Exchange Capacity	Sulfur Speciation	SEM Bulk Mineral	XRD Bulk Mineral
WBF-SDA-SB02	WBF-SS-SB-02-25/35-11182022	Normal Environmental Sample	X		X		X	X	X
WBF-SDA-SB05	WBF-SS-SB-05-10/30-11182022	Normal Environmental Sample	X		X		X	X	X
	WBF-SS-SB-05-FD01-11182022	Field Duplicate Sample	X		X		X	X	X
WBF-SB12	WBF-SS-SB12-13.5/19.5-07122021	Normal Environmental Sample	X	X	X	X			
	WBF-SS-FD01-07122021	Field Duplicate Sample	X	X	X	X			
WBF-SB13	WBF-SS-SB13-12.0/18.0-07122021	Normal Environmental Sample	X	X	X	X			
WBF-SB14	WBF-SS-SB14-12.5/18.5-07122021	Normal Environmental Sample	X	X	X	X			

Notes	Method
Cation Exchange Capacity	SW-846 9081
ID	identification
pH (laboratory)	SW-846 9045D
SEM Bulk Mineral	Scanning Electron Microscopy Bulk Mineral
SEP Metals	SW-846 6010B
Sulfur Speciation	SM 4500 S2-F
Total Organic Carbon	SW-846 9060A
XRD Bulk Mineral	X-Ray Diffraction Bulk Mineral

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

Table 2 - Soil Analytical Results for Geochemical Characterization
Watts Bar Fossil Plant

Sample Location		WBF-SDA-SB02	WBF-SDA-SB05		WBF-SB12		WBF-SB13	WBF-SB14
Sample Date		18-Nov-22	18-Nov-22	18-Nov-22	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21
Sample ID		WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB14-12.5/18.5-07122021
Parent Sample ID				WBF-SS-SB-05-10/30-11182022		WBF-SS-SB12-13.5/19.5-07122021		
Sample Depth		25 - 35 ft	10 - 30 ft	10 - 30 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	12 - 18 ft	12.5 - 18.5 ft
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample
SEM Bulk Mineral								
Al-Rich	%mass	0.0220	0.0500	0.0603	-	-	-	-
Ba-S Rich	%mass	0.00134	<0.0000000191	0.000925	-	-	-	-
Ca-Rich	%mass	0.00365	0.000706	<0.0000000104	-	-	-	-
Ca-S Rich	%mass	0.00836	0.0188	0.00395	-	-	-	-
Fe-Rich	%mass	0.167	4.42	0.155	-	-	-	-
Fe-S Rich	%mass	<0.0000000773	<0.0000000191	<0.0000000104	-	-	-	-
Mn-Rich	%mass	<0.0000000773	<0.0000000191	<0.0000000104	-	-	-	-
XRD Bulk Mineral								
Albite	%mass	5	7	6	-	-	-	-
Amorphous	%mass	<10	<10	<10	-	-	-	-
Chlorite	%mass	11	6	7	-	-	-	-
Clay	%mass	1	<1	1	-	-	-	-
Crystalline Silica, Quartz	%mass	45	61	57	-	-	-	-
Kaolinite	%mass	11	7	7	-	-	-	-
Mica/Illite	%mass	24	15	17	-	-	-	-
Microcline	%mass	4	4	4	-	-	-	-
Sulfur Speciciation								
Sulfur Organic	%	<0.01	<0.01	<0.01	-	-	-	-
Sulfur Pyritic Sulfide	%	<0.01	<0.01	<0.01	-	-	-	-
Sulfur Sulfate	%	0.06 J	0.03 J	0.08 J	-	-	-	-
Sulfur Total	%	0.06 J	0.03 J	0.08 J	-	-	-	-
Total Sulfur Minus Sulfate	%	<0.01	<0.01	<0.01	-	-	-	-
General Chemistry								
Cation Exchange Capacity	meq/100gm	-	-	-	18.1	20.6	13.1	13.3
pH (lab)	SU	-	-	-	6.5	7.2	4.3	6.1
Total Organic Carbon	mg/kg	7,270 J	7,680 J	11,000 J	1,560 J	2,840 J	1,480 J	3,530

Notes:

15.2	measured concentration
%mass	percent mass
<0.03	analyte was not detected at a concentration greater than the laboratory reporting limit.
ft	feet
ID	Identification
J	quantitation is approximate due to limitations identified during data validation
meq/100gm	milliequivalents per 100 grams
mg/kg	milligrams per Liter
SEM	Scanning Electron Microscopy
SU	Standard Units
XRD	X-ray diffraction analysis

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Table 3 - Soil Analytical Results for SEP Metals
Watts Bar Fossil Plant

Sample Location		WBF-SDA-SB02								
Sample Date		18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22
Sample ID		WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022	WBF-SS-SB-02-25/35-11182022
Parent Sample ID										
Sample Depth										
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Test Type		Step 1 - Exchangeable	Step 2 - Carbonate	Step 3 - Non-Crystalline	Step 4 - Metal Hydroxide	Step 5 - Organic	Step 6 - Acid/Sulfide	Step 7 - Residual	Steps 1 - 7 summation	Total
SEP Metals										
Aluminum	mg/kg	152	21.8 J	167	2,560	104 J	5,480	33,100	41,600 J	41,800
Antimony	mg/kg	-	-	-	-	-	-	-	-	-
Arsenic	mg/kg	<0.596	<0.447	1.89	1.06 U*	2.26 J	0.790	0.896 J	6.90 J	4.22
Barium	mg/kg	-	-	-	-	-	-	-	-	-
Beryllium	mg/kg	-	-	-	-	-	-	-	-	-
Cadmium	mg/kg	<0.0734	<0.0378	<0.0126	<0.0126	<0.183	<0.0126	0.0894 J	0.0894 J	0.225 J
Calcium	mg/kg	-	-	-	-	-	-	-	-	-
Chromium	mg/kg	-	-	-	-	-	-	-	-	-
Cobalt	mg/kg	1.96 J	<0.217	0.251 J	2.94	<0.688	1.79 J	0.849 J	7.80 J	7.53
Copper	mg/kg	-	-	-	-	-	-	-	-	-
Iron	mg/kg	<13.3	146	2,160	4,990	<50.4	5,040 J	5,590	17,900 J	18,200
Lead	mg/kg	-	-	-	-	-	-	-	-	-
Lithium	mg/kg	<0.688	<0.516	<0.172	4.90	2.68 J	6.04	13.1	26.7 J	20.6
Manganese	mg/kg	86.5	9.76	3.47 J	33.8 J	3.03 J	31.4 J	61.5 J	229 J	360
Molybdenum	mg/kg	<0.376	<0.282	0.146 J	<0.0940	<1.43	<0.113	<0.0940	0.146 J	0.341 J
Nickel	mg/kg	1.94 J	0.282 J	0.160 J	5.39	<1.03	5.46	4.04 J	17.3 J	13.1
Potassium	mg/kg	-	-	-	-	-	-	-	-	-
Selenium	mg/kg	-	-	-	-	-	-	-	-	-
Silver	mg/kg	-	-	-	-	-	-	-	-	-
Thallium	mg/kg	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	-	-	-	-	-	-	-	-	-
Zinc	mg/kg	-	-	-	-	-	-	-	-	-

See last page for notes.

Table 3 - Soil Analytical Results for SEP Metals
Watts Bar Fossil Plant

Sample Location		WBF-SDA-SB05							
Sample Date		18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22
Sample ID		WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022
Parent Sample ID			WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-05-10/30-11182022
Sample Depth									
Sample Type	Units	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample
Test Type		Step 1 - Exchangeable	Step 1 - Exchangeable	Step 2 - Carbonate	Step 2 - Carbonate	Step 3 - Non-Crystalline	Step 3 - Non-Crystalline	Step 4 - Metal Hydroxide	Step 4 - Metal Hydroxide
SEP Metals									
Aluminum	mg/kg	36.8 J	47.0 J	18.5 J	20.5 J	250	249	3,080	3,330
Antimony	mg/kg	-	-	-	-	-	-	-	-
Arsenic	mg/kg	<0.691	<0.618	<0.519	<0.464	0.742	1.08	0.891 U*	0.842 U*
Barium	mg/kg	-	-	-	-	-	-	-	-
Beryllium	mg/kg	-	-	-	-	-	-	-	-
Cadmium	mg/kg	0.138 J	0.147 J	0.0578 J	0.0517 J	<0.0146	<0.0131	0.0193 J	0.0190 J
Calcium	mg/kg	-	-	-	-	-	-	-	-
Chromium	mg/kg	-	-	-	-	-	-	-	-
Cobalt	mg/kg	1.65 J	2.56 J	0.730 J	0.442 J	1.06 J	0.621 J	2.10 J	2.25 J
Copper	mg/kg	-	-	-	-	-	-	-	-
Iron	mg/kg	<15.4	<13.8	52.0 J	97.4 J	745	811	3,500	3,610
Lead	mg/kg	-	-	-	-	-	-	-	-
Lithium	mg/kg	<0.798	<0.714	<0.598	<0.535	<0.199	<0.178	5.44	6.01
Manganese	mg/kg	38.7	44.7	13.5 J	6.96 J	22.8 J	6.82 J	44.5 J	39.8 J
Molybdenum	mg/kg	<0.436	<0.390	<0.327	<0.293	0.151 J	0.121 J	<0.109	<0.0975
Nickel	mg/kg	2.25 J	2.35 J	0.479 J	0.451 J	0.629 J	0.707 J	3.95	4.13
Potassium	mg/kg	-	-	-	-	-	-	-	-
Selenium	mg/kg	-	-	-	-	-	-	-	-
Silver	mg/kg	-	-	-	-	-	-	-	-
Thallium	mg/kg	-	-	-	-	-	-	-	-
Vanadium	mg/kg	-	-	-	-	-	-	-	-
Zinc	mg/kg	-	-	-	-	-	-	-	-

See last page for notes.

Table 3 - Soil Analytical Results for SEP Metals
Watts Bar Fossil Plant

Sample Location		WBF-SDA-SB05									
Sample Date		18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22	18-Nov-22
Sample ID		WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022	WBF-SS-SB-05-10/30-11182022	WBF-SS-SB-05-FD01-11182022
Parent Sample ID			WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-05-10/30-11182022
Sample Depth											
Sample Type	Units	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample
Test Type		Step 5 - Organic	Step 5 - Organic	Step 6 - Acid/Sulfide	Step 6 - Acid/Sulfide	Step 7 - Residual	Step 7 - Residual	Steps 1 - 7 summation	Steps 1 - 7 summation	Total	Total
SEP Metals											
Aluminum	mg/kg	75.2 J	79.4 J	8,570	6,990	30,300	33,200	42,400 J	43,900 J	45,600	45,700
Antimony	mg/kg	-	-	-	-	-	-	-	-	-	-
Arsenic	mg/kg	<2.53	<2.26	0.856	0.693	0.445 J	0.451 J	2.93 J	3.06 J	1.52	2.28
Barium	mg/kg	-	-	-	-	-	-	-	-	-	-
Beryllium	mg/kg	-	-	-	-	-	-	-	-	-	-
Cadmium	mg/kg	<0.213	<0.190	<0.0146	<0.0131	0.127 J	0.128 J	0.342 J	0.347 J	0.290 J	0.480
Calcium	mg/kg	-	-	-	-	-	-	-	-	-	-
Chromium	mg/kg	-	-	-	-	-	-	-	-	-	-
Cobalt	mg/kg	<0.798	<0.714	1.97 J	1.62 J	1.28 J	1.34 J	8.79 J	8.84 J	7.49 J	8.10 J
Copper	mg/kg	-	-	-	-	-	-	-	-	-	-
Iron	mg/kg	<58.5	53.1 J	5,100 J	4,370 J	6,000	5,700	15,400 J	14,600 J	14,000	11,700
Lead	mg/kg	-	-	-	-	-	-	-	-	-	-
Lithium	mg/kg	<2.93	<2.62	8.09	6.48	10.1	10.8	23.6	23.3	20.8	20.5
Manganese	mg/kg	5.00 J	4.94 J	37.3 J	32.8 J	116 J	98.3 J	278 J	234 J	247	214
Molybdenum	mg/kg	<1.66	<1.49	<0.132	<0.118	<0.109	<0.0975	0.151 J	0.121 J	0.377 J	0.390 J
Nickel	mg/kg	<1.20	<1.07	6.35	5.04	5.40	5.72	19.1 J	18.4 J	15.1	15.8
Potassium	mg/kg	-	-	-	-	-	-	-	-	-	-
Selenium	mg/kg	-	-	-	-	-	-	-	-	-	-
Silver	mg/kg	-	-	-	-	-	-	-	-	-	-
Thallium	mg/kg	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	-	-	-	-	-	-	-	-	-	-
Zinc	mg/kg	-	-	-	-	-	-	-	-	-	-

See last page for notes.

Table 3 - Soil Analytical Results for SEP Metals
Watts Bar Fossil Plant

Sample Location		WBF-SB12									
Sample Date		12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21
Sample ID		WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021
Parent Sample ID			WBF-SS-SB12-13.5/19.5-07122021		WBF-SS-SB12-13.5/19.5-07122021		WBF-SS-SB12-13.5/19.5-07122021		WBF-SS-SB12-13.5/19.5-07122021		WBF-SS-SB12-13.5/19.5-07122021
Sample Depth		13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft
Sample Type	Units	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Field Duplicate
Test Type		Step 1 - Exchangeable	Step 1 - Exchangeable	Step 2 - Carbonate	Step 2 - Carbonate	Step 3 - Non-Crystalline	Step 3 - Non-Crystalline	Step 4 - Metal Hydroxide	Step 4 - Metal Hydroxide	Step 5 - Organic	Step 5 - Organic
SEP Metals											
Aluminum	mg/kg	<8.17	<7.86	105	47.7	557	461	3,210	2370	308	223
Antimony	mg/kg	<1.43	<1.38	<1.07	<1.03	<0.357	<0.344	<0.574	<0.553	<5.36	<5.16
Arsenic	mg/kg	<0.663	<0.639	<0.498	<0.479	0.581 J	0.605 J	1.21 J	0.920	<2.42	<2.33
Barium	mg/kg	<0.612	<0.589	0.752 J	0.851 J	1.42 J	2.16 J	21.8 J	15.4 J	28.5 J	38.4 J
Beryllium	mg/kg	<0.393	<0.378	<0.0612	<0.0589	0.146 J	0.140 J	0.345	0.228 J	<0.402	<0.387
Cadmium	mg/kg	<0.0817	<0.0786	<0.0421	<0.0405	<0.0140	<0.0135	0.0574 J	<0.0135	<0.204	<0.196
Calcium	mg/kg	1,260 J	1730	547 J	1060	10.6 J	8.53 J	152 J	356	43.2 U*	131 J
Chromium	mg/kg	<0.357	<0.344	<0.268	<0.258	1.26 J	2.35 J	5.73	5.41	3.20 J	4.61 J
Cobalt	mg/kg	<0.230	<0.221	<0.241	<0.232	0.836 J	1.06 J	1.79 J	1.50 J	<0.766	<0.737
Copper	mg/kg	<0.408	<0.393	<0.612	<0.589	1.50 J	1.72	4.94	3.67	<1.53	<1.47
Iron	mg/kg	<14.8	<14.2	15.9 J	<10.7	3,530	2700	9,740	7110	<56.1	<54.0
Lead	mg/kg	<0.561	<0.540	0.976 J	0.706 J	2.39	1.61	4.05	3.44	<2.11	<2.03
Lithium	mg/kg	<0.766	<0.737	<0.574	<0.553	0.311 U*	<0.184	3.95	2.59 J	3.38 U*	4.51 U*
Manganese	mg/kg	6.93	0.238 J	2.75 J	4.84	94.5	109	81.2	68.7	<2.36	3.18 J
Molybdenum	mg/kg	<0.418	<0.403	<0.314	<0.302	0.139 J	0.306 J	0.267 J	0.395 J	<1.59	<1.54
Nickel	mg/kg	<0.347	<0.334	<0.191	<0.184	0.121 J	0.345 J	4.72	3.54	1.42 J	1.42 J
Potassium	mg/kg	<133	<128	<99.5	173 U*	<33.2	<31.9	42.7 J	43.9 J	2,760 U*	3,150 U*
Selenium	mg/kg	<0.868	<0.835	<0.651	<0.626	<0.217	0.294 J	<0.600	0.742	<3.32	<3.19
Silver	mg/kg	<0.561	<0.540	<0.268	<0.258	<0.140	<0.135	<0.128	<0.123	<2.04	<1.96
Thallium	mg/kg	<1.07	<1.03	<0.804	<0.774	<0.268	<0.258	<0.370	<0.356	<4.47	<4.30
Vanadium	mg/kg	<0.250	<0.241	<0.612	<0.589	4.63	3.46	8.53	6.03	1.59 J	1.42 J
Zinc	mg/kg	<1.22	<1.18	0.766 UJ	1.30 J	1.58 U*	4.69 U*	19.6 J	17.6	4.68 U*	8.11 U*

See last page for notes.

Table 3 - Soil Analytical Results for SEP Metals
Watts Bar Fossil Plant

Sample Location		WBF-SB12							
Sample Date		12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21
Sample ID		WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021	WBF-SS-SB12-13.5/19.5-07122021	WBF-SS-FD01-07122021
Parent Sample ID			WBF-SS-SB12-13.5/19.5-07122021		WBF-SS-SB12-13.5/19.5-07122021		WBF-SS-SB12-13.5/19.5-07122021		WBF-SS-SB12-13.5/19.5-07122021
Sample Depth		13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft	13.5 - 19.5 ft
Sample Type	Units	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Field Duplicate
Test Type		Step 6 - Acid/Sulfide	Step 6 - Acid/Sulfide	Step 7 - Residual	Step 7 - Residual	Steps 1 - 7 summation	Steps 1 - 7 summation	Total	Total
SEP Metals									
Aluminum	mg/kg	8,490	7020	42,500 J	29,100 J	55,200 J	39,300 J	69,200 J	42,800 J
Antimony	mg/kg	<0.357	<0.344	0.919 J	0.508 J	0.919 J	0.508 J	0.377 J	0.805 J
Arsenic	mg/kg	1.52	1.43	2.40	1.38	5.71 J	4.34 J	7.53 J	4.21 J
Barium	mg/kg	86.3	96.7	372	350	511 J	504 J	688	575
Beryllium	mg/kg	0.231 J	0.174 J	0.807	1.15	1.53 J	1.69 J	1.31 J	1.46
Cadmium	mg/kg	0.0848 J	<0.0135	0.217 J	0.105 J	0.359 J	0.105 J	0.143 J	0.454
Calcium	mg/kg	66.0 J	87.8 J	1,250 J	1260	3,330 J	4,630 J	5,120	6110
Chromium	mg/kg	8.30	6.78	24.4	25.7	42.8 J	44.9 J	47.2 J	39.9
Cobalt	mg/kg	2.58 J	2.26 J	1.38 J	3.84 J	6.59 J	8.66 J	9.31 J	8.96 J
Copper	mg/kg	4.90	4.26	1.17 J	5.24 J	12.5 J	14.9 J	16.1 J	12.2
Iron	mg/kg	10,300	8910	6,560 J	16,400 J	30,200 J	35,100 J	37,200 J	27100
Lead	mg/kg	2.00	1.87	3.94	3.46	13.3 J	11.1 J	18.6	13.9
Lithium	mg/kg	8.86	7.03	19.2 J	21.6 J	35.7 J	35.7 J	36.4 J	26.4
Manganese	mg/kg	63.1	58.3	61.1	86.7	309 J	331 J	386 J	379
Molybdenum	mg/kg	<0.126	0.154 J	<0.105	0.193 J	0.406 J	1.05 J	0.653 J	1.40 J
Nickel	mg/kg	7.64	6.28	8.57 J	11.6 J	22.5 J	23.2 J	24.0 J	17.9
Potassium	mg/kg	1,350	1200	16,700	13800	20,900 J	18,400 J	22,300	18200
Selenium	mg/kg	<0.217	0.609 J	<0.434	<0.209	0.170 UJ	1.64 J	3.05 J	0.209 UJ
Silver	mg/kg	<0.153	<0.147	0.294 J	0.362 J	0.294 J	0.362 J	0.342 J	0.357 J
Thallium	mg/kg	<0.268	<0.258	0.840 J	0.819 J	0.840 J	0.819 J	1.35 J	<1.11
Vanadium	mg/kg	10.9	9.28	41.2	42.2	66.9 J	62.4 J	80.2 J	55.9 J
Zinc	mg/kg	28.9	23.7	20.8	15.4	75.6 J	70.9 J	96.5	75.9

See last page for notes.

Table 3 - Soil Analytical Results for SEP Metals
Watts Bar Fossil Plant

Sample Location		WBF-SB13								
Sample Date		12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21
Sample ID		WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021	WBF-SS-SB13-12.0/18.0-07122021
Parent Sample ID										
Sample Depth		12 - 18 ft	12 - 18 ft	12 - 18 ft	12 - 18 ft	12 - 18 ft	12 - 18 ft	12 - 18 ft	12 - 18 ft	12 - 18 ft
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Test Type		Step 1 - Exchangeable	Step 2 - Carbonate	Step 3 - Non-Crystalline	Step 4 - Metal Hydroxide	Step 5 - Organic	Step 6 - Acid/Sulfide	Step 7 - Residual	Steps 1 - 7 summation	Total
SEP Metals										
Aluminum	mg/kg	238	90.4	446	2,810	272	7,260	36,100	47,300	44,100
Antimony	mg/kg	<1.36	<1.02	<0.340	<0.547	<5.10	<0.340	0.647 J	0.647 J	0.444 J
Arsenic	mg/kg	<0.632	<0.474	0.500 J	0.853 J	<2.31	1.17	1.81	4.34 J	4.30 J
Barium	mg/kg	<0.583	<0.437	1.32 J	26.0	27.1 J	63.8	319	438 J	491
Beryllium	mg/kg	<0.374	<0.0583	0.113 J	0.267 J	<0.383	0.191 J	0.695	1.27 J	0.675 J
Cadmium	mg/kg	<0.0777	<0.0401	<0.0134	0.0389 J	<0.194	0.0662 J	0.200 J	0.306 J	0.151 J
Calcium	mg/kg	427 J	58.2 J	12.3 J	42.9 J	29.7 U*	72.3 J	1,390 J	2,030 J	4,120
Chromium	mg/kg	<0.340	<0.255	0.930	5.13	3.15 J	7.19	21.0	37.4 J	31.8 J
Cobalt	mg/kg	<0.219	<0.230	0.868 J	1.43 J	<0.729	2.19 J	1.35 J	5.83 J	6.47 J
Copper	mg/kg	<0.389	<0.583	1.48 J	3.70	<1.46	3.85	0.881 J	9.91 J	8.12 J
Iron	mg/kg	<14.1	24.8	2,890	7,710	<53.4	8,580	5,820	25,000	23,300 J
Lead	mg/kg	<0.534	0.654 J	2.36	2.77	<2.00	1.51	3.36	10.7 J	12.1
Lithium	mg/kg	<0.729	<0.547	0.323 U*	3.91	4.78 U*	7.58	16.5	33.1 J	21.0 J
Manganese	mg/kg	7.13	1.07 J	107	71.8	<2.25	56.2	67.2	310 J	358 J
Molybdenum	mg/kg	<0.398	<0.299	<0.0996	0.114 J	<1.52	<0.120	<0.0996	0.114 J	0.227 J
Nickel	mg/kg	<0.330	<0.182	<0.102	3.69	1.28 J	6.26	7.56 J	18.8 J	15.2 J
Potassium	mg/kg	<126	<94.7	<31.6	40.9 J	2,720 U*	1,160	13,800	17,700 J	16,700
Selenium	mg/kg	<0.826	<0.620	<0.207	<0.571	<3.16	<0.207	<0.413	<0.170	1.78 J
Silver	mg/kg	<0.534	<0.255	<0.134	<0.121	<1.94	<0.146	0.259 J	0.259 J	0.276 J
Thallium	mg/kg	<1.02	<0.765	<0.255	<0.352	<4.25	<0.255	0.542 J	0.542 J	<1.09
Vanadium	mg/kg	<0.238	<0.583	3.76	6.76	<1.40	9.35	35.5	55.4	50.3 J
Zinc	mg/kg	<1.17	<0.729	0.966 U*	16.5 J	4.25 U*	24.7	19.0	65.4 J	61.4

See last page for notes.

Table 3 - Soil Analytical Results for SEP Metals
Watts Bar Fossil Plant

Sample Location		WBF-SB14								
Sample Date		12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21	12-Jul-21
Sample ID		WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021	WBF-SS-SB14-12.5/18.5-07122021
Parent Sample ID										
Sample Depth		12.5 - 18.5 ft	12.5 - 18.5 ft	12.5 - 18.5 ft	12.5 - 18.5 ft	12.5 - 18.5 ft	12.5 - 18.5 ft	12.5 - 18.5 ft	12.5 - 18.5 ft	12.5 - 18.5 ft
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Test Type		Step 1 - Exchangeable	Step 2 - Carbonate	Step 3 - Non-Crystalline	Step 4 - Metal Hydroxide	Step 5 - Organic	Step 6 - Acid/Sulfide	Step 7 - Residual	Steps 1 - 7 summation	Total
SEP Metals										
Aluminum	mg/kg	27.0 J	30.9 J	357	2,710	263	7,230	35,500	46,100 J	45,900
Antimony	mg/kg	<1.36	<1.02	<0.340	<0.546	<5.10	<0.340	0.956 J	0.956 J	0.289 J
Arsenic	mg/kg	<0.631	<0.473	0.571 J	0.860 J	<2.31	1.08	1.54	4.05 J	3.64
Barium	mg/kg	<0.582	1.21 J	1.76 J	18.1	18.1 J	69.2	354	463 J	500
Beryllium	mg/kg	<0.374	0.144 J	0.411	0.450	<0.382	0.253 J	0.842	2.10 J	1.03 J
Cadmium	mg/kg	<0.0777	<0.0400	0.0133 J	0.0643 J	<0.194	0.0631 J	0.208 J	0.349 J	0.282 J
Calcium	mg/kg	985 J	142 J	16.0 J	60.1 J	33.9 U*	75.8 J	1,210 J	2,530 J	4,370
Chromium	mg/kg	0.714 J	<0.255	0.871	5.10	3.10 J	7.10	24.4	41.3 J	29.3 J
Cobalt	mg/kg	<0.218	<0.229	3.81	3.05	<0.728	2.62 J	2.28 J	11.8 J	11.8 J
Copper	mg/kg	<0.388	<0.582	1.50 J	3.56	<1.46	3.75	1.49 J	10.3 J	7.82 J
Iron	mg/kg	15.5 J	<10.6	1,970	7,550	<53.4	8,580	7,350	25,500 J	20,300 J
Lead	mg/kg	<0.534	<0.400	2.72	2.49	<2.00	1.31	3.86	10.4	12.1
Lithium	mg/kg	<0.728	<0.546	0.357 U*	3.73	3.07 U*	7.46	18.7	33.3 J	19.9 J
Manganese	mg/kg	19.6	6.48	202	110	<2.24	63.8	76.8	479	474 J
Molybdenum	mg/kg	<0.398	<0.299	<0.0995	0.119 J	<1.52	<0.120	<0.0995	0.119 J	0.235 J
Nickel	mg/kg	0.379 J	<0.182	0.400 J	3.95	1.47 J	6.11	8.19 J	20.5 J	14.4 J
Potassium	mg/kg	<126	<94.6	<31.5	40.9 J	2,600 U*	1,410	16,100	20,100 J	17,000
Selenium	mg/kg	<0.825	<0.619	<0.206	<0.570	<3.15	<0.206	0.293 J	0.293 J	1.52 J
Silver	mg/kg	<0.534	<0.255	<0.133	<0.121	<1.94	<0.146	0.265 J	0.265 J	0.254 J
Thallium	mg/kg	<1.02	<0.764	<0.255	<0.352	<4.25	<0.255	<1.09	<0.180	<1.09
Vanadium	mg/kg	<0.238	<0.582	3.24	6.63	1.59 J	9.22	40.6	61.3 J	45.8 J
Zinc	mg/kg	1.54 J	1.45 J	2.38 U*	18.3 J	4.69 U*	24.7	23.1	76.2 J	68.3

Notes:

15.2	measured concentration
<0.03	analyte was not detected at a concentration greater than the laboratory reporting limit.
ft	feet
ID	Identification
-	Parameter not analyzed / not available.
J	quantitation is approximate due to limitations identified during data validation
mg/kg	milligrams per kilogram
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.
SEP	Sequential Extraction Procedure

Stantec

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Table 4 - Pore Water Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-TW03				WBF-TW04			
Sample Date		17-Sep-19	17-Sep-19	30-Mar-21	5-May-21	18-Sep-19	31-Mar-21	31-Mar-21	6-May-21
Sample ID		WBF-PW-TW03-20190917	WBF-PW-DUP01-20190917	WBF-PW-TW03-03302021	WBF-PW-TW03-05052021	WBF-PW-TW04-20190918	WBF-PW-TW04-03312021	WBF-PW-FD-03312021	WBF-PW-TW04-05062021
Sample Depth		25.2 ft	25.2 ft	25.2 ft	25.2 ft	20.3 ft	17.7 ft	17.7 ft	17.7 ft
Sample Type	Units	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample
Total Metals									
Aluminum	ug/L	-	-	19.0 J	98.8	-	941	966	153 J
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	4.15 U*	5.39	5.40	10.9
Arsenic	ug/L	71.6	73.4	80.6	68.5	58.7	102	104	111
Barium	ug/L	45.3	46.7	44.8	42.8	165	66.1	66.3	88.3
Beryllium	ug/L	0.942 U*	0.646 U*	<0.182	<0.182	0.620 U*	<0.182	<0.182	<0.182
Boron	ug/L	6,220	6,360	4,250 J	3,440	6,000	2,340 J	2,370 J	5,980
Cadmium	ug/L	<0.125	<0.125	<0.217	<0.217	0.466 J	0.364 J	0.298 J	0.224 J
Calcium	ug/L	484,000	489,000	231,000	267,000	482,000	71,800	72,900	201,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	2.58	2.50	2.40	<1.53
Cobalt	ug/L	1.15	1.08	1.60	2.47	0.369 U*	0.479 J	0.494 J	<0.134
Copper	ug/L	1.82 U*	1.73 U*	3.40	<0.627	2.58 U*	4.47	4.90	0.998 J
Iron	ug/L	46,200	46,500	39,300	49,800	488	681	690	45.1 J
Lead	ug/L	0.391 U*	0.364 U*	0.245 J	0.164 J	1.76	1.85	1.84	0.156 J
Lithium	ug/L	124	121	117	97.7	245	14.5	14.9	97.2
Magnesium	ug/L	-	-	19,800	22,200	-	7,510	7,670	10,100
Manganese	ug/L	4,990	4,990	1,210	1,440	61.6	62.6	63.4	64.8
Mercury	ug/L	<0.101	<0.101	<0.130	<0.130	<0.101	<0.130	<0.130	<0.130
Molybdenum	ug/L	135	136	156	209	1,360	119	120	590
Nickel	ug/L	4.34 U*	6.68 U*	3.23	4.63	3.09	1.37	1.36	0.515 J
Potassium	ug/L	-	-	24,000	22,000	-	11,400	11,500	39,100
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	3.68 J	7.69	8.25	6.76
Silicon	ug/L	-	-	16,800	16,400	-	5,430	5,530	3,360
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	-	-	12,100	8,270	-	36,100	37,100	42,400
Thallium	ug/L	<0.148	<0.148	0.249 J	<0.148	0.791 U*	4.78	4.84	4.29
Vanadium	ug/L	<0.991	1.20	<0.991	<0.991	84.5	94.9	96.0	141
Zinc	ug/L	13.4 U*	13.8 U*	9.30	7.82	9.01 U*	11.2	11.3	80.7
Dissolved Metals									
Aluminum	ug/L	-	-	<12.5	<12.5	-	103	88.5	170 J
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	4.28 U*	5.00	5.15	10.7
Arsenic	ug/L	71.9	73.3	65.8	60.8	52.2	92.5	94.2	113
Barium	ug/L	45.4	46.4	45.5	41.6	158	55.3	55.1	89.8
Beryllium	ug/L	0.853 U*	0.537 U*	<0.182	<0.182	0.356 U*	<0.182	<0.182	<0.182
Boron	ug/L	6,420	6,560	4,470	3,470	5,940	2,220	2,210	6,190
Cadmium	ug/L	<0.125	<0.125	<0.217	<0.217	0.227 J	0.221 J	<0.217	<0.217
Calcium	ug/L	504,000	507,000	242,000	267,000	477,000	69,200	69,100	199,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	1.07	0.932	1.61	2.30	0.131 U*	0.187 J	<0.134	<0.134
Copper	ug/L	1.08 U*	1.04 U*	1.54 J	<0.627	1.11 J	3.00	2.85	1.12 U*
Iron	ug/L	47,400	47,100	36,800	48,400	50.4	72.1	58.7	59.1
Lead	ug/L	<0.128	<0.128	<0.128	<0.128	0.186 U*	0.245 J	0.186 J	0.165 J
Lithium	ug/L	119	125	122	97.6	235	12.9	13.1	98.7
Magnesium	ug/L	-	-	20,600	22,300	-	7,240	7,150	10,200
Manganese	ug/L	5,300	5,350	1,260	1,460	52.7	52.0	51.2	65.7
Mercury	ug/L	<0.101	<0.101	<0.130	<0.130	<0.101	<0.130	<0.130	<0.130
Molybdenum	ug/L	139	141	165	210	1,340	116	115	592
Nickel	ug/L	4.95 U*	4.08 U*	3.33	4.56	0.686 U*	0.636 J	<0.336	0.573 J
Potassium	ug/L	-	-	25,300	22,100	-	10,700	10,700	39,000
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	4.82 J	7.94	7.52	6.92
Silicon	ug/L	-	-	17,300	16,200	-	4,330	4,440	3,360
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	-	-	13,200	8,500	-	35,200	34,900	32,500
Thallium	ug/L	<0.148	<0.148	0.241 J	0.182 J	0.768 U*	4.43	4.42	4.26
Vanadium	ug/L	<0.991	<0.991	<0.991	<0.991	75.3	86.3	86.4	141
Zinc	ug/L	13.1 U*	13.1 U*	7.77	6.81 U*	3.57 U*	3.63 J	3.56 J	6.62 U*
Radiological Parameters									
Radium-226	pCi/L	0.0672 +/-(0.0806)U	0.0382 +/-(0.0673)U	1.05 +/-(0.725)	0.804 +/-(0.649)U	0.428 +/-(0.127)	0.269 +/-(0.479)U	0.515 +/-(0.476)U	0.546 +/-(0.576)U
Radium-228	pCi/L	0.270 +/-(0.200)U	0.205 +/-(0.210)U	0.370 +/-(0.265)	0.172 +/-(0.316)U	0.577 +/-(0.288)	0.210 +/-(0.336)U	0.411 +/-(0.426)U	0.590 +/-(0.538)U
Radium-226+228	pCi/L	0.337 +/-(0.216)U	0.243 +/-(0.221)U	1.42 +/-(0.772)	0.976 +/-(0.722)U	1.00 +/-(0.315)	0.479 +/-(0.585)U	0.926 +/-(0.639)U	1.14 +/-(0.788)U
Anions									
Chloride	mg/L	10.6	9.63	8.92	8.57	6.69	20.7	20.0	15.2
Fluoride	mg/L	0.0766 J	0.0791 J	0.0588 J	0.0660 J	0.137 J	0.164	0.156	0.145
Sulfate	mg/L	913	859	281	422	1,160	62.6	60.7	443
General Chemistry									
Alkalinity, Bicarbonate	mg/L	-	-	345	305	-	212	199	145
Alkalinity, Carbonate	mg/L	-	-	<5.00	<5.00	-	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	-	-	345	305	-	212	199	145
Ammonia Nitrogren	mg/L	-	-	0.835	0.764	-	0.962	0.955	0.319
Carbon, dissolved organic	mg/L	-	-	0.600 J	0.628 J	-	5.78	5.74	1.88
Depth to Water	ft	18.75	-	15.45	16.36	14.44	11.03	-	11.88
Dissolved Oxygen	%	5.0	-	2.4	0.9	3.4	51.0	-	2.3
Dissolved Oxygen	mg/L	0.44	-	0.22	0.08	0.31	5.11	-	0.25
Ethane	ug/L	-	-	<0.291	<0.291	-	<0.291	<0.291	<0.291
Ferrous Iron - Field	mg/L	-	-	5.5	5.0	-	<0.5	-	0
Flow Rate	mL/min	-	-	170	180	-	100	-	100
Methane	ug/L	-	-	8.26	7.73	-	0.723 U*	0.727 U*	6.03
Nitrate-Nitrite	mg/L	-	-	<0.0650	<0.0650	-	1.58	1.50	1.00
ORP	mV	-104.1	-	-86.4	-109.8	-1.2	172.7	-	206.0
pH (field)	SU	6.79	-	6.66	6.62	9.41	7.65	-	7.44
Propane	ug/L	-	-	<0.380	<0.380	-	<0.380	<0.380	<0.380
Specific Cond. (Field)	uS/cm	2,119	-	1,221	986	2,087	535.6	-	1,017
Sulfide	mg/L	-	-	<1.34	<1.34	-	<1.34	<1.34	<1.34
Temperature, Water (C)	DEG C	21.6	-	18.4	16.7	20.1	15.1	-	15.7
Total Dissolved Solids	mg/L	1,840	1,910	917	963	1,900	363	355	968
Total Organic Carbon	mg/L	0.837 J	0.934 J	0.671 J	0.705 J	1.15	5.55	5.64	1.97
Turbidity, field	NTU	13.4	-	48.0	16.3	20.6	19.0	-	2.02

See last page for notes.

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Table 4 - Pore Water Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-TW05			
Sample Date		17-Sep-19	1-Apr-21	3-May-21	3-May-21
Sample ID		WBF-PW-TW05-20190917	WBF-PW-TW05-04012021	WBF-PW-FD-05032021	WBF-PW-TW05-05032021
Sample Depth		19.1 ft	17.7 ft	17.7 ft	17.7 ft
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample
Total Metals					
Aluminum	ug/L	-	19.9 J	31.4	34.1
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	17.4	5.04	5.40	6.03
Barium	ug/L	37.6	19.5	18.5	19.1
Beryllium	ug/L	0.976 U*	<0.182	<0.182	<0.182
Boron	ug/L	269	264 U*	264	285
Cadmium	ug/L	<0.125	<0.217	<0.217	<0.217
Calcium	ug/L	470,000	382,000	321,000	347,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	3.93	4.13	5.97	6.17
Copper	ug/L	1.15 U*	<0.627	<0.627	<0.627
Iron	ug/L	94,900	91,400	101,000	103,000
Lead	ug/L	0.165 U*	<0.128	<0.128	<0.128
Lithium	ug/L	50.4 U*	40.4	54.9	56.9
Magnesium	ug/L	-	48,000	44,300	46,700
Manganese	ug/L	31,600	17,000	9,950	10,300
Mercury	ug/L	<0.101	<0.130	<0.130	<0.130
Molybdenum	ug/L	0.791 U*	<0.610	<0.610	<0.610
Nickel	ug/L	9.25 J	8.21	11.4	11.5
Potassium	ug/L	-	17,600	18,300	19,400
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	-	20,700	21,300	21,900
Silver	ug/L	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	-	15,200	9,840	10,600
Thallium	ug/L	<0.148	<0.148	0.182 U*	0.224 U*
Vanadium	ug/L	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	23.6	18.6	21.1	21.2
Dissolved Metals					
Aluminum	ug/L	-	<12.5	14.7 J	15.4 J
Antimony	ug/L	0.634 U*	<0.378	<0.378	<0.378
Arsenic	ug/L	18.9	4.95	5.61	5.55
Barium	ug/L	39.7	21.4	18.5	19.0
Beryllium	ug/L	0.474 U*	<0.182	0.211 J	<0.182
Boron	ug/L	260	265 U*	280	276
Cadmium	ug/L	<0.125	<0.217	<0.217	<0.217
Calcium	ug/L	490,000	396,000	336,000	335,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	4.04	4.20	6.22	6.21
Copper	ug/L	1.34 U*	<0.627	<0.627	<0.627
Iron	ug/L	101,000	93,400	103,000	105,000
Lead	ug/L	<0.128	<0.128	<0.128	<0.128
Lithium	ug/L	54.9 U*	41.9	56.8	57.3
Magnesium	ug/L	-	49,500	45,600	46,100
Manganese	ug/L	32,800	17,500	10,500	10,700
Mercury	ug/L	<0.101	<0.130	<0.130	<0.130
Molybdenum	ug/L	0.920 J	<0.610	<0.610	<0.610
Nickel	ug/L	10.7 J	8.47	11.8	11.5
Potassium	ug/L	-	18,100	19,200	19,500
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	-	21,500	22,100	22,400
Silver	ug/L	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	-	16,000	10,300	10,300
Thallium	ug/L	<0.148	<0.148	0.607 J	0.174 J
Vanadium	ug/L	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	25.0	20.6	21.6	21.6
Radiological Parameters					
Radium-226	pCi/L	0.237 +/-(0.108)	0.215 +/-(0.439)U	0.00235 +/-(0.282)U	0.00135 +/-(0.275)U
Radium-228	pCi/L	0.611 +/-(0.299)	1.22 +/-(0.711)J	0.165 +/-(0.272)U	0.342 +/-(0.400)U
Radium-226+228	pCi/L	0.848 +/-(0.318)	1.44 +/-(0.835)J	0.167 +/-(0.392)U	0.344 +/-(0.485)U
Anions					
Chloride	mg/L	9.26	5.91	5.42	5.56
Fluoride	mg/L	<0.0658	<0.0260	<0.0260	0.0308 J
Sulfate	mg/L	1,430	1,120	1,140	1,220
General Chemistry					
Alkalinity, Bicarbonate	mg/L	-	38.4 J	<5.00	<5.00
Alkalinity, Carbonate	mg/L	-	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	-	38.4 J	<5.00	<5.00
Ammonia Nitrogren	mg/L	-	1.13	1.18	1.18
Carbon, dissolved organic	mg/L	-	1.30	1.17	1.19
Depth to Water	ft	15.27	12.30	-	12.80
Dissolved Oxygen	%	5.5	8.1	-	1.9
Dissolved Oxygen	mg/L	0.44	0.80	-	0.18
Ethane	ug/L	-	0.514 J	0.318 J	0.313 J
Ferrous Iron - Field	mg/L	-	4.5	-	1.5
Flow Rate	mL/min	-	120	-	150
Methane	ug/L	-	76.4	89.3	81.9
Nitrate-Nitrite	mg/L	-	<0.0650	<0.0650	<0.0650
ORP	mV	-8.4	53.3	-	51.7
pH (field)	SU	5.90	5.68	-	5.39
Propane	ug/L	-	<0.380	<0.380	<0.380
Specific Cond. (Field)	uS/cm	2,365	1,953	-	1,526
Sulfide	mg/L	-	<6.70	<6.70	<13.4
Temperature, Water (C)	DEG C	25.3	13.1	-	18.5
Total Dissolved Solids	mg/L	2,490	1,810	1,810	1,780
Total Organic Carbon	mg/L	1.81	1.66	1.06	1.12
Turbidity, field	NTU	6.83	25.2	-	17.2

Notes:

15.2	measured concentration did not exceed the indicated standard
<0.03	analyte was not detected at a concentration greater than the laboratory reporting limit.
ft	feet
%	percent
Cond.	conductance
DEG C	degrees Celsius
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
mL/min	milliliters per minute
mV	millivolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
pCi/L	picocuries per Liter
SU	Standard Units
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter
uS/cm	microSiemens per centimeter

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Table 5 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-102									
Sample Date		28-Aug-19	30-Oct-19	8-Jan-20	3-Mar-20	27-Apr-20	7-Jul-20	24-Mar-21	24-Mar-21	18-Aug-21	21-Apr-22
Sample ID		WBF-GW-006-20190828	WBF-GW-006-20191030	WBF-GW-006-20200108	WBF-GW-006-20200303	WBF-GW-006-20200427	WBF-GW-006-20200707	WBF-GW-WBF-102-03242021	WBF-GW-FD02-03242021	WBF-GW-WBF-102-08182021	WBF-GW-WBF-102-04212022
Parent Sample ID									WBF-GW-WBF-102-03242021		
Sample Depth		23 ft	23 ft	23 ft	23 ft	23 ft	23 ft	23 ft	23 ft	23 ft	23 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	<12.5	<12.5	<12.5	<15.5
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.506
Arsenic	ug/L	0.495 J	0.468 J	0.866 U*	0.483 J	0.464 U*	0.393 J	<0.313	0.564 J	<0.313	0.369 J
Barium	ug/L	61.5	60.6	36.7	50.5	52.2	42.9	24.7	25.7	23.7	39.3
Beryllium	ug/L	<0.182	<0.182	0.486 U*	<0.182	<0.182	0.261 U*	<0.182	0.256 J	<0.182	<0.274
Boron	ug/L	105 U*	90.8	60.2 J	60.5 J	42.0 J	58.6 J	71.2 U*	90.2 U*	88.9	72.7 J
Cadmium	ug/L	0.178 J	0.127 J	<0.217	<0.217	<0.217	<0.217	<0.217	0.232 J	<0.217	<0.217
Calcium	ug/L	309,000	212,000	89,300	99,300	131,000	220,000	98,900 J	103,000 J	119,000	151,000
Chromium	ug/L	<1.53	2.74 U*	<1.53	<1.53	<1.53	<1.53	1.95 J	2.56	2.39	1.91 J
Cobalt	ug/L	11.1	1.15	<0.134	<0.134	<0.134	<0.134	<0.134	0.195 J	<0.134	<0.261
Copper	ug/L	1.02 J	2.06 U*	1.71 U*	0.670 J	0.804 U*	<0.627	<0.627	<0.627	<0.627	<1.14
Iron	ug/L	-	-	-	-	-	-	20.3 U*	<19.5	27.5 J	<27.7
Lead	ug/L	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128	0.207 J	<0.128	0.199 J
Lithium	ug/L	3.46 U*	<3.39	4.23 J	<3.39	5.63 U*	<3.39	<3.39	<3.39	<3.39	<0.831
Magnesium	ug/L	55,800	31,000	13,100	12,800	18,000	34,100	16,000	16,800	16,900	22,800
Manganese	ug/L	-	-	-	-	-	-	1.44 U*	1.19 U*	3.62 U*	2.43 U*
Mercury	ug/L	<0.101	0.564	<0.101	<0.101	0.543	1.23	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	0.713 J	4.32 J	2.86 J	1.62 U*	<0.610	0.656 J	0.787 J	<0.610	0.648 J
Nickel	ug/L	2.21	1.31 U*	1.27 U*	<0.336	0.362 U*	0.726 U*	<0.336	<0.336	0.397 J	<0.517
Potassium	ug/L	1,580	2,350	3,210	2,720	2,690	1,560	1,260	1,460	1,320	2,320
Selenium	ug/L	<1.51	5.48	<1.51	<1.51	2.48 J	2.45 J	<1.51	1.56 J	2.19 J	1.89 J
Silicon	ug/L	-	-	-	-	-	-	2,340 J	2,690 J	3,860	4,090 J
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.223
Sodium	ug/L	11,800	58,800	7,430	9,430	12,300	14,100	6,830	6,500	6,150	13,100
Thallium	ug/L	<0.148	<0.148	<0.148	0.237 J	0.148 U*	0.263 J	0.230 J	0.651 J	<0.148	0.589 J
Vanadium	ug/L	1.57	1.68	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.776
Zinc	ug/L	6.25 U*	7.24 U*	<3.22	<3.22	<3.22	4.14 J	<3.22	<3.22	<3.22	3.07 J
Radiological Parameters											
Radium-226	pCi/L	0.477 +/-(0.594)U	0.553 +/-(0.462)U	-0.225 +/-(0.407)U	0.910 +/-(0.681)U	0.310 +/-(0.517)U	0.475 +/-(0.565)U	0.0420 +/-(0.223)U	0.0932 +/-(0.256)U	-0.141 +/-(0.332)U	-0.0769 +/-(0.303)U
Radium-228	pCi/L	0.225 +/-(0.389)U	-0.0587 +/-(0.214)U	0.213 +/-(0.328)U	0.484 +/-(0.425)U	0.290 +/-(0.322)U	0.474 +/-(0.381)U	0.657 +/-(0.448)U*	0.230 +/-(0.363)U	0.150 +/-(0.236)U	0.327 +/-(0.303)U
Radium-226+228	pCi/L	0.702 +/-(0.710)U	0.553 +/-(0.509)U	0.213 +/-(0.522)U	1.39 +/-(0.802)U	0.600 +/-(0.609)U	0.949 +/-(0.681)U	0.699 +/-(0.501)U*	0.323 +/-(0.445)U	0.150 +/-(0.407)U	0.327 +/-(0.429)U
Anions											
Chloride	mg/L	19.8	18.5	4.53	8.42	12.2	25.8	5.49	5.29	4.15	37.8
Fluoride	mg/L	0.0439 J	0.0415 U*	0.0989 J	0.0816 J	0.126 U*	0.0629 U*	0.0515 J	0.0450 J	0.0799 U*	0.0611 J
Sulfate	mg/L	664	545	90.2 J	141	194	452	110	104	161	179
General Chemistry											
Alkalinity, Bicarbonate	mg/L	367	246	226	210	252	301	247	226	201	280
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Total Dissolved Solids	mg/L	1,280	1,140	386	464	562	1,040	433	459	460	573

See notes on last page.

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Table 5 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-103									
Sample Date		27-Aug-19	29-Oct-19	7-Jan-20	3-Mar-20	28-Apr-20	7-Jul-20	23-Mar-21	17-Aug-21	21-Apr-22	18-Oct-22
Sample ID		WBF-GW-007-20190827	WBF-GW-007-20191029	WBF-GW-007-20200107	WBF-GW-007-20200303	WBF-GW-007-20200428	WBF-GW-007-20200707	WBF-GW-WBF-103-03232021	WBF-GW-WBF-103-08172021	WBF-GW-WBF-103-04212022	WBF-GW-WBF-103-10182022
Parent Sample ID											
Sample Depth		19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft	19.5 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	107	25.8 J	<15.5	17.0 J
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.506	<0.506
Arsenic	ug/L	<0.323	0.324 J	0.781 U*	<0.313	<0.313	<0.313	<0.313	<0.313	0.373 J	<0.282
Barium	ug/L	120	155	76.4	83.2	70.5	81.7	65.8	73.0	76.1	73.0
Beryllium	ug/L	<0.182	<0.182	0.235 U*	<0.182	<0.182	<0.182	<0.182	<0.182	<0.274	<0.274
Boron	ug/L	80.2 U*	52.2 J	58.8 J	<38.6	<38.6	41.8 J	82.7 U*	61.2 J	79.5 J	<60.1
Cadmium	ug/L	<0.125	<0.125	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217
Calcium	ug/L	21,600	36,400	40,200	17,800	20,600	17,600	22,700	14,300	44,200	12,800
Chromium	ug/L	<1.53	2.04 U*	<1.53	1.55 J	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	1.03	2.34	4.44	1.12	0.903 U*	0.905	0.607	0.434 J	0.827	0.317 J
Copper	ug/L	<0.627	1.22 U*	<0.627	2.92	<0.627	<0.627	<0.627	<0.627	<1.14	<1.14
Iron	ug/L	-	-	-	-	-	-	202	27.4 U*	38.5 J	<27.7
Lead	ug/L	<0.128	<0.128	<0.128	6.21	<0.128	<0.128	<0.128	<0.128	<0.167	<0.167
Lithium	ug/L	<3.39	<3.39	<3.39	<3.39	4.97 U*	<3.39	<3.39	<3.39	<0.831	<0.831
Magnesium	ug/L	4,670	7,390	8,290	4,110	4,660	4,030	5,920	3,190	8,640	3,240
Manganese	ug/L	-	-	-	-	-	-	2,400	605	1,720 J	606
Mercury	ug/L	<0.101	<0.101	<0.101	<0.101	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	2.70	3.16	3.40 U*	1.66	1.38 U*	2.33 U*	1.29	1.34	1.46	1.14
Potassium	ug/L	4,450	6,530	7,500	4,060	4,050	3,520	5,220	3,170	5,960	2,920
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<0.739	0.930 J
Silicon	ug/L	-	-	-	-	-	-	2,930	3,590	3,090 J	3,840
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.223	<0.223
Sodium	ug/L	5,830	11,600	10,200	5,370	5,540	6,220	4,150	4,890	13,900	5,050
Thallium	ug/L	<0.148	<0.148	0.649 U*	<0.148	<0.148	<0.148	<0.148	0.172 J	<0.472	<0.472
Vanadium	ug/L	0.999 J	1.22 U*	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.776	<0.776
Zinc	ug/L	6.70 U*	8.94 U*	4.66 J	9.38	<3.22	6.65	<3.22	<3.22	<2.88	<2.88
Radiological Parameters											
Radium-226	pCi/L	0.539 +/-(0.601)U	0.543 +/-(0.584)U	0.440 +/-(0.542)U	0.537 +/-(0.554)U	0.561 +/-(0.480)U	-0.0548 +/-(0.389)U	0.0654 +/-(0.236)U	-0.0371 +/-(0.231)U	0.237 +/-(0.398)U	-0.0695 +/-(0.200)U
Radium-228	pCi/L	0.208 +/-(0.347)U	0.302 +/-(0.310)U	0.134 +/-(0.352)U	0.215 +/-(0.435)U	-0.00991 +/-(0.351)U	0.430 +/-(0.354)U	0.758 +/-(0.386)U*	-0.0227 +/-(0.227)U	0.321 +/-(0.387)U	0.540 +/-(0.555)U
Radium-226+228	pCi/L	0.747 +/-(0.694)U	0.845 +/-(0.661)U	0.574 +/-(0.646)U	0.752 +/-(0.704)U	0.561 +/-(0.594)U	0.430 +/-(0.526)U	0.823 +/-(0.452)U*	0.000 +/-(0.324)U	0.558 +/-(0.555)U	0.540 +/-(0.590)U
Anions											
Chloride	mg/L	5.63	4.51	4.58	5.51	5.26	5.63	5.30	4.72	4.41	6.68
Fluoride	mg/L	<0.0263	0.0443 U*	0.0362 J	0.0276 J	0.0450 U*	0.0669 U*	<0.0260	0.0446 U*	0.0324 J	0.0562 J
Sulfate	mg/L	84.7	71.3	86.6	67.4	61.6	60.8	50.3	32.9	102	34.5
General Chemistry											
Alkalinity, Bicarbonate	mg/L	60.4	78.2	73.5	36.7	44.4	36.7	37.0	28.8	77.6	26.6
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<2.60
Total Dissolved Solids	mg/L	184	196	230	162	183	152	147	97.0	223	109

See notes on last page.

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Table 5 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-104											
Sample Date		27-Aug-19	29-Oct-19	7-Jan-20	4-Mar-20	28-Apr-20	8-Jul-20	8-Jul-20	24-Mar-21	19-Aug-21	20-Apr-22	19-Oct-22	19-Oct-22
Sample ID		WBF-GW-008-20190827	WBF-GW-008-20191029	WBF-GW-008-20200107	WBF-GW-008-20200304	WBF-GW-008-20200428	WBF-GW-008-20200708	WBF-GW-DUP01-20200708	WBF-GW-WBF-104-03242021	WBF-GW-WBF-104-08192021	WBF-GW-WBF-104-04202022	WBF-GW-WBF-104-10192022	WBF-GW-FD02-10192022
Parent Sample ID								WBF-GW-008-20200708					WBF-GW-WBF-104-10192022
Sample Depth		26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft	26.4 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program		
Total Metals													
Aluminum	ug/L	-	-	-	-	-	-	-	26.9 U*	45.0	32.6	58.1	58.6
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.506	<0.506	0.510 J
Arsenic	ug/L	0.701 J	0.594 J	0.872 U*	0.318 J	0.559 U*	0.685 U*	0.658 U*	0.475 J	0.502 U*	0.517 J	<0.282	0.309 J
Barium	ug/L	21.1	27.3	23.2	43.4	38.3	33.8	34.7	22.2	22.5	19.8	19.7	19.9
Beryllium	ug/L	0.182 J	<0.182	0.198 U*	0.229 J	0.200 U*	0.309 J	0.332 J	0.225 J	0.240 J	<0.274	<0.274	0.281 J
Boron	ug/L	4,940	3,750	1,910	3,570	3,420	4,260 J	4,500 J	3,930	5,150	4,700	5,320	5,150
Cadmium	ug/L	7.60	10.5	6.08	7.28	6.87	8.14	8.32	8.60	9.08	9.65	10.9	11.0
Calcium	ug/L	581,000	442,000	208,000	450,000	456,000	576,000	587,000	523,000 J	604,000	534,000	496,000	510,000
Chromium	ug/L	<1.53	1.70 U*	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	437	379	167	256	249	365	373	460	541	598	596	608
Copper	ug/L	1.06 J	2.10 U*	<0.627	<0.627	0.878 U*	<0.627	<0.627	<0.627	<0.627	<1.14	<1.14	<1.14
Iron	ug/L	-	-	-	-	-	-	-	177	382	268	191	197
Lead	ug/L	0.232 J	0.178 J	<0.128	<0.128	0.218 U*	0.214 U*	0.217 U*	<0.128	<0.128	<0.167	<0.167	<0.167
Lithium	ug/L	5.98 U*	4.06 J	<3.39	<3.39	7.07 U*	3.59 J	4.10 J	<3.39	<3.39	3.54 J	3.92 J	3.83 J
Magnesium	ug/L	69,700	53,900	25,500	52,800	52,800	64,500	65,700	66,400	71,800	73,100	69,000	69,200
Manganese	ug/L	-	-	-	-	-	-	-	68,500	76,300	77,700	81,400	83,100
Mercury	ug/L	<0.101	<0.101	<0.101	<0.101	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	65.6	66.9	32.2	51.0	50.2	67.5	69.3	76.3	93.5	98.9	105	106
Potassium	ug/L	1,610	1,660	909	1,340	1,390	1,640	1,670	1,620	1,790	1,740	2,010	2,050
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<0.739	<0.739	<0.739
Silicon	ug/L	-	-	-	-	-	-	-	17,000 J	19,200	21,700	21,300	21,800
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.223	<0.223	<0.223
Sodium	ug/L	29,800	35,700	14,500	23,300	22,200	26,200	26,000	26,800	28,000	30,800	27,600	27,900
Thallium	ug/L	<0.148	<0.148	<0.148	<0.148	0.231 U*	0.209 U*	0.250 U*	0.158 J	<0.148	<0.472	<0.472	<0.472
Vanadium	ug/L	1.02	1.18 U*	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.776	<0.776	<0.776
Zinc	ug/L	102	113	48.0	91.1	87.5	125	126	145	185	174	241	245
Radiological Parameters													
Radium-226	pCi/L	0.541 +/-(0.608)U	0.325 +/-(0.383)U	-0.0750 +/-(0.402)U	1.20 +/-(0.727	0.309 +/-(0.502)U	0.500 +/-(0.523)U	0.370 +/-(0.552)U	0.182 +/-(0.332)U	0.623 +/-(0.542)U	-0.0650 +/-(0.313)U	0.481 +/-(0.398)U	0.0626 +/-(0.240)U
Radium-228	pCi/L	-0.0176 +/-(0.367)U	0.150 +/-(0.271)U	0.0847 +/-(0.313)U	0.166 +/-(0.354)U	0.449 +/-(0.298	0.502 +/-(0.415)U	0.903 +/-(0.434	0.538 +/-(0.411)U	0.0202 +/-(0.323)U	0.986 +/-(0.589	0.321 +/-(0.321)U	0.354 +/-(0.386)U
Radium-226+228	pCi/L	0.541 +/-(0.710)U	0.476 +/-(0.469)U	0.0847 +/-(0.510)U	1.36 +/-(0.808)J	0.758 +/-(0.584)J	1.00 +/-(0.668)U	1.27 +/-(0.702)J	0.721 +/-(0.528)U	0.643 +/-(0.631)U	0.986 +/-(0.667)J	0.802 +/-(0.511)U	0.417 +/-(0.454)U
Anions													
Chloride	mg/L	5.03	5.53	2.95	5.54	5.55	7.08	7.06	6.89	7.50	11.1	6.93	6.84
Fluoride	mg/L	<0.0658	0.0411 U*	0.0777 J	0.0368 J	0.0622 U*	0.149 U*	0.158 U*	<0.0650	0.0650 UJ	0.0328 U*	<0.0650	<0.0650
Sulfate	mg/L	1,970	1,380	726	1,510	1,280	1,750	1,770	1,560	1,750	1,860	1,720	1,700
General Chemistry													
Alkalinity, Bicarbonate	mg/L	70.3	60.7	41.9	49.4	55.5	55.1	54.4	48.4	46.8	41.7	46.1	50.1
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<2.60	<2.60
Total Dissolved Solids	mg/L	2,720	2,130	1,050	1,720	2,000	2,810	2,720	1,350	2,320	2,450	2,380	2,570

See notes on last page.

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Table 5 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-105									
Sample Date		28-Aug-19	30-Oct-19	8-Jan-20	4-Mar-20	28-Apr-20	7-Jul-20	25-Mar-21	19-Aug-21	20-Apr-22	17-Oct-22
Sample ID		WBF-GW-009-20190828	WBF-GW-009-20191030	WBF-GW-009-20200108	WBF-GW-009-20200304	WBF-GW-009-20200428	WBF-GW-009-20200707	WBF-GW-WBF-105-03252021	WBF-GW-WBF-105-08192021	WBF-GW-WBF-105-04202022	WBF-GW-WBF-105-10172022
Parent Sample ID											
Sample Depth		35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft	35.1 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	CCR Program	
Total Metals											
Aluminum	ug/L	-	-	-	-	-	-	<12.5	<12.5	<15.5	<15.5
Antimony	ug/L	0.563 U*	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.506	0.584 J
Arsenic	ug/L	1.32	1.54	1.70 U*	1.35	1.27 U*	1.39	1.24	1.32 U*	1.22	1.31
Barium	ug/L	112	101	110	97.4	101	96.1	97.1	99.2	95.0	92.0
Beryllium	ug/L	<0.182	<0.182	0.238 U*	<0.182	<0.182	0.347 U*	<0.182	<0.182	<0.274	<0.274
Boron	ug/L	52.3 U*	56.1 J	<38.6	49.7 J	47.8 J	47.8 J	<38.6	114 U*	<60.1	64.5 J
Cadmium	ug/L	<0.125	<0.125	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217
Calcium	ug/L	127,000	135,000	132,000	133,000	140,000	128,000	133,000	139,000	136,000	130,000
Chromium	ug/L	<1.53	2.04 U*	<1.53	<1.53	<1.53	10.9 U*	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	0.151 J	0.113 J	0.262 U*	<0.134	0.212 U*	<0.134	<0.134	<0.134	<0.261	<0.261
Copper	ug/L	0.930 J	1.02 U*	0.736 U*	<0.627	<0.627	<0.627	<0.627	<0.627	<1.14	<1.14
Iron	ug/L	-	-	-	-	-	-	66,100	64,200	61,700	61,600
Lead	ug/L	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128	<0.128	<0.167	<0.167
Lithium	ug/L	5.46 U*	<3.39	<3.39	<3.39	6.41 U*	<3.39	<3.39	<3.39	1.16 J	<0.831
Magnesium	ug/L	19,100	19,400	20,600	19,300	19,200	18,100	19,000	19,700	20,100	19,100
Manganese	ug/L	-	-	-	-	-	-	3,800	3,970	3,520	3,720
Mercury	ug/L	<0.101	<0.101	<0.101	<0.101	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	1.40 J	<0.610	<0.610	<0.610	0.615 J
Nickel	ug/L	<0.336	<0.336	0.865 U*	<0.336	<0.336	0.360 U*	<0.336	<0.336	<0.517	<0.517
Potassium	ug/L	894	915	857	832	911	891	876	880	877	868
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<0.739	<0.739
Silicon	ug/L	-	-	-	-	-	-	15,600	16,700	17,600	16,800
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.223	<0.223
Sodium	ug/L	29,700	30,500	29,400	29,300	29,600	27,500	30,800	28,800	30,100	28,700
Thallium	ug/L	<0.148	<0.148	<0.148	<0.148	<0.148	0.294 J	<0.148	0.409 U*	<0.472	<0.472
Vanadium	ug/L	<0.991	1.01	<0.991	<0.991	<0.991	1.40	<0.991	<0.991	<0.776	<0.776
Zinc	ug/L	4.51 U*	<3.22	<3.22	<3.22	<3.22	4.39 J	<3.22	<3.22	<2.88	3.05 J
Radiological Parameters											
Radium-226	pCi/L	0.847 +/-(0.698)U	0.310 +/-(0.364)U	0.301 +/-(0.538)U	1.33 +/-(0.785	0.886 +/-(0.639	0.522 +/-(0.527)U	0.491 +/-(0.458)U	0.434 +/-(0.511)U	0.469 +/-(0.460)U	0.00229 +/-(0.272)U
Radium-228	pCi/L	0.0921 +/-(0.352)U	0.507 +/-(0.366)U	0.229 +/-(0.357)U	0.182 +/-(0.247)U	0.350 +/-(0.281)U	0.792 +/-(0.451	0.220 +/-(0.385)U	0.262 +/-(0.308)U	0.137 +/-(0.331)U	0.436 +/-(0.577)U
Radium-226+228	pCi/L	0.939 +/-(0.782)U	0.817 +/-(0.516)U	0.530 +/-(0.645)U	1.51 +/-(0.823)J	1.24 +/-(0.698)J	1.31 +/-(0.694)J	0.710 +/-(0.599)U	0.696 +/-(0.597)U	0.606 +/-(0.567)U	0.438 +/-(0.638)U
Anions											
Chloride	mg/L	4.24	5.21	5.59	5.52	5.68	6.02	5.54	5.89	5.55	7.86
Fluoride	mg/L	0.0790 J	0.0741 U*	0.0722 J	0.0530 J	0.115 U*	0.132 U*	0.0625 J	0.139 U*	0.0944 U*	0.0793 J
Sulfate	mg/L	341	335	350 J	347	329	349	326	341	354	344
General Chemistry											
Alkalinity, Bicarbonate	mg/L	173	153	136	109	110	115	120	148	117	146
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<2.60
Total Dissolved Solids	mg/L	654	657	710	640	668	709	670	692	687	716

See notes on last page.

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Table 5 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-106										
Sample Date		28-Aug-19	28-Aug-19	30-Oct-19	30-Oct-19	8-Jan-20	8-Jan-20	4-Mar-20	4-Mar-20	29-Apr-20	29-Apr-20	8-Jul-20
Sample ID		WBF-GW-010-20190828	WBF-GW-DUP01-20190828	WBF-GW-010-20191030	WBF-GW-DUP01-20191030	WBF-GW-010-20200108	WBF-GW-DUP01-20200108	WBF-GW-010-20200304	WBF-GW-DUP01-20200304	WBF-GW-010-20200429	WBF-GW-DUP01-20200429	WBF-GW-010-20200708
Parent Sample ID			WBF-GW-010-20190828		WBF-GW-010-20191030		WBF-GW-010-20200108		WBF-GW-010-20200304		WBF-GW-010-20200429	
Sample Depth		32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft	32.6 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample
Program	Units	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP	EIP
Total Metals												
Aluminum	ug/L	-	-	-	-	-	-	-	-	-	-	-
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	1.70	1.72	0.733 J	0.735 J	1.02 U*	0.848 U*	0.468 J	0.576 J	0.921 U*	0.921 U*	1.66 U*
Barium	ug/L	51.4	51.0	34.4	33.6	30.2	30.5	33.2	33.0	27.7	27.6	35.9
Beryllium	ug/L	<0.182	<0.182	<0.182	<0.182	0.642 U*	0.566 U*	<0.182	<0.182	<0.182	<0.182	<0.182
Boron	ug/L	57.7 U*	43.1 U*	260	261	237	235	212	217	66.4 J	51.5 J	65.2 U*
Cadmium	ug/L	<0.125	<0.125	0.958 J	1.05	0.980 J	0.938 J	0.354 J	0.375 J	<0.217	<0.217	0.218 J
Calcium	ug/L	161,000	163,000	162,000	166,000	163,000	166,000	161,000	161,000	160,000	160,000	158,000
Chromium	ug/L	<1.53	1.61 J	1.76 U*	1.96 U*	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	2.19	2.13	80.7	79.2	78.4	79.5	72.4	73.4	25.9	26.3	10.3
Copper	ug/L	<0.627	0.723 J	1.71 U*	0.894 U*	<0.627	1.98 U*	<0.627	<0.627	3.89 U*	2.33 U*	<0.627
Iron	ug/L	-	-	-	-	-	-	-	-	-	-	-
Lead	ug/L	0.251 J	0.226 J	0.137 J	0.348 J	<0.128	<0.128	<0.128	0.208 J	0.138 U*	0.131 U*	0.223 U*
Lithium	ug/L	3.81 U*	4.42 U*	3.83 J	4.36 J	3.93 J	3.88 J	<3.39	<3.39	<3.39	<3.39	<3.39
Magnesium	ug/L	34,800	35,000	24,500	24,400	25,200	25,500	23,000	23,300	28,400	28,400	29,800
Manganese	ug/L	-	-	-	-	-	-	-	-	-	-	-
Mercury	ug/L	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101	<0.101	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	0.359 J	0.469 J	15.8	16.1	16.5	16.2	13.8	14.0	4.57	4.69	1.79 U*
Potassium	ug/L	1,010	1,020	5,300	5,290	5,440	5,490	4,720	4,770	2,740	2,750	1,580
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	-	-	-	-	-	-	-	-	-	-	-
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	31,600	31,700	8,840	8,890	7,350	7,430	8,240	8,250	27,900	27,900	29,200
Thallium	ug/L	<0.148	<0.148	<0.148	<0.148	0.570 U*	0.205 U*	<0.148	<0.148	0.153 U*	<0.148	0.307 U*
Vanadium	ug/L	<0.991	1.07	1.01	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	5.44 U*	5.06 U*	42.1	39.9	35.5	35.1	34.4	36.2	10.8	11.2	6.09
Radiological Parameters												
Radium-226	pCi/L	0.623 +/-(0.591)U	0.342 +/-(0.539)U	0.411 +/-(0.399)U	0.322 +/-(0.433)U	0.823 +/-(0.675)U	0.768 +/-(0.632)U	0.433 +/-(0.540)U	0.558 +/-(0.618)U	1.21 +/-(0.751)J	0.213 +/-(0.523)UJ	0.461 +/-(0.509)U
Radium-228	pCi/L	0.519 +/-(0.407)U	0.260 +/-(0.446)U	0.192 +/-(0.277)U	0.214 +/-(0.273)U	0.511 +/-(0.398)U	-0.0265 +/-(0.258)U	0.179 +/-(0.247)U	0.326 +/-(0.460)U	0.575 +/-(0.387	0.151 +/-(0.313)U	-0.116 +/-(0.432)U
Radium-226+228	pCi/L	1.14 +/-(0.718)U	0.602 +/-(0.700)U	0.603 +/-(0.486)U	0.535 +/-(0.512)U	1.33 +/-(0.784)U	0.768 +/-(0.682)U	0.612 +/-(0.594)U	0.884 +/-(0.770)U	1.78 +/-(0.845)J	0.364 +/-(0.609)UJ	0.461 +/-(0.668)U
Anions												
Chloride	mg/L	3.30	3.38	4.15	4.32	4.90	4.56	4.88	4.86	4.50	4.84	4.96
Fluoride	mg/L	0.0899 J	0.0861 J	0.0783 U*	0.0789 U*	0.0584 J	0.0508 J	0.0267 J	0.0291 J	0.132 U*	0.140 U*	0.133 U*
Sulfate	mg/L	527	527	511	515	524 J	570 J	550	522	453	465	481
General Chemistry												
Alkalinity, Bicarbonate	mg/L	140	138	35.4	35.2	34.0	34.7	10.9 J	20.6 J	77.1	69.2	122
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Total Dissolved Solids	mg/L	878	895	793	794	891	847	791	794	862	836	885

See notes on last page.

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Table 5 - Groundwater Analytical Results
Watts Bar Fossil Plant

Sample Location		WBF-106			
Sample Date		25-Mar-21	19-Aug-21	21-Apr-22	17-Oct-22
Sample ID		WBF-GW-WBF-106-03252021	WBF-GW-WBF-106-08192021	WBF-GW-WBF-106-04212022	WBF-GW-WBF-106-10172022
Parent Sample ID					
Sample Depth		32.6 ft	32.6 ft	32.6 ft	32.6 ft
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Program	Units	EIP	EIP	CCR Program	
Total Metals					
Aluminum	ug/L	18.7 J	39.7	<15.5	27.0 J
Antimony	ug/L	<0.378	<0.378	<0.506	<0.506
Arsenic	ug/L	0.414 J	0.731 U*	<0.282	0.382 J
Barium	ug/L	18.8	42.1	17.6	24.5
Beryllium	ug/L	0.198 J	0.186 J	<0.274	<0.274
Boron	ug/L	200	252 U*	199	234
Cadmium	ug/L	0.720 J	0.375 J	0.722 J	0.614 J
Calcium	ug/L	143,000	148,000	132,000	135,000
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	63.6	68.0	59.2	64.7
Copper	ug/L	<0.627	<0.627	<1.14	<1.14
Iron	ug/L	23,300	30,500	20,800	23,500
Lead	ug/L	<0.128	<0.128	<0.167	<0.167
Lithium	ug/L	<3.39	<3.39	2.10 J	2.27 J
Magnesium	ug/L	19,900	21,100	18,500	19,700
Manganese	ug/L	13,400	14,900	11,300 J	14,100
Mercury	ug/L	<0.130	<0.130	<0.130	<0.130
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610
Nickel	ug/L	12.7	12.8	11.5	12.8
Potassium	ug/L	4,840	5,180	4,810	5,470
Selenium	ug/L	<1.51	<1.51	<0.739	<0.739
Silicon	ug/L	8,910	11,200	9,730 J	11,000
Silver	ug/L	<0.177	<0.177	<0.223	<0.223
Sodium	ug/L	7,390	8,060	6,850	8,010
Thallium	ug/L	<0.148	<0.148	<0.472	<0.472
Vanadium	ug/L	<0.991	<0.991	<0.776	<0.776
Zinc	ug/L	30.1	34.1	26.5	30.3
Radiological Parameters					
Radium-226	pCi/L	0.0151 +/-(0.290)U	0.533 +/-(0.580)U	-0.0324 +/-(0.415)U	0.659 +/-(0.459
Radium-228	pCi/L	0.461 +/-(0.501)U	0.107 +/-(0.271)U	0.0967 +/-(0.315)U	-0.219 +/-(0.435)U
Radium-226+228	pCi/L	0.477 +/-(0.579)U	0.640 +/-(0.640)U	0.0967 +/-(0.521)U	0.659 +/-(0.633)J
Anions					
Chloride	mg/L	4.02	3.75	7.11	7.79
Fluoride	mg/L	0.0305 J	0.0778 U*	0.0642 J	0.0628 J
Sulfate	mg/L	484	464	427	434
General Chemistry					
Alkalinity, Bicarbonate	mg/L	<5.00	44.0	22.0	31.8
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<2.60
Total Dissolved Solids	mg/L	740	741	636	726

Notes:

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

15.2	measured concentration did not exceed the indicated standard
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	Parameter not analyzed / not available.
ft	feet
ID	Identification
J	quantitation is approximate due to limitations identified during data validation
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.
mg/L	milligrams per Liter
pCi/L	picocuries per Liter
ug/L	micrograms per Liter

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EXHIBITS

Exhibit No.

1

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Title

Soil Boring and Well Locations - Ash Pond and Slag Disposal Area

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2024-04-11
Technical Review by MW on 2024-04-11

0 150 300 450 600 Feet

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

Legend

- Boring with Vibrating Wire Piezometer for Geochemical Sampling
- Groundwater Investigation Monitoring Well
- Other Monitoring Well
- Soil Boring
- Temporary Well within CCR Material
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

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

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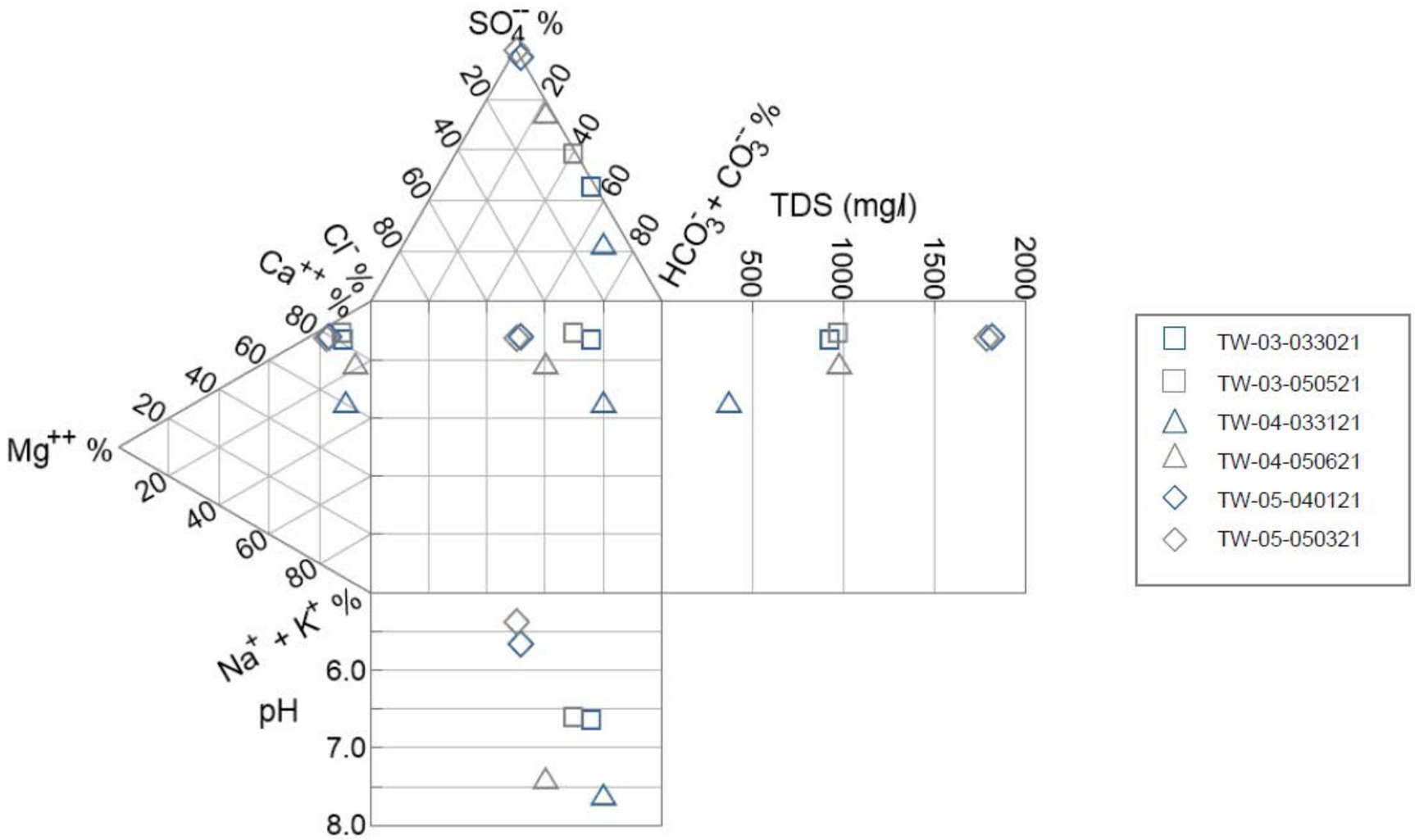

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Exhibit No.

2

Title

Pore Water Durov Diagram

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-05-29
TR by BL on 2024-05-29
IR Review by RB on 2024-05-29

Legend

Notes

1. Percent -milliequivalent per kilogram
2. Ca^{++} - Calcium
3. Cl^- - Chloride
4. CO_3 - Carbonate
5. HCO_3 - Bicarbonate
6. K^+ - Potassium
7. Mg^{++} - Magnesium
8. Na^+ - Sodium
9. SO_4 - Sulfate

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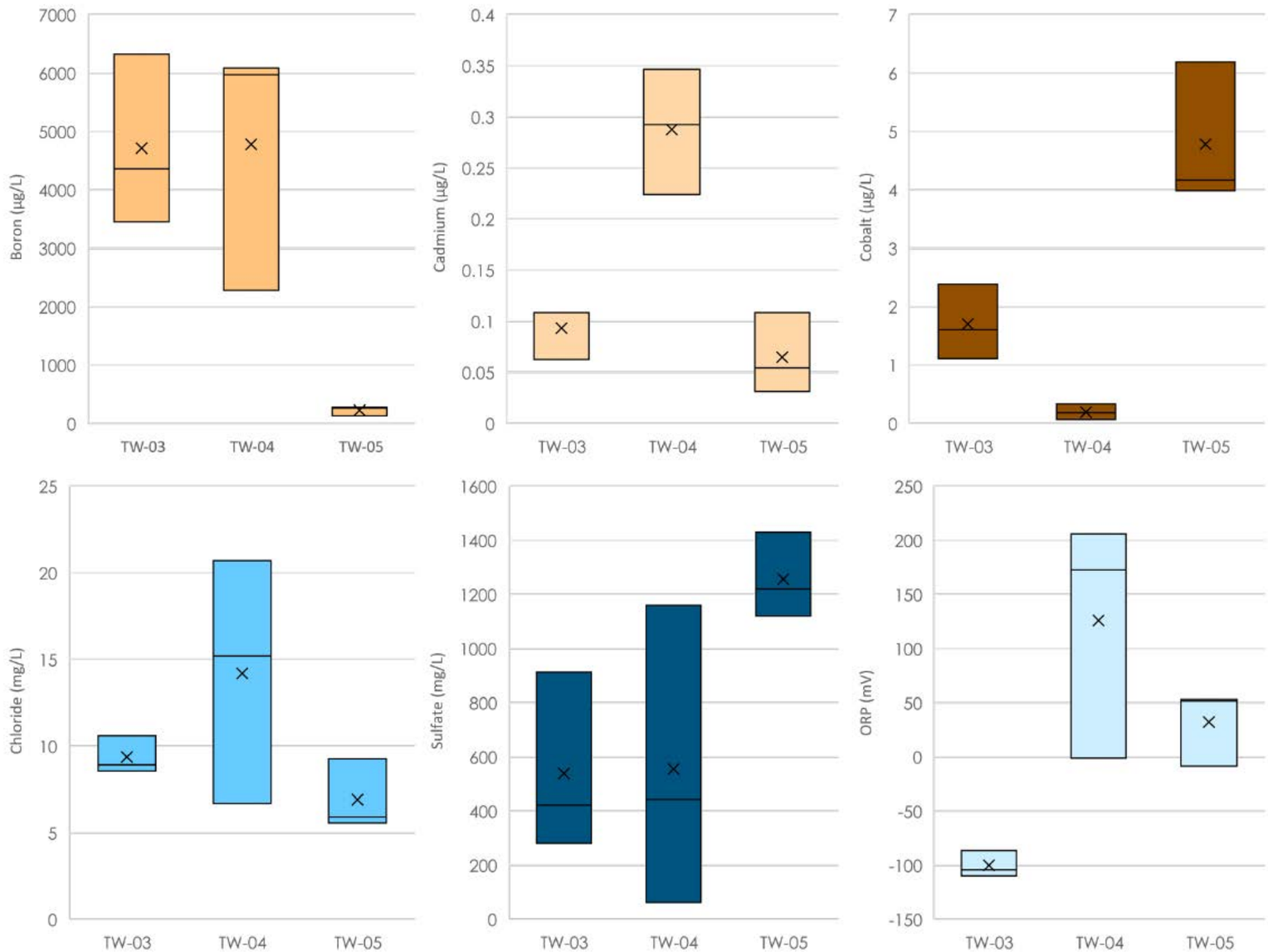

DRAFT

Exhibit No.

3

Title

Box Plots of Select CCR Constituents in Pore Water

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-06-03
TR by BL on 2024-06-03
IR Review by RB on 2024-06-03

Notes
µg/L – microgram per Liter
mg/L – milligram per Liter
mV - millivolts
ORP - Oxidation Reduction Potential

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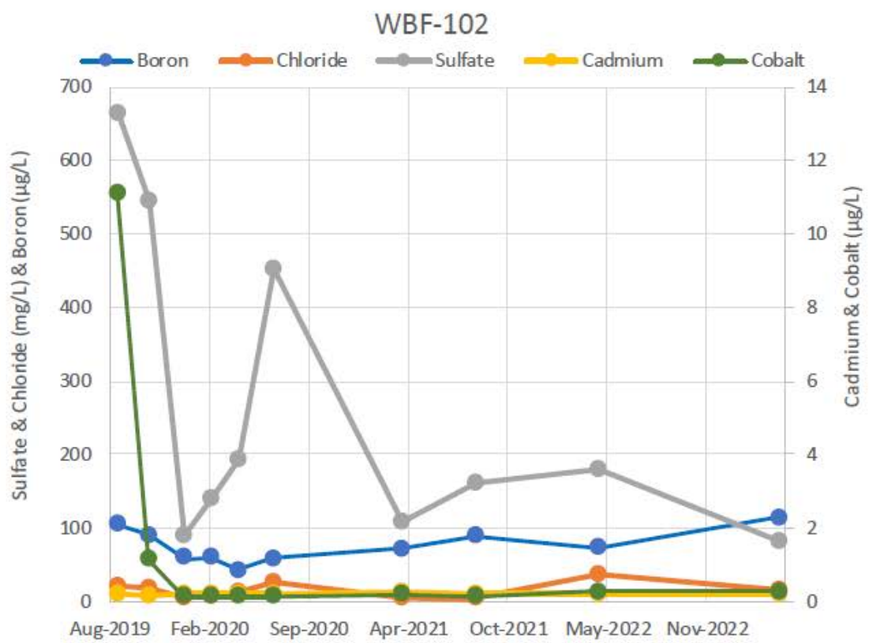

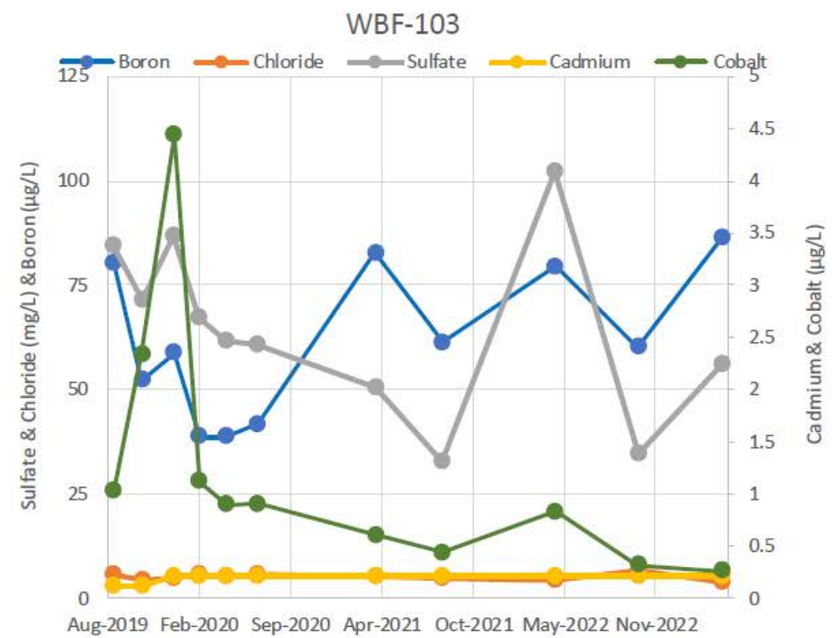

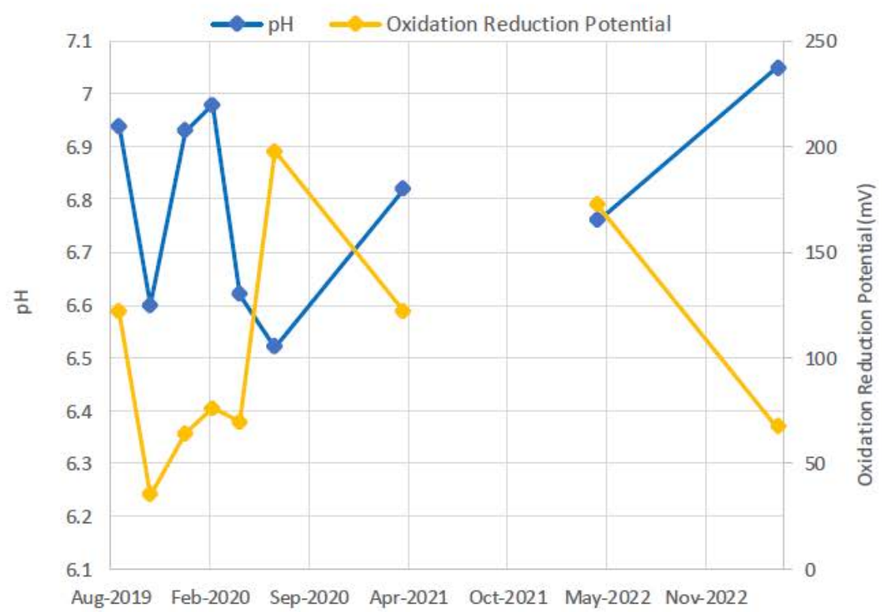

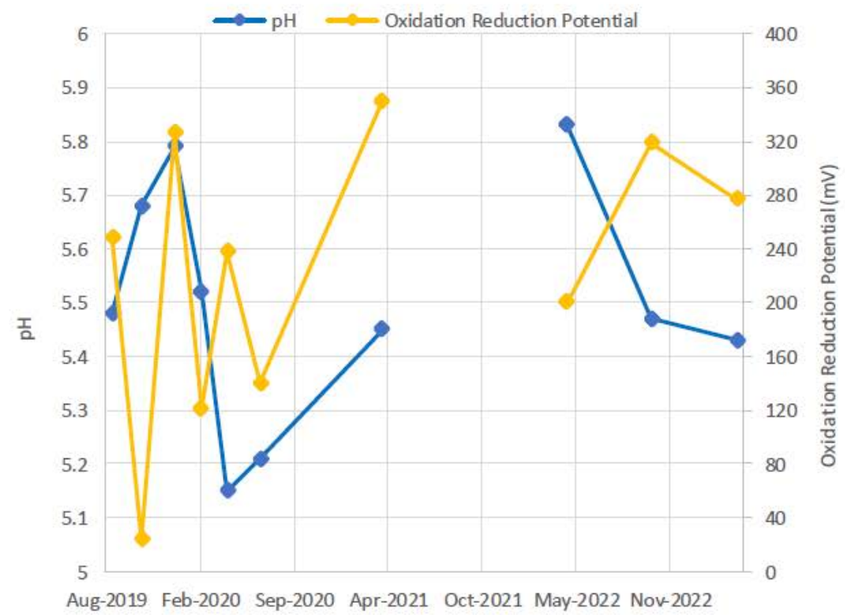

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Exhibit No.

4

Title

Concentration Time Series Plots of CCR Tracers in Groundwater Upgradient of the CCR Units

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-01-10
TR by BL on 2024-01-10
IR Review by RB on 2024-01-10

Legend

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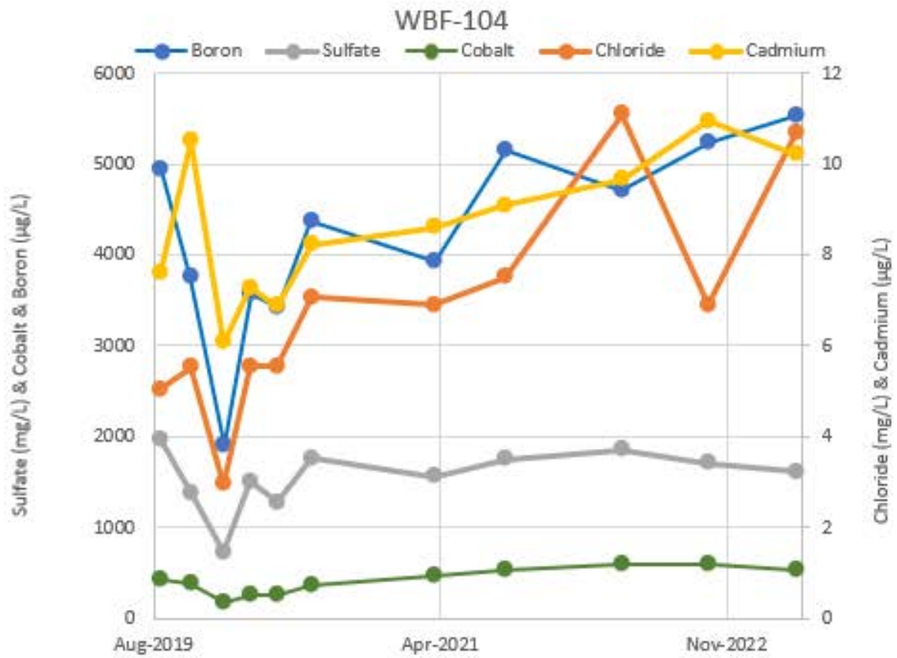

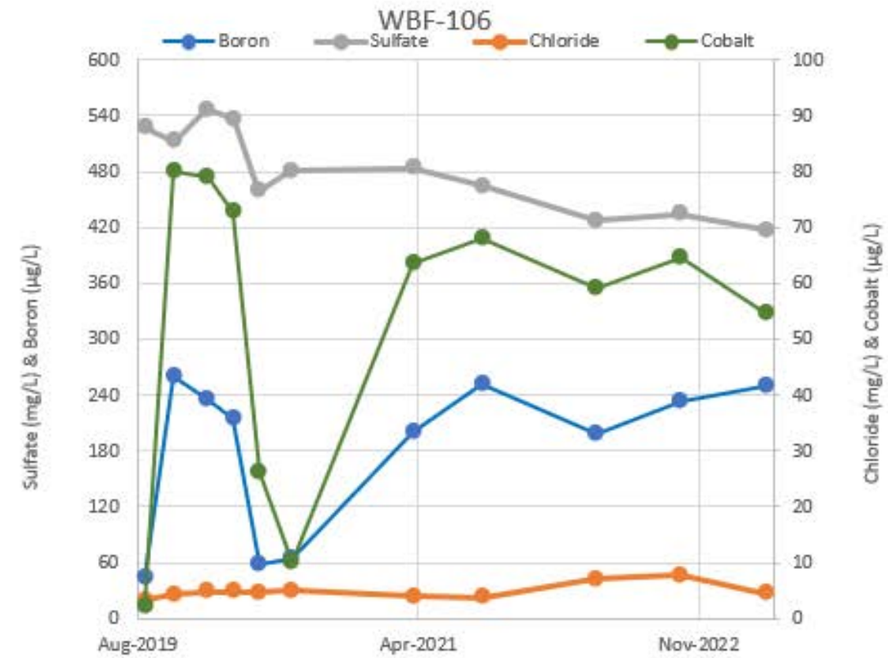

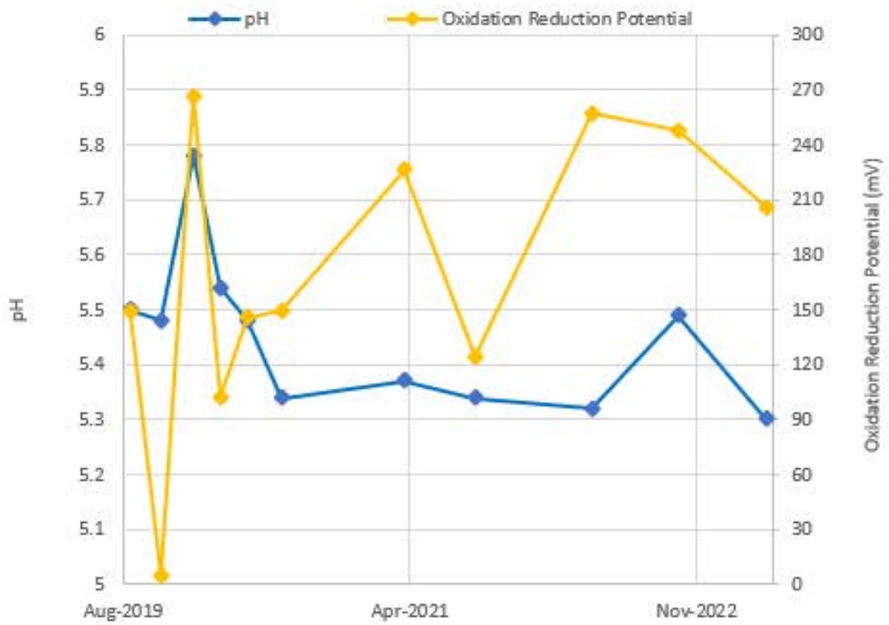

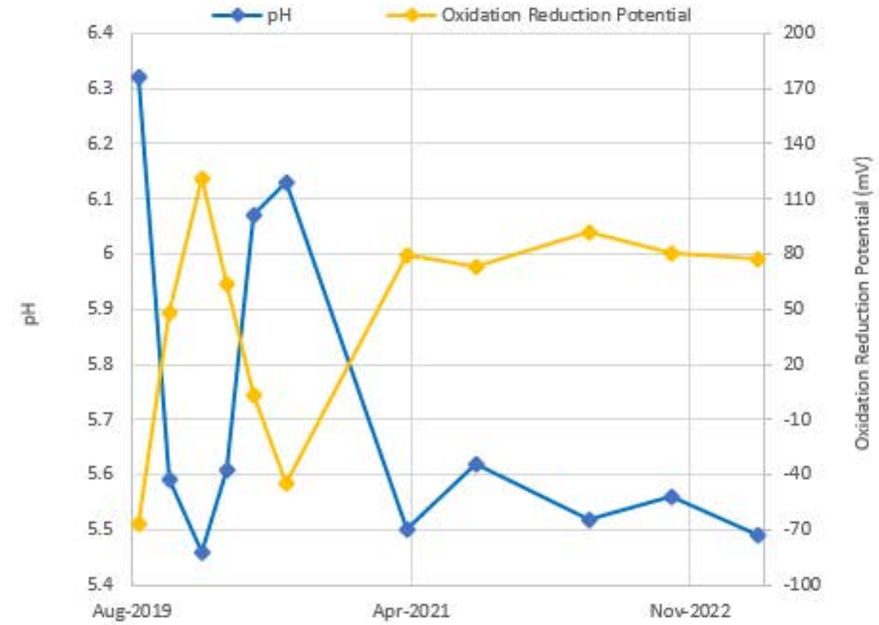

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Exhibit No.

5

Title

Concentration Time Series Plots of CCR Tracers in Groundwater Downgradient of the Slag Disposal Area

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-02-08
TR by BL on 2024-02-08
IR Review by RB on 2024-02-08

Legend

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Exhibit No.

6

Title

Bulk Mineralogy of Soil Samples in the Vicinity of WBF-104 and WBF-106

Client/Project 175668050

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

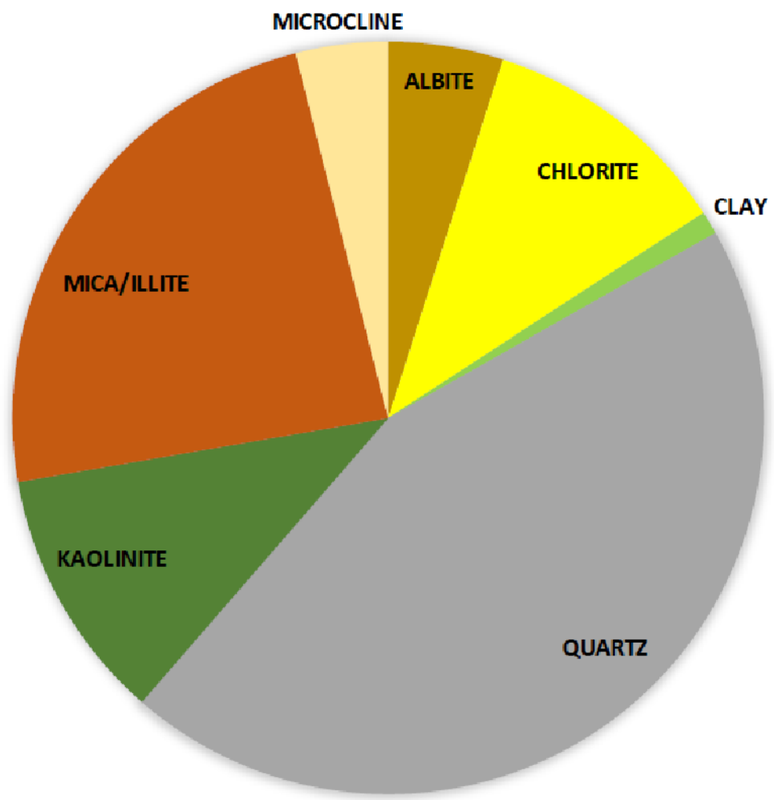
Project Location

Spring City, Tennessee

Prepared by DMB on 2024-01-11
TR by BL on 2024-01-11
IR Review by RB on 2024-01-11

Legend

WBF-SS-SB-02-25/35-11182022



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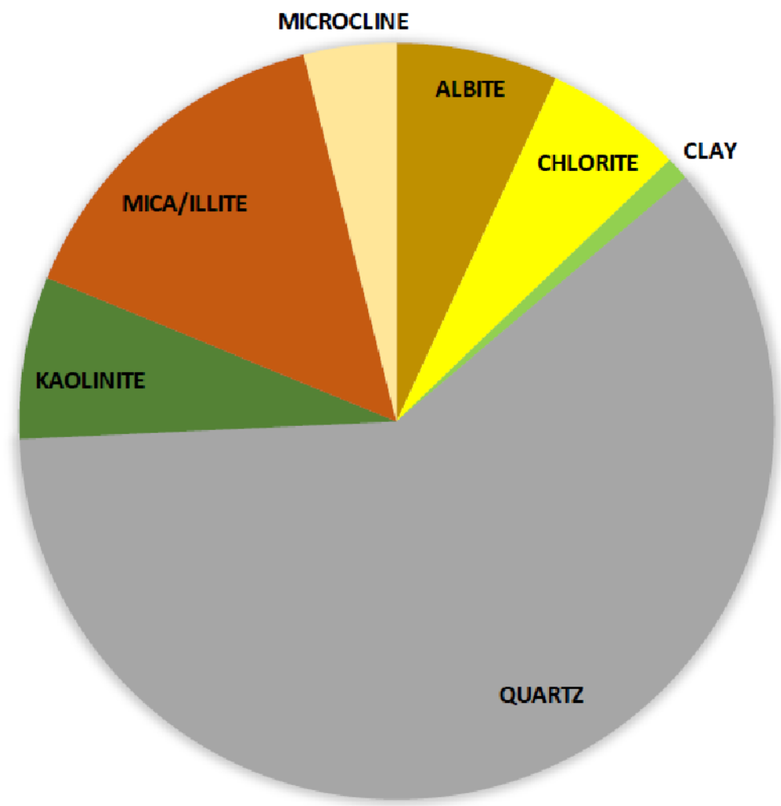

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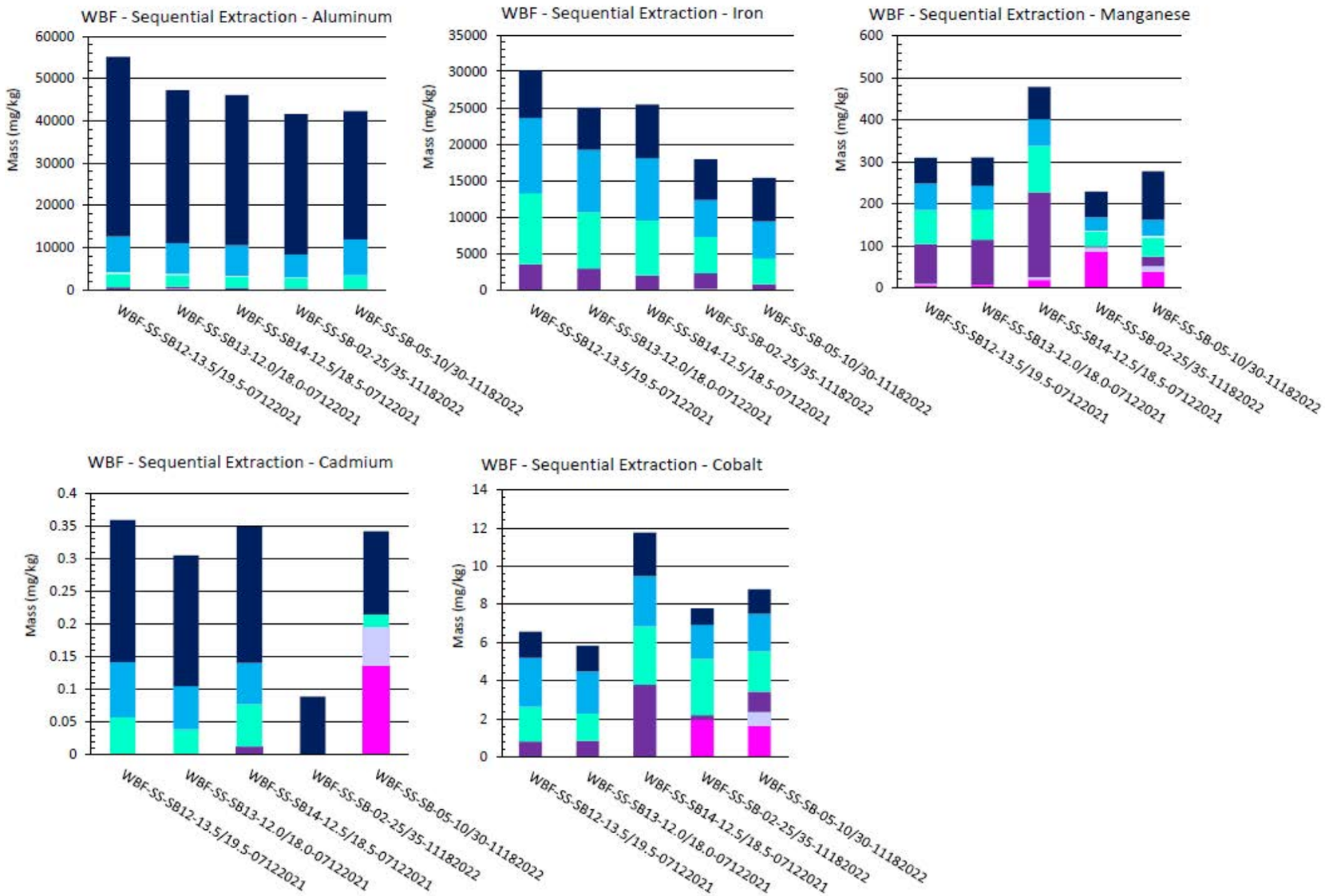

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Exhibit No.

7

Title

Sequential Extraction Results for Soil Samples in the Vicinity of WBF-104 and WBF-106

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2024-05-29
TR by BL on 2024-05-29
IR Review by RB on 2024-05-29

Notes

mg/kg - milligrams per kilograms

- Step 7 - Residual
- Step 6 - Acid/Sulfide
- Step 5 - Organic
- Step 4 - Metal Hydroxide
- Step 3 - Non-Crystalline
- Step 2 - Carbonate
- Step 1 - Exchangeable

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ATTACHMENT A - SURFACE WATER INVESTIGATION SUMMARY

Attachment A – Surface Water Investigation Summary – DRAFT

TDEC Commissioner's Order
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, TN 37402

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Sign-off Sheet

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Prepared by _____

Andrew Stevens, PG, Geologist

Reviewed by _____

Jamie Snider, PG, Geologist

Approved by _____

Carole Farr, PG, Senior Principal Geologist

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Abbreviations

CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
CCR Rule	Title 40, Code of Federal Regulations, Part 257
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DO	Dissolved Oxygen
ENV	Environmental
EnvStds	Environmental Standards, Inc.
Eurofins	Eurofins Environmental Testing
FSP	Field Sampling Personnel
GEL	GEL Laboratories
ORP	Oxidation-Reduction Potential
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order No. OGC15-0177
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this *Surface Water Investigation Summary* to summarize the fieldwork activities conducted to support a surface water investigation at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

The purpose of the surface water investigation was to evaluate whether the coal combustion residuals (CCR) -related constituents listed in Appendices III and IV of 40 Code of Federal Regulations (CFR) 257coal combustion residuals material was present in surface water at the WBF Plant. The primary objective was to collect onsite surface water samples for the evaluation of potential impacts hydraulically upgradient or cross-gradient of two closed CCR units, the Ash Pond and Slag Disposal Area. The surface water sample results were included in the geochemical evaluation. The sample results were then incorporated into an overall geochemical evaluation for the WBF Plant as presented in Appendix H of the Corrective Action/Risk Assessment (CARA) Plan.

The surface water investigation activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the Title 40 of the Code of Federal Regulations (CFR) Part 257 (CCR Rule) and the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015) (TDEC Order). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The surface water sampling was performed in general accordance with the following documents:

- *Watts Bar Fossil Plant Sampling and Analysis Plan (SAP) - CCR Rule Surface Water Sampling* (Stantec 2021)
- *TDEC Order Environmental Investigation Plan* (Stantec 2018)
- *CCR Rule Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. [EnvStds] 2020).

The SAP was implemented in accordance with TVA- and TDEC-approved programmatic and project-specific changes. Field documentation for work performed under the SAP was reviewed for variations in scope and procedures.

Minor variations in scope and procedures from those outlined in the SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Variations section of this summary.

Details on sampling activities are presented in the following sections.

2.0 FIELD AND SAMPLING ACTIVITIES

The surface water investigation was conducted on December 1 and 2, 2021.A total of seven surface water samples (WBF-SW-01 through WBF-SW-07) were collected to assess the pond east of monitoring well WBF-103, the north and south ditches northwest of monitoring well WBF-103, the pond northwest of WBF-106, and the Stormwater Ponds near monitoring well MW-3 as shown on Exhibit 1.

Stantec performed the surface water field activities based on guidance and specifications listed in TVA's Environmental (ENV) Technical Instructions (TIs), the SAP, and the QAPP. As part of TVA's commitment to generate representative and reliable data, oversight and centralized data management were performed by EnvStds under direct contract with TVA. EnvStds also provided quality reviews of field documentation.

During the surface water investigation, Stantec conducted the following field activities:

- Surface water quality parameters including pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity were measured with a calibrated YSI Pro Plus water quality meter and a calibrated Hach 2100Q turbidity meter at each sample location in accordance with ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde. Water quality parameters were taken from decontaminated dipper pole at each surface water location prior to sampling.* Surface water quality parameters are presented in Table 1.

- Seven surface water samples were collected at seven sampling locations using a decontaminated dipper pole at each of sampling location in accordance with ENV-TI-05.80.40, *Surface Water Sampling and* ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*. Surface water was collected from the edge of the surface water with a dipper pole and decanted into sample bottles. Dissolved metals samples were first decanted into an unpreserved 1L plastic bottle, sealed and placed on ice. The collected water was transferred using a peristaltic pump through a new 0.45-micron disposable inline filter attached to non-dedicated tubing into laboratory-provided sample bottles in accordance with ENV-TI-05.80.40, *Surface Water Sampling.*

- Quality control (QC) samples were collected and included one field duplicate, one matrix spike/matrix spike duplicate, two field blanks, one equipment blank, one filter blank, and one tubing blank in accordance with ENV-TI-05.80.04, *Field Sampling Quality Control*.

- Sample containers were filled, capped, labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody.* Field Sampling Personnel (FSP) secured caps on each bottle, attached a custody seal across the cap, and placed the bottles in a cooler on ice within 15 minutes of collection.

- Samples were packed and shipped under Chain-of-Custody (COC) procedures specified in ENV-TI-05.80.06, *Handling and Shipping of Samples and* ENV-TI-05.80.02, *Sample Labeling and Custody.* The samples were shipped by FedEx to the GEL Laboratories (GEL) in Charleston, South

Carolina (radium samples only), and to Eurofins Environmental Testing (Eurofins) in Pittsburgh, Pennsylvania (other analytes).

- Surface water samples were analyzed for total and dissolved metals, radium, anions, alkalinity, nitrate-nitrite, total dissolved solids, and total and dissolved organic carbon. The sample summary is provided in Table 2 and the analytical results are summarized in Table 3.
- Investigation derived waste such as used disposable personal protective equipment (e.g., nitrile gloves) and general trash were placed in garbage bags and disposed of in a general trash dumpster at the end of each day, and used calibration solutions were managed as authorized by WBF Plant facility management in accordance with ENV-TI-05.80.05 *Field Sampling Equipment Cleaning and Decontamination,* the SAP, the WBF Plant-specific waste management plan, and local, state, and federal regulations.

2.1 Field Documentation

Stantec maintained field documentation in general accordance with TVA ENV-TI-05.80.03, Field Record Keeping, the SAP, and the QAPP. Field activities and data were primarily recorded on Plant-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements.

COC forms were completed in accordance with TVA ENV-TI-05.80.02: Sample Labeling and Custody. Stantec.

2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAPs, QAPP, and TVA ENV-TI-05.80.46, Field Measurement Using a Multi-Parameter Sonde. FSP documented the calibration results for temperature, turbidity, specific conductance, pH, DO, and ORP, and verified that the field instruments' sensors were operating within acceptance criteria. Afternoon calibration verification was performed to evaluate if the instrument remained within acceptance criteria during use. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Dayton, Tennessee. Additional details regarding equipment calibration were recorded on an Equipment Calibration Form.

2.3 Surface Stream Field Parameter Measurement Form

Stantec FSP recorded the temperature, pH, specific conductance, DO, ORP, turbidity, and other observations during surface water sampling activities at each sampling location in accordance with CCR Rule Surface Water Sampling SAP. Field measurements were recorded on a Surface Stream Field Parameter Measurement Form.

2.4 Variations

The proposed scope and procedures for surface water sampling were outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this summary for the surface water investigation sampling event at the WBF Plant.

There were no variations in scope during the surface water investigation sampling at the WBF Plant.

Variations in procedures occurring in the field are provided below.

- A dipper-pole was used instead of a water bottle sampler to collect surface water samples. A dipper pole sampler was used to collect surface water samples and was decontaminated between sampling locations in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

3.0 SUMMARY

The data presented in this report are from implementation of the surface water investigation at the WBF Plant. The scope of work for the surface water investigation included:

- Collection of seven surface water samples at seven locations
- Collection of QC samples for laboratory analysis
- Shipment of samples via FedEx to GEL and Eurofins for analysis.

A summary of surface water samples is presented in Table 2 and surface water analytical results are presented in Table 3. The results have been validated and are usable for reporting and evaluation in the CARA Plan.

4.0 REFERENCES

Environmental Standards, Inc. (2020). *Tennessee Valley Authority Coal Combustion Residuals Groundwater Monitoring and Investigation Quality Assurance Project Plant. Revision 4.* Prepared for Tennessee Valley Authority. December 2020.

Stantec. (2021). *Watts Bar Fossil Plant Sampling and Analysis Plan – CCR Rule Surface Water Sampling.* Revision 1. Prepared for Tennessee Valley Authority. November 10, 2021.

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

Tennessee Valley Authority (TVA). ENV-TI-05.80.02, *Sample Labeling and Custody*.

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

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

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

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

TVA. ENV-TI-05.80.40, *Surface Water Sampling*.

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

TABLES

Table 1 - Surface Water Quality Parameters
Watts Bar Fossil Plant

Sample Location		WBF-SW-01	WBF-SW-02	WBF-SW-03	WBF-SW-04	WBF-SW-05	WBF-SW-06	WBF-SW-07
Sample Date		1-Dec-21	1-Dec-21	1-Dec-21	1-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21
Sample ID		WBF-SW-01-12012021	WBF-SW-02-12012021	WBF-SW-03-12012021	WBF-SW-04-12012021	WBF-SW-05-12022021	WBF-SW-06-12022021	WBF-SW-07-12022021
Parent Sample ID								
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
Field Parameters								
Dissolved Oxygen	mg/L	9.67	7.86	6.09	12.12	9.09	4.71	10.85
ORP	mV	158.8	169.3	163	158.1	64.2	69.4	58.9
pH (lab)	SU	7.02	7.24	6.74	6.98	7.31	7.6	7.89
Specific Cond. (Field)	uS/cm	361.9	320.9	850.1	166.7	573.3	488.8	357.1
Temperature, Water (C)	DEG C	11.4	12.5	11.8	10.2	7.7	12.1	20.1
Turbidity, field	NTU	269	1.81	999	2.01	20.4	31.9	29.7

Notes:

%	percent
Cond.	conductance
DEG C	degrees Celsius
ID	identification
mg/L	milligrams per Liter
mV	milliVolts
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential, measured using a silver reference electrode which has a standard potential of 200 mV
SU	Standard Units
uS/cm	microSiemens per centimeter

TABLE 2 – Summary of Surface Water Samples
Watts Bar Fossil Plant

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			Analysis								
Location ID	**Sample ID**	**Sample Type**	**Total Metals**	**Dissolved Metals**	**Radium**	**Anions**	**Alkalinity**	**Total Disolved Solids**	**Total Organic Carbon**	**Dissolved Organic Carbon**	**Nitrate-Nitrite**
WBF-SW-01	WBF-SW-01-12012021	Normal Environmental Sample	X	X	X	X	X	X	X	X	X
WBF-SW-02	WBF-SW-02-12012021	Normal Environmental Sample	X	X	X	X	X	X	X	X	X
WBF-SW-03	WBF-SW-03-12012021	Normal Environmental Sample	X	X	X	X	X	X	X	X	X
WBF-SW-04	WBF-SW-04-12012021	Normal Environmental Sample	X	X	X	X	X	X	X	X	X
WBF-SW-05	WBF-SW-05-12022021	Normal Environmental Sample	X	X	X	X	X	X	X	X	X
WBF-SW-06	WBF-SW-06-12022022	Normal Environmental Sample	X	X	X	X	X	X	X	X	X
	WBF-SW-FD01-12022022	Field Duplicate Sample	X	X	X	X	X	X	X	X	X
WBF-SW-07	WBF-SW-07-12022022	Normal Environmental Sample	X	X	X	X	X	X	X	X	X

Notes	Method
Alkalinity	SM2320B
Anions	EPA 300.0/SW846 9056
Dissolved Organic Carbon	SW-846 9060A
ID	identification
Nitrate-Nitrite	EPA 353.2
Radium	EPA 903.0/EPA 904.0
Total and Dissolved Metals	SW-846 6020A
Total Dissolved Solids	SM2540C
Total Organic Solids	SM2540C
Total Organic Carbon	SW-846 9060A

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

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TABLE 3 - Surface Water Analytical Results for Geochemical Characterization Watts Bar Fossil Plant

Sample Location		WBF-SW-01	WBF-SW-02	WBF-SW-03	WBF-SW-04	WBF-SW-05	WBF-SW-06		WBF-SW-07
Sample Date		1-Dec-21	1-Dec-21	1-Dec-21	1-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21	2-Dec-21
Sample ID		WBF-SW-01-12012021	WBF-SW-02-12012021	WBF-SW-03-12012021	WBF-SW-04-12012021	WBF-SW-05-12022021	WBF-SW-06-12022021	WBF-SW-FD01-12022021	WBF-SW-07-12022021
Sample Type		Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate Sample	Normal Environmental Sample
Level of Review	Units	Validated	Validated	Validated	Validated	Validated	Validated	Validated	Validated
Metals, Total									
Aluminum	ug/L	607	171	4,430	350	24.5 J	1,200 J	636 J	109
Antimony	ug/L	<0.378	<0.378	0.910 J	<0.378	<0.378	0.520 J	<0.378	<0.378
Arsenic	ug/L	1.01 U*	0.340 U*	76.0	0.599 U*	0.776 U*	3.04	2.76	0.932 U*
Barium	ug/L	92.3 J	40.5 J	101 J	27.3 J	34.9 J	82.1 J	76.6 J	44.1 J
Beryllium	ug/L	0.192 J	<0.182	0.646 J	<0.182	<0.182	<0.182	<0.182	<0.182
Boron	ug/L	<38.6	<38.6	73.0 U*	<38.6	44.5 U*	<38.6	<38.6	43.0 U*
Cadmium	ug/L	<0.217	<0.217	0.370 J	<0.217	<0.217	<0.217	<0.217	<0.217
Calcium	ug/L	60,300	10,400	98,000	21,700 R	89,500	72,500	71,200	52,000
Chromium	ug/L	<1.53	<1.53	5.90	<1.53	<1.53	2.66	<1.53	<1.53
Cobalt	ug/L	12.5 J	3.72	18.8	27.4	8.10	2.35	2.02	0.262 U*
Copper	ug/L	0.868 U*	0.758 U*	10.5	<0.627	<0.627	1.58 J	1.14 J	<0.627
Iron	ug/L	3,430	434	74,600	3,850	3,020 J	3,450	2,930	129
Lead	ug/L	0.817 J	0.130 J	8.23	<0.128	<0.128	1.97	1.62	<0.128
Lithium	ug/L	3.45 J	3.50 J	7.77	<3.39	7.88	<3.39	<3.39	<3.39
Magnesium	ug/L	6,340	2,060	33,200	4,160 J	14,700	9,060	8,950	7,510
Manganese	ug/L	2,340	498	21,400	3,780	2,960 J	2,690	2,630	57.8
Molybdenum	ug/L	<0.610	<0.610	1.93 J	<0.610	<0.610	0.694 J	<0.610	1.71 J
Nickel	ug/L	4.98 J	3.74	22.4	13.1	6.18	2.31	1.86 U*	0.800 U*
Potassium	ug/L	2,590	1,260	11,200	1,440 J	2,990	17,700	17,400	2,940
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	8,320	4,720	20,100	4,910 J	5,270	2,940 J	2,090 J	3,350
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	4,200	1,770	11,700	2,020 J	5,400	1,350	1,290	2,120
Thallium	ug/L	<0.148	<0.148	0.625 U*	<0.148	<0.148	<0.148	<0.148	<0.148
Vanadium	ug/L	<0.991	<0.991	12.1	<0.991	<0.991	3.07	2.49	<0.991
Zinc	ug/L	25.3	7.17	64.8	14.1	<3.22	13.9 J	4.34 J	<3.22
Metals, Dissolved									
Aluminum	ug/L	149	20.3 J	23.2 J	17.3 J	<12.5	155 J	28.6 J	21.5 U*
Antimony	ug/L	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378	<0.378
Arsenic	ug/L	0.392 U*	<0.313	13.8	0.510 U*	0.740 U*	1.98	1.90	0.864 U*
Barium	ug/L	27.1	36.3	41.1	69.4 J	39.6	65.7	60.7	40.6 J
Beryllium	ug/L	<0.182	<0.182	<0.182	<0.182	<0.182	<0.182	<0.182	<0.182
Boron	ug/L	<38.6	<38.6	66.4 U*	<38.6	43.1 U*	<38.6	<38.6	50.3 U*
Cadmium	ug/L	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217	<0.217
Calcium	ug/L	19,000	10,100	93,500	58,500 R	92,500	71,300	69,400	50,400
Chromium	ug/L	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53	<1.53
Cobalt	ug/L	18.8 J	1.93	2.30	0.732 U*	7.87	1.47	1.44	0.153 U*
Copper	ug/L	<0.627	<0.627	<0.627	<0.627	<0.627	<0.627	<0.627	<0.627
Iron	ug/L	1,530	42.8 U*	18,600	86.7 U*	3,400 J	429 U*	148 U*	<19.5
Lead	ug/L	<0.128	<0.128	<0.128	<0.128	<0.128	0.253 J	<0.128	<0.128
Lithium	ug/L	<3.39	<3.39	<3.39	<3.39	7.95	<3.39	<3.39	<3.39
Magnesium	ug/L	3,520	1,980	32,100	5,800 J	15,000	8,880	8,560	7,560
Manganese	ug/L	2,480	268	19,900	566	3,430 J	2,500	2,440	11.8
Molybdenum	ug/L	<0.610	<0.610	<0.610	<0.610	<0.610	0.625 J	0.641 J	1.87 J
Nickel	ug/L	9.48 J	2.40	2.13	0.888 U*	5.64	1.17 U*	1.16 U*	0.618 U*
Potassium	ug/L	1,400	1,170	10,200	2,390 J	3,000	17,200	16,800	2,820
Selenium	ug/L	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51	<1.51
Silicon	ug/L	4,850	4,620	14,700	7,460 J	5,380	1,450	1,270	3,240 J
Silver	ug/L	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177	<0.177
Sodium	ug/L	1,960	1,730	11,500	4,170 J	5,460	1,290	1,260	2,150
Thallium	ug/L	<0.148	<0.148	<0.148	<0.148	<0.148	<0.148	<0.148	0.226 U*
Vanadium	ug/L	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991	<0.991
Zinc	ug/L	11.0 U*	4.34 U*	<3.22	<3.22	4.57 U*	<3.22	<3.22	<3.22
Radiological Parameters									
Radium-226	pCi/L	0.109 +/-(0.359)U	0.206 +/-(0.366)U	0.311 +/-(0.378)U	-0.103 +/-(0.247)U	0.0631 +/-(0.321)U	0.146 +/-(0.341)U	0.417 +/-(0.504)U	0.164 +/-(0.343)U
Radium-228	pCi/L	0.0866 +/-(0.243)U	0.332 +/-(0.437)U	1.17 +/-(0.499)	0.261 +/-(0.277)U	0.312 +/-(0.318)U	0.546 +/-(0.404)U	0.123 +/-(0.442)U	-0.00192 +/-(0.349)U
Radium-226+228	pCi/L	0.196 +/-(0.434)U	0.538 +/-(0.570)U	1.49 +/-(0.626)J	0.261 +/-(0.371)U	0.375 +/-(0.453)U	0.692 +/-(0.529)U	0.539 +/-(0.670)U	0.164 +/-(0.489)U
Anions									
Chloride	mg/L	1.01 J	1.03 J	9.73	1.23 J	3.08	8.82	9.55	1.68 J
Fluoride	mg/L	0.344 U*	0.0819 U*	0.204 U*	0.168 U*	0.233 U*	0.163 U*	0.286 U*	0.169 U*
Sulfate	mg/L	29.9	25.6	150	71.2	182	30.1	32.6	60.4
General Chemistry									
Alkalinity, Bicarbonate	mg/L	146	5.18	224	5.18	114	193	197	104
Alkalinity, Carbonate	mg/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Alkalinity, Total as CaCO3	mg/L	146	5.18	224	5.18	114	193	197	104
Carbon, dissolved organic	mg/L	0.516 J	<0.508	21.3	1.37	1.43	13.9	13.6	6.50
Nitrate-Nitrite	mg/L	<0.0650	<0.0650	<0.0650	<0.0650	<0.0650	<0.0650	<0.0650	0.105
Total Dissolved Solids	mg/L	193	54.0	476	101	385	267	273	195
Total Organic Carbon	mg/L	0.619 J	<0.508	21.5	1.44	2.44 U*	15.3	14.7	6.22

Notes:

15.2	measured concentration did not exceed the indicated standard
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
ID	Identification
J	quantitation is approximate due to limitations identified during data validation
R	unreliable positive result; compound may or may not be present in sample.
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
mg/L	milligrams per Liter
pCi/L	picocuries per Liter
ug/L	micrograms per Liter

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

Stantec

EXHIBITS

Exhibit No.

1

Title

Surface Water Sampling Locations

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2024-04-18
Technical Review by AS on 2024-04-18

0 150 300 450 600 Feet

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

Legend

- Surface Water Sampling Location
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
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APPENDIX I
IN SITU TREATMENT EVALUATION

APPENDIX I.1

IN SITU TREATMENT TECHNICAL MEMORANDUM

Appendix I.1 – Bench-Scale *In Situ* Treatment Testing Technical Memorandum - Draft

TDEC Commissioner's Order:
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

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1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
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Sign-Off Sheet

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Prepared by _____
Emilia Arteaga, Geochemist

Prepared by _____
Aaron Line, Environmental Engineer

Reviewed by _____
Angus McGrath, Senior Principal

Reviewed by _____
David Collins, Principal Engineer

Approved by _____
Carole M. Farr, PG, Senior Principal Geologist

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Abbreviations

CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
EAR	Environmental Assessment Report
EnvStds	Environmental Standards
$FeCl_3$	Ferric Chloride
g	Gram(s)
GWPS	Groundwater Protection Standard
HDD	Horizontal Directionally Drilled
HDPE	High-Density Polyethylene
LSMS	Limestone Manufactured Sand
µg/L	Microgram(s) per Liter
mL	Milliliter(s)
mL/min	Milliliter(s) per minute
mg/kg	Milligram(s) per kilogram
$NaHCO_3$	Sodium Bicarbonate
NaOH	Sodium Hydroxide
ORP	Oxidation-Reduction Potential
%	Percent
PRB	Permeable Reactive Barrier
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SEP	Sequential Extraction Procedure
Stantec	Stantec Consulting Services Inc.
SU	Standard Unit
TDEC	Tennessee Department of Environment and Conservation

TDEC Order	TDEC Commissioner's Order OGC15-0177
TDS	Total Dissolved Solids
TM	Technical Memorandum
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant
wt%	Weight Percent

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this Bench-Scale *In Situ* Treatment Testing Technical Memorandum (TM) to present the methods and results of bench scale reagent treatability testing that was performed as an initial step in evaluating *in situ* treatment as a potential corrective measure. This TM also summarizes *in situ* treatment technologies and a proposed field-scale pilot test to collect data for a full-scale design, and outline a preliminary conceptual design for *in situ* treatment to address coal combustion residual (CCR) constituents at concentrations above groundwater protection standards (GWPS) in groundwater at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee (Exhibit 1). The GWPS are summarized in Table 1-1 of the Corrective Action/Risk Assessment (CARA) Plan.

This work was performed in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The CARA Plan is being prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA. This TM is included as an appendix in the CARA Plan to support evaluation of potential corrective measures at the WBF Plant CCR unit.

In situ treatment is a technique that is implemented to alter the groundwater and soil geochemistry in such a way that favorable conditions for constituent attenuation are attained and lead to a decrease in groundwater constituent concentrations that will be maintained. Prior to implementation of a full-scale treatment system, several investigative steps are required. The first phase of investigation is bench-scale testing, which is used to evaluate various reagents and reagent concentrations resulting in selection of a reagent or reagents and recommended dosing levels for the next phase of investigation. The second phase of investigation consists of pilot-scale implementation that evaluates application of the selected reagent in the field and allows for adjustments based on conditions at the site. A variety of methods can be used to deliver the *in situ* treatment reagent depending on the reagent disposition (i.e., solid, slurry, or aqueous), treatment zone configurations, site conditions, and operational constraints. Additional information regarding deployment methods is provided in Attachment A. The final stage of the *in situ* treatment technique is full-scale implementation.

This TM focuses on the Slag Disposal Area CCR unit.

2.0 BENCH-SCALE IN SITU TREATMENT TESTING APPROACH

The bench-scale testing is designed to provide specific information in a controlled environment regarding potential *in situ* treatment reagents and is used to guide development of potential pilot-scale field test implementation. The bench-scale testing uses a phased approach to promote an efficient collection of data used to evaluate effective treatment reagents. Each testing phase represents an increase in complexity aimed at better simulating actual site conditions. However, while this testing provides vital information to help guide further bench- or field-scale testing, the bench-scale testing cannot duplicate the complexity and variability of field-scale testing or full-scale implementation.

When an initial round of testing is completed for a given phase, variables may be adjusted (e.g., reagent dose, reaction time, or flow rate) to improve effectiveness or to better understand important treatment mechanisms or influence on performance. Treatability testing is inherently an iterative process, and adjustments are made to the testing regimen throughout the process based on the observed capability of various reagents or reagent combinations to reduce constituent concentrations or meet other pertinent performance criteria. Depending on initial test results, treatment reagents may be introduced in batches or continuously, in combination or sequentially, reagent dosing ratios may be adjusted, and other iterative determinations may be made to adjust conditions based on observations and data collected. Each phase of the bench-scale treatability testing is discussed at a conceptual level below.

Baseline Data Collection

Collection and sub-sample analysis of site-specific soil and groundwater samples provide baseline geochemical data, specific to bench-scale testing, to aid the interpretation of each phase of bench-scale testing results.

Phase 1 – Treatment Reagent Demand Testing

This phase is completed to evaluate the site-specific physical and chemical parameters affecting chemical fixation processes. The reagent demand testing phase evaluates the amount and concentration of various reagents required to shift the groundwater pH or influence the oxidation reduction potential (ORP) to conditions favorable for inducing a decrease in target constituent(s) concentration in groundwater. Titrations tests may be completed during this phase of the testing to evaluate the amount of reagent necessary to induce the desired geochemical change while considering the natural buffering capacity of site soils. Following the titration tests, various reagent concentrations are tested over a set reaction duration to evaluate the effectiveness of the various applications while also monitoring for potential adverse effects (e.g., increased concentrations of non-target constituents). The results of Phase 1 testing are used to determine which reagents and doses are carried over to Phase 2 testing.

Phase 2 – Batch (Microcosm) Testing

This phase is designed to simulate potential site-specific conditions under treatment with the selected reagents and evaluate their efficacy to induce attenuation of target constituents in groundwater as batches of untreated groundwater mix with treated soil. The microcosm test consists of a site-specific soil to groundwater ratio designed to mimic the estimated field conditions, with reagent dosing guided by the results from the Phase 1 testing. Following an initial treatment and reaction interval, the groundwater in the microcosm is collected and analyzed. The microcosm groundwater is replaced with fresh site-specific groundwater at the same soil to water ratio, but no additional treatment reagent is added. This cycle is repeated a number of times, yielding information about the potential longevity of a single treatment application and providing further insight as to the potential for adverse effects (e.g., increased concentrations of non-target constituents). These results guide the selection of reagents for Phase 3 testing.

Phase 3 – Column Testing

The third and final phase of bench-scale testing is designed to simulate groundwater flow through site-specific soil treated with the reagents selected based on the results of testing Phases 1 and 2. Additional parameters that influence the design include site-specific groundwater flow rates, hydraulic characteristics of reagents and soil, anticipated reaction rates, and required residence time. This phase of testing allows for evaluation of reagent dosing levels and frequency required to maintain attenuation of dissolved metals based on breakthrough analysis of target constituents. The duration of the test is determined based on test performance and observed breakthrough of constituents.

The treatment reagents for bench-scale testing are selected based on their potential to meet the following performance criteria:

- Can be handled and used safely in both laboratory and field-scale implementation.
- Reduce target constituent concentrations to levels below the respective GWPS in a form that is stable in the environment.
- Minimize the mobilization of non-target constituents existing in the soil and maintain concentrations below GWPS.

While the bench-scale *in situ* treatability testing evaluates reagents capable of inducing a decrease in the concentration of a target metal, the testing is not capable of mimicking exact geochemical conditions that occur in the natural soil and groundwater water system when the reagent is introduced. Trends in metals that are observed in the laboratory during the test may differ from metal concentrations in the field due to the heterogeneous composition of the soil in the study area. In addition, metal concentrations may be affected by the introduction of external agents (e.g., atmospheric oxygen) when the samples are collected, prepared or analyzed in the laboratory setting. Laboratory testing also involves working with small quantities that are more easily mixed, typically resulting in more complete treatment than can be achieved in the field. Therefore, bench-scale observations are not expected to provide the same

resolution of data as its application in the field; however, bench-scale observations do provide guidance for future pilot-scale testing.

Once the phased treatment test approach has identified a reagent and dosing rate that meets the objectives of the bench-scale testing, a field pilot-scale test may be designed and implemented.

2.1 OBJECTIVES

Bench-scale *in situ* treatability testing was performed to evaluate various reagents to promote cobalt and cadmium concentration reductions in a controlled laboratory setting using soil and groundwater samples collected from or near downgradient wells WBF-104 and WBF-106, where cobalt and cadmium are the only constituents present in groundwater at concentrations above the GWPS. The specific objectives of this bench-scale testing program were to:

- Identify treatment reagents and required dosing rates to reduce concentrations of cobalt and cadmium below their GWPS
- Evaluate the ability of treatment reagents to sustain treatment over time (dosing rate and frequency)
- Evaluate the interaction of the treatment reagent(s) with site-specific soils and their influence on non-target constituent concentrations relative to the GWPS
- Evaluate the probable mechanisms of constituent concentration reduction and develop a qualitative understanding of their stability.

2.2 BACKGROUND AND APPROACH

The WBF Plant has been investigated and monitored to support hydrogeological, geotechnical, environmental, and engineering objectives of the TDEC Order. The hydrogeology of the Slag Disposal Area was reported in the WBF Plant *Environmental Assessment Report* (EAR) (TVA 2024). The horizontal groundwater flow direction in the uppermost aquifer is to the east-southeast toward the Tennessee River and groundwater flow in the vicinity of the unit is bounded to the east by the river. Table H.1-6 in *Appendix H.1 – Technical Evaluation of Hydrogeology* of the *Environmental Assessment Report* (TVA 2024) provides groundwater velocities calculated for the Slag Disposal Area CCR unit ranging from 35 to 40 feet per year.

Appendix H.1 – Geochemical Modeling Technical Memorandum describes the geochemical processes influencing the groundwater chemistry at the Slag Disposal Area CCR unit when groundwater flows through the subsurface (i.e., unconsolidated materials). The document describes the presence and abundance of geochemically reactive minerals that support adsorption and cation exchange processes, such as iron hydroxide or ferrihydrite and clays (such as smectite, illite, and kaolinite). CCR constituents detected in groundwater may be affected by these geochemical processes in groundwater, which may result in attenuation of the CCR constituents.

The *in situ* treatability tests aimed to find a reagent that adjusts groundwater pH to promote removal of cobalt and cadmium at a bench scale. Bench scale tests were designed to simulate conditions within the downgradient edge of the Slag Disposal Area CCR unit where the treatment would be implemented. The *in situ* treatability testing investigation was conducted between January 2022 and March 2023 using soil collected from borings WBF-SDA-SB02 and WBF-SDA-SB05 and groundwater from wells WBF-104 and WBF-106 in accordance with the *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021a).

2.3 SOIL AND GROUNDWATER COLLECTION

Site-specific soil and groundwater required for the bench-scale *in situ* treatability testing activities were collected following the *Supplemental Investigation Sampling and Analysis Plan Watts Bar Fossil Plant (*Stantec 2021b). Groundwater collection procedures are described in *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021a). Soil sampling occurred in accordance with the methodology outlined in *Opportunistic Sampling of Sediment for Geochemical Analysis* (Stantec 2021c). The scope of work for the collection of site-specific media for the *in situ* treatability testing included:

- Drilling and sampling of soil for use in treatability testing
- Collection of bulk groundwater samples for use in treatability testing.

A summary of the fieldwork and activities to collect soil and groundwater is included in the *Appendix I.2 - In Situ Treatment Investigation Fieldwork Summary* of the CARA Plan.

The following site-specific media were collected for the treatability tests:

- Soil from SB05 and groundwater from well WBF-104
- Soil from SB02 and groundwater from well WBF-106

Locations of the monitoring wells and soil borings are shown in Exhibit 1.

2.4 TREATABILITY TESTING

A bench-scale *in situ* treatability testing program was developed using data and analysis from the hydrogeologic investigations associated with the EAR and geochemical field work and modeling. Bench-scale treatability testing was conducted between January 2022 and March 2023 in accordance with the *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021b). The bench-scale tests were designed to simulate conditions within the downgradient perimeter of the Slag Disposal Area at wells WBF-104 and WBF-106, respectively, using soil and groundwater representative of the target area where the proposed treatment would be implemented.

The bench-scale *in situ* treatability testing consisted of the following activities in order:

1. Baseline characterization of the soil and groundwater to establish pre-testing concentrations of select constituents useful for interpretation of treatment results.
2. Reagent demand testing to evaluate how much reagent is needed to reduce concentrations of target constituents to below the respective GWPS.
3. Microcosm testing to evaluate the longevity of treatment in soil and groundwater from the CCR units through iterative addition of untreated groundwater to assess the re-dosing frequency.
4. Column testing to evaluate the efficacy of treatment over time and under simulated flow-through conditions.

2.4.1 Baseline Characterization

The objective of conducting baseline characterization of the soil and groundwater, specifically for the bench-scale *in situ* treatability testing, was to provide a basis for a quantitative comparison of pre- and post-test results. The baseline concentrations were used to assess initial conditions prior to reagent effectiveness testing and to evaluate the potential mechanisms contributing to the control of cobalt and cadmium concentrations in groundwater. Soil samples are difficult to preserve effectively after sampling and can undergo oxidation or reduction reactions, depending on soil conditions, which can influence baseline concentrations as well as reagent demand, microcosm, and column testing results. Groundwater baseline samples were analyzed in each test to ensure groundwater chemistry did not change significantly with time. The activities associated with sample preparation and analysis to establish baseline are described below.

2.4.1.1 Methods

<u>Baseline Soil</u>

Soil samples were collected in the field from the borings listed below, placed in sealed plastic bags, packed in coolers with ice to maintain a temperature of less than six degrees Celsius, and shipped to the Stantec Treatability Facility in Sylvania, Ohio. Upon receipt of the soil for treatability testing, saturated soil sub-samples were removed from the individual sample containers and composited across an interval comparable to the screened interval of the adjacent groundwater monitoring well (Table 1). The lithology of the uppermost aquifer for the WBF Plant includes alluvial sands and gravels. The uppermost aquifer is overlain by a less permeable clay-rich layer. Lithologic interpretations in boring logs for WBF-SDA-SB02 and WBF-SDA-SB05 confirm that the alluvial deposits in the area of interest consist mostly of alluvial clay underlain by alluvial sand and gravel lenses deposited on top of bedrock.

The largest gravels were removed prior to mixing and the soils were placed in a container and homogenized to the extent possible by mechanical mixing. Samples were not sieved to isolate a uniform grain size, thereby being more representative of *in situ* conditions with a trade-off of being less replicative between evaluation stages. Each soil composite was placed in a secondary container, labeled with the

composite sample identification, sealed, and stored at temperatures less than six degrees Celsius for subsequent sampling and testing. A grab sample was obtained from each of the soil composite samples and analyzed according to the baseline soil analysis suite in Table 2.

Baseline Groundwater

Groundwater samples were collected from each of the downgradient monitoring wells, WBF-104 and WBF-106, into Cubitainers®, packed in coolers with ice to maintain a temperature of less than six degrees Celsius, and shipped to the Stantec Treatability Facility in Sylvania, Ohio. Upon receipt, the Cubitainers® were again stored at temperatures less than six degrees Celsius. Sub-samples of stored groundwater were collected at the Stantec Treatability Facility in Sylvania, Ohio from each Cubitainer® used for a given phase of treatability testing and analyzed according to Table 3. Groundwater samples were packaged and submitted under chain-of-custody documentation to the approved laboratory to determine baseline concentrations of the analytical suite.

2.4.1.2 Results

Baseline Soil

In the context of the treatability testing program, soil characterization results were utilized primarily for the following:

1. Determine the primary reactive mineral phases that may be involved in geochemical reactions influenced by the treatment reagents that result in the reduction of CCR constituent concentrations, and
2. Quantify the mass of metal that may either be attenuated by or released from the soil[1].

Two soil samples were collected from boreholes near target groundwater wells and were composited into two samples for baseline testing: WBF-SS-SB05-10/30-01142022 (near well WBF-104) and WBF-SS-SB02-25/35-01142022 (near well WBF-106). The soil at each boring sample location is considered representative of the lithology in the screen interval of the associated groundwater well. For simplicity, these samples will be referred to as SB05 and SB02.

WBF-104/SB05

Baseline mineralogy results are presented in Table 4. Bulk mineralogy in SB05 was dominated by quartz (57 weight percent [wt%]), followed by clay minerals (17 wt%) and chlorite group minerals (15 wt%). Illite was the dominant clay mineral present in the sample. Feldspar minerals microcline and albite were present at 4 wt% and 6 wt%, respectively. Mineralogical analyses indicated the existence of iron (possibly siderite and ferrihydrite) and aluminum-rich (possibly gibbsite and boehmite) fractions within the soil.

[1] Further detail regarding the Sequential Extraction Procedure (SEP) methodology and interpretation of results is provided in the Geochemical Modeling Technical Memorandum provided as Appendix H.1 to the WBF Plant CARA Plan.

Sulfur speciation analytical results were mostly non-detect with an estimated percentage of 0.08% as sulfate (gypsum) sulfur. There was no detectable sulfur as pyritic sulfide in the soil sample from SB05.

Results of the sequential extraction procedure (SEP) for SB05 soil are presented in Table 5. The analysis reported a total cobalt and cadmium concentrations of approximately 8.79 milligrams per kilogram (mg/kg) and 0.34 mg/kg, with roughly 63% of the cobalt and cadmium, each, associated with the geochemical reactive phases, which include steps one, two, three, and four of the sequential extraction (primarily non-crystalline in step 3 and metal hydroxide phases in step 4).

WBF-106/SB02

Bulk mineralogy in SB02 was dominated by quartz (45 wt%), followed by clay minerals (24 wt%) and chlorite group minerals (11 wt%). Illite was the dominant clay mineral present in the sample. Feldspar minerals microcline and albite were present at 4 wt% and 5 wt%, respectively Mineralogical analyses indicated the existence of iron (possibly siderite and ferrihydrite) and calcium-rich (possibly calcite and gypsum) fractions within the soil. Sulfur speciation analytical results were mostly non-detect with an estimated percentage of 0.06% as sulfate (gypsum) sulfur. There was no detectable sulfur as pyritic sulfide in the soil sample from SB02.

Results of the SEP for SB02 soil analysis reported total cobalt concentrations of approximately 7.8 mg/kg and indicated that roughly 66% of the cobalt was associated with geochemically reactive phases (predominantly steps one through four).

Baseline Groundwater

Constituent concentrations in baseline groundwater were established for the bench-scale *in situ* treatability testing using groundwater samples collected from monitoring wells WBF-104 and WBF-106 downgradient of the Slag Disposal Area. The groundwater samples were collected and analyzed for a select suite of United States Environmental Protection Agency CCR Rule (Title 40, Code of Federal Regulations Part 257, Subpart D) Appendix IV CCR constituents that included arsenic, cadmium, cobalt, lithium, and molybdenum, as well as other constituents including iron and manganese (Table 3). Cobalt and cadmium concentrations were monitored throughout the testing program because they were found to be above the respective GWPS at various locations across the WBF Plant. Arsenic, lithium, and molybdenum were monitored throughout the testing program to evaluate the potential for concurrent responses during and after treatment. Molybdenum and lithium concentrations were not analyzed in the baseline groundwater samples but were tested in subsequent phases (microcosm and column tests). Iron and manganese were the primary geochemically reactive metals that can form adsorbent mineral phases and were similarly monitored throughout the testing program to provide information about the geochemical response of the system to the various treatment reagents. Results from the baseline groundwater characterization are presented in Table 6.

WBF-104

The baseline dissolved cobalt concentration in the groundwater sample collected from WBF-104 was 581 micrograms per liter (µg/L), above the GWPS. The baseline dissolved cadmium concentration was above

the GWPS and at a value of 54.7 µg/L. Concentrations of the other dissolved CCR constituents were below their respective GWPS, with arsenic at 2.24 µg/L. Dissolved iron concentrations were 19.5 µg/L and dissolved manganese concentration was 86,600 µg/L.

WBF-106

The baseline dissolved cobalt concentration in the groundwater sample collected from WBF-106 was 62.9 µg/L, above the GWPS of 6 µg/L. Concentrations of the other dissolved CCR constituents were below their respective GWPS, with cadmium at an estimated value of 0.686 µg/L and arsenic at an estimated value of 0.313 µg/L. Dissolved iron and manganese concentrations were 19,200 µg/L and 12,700 µg/L, respectively.

2.4.2 Reagent Demand Tests

Bench-scale reagent demand testing representative of the Slag Disposal Area involved evaluation of the mass or volume (depending on reagent disposition) and concentration of reagent required to raise the groundwater pH and simultaneously cause a decrease in the concentrations of cobalt and cadmium while maintaining non-target constituents below their respective GWPS. The pH was incrementally adjusted to a neutral to slightly alkaline level (pH 7.00 to 8.00 standard units [SU]) to evaluate the system response.

Bench-scale reagent demand testing representative of the Slag Disposal Area involved evaluation of the volume and concentration of reagent required to enhance oxidation and simultaneously cause a decrease in the concentrations of cobalt and cadmium while maintaining non-target constituents below their respective GWPS. An oxidant was incrementally added to evaluate the system response.

2.4.2.1 Methods

Bench-scale reagent demand testing consisted of a fixed mass of soil from each composite sample (SB05 and SB02) and volume of groundwater of the corresponding well (WBF-104 and WBF-106) at a 40:60 (e.g. 150/225 or 300/450) ratio by mass. Each test consisted of approximately 150 grams (g) of soil and 225 milliliters (mL) of site groundwater that was placed in a sealed glass container and manually stirred/shaken. The ratio of soil to groundwater was maintained at a constant value throughout the testing phase.

The term ‘Control’ in the following discussion of reagent demand tests results refers to a comparable mixture of groundwater and soil with no treatment reagent added, and ‘Test’ refers to a comparable mixture of groundwater and soil dosed with treatment reagent. Due to testing design, there may be more than one Control that is used that correlates with specific CCR units and testing dates.

A specific volume or mass of the reagents, referred to as dose, was introduced to each Test. The reagents evaluated included: limestone – manufactured sand (LSMS), sodium hydroxide (NaOH), and sodium bicarbonate ($NaHCO_3$). The form, concentration, and manufacturer of each reagent is presented in Table 8. Two to three doses of LSMS, NaOH, and $NaHCO_3$ were tested in each soil and groundwater mixture (Table 9). Test containers for each soil, groundwater, and reagent dose were reacted and allowed to settle for a period of approximately two days, after which time a water sample was collected and

analyzed for general chemistry and select dissolved metals concentrations (arsenic, cadmium, cobalt, lithium, iron, and manganese) according to Table 9.

2.4.2.2 Results

Table 9 summarizes the bench-scale reagent demand test results. Results are described separately for each groundwater monitoring well in the following sub-sections.

WBF-104

Bench-scale reagent demand tests for the material collected from the area around groundwater monitoring well WBF-104 were conducted using LSMS, NaOH, and $NaHCO_3$ reagents. Findings of the bench-scale reagent demand tests include:

Control

- The pH was 5.33 SU
- Cobalt was reported above the GWPS at a concentration of 228 µg/L
- The arsenic concentration was below the GWPS at an estimated concentration of 0.631 µg/L
- The cadmium concentration was above the GWPS at a concentration of 17.2 µg/L.

Limestone Manufactured Sand (LSMS)

- LSMS reagent was evaluated at incremental additions of 3.33 and 6.67 percent (%).
- The pH increased to a maximum of 7.62 SU at the highest dose.
- Cobalt concentrations decreased with increasing dose from 102 to 82.5 µg/L but remained above the GWPS.
- Arsenic concentrations decreased slightly with increasing dose from 0.956 to 0.441 µg/L and were below the GWPS.
- Cadmium concentrations decreased to below the GWPS and increased slightly with increasing dose from 1.99 to 2.71 µg/L.

Sodium Hydroxide (NaOH)

- NaOH reagent was evaluated at incremental additions of 0.0533, 0.0667, and 0.0800%.
- The pH increased with increasing to a maximum of 7.83 SU at the highest dose.
- Cobalt concentrations decreased to 4.81 µg/L at the highest dose. The cobalt concentration in the low and intermediate doses were above the GWPS.

- Arsenic concentrations fluctuated with the highest concentration of 2.07 µg/L (below the GWPS) observed at the highest dose.
- Cadmium concentrations decreased with increasing dose to below the reporting limit (0.217 µg/L), with concentrations below the GWPS in each of the Tests.

Sodium Bicarbonate ($NaHCO_3$)

- $NaHCO_3$ reagent was evaluated at incremental additions of 3.33, 6.67, and 13.3%.
- The pH increased to a maximum 7.62 SU at the highest dose.
- Cobalt concentrations increased slightly with increasing dose from 27.3 to 28.1 µg/Land remained above the GWPS.
- Arsenic concentrations increased with increasing dose to above the GWPS in the intermediate (16.9 µg/L) and highest dose (40.5 µg/L).
- Cadmium concentrations decreased to below the detection limit (2.17 µg/L) and GWPS in each of the Tests.

The reagent demand tests indicated that increasing the pH in groundwater from monitoring well WBF-104 decreased cobalt and suggest site soil has the capacity to naturally attenuate dissolved cadmium. However, only treatment with NaOH achieved a reduction in cobalt concentrations to below the GWPS. Molybdenum and lithium concentrations were not analyzed in the NaOH reagent demand tests but were tested in the $NaHCO_3$ reagent demand test and subsequent phases. Based on the results observed, the dose of 0.080% NaOH yielded the most favorable outcome in terms of maintaining concentrations of each constituent evaluated below their respective GWPS, and as such, NaOH is recommended for further evaluation in the WBF-104 microcosm testing phase.

WBF-106

Reagent demand tests for the material from the area around groundwater monitoring well WBF-106 were conducted using LSMS, NaOH and $NaHCO_3$ reagents. Findings of the reagent demand tests include:

Control

- The pH was reported at 5.37 SU.
- Cobalt concentration was reported above the GWPS at 189 µg/L.
- The arsenic concentration was below the GWPS at 1.11 µg/L.
- The cadmium concentration was above the GWPS at 6.46 µg/L.

Limestone Manufactured Sand (LSMS)

- LSMS reagent was evaluated at incremental additions of 3.33 and 6.67%.
- The pH increased to a maximum of 7.81 SU at the highest dose.
- Cobalt concentrations decreased to 12.9 ug/L at the low dose and 14.7 ug/L at the highest dose but remained above the GWPS.
- Arsenic concentrations decreased slightly to 0.811 µg/L and remained below the GWPS.
- Cadmium concentrations decreased to below the reporting limit (0.217 µg/L) and GWPS.

Sodium Hydroxide (NaOH)

- NaOH reagent was evaluated at incremental additions of 0.0267, 0.0356, and 0.0444%.
- The pH increased to a maximum of 7.71 SU at the highest dose.
- Cobalt concentrations decreased with increasing dose, ranging from above the GWPS at the lowest dose (8.08 µg/L) to below the GWPS in the intermediate (3.33 µg/L) and highest dose (2.15 µg/L).
- Arsenic concentrations were at or below 2.29 µg/L and less than the GWPS.
- Cadmium concentrations were below the reporting limit and the GWPS in each of the three doses tested.

Sodium Bicarbonate ($NaHCO_3$)

- $NaHCO_3$ reagent was evaluated at incremental additions of 0.667, 3.33, and 6.67%.
- The pH increased from to a maximum of 7.62 SU at the highest dose.
- Cobalt, arsenic, and cadmium concentrations decreased to below the reporting limit and were below the respective GWPS in each of the Tests.

Similar to results at WBF-104, the bench-scale reagent demand tests indicated that, except for limestone, increasing the groundwater pH in the vicinity of monitoring well WBF-106 decreased cobalt concentrations. The intermediate dose of NaOH (0.0356 wt%) and the lowest dose of $NaHCO_3$ (0.667 wt%) yielded favorable outcomes in terms of maintaining concentrations of each of the constituents evaluated below their respective GWPS, and as such, both reagents are recommended for further evaluation in the WBF-106 microcosm testing phase.

2.4.3 Microcosm Testing

Microcosm testing consisted of an initial dose of reagent into soil and groundwater followed by repeated flushing with untreated groundwater. Redosing with selected reagents was performed to raise the pH as

needed. Sodium hydroxide, NaOH, and sodium bicarbonate, $NaHCO_3$, were selected for this phase of the testing based on the results from the bench-scale reagent demand tests. The microcosm testing methods and results are described in the following sub-sections.

2.4.3.1 Methods

The microcosm testing was conducted using soils from SB05 and SB02 and groundwater collected from WBF-104 and WBF-106 monitoring wells to represent the Slag Disposal Area. Five microcosms were prepared: (1) WBF-104 Control, (2) WBF-104 NaOH, (3) WBF-106 Control, (4) WBF-106 NaOH, and (5) WBF-106 $NaHCO_3$. Each microcosm consisted of a one-gallon container with a drain valve connected at the base loaded with approximately 474 g of the soil composite sample and 675 mL of groundwater. The microcosms were treated with an initial dose of the reagent to bring the pH within 7.00 to 8.00 SU (identified as the target pH).

The Control and Test microcosms were drained and sampled for the microcosm test analytical suite (Table 3) at periodic intervals through the end of testing, as shown in Table 9. Following sampling, the microcosms were recharged with 675 mL of untreated groundwater. The microcosms were agitated for a few seconds after each recharge to mix the new aliquot of groundwater with the soil. Each microcosm was allowed to react for a total testing time of 42 days.

2.4.3.2 Results

Results of the microcosm tests are presented in Table 10. Results are discussed below in relation to values and concentrations of groundwater as compared to those in Control and Test samples.

WBF-104

Control

- The initial pH ranged from 5.48 to 5.74 SU.
- Cobalt and cadmium exceeded the GWPS with concentrations ranging from 394 to 619 µg/L and 34.1 to 48.6 µg/L, respectively.

Sodium Hydroxide (NaOH)

- Following the initial NaOH addition to the microcosm, the pH increased to 8.86 SU and then decreased over time. Redosing on Day 32 with 5 mL of 1 wt% NaOH increased the pH from 7.10 to 7.31 SU that was then followed by another decrease.
- NaOH treatment reduced cobalt to 14.8 µg/L and cadmium to less than the reporting limit (0.354 µg/L) at the start of the study.
- Cobalt concentrations never dropped below the GWPS and exhibited steadily increasing trends after reagent doses were applied.

- Cadmium decreased to below the GWPS after the initial dose and then increased above the GWPS by Day 21 and remained above the GWPS even after redosing on Day 32.
- Arsenic increased above the GWPS in the first test (14.7 µg/L on Day 4), and then steadily decreased and was below the GWPS during the remainder of the test.
- Lithium was unaffected by treatment and remained below the GWPS.
- Molybdenum concentrations increased above the Control (but below the GWPS) at the start of the test and then steadily decreased during the remainder of the test.

The microcosm testing results indicate that native soil from the area around WBF-104 has the capacity to sorb cobalt and cadmium when the pH in groundwater is adjusted with NaOH, although not at the level required to treat them to below their respective GWPS based on the conditions tested. Also, there is the potential of mobilizing arsenic above its respective GWPS.

WBF-106

Control

- Mixing the soil and groundwater in the Control changed the initial pH of the WBF-106 groundwater from a pH of 5.82 to 5.84 to 5.53 SU. The pH subsequently increased slightly during the remainder of the test.
- Cobalt concentrations decreased in the Control compared to the baseline groundwater sample (54.7/65.6 µg/L) and remained relatively consistent during the test ranging from 25.5 to 34.3 µg/L, with all results above the GWPS.

Sodium Hydroxide (NaOH)

- NaOH addition to the microcosm resulted in increased pH to 8.31 SU on Day 4. During the remainder of the test, pH was maintained between 6.82 to 7.48 SU by re-dosing with 10 mL of 1 wt% NaOH on Days 21, 25, 32, and 39.
- Cobalt dropped below the GWPS after the initial dose (3.8 µg/L on Day 4) and then steadily increased to 30.7 ug/L on Day 21 when the microcosm was re-dosed. Cobalt concentrations then fluctuated as the microcosm was re-dosed three additional times with two sample results falling below the GWPS (3.52 µg/L on Day 28 and 1.35 µg/L on Day 35).
- Arsenic, cadmium, lithium, and molybdenum concentrations were not detected above their respective GWPS during treatment.

Sodium Bicarbonate ($NaHCO_3$)

- Sodium bicarbonate addition to the microcosm resulted in increased pH to 7.33 SU on Day 4. The pH was relatively stable during the test, ranging from 6.96 to 7.29 until Day 39 when the microcosm was re-dosed with 0.5 grams of $NaHCO_3$, raising the pH to 7.68 SU.

- Cobalt concentrations dropped below the GWPS after the initial dose (1.84 µg/L Day 4) and increased above the GWPS in the subsequent days (9.93 µg/L on Day 7). Concentrations then remained slightly above the GWPS for the remainder of the test, ranging from 6.09 to 15.9 µg/L, with the exception of two Tests (5.12 µg/L on Day 11 and 5.45 µg/L on Day 42 after re-dosing).
- Arsenic, cadmium, lithium, and molybdenum concentrations were not detected above their respective GWPS during treatment.

The microcosm testing results indicate that native soil from the area around WBF-106 has the capacity to sorb cobalt when pH is adjusted. Treatment with NaOH and $NaHCO_3$ did not increase arsenic, cadmium, lithium, and molybdenum concentrations above their respective GWPS, even after re-dosing. This suggests that a higher dose of NaOH could be applied to achieve cobalt GWPS without mobilizing other constituents.

Summary

The microcosm tests applied to WBF-104 and WBF-106 groundwater suggest that both NaOH and $NaHCO_3$ reagents have the potential to treat cobalt. $NaHCO_3$ performed well in the WBF-106 microcosm test; however, arsenic was mobilized in the WBF-106 reagent demand test. Therefore, only NaOH was selected for evaluation in the column phase test. Higher concentrations and/or repeated, frequent re-dosing of the reagents may be necessary to achieve the GWPS.

2.4.4 Column Testing

Column testing was designed to simulate injection of an aqueous reagent (NaOH) into the groundwater system under simulated groundwater flow conditions. The column test design used the groundwater collected from monitoring wells WBF-104 and WBF-106 and flow rates representative of the natural hydrogeological system. Column size was configured based on the effluent volume required for laboratory analysis, established groundwater flow rate, and soil mass available for testing.

2.4.4.1 Methods

The standard configuration for the column testing and consisted of a two-inch inner diameter, 12-inch long polyvinyl chloride (PVC) columns. The columns were oriented vertically and slowly filled and carefully packed with soil composite sample to achieve uniform deposition and avoid potential void spaces or short circuiting. The bottom and top of each column media bed were lined with a layer of glass wool and silica sand to prevent loss of soil from the columns during testing activities. The column inflow and outflow lines were equipped with isolation valves and sample ports.

Four columns were prepared for testing: (1) WBF-104 Control, (2) WBF-104 NaOH, (3) WBF-106 Control, and (4) WBF-106 NaOH. The WBF-104 Control and NaOH columns used soil composited from boring WBF-SDA-SB05 and groundwater from monitoring well WBF-104. The WBF-106 Control and NaOH columns used soil from boring WBF-SDA-SB02 and groundwater from well WBF-106.

No reagent was added to the Control columns. In the Test columns, NaOH was periodically injected into the glass wool near the influent port with the intent to maintain the pH within the target range (i.e., 7.00 to 8.00 SU). The WBF-104 NaOH column was initially dosed with 46 mL of 1 wt% NaOH solution on Day 0 and was re-dosed with 25, 50, and 15 mL of NaOH on Days 5, 7, and 15, respectively. The WBF-106 NaOH column was dosed with 40 mL of 1 wt% NaOH amendment at Day 0 and re-dosed with 25, 50, and 15 mL of NaOH on Days 5, 7, and 15, respectively.

Influent and effluent samples were collected periodically from each column to evaluate performance. The samples were analyzed in the Stantec Treatability Facility for pH, oxidation-reduction potential (ORP), specific conductance, total dissolved solids, and temperature. Split samples were sent to Eurofins Test America for dissolved metals and anion analysis. The influent groundwater was sampled and tested for the analysis suite in Table 3 for quality purposes and was held in a collapsible Tedlar® bag throughout the duration of the test to minimize aeration of the influent water during testing. Effluent water to be sampled was similarly collected in a small collapsible Tedlar® bag to minimize aeration of the sampled water.

2.4.4.2 Results

Results of the column tests are presented in Table 11 and findings are described in the following sub-sections.

WBF-104

Control Column

- pH values decreased from 5.83 SU in the groundwater to 5.29 SU in the Control on Day 2. The pH continued to decrease to 4.51 SU on Day 7 before slowly increasing to 5.46 SU by the end of the test (Day 23).
- Cobalt concentrations remained above the GWPS for the entirety of the test. Concentrations initially decreased in the Control to 154 µg/L by Day 3, compared to an initial concentration of 565 µg/L as measured in the groundwater from monitoring well WBF-104. Cobalt concentrations subsequently increased and fluctuated between and 160 and 373 µg/L for the remainder of the test.
- Cadmium concentrations also decreased from 51.0 µg/L in the groundwater to 12.3 µg/L in the Control by Day 3. The concentration increased in the following days and remained above the GWPS for the entirety of the test.
- Arsenic, lithium, and molybdenum remained below their respective GWPS throughout the test.

WBF-104 NaOH Column

- The pH increased to 6.35 SU on Day 2 after the initial NaOH dose and reached the target range (7.0 to 8.0 SU) with a pH of 8.01 on Day 9 following redosing of 25 and 50 mL on Days 5 and 7, respectively.
- Cobalt decreased from 161 µg/L on Day 2 to the lowest concentration measured during the test of 29.7 µg/L on Day 9, which corresponded to the pH reaching the target range. However, the pH subsequently increased and never achieved the GWPS during the test.
- Cadmium concentrations decreased steadily to below the GWPS on Day 9 (1.93 µg/L). However, concentrations subsequently increased to above the GWPS (with the exception of the last result on Day 23) despite the pH being within the target range of 7.0 to 8.0 SU.
- Arsenic, lithium, and molybdenum remained below their respective GWPS throughout the test.

Results from the column test conducted with media from the area surrounding monitoring well WBF-104 indicate that the dose of NaOH applied to the influent groundwater raised the pH to the target range of 7.00 to 8.00 SU and resulted in significant decreases in dissolved cobalt and cadmium concentrations. However, cobalt did not decrease to below the GWPS and cadmium concentrations below the GWPS could not be consistently maintained.

WBF-106

Control Column

- pH values in the Control were slightly lower than pH in the groundwater, ranging from 5.56 SU (Day 2) to 4.32 SU (Day 7)
- Cobalt concentrations were above the GWPS throughout the test and exhibited a steadily decreasing trend with an initial concentration of 1,390 µg/L on Day 2 and 122 µg/L on Day 23
- Cadmium was higher in the Control, exceeding the GWPS, compared to the groundwater which had an initial concentration of 0.514 µg/L. Concentrations in the Control exhibited a steadily decreasing trend during the test with an initial concentration of 50.9 µg/L on Day 2 and a concentration of 6.14 µg/L (near the GWPS) on Day 23.
- Arsenic and lithium concentrations were also higher in the Control compared to the groundwater, with initial lithium concentrations in the Control exceeding the GWPS. Concentrations of both constituents decreased during the test with lithium dropping below the GWPS by Day 7.
- Molybdenum was below the reporting limit and the GWPS for the entirety of the test.

WBF-106 NaOH Column

- The target pH increased to 6.54 SU following the initial NaOH dose but did not achieve the target pH range until Day 9 (slightly above the range with a pH of 8.13 SU) after two additional NaOH doses of 25 and 50 mL. The pH remained within the target range for the remainder of the test.
- Cobalt concentrations were lower than the Control but remained above the GWPS for the entirety of the test. Cobalt decreased from an initial concentration of 482 µg/L on Day 2 to a low of 11.9 µg/L on Day 9 (corresponding to the pH achieving the target range) and subsequently increased to 41.0 µg/L before decreasing again to 13.9 µg/L by the end of the test.
- Arsenic and lithium concentrations were higher in the NaOH Test column compared to the groundwater, with an initial lithium concentration (51.5 µg/L) exceeding the GWPS. Concentrations of both constituents decreased during the test with lithium dropping below the GWPS by Day 3.
- Cadmium concentrations in the NaOH Test column were higher than groundwater but less than the Control. An initial concentration of 17.8 µg/L on Day 2 exceeded the GPWS, and then, with the exception of Day 7, concentrations decreased to below the GWPS for the remainder of the test.
- Molybdenum concentrations were below the reporting limit and the GWPS during the test.

Similar to WBF-104, results from the column test conducted with media from the area surrounding monitoring well WBF-106 indicate that the dose of NaOH applied to the influent groundwater raised pH to the target range of 7.00 to 8.00 SU and resulted in significant decreases in dissolved cobalt. However, cobalt concentrations were not reduced to below the GWPS and suggest the target pH could have been set at a higher level.

Summary

Treatment with NaOH in the columns increased the pH to the target range, and in some cases resulted in significant decreases in cobalt concentrations in media from both areas (WBF-104 and WBF-106) and a reduction in cadmium below the GWPS in media from WBF-104. However, the results of the column testing suggest that a higher dose of NaOH may be needed to reduce and maintain cobalt and cadmium concentrations below the GWPS.

2.4.5 Supplemental Column Testing

Since the results of the first round of column testing showed favorable results with the NaOH dosage but did not consistently reduce cobalt and cadmium concentrations to below the respective GWPS, a supplemental round of column testing was performed to evaluate higher doses of NaOH, as well as a mixture of ferric chloride ($FeCl_3$) and NaOH.

Sodium Hydroxide Testing

Soil composited from boring WBF-SDA-SB05 and groundwater from monitoring well WBF-104 were used to prepare four columns for testing: (1) WBF-104 Control, (2) WBF-104 3 wt% NaOH, (3) WBF-104 5 wt% NaOH, and (4) WBF-104 7 wt% NaOH. In each of the columns, site groundwater was pumped through the column at a constant rate of 0.15 mL/min. No reagent was added to the Control column. In the Test columns, the varying concentrations of NaOH were periodically injected into the glass wool near the influent port with the intent to maintain the pH within a target range of 8.00 to 8.50 SU.

Influent and effluent samples were collected periodically from each column to evaluate performance. The samples were analyzed in the Stantec Treatability Facility for pH, ORP, specific conductance, TDS, and temperature, and split samples were sent to Eurofins Test America for the dissolved metals and anion analyses outlined in Table 3.

Testing results are summarized in Table 12. The following observations are based on the preliminary results:

- Cobalt and cadmium concentrations were reduced to below the respective GWPS by Day 23 in each of the test columns when the corresponding pH was near or above 8.00 SU
- The column dosed with 7 wt% NaOH appeared to overdose the system resulting in pH values above the target range (greater than 8.50 SU)
- Arsenic concentrations were observed above the GWPS in each of the test columns but decreased to below the GWPS by Day 23 in the columns dosed with 5 and 7 wt%
- Overall, the preliminary data indicate that the 5 wt% NaOH test column was best able to attain the targeted pH range and achieve the GWPS for cobalt and cadmium while also maintaining the concentrations of other metals (e.g., arsenic) below GWPS.

Ferric Chloride and Sodium Hydroxide Testing

Ferric chloride addition was evaluated as a means of increasing iron sorption capacity. Since $FeCl_3$ is acidic and lowers the pH, NaOH was periodically added to increase and maintain the pH within the target range of 8.00 to 8.50 SU. The first test consisted of reagent demand testing using soil from soil boring WBF-SDA-SB05 and groundwater collected from monitoring well WBF-104. Each test consisted of approximately 150 g of soil and 300 mL of site groundwater that was placed in a sealed glass container and manually stirred/shaken. Six tests were prepared with 1 g of ferric chloride and varying amounts of 3 wt% NaOH to increase the pH to the target range: (1) WBF-104 Control, (2) WBF-104 $FeCl_3$ + 25 mL 3wt% NaOH, (3) WBF-104 $FeCl_3$ + 27 mL 3wt% NaOH, (4) WBF-104 $FeCl_3$ + 29 mL 3wt% NaOH, (5) WBF-104 $FeCl_3$ + 31 mL 3wt% NaOH, and (6) WBF-104 $FeCl_3$ + 33 mL 3wt% NaOH.

Effluent samples were collected after three days from each test to evaluate performance. The samples were analyzed in the Stantec Treatability Facility for pH, ORP, specific conductance, TDS, and temperature and split samples were sent to Eurofins Test America for the dissolved metals and anion

analyses outlined in Table 3. Preliminary results indicate each of the tests achieved the GWPS for cobalt and cadmium. The tests with $FeCl_3$ 1g and NaOH doses of 29 mL and 31 mL 3wt% NaOH increased the pH into the target range while the tests dosed with $FeCl_3$ 1g and 25 mL and 27 mL 3wt% NaOH were below the target pH range, and the test dosed with $FeCl_3$ 1g and 33 mL 3wt% NaOH was above the target pH range.

Column testing was subsequently performed based on the favorable results in the reagent demand tests. Soil composited from boring WBF-SDA-SB05 and groundwater from monitoring well WBF-104 were used to prepare four columns for testing: (1) WBF-104 Control, (2) WBF-104 $FeCl_3$ 1g + NaOH 3wt%, (3) WBF-104 $FeCl_3$ 2g + NaOH 3wt%, and (4) WBF-104 $FeCl_3$ 3g + NaOH 3wt%. In each of the columns, site groundwater was pumped through the column at a constant rate of 0.15 mL/min. No reagent was added to the Control column. In the Test columns, the varying concentrations of $FeCl_3$ and NaOH were periodically injected into the glass wool near the influent port with the intent to increase the pH within a target range of 8.00 to 8.50 SU.

Testing results are summarized in Table 13. The following observations are based on the preliminary results:

- The addition of NaOH did not achieve the target pH range of 8.00 to 8.50 SU, increasing the pH only from 4.89 to 5.35 SU in the Control, and only to above 7.0 SU in each of the test columns
- The column with 2 g of $FeCl_3$ achieved the GWPS for cobalt and cadmium concentrations only on Days 25 and 36. However, none of the other samples from the three test columns reduced both cobalt and cadmium to below the respective GWPS
- Overall, the preliminary data indicate that a dose of 2 g of $FeCl_3$ and 3 wt% NaOH could achieve the GWPS, though not consistently, and additional testing would be required to further evaluate effectiveness.

2.5 DATA QUALITY ASSESSMENT

The data generated through the bench-scale treatability testing program were used in support of evaluations for the CARA Plan. The treatability testing results were used qualitatively to assess generalized trends and system responses in relation to the application of a geochemically reactive treatment reagent in the presence of soil and groundwater. Quality Assurance/Quality Control (QA/QC) sampling was performed in general accordance with the *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021a) during the testing program to the degree practicable due to the limited quantity of soil and groundwater available and the need to maintain consistent soil to water ratios throughout the treatability testing program.

The QA/QC replicate sampling results are presented in Tables 10 and 11. The QA/QC samples were submitted to Eurofins Test America for dissolved metals analysis according to the analytical methods described in the *Coal Combustion Residuals Groundwater Monitoring and Investigation Quality Assurance Project Plan (QAPP), Revision 7*, December 2023 (Environmental Standards, Inc [EnvStds]

2023). The replicate samples were qualitatively compared with the parent sample results but demonstrate that a degree of heterogeneity exists within the soil matrix that resulted in variability in the data. Even with the observed heterogeneity, the results from the WBF Plant treatability testing program established a predictable trend of increasing or decreasing constituent concentrations in response to the progressive increase in reagent dosage that is consistent with fundamental geochemical principals.

QA/QC of the baseline, bench-scale reagent demand, microcosm, and column test results were conducted and verified by Stantec personnel in accordance with the *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021a). The baseline, microcosm, and column testing analytical results were also final verified or validated as specified in the QAPP (2023) by EnvStds.

2.6 SUMMARY

The bench-scale treatability testing program for the WBF Plant evaluated the viability of *in situ* groundwater treatment using geochemical adjustments to reduce concentrations of cobalt and cadmium in groundwater downgradient of the Slag Disposal Area CCR Unit without mobilizing other Appendix IV constituents above their GWPS. The results of this bench-scale testing program were used in a qualitative sense to assess generalized trends and system responses in relation to the application of a geochemically reactive treatment reagent in the presence of soil and groundwater collected from the WBF Plant.

The treatment reagents evaluated were selected predominantly for their tendency to neutralize groundwater pH to a target range between 7.0 and 8.0 SU and take advantage of the natural sorption characteristics of metals, such as cobalt and cadmium in groundwater, on naturally occurring soil phase minerals. The reagents evaluated included limestone manufactured sand, sodium hydroxide, and sodium bicarbonate.

The bench-scale treatability testing program consisted of the following series of progressively more complex phases of testing:

- Baseline characterization of soil and groundwater collected to establish pre-testing concentrations of select constituents useful for interpretation of treatment results
- Bench-scale reagent demand testing to evaluate the amount of reagent required to reduce concentrations of CCR constituents in groundwater to below the respective GWPS
- Microcosm testing to evaluate the groundwater volume treated with a given dose of reagent and to estimate the necessary dosing frequency
- Column testing to evaluate the efficacy of treatment over time and under flow-through conditions.

The reagent demand testing represented only a snapshot in time and does not fully capture the dynamic nature of the groundwater system, whereas the later phases of testing (i.e., the microcosm and column tests) provide closer approximations of the *in situ* system. The bench-scale testing is a simplification of

the natural hydrogeochemical system and is useful mainly in guiding further bench-scale or pilot-scale *in situ* testing used for full-scale practicability assessment.

Specific supporting observations from each of the phases of bench- scale testing are as follows:

Baseline Characterization

- The majority of cobalt bound within the soil matrix is associated with geochemically reactive mineral phases, particularly the exchangeable and metal hydroxide extraction steps of the sequential extraction procedure. Cobalt concentrations in the sum of the seven steps and total metal concentrations were close to and below the reporting limit.
- Similarly, approximately 99% of molybdenum is associated with the non-crystalline extraction step, with generally higher concentrations associated with the SB05 soils relative to SB02.
- Approximately 50 and 45% of the arsenic associated with the SB05 and SB02 soils, respectively, were observed to be related to the reactive phases. While this proportion of arsenic can be easily mobilized, the total concentrations in SB05 and SB02 were only 1.52 and 4.22 mg/kg, respectively.
- Cadmium and cobalt concentrations in WFB-104 groundwater and cobalt concentrations in WBF-106 groundwater were above the GWPS.

Reagent Demand Test

- Treatment with LSMS did not reduce cobalt concentrations below the GWPS in either sample.
- NaOH reagent doses of 0.0800 wt% in WBF-104 groundwater and 0.0356 wt% in WBF-106 groundwater resulted in cobalt concentrations below the GWPS. Arsenic concentrations increased slightly with increasing dosage in WBF-104, but values remained below the GWPS.
- Addition of $NaHCO_3$ resulted in cadmium below the GWPS in WBF-104 and cobalt below GWPS in WBF-106 but did not achieve the GWPS for cobalt in WBF-104.

Microcosm Test

- In WBF-104, cadmium and cobalt concentrations in the Control microcosm exceeded the GWPS and were less than the initial concentrations in the groundwater (cobalt from Day 11). Cadmium concentrations increased slightly and cobalt decreased slightly during the test. In WBF-106, cobalt in the Control was lower than the groundwater and remained stable above the GWPS while cadmium concentrations were higher than the groundwater but below the GWPS and decreased throughout the test.
- Treatment with NaOH resulted in significant decreases in cobalt in both the WBF-104 and WBF-106 microcosms, especially when the pH was greater than eight SU. However, only WBF-106 exhibited cobalt concentrations below the GWPS. In WBF-104, cadmium concentrations

decreased to below the GWPS only for the first 18 days of the test. Arsenic was initially mobilized above the GWPS but dropped back below the GWPS by Day 7 and remained below through the end of the test. In WBF-106, constituents analyzed other than cobalt were below their respective GWPS (i.e., were not mobilized).

- In WBF-106, treatment with $NaHCO_3$ increased the pH to within the target range for the entirety of the test with only one re-dosing required at Day 39. Cobalt concentrations were generally reduced; however, the effects appeared to be short-term as concentrations steadily increased to above the GWPS after dosing.

Column Test

- Treatment with NaOH significantly reduced cobalt concentrations in both WBF-104 and WBF-106 compared to groundwater samples and Controls. However, cobalt concentrations did not decrease to below the GWPS in either column.
- Arsenic and molybdenum were maintained below their respective GWPS in the WBF-104 and WBF-106 column effluent.
- Cadmium concentrations in WBF-104 decreased in comparison to the Control column although cadmium concentrations were reported above the GWPS through the remainder of the test except on Days 9 and 23, potentially due to re-dosing. Cadmium in the WBF-106 NaOH column decreased with respect to the Control column and to below the GWPS except for Days 2 and 7.
- Lithium was reported below the GWPS in WBF-104 columns and initially above the GWPS in the WBF-106 columns, however concentrations decreased to below the GWPS during the first week of testing.

Supplemental Column Test

- Increasing the NaOH dose to 5 wt% NaOH attained the targeted pH range and achieved the GWPS for cobalt and cadmium while also maintaining the concentrations of other metals below GWPS.
- Ferric chloride addition at a dose of 2 g $FeCl_3$ and 3 wt% NaOH achieved the GWPS only in limited discrete samples, and additional testing would be required to further evaluate overall effectiveness.

2.7 CONCLUSIONS

Conclusions from the WBF Plant bench-scale *in situ* treatability testing program are the following:

- The potential mechanism of cobalt and cadmium reduction was sorption through pH adjustment. The bench-scale treatability testing results demonstrated overall system response to the geochemical adjustments is consistent with the fundamental geochemical principles that govern metal mobility in groundwater.

- The results of the treatability testing identified one reagent, NaOH as having the greatest potential of the reagents evaluated to reduce cobalt and cadmium concentrations below the GWPS while maintaining arsenic, lithium, and molybdenum concentrations below their respective GWPS.
- The results suggested a higher pH, and as a result higher dosages of NaOH than were initially tested, are required to treat cobalt and cadmium to below the respective GWPS. Preliminary results of supplemental treatability testing using higher NaOH doses achieved the GWPS for cobalt and cadmium.
- A potential exists for lithium (and arsenic to a lesser extent) to be mobilized at concentrations that could exceed the GWPS if the groundwater pH is not effectively managed.
- The treatability testing showed that NaOH addition for pH adjustment to facilitate sorption has the potential to reduce the concentrations of cobalt and cadmium in groundwater at the bench scale. Based on results of the bench scale testing, work on a field-scale pilot study has begun as described in the sections below.

3.0 *IN SITU* TREATMENT TECHNOLOGY EVALUATION

In situ treatment was identified as a potential corrective action approach for the Slag Disposal Area CCR unit. Previous investigations have identified exceedances of cobalt and cadmium in groundwater from wells along the eastern perimeter of the Slag Disposal Area CCR unit. Establishing a permeable reactive barrier via injection is an industry-accepted technology for *in situ* groundwater treatment along remedial perimeters. The objective is to deliver reactive media (i.e., the reagent identified in the treatability testing phase) into the coarser grained intervals of the saturated zone that have higher transmissivities, and therefore greater groundwater flux, to intercept and treat groundwater. A variety of technologies can be used to deliver the reagent depending on the reagent form (i.e., solid, slurry, or aqueous), permeable reactive barrier (PRB) configurations, site conditions, and operational constraints. As demonstrated in the WBF Plant treatability tests, aqueous NaOH provided favorable results with respect to reducing cadmium and cobalt and, pending the results of an additional phase of microcosm and column testing to refine the dose, will be utilized as the reagent for *in situ* treatment of groundwater in the full-scale field application.

Three technologies were considered to deliver the aqueous NaOH reagent and establish a PRB in perimeter areas at the Slag Disposal Area CCR unit:

- Vertical Injection Wells
- Horizontal Injections Wells
- Funnel and Gate.

A comparative analysis was performed to evaluate the suitability of each technology in consideration of site-specific characteristics and constraints. Evaluation criteria included short- and long-term effectiveness, implementability and constructability, environmental and community impacts, operation and maintenance requirements, and total life cycle cost. This section provides a description of the unit-specific conditions and each delivery technology, summary of the comparative analysis, and recommendation of the preferred method.

3.1 UNIT-SPECIFIC CONSIDERATIONS

In situ treatment is being considered along the eastern perimeter of the Slag Disposal Area CCR unit. Unit-specific conditions considered during evaluation of the *in situ* treatment reagent deployment methods include:

- Current and future use of the Slag Disposal Area CCR unit area
- Perimeter treatment areas – location and length of perimeter treatment areas
- Hydrogeologic properties of the subsurface along the perimeter of the unit that will influence the delivery, transport, and reaction of the reagent – lithology and stratigraphy, depth, thickness, and

heterogeneity of the coarse-grained (i.e., transmissive) zone, groundwater velocity, occurrence of the confining foundation soils and bedrock

- Construction considerations – physical features and geometry of the Slag Disposal Area CCR unit, presence of Plant infrastructure (roads, boat ramps, ponds, water and power supply infrastructure), space limitations, and access restrictions for remedial technology construction equipment and treatment system installation. Geotechnical stability of the unit, perimeter dike, and features during and after construction, and potential interference with planned future infrastructure to improve geotechnical stability will also be considered as part of the construction considerations

- Ecological and community impacts – disturbance of native vegetation, truck traffic during remedial construction and treatment system operation, and potential for chemical spills.

3.1.1 Current and Future Use

Following the WBF Plant retirement in 1982, available slag was reclaimed for beneficial use between 1996 and 2005. In 2009, the Slag Disposal Area was capped with soil and closed in accordance with applicable regulations at the time. As such, there is no ongoing placement or planned future harvesting of CCR material or planned beneficial uses for the Slag Disposal Area CCR unit.

3.1.2 Treatment Perimeters

The *in situ* treatment areas along the perimeter of the Slag Disposal Area CCR unit are based on historical constituent concentrations in groundwater above GWPS in two wells (WBF-104 and WBF-106) and concentrations below the GWPS in WBF-101 and WBF-105. Treatment areas are also based on the interpreted groundwater flow direction near the CCR unit and the assumption *in situ* treatment will be implemented hydraulically downgradient of the CCR unit and upgradient of existing compliance groundwater monitoring wells. Groundwater concentrations compared to the GWPS at the WBF Plant CCR units are presented in Exhibit 2 and further discussed in the *Environmental Assessment Report* (TVA 2024). This TM evaluates in situ treatment to address groundwater conditions along the downgradient boundary of the Slag Disposal Area at wells WBF-104 and WBF-106. Groundwater conditions at well MW-1 are evaluated and discussed in Chapter 6.5 and Appendix D of the CARA Plan.

Two *in situ* treatment perimeters are being considered. One starts halfway between WBF-101 and WBF-104 and extends along the western perimeter to halfway between WBF-104 and WBF-105. The second treatment perimeter extends from halfway between WBF-105 and WBF-106 to the northern edge of the unit boundary and continues along the northern unit boundary west of WBF-106. The treatment perimeter extends west of WBF-106 to address potential groundwater flux influenced by the stormwater collection pond in the northeast corner of the Slag Disposal Area CCR unit. In total, the perimeter of the Slag Disposal Area CCR unit being considered for *in situ* treatment extends for approximately 1,500 linear feet.

3.1.3 Hydrogeologic and Geologic Considerations

The unconsolidated alluvial deposits above bedrock are considered to be the uppermost aquifer. Borehole logs show that the alluvial deposits consist of mostly alluvial clay underlain by alluvial sand and gravel lenses ranging from 10 to 32 feet thick deposited on top of bedrock. The alluvial clay layer forms a confining unit where groundwater is contained in and flows through the sand and gravel lenses under pressure. Most of the groundwater flow and geochemical reactions between groundwater and aquifer materials occur within the unconsolidated alluvium. The sand and gravel lenses in the unconsolidated alluvium create a transmissive zone beneath the unit that extends approximately 25 to 35 feet below ground surface along the proposed treatment perimeter that will be targeted for *in situ* treatment with a PRB. The transmissive zone along the treatment perimeter is interpreted using available borehole logs from borings drilled along the southern and eastern Slag Disposal Area CCR unit perimeter. While the available data indicate the transmissive zone extends along the entire treatment perimeter, additional activities (e.g., installation of additional monitoring wells or exploratory borings) may be performed during the design phase to further characterize the treatment perimeter.

The groundwater flow direction within the uppermost aquifer near the Slag Disposal Area CCR unit is to the east-southeast toward the Tennessee River and calculated groundwater velocities range from 35 to 40 feet per year.

3.1.4 Construction Considerations

The *in situ* treatment technology evaluation must consider the physical layout and operational constraints specific to the WBF Plant and Slag Disposal Area CCR unit. Factors include the treatment area, geometry, proximity to existing site features, site geography that may limit certain treatment technologies, geotechnical stability of the unit, and potential interference with planned future infrastructure to improve geotechnical stability of the unit and perimeter dike.

The dike road extends along the southern and eastern treatment perimeters, acting as an access route for equipment operation and staging during construction. However, the road is relatively narrow (approximately 15 feet on the southern boundary and 10 feet along the eastern boundary) and may not support large earth-moving equipment as presently constructed. Areas to the north and south of the proposed treatment perimeter offer potential equipment staging locations, if necessary. The area available to install a treatment technology along the CCR unit perimeter between WBF-104 and WBF-106 is limited in width and is restricted by the edge of the CCR unit and the western bank of the Tennessee River. As such, the installation of the PRB will likely be close to the downgradient compliance perimeter, limiting reaction time of injected reagents. Treatment technologies that can maximize the treatment contact time before the compliance wells will be prioritized.

Due to the treatment area proximity to the CCR unit dike along much of the downgradient perimeter, consideration of construction equipment size, weight and installation method is necessary for construction worker safety and dike integrity. The selected treatment technology should be installed and operated in a manner to minimize disturbance to the dike and existing CCR material. Furthermore, surface and subsurface infrastructure associated with the Watts Bar Nuclear Facility is located near the northern edge

of the unit and presents construction constraints in the area. A subsurface box culvert that connects a pond used for cooling water supply and discharge pond to the Tennessee River is located approximately 100 feet north of WBF-106 and 25 to 35 feet below the dike road. Several 24- and 48-inch pipes are located approximately 10 feet below ground surface north of WBF-106 and water supply lines connected to the nuclear facility, cooling pond, and nearby hydroelectric dam are located along the western boundary of the unit.

Geotechnical considerations related to installation, operation, or other long-term effects of a recommended *in situ* treatment technology will be considered as part of the system design. Geotechnical considerations may include the use of drilling fluids, equipment-induced vibrations during drilling, borehole spacing and layout geometry, backfilling techniques, proximity to existing site infrastructure, and hydraulic fracturing during fluid injection. As part of the CARA phase of the TDEC Order, TVA will be evaluating seismic mitigation alternatives at the Slag Disposal Area CCR unit. *In situ* treatment design may need to coordinate with future seismic mitigation efforts planned for the unit.

3.1.5 Ecological and Community Considerations

Consideration of short- and long-term risks to the surrounding environment during the implementation of the selected treatment remedy will be factored into treatment evaluation. The downgradient perimeter of the Slag Disposal Area CCR unit is located along the west bank of the Tennessee River, which is a sensitive receptor for physical, chemical, or biological byproducts associated with the implementation of the selected treatment technology. Due to the proximity of the treatment area to surface water, construction impacts, treatment reagent staging and installation, and operation and maintenance activities should be managed to minimize impacts to riparian ecology, sediment, and surface water quality. The bank of the Tennessee River along the downgradient perimeter of the Slag Disposal Area CCR unit is primarily free of native vegetation, apart from a few sparse trees along the edge of the dike which may require removal depending on excavation/grading requirements for the selected treatment technology.

The area surrounding the WBF Plant is primarily undeveloped and includes forest, agricultural areas, and rural residential areas, with the nearest residence located approximately 1.4 miles northwest of the WBF Plant in Spring City. Impacts to nearby communities would likely be related to construction traffic associated with the installation of the selected treatment technology.

3.2 *IN SITU* TREATMENT DEPLOYMENT METHODS

The following sections provide a description of each of the technologies considered for *in situ* treatment of groundwater and a summary of the comparative analysis.

3.2.1 Vertical Injection Wells

The use of vertical wells for reagent injection into shallow groundwater is well established and the most commonly used method for many environmental remediation applications. Injection of aqueous NaOH into vertical wells to establish a PRB would consist of installing a number of wells perpendicular to groundwater flow along the perimeter of the unit. Vertical borings would be advanced using a hollow stem

auger rig or sonic drill rig and an injection well would be constructed in the borehole by setting a well casing screened across the vertical interval of the course-grained transmissive zone. Wells would be constructed of Schedule 40 or 80 PVC piping which are compatible with the aqueous NaOH reagent.

Injection wells would be laterally spaced along the treatment perimeter using a calculated radius of influence based on hydraulic properties of the subsurface and design injection parameters (i.e., injection pressure and flow rate). A reagent mixing and delivery system (reagent and water storage tanks, metering and injection pumps, injection manifold, and associated valves and instrumentation) would be installed and connected to the injection wells. A design reagent volume and concentration would be delivered to each well to create a reactive zone around the screened injection interval. Injection wells would be spaced such that the radius of influence of each well overlaps, creating a continuous reactive barrier along the treatment perimeter. Injected reagent would migrate with advective groundwater flow requiring periodic re-injections to maintain the target pH in the reaction zone around the injection wells.

Utilizing vertical injection wells to install the PRB has benefits related to treatment effectiveness, constructability, minimal ecological risks, and total life-cycle costs. Vertical injection wells can be installed and well screens individually adjusted to accurately deliver reagent to the transmissive zone and establish a continuous PRB, even if the transmissive zone varies with depth or thickness or lithologic heterogeneities are present along the treatment perimeter. Vertical injection wells have a relatively small construction footprint. Use of hollow stem auger or sonic drilling methods does not require large equipment staging areas, and only generates soil spoils from borehole advancement, which can be easily managed along the riverbank. Drilling equipment would be able to navigate the relatively narrow dike roads to install wells along the perimeter with minimal excavation disturbance. The methods used for installing vertical injection wells would be the same as methods used to install existing monitoring wells located along the site perimeter and would have minimal effects on geotechnical stability at each well location.

The primary disadvantage of vertical injection wells is the number of wells required to establish the PRB along the treatment perimeters. A practical injection radius of influence is assumed to be approximately 5 to 15 feet and would need to overlap between injection wells. Given a total treatment perimeter of approximately 1,500 feet, this would require up to 150 individual injection wells to establish a continuous PRB. This would also require large volumes of reagent to establish the reaction zone which would need to be intermittently re-injected to maintain the long-term effectiveness of the PRB resulting in significant chemical and labor costs over the project lifecycle. In addition, with limited available distance between the edge of CCR material, the proposed injection wells, and the existing compliance perimeter, mixing and contact time between the injected reagent and groundwater would be limited, thereby reducing treatment effectiveness. A dedicated injection and conveyance system would be required to store, mix, and deliver the treatment reagent to the injection wells. The large number of injection points and large reagent volumes needed for vertical wells could complicate the injection conveyance infrastructure. Due to the length of the treatment perimeter, even a centrally located system would require long runs of conveyance lines to reach the most distal injection points. This would likely increase long-term operations and maintenance costs associated with the injection system, as the corrosivity of a caustic reagent such as NaOH generally leads to increased equipment maintenance.

3.2.2 Horizontal Injection Wells

The adaptation of horizontal directionally drilled (HDD) boring technologies to install horizontally aligned environmental wells has increasing widespread use over the past 30 years. Horizontal injection wells can be installed as single-ended (one entry point at ground surface) or double-ended (having an entry point and an exit point at ground surface). When site conditions allow, a double-ended horizontal well is recommended for most applications because well installation, development, and operation and maintenance can be more readily controlled using two access points to the well. Horizontal extraction wells are constructed by advancing a diagonal pilot hole from a shallow entry pit. The pilot holes are steered to the target depth (i.e., within the transmissive zone). The drill head is then remotely reoriented to traverse the targeted alignment horizontally. For a single ended horizontal well, the boring is terminated at the end of its horizontal traverse along the targeted injection interval. For a double ended horizontal well, the drill head is again reoriented along an upward diagonal to an exit pit. The pilot bit is replaced with an appropriately sized reaming bit and then rotated back through the pilot hole to enlarge the boring to the correct size and install the well casing and injection lines within the borehole. Each injection line within the well casing terminates in a well screen that is typically 5 to 30 feet long. Well screens are installed end to end to create a continuous injection plane along the length of the horizontal boring.

Horizontal injection wells deliver the reagent within the transmissive zone parallel to the treatment perimeter and would be installed along the downgradient southern and eastern unit boundaries. Multiple horizontal wells would be required for coverage of the treatment perimeter. The wells would be installed set back from the compliance perimeter to allow additional time for injected reagent transport, dispersion, and reaction time. Similar to the vertical injection well alternative, a reagent and water storage, mixing, and injection system would be installed and connected to the injection lines in each horizontal well, and reagent would be injected under pressure into the subsurface. A design volume and concentration of reagent would be delivered to each injection line to create a reaction zone around each screened horizontal interval. The injected reagent would migrate with advective groundwater movement requiring periodic re-injections of the reagent to maintain the reaction zone around the injection lines.

Utilizing horizontal injection wells to install the PRB has similar advantages to vertical wells, with several added benefits related to treatment effectiveness and constructability. Directional drilling offers the ability to set each horizontal well further upgradient (and potentially beneath the unit) from the compliance perimeter, creating additional time for dispersive mixing and treatment. The open screen area of a horizontal injection well in contact with the targeted transmissive zone is greater than that of a vertical well, which optimizes reagent delivery. One factor that can limit the effectiveness of horizontal wells is lithologic heterogeneity and the presence of fine-grained lenses within the coarser-grained transmissive zone. However, boring logs along the Slag Disposal Area CCR Unit perimeter show a relatively homogeneous and continuous coarse-grained transmissive zone.

Because horizontal wells have a single entry and exit point, they have a smaller construction footprint relative to linear treatment extent per well compared to vertical wells. Although the construction cost of HDD techniques relative to vertical drilling is generally more expensive, horizontal wells have the benefit of being able to access areas with limited or no surface access, or where remedial design calls for injection within a discrete alignment. Use of directional drilling equipment does not require a large

equipment staging area but does need more space than vertical wells for injection tooling and spoils management. HDD borings typically use drilling fluids to maintain the integrity of the boring during advancement, reaming, and well installation. Drilling fluids would be staged in an excavated mud pit or mud box and would need to be managed and dried prior to disposal.

Similar to vertical injection wells, a dedicated injection and conveyance system is required to store, mix, and deliver the treatment reagent to the horizontal wells. However, with fewer individual injection points and injection connections at each horizontal well head, conveyance piping is less extensive in comparison to vertical wells. Operationally, less conveyance line and smaller injection volumes are required compared to vertical injections which reduces long-term operations and maintenance cost.

There are several disadvantages associated with horizontal directional drilling and injection wells. While not prohibitive for implementation, horizontal directional drilling does require a larger construction footprint than the vertical well technology which would provide some constraints with installation locations and staging. Steering the pilot bore to target the transmissive zone can also be challenging, especially in softer lithologic materials, or where there is limited lithologic data along the boring path that confirms the vertical interval of the transmissive zone. This method would likely require additional exploratory borings to fill data gaps along the treatment perimeter to confirm the installation depth of each horizontal well. While a smaller casing is more flexible and can provide benefits for bending and turning, a larger diameter casing is stiffer and can be positioned more accurately. The bend radius of the pilot bore is dependent on the casing size which can limit the amount and number of bends when setting the horizontal injection well which can present challenges with certain well alignments.

3.2.3 Funnel and Gate

The funnel and gate technology consists of installing alternating low permeability barrier walls (funnels) and relatively higher permeability zones (gates) along the treatment perimeter. The funnel walls direct groundwater through the gates where reagent is delivered to create the PRB. A funnel and gate system at the Slag Disposal Area CCR unit would be installed using a continuous or one pass trencher, specialized equipment capable of excavating and backfilling a trench in a single pass. Funnels are typically constructed with a soil-cement-bentonite mixture while gates are constructed with a sand-gravel mixture to create a transmissive zone for groundwater flow and reagent emplacement.

A one pass trencher is capable of installing barriers at a variety of depths and widths, depending on the project needs. For application at the Slag Disposal Area CCR unit, the funnel and gate trench would be approximately three feet wide and 35 feet deep. The aqueous NaOH reagent would be injected into the gate sections via vertical or horizontal injection wells connected to a mixing and delivery system similar to the alternatives discussed previously.

Benefits of the funnel and gate systems include reducing the overall footprint and quantities of reagent required for treatment and reducing the available area of preferential pathways for contaminant migration along the treatment perimeter. The presence of lower permeability lenses within the transmissive zone can limit the distribution and transport of the injected reagent. By replacing the natural heterogeneous soils within the gate sections with homogeneous coarser grained material, the treatment reagent can be

more evenly distributed within the vertical interval of the transmissive zone. This optimizes reagent contact with groundwater, which may otherwise be affected by the presence of low permeability lenses if only utilizing the vertical or horizontal well delivery methods. While funnel and gate systems cost more than other alternatives to construct, there are decreased long-term operational costs. due to reducing the length of the treatment perimeter and the corresponding volume of injected reagent. Subsequently, total lifecycle costs associated with reagent injection and treatment system operation and maintenance is less than alternatives that install a PRB along the entire extent of the treatment perimeter.

There are several challenges associated with funnel and gate systems. System installation is an invasive approach that requires significant ground disturbance and excavation that may interfere with existing subsurface infrastructure. The one pass trencher is much larger and heavier than either vertical or horizontal drilling methods. Due to the narrow dike roads at the site where the one pass trencher would operate, additional site preparation (e.g., dike road widening) would likely be required prior for mobilization. The one pass trencher also generates more spoils than vertical or horizontal well installations, increasing waste management costs and increasing the risk to nearby surface waters due to spoils stockpiling. This method would require more strict dust mitigation and erosion and sediment control measures. While the one pass trencher equipment is regularly used on dikes or areas with similar concerns regarding geotechnical stability, this method does exert higher loading pressures and ground disturbances compared to vertical and horizontal well installation.

Due to the equipment requirements, material costs, and implementation time, this treatment method is the most expensive to implement of the three technologies considered. Furthermore, once the funnel and gate system is installed, additional mobilization would be required to install vertical or horizontal wells in the gate sections and a dedicated mixing and delivery system.

3.3 RECOMMENDED METHODS

Based on the comparison of *in situ* treatment technologies and site-specific considerations, injection of aqueous NaOH into a combination of horizontal and vertical wells is the recommended approach for *in situ* treatment at the Slag Disposal Area CCR unit. Horizontal wells will be the primary injection method to deliver the reagent along the identified treatment perimeters. Vertical wells will be utilized in the area west of WBF-106 where above and below ground infrastructure constrain the installation of horizontal wells.

4.0 PILOT TESTING

4.1 PILOT TEST OBJECTIVES

A pilot test was conducted to evaluate injection of aqueous NaOH solution as a treatment technology in the field and collect data for a full-scale system design. Details of the proposed pilot test are described in the *In Situ Treatment Pilot Test Work Plan* (Stantec 2024). Specific pilot test objectives were:

- Raise and maintain the pH to between 8.2 to 8.5 SU in and immediately downgradient of the injection wells (i.e., the reaction zone) and reduce cobalt and cadmium concentrations to below their respective GWPS in downgradient observation wells
- Evaluate the potential for mobilization of other CCR constituents
- Evaluate the longevity and potential reversibility of the geochemical reactions
- Determine parameters for full-scale application:
    - Amendment dosing – injection flow rate and reagent concentration
    - Frequency of pulsed injections required to maintain the target pH in the reaction zone
    - Injection pressure that will adequately and safely deliver the reagent into the subsurface
    - Time required for the reagent and geochemical effects to reach the downgradient observation wells.

Details and a summary of the fieldwork and pilot testing are included in Appendix I.3 – *In Situ* Treatment Pilot Test Technical Memorandum.

5.0 REFERENCES

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TABLES

Table 1 - Soil Sample Composite Intervals
Watts Bar Fossil Plant

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CCR Unit	Target Well ID	Sample Date	Boring ID	Composite Soil Interval	Composite Sample ID
Slag Disposal Area	WBF-104	9/29/2021	WBF-SDA-SB05	10.0 - 30.0 ft bgs	WBF-SS-SB-05-10/30-11182022
	WBF-106	9/28/2021	WBF-SDA-SB02	25.0 - 35.0 ft bgs	WBF-SS-SB-02-25/35-11182022

Notes:

CCR	coal combustion residuals
ft bgs	feet below ground surface
ID	identification
WBF	Watts Bar Fossil Plant

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Table 2 - Baseline Soil Sample Geochemical Analysis Suite
Watts Bar Fossil Plant

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Parameter	Method	Analytical Laboratory
Sequential Extraction Procedure (SEP) Metals (aluminum, arsenic, cadmium, cobalt, iron, lithium, manganese, molybdenum, nickel)	Tessier, A. (1979)/SW-846 3010A/6010B	Eurofins TestAmerica
X-Ray Diffraction (XRD)	ASTM D934-13	R.J. Lee Group, Inc.
Scanning electron microscopy energy dispersive spectroscopy (SEM-EDS)	ASTM E 1508	R.J. Lee Group, Inc.
Sulfur Speciation (total, sulfide/pyritic, sulfate, and organic/residual sulfur)	EPA 600/2-78-054 3.2.4	ACZ Laboratories

Table 3 - Groundwater Sample Geochemical Analysis Suite
Watts Bar Fossil Plant

DRAFT

Testing Phase	Parameter	Method	Analytical laboratory
Baseline Characterization Reagent Demand Test Microcosm Test Column Test	General Chemistry (pH, Oxidation Reduction Potential [ORP], Conductivity, Total Dissolved Solids [TDS], Temperature)	Various (e.g. SM 4500-H)	Stantec Treatability Facility
	Dissolved Metals (arsenic, cadmium, cobalt, iron, lithium[a], manganese, molybdenum[ab])	SW-846 6020A/B	Eurofins TestAmerica

Notes:

[a] Not conducted as part of baseline characterization testing

[b] Not conducted as part of reagent demand testing

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Table 4 - Baseline Soil Sample Mineralogy Results
Watts Bar Fossil Plant

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Target Well ID Composite Soil Sample ID CCR Unit Analysis Date Parent Sample ID Sample Type	WBF-104 WBF-SS-SB-05-10/30-11182022 Slag Disposal Area 12/16/2022 and 12/17/2022	WBF-104 WBF-SS-SB-05-FD01-11182022 Slag Disposal Area 12/16/2022 and 12/17/2022 WBF-SS-SB-05-10/30-11182022 Field Duplicate	WBF-106 WBF-SS-SB-02-25/35-11182022 Slag Disposal Area 12/16/2022 and 12/17/2022
X-Ray Diffraction, Rietveld Quantitative Analysis (wt%)			
Quartz	61	57	45
Microcline	4	4	4
Chlorite Group	6	7	11
Albite	7	6	5
Illite	15	17	24
Kaolinite	7	7	11
Amorphous[1]	10 U	10 U	10 U
Clay[2]	1 U	1	1
SEM-EDS, Analytical Sensitivity (wt%)			
Fe rich[3]	4.42	0.155	0.167
Al rich[4]	0.0500	0.0603	0.0220
Ba-S rich[5]	0.0000000191 U	0.000925	0.00134
Ca-S rich[6]	0.0188	0.00395	0.00836
Fe-S rich[7]	0.0000000191 U	0.0000000104 U	0.0000000773 U
Ca rich[8]	0.000706	0.0000000104 U	0.00365
Mn rich[9]	0.0000000191 U	0.0000000104 U	0.0000000773 U
Spectophotometry, General Subcontract Method (%)			
Sulfur Organic	0.01 U	0.01 U	0.01 U
Sulfur Pyritic Sulfide	0.01 U	0.01 U	0.01 U
Sulfur Sulfate	0.03 J	0.08 J	0.06 J
Sulfur Total	0.03 J	0.08 J	0.06 J
Total Sulfur minus Sulfate	0.01 U	0.01 U	0.01 U

Notes:
% - percent
CCR - coal combustion residuals
ID - identification
J - quantitation is approximate due to limitations identified during data validation
SEMS-EDS - scanning electron microscopy energy dispersive spectroscopy
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the same quantitation limit or the sample detection limit.
WBF- Watts Bar Fossil Plant
wt% - weight percent
[1]Amorphous content, crystalline phases present at trace levels and phases that are not currently part of the ICDD PDF 4+ database may remain unidentified
[2] Compositions are approximate and represent an idealized formula for that structure, not including possible elemental substitutions into that crystal structure
[3] Fe-rich particles can include ferrihydrite, siderite, hematite, geothite, magnetite, and lepidocrocite
[4] Al-rich particles can include gibbsite and corundum
[5] Ba-S-rich particles can include barite
[6] Ca-S-rich particles can include gypsum and anhydrite
[7] Fe-S-rich particles can include pyrite, mackinawite, marcasite, and pyrrhotite
[8] Ca-rich particles can include calcite, and aragonite
[9] Mn-rich particles can include rhodochrosite, and pyrolusite

Table 5 - Baseline Soil Sample Sequential Extraction Procedure (SEP) Results
Watts Bar Fossil Plant

DRAFT

Composite Soil Sample ID	Target Well ID	Sample Collection Date	SEP Step 1 Exchangeable Phase	SEP Step 2 Carbonate Phase	SEP Step 3 Non-Crystalline Minerals Phase	SEP Step 4 Metal Hydroxide Phase	SEP Step 5 Organic Phase	SEP Step 6 Acid/Sulfide Fraction	SEP Step 7 Residual Fraction	Sum SEP Steps 1-7	Total Metals Concentration
Aluminum											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	36.8 J	18.5 J	250	3,080	75.2 J	8,570	30,300	42,400 J	45,600
Percent of Sum SEP Steps 1-7			0.0868%	0.0436%	0.590%	7.26%	0.177%	20.2%	71.5%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	152	21.8 J	167	2,560	104 J	5,480	33,100	41,600 J	41,800
Percent of Sum SEP Steps 1-7			0.365%	0.0524%	0.401%	6.15%	0.250%	13.2%	79.6%		
Arsenic											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	0.691 U	0.519 U	0.742	0.891 U*	2.53 U	0.856	0.445 J	2.93 J	1.52
Percent of Sum SEP Steps 1-7					25.3%	30.4%		29.2%	15.2%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	0.596 U	0.447 U	1.89	1.06 U*	2.26 J	0.790	0.896 J	6.90 J	4.22
Percent of Sum SEP Steps 1-7					27.4%	15.4%	32.8%	11.4%	13.0%		
Cadmium											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	0.138 J	0.0578 J	0.0146 U	0.0193 J	0.213 U	0.0146 U	0.127 J	0.342 J	0.290 J
Percent of Sum SEP Steps 1-7			40.4%	16.9%		5.64%			37.1%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	0.0734 U	0.0378 U	0.0126 U	0.0126 U	0.183 U	0.0126 U	0.0894 J	0.0894 J	0.225 J
Percent of Sum SEP Steps 1-7									100%		
Cobalt											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	1.65 J	0.730 J	1.06 J	2.10 J	0.798 U	1.97 J	1.28 J	8.79 J	7.49 J
Percent of Sum SEP Steps 1-7			18.8%	8.30%	12.1%	23.9%		22.4%	14.6%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	1.96 J	0.217 U	0.251 J	2.94	0.688 U	1.79 J	0.849 J	7.80 J	7.53
Percent of Sum SEP Steps 1-7			25.1%		3.22%	37.7%		22.9%	10.9%		
Iron											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	15.4 U	52.0 J	745	3,500	58.5 U	5,100 J	6,000	15,400 J	14,000
Percent of Sum SEP Steps 1-7				0.338%	4.84%	22.7%		33.1%	39.0%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	13.3 U	146	2,160	4,990	50.4 U	5,040 J	5,590	17,900 J	18,200
Percent of Sum SEP Steps 1-7				0.816%	12.1%	27.9%		28.2%	31.2%		
Lithium											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	0.798 U	0.598 U	0.199 U	5.44	2.93 U	8.09	10.1	23.6	20.8
Percent of Sum SEP Steps 1-7						23.1%		34.3%	42.8%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	0.688 U	0.516 U	0.172 U	4.90	2.68 J	6.04	13.1	26.7 J	20.6
Percent of Sum SEP Steps 1-7						18.4%	10.0%	22.6%	49.1%		
Manganese											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	38.7	13.5 J	22.8 J	44.5 J	5.00 J	37.3 J	116 J	278 J	247
Percent of Sum SEP Steps 1-7			13.9%	4.86%	8.20%	16.0%	1.80%	13.4%	41.7%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	86.5	9.76	3.47 J	33.8 J	3.03 J	31.4 J	61.5 J	229 J	360
Percent of Sum SEP Steps 1-7			37.8%	4.26%	1.52%	14.8%	1.32%	13.7%	26.9%		
Molybdenum											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	0.436 U	0.327 U	0.151 J	0.109 U	1.66 U	0.132 U	0.109 U	0.151 J	0.377 J
Percent of Sum SEP Steps 1-7					100%						
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	0.376 U	0.282 U	0.146 J	0.094 U	1.43 U	0.113 U	0.094 U	0.146 J	0.341 J
Percent of Sum SEP Steps 1-7					100%						
Nickel											
WBF-SS-SB-05-10/30-11182022	WBF-104	11/18/2022	2.25 J	0.479 J	0.629 J	3.95	1.2 U	6.35	5.4	19.1 J	15.1
Percent of Sum SEP Steps 1-7			11.8%	2.51%	3.29%	20.7%		33.2%	28.3%		
WBF-SS-SB-02-25/35-11182022	WBF-106	11/18/2022	1.94 J	0.282 J	0.160 J	5.39	1.03 U	5.46	4.04 J	17.3 J	13.1
Percent of Sum SEP Steps 1-7			11.2%	1.63%	0.925%	31.2%		31.6%	23.4%		

Notes:
All units are in mg/kg
Composite soil samples from the Slag Disposal Area
The Sum of SEP steps 1-7 and the total metal concentration are compared as a qualitative measure of performance of the SEP extractions, but they are not expected to be precisely the same number. The SEP performs a series of seven extractions and there is inherent error compounds with the analysis of each iterative step reflected in the sum.
% - percent
CCR - coal combustion residuals
J - result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
U - not detected above method detection limit
U* - result should be considered “not detected” because it was detected in an associated field

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Table 6 - Baseline Groundwater Sample Results
Watts Bar Fossil Plant

Target Well ID	CCR Unit	Sample ID	Sample Date	pH	ORP	Eh	Specific Conductanc	TDS	Temp	Arsenic	Cadmium	Cobalt	Iron	Manganese
				SU	mV	mV	µS/cm	mg/L	deg-C	µg/L	µg/L	µg/L	µg/L	µg/L
GWPS				--	--	--	--	--	--	**10**	**5**	**6**	--	--
WBF-104	Slag Disposal Area	WBF-GW-WBF104-20211216	7-Dec-2021	5.45	287	487	232.5	1928	21.8	2.24	**54.7**	**581**	19.5 U	86,600
		WBF-WBF-104-P3-GW-11102023	10-Nov-2023	5.36	218	418	2723	1998	20.7	0.694 J	**28.6**	**712**	224 J	90,300
WBF-106		WBF-GW-WBF106-20211216	7-Dec-2021	5.52	194	394	780.1	604.6	21.8	0.313 U	0.686 J	**62.9**	19,200	12,700

Notes:
Groundwater samples were filtered prior to analysis

--	not available
Bold	concentration is greater than or equal to the indicated standard.
CCR	coal combustion residuals
deg-C	degrees celsius
Eh	redox potential. Eh is equal to ORP (mV) summed with a standard of 200 mV
GWPS	groundwater protection standard
ID	identification
J	result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
mg/L	milligrams per Liter
mV	millivolts
ORP	oxidation reduction potential
SU	standard units
TDS	total dissolved solids
Temp	temperature
µg/L	micrograms per Liter
µS/cm	microsiemens per centimeter
U	not detected above method detection limit
WBF	Watts Bar Fossil Plant

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Table 7 - Titration Results
Watts Bar Fossil Plant

Date	1/10/2022		1/10/2022	
Volume of Groundwater	100 mL		100 mL	
Reagent	1 wt% NaOH		1 wt% NaOH	
Composite Soil Sample ID	WBF-SS-SB-05-10/30-11182022		WBF-SS-SB-02-25/35-11182022	
Groundwater Sample ID	WBF-GW-WBF104-20211207		WBF-GW-WBF106-20211207	
	WBF-104		**WBF-106**	
	Soil Mass (g) approximately 25		Soil Mass (g) approximately 25	
	NaOH (mL)	**pH (SU)**	**NaOH (mL)**	**pH (SU)**
	Assay 1		Assay 1	
	0	5.75	0	6.22
	0.1	6.97	0.1	7.95
	0.2	8.12	Assay 2	
	0.3	9.23	0	6.19
	Assay 2		0.1	8.13
	0	5.76	Assay 3	
	0.1	6.87	0	6.18
	0.2	8.06	0.1	8.11
	0.3	9.07		
	Assay 3			
	0	5.78		
	0.1	6.91		
	0.2	8.13		
	0.3	9.15		

Notes:
Each titration step represents mass addition mixed with 25 g soil and 100 mL of groundwater

ID - identification
mL - milliliter
g - gram
SU - standard units
NaOH - sodium hydroxide
WBF - Watts Bar Fossil Plant
wt% - weight percent

Table 8 - Reagent Manufacturer Information
Watts Bar Fossil Plant

Reagent	Chemical Formula	Reagent Form	Solution Strength	Manufacturer
Ferric Chloride	$FeCl_3$	Dissolved Solid	1, 2, 3 wt%	Sigma-Aldrich
Limestone Manufactured Sand	LSMS	Solid	n/a	Rogers Group, Inc.
Sodium Hydroxide	NaOH	Aqueous Solution	1, 3, 5, 7 wt%	Fisher Scientific
Sodium Bicarbonate	$NaHCO_3$	Solid	n/a	Church & Dwight Company

Notes:

n/a - not applicable

wt% - weight percent

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Table 9 - Reagent Demand Test Results
Watts Bar Fossil Plant

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CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Percent Reagent	pH	ORP	Eh	Specific Conductance	TDS	Temp	Arsenic	Cadmium	Cobalt	Iron	Lithium	Manganese
				SU	mV	mV	µS/cm	mg/L	deg-C	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
GWPS				--	--	--	--	--	--	**10**	**5**	**6**	--	**40**	--
Slag Disposal Area (SB05 / WBF-104)	**Control**														
	WBF-WBF-104-P1-0-04192024	19-Apr-24	0.00%	5.33	219	419	2599	1889	23.0	0.631 J	**17.2**	**228**	118	9.47	45,800
	LSMS														
	WBF-WBF-104-P1/2-LSMS-5-02182022	18-Feb-22	3.33%	7.22	159	359	2393	1995	20.9	0.956 J B	1.99	**102**	27.7 U	NA	24,800
	WBF-WBF-104-P1/2-LSMS-10-02182022	18-Feb-22	6.67%	7.62	128	328	2701	2002	20.9	0.441 J B	2.71	**82.5**	33.3 J	NA	25,400
	NaOH 1wt%														
	WBF-WBF-104-P1/2-NAOH-12-03242022	24-Mar-22	0.0533%	6.98	78	278	3286	2446	23.1	1.81	1.09	**35.8**	235	NA	18,800
	WBF-WBF-104-P1/2-NAOH-15-03242022	24-Mar-22	0.0667%	7.40	73	273	3540	2652	23.1	1.35	0.625 J	**21.3**	203	NA	12,600
	WBF-WBF-104-P1/2-NAOH-18-03242022	24-Mar-22	0.0800%	7.83	69	269	3606	2705	23.1	2.07	0.217 U	4.81	143	NA	3,470
	$NaHCO_3$														
	WBF-WBF-104-P1-NAHC03-5-07212022	21-Jul-22	3.33%	7.03	167	367	13470	11520	25.6	6.92 J	2.17 U	**27.3**	329 J	10.4 J	1,620
	WBF-WBF-104-P1-NAHC03-10-07212022	21-Jul-22	6.67%	7.30	163	363	25240	24080	25.6	**16.9**	2.17 U	**27.7**	1,880	11.2 J	727
	WBF-WBF-104-P1-NAHC03-20-07212022	21-Jul-22	13.3%	7.62	157	357	41760	43330	25.6	**40.5**	2.17 U	**28.1**	5,790	14.4 J	356
Slag Disposal Area (SB02 / WBF-106)	**Control**														
	WBF-WBF-106-P1-0-04192024	19-Apr-24	0.00%	5.37	224	424	1281	884	23.0	1.11	**6.46**	**189**	341	20.9	40,200
	LSMS														
	WBF-WBF-106-P1/2-LSMS-5-02182022	18-Feb-22	3.33%	7.15	122	322	971	673	20.9	0.852 J B	0.217 U	**12.9**	1,450	NA	9,070
	WBF-WBF-106-P1/2-LSMS-10-02182022	18-Feb-22	6.67%	7.81	119	319	1014	691	20.9	0.811 J B	0.217 U	**14.7**	1,360	NA	9,900
	NaOH 1wt%														
	WBF-WBF-106-P1/2-NAOH-6-03242022	24-Mar-22	0.0267%	6.69	104	304	1161	812	23.1	2.29	0.312 J	**8.08**	265	NA	6,850
	WBF-WBF-106-P1/2-NAOH-8-03242022	24-Mar-22	0.0356%	7.21	102	302	1335	934	23.1	1.39	0.217 U	3.33	534	NA	3,410
	WBF-WBF-106-P1/2-NAOH-10-03242022	24-Mar-22	0.0444%	7.71	90	290	1386	971	23.1	1.87	0.217 U	2.15	1,660	NA	1,020
	$NaHCO_3$														
	WBF-WBF-106-P1-NAHC03-1-07212022	21-Jul-22	0.667%	7.04	163	363	3786	2830	25.6	2.82 U	2.17 U	2.98 J	277 U	8.31 U	11,900
	WBF-WBF-106-P1-NAHC03-5-07212022	21-Jul-22	3.33%	7.36	156	356	12200	10300	25.6	2.82 U	2.17 U	2.61 U	476 J	8.31 U	607
	WBF-WBF-106-P1-NAHC03-10-07212022	21-Jul-22	6.67%	7.62	170	370	20550	18940	25.6	3.14 J	2.17 U	2.61 U	808	9.52 J	542

Notes:
Groundwater samples were filtered prior to analysis
Sample reaction time was approximately two days.
See Table 8 for reagent concentrations
Percent Reagent was calculated in reference to soil mass and groundwater volume utilized in each reagent demand test

--	not available
%	percent
Bold	concentration is greater than or equal to the indicated standard.
B	compound was found in the blank and sample
CCR	coal combustion residuals
deg-C	degrees celsius
Eh	redox potential. Eh is equal to ORP (mV) summed with a standard of 200 mV
GWPS	groundwater protection standard
ID	identification
J	result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
LSMS	Limestone Manufactured Sand
mg/L	milligrams per Liter
mV	millivolts
NA	not analyzed
$NaHCO_3$	sodium bicarbonate
NaOH	sodium hydroxide
ORP	oxidation reduction potential
SU	standard units
TDS	total dissolved solids
Temp	temperature
µg/L	micrograms per Liter
µS/cm	microsiemens per centimeter
U	not detected above method detection limit
WBF	Watts Bar Fossil Plant
wt%	weight percent

Table 10 - Microcosm Test Results
Watts Bar Fossil Plant

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CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	Groundwater Recharge Volume mL	Reagent Dose Delivered mL-NaOH g-$NaHCO_3$	pH SU	ORP mV	Eh mV	Specific Conductance µS/cm	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS						--	--	--	--	--	--	10	5	6	--	40	--	100
Slag Disposal Area (SB05 / WBF-104)	**WBF-104 Groundwater**																	
	WBF-GW-WBF-104-1-09212022	21-Sep-22	0	n/a	n/a	6.92	205	405	2526	1870	6.6	2.54	**55.5**	**537**	423	3.13 J	83,800	0.610 U
	WBF-GW-WBF-104-3-09212022	21-Sep-22	0	n/a	n/a	6.87	199	399	2498	1963	6.8	2.16	**52.3**	**513**	407	2.81 J	79,800	0.610 U
	WBF-104 Control																	
	Start	**08-Sep-22**	**0**	**675**	**0**													
	WBF-WBF-104-P2-0-09122022	12-Sep-22	4	675	0	5.48	235	435	2673	1975	22.7	1.88	**39.3**	**619**	754	13.6	62,200	0.610 U
	WBF-WBF-104-P2-0-09152022	15-Sep-22	7	675	0	5.56	202	402	2604	1918	23.3	1.05	**39.0**	**547**	731	9.47	67,300	0.610 U
	WBF-WBF-104-P2-0-09192022	19-Sep-22	11	675	0	5.50	199	399	2564	1885	23.3	0.633 J	**34.1**	**452**	756	7.00	68,500	0.610 U
	WBF-WBF-104-P2-0-09222022	22-Sep-22	14	675	0	5.72	194	394	2571	1890	23.1	0.496 J	**35.8**	**451**	399	4.63 J	74,100	0.610 U
	WBF-WBF-104-P2-0-09262022	26-Sep-22	18	675	0	5.68	187	387	2539	1878	23.3	0.741 J	**35.1**	**479**	389	5.97 J	66,100	0.610 U
	WBF-WBF-104-P2-0-09292022	29-Sep-22	21	675	0	5.63	190	390	2492	1836	19.2	0.282 U	**37.4**	**453**	601	3.85 J	78,100	0.610 U
	WBF-WBF-104-P2-0-10032022	03-Oct-22	25	675	0	5.72	188	388	2625	1946	19.0	0.674 J	**40.1**	**451**	983	3.34 J	70,700	0.610 U
	WBF-WBF-104-P2-0-10062022	06-Oct-22	28	675	0	5.66	186	386	2582	1904	21.2	0.416 J	**42.9**	**450**	805	3.09 J	78,900	0.610 U
	WBF-WBF-104-P2-0-10102022	10-Oct-22	32	675	0	5.69	169	369	2646	1952	21.6	0.282 U	**43.6**	**425**	276 J	2.73 J	74,400	1.04 J
	WBF-WBF-104-P2-0-10132022	13-Oct-22	35	675	0	5.74	181	381	2610	1926	21.5	0.282 U	**42.7**	**402**	295	2.11 J	82,900	0.823 J
	WBF-WBF-104-P2-0-10172022	17-Oct-22	39	675	0	5.67	192	392	2698	1987	21.1	0.458 J	**42.9**	**394**	114	2.75 J	71,000	0.927 J
	WBF-WBF-104-P2-0-10202022	20-Oct-22	42	0	0	5.65	191	391	2597	1918	20.8	0.414 J	**48.6**	**429**	417	3.08 J	80,700	0.797 J
	WBF-104 NaOH 1wt%																	
	Start	**08-Sep-22**	**0**	**675**	**96**													
	WBF-WBF-104-P2-NAOH-96-09122022	12-Sep-22	4	675	0	8.86	137	337	7568	6107	22.7	**14.7**	0.354 J	**14.8**	1,300	2.91 J	437	31.8
	WBF-WBF-104-P2-NAOH-96-09152022	15-Sep-22	7	675	0	8.65	173	373	3193	2373	23.3	5.58	0.450 J	**16.2**	1,030	1.62 J	1,400	13.6
	WBF-WBF-104-P2-NAOH-96-09192022	19-Sep-22	11	675	0	8.20	137	337	2864	2129	23.3	2.09	1.41	**14.4**	816	2.35 J	16,700	5.45
	WBF-WBF-104-P2-NAOH-96-09222022	22-Sep-22	14	675	0	8.01	161	361	2723	2015	23.1	1.32	2.86	**28.8**	450	1.27 J	27,500	2.34 J
	WBF-WBF-104-P2-NAOH-96-09262022	26-Sep-22	18	675	0	7.81	155	355	2681	2016	23.3	1.29	4.27	**63.5**	549	2.74 J	37,300	1.33 J
	WBF-WBF-104-P2-NAOH-96-09292022	29-Sep-22	21	675	0	7.78	163	363	2541	1877	19.2	0.673 J	**5.97**	**89.0**	536	1.64 J	48,400	0.831 J
	WBF-WBF-104-P2-NAOH-96-10032022	03-Oct-22	25	675	0	7.51	162	362	2641	1960	19.0	0.818 J	**10.0**	**94.4**	529	0.831 UJ	45,800	1.04 J
	WBF-WBF-104-P2-NAOH-96-10062022	06-Oct-22	28	675	0	7.52	161	361	2634	1947	21.2	0.599 J	**13.7**	**119**	885	1.85 J	54,100	0.726 J
	WBF-WBF-104-P2-NAOH-96-10102022	10-Oct-22	32	675	5	7.10	184	384	2626	1933	21.6	0.343 J	**16.1**	**131**	70.2	1.26 J	52,700	0.854 J
	WBF-WBF-104-P2-NAOH-96-10132022	13-Oct-22	35	675	0	7.31	197	397	2647	1954	21.5	0.521 J	**13.3**	**102**	65.2	1.47 J	61,400	0.864 J
	WBF-WBF-104-P2-NAOH-96-10172022	17-Oct-22	39	675	0	7.24	192	392	2733	2031	21.1	0.526 J	**12.8**	**101**	103	1.86 J	52,000	0.774 J
	WBF-WBF-104-P2-NAOH-96-10202022	20-Oct-22	42	0	0	6.97	192	392	2626	1943	20.8	0.585 J	**22.7**	**195**	529	2.79 J	67,200	0.610 U
Slag Disposal Area (SB02 / WBF-106)	**WBF-106 Groundwater**																	
	WBF-GW-WBF-106-1-09212022	21-Sep-22	0	n/a	n/a	5.82	216	416	839.2	576.3	6.8	0.282 U	0.673 J	**54.7**	6,230	1.74 J	11,100	0.610 U
	WBF-GW-WBF-106-3-09212022	21-Sep-22	0	n/a	n/a	5.84	207	407	843.6	591.5	6.8	0.615 J	0.628 J	**65.6**	12,900	1.64 J	11,000	38.5
	WBF-106 Control																	
	Start	**08-Sep-22**	**0**	**675**	**0**													
	WBF-WBF-106-P2-0-09122022	12-Sep-22	4	675	0	5.53	134	334	866.1	594.2	22.7	0.970 J	4.12	**27.2**	1,720	3.80 J	20,700	0.610 U
	WBF-WBF-106-P2-0-09152022	15-Sep-22	7	675	0	5.67	203	403	863.6	592.5	23.3	0.547 J	3.56	**27.2**	747	2.73 J	21,100	0.610 U
	WBF-WBF-106-P2-0-09192022	19-Sep-22	11	675	0	5.54	152	352	836.6	572.4	23.3	0.345 J	3.66	**25.5**	1,110	3.64 J	21,000	0.610 U
	WBF-WBF-106-P2-0-09222022	22-Sep-22	14	675	0	5.56	161	361	894.4	614.5	23.1	0.320 J	2.91	**26.1**	866	3.15 J	18,900	0.610 U
	WBF-WBF-106-P2-0-09262022	26-Sep-22	18	675	0	5.53	151	351	892.2	617.8	23.3	0.282 U	2.32	**31.5**	440	2.91 J	14,400	0.610 U
	WBF-WBF-106-P2-0-09292022	29-Sep-22	21	675	0	5.59	169	369	854.7	592.2	19.2	0.431 J	2.36	**34.3**	411	2.46 J	16,600	0.610 U
	WBF-WBF-106-P2-0-10032022	03-Oct-22	25	675	0	5.75	158	358	854.9	592.4	19.0	0.282 U	2.34	**30.3**	662	1.41 J	28,100	0.610 U
	WBF-WBF-106-P2-0-10062022	06-Oct-22	28	675	0	5.64	173	373	861.4	593.8	21.2	0.300 J	2.00	**28.8**	1,790	2.95 J	14,600	0.610 U
	WBF-WBF-106-P2-0-10102022	10-Oct-22	32	675	0	5.72	177	377	871.2	600.5	21.6	0.282 U	2.38	**26.7**	1,100	2.40 J	14,700	0.610 U
	WBF-WBF-106-P2-0-10132022	13-Oct-22	35	675	0	5.72	190	390	869.7	599.2	21.5	0.282 U	2.27	**27.0**	703	1.63 J	3,030	0.610 U
	WBF-WBF-106-P2-0-10172022	17-Oct-22	39	675	0	5.72	190	390	877.3	606.3	21.1	0.282 U	2.33	**26.6**	547	2.60 J	15,300	0.610 U
	WBF-WBF-106-P2-0-10202022	20-Oct-22	42	0	0	5.75	167	367	871.3	602.5	20.8	2.10	2.24	**28.5**	27.7 U	1.99 J	14,300	0.610 U
	WBF-106 NaOH 1wt%																	
	Start	**08-Sep-22**	**0**	**675**	**30**													
	WBF-WBF-106-P2-NAOH-30-09122022	12-Sep-22	4	675	0	8.31	96	296	988.1	682.7	22.7	0.641 J	0.460 J	3.80	689	1.94 J	5,780	0.610 U
	WBF-WBF-106-P2-NAOH-30-09152022	15-Sep-22	7	675	0	7.26	228	428	851.5	583.8	23.3	0.538 J	1.82	**15.3**	1,040	2.23 J	16,000	0.610 U
	WBF-WBF-106-P2-NAOH-30-09192022	19-Sep-22	11	675	0	7.36	164	364	832.3	569.4	23.3	0.297 J	2.55	**18.2**	908	2.41 J	17,700	0.610 U
	WBF-WBF-106-P2-NAOH-30-09222022	22-Sep-22	14	675	0	7.22	169	369	833.4	570.7	23.1	0.282 U	2.71	**21.9**	424	2.12 J	16,900	0.610 U
	WBF-WBF-106-P2-NAOH-30-09262022	26-Sep-22	18	675	0	7.18	157	357	822.9	564.1	23.3	0.282 U	2.03	**28.6**	345	2.65 J	13,600	0.610 U
	WBF-WBF-106-P2-NAOH-30-09292022	29-Sep-22	21	675	10	6.82	180	380	834.8	576.9	19.2	0.282 U	2.02	**30.7**	738	2.21 J	15,500	0.610 U
	WBF-WBF-106-P2-NAOH-30-10032022	03-Oct-22	25	675	10	6.82	168	368	853.3	591.2	19.0	0.282 U	1.98	**27.5**	668	1.05 J	14,400	0.610 U
	WBF-WBF-106-P2-NAOH-30-10062022	06-Oct-22	28	675	0	7.43	176	376	913.7	632.1	21.2	0.405 J	0.225 J	3.52	1,750	2.11 J	3,930	0.610 U
	WBF-WBF-106-P2-NAOH-30-10102022	10-Oct-22	32	675	10	6.91	170	370	880.3	607.2	21.6	0.282 U	0.885 J	**8.18**	596	1.58 J	8,280	0.610 U
	WBF-WBF-106-P2-NAOH-30-10132022	13-Oct-22	35	675	0	7.22	177	377	912.3	630.4	21.5	0.282 U	0.217 U	1.35	80.8 J	0.831 U	2,130	0.849 J
	WBF-WBF-106-P2-NAOH-30-10172022	17-Oct-22	39	675	10	6.89	184	384	893.1	617.8	21.1	0.282 U	0.489 J	**8.90**	1,350	2.23 J	8,940	0.610 U
	WBF-WBF-106-P2-NAOH-30-10202022	20-Oct-22	42	0	0	7.48	165	365	867.2	600.1	20.8	0.282 U	0.873 J	**15.5**	94.6 J	1.27 J	10,100	0.610 U
	WBF-106 $NaHCO_3$																	
	Start	**08-Sep-22**	**0**	**675**	**3**													
	WBF-WBF-106-P2-NAHCO3-3-09122022	12-Sep-22	4	675	0	7.33	96	296	3047	2253	22.7	0.282 U	0.217 U	1.84	1,300	4.41 J	599	12.9
	WBF-WBF-106-P2-NAHCO3-3-09152022	15-Sep-22	7	675	0	7.29	248	448	1224	853.6	23.3	0.387 J	0.520 J	**9.93**	881	1.79 J	9,340	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-09192022	19-Sep-22	11	675	0	7.26	155	355	969.2	668.1	23.3	0.378 J	0.540 J	5.12 J	1,240 J	1.79 J	8,520	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-09222022	22-Sep-22	14	675	0	7.09	163	363	873.6	599.3	23.1	0.334 J	0.522 J	**6.09**	1,230	1.90 J	9,430	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-09262022	26-Sep-22	18	675	0	7.14	152	352	861.7	608.4	23.3	0.282 U	0.723 J	**11.6**	347	1.99 J	10,900	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-09292022	29-Sep-22	21	675	0	7.13	179	379	852.9	590.8	19.2	0.282 U	0.744 J	**15.9**	556	1.40 J	14,300	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-10032022	03-Oct-22	25	675	0	7.05	167	367	862.5	597.9	19.0	0.282 U	0.779 J	**11.7**	452	0.831 UJ	12,500	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-10062022	06-Oct-22	28	675	0	7.16	182	382	849.7	585.2	21.2	0.316 J	0.735 J	**12.6**	1,370	1.59 J	12,300	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-10102022	10-Oct-22	32	675	0	7.07	169	369	858.4	591.5	21.6	0.282 U	0.783 J	**13.4**	835	1.73 J	13,400	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-10132022	13-Oct-22	35	675	0	7.09	185	385	854.2	588.6	21.5	0.282 U	0.710 J	**14.2**	97.6	0.832 J	13,500	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-10172022	17-Oct-22	39	675	0.5	6.96	176	376	876.2	605.7	21.1	0.282 U	0.772 J	**12.4**	99.5	1.37 J	13,400	0.610 U
	WBF-WBF-106-P2-NAHCO3-3-10202022	20-Oct-22	42	0	0	7.68	146	346	1317	926.1	20.8	2.05	0.219 J	5.45	27.7 U	1.37 J	7,450	0.889 J

Table 10 - Microcosm Test Results
Watts Bar Fossil Plant

Microcosm Test Replicate Sample Results																		
CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	Groundwater Recharge Volume mL	Reagent Dose Delivered (mL-NaOH) (g-$NaHCO_3$)	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS						--	--	--	--	--	--	**10**	**5**	**6**	--	**40**	--	**100**
Slag Disposal Area (SB05 / WBF-104)	**WB-104 Control**																	
	WBF-WBF-104-P2-FD01-10102022	10-Oct-22	32	n/a	n/a	5.69	169	369	2646	1952	21.6	0.321 J	**44.3**	**425**	660 J	3.27 J	69,400	1.09 J
	WB-104 NaOH 1wt%																	
	WBF-WBF-104-P2-FD01-10172022	17-Oct-22	39	n/a	n/a	7.24	192	392	2733	2031	21.1	0.393 J	**12.8**	**96.1**	114	1.98 J	51,400	0.743 J
Slag Disposal Area (SB02 / WBF-106)	**WBF-106 $NaHCO_3$**																	
	WBF-WBF-106-P2-FD01-09192022	19-Sep-22	11	n/a	n/a	7.26	155	355	969.2	668.1	23.3	0.536 J	0.615 J	**6.64** J	1,960 J	2.49 J	9,190	0.610 U
	WBF-WBF-106-P2-FD01-10062022	06-Oct-22	28	n/a	n/a	7.16	182	382	849.7	585.2	21.2	0.282 U	0.714 J	**12.7**	1,430	1.38 J	12,400	0.610 U
	WBF-106 NaOH 1wt%																	
	WBF-WBF-106-P2-FD01-10032022	03-Oct-22	25	n/a	n/a	6.82	168	368	853.3	591.2	19	0.335 J	2.30	**27.0**	551	1.04 J	14,300	0.610 U
	WBF-WBF-106-P2-FD01-10132022	13-Oct-22	35	n/a	n/a	7.22	177	377	912.3	630.4	21.5	0.318 J	0.217 U	1.33	189 J	0.831 U	2,110	0.779 J
	WBF-WBF-106-P2-FD01-10202022	20-Oct-22	42	n/a	n/a	7.48	165	365	867.2	600.1	20.8	0.282 U	0.869 J	**16.1**	819 J	1.92 J	9,940	0.610 U

Notes:
Groundwater samples were filtered prior to analysis

--	not available
Bold	concentration is greater than or equal to the indicated standard.
CCR	coal combustion residuals
deg-C	degrees celsius
Eh	redox potential. Eh is equal to ORP (mV) summed with a standard of 200 mV
g	gram
GWPS	groundwater protection standard
ID	identification
J	result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
mg/L	milligrams per Liter
mL	milliliter
mV	millivolts
n/a	not applicable
$NaHCO_3$	sodium bicarbonate
NaOH	sodium hydroxide
ORP	oxidation reduction potential
SU	standard units
TDS	total dissolved solids
Temp	temperature
µg/L	micrograms per Liter
µS/cm	microsiemens per centimeter
U	not detected above method detection limit
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.
WBF	Watts Bar Fossil Plant
wt%	weight percent

Table 11 - Column Test Results
Watts Bar Fossil Plant

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CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS				--	--	--	--	--	--	10	5	6	--	40	--	100
Slag Disposal Area (SB05 / WBF-104)	**Groundwater**															
	WBF-WBF-104-P3-GW-02102023	10-Feb-23	2	5.83	226	426	2634	1927	21.4	3.89	**51.0**	**565**	1,040	4.46 U*	75,800	0.610 U
	WBF-WBF-104-P3-GW-02112023	11-Feb-23	3	5.68	224	424	2643	1931	21.2	7.05	**50.8**	**513**	1,750	4.26 J	70,800	0.610 U
	WBF-WBF-104-P3-GW-02132023	13-Feb-23	5	5.4	238	438	2640	1928	21.5	3.33	**52.5**	**566**	919	3.98 J	73,200	0.610 U
	WBF-WBF-104-P3-GW-02152023	15-Feb-23	7	5.51	274	474	2648	1936	21.5	3.15	**50.6**	**602**	703	5.23 U*	76,400	0.610 U
	WBF-WBF-104-P3-GW-02172023	17-Feb-23	9	5.61	149	349	2649	1941	20.7	2.65	**51.4**	**606**	558	4.28 U*	71,200	0.610 U
	WBF-WBF-104-P3-GW-02212023	21-Feb-23	13	5.51	184	384	2620	1916	20.3	0.629 J	**48.0**	**539**	27.7 U	6.00	70,100	0.610 U
	WBF-WBF-104-P3-GW-02232023	23-Feb-23	15	5.53	187	387	2610	1911	20.5	0.625 J	**50.8**	**579**	27.7 U	5.00	74,700	0.610 U
	WBF-WBF-104-P3-GW-02272023	27-Feb-23	19	5.62	182	382	2636	1928	20.4	0.817 J	**49.9**	**568**	27.7 U	4.74 J	80,100	0.623 J
	WBF-WBF-104-P3-GW-03032023	03-Mar-23	23	5.62	168	368	2613	1905	22.3	0.949 J	**53.1**	**554**	133	4.12 J	87,900	0.610 U
	Control															
	Start	**08-Feb-23**	0													
	WBF-WBF-104-P3-0-02102023	10-Feb-23	2	5.29	270	470	2083	1490	21.4	2.71	**51.8**	**548**	772	4.53 U*	75,300	0.610 U
	WBF-WBF-104-P3-0-02112023	11-Feb-23	3	4.86	336	536	2251	1622	21.2	1.44 J	**12.3**	**154**	205	18.7	21,800	0.610 U
	WBF-WBF-104-P3-0-02132023	13-Feb-23	5	4.67	402	602	2472	1796	21.5	1.41 J	**12.6**	**160**	216	19.3	21,600	0.610 U
	WBF-WBF-104-P3-0-02152023	15-Feb-23	7	4.51	322	522	2678	1958	21.5	1.35	**12.8**	**187**	242	17.5	35,200	0.610 U
	WBF-WBF-104-P3-0-02172023	17-Feb-23	9	4.69	189	389	2622	1921	20.7	0.873 J	**26.8**	**373**	167	10.1	56,800	0.610 U
	WBF-WBF-104-P3-0-02212023	21-Feb-23	13	4.88	277	477	2229	1608	20.3	0.629 J	**16.1**	**285**	249	11.1	47,300	0.610 U
	WBF-WBF-104-P3-0-02232023	23-Feb-23	15	4.96	286	486	2639	1927	20.5	0.649 J	**24.7**	**319**	38.3 J	5.67	69,300	0.610 U
	WBF-WBF-104-P3-0-02272023	27-Feb-23	19	4.97	258	458	2642	1932	20.4	0.749 J	**24.2**	**273**	132	6.02	66,500	0.610 U
	WBF-WBF-104-P3-0-03032023	03-Mar-23	23	5.46	249	449	2662	1943	22.3	0.655 J	**29.0**	**280**	78.2 J	5.36	77,000	0.610 U
	NaOH 1wt%															
	Start	**08-Feb-23**	0													
	WBF-WBF-104-P3-NAOH-02102023	10-Feb-23	2	6.35	265	465	1992	1421	21.4	1.33	**15.4**	**161**	27.7 U	25.7	21,900	0.610 U
	WBF-WBF-104-P3-NAOH-02112023	11-Feb-23	3	6.21	317	517	2319	1444	21.2	1.33	**11.4**	**102**	52.4	16.9	17,500	0.610 U
	WBF-WBF-104-P3-NAOH-02132023	13-Feb-23	5	6.03	432	632	2448	1776	21.5	1.34 J	**12.3**	**105**	59.5 J	17.5	18,300	0.610 U
	WBF-WBF-104-P3-NAOH-02152023	15-Feb-23	7	6.42	321	521	2746	2014	21.5	1.19	**10.3**	**102**	52.4	12.9	27,100	0.610 U
	WBF-WBF-104-P3-NAOH-02172023	17-Feb-23	9	8.01	149	349	2943	2161	20.7	0.792 J	1.93	**29.7**	149	13.3	13,700	1.590 J
	WBF-WBF-104-P3-NAOH-02212023	21-Feb-23	13	7.98	273	473	2708	1989	20.3	0.362 J	**12.1**	**151**	64.7	5.00	44,200	0.610 U
	WBF-WBF-104-P3-NAOH-02232023	23-Feb-23	15	7.16	270	470	2674	1956	20.5	0.373 J	**14.9**	**178**	33.4 J	3.91 J	57,200	0.610 U
	WBF-WBF-104-P3-NAOH-02272023	27-Feb-23	19	8.05	222	422	3494	2599	20.4	0.837 J	**9.96**	**162**	27.7 U	5.13	58,400	1.09 J
	WBF-WBF-104-P3-NAOH-03032023	03-Mar-23	23	7.86	222	422	2727	1996	22.3	0.748 J	4.26	**85.4**	336	2.40 J	37,600	0.613 J
Slag Disposal Area (SB02 / WBF-106)	**Groundwater**															
	WBF-WBF-106-P3-GW-02102023	10-Feb-23	2	5.65	219	419	864.4	591.2	21.4	0.282 U	0.514 J	**60.2**	3,600	3.37 U*	13,200	0.610 U
	WBF-WBF-106-P3-GW-02112023	11-Feb-23	3	5.41	228	428	861.3	589.7	21.2	0.282 U	0.511 J	**52.0**	27.7 U	2.83 J	12,000	0.610 U
	WBF-WBF-106-P3-GW-02132023	13-Feb-23	5	5.36	236	436	854.8	583.6	21.5	0.282 U	0.513 J	**50.5**	27.7 U	3.06 J	12,700	0.610 U
	WBF-WBF-106-P3-GW-02152023	15-Feb-23	7	5.43	281	481	869.1	591.7	21.5	0.282 U	0.458 J	**60.5**	27.7 U	3.46 U*	12,100	0.610 U
	WBF-WBF-106-P3-GW-02172023	17-Feb-23	9	5.56	185	385	730.5	495.2	20.7	0.282 U	0.402 J	**58.4**	451	3.45 U*	11,500	0.610 U
	WBF-WBF-106-P3-GW-02212023	21-Feb-23	13	5.53	177	377	949.9	649.8	20.3	0.282 U	2.05	**78.5**	27.7 U	3.37 J	14,600	0.610 U
	WBF-WBF-106-P3-GW-02232023	23-Feb-23	15	5.64	224	424	940.3	643.7	20.5	0.282 U	1.99	**74.6**	42.1 J	3.18 J	13,500	0.610 U
	WBF-WBF-106-P3-GW-02272023	27-Feb-23	19	5.67	226	426	923.9	633.7	20.4	0.282 U	2.15	**73.0**	27.7 U	3.04 J	14,400	0.610 U
	WBF-WBF-106-P3-GW-03032023	03-Mar-23	23	5.51	224	424	926.2	632.1	22.3	0.282 U	2.53	**73.2**	34.2 J	2.40 J	12,900	0.610 U
	Control															
	Start	**08-Feb-23**	0													
	WBF-WBF-106-P3-0-02102023	10-Feb-23	2	5.56	283	483	2168	897.4	21.4	8.10	**50.9**	**1,390**	2,040	**89.6**	74,400	0.610 U
	WBF-WBF-106-P3-0-02112023	11-Feb-23	3	4.79	396	596	1708	910.1	21.2	3.19	**17.9**	**457**	1,880	**42.1**	25,100	0.610 U
	WBF-WBF-106-P3-0-02132023	13-Feb-23	5	4.48	485	685	1324	918.8	21.5	3.21	**17.7**	**444**	1,960	**43.2**	25,200	0.610 U
	WBF-WBF-106-P3-0-02152023	15-Feb-23	7	4.32	476	676	1010	687.6	21.5	1.91	**11.8**	**338**	1,860	32.2	17,100	0.610 U
	WBF-WBF-106-P3-0-02172023	17-Feb-23	9	4.49	415	615	978.7	673.8	20.7	0.801 J	**9.97**	**282**	3,730	22.1	15,600	0.610 U
	WBF-WBF-106-P3-0-02212023	21-Feb-23	13	4.55	480	680	953.5	655.4	20.3	0.830 J	**8.46**	**199**	2,080	13.5	15,800	0.610 U
	WBF-WBF-106-P3-0-02232023	23-Feb-23	15	4.65	466	666	932.2	636.7	20.5	0.881 J	**6.71**	**150**	1,340	10.0	14,900	0.610 U
	WBF-WBF-106-P3-0-02272023	27-Feb-23	19	4.63	474	674	956.5	655.9	20.4	0.682 J	**5.03**	**109**	1,430	9.18	12,900	0.610 U
	WBF-WBF-106-P3-0-03032023	03-Mar-23	23	4.68	484	684	964.9	659.2	22.3	0.541 J	**6.14**	**122**	1,380	10.6	12,800	0.610 U
	NaOH 1wt%															
	Start	**08-Feb-23**	0													
	WBF-WBF-106-P3-NAOH-02102023	10-Feb-23	2	6.54	305	505	3337	2467	21.4	4.26	**17.8**	**482**	1,200	**51.5**	18,500	0.610 U
	WBF-WBF-106-P3-NAOH-02112023	11-Feb-23	3	6.29	398	598	2268	1569	21.2	2.22	4.03	**108**	576	20.8	3,870	0.610 U
	WBF-WBF-106-P3-NAOH-02132023	13-Feb-23	5	6.05	481	681	1075	740.3	21.5	2.21	4.14	**108**	550	21.8	4,060	0.610 U
	WBF-WBF-106-P3-NAOH-02152023	15-Feb-23	7	6.03	489	689	1053	723.2	21.5	1.66	**8.51**	**267**	2,090	19.8	8,600	0.610 U
	WBF-WBF-106-P3-NAOH-02172023	17-Feb-23	9	8.13	152	352	1012	699.7	20.7	5.55	0.335 J	**11.9**	1,360	6.20 U*	1,950	3.24 J
	WBF-WBF-106-P3-NAOH-02212023	21-Feb-23	13	8.02	267	467	920.3	631.4	20.3	1.20	1.68	**41.0**	1,470	5.63	4,820	0.610 U
	WBF-WBF-106-P3-NAOH-02232023	23-Feb-23	15	7.11	288	488	946.3	649.2	20.5	0.515 J	2.18	**40.3**	57	5.07	6,550	0.610 U
	WBF-WBF-106-P3-NAOH-02272023	27-Feb-23	19	7.97	265	465	1021	703.1	20.4	0.501 J	1.07	**23.8**	37.2 J	4.08 J	4,800	0.610 U
	WBF-WBF-106-P3-NAOH-03032023	03-Mar-23	23	7.79	222	422	935.1	638.3	22.3	0.335 J	0.626 J	**13.9**	119	2.24 J	2,800	0.610 U

Table 11 - Column Test Results
Watts Bar Fossil Plant

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Column Test Replicate Sample Results

CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS				**--**	**--**	**--**	**--**	**--**	**--**	**10**	**5**	**6**	**--**	**40**	**--**	**100**
Slag Disposal Area (SB05 / WBF-104)	**Groundwater**															
	WBF-WBF-104-P3-FD01-02102023	10-Feb-23	2	5.83	226	426	2634	1927	21.4	3.36	**48.4**	**509**	945	4.46 U*	71,900	0.610 U
	Control															
	WBF-WBF-104-P3-FD01-02212023	21-Feb-23	13	4.88	277	477	2229	1608	20.3	0.763 J	**16.5**	**283**	249	12.4	48,100	0.610 U
	WBF-WBF-104-P3-FD01-02272023	27-Feb-23	19	4.97	258	458	2642	1932	20.4	0.652 J	**23.3**	**263**	127	5.66 J	62,900	0.610 U
Slag Disposal Area (SB02 / WBF-106)	**Groundwater**															
	WBF-WBF-106-P3-FD01-02132023	13-Feb-23	5	5.36	236	436	854.8	584	22	0.282 U	0.533 J	**54.7**	27.7 U	3.15 J	12,800	0.610 U
	Control															
	WBF-WBF-106-P3-FD01-02172023	17-Feb-23	9	4.49	415	615	978.7	674	21	0.711 J	**10.4**	**286**	3,560	22.0	16,000	0.610 U
	NaOH 1wt%															
	WBF-WBF-106-P3-FD01-02232023	23-Feb-23	15	7.11	288	488	946.3	649	21	0.607 J	2.16	**42.0**	54.4	5.02	6,830	0.610 U
	WBF-WBF-106-P3-FD01-03032023	03-Mar-23	23	7.79	222	422	935.1	638	22	0.333 J	0.495 J	**12.5**	161	2.27 J	2,500	0.610 U

Notes:

Grounwater samples were filtered prior to analysis

--	not available
Bold	concentration is greater than or equal to the indicated standard.
CCR	coal combustion residuals
deg-C	degrees celsius
Eh	redox potential. Eh is equal to ORP (mV) summed with a standard of 200 mV
GWPS	groundwater protection standard
ID	identification
J	result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
mg/L	milligrams per Liter
mL	milliliter
mV	millivolts
NaOH	sodium hydroxide
ORP	oxidation reduction potential
SU	standard units
TDS	total dissolved solids
Temp	temperature
µg/L	micrograms per Liter
µS/cm	microsiemens per centimeter
U	not detected above method detection limit
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
WBF	Watts Bar Fossil Plant
wt%	weight percent

Dosing Key

Day	WBF-104 NaOH 1wt% (mL)	WBF-106 NaOH 1wt% (mL)
0	46	40
5	25	25
7	50	50
15	15	15

Table 12 - Supplemental Column Test Results (NaOH)
Watts Bar Fossil Plant

CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS				--	--	--	--	--	--	10	5	6	--	40	--	100
Slag Disposal Area (SB05 / WBF-104)	**Groundwater[1]**															
	WBF-WBF-104-P3-GW-01162024	16-Jan-24	6	5.42	224	424	2646	1944	17.8	0.712 J	**28.9**	**720**	47.3 J	3.71 J	76,000	0.610 U
	WBF-WBF-104-P3-GW-01192024	19-Jan-24	9	5.47	234	434	2667	1958	19.5	0.282 U	**28.0**	**707**	169 J	5.23	75,300	0.610 U
	WBF-WBF-104-P3-GW-01222024	22-Jan-24	12	5.51	247	447	2741	2012	20	1.07	**31.1** J	**755** J	1,280	6.82	68,100 J	0.610 U
	WBF-WBF-104-P3-GW-01262024	26-Jan-24	16	5.43	218	418	2603	1896	20.8	1.02	**27.0**	**664**	90.0	5.00	71,900	0.610 U
	WBF-WBF-104-P3-GW-01292024	29-Jan-24	19	5.45	218	418	2614	1903	21.1	0.747 J	**28.2**	**676**	64.4	4.49 J	72,300	0.610 U
	WBF-WBF-104-P3-GW-02022024	02-Feb-24	23	5.51	217	417	2684	1958	22.1	0.809 J	**29.0**	**693**	292	5.69	75,000	0.610 U
	WBF-WBF-104-P3-GW-02052024	05-Feb-24	26	5.48	157	357	2778	2027	22.3	0.881 J	**28.1**	**705**	46.1 J	4.41 J	84,300	0.610 U
	WBF-WBF-104-P3-GW-02092024	09-Feb-24	30	5.42	208	408	2661	1938	22.7	2.18	**27.7**	**710**	2,640	6.81	71,700	0.610 U
	Control															
	Start	**10-Jan-24**	0													
	WBF-WBF-104-P3-0-01162024	16-Jan-24	6	5.22	206	406	2997	2136	18.3	0.950 J	**23.8**	**433**	53.4	8.77	55,000	0.610 U
	WBF-WBF-104-P3-0-01192024	19-Jan-24	9	5.46	179	379	3276	2425	19.5	0.334 J	**15.6**	**226**	79.7	13.4	35,100	0.839 J
	WBF-WBF-104-P3-0-01222024	22-Jan-24	12	5.52	151	351	2905	2149	19.8	0.754 J	**13.8** J	**233** J	45.4 J	8.54	31,400 J	0.610 U
	WBF-WBF-104-P3-0-01262024	26-Jan-24	16	5.52	192	392	2821	2073	20.8	2.19	**10.8**	**74.7**	886	16.1	32,800	0.610 U
	WBF-WBF-104-P3-0-01292024	29-Jan-24	19	5.54	192	392	2889	2129	21.2	2.18	**10.2**	**110**	606	16.2	45,500	0.610 U
	WBF-WBF-104-P3-0-02022024	02-Feb-24	23	5.54	216	416	2870	2105	22.1	1.95	**15.8**	**126**	259	15.6	49,100	0.610 U
	WBF-WBF-104-P3-0-02052024	05-Feb-24	26	5.56	222	422	2981	2176	22.3	2.71	**17.8**	**140**	161	16.2	62,500	0.610 U
	WBF-WBF-104-P3-0-02092024	09-Feb-24	30	5.54	216	416	2923	2150	22.7	2.42	**12.8**	**129**	173	15.9	54,800	0.610 U
	NaOH 3wt.%															
	Start	**10-Jan-24**	0													
	WBF-WBF-104-P3-NAOH-3-01162024	16-Jan-24	6	6.73	173	373	3124	2308	18.3	0.824 J	**9.28**	**26.0**	91.2	13.8	18,000	0.610 U
	WBF-WBF-104-P3-NAOH-3-01192024	19-Jan-24	9	7.22	184	384	3676	2746	19.5	0.481 J	**9.45**	**35.5**	63.8	15.6	18,600	0.954 J
	WBF-WBF-104-P3-NAOH-3-01222024	22-Jan-24	12	7.79	168	368	3718	2843	19.8	**22.5**	2.06 J	**14.8** J	2,370	4.06 J	3,340 J	7.46
	WBF-WBF-104-P3-NAOH-3-01262024	26-Jan-24	16	8.24	203	403	3943	2947	20.8	**70.3**	4.30	**41.7**	8,580	6.06	3,830	5.85
	WBF-WBF-104-P3-NAOH-3-01292024	29-Jan-24	19	8.13	204	404	3814	2850	21.2	**36.0**	1.61	**15.9**	2,530	1.50 J	1,670	4.68 J
	WBF-WBF-104-P3-NAOH-3-02022024	02-Feb-24	23	7.86	202	402	3708	2752	22.1	**13.9**	0.217 U	1.87 J	747 J	1.84 J	545	7.91
	WBF-WBF-104-P3-NAOH-3-02052024	05-Feb-24	26	7.82	205	405	3911	2921	22.3	**12.3**	0.217 U	1.57	230	1.29 U	442	5.93
	WBF-WBF-104-P3-NAOH-3-02092024	09-Feb-24	30	7.76	194	394	3906	2906	22.7	**13.2**	0.272 J	3.89	2,460	4.05 J	771	7.01
	NaOH 5wt.%															
	Start	**10-Jan-24**	0													
	WBF-WBF-104-P3-NAOH-5-01162024	16-Jan-24	6	7.23	177	377	3315	2458	18.3	1.50	**11.9**	**36.0**	36.1 J	15.3	19,200	0.610 U
	WBF-WBF-104-P3-NAOH-5-01192024	19-Jan-24	9	7.57	206	406	4258	3221	19.5	0.578 J	**10.1**	**36.6**	57.9	19.7	15,100	0.610 U
	WBF-WBF-104-P3-NAOH-5-01222024	22-Jan-24	12	8.37	154	354	3951	2966	19.8	2.97	4.99 J	**27.8** J	145	9.18	8,900 J	2.70 J
	WBF-WBF-104-P3-NAOH-5-01262024	26-Jan-24	16	9.75	128	328	4097	3073	20.8	**34.9**	0.507 J	**13.1**	1,040	5.77	216	13.1
	WBF-WBF-104-P3-NAOH-5-01292024	29-Jan-24	19	8.85	169	369	3891	2906	21.2	**11.4**	0.217 U	3.51	346	6.14	208	7.29
	WBF-WBF-104-P3-NAOH-5-02022024	02-Feb-24	23	8.11	164	364	3883	2889	22.1	3.86	0.217 U	2.39	131	6.10	4,070	2.86 J
	WBF-WBF-104-P3-NAOH-5-02052024	05-Feb-24	26	8.76	186	386	4046	3032	22.3	3.35	0.217 U	3.25	57.6	1.81 J	2,950	2.35 J
	WBF-WBF-104-P3-NAOH-5-02092024	09-Feb-24	30	8.51	187	387	3811	2831	22.7	4.07	0.217 U	2.47	312	1.29 U	443	3.14 J
	NaOH 7wt.%															
	Start	**10-Jan-24**	0													
	WBF-WBF-104-P3-NAOH-7-01162024	16-Jan-24	6	7.59	142	342	3488	2601	18.3	0.942 J	**12.2**	**45.9**	91.0	14.9	21,100	0.610 U
	WBF-WBF-104-P3-NAOH-7-01192024	19-Jan-24	9	10.26	192	392	4413	3355	19.5	**39.2**	**5.72**	**45.7**	1,280	9.44	8,360	6.91
	WBF-WBF-104-P3-NAOH-7-01222024	22-Jan-24	12	10.21	149	349	5286	5962	19.8	**310**	3.07 J	**82.8** J	3,940	3.33 J	1,850 J	12.5 J
	WBF-WBF-104-P3-NAOH-7-01262024	26-Jan-24	16	11.26	99	299	7459	5915	20.8	**214**	2.52	**46.6**	3,680 J	3.09 J	853	9.96
	WBF-WBF-104-P3-NAOH-7-01292024	29-Jan-24	19	10.05	137	337	4056	3047	21.2	**20.7**	0.245 J	**7.17**	235	1.62 J	28.5 J	7.30
	WBF-WBF-104-P3-NAOH-7-02022024	02-Feb-24	23	9.47	142	342	3713	2757	22.1	6.73	0.217 U	5.62	190	1.43 J	73.2	4.87 J
	WBF-WBF-104-P3-NAOH-7-02052024	05-Feb-24	26	9.28	149	349	3863	2884	22.3	5.41	0.217 U	4.25	27.7 U	1.29 U	4.54 J	3.52 J
	WBF-WBF-104-P3-NAOH-7-02092024	09-Feb-24	30	8.8	181	381	3916	2911	22.7	4.84	0.217 U	3.59	203	1.29 U	23.4	2.92 J

Table 12 - Supplemental Column Test Results (NaOH)
Watts Bar Fossil Plant

Supplemental Column Test Replicate Sample Results

CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS				--	--	--	--	--	--	**10**	**5**	**6**	--	**40**	--	**100**
Slag Disposal Area (SB05 / WBF-104)	**Groundwater[1]**															
	WBF-WBF-104-P3-FD01-01162024	16-Jan-24	6	5.42	224	424	2646	1944	17.8	0.929 J	**28.8**	**738**	48.2 J	3.97 J	74,300	0.610 U
	WBF-WBF-104-P3-FD01-01192024	19-Jan-24	9	5.47	234	434	2667	1958	19.5	0.282 U	**28.6**	**697**	52.3 J	4.82 J	72,600	0.610 U
	WBF-WBF-104-P3-FD01-01222024	22-Jan-24	12	5.51	247	447	2741	2012	20	0.991 J	**27.5** J	**697** J	1,140	6.25	78,800 J	0.610 U
	WBF-WBF-104-P3-FD01-01292024	29-Jan-24	19	5.45	218	418	2614	1903	21.1	0.874 J	**28.2**	**669**	56.8	4.38 J	71,400	0.610 U
	WBF-WBF-104-P3-FD01-02052024	05-Feb-24	26	5.48	157	357	2778	2027	22.3	0.683 J	**28.1**	**716**	43.0 J	3.94 J	84,200	0.610 U
	WBF-WBF-104-P3-FD01-02092024	09-Feb-24	30	5.42	208	408	2661	1938	22.7	2.18	**27.9**	**716**	2,520	4.62 J	70,400	0.610 U
	NaOH 3wt.%															
	WBF-WBF-104-P3-FD01-02022024	02-Feb-24	23	7.86	202	402	3708	2752	22.1	**14.0**	0.217 U	2.46 J	1,510 J	2.36 J	595	8.70
	NaOH 7wt.%															
	WBF-WBF-104-P3-FD01-01262024	26-Jan-24	16	11.26	99	299	7459	5915	20.8	**178**	2.22	**42.6**	2,520 J	2.36 J	728	10.5

Notes:
Grounwater samples were filtered prior to analysis
[1] Chemistry of groundwater samples included for quality control

--	not available
Bold	concentration is greater than or equal to the indicated standard.
CCR	coal combustion residuals
deg-C	degrees celsius
Eh	redox potential. Eh is equal to ORP (mV) summed with a standard of 200 mV
GWPS	groundwater protection standard
ID	identification
J	result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
mg/L	milligrams per Liter
mL	milliliter
mV	millivolts
NaOH	sodium hydroxide
ORP	oxidation reduction potential
SU	standard units
TDS	total dissolved solids
Temp	temperature
µg/L	micrograms per Liter
µS/cm	microsiemens per centimeter
U	not detected above method detection limit
WBF	Watts Bar Fossil Plant
wt%	weight percent

Dosing Key

Day	NaOH 3wt% (mL)	NaOH 5wt% (mL)	NaOH 7wt% (mL)
1	3	3	3
2	9	9	9
3	6	6	6
5	6	6	6
6	9	9	9
7	9	9	9
8	9	9	9
9	9	9	0
10	4	4	0
12	9	9	0
21	2	0	0
23	6	6	0
26	6	0	0
27	6	0	0
28	9	0	0
29	4	4	0

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Table 13 - Supplemental Column Test Results ($FeCl_3$ and NaOH)
Watts Bar Fossil Plant

CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS				--	--	--	--	--	--	10	5	6	--	40	--	100
Slag Disposal Area (SB05 / WBF-104)	**Groundwater[1]**															
	WBF-WBF-104-P3-GW-04192024	19-Apr-24	11	4.75	153	353	2736	1995	23.6	0.563 U	**15.0**	**640**	30.7 J	2.85 J	67,400	0.610 U
	WBF-WBF-104-P3-GW-04232024	23-Apr-24	15	4.89	210	410	2522	1832	21.8	0.563 U	**15.1**	**679**	27.7 U	4.03 J	65,300	0.610 U
	WBF-WBF-104-P3-GW-04262024	26-Apr-24	18	4.97	216	416	2548	1857	20.4	0.563 U	**15.7**	**674**	34.6 J	4.16 J	63,200	0.610 U
	WBF-WBF-104-P3-GW-04302024	30-Apr-24	22	4.94	232	432	2558	1859	21.7	0.738 J	**16.4**	**726**	33.2 J	4.51 J	72,800	0.610 U
	WBF-WBF-104-P3-GW-05032024	03-May-24	25	4.96	194	394	2522	1830	22.4	0.563 U	**15.8**	**726**	27.7 U	4.67 J	72,000	0.610 U
	WBF-WBF-104-P3-GW-05072024	07-May-24	29	4.94	180	380	2549	1852	22.2	0.563 U	**16.2**	**754**	27.8 U*	4.21 J	73,200	0.610 U
	WBF-WBF-104-P3-GW-05102024	10-May-24	32	4.96	189	389	2564	1867	21.8	0.563 U	**14.9**	**662**	77.5	6.45 U	68,200	0.610 U
	WBF-WBF-104-P3-GW-05142024	14-May-24	36	4.91	176	376	2510	1814	21.8	0.563 U	**16.8**	**679**	27.7 U	6.45 U	66,000	1.06 J
	WBF-WBF-104-P3-GW-05172024	17-May-24	39	4.96	171	371	2452	1773	22.4	0.563 U	**15.5**	**653**	34.8 J	3.91 J	64,100	0.610 U
	WBF-WBF-104-P3-GW-05212024	21-May-24	43	4.96	187	387	2469	1781	24.2	0.563 U	**15.1**	**722**	53.7	3.15 J	61,600	0.610 U
	WBF-WBF-104-P3-GW-05242024	24-May-24	46	4.92	152	352	2492	1803	24.5	0.563 U	**17.0**	**755**	54.4	3.31 J	72,900	0.610 U
	WBF-WBF-104-P3-GW-05282024	28-May-24	50	4.93	185	385	2460	1782	22.2	0.563 U	**16.7**	**716**	48.7 J	3.71 J	67,900	0.610 U
	WBF-WBF-104-P3-GW-05312024	31-May-24	53	4.91	193	393	2480	1802	20.8	0.563 U	**15.6**	**682**	27.7 U	3.69 J	67,500	0.610 U
	WBF-WBF-104-P3-GW-06042024	04-Jun-24	57	4.94	175	375	2536	1841	22.7	0.617 J	**16.2**	**707**	628	4.04 J	68,100	0.610 U
		07-Jun-24	60	No sample collected; groundwater supply depleted												
	Control															
	Start	**08-Apr-24**	0													
	WBF-WBF-104-P3-0-04192024	19-Apr-24	11	4.89	247	447	2972	2174	23.5	0.563 U	**12.8**	**111**	39.7 J	13.6	31,700	0.610 U
	WBF-WBF-104-P3-0-04232024	23-Apr-24	15	5.27	249	449	2847	2100	21.8	3.15	**13.0**	**105**	35.7 U*	15.2	35,100	0.610 U
	WBF-WBF-104-P3-0-04262024	26-Apr-24	18	5.18	227	427	2813	2074	20.4	0.620 J	**14.0**	**375**	29.9 J	9.60	51,100	0.610 U
	WBF-WBF-104-P3-0-04302024	30-Apr-24	22	5.16	197	397	2776	2035	21.7	1.48	**13.3**	**97.7**	27.7 U	14.5	42,500	0.610 U
	WBF-WBF-104-P3-0-05032024	03-May-24	25	5.35	262	462	2728	1999	22.4	0.793 J	**13.6**	**107**	30.1 J	15.3	41,800	0.610 U
	WBF-WBF-104-P3-0-05072024	07-May-24	29	5.31	158	358	2677	1960	22.2	1.16	**14.0**	**129**	27.7 U	14.0	51,900	0.610 U
	WBF-WBF-104-P3-0-05102024	10-May-24	32	5.28	199	399	2663	1948	21.8	0.859 J	**14.3**	**131**	27.7 U	12.3 J	54,400	0.610 U
	WBF-WBF-104-P3-0-05142024	14-May-24	36	5.07	189	389	2689	1965	21.8	2.01	**13.5**	**132**	27.7 U	12.1 J	59,900	0.610 U
	WBF-WBF-104-P3-0-05172024	17-May-24	39	5.06	190	390	2893	2130	22.4	2.60	**12.2**	**139**	34.7 J	11.5	52,200	0.610 U
	WBF-WBF-104-P3-0-05212024	21-May-24	43	5.13	185	385	2463	1778	24.2	0.697 J	**9.70**	**277**	63.4	6.29 J	55,600	0.610 U
	WBF-WBF-104-P3-0-05242024	24-May-24	46	5.06	183	383	2553	1856	24.5	0.563 U	**9.82**	**255**	27.7 U	7.16	62,600	0.610 U
	WBF-WBF-104-P3-0-05282024	28-May-24	50	5.08	181	381	2493	1811	22.2	0.563 U	**10.3**	**217**	59.8	6.78	62,300	0.610 U
	WBF-WBF-104-P3-0-05312024	31-May-24	53	5.09	202	402	2568	1876	20.8	0.563 U	**9.09**	**204**	38.9 J	5.14	57,300	0.610 U
	WBF-WBF-104-P3-0-06042024	04-Jun-24	57	5.09	171	371	2581	1880	22.7	0.604 J	**9.18**	**189**	86.2	7.15	60,100	0.610 U
	WBF-WBF-104-P3-0-06072024	07-Jun-24	60	5.09	171	371	2568	1869	22	0.732 J	**9.42**	**169**	110	8.24	64,400	0.610 U
	$FeCl_3$ 1 + NaOH 3wt. %															
	Start	**08-Apr-24**	0													
	WBF-WBF-104-P3-FECL3-1-NAOH-3-04192024	19-Apr-24	11	6.12	230	430	2814	2069	23.5	0.563 U	**14.7**	**50.3**	63.0	15.7	26,100	0.610 U
	WBF-WBF-104-P3-FECL3-1-NAOH-3-04232024	23-Apr-24	15	6.76	287	487	3429	2543	21.8	0.720 J	**14.7**	**81.5**	313	22.0	28,300	0.610 U
	WBF-WBF-104-P3-FECL3-1-NAOH-3-04262024	26-Apr-24	18	7.15	255	455	3619	2704	20.4	0.671 J	**9.47**	**37.3**	68.6	16.7	18,500	0.610 U
	WBF-WBF-104-P3-FECL3-1-NAOH-3-04302024	30-Apr-24	22	7.23	177	377	3458	2561	21.7	1.79	4.15	**35.7**	588	13.4	9,360	2.44 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05032024	03-May-24	25	7.37	278	478	3520	2609	22.4	2.04	1.08	**20.5**	563	6.00	3,810	4.98 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05072024	07-May-24	29	7.5	162	362	3363	2486	22.2	1.84	0.912 J	**14.9**	118 U*	2.73 J	3,120	3.96 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05102024	10-May-24	32	7.28	169	369	3260	2404	21.8	1.31	0.879 J	**18.6**	106	6.45 U	3,830	2.45 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05142024	14-May-24	36	7.18	187	387	3139	2303	21.8	0.767 J	1.05	**17.7**	92.7	6.45 U	3,820	1.15 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05172024	17-May-24	39	7.07	153	353	3164	2424	22.4	0.716 J	4.53	**64.6**	221	5.81	19,600	0.625 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05212024	21-May-24	43	7.12	152	352	2545	1843	24.2	1.46	1.46	**74.9**	209	1.29 U	17,000	2.10 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05242024	24-May-24	46	7.16	178	378	2686	1962	24.5	0.809 J	0.881 J	**15.7**	94.3	1.29 U	6,800	3.66 J
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05282024	28-May-24	50	8.7	141	341	4995	3836	22.2	4.80	0.257 J	**10.8**	796	1.29 U	1,480	9.56
	WBF-WBF-104-P3-FECL3-1-NAOH-3-05312024	31-May-24	53	8.29	187	387	5109	3943	20.8	5.16	0.418 J	**12.0**	197	1.29 U	1,080	15.5
	WBF-WBF-104-P3-FECL3-1-NAOH-3-06042024	04-Jun-24	57	8.38	136	336	5882	4579	22.7	6.12	0.217 U	**10.3**	150	1.29 U	657	20.5
	WBF-WBF-104-P3-FECL3-1-NAOH-3-06072024	07-Jun-24	60	8.53	121	321	4374	3309	22	6.04	0.266 J	**9.50**	524 J	1.29 U	692	14.0

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Table 13 - Supplemental Column Test Results ($FeCl_3$ and NaOH)
Watts Bar Fossil Plant

CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS				--	--	--	--	--	--	10	5	6	--	40	--	100
Slag Disposal Area (SB05 / WBF-104)	**$FeCl_3$ 2 + NaOH 3wt. %**															
	Start	**08-Apr-24**	0													
	WBF-WBF-104-P3-FECL3-2-NAOH-3-04192024	19-Apr-24	11	2.56	267	467	7431	5912	23.5	1.76	**133**	**828**	281	**50.3**	114,000	0.610 U
	WBF-WBF-104-P3-FECL3-2-NAOH-3-04232024	23-Apr-24	15	3.26	278	478	4499	3424	21.8	1.64	**19.8**	**258**	212	40.0	35,600	0.610 U
	WBF-WBF-104-P3-FECL3-2-NAOH-3-04262024	26-Apr-24	18	3.86	286	486	3756	2815	20.4	0.635 J	**7.63**	**105**	224	26.3	17,100	0.680 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-04302024	30-Apr-24	22	9.55	137	337	4398	3322	21.7	**55.0**	0.495 J	**13.3**	1,750	3.42 J	265	13.4
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05032024	03-May-24	25	8.08	242	442	3551	2636	22.4	4.92	0.217 U	4.99	2,270	7.98	2,430	3.03 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05072024	07-May-24	29	7.64	172	372	3355	2481	22.2	1.26	0.464 J	**20.6**	517	4.26 J	6,430	1.03 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05102024	10-May-24	32	7.35	153	353	3295	2433	21.8	0.815 J	0.293 J	**13.4**	120	6.45 U	3,640	1.07 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05142024	14-May-24	36	7.32	146	346	3218	2366	21.8	0.593 J	0.217 U	5.24	130	6.45 U	1,310	0.671 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05172024	17-May-24	39	7.23	160	360	3162	2322	22.4	0.563 U	0.235 J	**13.1**	208	2.19 J	3,690	0.724 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05212024	21-May-24	43	7.22	141	341	2577	1868	24.2	0.647 J	1.29	**72.7**	321	1.29 U	16,500	0.691 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05242024	24-May-24	46	7.24	173	373	2692	1966	24.5	0.563 U	1.50	**29.5**	1,320	1.81 J	14,000	1.17 J
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05282024	28-May-24	50	9.28	124	324	6796	5362	22.2	**20.1**	0.494 J	**42.2**	2,250	2.98 J	2,360	17.4
	WBF-WBF-104-P3-FECL3-2-NAOH-3-05312024	31-May-24	53	9.54	148	348	9674	7946	20.8	**16.5**	0.279 J	**35.6**	990	1.56 J	1,140	30.9
	WBF-WBF-104-P3-FECL3-2-NAOH-3-06042024	04-Jun-24	57	8.84	127	327	9374	7648	22.7	**14.5**	0.217 U	**11.9**	182 J	1.29 U	81.5	25.7
	WBF-WBF-104-P3-FECL3-2-NAOH-3-06072024	07-Jun-24	60	8.77	115	315	4808	3668	22	6.61	0.217 U	**12.6**	1,400	2.42 J	175	9.94
	$FeCl_3$ 3 + NaOH 3wt. %															
	Start	**08-Apr-24**	0													
	WBF-WBF-104-P3-FECL3-3-NAOH-3-04192024	19-Apr-24	11	2.03	360	560	7641	6099	23.5	6.14	**114**	**2,140**	2,090	**106**	142,000	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-04232024	23-Apr-24	15	3.03	285	485	5932	4629	21.8	**26.9**	**53.9**	**2,560**	263	**127**	110,000	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-04262024	26-Apr-24	18	3.35	323	523	4360	3316	20.4	**14.2**	**10.3**	**771**	1,840	**66.4**	26,500	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-04302024	30-Apr-24	22	9.33	152	352	4627	3515	21.7	**41.3**	0.999 J	**19.7**	3,380	2.98 J	717	3.51 J
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05032024	03-May-24	25	8.16	260	460	3623	2695	22.4	1.80	0.217 U	**16.4**	2,840	6.15	1,620	0.924 J
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05072024	07-May-24	29	7.5	157	357	3195	2348	22.2	2.90	0.799 J	**91.0**	46.5 U*	5.06	4,770	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05102024	10-May-24	32	7.28	161	361	2989	2185	21.8	3.59	1.69	**132**	55.7	6.45 U	7,280	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05142024	14-May-24	36	7.28	167	367	2940	2169	21.8	3.18	1.83	**101**	27.7 U	6.45 U	6,400	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05172024	17-May-24	39	7.24	158	358	2872	2113	22.4	2.05	1.37	**77.7**	39.2 J	3.13 J	4,240	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05212024	21-May-24	43	7.23	144	344	2473	1815	24.2	2.75	4.15	**288**	1,800	5.74 J	34,100	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05242024	24-May-24	46	7.27	165	365	2764	2023	24.5	1.45	3.62	**182** J	193	2.06 J	25,600 J	0.610 U
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05282024	28-May-24	50	9.69	125	325	9747	7992	22.2	4.99	0.217 U	**26.9**	353	9.32	60.8	15.2
	WBF-WBF-104-P3-FECL3-3-NAOH-3-05312024	31-May-24	53	9.32	130	330	9276	7586	20.8	1.66	0.241 J	**63.7**	149	3.81 J	5,770	6.68
	WBF-WBF-104-P3-FECL3-3-NAOH-3-06042024	04-Jun-24	57	8.59	122	322	7753	6192	22.7	0.624 J	0.217 U	**19.9**	1,150	1.29 U	916	3.38 J
	WBF-WBF-104-P3-FECL3-3-NAOH-3-06072024	07-Jun-24	60	8.39	104	304	6418	5030	22	1.04	0.281 J	**19.2**	2,770	1.81 J	757	3.36 J

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Table 13 - Supplemental Column Test Results ($FeCl_3$ and NaOH)
Watts Bar Fossil Plant

Supplemental Column Test Replicate Sample Results

CCR Unit (Boring ID / Target Well ID)	Sample ID	Sample Date	Day	pH (SU)	ORP (mV)	Eh mV	Specific Conductance (µS/cm)	TDS mg/L	Temp deg-C	Arsenic µg/L	Cadmium µg/L	Cobalt µg/L	Iron µg/L	Lithium µg/L	Manganese µg/L	Molybdenum µg/L
GWPS				--	--	--	--	--	--	10	5	6	--	40	--	100
Slag Disposal Area (SB05 / WBF-104)	**Groundwater[1]**															
	WBF-WBF-104-P3-FD01-04192024	19-Apr-24	11	4.75	153	353	2736	1995	23.6	0.563 U	**14.8**	**632**	29.0 J	2.79 J	68,000	0.610 U
	WBF-WBF-104-P3-FD01-05032024	03-May-24	25	4.96	194	394	2522	1830	22.4	0.563 U	**15.2**	**710**	27.7 U	4.39 J	69,200	0.610 U
	WBF-WBF-104-P3-FD01-05142024	14-May-24	36	4.91	176	376	2510	1814	21.8	0.563 U	**15.7**	**696**	27.7 U	6.45 U	70,100	0.610 U
	WBF-WBF-104-P3-FD01-05312024	31-May-24	53	4.91	193	393	2480	1802	20.8	0.563 U	**15.7**	**677**	27.7 U	3.55 J	66,400	0.610 U
	$FeCl_3$ 1 + NaOH 3wt. %															
	WBF-WBF-104-P3-FD01-04262024	26-Apr-24	18	7.15	255	455	3619	2704	20.4	0.563 U	**9.09**	**38.3**	69.4	16.8	18,800	0.610 U
	WBF-WBF-104-P3-FD01-04302024	30-Apr-24	22	7.23	177	377	3458	2561	21.7	1.56	4.51	**35.2**	582	13.4	9,430	2.41 J
	WBF-WBF-104-P3-FD01-05072024	07-May-24	29	7.5	162	362	3363	2486	22.2	1.62	0.814 J	**14.3**	123 U*	2.54 J	3,010	3.79 J
	WBF-WBF-104-P3-FD01-05172024	17-May-24	39	7.07	153	353	3164	2424	22.4	0.563 U	4.38	**63.2**	225	5.10	19,500	0.610 U
	WBF-WBF-104-P3-FD01-06072024	07-Jun-24	60	8.53	121	321	4374	3309	22	6.71	0.217 U	**9.71**	258 J	1.29 U	695	15.1
	$FeCl_3$ 2 + NaOH 3wt. %															
	WBF-WBF-104-P3-FD01-05102024	10-May-24	32	7.35	153	353	3295	2433	21.8	0.765 J	0.255 J	**11.4**	113	6.45 U	3,110	1.11 J
	WBF-WBF-104-P3-FD01-05212024	21-May-24	43	7.22	141	341	2577	1868	24.2	0.583 J	1.36	**68.2**	308	1.29 U	16,500	0.764 J
	WBF-WBF-104-P3-FD01-06042024	04-Jun-24	57	8.84	127	327	9374	7648	22.7	**13.9**	0.217 U	**11.6**	276 J	1.29 U	86.1	25.8
	$FeCl_3$ 3 + NaOH 3wt. %															
	WBF-WBF-104-P3-FD01-04232024	23-Apr-24	15	3.03	285	485	5932	4629	21.8	**27.1**	**55.7**	**2,610**	303	**133**	97,000	0.610 U
	WBF-WBF-104-P3-FD01-05242024	24-May-24	46	7.27	165	365	2764	2023	24.5	1.60	4.08	**226** J	158	2.52 J	32,100 J	0.610 U
	WBF-WBF-104-P3-FD01-05282024	28-May-24	50	9.69	125	325	9747	7992	22.2	5.85	0.217 U	**25.9**	351	8.85	61.7	15.3

Notes:

Grounwater samples were filtered prior to analysis

[1] Chemistry of groundwater samples included for quality control

--	not available
Bold	concentration is greater than or equal to the indicated standard.
CCR	coal combustion residuals
deg-C	degrees celsius
Eh	redox potential. Eh is equal to ORP (mV) summed with a standard of 200 mV
$FeCl_3$	ferric chloride
GWPS	groundwater protection standard
ID	identification
J	result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value
mg/L	milligrams per Liter
mL	milliliter
mV	millivolts
NaOH	sodium hydroxide
ORP	oxidation reduction potential
SU	standard units
TDS	total dissolved solids
Temp	temperature
µg/L	micrograms per Liter
µS/cm	microsiemens per centimeter
U	not detected above method detection limit
U*	result should be considered "not detected" because it was detected in an associated field or laboratory blank at a similar level
WBF	Watts Bar Fossil Plant
wt.%	weight percent

Dosing Key

	$FeCl_3$ 1 + NaOH 3w t%			$FeCl_3$ 2 + NaOH 3w t%			$FeCl_3$ 3 + NaOH 3w t%		
Day	$FeCl_3$ 1w t% (mL)	$FeCl_3$ 10w t% (mL)	NaOH 3w t% (mL)	$FeCl_3$ 1w t% (mL)	$FeCl_3$ 10w t% (mL)	NaOH 3w t% (mL)	$FeCl_3$ 1w t% (mL)	$FeCl_3$ 10w t% (mL)	NaOH 3w t% (mL)
0	20	0	0	20	0	0	20	0	0
1	30	0	0	30	0	0	30	0	0
2	30	0	0	30	0	0	30	0	0
3	20	0	0	20	0	0	20	0	0
4	0	0	9	30	0	0	30	0	0
5	0	0	9	30	0	0	30	0	0
6	0	0	9	30	0	0	30	0	0
7	0	0	9	10	0	6	30	0	0
8	0	0	9	0	0	9	30	0	0
9	0	0	9	0	0	9	30	0	0
10	0	0	9	0	0	9	20	0	3
11	0	0	9	0	0	9	0	0	9
12	0	0	3	0	0	9	0	0	9
13	0	0	0	0	0	6	0	0	6
14	0	0	9	0	0	9	0	0	9
15	0	0	9	0	0	9	0	0	9
16	0	0	9	0	0	9	0	0	9
17	0	0	9	0	0	9	0	0	9
18	0	0	9	0	0	9	0	0	9
46	0	10	30	0	20	40	0	30	40
47	0	0	5	0	0	20	0	0	20
49	0	0	0	0	0	5	0	0	15

EXHIBITS

Exhibit No.

1

Title

WBF Plant Overview

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2024-04-29
Technical Review by AL on 2024-04-29

0 150 300 450 600 Feet

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

Legend

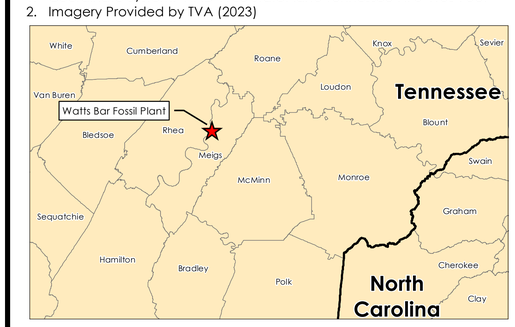
- Groundwater Monitoring Well
- Soil Boring
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

DRAFT

CCR: Coal combustion residuals

Notes

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



Stantec TVA

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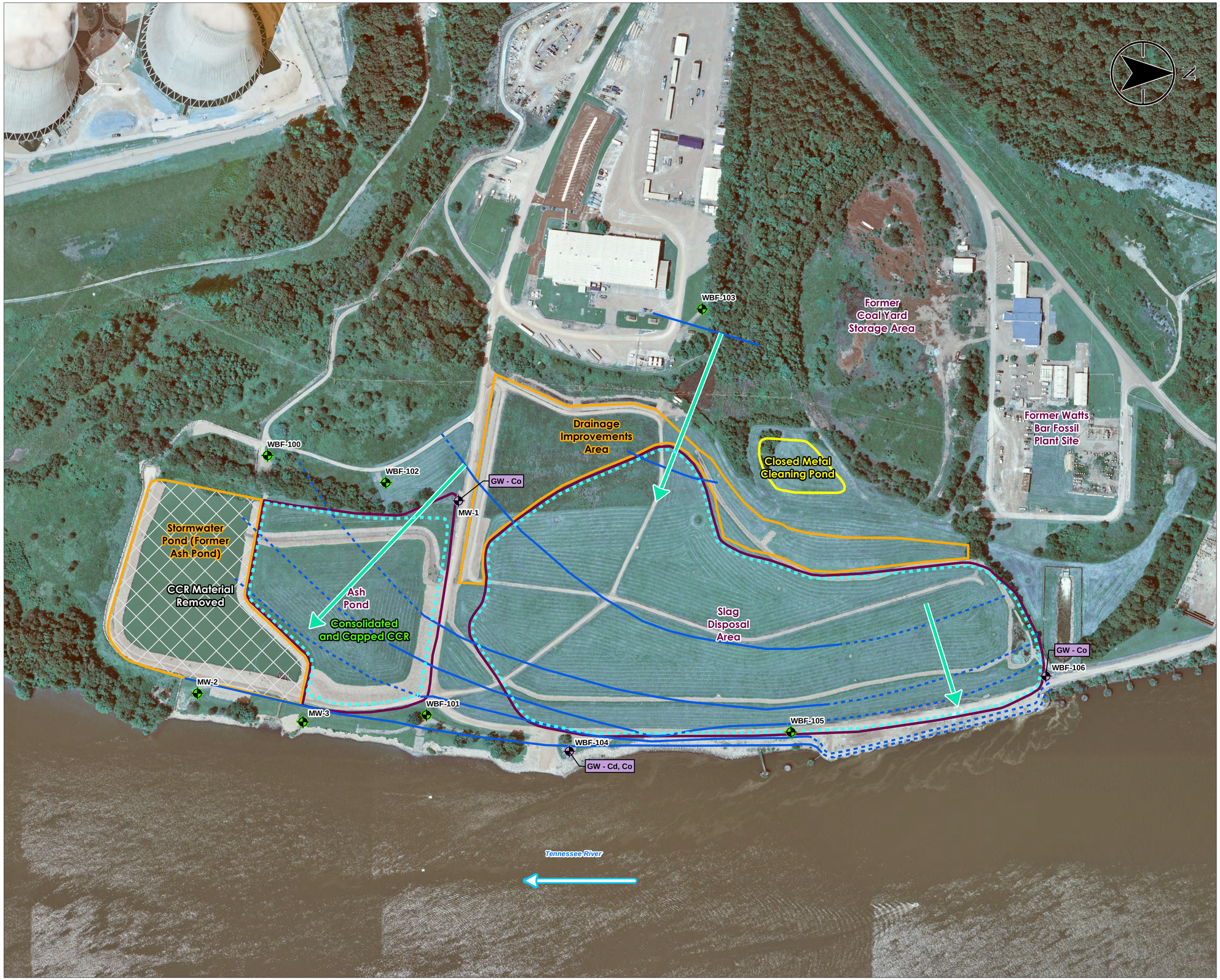


Exhibit No.

2

Title

Environmental Investigation Findings at WBF Plant CCR Units

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by DMB on 2024-08-26
Technical Review by MD on 2024-08-26

0 150 300 450 600 Feet

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

Legend

- Groundwater Results Below Groundwater Screening Levels
- Groundwater Results Above Groundwater Screening Levels
- Inferred Groundwater Flow
- Interpolated Groundwater Contour (5 ft interval)
- Groundwater Contour (5 ft interval)
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

DRAFT

GW - Groundwater
Cd - Cadmium
Co - Cobalt

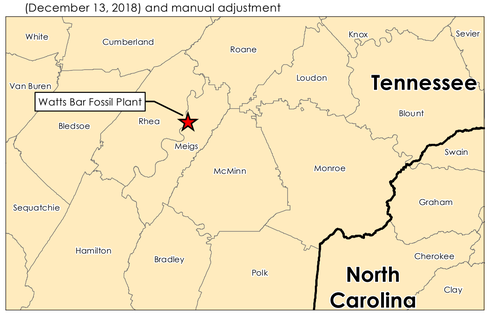
CCR: Coal combustion residuals

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

Groundwater conditions at well MW-1 are evaluated and discussed in Chapter 6.5 and Appendix D of the CARA Plan.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment



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APPENDIX I.2

IN SITU TREATMENT INVESTIGATION FIELDWORK SUMMARY

Appendix I.2 - *In Situ* Treatment Investigation Fieldwork Summary - DRAFT

TDEC Commissioner's Order:
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Log

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Date Revised for Reissuance. No other changes made to this Appendix	December 5, 2025

Sign-off Sheet

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Prepared by _____

Anna Wilson, Earth Scientist

Reviewed by _____

Jamie Snider, PG, Geologist

Approved by _____

Carole Farr, Senior Principal Geologist

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Abbreviations

ASTM	ASTM International
bgs	Below Ground Surface
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
COC	Chain-of-Custody
DO	Dissolved Oxygen
DPT	Direct Push Technology
EIP	Environmental Investigation Plan
ENV	Environmental
EnvStds	Environmental Standards, Inc.
FSP	Field Sampling Personnel
ID	Identification
IDW	Investigation Derived Waste
ORP	Oxidation Reduction Potential
%	Percent
PG	Professional Geologist
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SB	Soil Boring
SDA	Slag Disposal Area
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner’s Order No. OGC15-0177
TI	Technical Instruction
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this Appendix to summarize the fieldwork activities conducted to support an *in situ* treatment investigation at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

The purpose of the *in situ* treatment investigation was to collect additional site-specific data at the WBF Plant to supplement the dataset collected during the environmental investigation, support evaluation of source control measures, and inform potential corrective measures at the WBF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan is being prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of coal combustion residuals (CCR) material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA.

The *in situ* treatment investigation activities were performed in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order:

- *Supplemental Investigation Sampling and Analysis Plan (SAP)* (Stantec 2021a)
- *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021b)
- *TDEC Order Environmental Investigation Plan (EIP)* (Stantec 2018)
- *Coal Combustion Residuals Groundwater Monitoring and Investigation Quality Assurance Project Plan, (QAPP) Revision 7* (Environmental Standards, Inc. [EnvStds] 2023).

The SAPs were implemented in accordance with TVA- and TDEC-approved Programmatic and Project-specific changes. Field documentation for work performed under these Plans was reviewed for variations in scope and procedures, and the findings are provided in Section 3.7.

Quality Assurance oversight on field data acquisition protocols, sampling practices, and data review were performed by EnvStds under direct contract to TVA.

2.0 OBJECTIVE AND SCOPE

The primary objective of the *in situ* treatment investigation was to collect soil and groundwater samples to evaluate *in situ* treatment remedial options at one of the closed CCR units. Cobalt is the primary target for *in situ* treatment in the areas downgradient of the Slag Disposal Area.

The approach for the *in situ* treatment investigation was to:

- Collect soil samples from the screened intervals of wells WBF-104 and WBF-106 for bench scale testing
- Collect groundwater samples for bench scale testing.

The scope of work for the *in situ* treatment investigation was conducted during various field events outlined below:

- Drilling and sampling of soil borings advanced adjacent to existing monitoring wells WBF-104 and WBF-106
- Groundwater sample collection from monitoring wells WBF-104 and WBF-106.

Soil and groundwater collected for treatability testing were maintained in the Stantec Treatability Facility in Sylvania, Ohio under project storage and custody protocols until such time the materials were ready for the *in situ* bench scale testing. Details on each activity are presented in the sections below.

3.0 FIELD ACTIVITIES

Drilling and sampling of soil borings, and groundwater sampling of monitoring wells for the *in situ* treatment investigation were conducted between September 28 and 29, 2021, and between December 6 and 7, 2021, respectively, and consisted of direct push technology (DPT) drilling, soil sampling, measuring water levels, and collecting groundwater samples. Prior to initiating field activities, TVA conducted environmental reviews, obtained permits, and performed utility clearances as necessary to complete the field work.

Stantec performed the *in situ* treatment investigation field activities based on guidance and specifications of TVA's Environmental (ENV) Technical Instructions (TIs), the SAPs, and the QAPP, except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, oversight of select field activities, field documentation, and centralized data management were performed by EnvStds. EnvStds also provided quality reviews of field documentation.

During the *in situ* treatment investigation, Stantec conducted the following field activities:

- Confirmed drilling locations for planned boring locations
- Drilled two borings under the direction of a Stantec Professional Geologist (PG) licensed in the State of Tennessee
- Collected 26 saturated soil samples using DPT polyvinyl chloride (PVC) sample sleeves at two boring locations
- Collected groundwater level measurements from two monitoring wells prior to sampling
- Recorded field measurements of groundwater quality parameters during purging at the sampled wells
- Collected groundwater samples from two monitoring well locations
- Shipped collected samples via FedEx or delivered via courier to the Stantec Treatability Facility in Sylvania, Ohio for analysis.

Drilling and sampling activities were performed in general concordance with the SAPs.

Details on each activity are presented in the following sections. The *in situ* treatment investigation borings and sampled wells are shown on Exhibit 1. Tabulated information collected during the investigation, including summaries of soil boring locations, and soil and groundwater samples collected are summarized in Tables 1 through 3, respectively. Subsurface boring logs are provided in Attachment A and a photographic log of the soil lithology is provided in Attachment B.

3.1 WORK LOCATION

The *in situ* treatment investigation field activities were completed at two borings under the *Supplemental Investigation SAP*. Boring locations are shown on Exhibit 1. A summary of the boring locations is provided in Table 1.

Table 1. Summary of Boring Locations

CCR Unit	Target Well Location	Boring ID	Total Depth (feet bgs)	Sampling Interval (feet bgs)
Slag Disposal Area	WBF-104	WBF-SDA-SB05	30.0	5.0-30.0
	WBF-106	WBF-SDA-SB02	35.0	8.0-35.0

Notes: SB – Soil Boring, bgs – below ground surface, ID = identification, SDA – Slag Disposal Area

3.2 DOCUMENTATION

Stantec maintained field documentation in general accordance with TVA ENV-TI-05.80.03, *Field Record Keeping*, the SAPs, and the QAPP. Field activities and data were primarily recorded on Plant-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements.

Deviations from the SAPs, TIs, or QAPP were documented during field activities and are summarized in Section 3.7 of this report. Chain-of-Custody forms (COCs) were completed in accordance with TVA ENV-TI-05.80.02*: Sample Labeling and Custody*.

3.2.1 Field Forms

Stantec used program-specific field forms to record field observations and data for specific activities. Field forms used during the *in situ* treatment investigation included:

- *Daily Field Activity Log*
- *Subsurface Boring Log*
- *Chain-of-Custody (COC)*
- *Equipment Calibration Form*
- *Groundwater Collection Form.*

3.2.1.1 Daily Field Activity Log

Stantec field sampling personnel (FSP) recorded field activities, observations, and data on *Daily Field Activity Logs* to chronologically document the field program.

3.2.1.2 Subsurface Boring Log

A Stantec PG licensed in the State of Tennessee prepared a *Subsurface Boring Log* for each of the subsurface borings. The logs documented time, boring location, drilling personnel, tooling/equipment used, depth to water, sample number, sample recovery, soil lithology, and other relevant observations. Soil color was logged per the appropriate Munsell Soil Color Chart (Munsell Color 2009). Information from these logs was used to construct the subsurface logs provided in Attachment A.

3.2.1.3 Chain of Custody

Stantec FSP logged each soil and groundwater sample collected during the investigation field activities on a *COC*. Information on the *COC* included the sample identification (ID), sample location, sample depth, type of sample, sampling date, and sample custody record. *COCs* were completed in general accordance with TVA ENV-TI-05.80.02*: Sample Labeling and Custody* and reviewed by the laboratory manager.

3.2.1.4 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and turbidity meter when used and documented the results on an *Equipment Calibration Form*. FSP documented the calibration results for temperature, turbidity, specific conductance, pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP), and verified that the field instruments' sensors were operating within acceptance criteria. Refer to Section 3.2.2 for additional details on equipment calibration procedures.

3.2.1.5 Groundwater Collection Form

Stantec FSP recorded the depth to water, purge flow rate, volume of groundwater purged, temperature, pH, specific conductance, DO, ORP, turbidity, color of water, and other observations during groundwater purging and sampling activities at wells WBF-104 and WBF-106 in accordance with TVA ENV-TI-05.80.42, *Groundwater Sampling*. Field measurements were recorded on a *Groundwater Collection Form*. The form also documented the time intervals between measurements of field parameters, extraction rates, and water level drawdown until purging was complete.

3.2.2 Equipment Calibration

Field instruments used to collect, generate, or measure water quality parameters were calibrated each day prior to use as specified in the SAPs, QAPP, and TVA ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verification was performed to evaluate if the instrument remained within acceptance criteria during use. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Dayton, Tennessee. Additional details regarding equipment calibration were recorded on an *Equipment Calibration Form*, as described in Section 3.2.1.4.

3.2.3 Photographs

In addition to documentation of field activities described above, photographs were taken to document the field investigation. A photographic log of soil cores recovered from the borings is provided in Attachment B.

3.3 DRILLING AND SAMPLING

The following sections present drilling and soil sampling procedures used in the *in situ* treatment investigation. Drilling and sampling activities were performed under the direction of a Stantec PG licensed in the State of Tennessee.

3.3.1 Drilling

The borings were advanced in the overburden by Hawkston, LLC a drilling company licensed in Tennessee, under Stantec oversight using DPT drilling techniques. The DPT rig was equipped with a dual tube soil sampling system and 60-inch long, three-inch diameter PVC liners. Soil samples were recovered in 5-foot runs for lithologic description and photographic documentation. The borings were drilled adjacent to monitoring wells WBF-104 and WBF-106 to the top of the saturated zone (based on the seasonal high groundwater levels in the adjacent wells) for soil sample collection as described in the following section. The borings were abandoned and tremie-backfilled with a 30 percent (%) solids bentonite grout.

During advancement of each boring, the Stantec PG prepared field subsurface logs using a mobile data collection platform. Inputs included a description of subsurface lithology, sample recovery, color using the Munsell Soil Color Chart, and other relevant parameters as required by the SAP and TIs. Subsurface boring logs are presented in Attachment A.

Following removal, non-disposable sampling equipment or instruments were decontaminated after use at each boring using Liquinox solution and deionized water in accordance with TVA TI ENV—TI-05.80.05, *Field Sampling Equipment and Cleaning and Decontamination*. Drilling tools were decontaminated by high pressure washer/steamer cleaner.

3.3.1.1 In Situ Treatability Soil Sampling

DPT sample sleeves were collected from borings installed adjacent to monitoring wells WBF-104 and WBF-106, for *in situ* treatability testing. Soil sampling was conducted in accordance with the *Supplemental Investigation SAP.* The collected DPT sample sleeve was placed on a clean, decontaminated sampling table. The field PG donned a new pair of nitrile gloves, measured the recovery, and then collected material from the bottom of the sleeve for visual classification in accordance with ASTM International (ASTM) Standard D-2487-17 *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).* Soil material was removed from the bottom of the sleeve using a clean, decontaminated sampling tool for lithologic description. Decontamination of sampling equipment was conducted in accordance with TVA ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Each end of the DPT sample sleeves was labeled, capped, and taped.

DPT sample sleeves were labeled and handled in accordance with TVA ENV-TI-05.80.02, *Sample Labeling and Custody*. Sample sleeves were placed in a cooler with ice (within 15 minutes of sample collection) for transport to the Stantec Treatability Facility in Sylvania, Ohio. The samples were held under project storage and custody protocols until such time the materials were ready for the *in situ* bench scale testing. The bench scale testing methods and analysis are summarized in the Bench Scale *In Situ* Treatment Testing Technical Memorandum (Appendix I.1 of the CARA Plan).

A list of the soil samples collected for treatability is provided in Table 2.

3.4 GROUNDWATER SAMPLING METHODS

The following sections present groundwater gauging and sampling procedures used in the *in situ* treatment investigation.

3.4.1 Static Water Level Measurements

Static groundwater level readings were measured at two monitoring wells (WBF-104 and WBF-106) in accordance with TVA ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement.* Groundwater level readings were measured prior to sampling and recorded to the nearest 0.01 feet from a reference point on the top of each well casing using an electronic water level indicator. Water level indicator probes were decontaminated prior to first use and between measurements, and the decontamination was documented as specified in TVA ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination.* Depth to groundwater measurements were recorded on a *Groundwater Collection Form.*

3.4.2 Groundwater Purging & Sampling

Groundwater samples were collected from monitoring wells (WBF-104 and WBF-106) downgradient from the Slag Disposal Area for a feasibility level investigation of potential *in situ* remedies by treatability testing.

Monitoring wells were purged using dedicated bladder pumps equipped with dedicated tubing using volume-averaged well purging and sampling techniques as specified in TVA ENV-TI-05.80.42, *Groundwater Sampling*. Monitoring wells were purged at an approximate flow rate of 500 milliliters per minute until three well volumes were removed. Field parameters were measured and recorded on *Groundwater Sampling Forms* during the initial purging and in between each sample container. Water quality field parameters including pH, specific conductance, temperature, ORP, and DO were measured using a calibrated water quality meter (YSI ProPlus with flow-through cell) and recorded on field forms. Depth to water and turbidity were measured and recorded using a decontaminated electronic water-level indicator (Solinst 101) and calibrated turbidimeters (Hach 2100Q). Purging was considered complete when three well volumes were removed, as specified in Attachment A of the *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021b). Water quality stabilization was not required for this scope of work.

Groundwater was collected in five-gallon Cubitainers® for a total of approximately 20 gallons per monitoring well. Laboratory-provided sample Cubitainers® were filled directly from the pump discharge line. FSP wore new, clean nitrile gloves when handling sample containers and did not touch the interior of containers or container caps. New gloves were used when handling each sample. When filling sample containers, care was taken to minimize sample aeration (i.e., water was directed down the inner walls of the sample container). Each sample container was capped before filling the next container. Following completion of sampling, final field parameter measurements were made.

Sample containers were labeled and handled in accordance with TVA ENV-TI-05.80.02, *Sample Labeling and Custody*. FSP secured caps on each container, attached a custody seal across the cap, and placed the containers in a cooler on ice within 15 minutes of collection.

The groundwater samples were submitted to the Stantec Treatability Facility in Sylvania, Ohio where they were held under project storage and custody protocols until such time the materials were ready for the *in situ* bench scale testing. The bench scale testing methods and analysis are summarized in the Bench Scale *In Situ* Treatment Testing Technical Memorandum (Appendix I.1 of the CARA Plan).

A list of the groundwater samples collected for treatability testing is provided in Table 3.

3.5 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during the *in situ* treatment investigation included:

- Soil cuttings
- Purge water
- Used calibration solutions
- Decontamination fluids
- Personal protective equipment (PPE)
- General trash.

IDW was handled in general accordance with TVA ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* and ENV-TI-05.80.42, *Groundwater Sampling* (purge water); the SAP, the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with TVA Plant facility management. Soil cuttings, purge water, used calibration solutions, and decontamination fluids were managed as authorized by WBF Plant facility management and in general accordance with the *Supplemental Investigation* SAP. Used disposable PPE (e.g., nitrile gloves) and general trash were placed in garbage bags and disposed of onsite in a municipal waste dumpster.

3.6 SAMPLE SHIPMENT

Samples were packed and transported under COC procedures as specified in TVA ENV-TI-05.80.06, *Handling and Shipping of Samples*. The soil and groundwater samples were shipped via FedEx or delivered via courier to the Stantec Treatability Facility in Sylvania, Ohio.

3.7 VARIATIONS

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

3.7.1 Variations in Scope

No variations in scope were documented during field activities.

3.7.2 Variations in Procedure

Variations in procedures occurring in the field are provided below.

- Less than three well volumes were purged from monitoring wells WBF-104 and WBF-106 prior to sampling, as specified in the *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater*.
- A NIST certified thermometer was not available for use during equipment calibration prior to sampling monitoring well WBF-106.

4.0 SUMMARY

The data presented in this report are from implementation of the *in situ* treatment investigation at the WBF Plant. The scope of work for the *in situ* treatment investigation included:

- Drilled two borings for TDEC Order under the direction of a Stantec PG licensed in the State of Tennessee
- Collected 26 saturated soil samples at two boring locations during drilling for treatability testing
- Collected groundwater level measurements from two monitoring wells prior to sampling
- Recorded field measurements of groundwater quality parameters during purging at the sampled wells
- Collected groundwater samples from two monitoring well locations
- Shipped collected samples via FedEx or delivered via courier to the Stantec Treatability Facility in Sylvania, Ohio for analysis.

A summary of boring locations is presented in Table 1. Soil and groundwater sample summaries are presented in Tables 2 and 3, respectively.

The data collected during the *in situ* treatment investigation are usable for reporting and evaluation in the CARA and meet the objectives of the TDEC Order EIP. The complete dataset from this event will be evaluated along with data collected under other TDEC Order environmental investigations, as well as data collected under other State and CCR programs. This evaluation will be provided in WBF Plant CARA.

5.0 REFERENCES

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

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

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

TVA. ENV-TI-05.80.42, *Groundwater Sampling.*

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

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

TABLES

TABLE 2 – Summary of Soil Samples
Watts Bar Fossil Plant

			Analysis Type
Location ID	**Sample ID**	**Sample Type**	**Treatability**
WBF-SDA-SB02	WBF-SS-SDA-SB02-8.0/10.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-10.0/12.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-12.0/14.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-14.0/16.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-16.0/18.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-18.0/20.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-20.0/22.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-22.0/24.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-24.0/26.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-26.0/28.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-28.0/30.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-30.0/32.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-32.0/34.0-20210928	Direct Push Technology	X
	WBF-SS-SDA-SB02-34.0/35.0-20210928	Direct Push Technology	X
WBF-SDA-SB05	WBF-SS-SDA-SB05-5.0/7.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-7.0/9.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-10.0/12.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-12.0/14.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-14.0/16.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-16.0/18.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-18.0/20.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-20.0/22.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-22.0/24.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-24.0/26.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-26.0/28.0-20210929	Direct Push Technology	X
	WBF-SS-SDA-SB05-28.0/30.0-20210929	Direct Push Technology	X

Notes

ID identification

TABLE 3 – Summary of Groundwater Samples
Watts Bar Fossil Plant

			Analysis Type
Location ID	**Sample ID**	**Sample Type**	**Treatability**
WBF-104	WBF-GW-WBF104-20211207	Normal Sample	X
WBF-106	WBF-GW-WBF106-20211207	Normal Sample	X

Notes

ID identification

Stantec

DRAFT

EXHIBITS

Exhibit No.
1

DRAFT

Title

Well and Soil Boring Locations

Client/Project

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

Project Location

Spring City, Tennessee

175668050
Prepared by MB on 2024-04-09
Technical Review by MW on 2024-04-09

0 150 300 450 600 Feet

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

Legend

- Downgradient Well
- Soil Boring
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

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

Stantec TVA

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ATTACHMENT A – SUBSURFACE LOGS

Subsurface Boring Legend

Lithology Graphics

Symbol	Lithology
	Fill
	Top Soil
	Gravel
	Well Graded Gravel (GW)
	Poorly Graded Gravel (GP)
	Silty Gravel (GM)
	Silty, Clayey Gravel (GC-GM)
	Clayey Gravel (GC)
	Well Graded Gravel with Silt (GW-GM)
	Well Graded Gravel with Clay (GW-GC)
	Poorly Graded Gravel with Silt (GP-GM)
	Poorly Graded Gravel with Clay (GP-GC)
	Well Graded Sand (SW)
	Poorly Graded Sand (SP)
	Silty Sand (SM)
	Silty, Clayey Sand (SC-SM)
	Clayey Sand (SC)
	Well Graded Sand with Silt (SW-SM)
	Well Graded Sand with Clay (SW-SC)
	Poorly Graded Sand with Silt (SP-SM)
	Poorly Graded Sand with Clay (SP-SC)
	Silt (ML)
	Silty Clay (CL-ML)
	Lean Clay (CL)
	Organic Silt (OL)
	Elastic Silt (MH)
	Fat Clay (CH)
	Organic Clay (OH)
	Shale
	Siltstone
	Coal
	Limestone
	Sandstone

Lithology Graphics are based on TVA drafting standards.

Other Graphics

Symbol	Description
	Denotes environmental analytical sample interval
	Denotes SS sample interval
	Denotes ST sample interval
	Denotes DP sample interval
	Denotes RS sample interval
	Denotes RC sample interval
	First water level reading
	Second water level reading

Common Abbreviations

Abbreviation	Definition
DP	Direct Push
HA	Hand Auger
HSA	Hollow Stem Auger
N/A	Not Applicable
NR	Not Recorded
RC	Rock Core
RQD	Rock Quality Designation
RS	Rotary Sonic
SS	Split Spoon
ST	Shelby Tube
WH	Weight of Hammer
WR	Weight of Rod

General Notes

The boring logs include sample numbering used during drilling. For assigned Environmental Analytical Sample ID numbers, see relevant Environmental Chain-of- Custody forms from the drilling date range listed on each log.

For pH readings and additional field data, see applicable field documentation (e.g., Soil pH Data Form) from the drilling date range listed on each log.

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SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-SDA-SB02**
Client	Tennessee Valley Authority	Boring Location	445,890.63 N; 2,362,865.65 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	701.6 ft — Elevation Datum: NGVD29
Project Name	WBF TDEC Order	Date Started	9/28/21 — Completed: 9/28/21
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	11.6 ft — Date/Time: 9/28/21 16:35
Inspector	B. Evans — Logger: B. Evans	Depth to Water	10.4 ft — Date/Time: 9/29/21 08:33
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT
Overburden Drilling and Sampling Tools (Type and Size)	Direct Push / Geoprobe Dual Tube DT45, 3" dia. x 60" length PVC liner		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	N/A	Overdrill Depth	N/A
Sampler Hammer Type	N/A — Weight: N/A	Drop: N/A	Efficiency: N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	E. Smith	Approved By	C. Millhollin

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	701.6		Top of Hole						
0 – 1.2	701.6 – 700.4		Crushed stone						
1.2 – 1.9	700.4 – 699.7		POORLY GRADED GRAVEL WITH CLAY, GW, 10YR 2/1 (black), fine to medium, medium dense, moist, [FILL], [CCR]	1.4/1.6-20210928					
1.9 – 3.0	699.7 – 698.6		LEAN CLAY WITH SAND, CL, 10YR 4/1 (dark gray), low to medium plasticity, firm to hard, moist, [FILL]		DP01E	0.0 - 5.0	0.0 - 5.0	4.6	N/A
3.0 – 8	698.6 – 693.6		SANDY LEAN CLAY, CL, 10YR 2/2 (very dark brown), low to medium plasticity, firm to soft, moist to wet, lightly micaecous	3.8/4.0-20210928 5.8/6.0-20210928 7.8/8.0-20210928	DP02E	5.0 - 10.0	5.0 - 10.0	5.0	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/20/22

DRAFT

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-SDA-SB02**
Client	Tennessee Valley Authority	Boring Location	445,890.63 N; 2,362,865.65 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	701.6 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
8			SANDY LEAN CLAY, CL, 10YR 2/2 (very dark brown), low to medium plasticity, firm to soft, moist to wet, lightly micaecous *(Continued)*					
9								
10				9.8/10.0-20210928				
11								
12				11.8/12.0-20210928	DP03E	10.0 - 15.0	5.0	N/A
13								
14				13.8/14.0-20210928				
15								
16				15.8/16.0-20210928				
17					DP04E	15.0 - 20.0	5.0	N/A
18				17.8/18.0-20210928				

10.0 - 15.0

15.0 - 20.0

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/20/22

DRAFT

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-SDA-SB02**
Client	Tennessee Valley Authority	Boring Location	445,890.63 N; 2,362,865.65 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	701.6 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft	Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
19			SANDY LEAN CLAY, CL, 10YR 2/2 (very dark brown), low to medium plasticity, firm to soft, moist to wet, lightly micaecous *(Continued)*	19.8/20.0-20210928				
20	20.0	681.6	FAT CLAY LITTLE SAND, CH, 10YR 4/4 (dark yellowish brown), medium plasticity, firm, moist	21.8/22.0-20210928	DP05E	20.0 - 25.0	5.0	N/A
21				23.8/24.0-20210928				
22								
23								
24	24.0	677.6	FAT CLAY, CH, 10YR 4/4 (dark yellowish brown), medium plasticity, firm, moist	25.8/26.0-20210928				
25	25.0	676.6	LEAN CLAY WITH SAND, CL, 10YR 4/3 (brown) with 2.5Y 4/1 (dark gray), low to medium plasticity, firm to soft, moist	27.8/28.0-20210928	DP06E	25.0 - 30.0	5.0	N/A
26								
27								
28								
29								

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/20/22

DRAFT

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-SDA-SB02**
Client	Tennessee Valley Authority	Boring Location	445,890.63 N; 2,362,865.65 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	701.6 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Lithology Elevation	Lithology Graphic	Description	Overburden: / Rock Core:	Sample[1,2]	RQD %	Depth Ft[3]	Run Ft	Rec. Ft	Rec. %	Blows/PSI
30.0	671.6				29.8/30.0-20210928						
30			WELL GRADED SAND SOME SILT, SW, 2.5Y 4/1 (dark gray), fine, loose, wet								
31					31.8/32.0-20210928						
32						DP07E	30.0 - 35.0	30.0 - 35.0	5.0	N/A	
33											
33.8	667.8				33.8/34.0-20210928						
34			SANDY POORLY GRADED GRAVEL SOME CLAY, GP, 7.5YR 3/1 (very dark gray)								
34.7	666.9				34.8/35.0-20210928						
35.0	666.6		Shale, brown, soft, laminated, completely weathered to completely weathered, dry								
35			Bedrock Refusal / Bottom of Hole at 35.0 Ft.								

Samples collected for PLM testing are shown in the graphical sample column. See COC WBF_SI_09272021_1C for additional information.
Additional samples collected for treatability testing from 8.0' to 35.0'. See COC WBF_coc_tt_20210928_SB02 for additional information.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/20/22

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-SDA-SB05**
Client	Tennessee Valley Authority	Boring Location	444,347.43 N; 2,363,091.64 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.8 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	9/29/21
		Completed	9/29/21
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	10.1 ft
		Date/Time	9/29/21 14:29
Inspector	B. Evans	Logger	B. Evans
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Hawkston (Subcontractor)	Drill Rig Type and ID	Geoprobe 3230DT

Overburden Drilling and Sampling Tools (Type and Size): Direct Push / Geoprobe Dual Tube DT45, 3" dia. x 60" length PVC liner

Rock Drilling and Sampling Tools (Type and Size): N/A

Overdrill Tooling (Type and Size): N/A Overdrill Depth: N/A

Sampler Hammer Type: N/A Weight: N/A Drop: N/A Efficiency: N/A

Borehole Azimuth: N/A Borehole Inclination (from Vertical): N/A

Reviewed By: E. Smith Approved By: C. Millhollin

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	695.8		Top of Hole						
1.2	694.6		Crushed stone						
2.8	693.0		CLAYEY WELL GRADED GRAVEL, GW, 10YR 5/1 (gray) and 10YR 3/1 (very dark gray), fine to coarse, [FILL]		DP01E	0.0 - 5.0	0.0 - 5.0	4.2	N/A
10.0	685.8		SANDY LEAN CLAY, CL, 10YR 4/3 (brown), low plasticity, firm to soft, moist to wet, micaecous		DP02E	5.0 - 10.0	5.0 - 10.0	4.2	N/A
			SILTY POORLY GRADED SAND, SP, 7.5YR 5/4 (brown), fine, loose, wet		DP03E	10.0 - 15.0	10.0 - 15.0	5.0	N/A

SUBSURFACE LOG

Client Borehole ID	N/A	Stantec Boring No.	**WBF-SDA-SB05**
Client	Tennessee Valley Authority	Boring Location	444,347.43 N; 2,363,091.64 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.8 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Description	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
16		SILTY POORLY GRADED SAND, SP, 7.5YR 5/4 (brown), fine, loose, wet *(Continued)*				
17			DP04E	15.0 - 20.0	5.0	N/A
18						
19						
20						
21						
22	673.8					
		SILTY LEAN CLAY SOME SAND, CL, low plasticity, firm, moist, micaecous, manganese nodules	DP05E	20.0 - 25.0	5.0	N/A
23						
24						
25	670.8					
		SILTY POORLY GRADED SAND SOME CLAY, SP, 5GY 4/1 (dark greenish gray)				
26						
27	668.8					
		SANDY WELL GRADED GRAVEL SOME CLAY, GW, 7.5YR 4/1 (dark gray), fine to coarse, medium dense, wet	DP06E	25.0 - 30.0	5.0	N/A
28						
29						
30	665.8					
		Bedrock Refusal / Bottom of Hole at 30.0 Ft.				

Overburden:
Rock Core:
RQD %
Run Ft
Rec. %

Samples collected for treatability testing from 5.0' to 30.0'. See COC WBF_coc_tt_20210929_SB05 for additional information.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 9/20/22

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ATTACHMENT B – PHOTOGRAPHIC LOG OF SOIL LITHOLOGY

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 1

Photo Location:
WBF-SDA-SB02

Photo Date:
9/28/2021

Comments:
Interval (0.0-5.0 feet).

Photograph ID: 2

Photo Location:
WBF-SDA-SB02

Photo Date:
9/28/2021

Comments:
Interval (5.0-10.0 feet).

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Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 3

Photo Location:
WBF-SDA-SB02

Photo Date:
9/28/2021

Comments:
Interval (10.0-15.0 feet).

Photograph ID: 4

Photo Location:
WBF-SDA-SB02

Photo Date:
9/28/2021

Comments:
Interval (15.0-20.0 feet).

DRAFT

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 5

Photo Location:
WBF-SDA-SB02

Photo Date:
9/28/2021

Comments:
Interval (20.0-25.0 feet).

Photograph ID: 6

Photo Location:
WBF-SDA-SB02

Photo Date:
9/28/2021

Comments:
Interval (25.0-30.0 feet).

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Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 7

Photo Location:
WBF-SDA-SB02

Photo Date:
9/28/2021

Comments:
Interval (30.0-35.0 feet).

Photograph ID: 8

Photo Location:
WBF-SDA-SB05

Photo Date:
9/29/2021

Comments:
Interval (0.0-5.0 feet).

DRAFT

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 9

Photo Location:
WBF-SDA-SB05

Photo Date:
9/29/2021

Comments:
Interval (5.0-10.0 feet).

Photograph ID: 10

Photo Location:
WBF-SDA-SB05

Photo Date:
9/29/2021

Comments:
Interval (10.0-15.0 feet).

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Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 11

Photo Location:
WBF-SDA-SB05

Photo Date:
9/29/2021

Comments:
Interval (15.0-20.0 feet).

Photograph ID: 12

Photo Location:
WBF-SDA-SB05

Photo Date:
9/29/2021

Comments:
Interval (20.0-25.0 feet).

DRAFT

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Watts Bar Fossil (WBF) Plant**	**Site Location:**	**Spring City, Tennessee**

Photograph ID: 13

Photo Location:
WBF-SDA-SB05

Photo Date:
9/29/2021

Comments:
Interval (25.0-30.0 feet).

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APPENDIX I.3

IN SITU TREATMENT PILOT TEST TECHNICAL MEMORANDUM

Appendix I.3 - *In Situ* Treatment Pilot Test Technical Memorandum - DRAFT

TDEC Commissioner's Order:
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Log

Revision	Description	Date
0	DRAFT Submittal to TDEC	December 5, 2025

Sign-off Sheet

This document entitled Appendix I.3 - In Situ Treatment Pilot Test Technical Memorandum was prepared by Stantec Consulting Services Inc. (“Stantec”) for the account of Tennessee Valley Authority (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule, and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by _____

Aaron Line, Environmental Engineer

Reviewed by _____

David Collins, Principal Engineer

Approved by _____

Carole Farr, Senior Principal Geologist

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Abbreviations

AST	AST Environmental Inc
ASTM	ASTM International
bgs	Below Ground Surface
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
COC	Constituent of Concern
DO	Dissolved Oxygen
DPT	Direct Push Technology
EAR	Environmental Assessment Report
EI	Environmental Investigation
ENV	Environmental
EnvStds	Environmental Standards, Inc.
EPA	Environmental Protection Agency
GPM	Gallons per Minute
GWPS	Groundwater Protection Standards
HSA	Hollow stem Auger
ID	Identification
IDW	Investigation Derived Waste
NaBr	Sodium Bromide
NaOH	Sodium Hydroxide
ORP	Oxidation Reduction Potential
%	Percent
PG	Professional Geologist
PSI	Pounds per Square Inch
PPE	Personal Protective Equipment
PRB	Permeable Reactive Barrier
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
Stantec	Stantec Consulting Services Inc.

TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order No. OGC15-0177
TI	Technical Instruction
TM	Technical Memorandum
TVA	Tennessee Valley Authority
SU	Standard Units
UIC	Underground Injection Control
USCS	Unified Soil Classification System
WBF Plant	Watts Bar Fossil Plant
Work Plan	In Situ Treatment Pilot Test Work Plan
Work Plan Addendum	In Situ Treatment Pilot Test Work Plan Addendum
µg/L	Micrograms per Liter

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this In Situ Pilot Test Technical Memorandum (TM) to present findings of the pilot project conducted at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee. The WBF Plant is a former TVA coal-fired power plant in Rhea County, located in east Tennessee (Exhibit 1). The pilot project was conducted to evaluate the efficacy of *in situ* treatment under the site-specific conditions present hydraulically downgradient of the WBF Plant Slag Disposal Area coal combustion residual (CCR) unit.

This work was performed in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment Plan (CARA Plan) is being prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA. This TM is included as an appendix in the CARA Plan to support evaluation of potential corrective measures at the WBF Plant CCR unit.

1.1 BACKGROUND

TVA conducted TDEC Order environmental investigations (EI) for the WBF Plant CCR units between 2018 and 2021. Most TDEC Appendix I and United States Environmental Protection Agency (EPA) CCR Rule (Title 40 Code of Federal Regulations Part 257, Subpart D) (CCR Rule) Appendix IV CCR constituent concentrations in onsite groundwater at the WBF Plant were below TDEC-approved groundwater protection standards (GWPS), and groundwater impacts are limited to onsite areas along the perimeter of the Slag Disposal Area CCR unit. The primary CCR constituents above GWPS are cadmium (WBF104) and cobalt (MW-1, WBF-104, and WBF-106). The Environmental Assessment Report (EAR) (TVA 2024) concluded that cobalt and cadmium concentration trends would continue to be monitored and the need for corrective action would be further evaluated in the CARA Plan.

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

Alluvial deposits are the primary unconsolidated materials through which groundwater flows. Based on historical geotechnical and hydrogeologic investigations, the alluvium consists of clay, silt, sand, and gravel ranging from 10 to 32 feet thick. The EI boring logs show that the alluvial deposits tend to consist of mostly alluvial clay underlain by alluvial sand and gravel lenses deposited on top of bedrock. The

alluvial clay layer forms a confining unit where groundwater is contained in and flows through the sand and gravel lenses under pressure. Most of the groundwater flow and geochemical reactions between groundwater and aquifer materials occur within the unconsolidated alluvium. The groundwater flow direction within the uppermost aquifer beneath the Slag Disposal Area CCR unit is east-southeast toward the Tennessee River, and groundwater flow in the vicinity of the unit is bounded to the east by the river.

A geochemical evaluation program was implemented to establish and quantify the geochemical properties of the unconsolidated materials from the WBF Plant and demonstrate which geochemical reactions (e.g., adsorption to metal hydroxide minerals, cation exchange by clay minerals, etc.) contribute to the observed changes in cobalt and cadmium concentrations in groundwater downgradient of the Slag Disposal Area CCR unit. Geochemical data were collected and used for input into the WBF Plant Geochemical Conceptual Site Model.

The dominant mechanism of cobalt and cadmium attenuation identified is sorption and/or co-precipitation to iron and manganese oxyhydroxides. The stability of these mineral phases *in situ* under current conditions is influenced by the groundwater geochemistry downgradient of the Slag Disposal Area.

In situ treatability tests were conducted between January 2022 and March 2023 in accordance with the *Programmatic Approach to Treatability Testing for In Situ Treatment of Groundwater* (Stantec 2021). Baseline characterization of the soil and groundwater samples were analyzed to establish pre-testing concentrations of select constituents useful for interpretation of treatment results. Three phases of treatability testing were performed:

- Reagent demand testing to evaluate how much reagent is needed to sufficiently attenuate concentrations of target constituents to below the GWPS.
- Microcosm testing to evaluate the groundwater volume treated with a given dose of reagent and the necessary dosing frequency, and the usefulness of pH as a field-based performance monitoring criterion.
- Column testing to evaluate the efficacy of treatment over time and under simulated flow-through conditions.

Results of the treatability testing demonstrated that pH adjustment has the potential to be utilized as a corrective measure to treat cobalt and cadmium in groundwater downgradient of the Slag Disposal Area CCR unit. Sodium hydroxide (NaOH) was identified as the most effective reagent for reducing cobalt and cadmium concentrations. However, while the testing demonstrated the effectiveness of NaOH to reduce dissolved cobalt and cadmium concentrations, the reagent doses tested did not lower the cobalt and cadmium concentrations in groundwater below their respective GWPS and additional testing was recommended to evaluate higher NaOH reagent doses.

A variety of methods can be used to deliver the reagent depending on the reagent form (i.e., solid, slurry, or aqueous), configurations, site conditions, and operational constraints. Four methods were considered to establish a permeable reactive barrier (PRB) at the Slag Disposal Area CCR unit including a continuous trench, vertical slurry injection, aqueous injection into vertical or horizontal wells, and a funnel

and gate system. An alternatives analysis was conducted based on effectiveness, implementability, cost, and safety criteria, and injection of aqueous NaOH into horizontal wells was selected as the preferred technology.

Based on the first phase of treatability testing results, which demonstrated effectiveness of NaOH to adjust groundwater pH and reduce cobalt and cadmium concentrations in a laboratory setting, and the alternatives analysis which selected aqueous injection of NaOH in horizontal wells to establish a PRB, a pilot test was recommended to demonstrate effectiveness of the technology in the field and collect additional data for a full-scale design.

1.2 PURPOSE AND OBJECTIVES

The purpose of this pilot test was to evaluate the efficacy of *in situ* treatment via NaOH injection in a field setting to reduce groundwater concentrations of cobalt and cadmium to below GWPS under site-specific conditions present downgradient of Slag Disposal Area CCR unit at the WBF Plant and potentially other CCR units governed by the TDEC Order. The pilot test location was specifically selected as a good candidate for testing *in situ* treatment of cobalt in groundwater based on the following:

- Relatively high current cobalt concentrations compared to the concentrations in groundwater at other CCR Units
- Limited number of constituents of concern with concentrations above the GWPS (primarily cobalt and slightly elevated cadmium concentrations)
- The presence of a well-defined, relatively thin, continuous coarse-grained zone that could be targeted for reagent delivery and transport
- A relatively high groundwater velocity (compared to other CCR sites) that would support advective reagent transport to the downgradient observation well network within a reasonable time frame (i.e, on the order of days to weeks).

The results of pilot testing will inform selection and design of *in situ* treatment if it is planned to be implemented for CCR units covered by the TDEC Order. Conducting pilot testing at a given CCR unit does not necessarily indicate that the Corrective Action/Risk Assessment (CARA) Plan will include *in situ* treatment as part of the corrective action for groundwater.

Specific objectives of the WBF Plant *in situ* treatment pilot test were:

- Raise and maintain the pH to the target range identified in the column testing in and immediately downgradient of the injection wells (i.e., the reaction zone) and reduce cobalt and cadmium concentrations to below GWPS in downgradient observation wells
- Evaluate the potential for mobilization of other CCR constituents
- Evaluate the longevity and potential reversibility of geochemical reactions.

- Determine parameters for full-scale application:
    - Amendment dosing – injection flow rate and reagent concentration
    - Frequency of pulsed injections required to maintain the target pH in the reaction zone
    - Injection pressure that will adequately and safely deliver the reagent into the subsurface.
- Determine the time required for the reagent and geochemical effects to reach the downgradient observation well.

Vertical injection wells and a small, skid-mounted mix and delivery system were selected for pilot test infrastructure to best simulate the selected treatment technology (i.e. aqueous injection of NaOH into horizontal wells) and evaluate treatment objectives. Although horizontal injection wells were selected as the full-scale reagent delivery method, vertical wells were utilized for the pilot test due to their ability to evaluate pilot test objectives at a lower cost and ease of implementation at a smaller scale.

2.0 FIELD ACTIVITIES

The pilot test was performed in accordance with the approved *In Situ Treatment Pilot Test Work Plan (Stantec 2024)* (Work Plan) and *In Situ Treatment Pilot Test Work Plan Addendum (Stantec 2025)* (Work Plan Addendum).

2.1 PRE-FIELD ACTIVITIES

Stantec obtained excavation permits from the WBF Plant for installing pilot test injection and observation wells prior to the initiated pilot test field activities. In accordance with TDEC requirements, a Class V Underground Injection Permit was obtained from the TDEC Division of Water Resources. Injections activities were conducted in accordance with Underground Injection Control (UIC) Authorization No. RHE 0000071 issued on May 31, 2024.

2.2 WELL INSTALLATION

Injection wells and observation wells were installed by Stantec and AST Environmental Inc (AST) in accordance with the methods and procedures outlined in the Work Plan and applicable TVA Technical Instructions (TI). Well construction details are presented in Table 1, locations are shown on Exhibit 2, and well installation logs are presented in Attachment A.

Boreholes for pilot test wells were advanced via hollow stem auger (HSA). Recovered soil cores were collected and logged in accordance with ASTM International (ASTM) D2488: *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* by a Stantec Tennessee licensed professional geologist (PG). Boring logs for each well are presented in Attachment B. Cross-sections with well placement within interpretated lithologic zones are presented in Attachment C.

2.2.1 Injection Wells

Three injection wells (IW-1, IW-2, and IW-3) were installed between May 9 and May 14, 2024. Injection wells were constructed with 1-inch diameter SCH 40 polyvinyl chloride (PVC) casing and 0.020-inch machine slotted well screen. The injection wells were screened to target the relatively coarser-grained interval above bedrock. IW-1 was screened from 24.4 to 29.4 feet bgs, IW-2 was screened from 25.3 to 30.3 feet bgs, and IW-3 was screened from 24.5 to 29.5 feet bgs. A filter pack was placed in the annular space surrounding the well screen and extended a minimum of 3 feet above the top of screen and approximately 0.5 feet below the bottom of screen. A minimum 2-foot bentonite seal was placed above the filter pack. A 30 percent (%) high solids grout mixture was tremied into the annulus from the top of the bentonite seal to the ground surface.

2.2.2 Observation Wells

Six observation wells (OBS-1, OBS-2, OBS-3, OBS-4, OBS-5, and OBS-6) were installed between April 30 and May 16, 2024. Four additional observations wells (OBS-7, OBS-8, OBS-9, and OBS-10) were

installed between May 14 and May 16, 2025. Observation wells were constructed with 4-inch diameter SCH 40 PVC casing and a 5-foot long 0.010-inch machine slotted well screen. A filter pack was placed in the annular space surrounding the well screen and extended approximately 2 feet above the top of screen and approximately 0.5 feet below the bottom of screen. A minimum 2-foot bentonite seal was placed above the filter pack. A 30% high solids grout mixture was tremied into the annulus from the top of the bentonite seal to the ground surface.

2.3 INJECTION SYSTEM CONSTRUCTION

Stantec subcontracted AST to construct and install a skid-mounted reagent injection system. The injection system skid was placed in a secondary containment berm on a gravel pad east of the pilot test well network and consisted of a 360-gallon mix tank, variable speed stainless steel mixing shaft and impeller, progressive cavity injection pump, and manual flow control valves. A process flow diagram of the injection system is presented in Exhibit 3.

2.4 PILOT TEST ACTIVITIES

2.4.1 Injection System Operation

The injection system was operated manually to deliver periodic batch injections during the pilot test. Each batch consisted of injecting 80 gallons of 3% by weight NaOH into each of the three injection wells concurrently (240 gallons total) over the course of a field day (approximately 8 hours). The frequency of batch injections was adjusted based on the results of observation monitoring in downgradient observation wells.

Pressure gauges were installed along the conveyance piping downstream of the injection pump, on each manifold branch, and on each injection well head packer. The gauges were used to monitor system operation and injection performance. Pressure valves at well head packers were the primary indicator of down well injection pressure during system operation. Injection pressure was continuously monitored during batch injections to ensure individual well pressures did not exceed 15 pounds per square inch (psi).

Dedicated flow meters that measured instantaneous and total flow were installed on each injection line. Flow readings were collected throughout system operation to ensure design injection volumes were correctly delivered to each injection well and did not exceed the maximum design flow rate.

Static water level elevations were measured with a field water level meter to monitor changes in the vicinity of the injection wells before, during, and after each batch injection.

The following parameters were collected during injections to ensure operational parameters were within criteria thresholds:

- Baseline and periodic depth to groundwater measurements
- Injection flow rate and total volume injected

- Injection Pressure (injection pump, injection manifold, injection well head).

Injection flow rate, pressure, and total volume were recorded every 10 minutes and depth to groundwater was measured every 30 minutes during injections.

2.4.2 Phase 1 Injections

Phase 1 batch injections were conducted on the following dates:

- June 13, 2024
- August 26, August 28, and August 30, 2024
- October 2 – 4, 2024 (three total batch events)
- October 16 – 18, 2024 (three total batch events)
- October 29 – 31, 2024 (three total batch events)
- November 13 – 15, 2024 (three total batch events)
- December 4 – 6, 2024 (three total batch events).

An initial single injection event was conducted on June 13, 2024, followed by a 10-week observation monitoring period to evaluate reagent transport and treatment effectiveness. The injection frequency was increased to three batch events during the week of August 26 and followed by four weeks of performance monitoring. The injection frequency was increased again to three events per week every other week from October 2 through December 6, 2024.

Water quality sondes connected to electronic data loggers were installed in three wells (OBS-1, OBS-2, and OBS-3) throughout the duration of Phase 1 injections. Sondes collected continuous readings of pH, dissolved oxygen (DO), oxidation reduction potential (ORP), conductivity, temperature, turbidity, total suspended solids, and depth. Additionally, water quality parameters (pH, DO, ORP, conductivity, turbidity, and temperature) were collected with a water quality meter during sample collection.

Groundwater samples were collected for laboratory analysis with dedicated tubing using low-flow sampling techniques. The dedicated pump intake was installed within the saturated well screen. Purging was limited to one filter pack pore volume to collect a representative sample of the target transmissive zone. Due to the expected pH variation caused by reagent injections, water quality parameter stabilization was not required.

Groundwater samples were collected in accordance with the Work Plan prior to the first injection and on a weekly basis during the Phase 1 injection period. Samples were collected from upgradient observation well OBS-1, injection well IW-2, and downgradient observation wells OBS-2, OBS-3, OBS-4, OBS-5 and OBS-6. Samples were analyzed for CCR constituents listed in Title 40 Code of Federal Regulations Part 257, Appendices III and IV, inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04, and additional parameters identified in the Work Plan.

2.4.3 Tracer Test

A bromide tracer test was performed between October 31, 2024 and January 17, 2025 to evaluate hydraulic communication between the pilot test injection wells and downgradient observation wells because the expected increase in pH was not observed in the observation wells during the Phase 1 injections.

Prior to the tracer test, groundwater samples were collected from the observation well network and sent to a laboratory for analysis of total bromide. A total of 500 grams of solid sodium bromide (NaBr) was mixed directly with the NaOH reagent solution and delivered to the injection wells on October 31, 2024.

A bromide ion selective electrode connected to a data logger was installed in downgradient well OBS-2 to measure the bromide concentrations during the tracer test, and bromide was added to the groundwater sample analysis suite for the weekly sample collection.

2.4.4 Grab Groundwater Investigation

A grab groundwater investigation was conducted in the pilot test area following limited increases in pH during the Phase 1 injections. The objective of the investigation was to identify and delineate the occurrence and extent of groundwater with elevated pH indicative of the presence of the NaOH reagent outside of the areas monitored by the existing observation well network.

The investigation focused on the area to the southeast of the injection wells based on minor increases in pH and sodium in OBS-2, OBS-3 and OBS-5 during the Phase 1 injections. Ten Borings were advanced using a direct push technology (DPT) drill rig (Exhibit 4). Borings were advanced to the approximate injection interval (23 to 28 feet bgs) for sample collection. Groundwater was purged using a peristaltic pump and tubing, and pH was measured continuously using a water quality meter.

The pH levels measured during the investigation are shown in Exhibit 5. Elevated pH was observed in borings B-1, B-2, B-5, SB-1, SB-2, and SB-3 and indicated the reagent had moved in a more southeasterly direction than predicted from regional groundwater gradients. The results were used to identify locations for four new observation wells, OBS-7 through OBS-10 (Exhibit 2).

2.4.5 Phase 2 Injections

Following installation of the new observation wells, a second phase of injections (Phase 2) were conducted between June 5 and July 24, 2025. A total of 11 batch injection events were conducted during Phase 2 on the following dates:

- June 5, 2025
- June 11, 2025
- June 18, 2025
- June 25, 2025

- July 2, 2025
- July 9 – 10, 2025
- July 16 – 17, 2025
- July 23 – 24, 2025.

Water quality sondes connected to electronic data loggers were installed in three wells (OBS-1, OBS-7, and OBS-8) during the Phase 2 injections. Sondes collected continuous readings of pH, DO, ORP, conductivity, temperature, turbidity, total suspended solids, and depth. Additionally, water quality parameters (pH, DO, ORP, conductivity, turbidity, and temperature) were collected with a water quality meter during sample collection.

Groundwater samples were collected for laboratory analysis with dedicated tubing using low-flow sampling techniques. The dedicated pump intake was installed within the saturated well screen. Purging was limited to one filter pack pore volume to collect a representative sample of the target transmissive zone. Due to the expected pH variation caused by reagent injections, water quality parameter stabilization was not required.

Groundwater samples were collected prior to initiating Phase 2 injections and on a weekly basis during injections from upgradient observation well OBS-1, injection well IW-2, and downgradient observation wells OBS-7 and OBS-8. Water quality parameters were also collected weekly from cross-gradient observation wells OBS-9 and OBS-10 to evaluate changes to subsurface flow conditions. Water quality parameters were also intermittently collected from observation wells OBS-2 and OBS-3 based on water quality parameter observations at other wells. Samples were sent to a laboratory for analysis of constituents consistent with Phase 1.

2.4.6 Post-injection Observation Monitoring

Post-injection observation monitoring was conducted for four weeks (between August 4 and August 25, 2025) following the completion of Phase 2 injections. The objective of post-injection monitoring was to evaluate reagent residence time, changes in geochemical conditions, and potential rebound of chemical constituent concentrations. Monitoring was performed in injection wells IW-2 and IW-3 and observation wells OBS-2 and OBS-7 based on analytical and water quality data collected throughout Phase 2 performance monitoring.

2.5 SAMPLE SHIPMENT AND LABORATORY ANALYSIS

Samples were packed and transported under chain of custody procedures as specified in TVA ENV-TI-05.80.06, *Handling and Shipping of Samples*. The soil and groundwater samples were shipped via FedEx or delivered via courier to Eurofins Test America in Pittsburgh, Pennsylvania, or GEL Laboratories in Valley Forge, Pennsylvania, as applicable.

2.6 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during the pilot test included:

- Soil cuttings
- Purge water
- Used calibration solutions
- Decontamination fluids
- Personal protective equipment (PPE)
- General trash.

IDW was handled in general accordance with TVA ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* and ENV-TI-05.80.42, *Groundwater Sampling* (purge water), the Sampling and Analysis Plan (SAP); the WBF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with TVA Plant facility management. Soil cuttings, purge water, used calibration solutions, and decontamination fluids were managed as authorized by WBF Plant facility management and in general accordance with the *Supplemental Investigation* SAP. Used disposable PPE (e.g., nitrile gloves) and general trash were placed in garbage bags and disposed of onsite in a municipal waste dumpster.

2.7 DEVIATIONS

The proposed scope and procedures for the investigation were outlined in the Work Plan, QAPP, and applicable TVA TIs and ASTM standards, as detailed in the sections above. There were no variations from the scope of work outlined in the Work Plan (Stantec 2024) or Work Plan Addendum (Stantec 2025), with the exception noted below:

- The grab groundwater investigation was conducted in support of the Phase 1 injections as described in Section 2.4.4. TVA provided TDEC a written description of the proposed investigation scope and methodology in an email sent on December 2, 2024. Grab groundwater investigation activities were initiated following TDEC approval on December 3, 2024.

3.0 RESULTS

Injection system data is presented in Table 2. Groundwater quality data (pH, conductivity, DO, ORP, and turbidity) and groundwater sample analytical results are presented in Table 3 and Tables 4a and 4b, respectively. In the following sections, inorganic analytes are evaluated as total concentrations and dissolved concentrations are specifically identified when the distinction is necessary.

3.1 PHASE 1 INJECTIONS

Amendment Delivery

Phase 1 consisted of 19 individual injection events conducted between June 13 and December 6, 2024. A total of 4,560 gallons of 3% NaOH was successfully delivered to the subsurface. The average injection rate per well ranged from 0.33 to 1.78 gallons per minute (gpm) and the maximum pressures observed during each injection event ranged from 2.5 to 10 psi. Total batch injection times ranged from 45 minutes to 240 minutes. Scatter plots depicting instantaneous flow rate measurements collected during each injection event are presented for IW-1, IW-2 and IW-3 in Exhibit 6 through Exhibit 8, respectively.

pH

The primary objective of the pilot test was to raise and maintain the pH between 8.0 and 8.5 SU in the area within and immediately downgradient of the injection wells (i.e., the reaction zone). Baseline pH in the pilot test area prior to Phase 1 injections ranged between 4.65 SU (OBS-3) and 5.60 SU (OBS-1).

Following the first injection event on June 13, 2024, the pH in IW-2 increased from 5.42 to within the target range at 8.31 SU. The pH subsequently decreased in IW-2 to 6.41 SU after one week and gradually returned to baseline after approximately nine weeks (August 20). Except for OBS-5, no increases in pH indicative of amendment arrival were observed in the downgradient observation wells. In OBS-5, the pH remained at background levels until August 5 (approximately 7 weeks after the first injection), when it increased from 4.87 to 5.48 SU. The pH subsequently returned to the baseline level of 4.86 SU in the next sampling event.

The next round of injections consisted of three batch events during the week of August 26. The pH increased up to 8.24 SU in IW-2, 7.34 in OBS-2, 7.31 in OBS-3, and 6.07 in OBS-4 in the month following the injections. An increase was not observed in cross-gradient wells OBS-5 and OBS-6.

Since the pH did not achieve the target range of 8.0 to 8.5 SU in downgradient observations wells, injections were increased to three times per week every two weeks beginning on October 2, 2024. The pH increased immediately to above the target range in IW-2, ranging up to 12.16 SU through the end of November. A slight increase was also observed in OBS-2, ranging up to 6.11 SU on November 19.

Cobalt

Cobalt was detected above the GWPS (6 micrograms per liter (µg/L)) in baseline samples collected from each of the pilot test wells and ranged from 65.8 µg/L (OBS-1) to 872 µg/L (OBS-5). In injection well IW-2,

cobalt decreased after the first injection event from a baseline concentration of 509 µg/L to 76.1 µg/L one week later. Cobalt steadily increased and rebounded back to baseline concentrations seven weeks later (518 µg/L on August 6).

Following the August injections, cobalt concentrations fluctuated and did not show a clear trend. Once the injection frequency was increased in October and November 2024, cobalt concentrations decreased significantly from 195 µg/L to 13.1 µg/L. While total cobalt concentrations in IW-2 were never reduced below the GWPS, dissolved cobalt concentrations decreased to as low as 1.3 µg/L towards the end of Phase 1. Total and dissolved cobalt concentrations relative to pH for IW-2 and OBS-2 are presented in Exhibit 9 and Exhibit 10, respectively.

In the downgradient observation wells, cobalt concentrations fluctuated and at times exhibited decreasing trends. However, concentrations remained elevated relative to injection well IW-2 and indicated the response to amendment injection was limited to the areas immediately around the injection wells.

Cadmium

Cadmium concentrations were below the GWPS (5 µg/L) in baseline samples collected from upgradient well OBS-1, injection well IW-2, and downgradient well OBS-2, and except for the sample collected from IW-2 on September 23, 2024, remained below the GWPS during Phase 1. Cadmium was not detected above the GWPS in baseline samples collected from wells OBS-3, OBS-4, OBS-5, and OBS-6, ranging from 6.25 µg/L in OBS-4 to 12.5 µg/L in OBS-5. While cadmium remained above the GWPS in OBS-3 during Phase 1, concentrations decreased to below the GWPS at least temporarily in OBS-4, OBS-5, and OBS-6.

Other Constituents of Interest

Raising the pH above the target range of 8.0 to 8.5 SU resulted in the increase of arsenic and vanadium above the GWPS. In injection well IW-2, arsenic ranged from 0.752 µg/L at a pH of 5.42 SU in the baseline sample to 5.35 µg/L at pH of 8.31 SU following the first injection in June and 1.19 µg/L at a pH of 6.34 SU after the second round of injections in August. However, arsenic increased above the GWPS to a maximum of 61.9 µg/L during the biweekly injections in October and November when pH increased up 12.16 SU. Vanadium was below the GWPS until the biweekly injections in October and November when it increased to a maximum of 336 µg/L, corresponding to a pH of 12.13 SU. The pH in the observation well network was not raised above the target range of 8.0 to 8.5 SU and arsenic and vanadium concentrations remained below the GWPS.

Increasing sodium concentrations observed in IW-2, OBS-2, OBS-3, OBS-4, and OBS-5 indicate hydraulic connectivity between pilot test wells and provides further evidence of reagent consumption prior to reaching downgradient wells. Sodium increases in IW-2 were observed immediately following the first injection, remained elevated for the duration of the Phase 1 injections, and were the highest detected in the well network (as would be expected). Sodium increased in the first downgradient well OBS-2 approximately three weeks after injections, in OBS-3 after seven weeks, and in OBS-4 after 16 weeks, and in each case remained elevated for the rest of the Phase 1 injections. In OBS-5, which is cross-

gradient to the southeast, increases were observed after six weeks and indicated reagent transport was further south than anticipated. Sodium concentration trends are presented in Exhibit 11.

Tracer Test

Following injection of the NaBr tracer on October 31, bromide was not detected in observation monitoring samples collected in November. Additionally, the bromide ion selective electrode installed in OBS-2 did not indicate the arrival of tracer amendment between October 31, 2024 and January 17, 2025. Consequently, a grab groundwater investigation was conducted using a direct push sampling tool in the pilot test area to further delineate downgradient reagent flow.

3.2 GRAB GROUNDWATER INVESTIGATION

A grab groundwater investigation was performed on December 9 and 10, 2024 to evaluate the potential for reagent transport into areas outside the observation well network. Sample locations and field-measured pH are shown on Exhibit 5. pH readings above the target range of 8.0 to 8.5 SU were observed in B-1, B-2, and SB-2 (ranging from 10.63 to 12.02 SU), and pH readings below the target range but above background were observed in B-3, B-4, B-5, SB-1, SB-3, and SB-4 (ranging from 5.78 to 6.90 SU). The data indicated that reagent transport was more southeasterly than expected based on the regional groundwater gradients.

3.3 PHASE 2 INJECTIONS

Amendment Delivery

Phase 2 injections consisted of 11 individual injection events conducted between June 5 and July 24, 2025. A total of 2,640 gallons of 3% NaOH was successfully delivered to the subsurface. The average injection rate per well ranged from 0.33 to 0.89 gpm and the maximum pressures observed during each injection event ranged from 2.5 to 11 psi. Total batch injection times ranged from 90 minutes to 240 minutes.

Scatter plots depicting instantaneous flow rate measurements collected during each injection event are presented for IW-1, IW-2 and IW-3 in Exhibit 6 through Exhibit 8, respectively.

pH

Baseline pH measured on June 3, 2025 ranged between 6.44 SU (OBS-8) and 8.87 SU (IW-2), which were significantly higher than baseline pH readings in Phase 1. However, samples collected from observation wells after the first Phase 2 injection event (in June) had measured pH levels that were more comparable to Phase 1 baseline conditions, ranging from 5.25 SU (OBS-8) to 6.00 SU (OBS-7). Elevated pH during the Phase 2 baseline sampling event suggests the potential for lingering effects of Phase 1 injections.

Phase 2 injections were initially implemented once per week based on Phase 1 observation monitoring results. Throughout Phase 2, pH at IW-2 ranged from 9.01 and 12.39 SU. Weekly injections between June 10 and July 8, 2025 resulted in limited pH increases in the immediate downgradient wells OBS-2

and OBS-7. As such, injection frequency was increased to twice per week, and field staff began purging 2 to 3 times the filter pack volumes to monitor groundwater further into the formation. Following this change, pH was observed in OBS-2 as high as 12.28 SU and in OBS-7 as high as 6.20 SU during Phase 2.

Cobalt

Cobalt was detected above the GWPS (6 µg/L) in baseline samples collected from each of the Phase 2 pilot test wells and ranged from 98.1 µg/L (OBS-1) to 694 µg/L (OBS-8).

In injection well IW-2, total cobalt exhibited a general decreasing trend during Phase 2 injections and ranged from 11.9 to 56.5 µg/L during the last five weeks. Dissolved cobalt concentrations temporarily decreased to below the GWPS by June 30 and remained near the GWPS for the remainder of the test, ranging from 4.58 µg/L to 12.4 µg/L.

In the downgradient observation wells, the lowest cobalt concentrations were observed in OBS-2 and OBS-7, both located approximately 5 feet downgradient from injection wells. In OBS-2, while total cobalt ranged from 194 to 274 µg/L, dissolved cobalt decreased to below the GWPS on July 15 (0.295 µg/L) and stayed below the GWPS for the remainder of the injections. In OBS-7, cobalt exhibited a decreasing trend, ranging from 130 µg/L on June 10 to 75.9 µg/L on July 22. Dissolved cobalt concentrations were comparable to the total concentrations and did not decrease to below the GWPS. Cobalt concentrations did not decrease in the furthest downgradient well OBS-8, located approximately 10 feet southeast of OBS-7. Total and dissolved cobalt concentrations relative to pH for IW-2, OBS-2 and OBS-7 are presented in Exhibit 9, Exhibit 10, and Exhibit 12, respectively.

Cadmium

Cadmium concentrations were below the GWPS (5 µg/L) in baseline samples collected from upgradient well OBS-1, injection well IW-2, and downgradient wells OBS-7, OBS-9 and OBS-10. Baseline concentrations were only detected above GWPS in in OBS-2 (7.29 µg/L) and OBS-8 (7.79 µg/L).

During the Phase 2 injections, cadmium remained below the GWPS in IW-2 and OBS-7. In OBS-2, cadmium decreased below the GWPS after injections began and was below the GWPS for the remainder of the test. Cadmium concentrations in OBS-8 did not change during the pilot test, staying slightly above the GWPS.

Other Constituents of Interests

Similar to Phase 1, increasing the pH above the target range of 8.0 to 8.5 SU resulted in an increase of arsenic and vanadium above the GWPS during Phase 2.

In IW-2, arsenic increased from 1.47 µg/L in the baseline sample to 97.7 µg/L during the week of the final injection when the pH increased to 12.26 SU. Arsenic concentrations subsequently decreased with decreasing pH once injections stopped, returning to below the GWPS after four weeks (7.52 µg/L at 6.75 SU on August 25). Vanadium increased to consistently above the GWPS during the last three weeks of injections when the pH was above 12.0 SU, ranging from 123 µg/L on July 13 to 182 µg/L on July 28, before decreasing back to below the GWPS during the post-injection monitoring period.

In OBS-2, arsenic increased above the GWPS in one sample during injections (11.3 µg/L at a pH of 12.28 SU on July 15) and one sample during the post-injection monitoring period (14.3 µg/L at a pH of 10.84 on August 25. Vanadium was detected above the GWPS on July 15 (117 µg/L) and 22 (132 µg/L); however, concentrations returned to below the GWPS during the post-injection monitoring period.

Baseline sodium concentrations collected prior to Phase 2 injections were elevated above background in IW-2, OBS-2, OBS-7, OBS-9, and OBS-10. Elevated sodium concentrations are attributed to residual sodium from amendment transport from Phase 1 injections, as evidenced by the grab groundwater investigation. Throughout the duration of Phase 2, sodium concentrations show increasing trends in IW-2 and OBS-2 corresponding with injections, and concentrations remained elevated above background in OBS-7. Sodium concentrations remained stable near background conditions in the most southeastern well OBS-8, which did not exhibit indications of reagent influence in Phase 2. Sodium concentrations trends are presented in Exhibit 11.

4.0 FINDINGS AND RECOMMENDATIONS

Evaluation of the pilot test data indicated the following:

- The pilot test demonstrated the ability to successfully deliver the NaOH reagent into the subsurface immediately around the three injection wells, with a total of 7,200 gallons of 3% NaOH solution injected during the two phases. Instantaneous injection rates showed that injection flow rates remained relatively stable for the duration of the injections.
- The pH was increased to within and above the target range of 8.0 to 8.5 SU in injection well IW-2 and reduced total cobalt concentrations to near the GWPS and dissolved cobalt to below the GWPS; and in post-injection monitoring following Phase 2, both total and dissolved cobalt concentrations were reduced to below the GWPS. In downgradient observation wells, reductions in total and dissolved cobalt concentrations were observed in OBS-3 and OBS-5 during Phase 1 and in OBS-2 and OBS-7 during Phase 2, with dissolved cobalt concentrations decreasing to below the GWPS in OBS-2. The results demonstrated that increasing the pH could successfully reduce cobalt to below the GWPS in the area immediately in and around the injection wells and lower cobalt concentrations in downgradient wells.
- While the pilot test demonstrated that increasing the pH to within or above the target range of 8.0 to 8.5 SU is possible, maintaining the pH within that range hydraulically downgradient of the injection wells without overdosing the area is difficult.
- Increasing the pH above the target range of 8.0 to 8.5 SU resulted in temporary increases of arsenic and vanadium of the GWPS; however, concentrations decreased to below the GWPS after injections stopped and the pH decreased.
- Increases in sodium concentrations demonstrated reagent transport to the east and southeast of the injection wells. Since the pH was not observed to increase significantly in the downgradient wells OBS-3, OBS-4, and OBS-7 during Phase 1 and 2 injections, it indicates that much of the alkalinity provided by addition of the NaOH reagent was consumed within a short distance from the injection wells. This might have contributed to the difficulty in reducing cobalt concentrations consistently below the GWPS and suggests that the introduction of a buffering reagent (e.g., sodium bicarbonate) could provide benefit.
- As evidenced by the grab groundwater investigation and increases in sodium concentrations during injections, the direction of the hydraulic gradient in the pilot test area was further to the southeast than the regional gradient and suggests variability in the localized conditions influenced reagent transport. Implementation of high-resolution site characterization tools (e.g., use of a hydraulic profiling tool to characterize flow zones and passive flux meters to characterize flow directions) prior to future injections could be used to improve the design of the observation well network.

Overall, the pilot test demonstrated that *in situ* treatment can reduce concentrations of the constituents of concern (including dissolved cobalt and total cadmium) in groundwater. However, injection of NaOH in the pilot test area did not consistently achieve the GWPS for total cobalt and additional testing, including use of a different reagent (e.g. sodium bicarbonate), may be required to achieve treatment objectives under the site-specific conditions observed at the WBF pilot test area. As such, *in situ* treatment was not retained as the primary groundwater corrective measure alternative for the WBF Plant Slag Disposal Area at this time (see Appendix D for further evaluation and recommendations).

5.0 REFERENCES

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TABLES

TABLE 1 - *In Situ* Pilot Test Well Construction Details
Watts Bar Fossil Plant

DRAFT

Well ID	Installation Date	Diameter and Material	Screen Length (ft)	Screen Slot Size (in)	WBF Plant Local Northing	WBF Plant Local Easting	Ground Surface Elevation (ft)	Top of Casing Elevation (ft)	Top of Screen Elevation (ft)	Bottom of Screen Elevation (ft)
Injection Wells										
IW-1	5/10/2024	1-inch SCH 40 PVC	5	0.020	444178.51	2363086.37	695.9	697.90	671.5	666.5
IW-2	5/14/2024	1-inch SCH 40 PVC	5	0.020	444183.08	2363087.30	695.8	697.44	670.5	665.5
IW-3	5/15/2024	1-inch SCH 40 PVC	5	0.020	444188.51	2363086.75	695.9	697.62	671.4	666.4
Groundwater Monitoring Wells - Phase 1										
OBS-1	5/16/2024	4-inch SCH 40 PVC	5	0.010	444183.30	2363081.46	696.5	702.11	672.5	667.5
OBS-2	5/7/2024	4-inch SCH 40 PVC	5	0.010	444183.15	2363092.43	694.8	696.23	670.8	665.8
OBS-3	5/3/2024	4-inch SCH 40 PVC	5	0.010	444182.74	2363098.16	694.1	696.24	670.4	665.4
OBS-4	5/1/2024	4-inch SCH 40 PVC	5	0.010	444183.28	2363102.62	693.2	696.36	670.9	665.9
OBS-5	5/8/2024	4-inch SCH 40 PVC	5	0.010	444173.57	2363102.39	693.7	697.26	671.4	666.4
OBS-6	5/9/2024	4-inch SCH 40 PVC	5	0.010	444192.69	2363102.64	693.3	696.23	670.5	665.5
Groundwater Monitoring Wells - Phase 2										
OBS-7	5/16/2025	4-inch SCH 40 PVC	5	0.010	444178.27	2363091.73	694.9	697.55	671.9	666.9
OBS-8	5/16/2025	4-inch SCH 40 PVC	5	0.010	444167.65	2363093.78	694.5	697.40	671.5	666.5
OBS-9	5/16/2025	4-inch SCH 40 PVC	5	0.010	444172.81	2363086.80	695.8	698.33	672.8	667.8
OBS-10	5/16/2025	4-inch SCH 40 PVC	5	0.010	444173.09	2363097.62	694.3	696.47	671.3	666.3

Notes

(a) Horizontal locations are referenced to Plant local North American Datum of 1927 (NAD27).
(b) Elevations shown are in datum NGVD 29, which indicates feet (ft) in elevations referenced to the National Geodetic Vertical Datum of 1929. Ground surface elevations rounded to the nearest 0.1 feet.

Abbreviations

SCH40 PVC = Schedule 40 Polyvinyl Chloride
ft-bgs = feet below ground surface
in = inches

TABLE 2 - *In Situ* Pilot Test Injection Summary
Watts Bar Fossil Plant

DRAFT

Pilot Test Phase	Batch Injection Event	Date	Max Well Head Pressure		Average Injection Rate per Well	Batch Volume	Cumulative Volume
			Injection Well	psi	gpm	gal	gal
Phase 1	1	6/13/2024	IW-3	7.0	1.78	240	240
	2	8/26/2024	IW-1	9.0	0.50	240	480
	3	8/28/2024	IW-1	2.5	0.47	240	720
	4	8/30/2024	IW-3	5.0	0.55	240	960
	5	10/2/2024	IW-3	10.0	0.60	240	1,200
	6	10/3/2024	IW-3	8.0	0.33	240	1,440
	7	10/4/2024	IW-3	6.0	0.38	240	1,680
	8	10/16/2024	IW-2	7.0	0.44	240	1,920
	9	10/17/2024	IW-3	9.0	0.44	240	2,160
	10	10/18/2024	IW-1	7.0	1.00	240	2,400
	11	10/29/2024	IW-1	10.0	0.53	240	2,640
	12	10/30/2024	IW-3	7.0	0.72	240	2,880
	13	10/31/2024	IW-1	9.0	0.50	240	3,120
	14	11/13/2024	IW-1	10.0	0.62	240	3,360
	15	11/14/2024	IW-3	10.0	0.57	240	3,600
	16	11/15/2024	IW-1	9.0	0.57	240	3,840
	17	12/4/2024	IW-3	10.0	0.57	240	4,080
	18	12/5/2024	IW-1 / IW-2	8.0	0.57	240	4,320
	19	12/6/2024	IW-3	10.0	0.57	240	4,560
Phase 2	20	6/5/2025	IW-1	11.0	0.62	240	4,800
	21	6/11/2025	IW-3	10.5	0.38	240	5,040
	22	6/18/2025	IW-3	3.5	0.33	240	5,280
	23	6/25/2025	IW-1	2.5	0.40	240	5,520
	24	7/2/2025	IW-3	7.0	0.69	240	5,760
	25	7/9/2025	IW-3	7.5	0.80	240	6,000
	26	7/10/2025	IW-1 / IW-3	4.5	0.89	240	6,240
	27	7/16/2025	IW-3	4.5	0.53	240	6,480
	28	7/17/2025	IW-3	7.0	0.50	240	6,720
	29	7/23/2025	IW-3	4.5	0.33	240	6,960
	30	7/24/2025	IW-2 / IW-3	4.5	0.40	240	7,200

Notes
(a) Maximum Well Head Pressures were collected from pressure gauges installed on injection well head packers.
(b) Average Injection Rates are derived from the cumulative batch injection rate divided by the number of injection wells.

Abbreviations
gal = gallons
gpm = gallons per minute
psi = pounds per square inch

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-1	Phase 1	Sample	6/6/2024	17.93	684.18	27.1	5.60	2,121	0.58	6.7	92.2	2.99
		Injection	6/13/2024	18.79	683.32	--	--	--	--	--	--	--
		Sample	6/17/2024	18.25	683.86	18.9	5.75	1,951	0.88	11.3	109.2	3.77
		Sample	6/25/2024	18.38	683.73	18.4	5.67	1,996	0.13	1.5	56.1	1.11
		Sample	7/1/2024	18.58	683.53	19.2	6.28	2,077	9.62	108.5	98.0	13.3
		Sample	7/8/2024	18.85	683.26	18.5	5.71	1,855	0.69	7.5	148.7	2
		Sample	7/16/2024	18.81	683.30	18.2	5.70	1,722	0.60	6.6	160.1	1.35
		Sample	7/23/2024	18.37	683.74	18.1	5.67	1,788	0.52	5.6	77.4	1.01
		Sample	7/30/2024	18.71	683.40	18.0	5.66	1,830	0.97	10.6	64.7	2.1
		Sample	8/6/2024	18.25	683.86	19.3	5.75	1,319	0.10	1.1	43.5	2.05
		Sample	8/14/2024	19.52	682.59	19.5	5.78	1,529	0.55	5.8	39.4	3.88
		Sample	8/20/2024	18.08	684.03	18.5	5.66	1,742	0.88	11.2	110.4	2.03
		Injection	8/26/2024	18.35	683.76	--	--	--	--	--	--	--
		Injection	8/28/2024	18.98	683.13	--	--	--	--	--	--	--
		Injection	8/30/2024	19.95	682.16	--	--	--	--	--	--	--
		Sample	9/3/2024	19.14	682.97	17.4	5.63	1,990	0.57	6.4	-19.9	2.17
		Sample	9/10/2024	19.85	682.26	17.5	5.66	2,176	0.56	5.9	27.1	1.19
		Sample	9/19/2024	19.49	682.62	19.7	7.09	1,993	23.11	251.9	17.1	24.4
		Sample	9/24/2024	19.97	682.14	16.9	6.28	2,052	3.64	38.6	1.2	1.77
		Injection	10/2/2024	14.7	687.41	--	--	--	--	--	--	--
		Injection	10/3/2024	15.02	687.09	--	--	--	--	--	--	--
		Injection	10/4/2024	16.10	686.01	--	--	--	--	--	--	--
		Sample	10/7/2024	17.78	684.33	18.8	5.64	2,081	2.77	26.9	39.3	1.56
		Injection	10/16/2024	19.54	682.57	--	--	--	--	--	--	--
		Injection	10/17/2024	19.64	682.47	--	--	--	--	--	--	--
		Injection	10/18/2024	19.79	682.32	--	--	--	--	--	--	--
		Sample	10/22/2024	21.42	680.69	18.4	5.73	2,085	1.27	13.6	35.8	3.78
		Injection	10/29/2024	21.72	680.39	--	--	--	--	--	--	--
		Injection	10/30/2024	21.81	680.30	--	--	--	--	--	--	--
		Injection	10/31/2024	21.92	680.19	--	--	--	--	--	--	--
		Sample	11/4/2024	21.20	680.91	18.8	5.66	2,105	0.62	6.1	59.1	2.73
		Injection	11/13/2024	22.48	679.63	--	--	--	--	--	--	--
		Injection	11/14/2024	22.18	679.93	--	--	--	--	--	--	--
		Injection	11/15/2024	22.13	679.98	--	--	--	--	--	--	--
		Sample	11/18/2024	22.37	679.74	19.1	5.56	2,095	24.50	26.6	61	2.31
		Sample	11/25/2024	22.97	679.14	18.1	5.63	2,101	1.15	12.2	55.3	2.9
		Injection	12/4/2024	23.09	679.02	--	--	--	--	--	--	--
		Injection	12/5/2024	23.34	678.77	--	--	--	--	--	--	--
		Injection	12/6/2024	22.13	679.98	--	--	--	--	--	--	--
OBS-1	Phase 2	Sample	6/3/2025	18.5	683.61	17.9	8.45	2,045	0.06	0.6	77.2	4.92
		Injection	6/5/2025	18.49	683.62	--	--	--	--	--	--	--
		Sample	6/10/2025	18.14	683.97	17.4	5.85	1,809	7.23	79.5	42.5	3.01
		Injection	6/11/2025	18.04	684.07	--	--	--	--	--	--	--
		Sample	6/16/2025	18.09	684.02	18.7	7.53	1,884	0.31	3.5	51.2	1.53
		Injection	6/18/2025	17.65	684.46	--	--	--	--	--	--	--
		Sample	6/24/2025	18.07	684.04	18.1	5.51	2,137	0.54	5.9	35.7	2.88
		Injection	6/25/2025	18.08	684.03	--	--	--	--	--	--	--
		Sample	6/30/2025	18.40	683.71	18.4	5.60	2,114	1.07	11.5	68.5	2.13
		Injection	7/2/2025	18.15	683.96	--	--	--	--	--	--	--
		Sample	7/8/2025	18.27	683.84	18.7	5.60	2,096	1.03	11.1	46.9	1.24
		Injection	7/9/2025	18.13	683.98	--	--	--	--	--	--	--
		Injection	7/10/2025	18.19	683.92	--	--	--	--	--	--	--
		Sample	7/14/2025	18.48	683.63	18.9	5.59	2,108	1.77	12.2	10.8	1.46
		Injection	7/16/2025	18.42	683.69	--	--	--	--	--	--	--
		Injection	7/17/2025	18.44	683.67	--	--	--	--	--	--	--
		Sample	7/21/2025	18.23	683.88	18.9	5.75	1,968	0.83	8.9	68.1	4.02
		Injection	7/23/2025	18.15	683.96	--	--	--	--	--	--	--
		Injection	7/24/2025	18.16	683.95	--	--	--	--	--	--	--
		Sample	7/28/2025	18.67	683.44	19.4	5.77	1,905	0.13	1.4	39.5	4.87

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
IW-1	Phase 1	Injection	6/13/2024	14.45	683.45	--	--	--	--	--	--	--
		Injection	8/26/2024	13.12	684.78	--	--	--	--	--	--	--
		Injection	8/28/2024	13.1	684.80	--	--	--	--	--	--	--
		Injection	8/30/2024	13.18	684.72	--	--	--	--	--	--	--
		Injection	10/2/2024	11.39	686.51	--	--	--	--	--	--	--
		Injection	10/3/2024	10.62	687.28	--	--	--	--	--	--	--
		Injection	10/4/2024	10.82	687.08	--	--	--	--	--	--	--
		Injection	10/16/2024	11.43	686.47	--	--	--	--	--	--	--
		Injection	10/17/2024	12.52	685.38	--	--	--	--	--	--	--
		Injection	10/18/2024	12.5	685.40	--	--	--	--	--	--	--
		Injection	10/29/2024	13.17	684.73	--	--	--	--	--	--	--
		Injection	10/30/2024	13.9	684.00	--	--	--	--	--	--	--
		Injection	10/31/2024	13.09	684.81	--	--	--	--	--	--	--
		Injection	11/13/2024	15.31	682.59	--	--	--	--	--	--	--
		Injection	11/14/2024	13.44	684.46	--	--	--	--	--	--	--
		Injection	11/15/2024	14.26	683.64	--	--	--	--	--	--	--
		Injection	12/4/2024	15.76	682.14	--	--	--	--	--	--	--
		Injection	12/5/2024	14.51	683.39	--	--	--	--	--	--	--
		Injection	12/6/2024	13.85	684.05	--	--	--	--	--	--	--
IW-1	Phase 2	Injection	6/5/2025	10.41	687.49	--	--	--	--	--	--	--
		Injection	6/11/2025	10.18	687.72	--	--	--	--	--	--	--
		Injection	6/18/2025	10.21	687.69	--	--	--	--	--	--	--
		Injection	6/25/2025	11.53	686.37	--	--	--	--	--	--	--
		Injection	7/2/2025	11.40	686.50	--	--	--	--	--	--	--
		Injection	7/9/2025	11.29	686.61	--	--	--	--	--	--	--
		Injection	7/10/2025	10.55	687.35	--	--	--	--	--	--	--
		Injection	7/16/2025	10.78	687.12	--	--	--	--	--	--	--
		Injection	7/17/2025	10.78	687.12	--	--	--	--	--	--	--
		Injection	7/23/2025	10.85	687.05	--	--	--	--	--	--	--
		Injection	7/24/2025	11.32	686.58	--	--	--	--	--	--	--
IW-2	Phase 1	Sample	6/11/2024	16.85	680.59	18.2	5.42	1,581	0.35	0.43	4.5	4.2
		Injection	6/13/2024	14.15	683.29	--	--	--	--	--	--	--
		Sample	6/17/2024	12.69	684.75	24.2	8.31	2,841	0.92	11.3	32.6	17.7
		Sample	6/25/2024	13.81	683.63	18.8	6.41	2,418	0.27	2.9	33.3	3.1
		Sample	7/2/2024	13.78	683.66	18.9	6.24	2,468	3.88	42.7	19.4	1.59
		Sample	7/9/2024	14.06	683.38	18.9	6.04	2,033	0.72	7.9	171.2	3.79
		Sample	7/16/2024	14.06	683.38	18.9	5.97	1,783	2.64	29.4	107.5	3.63
		Sample	7/22/2024	12.84	684.60	21.7	6.04	1,857	6.28	73.6	236.4	2.09
		Sample	7/30/2024	12.94	684.50	19.4	5.75	1,871	1.22	13.9	68.8	1.32
		Sample	8/6/2024	13.91	683.53	20.6	5.85	1,551	2.33	23.9	167.9	1.07
		Sample	8/14/2024	14.21	683.23	18.0	5.69	1,491	0.44	4.8	147	2.37
		Sample	8/20/2024	13.41	684.03	17.9	5.65	1,664	0.23	2.5	137.5	0.85
		Injection	8/26/2024	13.67	683.77	--	--	--	--	--	--	--
		Injection	8/28/2024	14.08	683.36	--	--	--	--	--	--	--
		Injection	8/30/2024	14.02	683.42	--	--	--	--	--	--	--
		Sample	9/4/2024	14.01	683.43	18.3	6.33	2,383	1.02	10.5	78.8	28.4
		Sample	9/10/2024	14.93	682.51	17.4	6.28	2,288	0.78	8.5	7.5	24.3
		Sample	9/19/2024	14.62	682.82	17.1	6.34	1,958	1.25	13.1	-0.8	2.83
		Sample	9/23/2024	14.48	682.96	17.4	8.24	1,981	0.88	9.3	-60.1	2.97
		Injection	10/2/2024	10.04	687.40	--	--	--	--	--	--	--
		Injection	10/3/2024	9.64	687.80	--	--	--	--	--	--	--
		Injection	10/4/2024	11.62	685.82	--	--	--	--	--	--	--
		Sample	10/7/2024	13.17	684.27	20.5	12.13	21,326	0.66	7.8	-171.4	55.5
		Injection	10/16/2024	13.58	683.86	--	--	--	--	--	--	--
		Injection	10/17/2024	13.93	683.51	--	--	--	--	--	--	--
		Injection	10/18/2024	14.78	682.66	--	--	--	--	--	--	--
		Sample	10/22/2024	16.11	681.33	19.0	12.06	10,325	0.36	4.0	-160.4	27.5
		Injection	10/29/2024	16.78	680.66	--	--	--	--	--	--	--
		Injection	10/30/2024	16.87	680.57	--	--	--	--	--	--	--
		Injection	10/31/2024	17.04	680.40	--	--	--	--	--	--	--
		Sample	11/4/2024	16.40	681.04	19.5	6.8	2,371	0.75	8.2	5.5	20
		Injection	11/13/2024	17.65	679.79	--	--	--	--	--	--	--
		Injection	11/14/2024	15.7	681.74	--	--	--	--	--	--	--
		Injection	11/15/2024	17.31	680.13	--	--	--	--	--	--	--
		Sample	11/18/2024	17.74	679.70	19.7	11.99	19,198	0.50	5.9	-73.6	42.7
		Sample	11/25/2024	16.98	680.46	18.8	12.16	8,484	0.37	4.1	-116.9	51.9
		Injection	12/4/2024	18.2	679.24	--	--	--	--	--	--	--
		Injection	12/5/2024	18.38	679.06	--	--	--	--	--	--	--
		Injection	12/6/2024	17.24	680.20	--	--	--	--	--	--	--

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
IW-2	Phase 2	Sample	6/3/2025	13.44	684.00	18.1	8.87	2,324	0.12	1.2	-76.2	12.2
		Injection	6/5/2025	13.77	683.67	--	--	--	--	--	--	--
		Sample	6/9/2025	13.37	684.07	18.7	12.00	7,185	3.93	45.6	-155.4	180
		Injection	6/11/2025	13.27	684.17	--	--	--	--	--	--	--
		Sample	6/17/2025	12.74	684.70	18.2	10.63	2,565	0.77	7.2	116.6	391
		Injection	6/18/2025	12.89	684.55	--	--	--	--	--	--	--
		Sample	6/24/2025	13.45	683.99	18.9	9.01	2,739	1.24	13.3	-317.1	11.4
		Injection	6/25/2025	13.32	684.12	--	--	--	--	--	--	--
		Sample	6/30/2025	13.50	683.94	19.3	12.20	1,552	0.45	5.1	-146.2	55.7
		Injection	7/2/2025	13.40	684.04	--	--	--	--	--	--	--
		Sample	7/8/2025	13.35	684.09	NR	11.15	2,822	0.16	1.8	-131.6	12.0
		Injection	7/9/2025	13.13	684.31	--	--	--	--	--	--	--
		Injection	7/10/2025	13.11	684.33	--	--	--	--	--	--	--
		Sample	7/14/2025	13.40	684.04	20.1	12.39	16,620	0.54	6.2	-172.2	38.1
		Injection	7/16/2025	13.51	683.93	--	--	--	--	--	--	--
		Injection	7/17/2025	13.53	683.91	--	--	--	--	--	--	--
		Sample	7/21/2025	13.30	684.14	20.1	12.26	21,842	0.20	2.2	-105.1	13.6
		Injection	7/23/2025	13.32	684.12	--	--	--	--	--	--	--
		Injection	7/24/2025	13.40	684.04	--	--	--	--	--	--	--
		Sample	7/28/2025	13.80	683.64	20.7	12.31	23,079	0.17	1.8	-149.2	16.7
		Sample	8/5/2025	13.26	684.18	19.4	11.94	7,377	0.44	4.9	-96.5	96.1
		Sample	8/11/2025	13.29	684.15	19.0	11.84	3,735	0.45	4.6	-104.2	223.0
		Sample	8/19/2025	13.36	684.08	19.2	8.92	2,308	0.17	1.8	-9.2	46.8
		Sample	8/25/2025	13.26	684.18	19.0	11.84	3,735	0.45	4.6	-104.2	223.0
IW-3	Phase 1	Injection	6/13/2024	14.30	683.32	--	--	--	--	--	--	--
		Injection	8/26/2024	13.71	683.91	--	--	--	--	--	--	--
		Injection	8/28/2024	14.35	683.27	--	--	--	--	--	--	--
		Injection	8/30/2024	14.22	683.40	--	--	--	--	--	--	--
		Injection	10/2/2024	10.52	687.10	--	--	--	--	--	--	--
		Injection	10/3/2024	10.95	686.67	--	--	--	--	--	--	--
		Injection	10/4/2024	11.74	685.88	--	--	--	--	--	--	--
		Injection	10/16/2024	14.43	683.19	--	--	--	--	--	--	--
		Injection	10/17/2024	14.6	683.02	--	--	--	--	--	--	--
		Injection	10/18/2024	14.67	682.95	--	--	--	--	--	--	--
		Injection	10/29/2024	16.79	680.83	--	--	--	--	--	--	--
		Injection	10/30/2024	16.52	681.10	--	--	--	--	--	--	--
		Injection	10/31/2024	16.33	681.29	--	--	--	--	--	--	--
		Injection	11/13/2024	17.51	680.11	--	--	--	--	--	--	--
		Injection	11/14/2024	16.73	680.89	--	--	--	--	--	--	--
		Injection	11/15/2024	16.46	681.16	--	--	--	--	--	--	--
		Injection	12/4/2024	17.95	679.67	--	--	--	--	--	--	--
		Injection	12/5/2024	17.88	679.74	--	--	--	--	--	--	--
		Injection	12/6/2024	16.13	681.49	--	--	--	--	--	--	--
	Phase 2	Injection	6/5/2025	13.87	683.75	--	--	--	--	--	--	--
		Injection	6/11/2025	11.86	685.76	--	--	--	--	--	--	--
		Injection	6/18/2025	12.59	685.03	--	--	--	--	--	--	--
		Injection	6/25/2025	13.19	684.43	--	--	--	--	--	--	--
		Injection	7/2/2025	13.36	684.26	--	--	--	--	--	--	--
		Injection	7/9/2025	13.27	684.35	--	--	--	--	--	--	--
		Injection	7/10/2025	12.34	685.28	--	--	--	--	--	--	--
		Injection	7/16/2025	13.36	684.26	--	--	--	--	--	--	--
		Injection	7/17/2025	12.97	684.65	--	--	--	--	--	--	--
		Injection	7/23/2025	13.18	684.44	--	--	--	--	--	--	--
		Injection	7/24/2025	13.24	684.38	--	--	--	--	--	--	--
		Sample	8/5/2025	13.49	684.13	19.3	12.34	12,358	0.27	3.0	-156.3	15.5
		Sample	8/11/2025	12.61	685.01	19.5	12.53	10,070	0.42	4.3	-149	36.8
		Sample	8/19/2025	15.34	682.28	19.9	8.88	2,145	0.40	4.1	-38.6	2.16
		Sample	8/25/2025	13.65	683.97	18.9	7.03	2,190	0.45	5.0	-160	12.3

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-2	Phase 1	Sample	6/5/2024	12.2	684.03	18.7	5.52	1,897	0.17	1.9	68.1	2.75
		Injection	6/13/2024	12.91	683.32	--	--	--	--	--	--	--
		Sample	6/18/2024	12.60	683.63	18.0	5.53	1,807	1.41	15	98.9	3.83
		Sample	6/25/2024	12.68	683.55	18.1	5.43	1,792	0.15	1.6	87.9	3.92
		Sample	7/2/2024	12.60	683.63	17.4	5.50	2,141	1.63	17.5	106	4.16
		Sample	7/9/2024	12.91	683.32	17.6	5.49	1,670	0.97	10.5	221.3	3.41
		Sample	7/16/2024	12.97	683.26	18.8	5.43	1,592	0.11	1.3	110.5	1.93
		Sample	7/23/2024	12.64	683.59	17.9	5.51	1,679	0.71	7.7	177.4	3.22
		Sample	7/30/2024	12.68	683.55	18.1	5.46	1,726	0.30	3.3	63.3	2.92
		Sample	8/6/2024	12.50	683.73	19.9	5.56	1,361	0.16	1.8	57.5	1.32
		Sample	8/14/2024	12.72	683.51	17.9	5.26	1,161	0.16	1.8	87.5	1.32
		Sample	8/20/2024	12.63	683.60	18.2	5.53	1,808	1.33	14.4	186.9	1.55
		Injection	8/26/2024	12.44	683.79	--	--	--	--	--	--	--
		Injection	8/28/2024	13.08	683.15	--	--	--	--	--	--	--
		Injection	8/30/2024	13.04	683.19	--	--	--	--	--	--	--
		Sample	9/4/2024	13.73	682.50	17.0	6.34	2,412	2.50	27.3	-18.6	86.6
		Sample	9/10/2024	13.59	682.64	17.7	6.95	2,473	0.45	5.1	-55.3	6.98
		Sample	9/19/2024	13.54	682.69	17.9	7.17	2,062	5.93	61.5	6.6	27.2
		Sample	9/24/2024	13.90	682.33	17.0	6.53	2,127	2.02	20.7	-13.6	5.02
		Injection	10/2/2024	8.82	687.41	--	--	--	--	--	--	--
		Injection	10/3/2024	9.16	687.07	--	--	--	--	--	--	--
		Injection	10/4/2024	10.24	685.99	--	--	--	--	--	--	--
		Sample	10/8/2024	12.08	684.15	18.8	6.34	2,317	0.91	9.4	4.9	2.6
		Injection	10/16/2024	13.62	682.61	--	--	--	--	--	--	--
		Injection	10/17/2024	13.68	682.55	--	--	--	--	--	--	--
		Injection	10/18/2024	13.85	682.38	--	--	--	--	--	--	--
		Sample	10/22/2024	15.36	680.87	18.5	5.60	2,093	1.05	11.3	93.4	2.95
		Injection	10/29/2024	15.77	680.46	--	--	--	--	--	--	--
		Injection	10/30/2024	15.84	680.39	--	--	--	--	--	--	--
		Injection	10/31/2024	15.97	680.26	--	--	--	--	--	--	--
		Sample	11/5/2024	16.20	680.03	18.9	5.78	2,166	3.11	26.4	71.9	1.6
		Injection	11/13/2024	16.53	679.70	--	--	--	--	--	--	--
		Injection	11/14/2024	16.26	679.97	--	--	--	--	--	--	--
		Injection	11/15/2024	16.19	680.04	--	--	--	--	--	--	--
		Sample	11/19/2024	16.80	679.43	18.8	6.11	2,318	0.79	8.5	19.2	8.87
		Sample	11/25/2024	16.98	679.25	18.7	5.53	2,142	0.66	7.3	84.9	2.6
		Injection	12/4/2024	17.17	679.06	--	--	--	--	--	--	--
		Injection	12/5/2024	17.42	678.81	--	--	--	--	--	--	--
		Injection	12/6/2024	16.18	680.05	--	--	--	--	--	--	--
OBS-2	Phase 2	Injection	6/5/2025	12.6	683.63	--	--	--	--	--	--	--
		Sample	6/10/2025	12.29	683.94	18.1	5.43	1,851	7.85	82.5	169.4	26
		Injection	6/11/2025	12.16	684.07	--	--	--	--	--	--	--
		Purge Only	6/17/2025	10.14	686.09	17.8	5.41	1,903	5.14	54.3	167.4	37.7
		Injection	6/18/2025	11.78	684.45	--	--	--	--	--	--	--
		Purge Only	6/24/2025	12.2	684.03	17.7	5.14	2,179	0.39	4.1	150.5	19.3
		Injection	6/25/2025	12.2	684.03	--	--	--	--	--	--	--
		Sample	7/1/2025	12.46	683.77		6.53	2,558	0.56	5.8	-50.9	31.6
		Injection	7/2/2025	12.28	683.95	--	--	--	--	--	--	--
		Purge Only	7/8/2025	12.72	683.51	17.9	5.99	2,304	6.86	72.4	-4.8	4.79
		Injection	7/9/2025	12.27	683.96	--	--	--	--	--	--	--
		Injection	7/10/2025	12.3	683.93	--	--	--	--	--	--	--
		Sample	7/15/2025	12.3	683.93	18.8	12.28	4,984	0.12	1.3	-247.5	235
		Injection	7/16/2025	12.54	683.69	--	--	--	--	--	--	--
		Injection	7/17/2025	12.55	683.68	--	--	--	--	--	--	--
		Sample	7/22/2025	12.30	683.93	18.9	11.49	8,551	0.11	1.3	-142.4	346
		Injection	7/23/2025	12.23	684.00	--	--	--	--	--	--	--
		Injection	7/24/2025	12.15	684.08	--	--	--	--	--	--	--
		Sample	7/29/2025	12.75	683.48	20.5	11.48	6,165	0.07	0.8	-163.1	220
		Sample	8/5/2025	12.29	683.94	18.6	7.38	2,453	0.25	2.5	-90.9	205
		Sample	8/11/2025	12.50	683.73	19.1	10.04	2,504	4.70	51.2	-43.2	347
		Sample	8/19/2025	12.44	683.79	18.4	8.25	2,312	0.71	7.4	-120.2	65.2
		Sample	8/25/2025	12.44	683.79	19.1	10.04	2,504	4.70	51.2	-43.2	347

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-3	Phase 1	Sample	6/5/2024	12	684.24	20.6	4.65	1,857	0.67	7.7	297.8	3.99
		Injection	6/13/2024	12.82	683.42							
		Sample	6/19/2024	12.67	683.57	17.5	4.51	1,689	0.50	5.3	267.8	3.23
		Sample	6/25/2024	12.64	683.60	17.5	4.74	1,732	2.44	26.5	236.6	1.8
		Sample	7/2/2024	12.93	683.31	17.2	4.64	2,113	0.29	3.1	249.4	1.36
		Sample	7/9/2024	13.31	682.93	17.7	4.67	1,654	0.15	1.6	241.1	4.25
		Sample	7/17/2024	12.68	683.56	18.1	4.67	1,624	0.20	2.1	266.6	4.08
		Sample	7/23/2024	12.65	683.59	17.8	4.58	1,670	0.94	10	271.5	1.96
		Sample	7/30/2024	12.44	683.80	18.1	4.57	1,758	0.73	7.9	241.3	1.5
		Sample	8/5/2024	12.30	683.94	20.1	4.62	1,340	0.23	2.6	228.6	6.2
		Sample	8/14/2024	12.65	683.59	18.2	4.54	1,595	0.23	2.6	271.2	1.89
		Sample	8/20/2024	12.72	683.52	18.0	4.51	1,776	0.72	9.9	292.2	1.76
		Injection	8/26/2024	12.37	683.87	--	--	--	--	--	--	--
		Injection	8/28/2024	13.00	683.24	--	--	--	--	--	--	--
		Injection	8/30/2024	12.97	683.27	--	--	--	--	--	--	--
		Sample	9/4/2024	13.14	683.10	16.7	4.44	2,112	0.97	10.1	185.4	2.12
		Sample	9/10/2024	13.45	682.79	16.9	4.46	2,156	0.94	10.2	232.6	0.87
		Sample	9/19/2024	13.5	682.74	17.4	7.32	1,950	3.60	40.1	106.4	2.18
		Sample	9/24/2024	14.05	682.19	16.9	5.28	1,948	1.52	16.3	168.3	3.17
		Injection	10/2/2024	8.8	687.44	--	--	--	--	--	--	--
		Injection	10/3/2024	9.11	687.13	--	--	--	--	--	--	--
		Injection	10/4/2024	10.12	686.12	--	--	--	--	--	--	--
		Sample	10/8/2024	12.57	683.67	18.5	4.80	1,982	9.40	99.7	333.7	21.9
		Injection	10/16/2024	13.5	682.74	--	--	--	--	--	--	--
		Injection	10/17/2024	13.57	682.67	--	--	--	--	--	--	--
		Injection	10/18/2024	13.75	682.49	--	--	--	--	--	--	--
		Sample	10/22/2024	15.56	680.68	18.2	4.37	2,014	0.94	10.1	349.4	0.94
		Injection	10/29/2024	15.65	680.59	--	--	--	--	--	--	--
		Injection	10/30/2024	15.77	680.47	--	--	--	--	--	--	--
		Injection	10/31/2024	15.82	680.42	--	--	--	--	--	--	--
		Sample	11/5/2024	16.20	680.04	18.8	4.39	2,026	3.66	39.5	334.7	4.57
		Injection	11/13/2024	16.42	679.82	--	--	--	--	--	--	--
		Injection	11/14/2024	16.14	680.10	--	--	--	--	--	--	--
		Injection	11/15/2024	16.04	680.20	--	--	--	--	--	--	--
		Sample	11/19/2024	16.24	680.00	18.7	4.26	2,045	0.85	9.2	308.4	1.02
		Sample	11/25/2024	16.25	679.99	18.8	4.22	1,051	0.65	7.0	337.8	1.79
		Injection	12/4/2024	17.04	679.20	--	--	--	--	--	--	--
		Injection	12/5/2024	17.29	678.95	--	--	--	--	--	--	--
		Injection	12/6/2024	16.08	680.16	--	--	--	--	--	--	--
OBS-3	Phase 2	Injection	6/5/2025	12.55	683.69	--	--	--	--	--	--	--
		Injection	6/11/2025	12.08	684.16	--	--	--	--	--	--	--
		Gauge Only	6/17/2025	12.02	684.22	--	--	--	--	--	--	--
		Injection	6/18/2025	11.69	684.55	--	--	--	--	--	--	--
		Gauge Only	6/24/2025	12.11	684.13	--	--	--	--	--	--	--
		Injection	6/25/2025	12.11	684.13	--	--	--	--	--	--	--
		Gauge Only	7/1/2025	11.96	684.28	--	--	--	--	--	--	--
		Injection	7/2/2025	12.22	684.02	--	--	--	--	--	--	--
		Injection	7/9/2025	12.19	684.05	--	--	--	--	--	--	--
		Injection	7/10/2025	12.24	684.00	--	--	--	--	--	--	--
		Injection	7/16/2025	12.47	683.77	--	--	--	--	--	--	--
		Injection	7/17/2025	12.48	683.76	--	--	--	--	--	--	--
		Injection	7/23/2025	12.16	684.08	--	--	--	--	--	--	--
		Injection	7/24/2025	12.18	684.06	--	--	--	--	--	--	--
		Sample	7/29/2025	12.66	683.58	19.3	4.34	1,898	196.70	0.07	NR	1.17

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-4	Phase 1	Sample	6/6/2024	12.11	684.25	17.9	5.39	1,979	3.78	41.9	168.5	28.7
		Injection	6/13/2024	13.02	683.34	--	--	--	--	--	--	--
		Sample	6/18/2024	12.49	683.87	17.6	5.34	1,690	0.43	4.6	155.7	6.61
		Sample	6/25/2024	12.71	683.65	17.8	5.30	1,775	0.52	5.7	219.1	2.81
		Sample	7/2/2024	12.85	683.51	17.4	5.29	2,158	1.47	15.7	171.6	3.15
		Sample	7/9/2024	13.11	683.25	17.8	5.31	1,701	0.48	5.2	246.8	3.29
		Sample	7/17/2024	13.04	683.32	18.0	5.35	1,708	0.41	4.5	235.6	3.07
		Sample	7/23/2024	12.85	683.51	18.2	5.31	1,726	0.19	2.0	181.1	2.05
		Sample	7/29/2024	12.64	683.72	17.9	5.35	1,756	0.89	9.3	190.3	2.36
		Sample	8/5/2024	12.35	684.01	18.5	5.53	2,169	0.15	1.6	132.7	2.4
		Sample	8/13/2024	12.58	683.78	18.2	5.34	1,246	1.27	13.7	267.0	2.67
		Sample	8/20/2024	13.31	683.05	18.1	5.36	1,634	1.40	15.1	293.8	1.84
		Injection	8/26/2024	12.65	683.71	--	--	--	--	--	--	--
		Injection	8/28/2024	13.08	683.28	--	--	--	--	--	--	--
		Injection	8/30/2024	13.04	683.32	--	--	--	--	--	--	--
		Sample	9/4/2024	12.60	683.76	16.8	5.35	2,197	0.70	7.3	122.6	1.00
		Sample	9/9/2024	13.83	682.53	16.5	5.29	2,221	0.76	8.1	111.5	1.00
		Sample	9/18/2024	13.9	682.46	16.9	5.41	2,040	8.01	81.7	94.3	2.07
		Sample	9/24/2024	13.92	682.44	16.6	6.07	2,031	0.97	10.1	-70.2	4.21
		Injection	10/2/2024	8.93	687.43	--	--	--	--	--	--	--
		Injection	10/3/2024	9.29	687.07	--	--	--	--	--	--	--
		Injection	10/4/2024	10.33	686.03	--	--	--	--	--	--	--
		Sample	10/8/2024	10.80	685.56	18.1	5.30	2,092	1.80	19.2	173.3	2.47
		Injection	10/16/2024	13.79	682.57	--	--	--	--	--	--	--
		Injection	10/17/2024	13.68	682.68	--	--	--	--	--	--	--
		Injection	10/18/2024	14.00	682.36	--	--	--	--	--	--	--
		Sample	10/21/2024	13.72	682.64	18.1	5.27	2,138	0.92	9.9	139.4	0.46
		Injection	10/29/2024	15.9	680.46	--	--	--	--	--	--	--
		Injection	10/30/2024	16.05	680.31	--	--	--	--	--	--	--
		Injection	10/31/2024	16.13	680.23	--	--	--	--	--	--	--
		Sample	11/5/2024	16.17	680.19	18.3	5.30	2,088	1.61	14.7	124.5	3.02
		Injection	11/13/2024	16.68	679.68	--	--	--	--	--	--	--
		Injection	11/14/2024	16.43	679.93	--	--	--	--	--	--	--
		Injection	11/15/2024	16.35	680.01	--	--	--	--	--	--	--
		Sample	11/19/2024	16.17	680.19	18.3	5.26	2,090	0.71	7.6	108.1	0.77
		Sample	11/26/2024	17.46	678.90	17.9	5.35	2,069	1.88	20	149.7	1.11
		Injection	12/4/2024	17.32	679.04	--	--	--	--	--	--	--
		Injection	12/5/2024	17.57	678.79	--	--	--	--	--	--	--
		Injection	12/6/2024	16.33	680.03	--	--	--	--	--	--	--
OBS-4	Phase 2	Injection	6/5/2025	12.85	683.51	--	--	--	--	--	--	--
		Injection	6/11/2025	12.31	684.05	--	--	--	--	--	--	--
		Gauge Only	6/17/2025	12.2	684.16	--	--	--	--	--	--	--
		Injection	6/18/2025	11.89	684.47	--	--	--	--	--	--	--
		Gauge Only	6/24/2025	12.39	683.97	--	--	--	--	--	--	--
		Injection	6/25/2025	12.37	683.99	--	--	--	--	--	--	--
		Gauge Only	7/1/2025	12.40	683.96	--	--	--	--	--	--	--
		Injection	7/2/2025	12.40	683.96	--	--	--	--	--	--	--
		Injection	7/9/2025	12.45	683.91	--	--	--	--	--	--	--
		Injection	7/10/2025	12.36	684.00	--	--	--	--	--	--	--
		Injection	7/16/2025	12.69	683.67	--	--	--	--	--	--	--
		Injection	7/17/2025	12.69	683.67	--	--	--	--	--	--	--
		Injection	7/23/2025	12.37	683.99	--	--	--	--	--	--	--
		Injection	7/24/2025	12.40	683.96	--	--	--	--	--	--	--

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-5	Phase 1	Sample	6/6/2024	13.07	684.19	21.4	4.87	1,916	0.53	6.2	319.1	3.86
		Injection	6/13/2024	14.01	683.25	--	--	--	--	--	--	--
		Sample	6/18/2024	13.36	683.90	17.4	4.96	1,571	0.35	3.6	237.6	4.61
		Sample	6/25/2024	13.75	683.51	17.4	4.91	1,711	0.10	1.1	205.7	1.75
		Sample	7/2/2024	13.87	683.39	17.3	4.86	2,082	0.11	1.1	222	1.05
		Sample	7/9/2024	14.12	683.14	17.7	4.89	1,644	0.50	5.5	294.3	1.15
		Sample	7/17/2024	14.06	683.20	18.2	4.90	1,684	0.14	1.5	246.6	2.36
		Sample	7/23/2024	13.83	683.43	18.1	4.89	1,672	0.66	6.9	201.3	1.09
		Sample	7/30/2024	13.34	683.92	18.5	4.87	1,783	0.37	3.8	183.8	1.64
		Sample	8/5/2024	13.70	683.56	18.5	5.48	2,067	0.86	9.2	134.5	2.79
		Sample	8/13/2024	13.47	683.79	18.3	4.86	1,138	0.62	6.5	210.6	1.79
		Sample	8/20/2024	14.21	683.05	17.6	4.87	1,636	0.97	12.6	321.3	2.13
		Injection	8/26/2024	13.55	683.71	--	--	--	--	--	--	--
		Injection	8/28/2024	14.23	683.03	--	--	--	--	--	--	--
		Injection	8/30/2024	14.17	683.09	--	--	--	--	--	--	--
		Sample	9/4/2024	14.37	682.89	16.6	4.81	2,021	5.80	0.55	158.3	1.13
		Sample	9/10/2024	14.50	682.76	16.1	4.83	1,932	1.02	11.3	150.3	1.45
		Sample	9/19/2024	14.68	682.58	16.4	4.90	1,831	8.08	78.4	94.5	2.44
		Sample	9/24/2024	14.93	682.33	16.4	4.80	1,823	1.57	15.5	94.4	2.86
		Injection	10/2/2024	9.9	687.36	--	--	--	--	--	--	--
		Injection	10/3/2024	10.24	687.02	--	--	--	--	--	--	--
		Injection	10/4/2024	11.31	685.95	--	--	--	--	--	--	--
		Sample	10/8/2024	13.18	684.08	17.9	4.76	1,870	0.60	6.4	224.6	1.57
		Injection	10/16/2024	14.76	682.50	--	--	--	--	--	--	--
		Injection	10/17/2024	14.81	682.45	--	--	--	--	--	--	--
		Injection	10/18/2024	14.99	682.27	--	--	--	--	--	--	--
		Sample	10/22/2024	16.21	681.05	17.4	4.82	1,898	1.03	11.1	171	0.68
		Injection	10/29/2024	16.88	680.38	--	--	--	--	--	--	--
		Injection	10/30/2024	17.05	680.21	--	--	--	--	--	--	--
		Injection	10/31/2024	17.14	680.12	--	--	--	--	--	--	--
		Sample	11/5/2024	17.20	680.06	18.3	4.84	1,902	1.19	11.5	206.4	1.98
		Injection	11/13/2024	17.67	679.59	--	--	--	--	--	--	--
		Injection	11/14/2024	16.41	680.85	--	--	--	--	--	--	--
		Injection	11/15/2024	17.31	679.95	--	--	--	--	--	--	--
		Sample	11/19/2024	17.15	680.11	18.1	4.79	1,826	1.41	15	176.8	0.3
		Sample	11/25/2024	17.54	679.72	18.1	4.75	1,795	1.70	18.1	224.8	0.45
		Injection	12/4/2024	18.32	678.94	--	--	--	--	--	--	--
		Injection	12/5/2024	18.58	678.68	--	--	--	--	--	--	--
		Injection	12/6/2024	17.32	679.94	--	--	--	--	--	--	--
OBS-5	Phase 2	Injection	6/5/2025	13.73	683.53	--	--	--	--	--	--	--
		Injection	6/11/2025	13.27	683.99	--	--	--	--	--	--	--
		Gauge Only	6/17/2025	12.94	684.32	--	--	--	--	--	--	--
		Injection	6/18/2025	12.90	684.36	--	--	--	--	--	--	--
		Gauge Only	6/24/2025	13.35	683.91	--	--	--	--	--	--	--
		Injection	6/25/2025	13.35	683.91	--	--	--	--	--	--	--
		Gauge Only	7/1/2025	13.40	683.86	--	--	--	--	--	--	--
		Injection	7/2/2025	13.40	683.86	--	--	--	--	--	--	--
		Injection	7/9/2025	13.45	683.81	--	--	--	--	--	--	--
		Injection	7/10/2025	13.45	683.81	--	--	--	--	--	--	--
		Injection	7/16/2025	13.68	683.58	--	--	--	--	--	--	--
		Injection	7/17/2025	13.67	683.59	--	--	--	--	--	--	--
		Injection	7/23/2025	13.35	683.91	--	--	--	--	--	--	--
		Injection	7/24/2025	13.36	683.90	--	--	--	--	--	--	--

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-6	Phase 1	Sample	6/7/2024	11.85	684.38	18.4	5.12	1,815	1.85	20.2	296.2	7.60
		Injection	6/13/2024	12.87	683.36	--	--	--	--	--	--	--
		Sample	6/18/2024	12.48	683.75	18.2	5.08	1,627	0.21	2.3	220.2	8.53
		Sample	6/24/2024	12.46	683.77	18.9	5.08	1,795	1.31	14.5	292.2	5.27
		Sample	7/2/2024	12.73	683.50	17.7	5.10	2,153	0.41	4.2	190.6	4.11
		Sample	7/9/2024	12.97	683.26	18.1	5.05	1,702	0.85	9.3	238.5	4.56
		Sample	7/17/2024	12.92	683.31	18.2	5.08	1,729	0.39	4.3	274.5	4.21
		Sample	7/23/2024	12.33	683.90	18.4	5.04	1,741	0.89	9.3	184.2	0.51
		Sample	7/29/2024	12.70	683.53	18.3	5.01	1,685	0.46	5.0	198.5	5.45
		Sample	8/5/2024	12.28	683.95	19.1	5.42	2,162	0.16	1.7	138.1	2.05
		Sample	8/13/2024	12.50	683.73	19.1	5.02	976	0.16	1.7	174.2	3.10
		Sample	8/19/2024	12.60	683.63	18.5	4.98	1,290	0.54	6.2	176.9	3.55
		Injection	8/26/2024	12.53	683.70	--	--	--	--	--	--	--
		Injection	8/28/2024	12.4	683.83	--	--	--	--	--	--	--
		Injection	8/30/2024	12.88	683.35	--	--	--	--	--	--	--
		Sample	9/4/2024	12.53	683.70	17.3	5.16	2,139	5.28	56.2	122.6	4.18
		Sample	9/9/2024	13.25	682.98	17.0	4.97	2,179	0.23	23.3	156.0	4.56
		Sample	9/18/2024	13.5	682.73	16.7	5.10	1,990	31.50	308.1	126.5	2.23
		Sample	9/24/2024	13.50	682.73	17.5	4.64	1,989	5.89	61.2	86.3	5.31
		Injection	10/2/2024	8.83	687.40	--	--	--	--	--	--	--
		Injection	10/3/2024	9.2	687.03	--	--	--	--	--	--	--
		Injection	10/4/2024	10.24	685.99	--	--	--	--	--	--	--
		Sample	10/8/2024	10.60	683.63	18.5	4.95	2,043	0.77	8.3	237.2	0.52
		Injection	10/16/2024	13.57	682.66	--	--	--	--	--	--	--
		Injection	10/17/2024	13.44	682.79	--	--	--	--	--	--	--
		Injection	10/18/2024	13.8	682.43	--	--	--	--	--	--	--
		Sample	10/21/2024	14.50	681.73	18.6	4.95	2,097	1.19	13.1	208.1	0.56
		Injection	10/29/2024	15.71	680.52	--	--	--	--	--	--	--
		Injection	10/30/2024	15.85	680.38	--	--	--	--	--	--	--
		Injection	10/31/2024	15.9	680.33	--	--	--	--	--	--	--
		Sample	11/5/2024	15.32	680.91	19.0	4.95	2,044	3.21	35.7	211.4	2.11
		Injection	11/13/2024	16.49	679.74	--	--	--	--	--	--	--
		Injection	11/14/2024	16.23	680.00	--	--	--	--	--	--	--
		Injection	11/15/2024	16.12	680.11	--	--	--	--	--	--	--
		Sample	11/19/2024	15.64	680.59	18.7	4.87	2,050	0.56	6	198.7	1.32
		Sample	11/26/2024	16.85	679.38	18.5	4.93	2,034	2.11	22.6	243.5	0.92
		Injection	12/4/2024	17.15	679.08	--	--	--	--	--	--	--
		Injection	12/5/2024	17.36	678.87	--	--	--	--	--	--	--
		Injection	12/6/2024	16.16	680.07	--	--	--	--	--	--	--
OBS-6	Phase 2	Injection	6/5/2025	12.61	683.62	--	--	--	--	--	--	--
		Injection	6/11/2025	12.09	684.14	--	--	--	--	--	--	--
		Gauge Only	6/17/2025	11.71	684.52	--	--	--	--	--	--	--
		Injection	6/18/2025	11.77	684.46	--	--	--	--	--	--	--
		Gauge Only	6/24/2025	12.17	684.06	--	--	--	--	--	--	--
		Injection	6/25/2025	12.22	684.01	--	--	--	--	--	--	--
		Gauge Only	7/1/2025	12.28	683.95	--	--	--	--	--	--	--
		Injection	7/2/2025	12.31	683.92	--	--	--	--	--	--	--
		Injection	7/9/2025	12.28	683.95	--	--	--	--	--	--	--
		Injection	7/10/2025	12.31	683.92	--	--	--	--	--	--	--
		Injection	7/16/2025	12.52	683.71	--	--	--	--	--	--	--
		Injection	7/17/2025	12.58	683.65	--	--	--	--	--	--	--
		Injection	7/23/2025	12.25	683.98	--	--	--	--	--	--	--
		Injection	7/24/2025	12.25	683.98	--	--	--	--	--	--	--

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-7	Phase 2	Sample	6/4/2025	13.69	683.86	17.2	6.52	2,240	0.28	2.9	38.1	16.2
		Injection	6/5/2025	13.99	683.56	--	--	--	--	--	--	--
		Sample	6/10/2025	13.80	683.75	17.9	6.00	1,995	18.16	192.4	48.5	23.9
		Injection	6/11/2025	13.57	683.98	--	--	--	--	--	--	--
		Sample	6/17/2025	14.00	683.55	17.5	5.94	2,069	1.62	17	71	8.04
		Injection	6/18/2025	13.14	684.41	--	--	--	--	--	--	--
		Sample	6/23/2025	13.87	683.68	17.9	5.75	2,233	0.16	1.7	-63.7	3.8
		Injection	6/25/2025	13.60	683.95	--	--	--	--	--	--	--
		Sample	6/30/2025	14.13	683.42	--	5.78	2,301	7.87	86.5	38.5	6.38
		Injection	7/2/2025	13.65	683.90	--	--	--	--	--	--	--
		Sample	7/7/2025	14.40	683.15	18.2	5.87	2,321	1.18	11.7	18.8	2.63
		Injection	7/9/2025	13.70	683.85	--	--	--	--	--	--	--
		Injection	7/10/2025	13.68	683.87	--	--	--	--	--	--	--
		Sample	7/14/2025	13.60	683.95	18.7	5.85	2,304	0.89	9.6	-23.2	3.67
		Injection	7/16/2025	13.93	683.62	--	--	--	--	--	--	--
		Injection	7/17/2025	13.93	683.62	--	--	--	--	--	--	--
		Sample	7/22/2025	14.50	683.05	18.8	6.07	2,160	0.32	3.4	11.2	0.56
		Injection	7/23/2025	13.58	683.97	--	--	--	--	--	--	--
		Injection	7/24/2025	13.63	683.92	--	--	--	--	--	--	--
		Sample	7/29/2025	14.18	683.37	19.7	6.13	2,145	0.28	3.1	106.4	3.71
		Sample	8/5/2025	13.56	683.99	19.2	6.14	1,958	5.53	58.8	62.0	5.77
		Sample	8/11/2025	14.30	683.25	19.3	6.20	1,994	0.59	9.0	56.0	7.37
		Sample	8/19/2025	14.75	682.80	19.3	6.20	1,994	0.59	9.0	52.9	3.2
		Sample	8/25/2025	14.75	682.80	19.3	6.20	1994.00	0.59	9.0	56.0	7.37
OBS-8	Phase 2	Sample	6/4/2025	15.25	682.15	17	6.44	1,924	0.09	0.9	168.5	10.2
		Injection	6/5/2025	13.47	683.93	--	--	--	--	--	--	--
		Sample	6/10/2025	13.74	683.66	17.4	5.25	1,710	9.74	102.8	27.2	10.5
		Injection	6/11/2025	13.24	684.16	--	--	--	--	--	--	--
		Sample	6/17/2025	13.53	683.87	17.2	5.18	1,780	0.90	9.5	99.6	12.8
		Injection	6/18/2025	12.80	684.60							
		Sample	6/23/2025	13.88	683.52	17.6	4.88	1,907	1.32	13.8	26.7	18.0
		Injection	6/25/2025	13.32	684.08	--	--	--	--	--	--	--
		Sample	7/1/2025	13.85	683.55		4.84	1,972	0.79	8.4	117.4	15.5
		Injection	7/2/2025	13.44	683.96	--	--	--	--	--	--	--
		Sample	7/7/2025	14.22	683.18	18.1	4.83	1,954	2.35	23.8	77.1	7.58
		Injection	7/9/2025	13.42	683.98	--	--	--	--	--	--	--
		Injection	7/10/2025	13.44	683.96	--	--	--	--	--	--	--
		Sample	7/15/2025	13.48	683.92	17.8	4.80	1,921	1.02	11.1	134.8	16.7
		Injection	7/16/2025	13.68	683.72	--	--	--	--	--	--	--
		Injection	7/17/2025	13.70	683.70	--	--	--	--	--	--	--
		Sample	7/22/2025	13.82	683.58	17.7	4.82	1,774	2.02	21.5	147.2	13.1
		Injection	7/23/2025	13.30	684.10	--	--	--	--	--	--	--
		Injection	7/24/2025	13.40	684.00	--	--	--	--	--	--	--
		Sample	7/29/2025	13.90	683.50	18.3	4.91	1,776	0.28	2.9	143.2	30.7
OBS-9	Phase 2	Sample	6/4/2025	11.78	686.55	17.6	7.11	2,016	0.10	1	126.5	11.9
		Injection	6/5/2025	12.49	685.84	--	--	--	--	--	--	--
		Purge Only	6/10/2025	11.45	686.88	17.3	5.57	1,798	24.44	256.8	137.5	5.16
		Injection	6/11/2025	11.86	686.47	--	--	--	--	--	--	--
		Purge Only	6/17/2025	12.25	686.08	17.8	5.5	1,862	1.54	16	115	6.63
		Injection	6/18/2025	11.80	686.53	--	--	--	--	--	--	--
		Purge Only	6/24/2025	11.72	686.61	17.3	5.18	2,093	0.12	1.3	119.8	7.88
		Injection	6/25/2025	11.98	686.35	--	--	--	--	--	--	--
		Purge Only	7/1/2025	11.70	686.63	17.4	5.16	2,047	1.61	17	79.7	7.78
		Injection	7/2/2025	12.09	686.24	--	--	--	--	--	--	--
		Purge Only	7/8/2025	11.87	686.46	18.4	5.23	2,013	1.58	16.9	70.3	5.53
		Injection	7/9/2025	12.29	686.04	--	--	--	--	--	--	--
		Injection	7/10/2025	12.05	686.28	--	--	--	--	--	--	--
		Purge Only	7/15/2025	11.52	686.81	18.5	5.62	2,029	0.68	7.1	-3.2	7.32
		Injection	7/16/2025	12.16	686.17	--	--	--	--	--	--	--
		Injection	7/17/2025	11.89	686.44	--	--	--	--	--	--	--
		Purge Only	7/22/2025	12.28	686.05	18.2	5.39	1,872	0.38	5.3	54.5	8.07
		Injection	7/23/2025	12.57	685.76	--	--	--	--	--	--	--
		Injection	7/24/2025	11.97	686.36	--	--	--	--	--	--	--

TABLE 3 - *In Situ* Pilot Test Field Parameters
Watts Bar Fossil Plant

DRAFT

Well ID	Injection Phase	Sample Event[(d)(e)]	Date	Depth to Groundwater[(a)]	Groundwater Elevation[(b)(c)]	Temperature	pH	Specific Conductivity	Dissolved Oxygen	Dissolved Oxygen	Oxidation Reduction Potential	Turbidity
				ft-btoc	ft	deg-C	SU	uS/cm	mg/L	%	mV	NTU
OBS-10	Phase 2	Sample	6/4/2025	12.25	684.22	17.3	7.5	2,123	0.12	1.2	166.5	19.2
		Injection	6/5/2025	11.57	684.90	--	--	--	--	--	--	--
		Purge Only	6/10/2025	11.19	685.28	17.1	5.52	1,910	14.04	145.9	177.6	13.2
		Injection	6/11/2025	11.42	685.05	--	--	--	--	--	--	--
		Purge Only	6/17/2025	10.62	685.85	17.3	5.42	2,001	0.56	5.9	176	20.4
		Injection	6/18/2025	11.14	685.33	--	--	--	--	--	--	--
		Purge Only	6/24/2025	11.27	685.20	17.1	5.02	2,251	0.10	1.1	176.9	17.8
		Injection	6/25/2025	11.51	684.96	--	--	--	--	--	--	--
		Purge Only	7/1/2025	11.35	685.12	17.3	5.04	2,219	2.34	24.1	136.7	13.5
		Injection	7/2/2025	11.48	684.99	--	--	--	--	--	--	--
		Purge Only	7/8/2025	11.23	685.24	18.2	5.10	2,205	4.70	5.1	134.9	9.38
		Injection	7/9/2025	11.66	684.81	--	--	--	--	--	--	--
		Injection	7/10/2025	11.53	684.94	--	--	--	--	--	--	--
		Purge Only	7/15/2025	11.22	685.25	18.3	5.44	2,222	0.46	5	88.9	9.18
		Injection	7/16/2025	11.64	684.83	--	--	--	--	--	--	--
		Injection	7/17/2025	11.52	684.95	--	--	--	--	--	--	--
		Purge Only	7/22/2025	11.78	684.69	17.7	5.68	2,118	0.42	5.1	57.9	5.6
		Injection	7/23/2025	11.55	684.92	--	--	--	--	--	--	--
		Injection	7/24/2025	11.45	685.02	--	--	--	--	--	--	--

Notes

(a) Depth to groundwater measurements presented were collected prior to sample purging was initated.
(b) Groundwater elevation is calculated by subtracting the depth to water measurement from surveyed top of casing elevation for each well.
(c) Elevations shown are in datum NGVD 29, which indicates feet (ft) in elevations referenced to the National Geodetic Vertical Datum of 1929.
(d) Groundwater quality data (temperature, pH, specific conductivity, DO, ORP, and turbidity) collected for "Sample" events are post-sample parameters.
(e) Groundwater quality data collected for "Purge Only" events are final purge parameters as no sample was collected.

Abbreviations

ft	= feet
ft-amsl	= feet above mean sea level
ft-btoc	= feet below top of casing
deg-C	= degrees Celcius
SU	= Standard Units
uS/cm	= microSiemens per centimeter
mg/L	= milligrams per liter
%	= percent
mV	= milliVolts
NTU	= Nephelometric Turbidity Unit
NR	= Not Recorded
--	= Not Measured

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Total Metals																	
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100
OBS-1	WBF-GW-OBS-1-1635-20240606	6/6/2024	141	0.967 U	1.53	46 J	0.274 U	3,390	0.227 J	419,000	1.53 U	65.8	1.14 U	2,770	0.376 U	3.3 J	61,100	28,200	0.147 U*	0.61 U
	WBF-GW-OBS-1-1430-20240617	6/17/2024	22.3 J	0.967 U	2.68	23.4	0.274 U	3,580	0.217 U	427,000	1.53 U	51.7	1.14 U	7,580	0.376 U	4.4 J	60,300 J	31,100	0.13 U	0.61 U
	WBF-GW-OBS-1-1010-20240625	6/25/2024	57.9	0.967 U	3.39	23.2	0.274 U	3,170	0.217 U	439,000 J	1.53 U	61.5	1.14 U	5,410	0.601 U*	3.62 J	68,600 J	29,000	0.13 U	0.61 U
	WBF-GW-OBS-1-1510-20240701	7/1/2024	153	0.967 U	3.07	23.2 J	0.274 U	2,620	0.217 U	399,000	1.53 U	54.5	1.14 U	4,290	0.623 J	5.07	59,200	22,800	0.13 U	0.61 U
	WBF-GW-OBS-1-1300-20240708	7/8/2024	36.5	0.967 U	3.1	19.6	0.274 U	3,350	0.23 J	439,000	1.53 U	54.7	1.14 U	4,940 J	0.376 U	3.94 J	58,700	26,800	0.13 U	0.61 U
	WBF-GW-OBS-1-0905-20240716	7/16/2024	21.8 UJ	0.967 U	2.87	18.1	0.274 U	3,270	0.217 U	443,000	1.53 U	57.5	1.14 U	4,430	0.376 U	3.62 J	65,400	26,800	0.13 U	0.61 U
	WBF-GW-OBS-1-0900-20240723	7/23/2024	59	0.967 U	3.03	18.1	0.274 U	3,280	0.217 U	436,000	1.53 U	57.2 J	1.14 U	5,270	0.376 U	3.79 J	67,100	26,900	0.13 U	0.61 U
	WBF-GW-OBS-1-0910-20240730	7/30/2024	90.4	0.967 U	3.21	19.7	0.274 U	3,510	0.217 U	423,000	1.53 U	64.7	1.14 U	5,360	0.376 U	4.37 J	69,000	26,000	0.13 U	0.642 J
	WBF-GW-OBS-1-1400-20240806	8/6/2024	27.7 J	0.967 U	2.56	18	0.274 U	3,340	0.217 U	441,000	1.53 U	59.1	1.14 U	5,100	0.376 U	3.82 J	66,200	24,900	0.13 U	0.61 U
	WBF-GW-OBS-1-1505-20240814	8/14/2024	21.8 U	0.967 U	2.2	18.5	0.274 U	3,430	0.217 U	430,000	1.53 U	53.5	1.14 U	3,720	0.376 U	4.74 J	66,000	23,200	0.13 U	0.61 U
	WBF-GW-OBS-1-1705-20240820	8/20/2024	35.9	0.967 U	2.58	17.6	0.274 U	4,030	0.217 U	447,000	1.53 U	57.1 J	1.14 U	4,710 J	0.376 U	4.01 J	65,200	26,000	0.13 U	0.61 U
	WBF-GW-OBS-1-1415-20240903	9/3/2024	66.2	0.967 U	2.19	17.8	0.415 J	3,800	0.32 J	469,000	1.53 U	73.3	1.14 U	5,180	0.376 U	4.07 J	68,100	27,700	0.13 U	0.61 U
	WBF-GW-OBS-1-1625-20240910	9/10/2024	22.4 J	0.57 U	2.65 J	16.1	0.313 J	3,640	0.19 J	418,000	1.2 U	56	1.7 U	5,270	0.45 U	3.44 U	64,100	26,500	0.13 U	1.18 J
	WBF-GW-OBS-1-1505-20240919	9/19/2024	131	0.57 U	1.56 J	16.1	0.273 U	2,960	0.222 J	414,000	1.2 U	55.6	1.7 U	4,660	0.45 U	3.78 J	62,000	24,900	0.13 U	1.08 U
	WBF-GW-OBS-1-0905-20240924	9/24/2024	106	0.57 U	1.74 J	17.5	0.273 U	3,800	0.117 J	439,000	1.2 U	56.4	1.7 U	5,070	0.45 U	4.16 J	65,900	26,800	0.13 U	1.08 U
	WBF-GW-OBS-1-1445-20241007	10/7/2024	103	0.57 U	1.55 J	18.4	0.273 U	3,490	0.077 U	486,000	1.2 U	66.1	1.7 U	5,350	0.45 U	3.89 J	72,000	25,800	0.13 U	1.08 U
	WBF-GW-OBS-1-1305-20241022	10/22/2024	25.9 J	0.57 U	1.2 J	16.4	0.273 U	3,490	0.104 J	439,000	1.2 U	57.5	1.7 U	3,630	0.45 U	3.44 U	66,800	24,800	0.13 U	1.08 U
	WBF-GW-OBS-1-1555-20241104	11/4/2024	177	0.57 U	0.75 U	17.8	0.273 U	4,010	0.305 J	448,000	1.2 U	68.5	1.7 U	4,310	0.45 U	3.44 U	65,000	27,300	0.13 U	1.08 U
	WBF-GW-OBS-1-1415-20241118	11/18/2024	90.4	0.57 U	1.02 J	16.2	0.273 U	3,570	0.255 J	435,000	1.2 U	63.3	1.7 U	4,110	0.45 U	4.27 J	66,100	27,100	0.13 U	1.08 U
	WBF-GW-OBS-1-0920-20241125	11/25/2024	63	0.57 U	1.62 J	16	0.273 U	3,760	0.302 U*	433,000	1.2 U	66.9	1.7 U	4,010 J	0.45 U	3.44 U	64,700	23,900	0.13 U	1.08 U
	WBF-GW-OBS01-1445-20250603	6/3/2025	30.3 U*	1.16 J	1.00 J	14.9	0.287 J	4,440	0.338 J	470,000	1.2 U	98.1	1.7 U	5,260	0.45 U	6.03 J	69,000	27,500	0.13 U	1.08 U
	WBF-GW-OBS01-0855-20250610	6/10/2025	27.1 J	0.57 U	0.75 U	14.2	0.273 U	4,460	0.216 J	402,000	1.2 U	116	1.7 U	6,000	2.38	3.56 J	56,600	30,100	0.13 U	1.08 U
	WBF-GW-OBS01-1355-20250616	6/16/2025	40.2 J	0.57 U	0.75 U	14.4	0.304 J	4,210	0.269 J	434,000	1.2 U	114	1.7 U	7,070 J	0.847 U*	6.14 J	65,800	28,300	0.13 U	1.2 J
	WBF-GW-OBS01-0815-20250624	6/24/2025	43 U*	0.57 U	0.75 U	13.6	0.318 J	4,460	0.331 J	443,000	1.2 U	101	1.7 U	6,230	0.45 U	3.44 U	65,500	29,300	0.13 U	1.08 U
	WBF-GW-OBS01-1320-20250630	6/30/2025	30.7 J	0.57 U	1.05 J	14	0.304 J	3,960	0.202 U*	425,000	1.2 U	96.6	2.66	5,870	0.45 U	3.53 J	64,200	26,700	0.13 U	1.08 U
	WBF-GW-OBS01-0950-20250708	7/8/2025	32.9 J	0.57 U	0.776 J	13.6	0.296 J	4,300	0.168 J	419,000	1.2 U	95.7	3.8	6,100	0.45 U	4.35 J	63,300	29,000	0.13 U	1.08 U
	WBF-GW-OBS01-1305-20250714	7/14/2025	32.1 J	0.57 U	1.2 J	13.7	0.38 J	4,130	0.2 J	438,000	1.2 U	95.7	12.1	5,620	0.45 U	4.17 J	62,800	26,500	0.13 U	1.08 U
	WBF-GW-OBS01-1340-20250721	7/21/2025	39.9 J	0.57 U	1.19 J	14.3	0.43 J	4,570	0.265 J	441,000	1.2 U	102	2.63	5,900	0.45 U	4.92 J	65,500	28,000	0.13 U	1.08 U
	WBF-GW-OBS01-1445-20250728	7/28/2025	40.5 U*	0.57 U	0.883 J	14.8	0.353 J	4,210	0.421 J	426,000	1.2 U	105	2.48	5,510	0.45 U	4.58 J	65,100	28,700	0.13 U	1.08 U
IW-2	WBF-GW-IW-2-1140-20240611	6/11/2024	379	0.967 U	0.752 U*	27.5	1.48	8,620	0.25 J	474,000	1.53 U	509	1.14 U	6,270	0.376 U	20.8	41,600	53,700	0.13 U	0.61 U
	WBF-GW-IW-2-1655-20240617	6/17/2024	3690	0.967 U	5.35	32.6	0.274 U	7,180	0.217 U	245,000	1.63 J	76.1	18.9	71	0.376 U	11.1	24,800 J	18,900	0.13 U	4.69 J
	WBF-GW-IW-2-1130-20240625	6/25/2024	184	0.967 U	2.06	41.2	0.274 U	6,800	0.217 U	439,000 J	1.53 U	286	1.31 J	1,070	0.588 U*	12.5	43,400 J	53,500	0.13 U	1.3 J
	WBF-GW-IW-2-0845-20240702	7/2/2024	103	0.967 U	2.54	30.2 J	0.274 U	6,500	0.217 U	478,000	1.53 U	362	1.14 U	5,090	0.376 U	13.6	41,500	54,700	0.13 U	0.62 J
	WBF-GW-IW-2-0825-20240709	7/9/2024	103	0.967 U	2.87	32.4	0.274 U	7,080	0.217 U	469,000	1.53 U	370	1.14 U	6,170	0.376 U	27.3 J	37,700	53,200	0.13 U	0.61 U
	WBF-GW-IW-2-1035-20240716	7/16/2024	138 U*	0.967 U	3.23	29.9	0.45 J	6,700	0.217 U	474,000 J	1.53 U	425 J	1.14 U	6,130	0.376 U	14.8	43,000	53,300	0.13 U	0.61 U
	WBF-GW-IW-2-1410-20240722	7/22/2024	131	0.967 U	3.09	31	0.671 J	6,800	0.217 U	470,000	1.53 U	485	1.14 U	5,560	0.376 U	16.5	42,500	50,700 J	0.13 U	0.61 U
	WBF-GW-IW-2-1010-20240730	7/30/2024	177	0.967 U	3.35	31.6	0.883 J	6,970	0.217 U	419,000	1.53 U	523	1.14 U	6,260	0.376 U	17.7	44,900	50,700	0.13 U	0.61 U
	WBF-GW-IW-2-1240-20240806	8/6/2024	197	0.967 U	4.00	30.7	0.906 J	7,020	0.217 U	453,000	1.53 U	518	1.14 U	6,090	0.376 U	17.6	42,200	52,900	0.13 U	0.61 U
	WBF-GW-IW-2-1400-20240814	8/14/2024	432	0.967 U	2.75	33.1	1.37	7,740	0.217 U	453,000	1.53 U	486	1.14 U	6,010	0.376 U	19	41,500	52,500	0.13 U	0.61 U
	WBF-GW-IW-2-1515-20240820	8/20/2024	234	0.967 U	2.45	29.8	1.59	7,450	0.217 U	447,000	1.53 U	474	1.14 U	5,790	0.376 U	19.6	40,500	52,800	0.13 U	0.61 U
	WBF-GW-IW-2-0900-20240904	9/4/2024	83.8	0.967 U	0.929 J	79.6	1.92	7,610	1.05	498,000	1.53 U	597	1.34 J	2,130	0.376 U	28.9	42,900	52,500	0.13 U	0.61 U
	WBF-GW-IW-2-1510-20240910	9/10/2024	410	0.57 U	0.774 J	36.3	2.81	7,540	0.077 U	359,000 J	1.62 J	404 J	1.7 U	9,540 J	0.45 U	19.5	31,400 J	57,600	0.13 U	1.08 U
	WBF-GW-IW-2-1340-20240919	9/19/2024	594	0.57 U	1.19 J	37.6	8.82	6,200	0.231 J	397,000	1.2 U	503	1.7 U	14,300	0.45 U	26.4	35,300	49,600	0.13 U	1.08 U
	WBF-GW-IW-2-1525-20240923	9/23/2024	589	0.57 U	1.13 J	38.5	10.5	6,980	0.24 J	400,000	1.2 U	485	1.7 U	14,600	0.45 U	26.7	34,800	44,800	0.13 U	1.08 U
	WBF-GW-IW-2-1600-20241007	10/7/2024	59800	0.57 U	61.9	27.7	0.921 J	5,290	6.09	22,200	15	30.6	175	2,500	6.69	4.79 J	2,190	472	0.224 J	20.4
	WBF-GW-IW-2-1155-20241022	10/22/2024	5350	0.57 U	4.1 J	29.9	0.273 U	5,660	0.445 J	81,300	3.34 J	17.8	10.1	439	0.544 J	4.17 J	14,600	5,660	0.13 U	2.52 J
	WBF-GW-IW-2-1405-20241104	11/4/2024	45.6 J	0.57 U	0.907 J	58.5	0.299 J	7,380	0.688 J	374,000	1.91 J	195	1.7 U	397	0.45 U	12.7	52,300	38,400	0.13 U	1.3 J
	WBF-GW-IW-2-1540-20241118	11/18/2024	13200	0.57 U	18.9	9.28	0.273 U	5,450	0.867 J	42,200	9.74	15.6	47.3	583	0.83 J	3.44 U	4,230	1,090	0.157 J	8.88
	WBF-GW-IW-2-1055-20241125	11/25/2024	9560	0.57 U	11.9	10.2	0.414 J	6,440	0.347 U*	73,800	2.17 J	13.1	17.2	231	0.57 J	3.44 U	8,330	4,840 J	0.13 U	4.74 J
	WBF-GW-IW02-1305-20250603	6/3/2025	423	0.57 U	1.47 J	50.6	0.321 J	7,450	0.077 U	500,000	1.2 U	309	1.7 U	8,980	0.45 U	10.4	43,400	57,900	0.13 U	1.08 U
	WBF-GW-IW02-1615-20250609	6/9/2025	6930	0.57 U	14.4	28.2	0.346 J	6,060	0.879 J	170,000	10.8	81.5	17.1	1,410	2.53	5.51 J	28,500	12,500	0.161 J	3.31 J
	WBF-GW-IW02-0835-20250617	6/17/2025	218 J	0.57 U	0.919 J	52.3	0.273 UJ	7,110	0.166 J	342,000	1.2 U	284	1.7 U	1,160 J	0.764 U*	16 J	52,100	42,800	0.13 U	1.08 U
	WBF-GW-IW02-0900-20250624	6/24/2025	76.7 U*	0.57 U	0.75 U	48.2	0.273 U	7,280	0.278 J	352,000	1.2 U	241	1.7 U	2,000	1.29	13.1	45,700	44,300	0.13 U	1.08 U
	WBF-GW-IW02-1425-20250630	6/30/2025	9290	0.57 U	25.3	9.95	0.319 J	5,510	0.803 J	53,100	9.21	11.9	34.9	420	1.61	3.44 U	6,620	2,410	0.13 U	8.19
	WBF-GW-IW02-1100-20250708	7/8/2025	949	0.57 U	5.35	25	0.273 U	135	0.354 J	185,000	6.17	56.5	9.33	493	0.965 J	12.1	49,800	250	0.13 U	4.25 J
	WBF-GW-IW02-1410-20250714	7/14/2025	24600 J	0.57 U	68.2 J	4.72 J	0.273 U	5,650	0.563 J	34,900 J	5.22	12.4	40.6	170	1.09	3.44 U	3,490 J	1,360 J	0.13 U	8.56
	WBF-GW-IW02-1520-20250721	7/21/2025	39000	0.658 J	97.7	4.07 J	0.273 U	5,950	0.792 J	20,800	6.24	15.3	78.2	162	1.49	3.44 U	2,480	565	0.13 U	13.1
	WBF-GW-IW02-1550-20250728	7/28/2025	40800	0.57 U	87.1	3.91 J	0.273 U	5,770	0.724 J	12,900	6.71	14.3	77.8	182	1.06	3.44 U	1,360	139	0.223	11.9
	WBF-GW-IW-2-1410-20250805	8/5/2025	19000	0.57 U	36.2	9.95	0.273 U	6,200	0.337 U*	43,000 J	4.62 J	19.5	34.5	126	0.601 J	3.87 J	12,100	5,140	0.197 J	8.16
	WBF-GW-IW-2-0925-20250811	8/11/2025	8840	0.57 U	23.6	19.7	0.273 U	7,200	0.413 J	136,000 J	4.28 J	42	23.6	230	0.655 J	10.7	27,900	11,600	0.13 U	6.76
	WBF-GW-IW-2-0955-20250819	8/19/2025	2690	0.57 U	11.7	36.7	0.273 U	7,350	0.364 J	194,000	10.7	81.5	19	890	0.638 J	11.9	44,100	17,700	0.13 U	4.1 J
	WBF-GW-IW02-0835-20250825	8/25/2025	988	0.57 U	7.52	51.5	0.273 U	7,320	0.331 J	243,000	5.66	137	11.2	1,620	0.45 U	13.3	48,400	26,900	0.13 U	3.89 J

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

			Total Metals									General Chemistry				Anions				Radiological Parameters		
Well ID	Sample ID	Sample Date	Nickel ug/L	Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L	TDS mg/L	Bicarbonate mg/L	Carbonate mg/L	Alkalinity mg/L	Bromide mg/L	Chloride mg/L	Fluoride mg/L	Sulfate mg/L	Radium 226 pCi/L	Radium 228 pCi/L	Radium 226 + 228 pCi/L
Screening Levels			100				100		2	86	5000											5
OBS-1	WBF-GW-OBS-1-1635-20240606	6/6/2024	17.4	1,710	1.53 U	14,800	0.223 U	42,100	0.472 U	0.776 U	24.2 U*	2,130	91.2	5 U	91.2	-	7.37	0.0615 J	1,490	0.333 U	0.612 U	0.946 U
	WBF-GW-OBS-1-1430-20240617	6/17/2024	15.5	1,390	1.53 U	15,700	0.223 U	34,900	0.472 U	0.776 U	16	2,120	101	5 U	101	-	6.96	0.0544	1,350	0.217 U	-0.00216 UJ	0.217 UJ
	WBF-GW-OBS-1-1010-20240625	6/25/2024	19.7	1,410	1.53 U	13,600	0.223 U	37,300	0.472 U	0.776 U	26.7 U*	2,130	97.1	5 U	97.1	-	6.72	0.0502 J	1,290	0.031 U	0.641 U*	0.672 U*
	WBF-GW-OBS-1-1510-20240701	7/1/2024	15	1,670	1.53 U	13,200	0.223 U	45,600	0.472 U	0.776 U	25.6	2,000	119	5 U	119	-	7.31	0.049 J	1,200	0.0627 UJ	0.683 U*	0.746 U*
	WBF-GW-OBS-1-1300-20240708	7/8/2024	17.2	1,230	1.53 U	14,800	0.223 U	31,200	0.481 J	0.776 U	18.9	2,160	95.4	5 U	95.4	-	6.65	0.0526 J	1,290	0.902	-0.0836 UJ	0.902 J
	WBF-GW-OBS-1-0905-20240716	7/16/2024	17.2	1,220	1.53 U	13,800	0.223 U	30,600	0.472 U	0.776 U	16.6	2,110	93.9	5 U	93.9	-	7.06	0.0406 J	1,360	1.07	1.02 U*	2.09 J
	WBF-GW-OBS-1-0900-20240723	7/23/2024	17.6	1,080	1.53 U	13,300	0.223 U	33,000	0.472 U	0.776 U	14.1 J	2,210	99.3	5 U	99.3	-	6.56	0.0473 U*	1,340	0.194 U	0.119 U	0.313 U
	WBF-GW-OBS-1-0910-20240730	7/30/2024	19.3	1,210	1.53 U	14,400	0.223 U	29,600	0.472 U	0.776 U	15.2 U*	2,210	101	5 U	101	-	6.83	0.041 J	1,330	0.0723 U	0.541 U	0.613 U
	WBF-GW-OBS-1-1400-20240806	8/6/2024	42.5	1,290	1.53 U	14,800	0.223 U	31,200	0.472 U	0.776 U	9.25 J	2,140	101	5 U	101	-	6.66	0.0427 J	1,300	0.365 U	0.224 UJ	0.589 UJ
	WBF-GW-OBS-1-1505-20240814	8/14/2024	14.5	1,400	1.53 U	14,500	0.223 U	39,200	0.472 U	0.776 U	6 U	2,040 J	124 J	5 UR	124 J	-	7.11 J	0.0572 J	1,330 J	0.464 U	0.383 U	0.847 U
	WBF-GW-OBS-1-1705-20240820	8/20/2024	17.1	1,230	1.53 U	13,700	0.223 U	29,200	0.472 U	0.776 U	10.2 J	2,150	102	5 U	102	0.053 U	6.79	0.0403 J	1,330	0.442 U	0.413 U	0.855 U
	WBF-GW-OBS-1-1415-20240903	9/3/2024	19.8	1,160	1.53 U	15,600	0.223 U	30,300	0.472 U	0.776 U	12.2 J	2,090	104	5 U	104	6.06	7.46	0.0497 J	1,390	0.505 U	0.646 U	1.15 U
	WBF-GW-OBS-1-1625-20240910	9/10/2024	17.7	1,170	3.26 J	15,700	0.053 U	26,200	0.508 U	0.82 U	15 U	2,160	95.7	5 U	95.7	4.65	6.78	0.0511 J	1,330	0.532 U	0.0782 UJ	0.61 UJ
	WBF-GW-OBS-1-1505-20240919	9/19/2024	16.7	1,180	0.89 U	15,800	0.053 U	25,500	0.508 U	0.82 U	15 U	2,040	96.9	5 U	96.9	4.54	6.77	0.0389 U*	1,320	0.292 U	1.25 U*	1.54 U*
	WBF-GW-OBS-1-0905-20240924	9/24/2024	17.8	1,150	0.89 U	14,100	0.053 U	25,600	0.508 U	0.82 U	15 U	2,140	93	5 U	93	4.52	6.75	0.039 J	1,210	0.276 U	0.796 U	1.07 U
	WBF-GW-OBS-1-1445-20241007	10/7/2024	19.9	1,380	0.89 U	12,100 J	0.053 U	27,800	0.508 U	0.82 U	15 U	2,080	106	5 U	106	0.246	6.51	0.154	1,380	0.0342 U	0.875 U*	0.909 U*
	WBF-GW-OBS-1-1305-20241022	10/22/2024	17	1,270	0.89 U	15,200	0.053 U	28,100	0.508 U	0.82 U	15 U	2,070	97.4	5 U	97.4	0.053 U	7.1	0.0653 J	1,350	0.245 U	0.704 U	0.949 U
	WBF-GW-OBS-1-1555-20241104	11/4/2024	17.8	1,230	0.89 U	17,500	0.053 U	25,700	0.508 U	0.82 U	15 U	2,060	91.5	5 U	91.5	0.053 U	7.06	0.0359 J	1,370	0.816	0.786 U*	1.6 J
	WBF-GW-OBS-1-1415-20241118	11/18/2024	18.5	1,140	0.89 U	16,400	0.053 U	25,000	0.508 U	0.82 U	15 U	1,990	95.1	5 U	95.1	0.053 UJ	7.07	0.0561 J	1,350	0.505 UJ	0.62	1.13 J
	WBF-GW-OBS-1-0920-20241125	11/25/2024	19.8	1,280	0.89 U	16,500	0.053 U	24,000	0.508 U	0.82 U	15 U	2,060	92.4	5 U	92.4	0.053 U	7.83	0.0975 J	1,420	0.339 U	1.03 J	1.37 J
	WBF-GW-OBS01-1445-20250603	6/3/2025	24.6	1,550	0.89 U	16,500	0.053 U	26,700	0.508 U	0.82 U	46.8	2,110	77.4	5 U	77.4	-	7.56 J	0.0615 J	1,420 J	0.562 U	0.752 U*	1.31 U*
	WBF-GW-OBS01-0855-20250610	6/10/2025	26.1	1,640	0.89 U	17,400	0.053 U	26,900	0.508 U	0.82 U	53.4	2,090	89.8	5 U	89.8	-	7.64 J	0.0714 J	1,390 J	0.487 U	0.118 U	0.605 U
	WBF-GW-OBS01-1355-20250616	6/16/2025	27.1	1,680	0.89 U	15,800	0.053 U	28,600	0.508 U	0.82 U	46.4	2,090	87.1	5 U	87.1	-	7.44 J	0.0847 J	1,420 J	0.356 U	0.545 U	0.902 U
	WBF-GW-OBS01-0815-20250624	6/24/2025	25	1,540	0.89 U	13,200	0.053 U	26,700	0.508 U	0.82 U	38.6	2,010	13.8 J	5 U	13.8 J	-	7.3	0.0268 J	1,320	0.642 U	0.455 U	1.1 U
	WBF-GW-OBS01-1320-20250630	6/30/2025	24.5	1,500	0.89 U	15,600	0.053 U	24,900	0.508 U	0.82 U	24.1	2,070	89.6	5 U	89.6	-	7.6	0.0877 J	1,480	0.29 U	1.12	1.41 J
	WBF-GW-OBS01-0950-20250708	7/8/2025	24.3	1,450	0.89 U	15,700	0.053 U	24,500	0.508 U	0.82 U	22.6	2,120	89.3	5 U	89.3	-	7.39	0.0719 J	1,430	1.22	0.646 U	1.87 J
	WBF-GW-OBS01-1305-20250714	7/14/2025	24.8	1,480	0.89 U	16,400	0.053 U	24,500	0.508 U	0.82 U	16.2 J	2,130	85.8	5 U	85.8	-	7.54	0.0614 J	1,480 J	0.216 U	0.145 UJ	0.361 UJ
	WBF-GW-OBS01-1340-20250721	7/21/2025	25.9 J	1,630	0.89 U	16,400	0.053 U	26,000	0.508 U	0.82 U	18.9 J	2,140	90.2	5 U	90.2	-	7.38	0.0353 J	1,450	0.937	0.924 U	1.86 J
	WBF-GW-OBS01-1445-20250728	7/28/2025	26.2	1,660	0.89 U	17,000	0.053 U	27,200	0.508 U	0.82 U	28.3	2,090	94.5 J	5 U	94.5 J	-	7.54	0.0697 J	1,400	0.701 U	0.963 U*	1.66 U*
IW-2	WBF-GW-IW-2-1140-20240611	6/11/2024	82.9	7,220	1.53 U	18,900	0.223 U	22,600	0.472 U	0.776 U	203	2,180	76.3	5 U	76.3	-	8.34	0.347	1,390	0.402 U	0.176 U	0.578 U
	WBF-GW-IW-2-1655-20240617	6/17/2024	28.9	8,590	1.53 U	9,700	0.223 U	426,000	0.472 U	33.8	6.27 J	2,330	293	5 U	293	-	9.09	0.995	1,380	0.442 U	1.28 U*	1.72 U*
	WBF-GW-IW-2-1130-20240625	6/25/2024	68.2	7,580	1.53 U	15,800	0.223 U	160,000	0.472 U	1.19	55.8	2,470	298	5 U	298	-	8.5	0.386	1,320	0.00252 U	0.866 U*	0.869 U*
	WBF-GW-IW-2-0845-20240702	7/2/2024	75	6,680	1.53 U	17,100	0.223 U	106,000	0.472 U	0.776 U	78.1	2,410	240	5 U	240	-	8.37	0.321	1,340	0.221 UJ	1.05 U*	1.27 U*
	WBF-GW-IW-2-0825-20240709	7/9/2024	78.3	3,450 J	1.53 U	18,200	0.223 U	79,900	0.472 U	0.776 U	127 J	2,340	199	5 U	199	-	8.26	0.328	1,320	0.232 U	1.2 U*	1.43 U*
	WBF-GW-IW-2-1035-20240716	7/16/2024	86.9 J	6,310 J	1.53 U	17,900	0.223 U	70,300 J	0.472 U	0.776 U	100 J	2,290	160	5 U	160	-	8.69	0.314	1,390	0.698 U	0.85 U*	1.55 U*
	WBF-GW-IW-2-1410-20240722	7/22/2024	91.3	5,960	1.53 U	16,600	0.223 U	65,700	0.472 U	0.776 U	133	2,210 J	142	5 U	142	-	8.47	0.376	1,340	0.667 U	0.711 U*	1.38 U*
	WBF-GW-IW-2-1010-20240730	7/30/2024	102	6,210	1.53 U	19,200	0.223 U	55,800	0.472 U	0.776 U	149	2,180	136	5 U	136	-	8.47	0.39	1,330	0.384 U	1.37 U*	1.75 U*
	WBF-GW-IW-2-1240-20240806	8/6/2024	98.1	7,210	1.53 U	20,100	0.223 U	55,700	0.472 U	0.776 U	176	2,150	127	5 U	127	-	8.31	0.388	1,320	0.734	0.608 UJ	1.34 J
	WBF-GW-IW-2-1400-20240814	8/14/2024	94.7	7,280	1.53 U	19,200	0.223 U	50,300	0.472 U	0.776 U	215	2,090 J	115 J	5 UR	115 J	-	8.34 J	0.41 J	1,370 J	0.804 U	0.525 U	1.33 U
	WBF-GW-IW-2-1515-20240820	8/20/2024	93.7	7,410	1.53 U	18,200	0.223 U	47,300	0.472 U	0.776 U	212	2,090	110	5 U	110	0.053 U	8.35	0.432	1,300	0.216 U	0.883 U	1.1 U
	WBF-GW-IW-2-0900-20240904	9/4/2024	127	9,910	1.76 J	18,700	0.223 U	69,700	0.472 U	0.776 U	219	2,260	347	5 U	347	6.1	10.2	0.64	1,310	0.596 U	1.09	1.68 J
	WBF-GW-IW-2-1510-20240910	9/10/2024	78.9 J	8,400 J	0.89 U	16,300 J	0.053 U	42,100 J	0.508 U	0.82 U	109	2,180	236	5 U	236	3.87	8.59	0.744	1,250	0.906 U*	1.47 U*	2.38 U*
	WBF-GW-IW-2-1340-20240919	9/19/2024	95.3	11,100	0.89 U	17,700	0.053 U	55,200	0.508 U	0.82 U	179	1,930	98	5 U	98	4.39	8.58	0.522 U*	1,240	0.401 U	1.43 U*	1.83 U*
	WBF-GW-IW-2-1525-20240923	9/23/2024	93.9	10,800	0.89 U	16,300	0.053 U	53,300	0.508 U	0.82 U	138	1,970	75.8	5 U	75.8	4.15	8.59	0.645	1,210	1.73	1.21 U*	2.94 J
	WBF-GW-IW-2-1600-20241007	10/7/2024	96	4,180	6.74	42,100	0.264 J	2,560,000	0.508 U	336	35.5	6,320	227 J	14.1 J	241 J	0.53 U	9.32 J	4.13	436 J	0.637 UJ	0.964 U*	1.6 U*
	WBF-GW-IW-2-1155-20241022	10/22/2024	16	4,880	0.89 U	16,000	0.053 U	1,420,000	0.508 U	34.1	15 U	4,360	5 U	256	259	0.265 U	9.33	0.524	1,190	0.346 U	-0.16 U	0.346 U
	WBF-GW-IW-2-1405-20241104	11/4/2024	60.4	7,350	0.89 U	18,400	0.053 U	201,000	0.508 U	0.82 U	27.3	2,190	288	5 U	288	0.053 U	8.82	0.212	1,260	1.06	0.898 U*	1.96 J
	WBF-GW-IW-2-1540-20241118	11/18/2024	34.6	3,580	2.15 J	13,400	0.111 J	1,590,000	0.508 U	80.3	15 U	4,100	5 U	238	270	0.265 UJ	9.12	2.35	1,210	0.081 UJ	0.444 U	0.525 UJ
	WBF-GW-IW-2-1055-20241125	11/25/2024	30.9	6,090	2.48 U*	14,800 J	0.057 J	1,000,000	0.508 U	70.6	15 U	3,140	950	5 U	950	1.38 J	9.39	0.969	1,310	0.555 U	0.491 UJ	1.05 UJ
	WBF-GW-IW02-1305-20250603	6/3/2025	70.1	6,980	0.89 U	21,500	0.053 U	94,400	0.508 U	1.32 J	20.3	2,350	315	5 U	315	-	8.72	0.367	1,390 J	0.393 U	1.3 U*	1.69 U*
	WBF-GW-IW02-1615-20250609	6/9/2025	64.8	6,380	1.01 J	20,300	0.082 J	1,000,000	0.508 U	92.9	15 U	3,650	5 U	357	786	-	8.83	0.721	1,380	0.517 U	0.994 U	1.51 U
	WBF-GW-IW02-0835-20250617	6/17/2025	93	7,210	0.89 U	15,500	0.053 U	305,000	0.508 U	3.89 J	17.3 J	2,240	241	5 U	241	-	9.99 J	0.0781 J	1,450	0.362 U	1.08 U*	1.44 U*
	WBF-GW-IW02-0900-20250624	6/24/2025	90.1	7,800	0.89 U	15,600	0.053 U	286,000	0.508 U	1.09 J	30.6	2,390	405 J	5 UJ	405 J	-	8.87	0.108	1,320	1.84	0.0697 U	1.91 J
	WBF-GW-IW02-1425-20250630	6/30/2025	43.8	4,080	3.03 J	16,900	0.062 J	1,550,000	0.508 U	82.2	15 U	5,720	5 U	218	255	-	8.97 J	1.75	1,230	-0.471 U	0.754 U	0.754 U
	WBF-GW-IW02-1100-20250708	7/8/2025	38.7	7,100	1.08 J	10,200	0.058 J	451,000	0.508 U	9.28	15 U	2,020	315	5 U	315	-	8.99	0.183	1,330	0.696 U	0.399 U	1.09 U
	WBF-GW-IW02-1410-20250714	7/14/2025	51.9	4,880	3.82 J	25,900	0.076 J	2,010,000	0.508 U	123	15 U	5,790	5 U	76.2 J	994 J	-	0.988 J	0.14	122 J	-0.0672 U	0.0575 UJ	0.0575 UJ
	WBF-GW-IW02-1520-20250721	7/21/2025	77.5	4,640	6.38	32,400 J	0.107 J	2,440,000	0.508 U	175	15 U	7,080	320 J	5 U	320 J	-	9.74 J	1.18	1,130	0.276 U	0.811 U	1.09 U
	WBF-GW-IW02-1550-20250728	7/28/2025	84	4,110	6.21	40,400	0.095 J	2,530,000	0.508 U	182	15 U	7,940	5 U	5 U	5 U	-	9.78 J	1.46	1,050	0.157 UJ	0.871 U	1.03 UJ
	WBF-GW-IW-2-1410-20250805	8/5/2025	56.9	6,890	3.77 J	22,200	0.055 J	1,150,000	0.508 U	99.4	15 U	3,450	5 U	166 J	992 J	-	8.37	0.67	1,250	-	-	-
	WBF-GW-IW-2-0925-20250811	8/11/2025	49.2	8,580	3.46 J	15,700	0.09 J	719,000	0.508 U	62.3	15 U	2,220 J	5 UR	103 J	706 J	-	9.02 J	0.5 J	1,260 J	-	-	-
	WBF-GW-IW-2-0955-20250819	8/19/2025	71.1	8,330	1.44 J	15,300	0.121 J	450,000	0.508 U	31.8	15 U	2,110	268	5 U	268	-	8.65	0.241	1,270	-	-	-
	WBF-GW-IW02-0835-20250825	8/25/2025	71.2	9,000	1.67 J	15,300	0.069 J	322,000	0.508 U	14.8	15 U	2,250	315	5 U	315	-	8.49	0.266	1,270	-	-	-

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Total Metals																	
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100
DUP-01 (IW-2 Duplicate)	WBF-GW-DUP01-20240606	6/6/2024	119	0.967 U	1.56	27.5 J	0.274 U	3,240	0.241 J	418,000	1.53 U	62.5	1.14 U	2,880	0.376 U	3.05 J	60,900	29,100	0.148 U*	0.611 J
	WBF-GW-DUP01-20240618	6/18/2024	180	0.967 U	2.38	25.7	0.457 J	8,100	0.83 J	471,000	1.53 U	520	3.1	15,300	0.441 J	13.5	42,400 J	58,800	0.13 U	0.61 U
	WBF-GW-DUP01-20240624	6/24/2024	461	0.967 U	1.21	30.8	0.812 J	7,760	9.31	466,000 J	1.53 U	783	1.15 J	1,590	0.899 U*	16.8	39,800 J	56,400	0.13 U	0.61 U
	WBF-GW-DUP01-20240702	7/2/2024	2870	0.967 U	7.16	19.2 J	16.3	7,830	7.69	439,000	1.53 U	895	1.14 U	1,340	0.98 J	33.5	34,600	52,500	0.13 U	0.61 U
	WBF-GW-DUP01-20240709	7/9/2024	225	0.967 U	2.04	25.4	0.499 J	7,150	0.645 J	462,000	1.53 U	561	2.14	12,000	0.376 U	25.9 J	36,100	48,800	0.13 U	0.61 U
	WBF-GW-DUP01-20240716	7/16/2024	21.8 UJ	0.967 U	3.21	17.8	0.274 U	3,310	0.217 U	436,000	1.53 U	57.7	1.14 U	4,690	0.376 U	4.2 J	63,800	25,700	0.13 U	0.61 U
	WBF-GW-DUP01-20240723	7/23/2024	316	0.967 U	1.84	26.6	0.798 J	8,200	0.649 J	415,000	1.53 U	531	1.35 J	11,700	0.398 J	19.7	40,000	54,000 J	0.13 U	0.61 U
	WBF-GW-DUP01-20240729	7/29/2024	958	0.967 U	1.56	29.2	3.51	7,950	3.95	448,000	1.53 U	855	1.14 U	2,200	0.654 J	23.3	41,000	52,500	0.13 U	0.61 U
	WBF-GW-DUP01-20240805	8/5/2024	678	0.967 U	1.4	26.8	3.66	8,080	3.42 J	463,000	1.53 U	802	1.14 U	1,930	0.376 U	22.7	38,200	54,100	0.13 U	0.61 U
	WBF-GW-DUP01-20240813	8/13/2024	728	0.967 U	1.54	27.7	4.95	7,750	6.06 J	480,000	1.53 U	773	1.14 U	2,280	0.43 J	19.1	39,200	53,500	0.13 U	0.61 U
	WBF-GW-DUP01-20240819	8/19/2024	660	0.967 U	1.32	26.5	4.05	8,160	3.51	459,000	1.53 U	728	1.14 U	2,090	0.376 U	24	37,400	53,000	0.13 U	0.61 U
	WBF-GW-DUP01-20240904	9/4/2024	1420	0.967 U	2.47	29.5	2.74	7,370	0.87 J	405,000	5.28	509	6.36	10,900	3.72	23.4	36,800	42,300	0.13 U	1.39 J
	WBF-GW-DUP01-20240909	9/9/2024	806	0.57 U	0.75 U	25.3	5.37	7,610	6.41	423,000	1.2 U	726	1.7 U	1,530	0.45 U	23.8	37,600	53,400	0.13 U	1.08 U
	WBF-GW-DUP01-20240918	9/18/2024	76.8	0.57 U	1.73 J	20.3	0.283 J	7,930	1.23	440,000	1.2 U	521	1.7 U	7,710	0.45 U	6.08 J	38,600	67,200	0.13 U	1.08 U
	WBF-GW-DUP01-20240924	9/24/2024	115	0.57 U	1.84 J	17.7	0.273 U	3,890	0.127 J	443,000	1.2 U	56.5	1.7 U	5,150	0.45 U	4.21 J	66,700	27,100	0.13 U	1.08 U
	WBF-GW-DUP01-20241007	10/7/2024	59300	0.57 U	60.5	26.9	0.98 J	5,390	5.7	22,300	15	31	171	2,480	6.65	4.35 J	2,190	474	0.484 J	20
	WBF-GW-DUP01-20241021	10/21/2024	62.2	0.57 U	1.7 J	21.2	0.436 U*	7,610	2.26	452,000	1.2 U	545	1.7 U	6,540	0.45 U	7.09 J	39,400	55,400	0.13 U	1.08 U
	WBF-GW-DUP01-20241104	11/4/2024	179	0.57 U	1.81 J	17.1	0.273 U	3,640	0.247 J	429,000	1.2 U	65	2.81	4,070	0.45 U	3.44 U	62,500	23,000 J	0.178 U*	1.08 U
	WBF-GW-DUP01-20241118	11/18/2024	80.1	0.57 U	1.23 J	16.3	0.273 U	3,440	0.251 U*	442,000	1.2 U	64.5	1.7 U	4,140	0.45 U	4.16 J	66,700	29,700	0.13 U	1.08 U
	WBF-GW-DUP01-20241125	11/25/2024	10600	0.57 U	12.7	10	0.297 J	6,450	0.349 U*	65,700 J	2.44 J	12.1	19.3	273	0.544 J	3.44 U	7,220	3,710 J	0.13 U	5.21
	WBF-GW-DUP01-20250603	6/3/2025	364	0.57 U	1.66 J	51.7	0.273 U	7,370	0.077 U	503,000	1.2 U	302	1.7 U	9,290	0.45 U	12.6	42,900	57,900	0.13 U	1.44 U*
	WBF-GW-DUP01-20250610	6/10/2025	22.3 J	0.57 U	0.75 U	13.6	0.273 U	4,620	0.211 J	378,000	1.2 U	105	1.7 U	5,960	2.18	6.4 J	53,200	30,800	0.13 U	1.08 U
	WBF-GW-DUP01-20250617	6/17/2025	281 J	0.57 U	0.75 U	50.3	0.273 UJ	7,100	0.187 J	333,000	1.2 U	261	1.7 U	1,210 J	0.45 U	16.2 J	52,900	40,000	0.13 U	1.08 U
	WBF-GW-DUP01-20250623	6/23/2025	1830	0.57 U	0.75 U	32.1	9.71	6,670	7.17	391,000	2.36 J	627	6.32	12,200	1.99	21.7	35,600	46,700	0.13 U	1.08 U
	WBF-GW-DUP01-20250630	6/30/2025	33.7 J	0.57 U	0.792 J	13.6	0.273 U	4,020	0.235 U*	437,000	1.2 U	95.8	1.7 U	5,980	0.45 U	3.65 J	64,600	26,600	0.13 U	1.08 U
	WBF-GW-DUP01-20250707	7/7/2025	164 J	0.57 U	1.3 J	18.6	0.273 U	6,520	0.54 J	367,000	1.2 U	103	1.7 U	8,030 J	0.45 U	3.74 J	40,400	34,400	0.13 U	1.08 U
	WBF-GW-DUP01-20250714	7/14/2025	31700 J	0.57 U	89.5 J	5.65	0.273 U	5,650	0.668 J	42,800	5.09	14.7	45.7	232	1.03	3.44 U	4,880 J	1,800 J	0.136 J	8.66
	WBF-GW-DUP01-20250721	7/21/2025	37300	0.57 U	89.8	3.83 J	0.273 U	5,730	0.716 J	19,600	5.52	14.2	72.8	158	1.14	3.44 U	2,360	541	0.141 J	11.2
	WBF-GW-DUP01-20250728	7/28/2025	40.6 U*	0.57 U	0.75 U	14.2	0.34 J	4,430	0.426 J	419,000	1.2 U	104	1.81 J	5,420	0.45 U	4.87 J	64,200	28,300	0.13 U	1.08 U
	WBF-GW-DUP01-20250805	8/5/2025	18400	0.57 U	40.8	11.6	0.273 U	6,240 J	0.311 U*	78,500 J	4.36 J	19.2	37	133	1.02	4.61 J	11,600	4,920	0.183 J	8.14
	WBF-GW-DUP01-20250811	8/11/2025	7800	0.57 U	20.9	19.5	0.273 U	6,780	0.238 J	135,000 J	3.59 J	40.1	20.5	140	0.474 J	10.2	26,600	10,900	0.13 U	5.75
	WBF-GW-DUP01-20250819	8/19/2025	56.8	0.57 U	0.917 J	45	0.273 U	7,660	0.099 J	176,000	1.2 U	6.18	1.7 U	47 U	0.45 U	7.01 J	44,800	7,990	0.13 U	1.17 J
	WBF-GW-DUP01-20250825	8/25/2025	322	0.57 U	1.24 J	18.6	0.273 U	6,660	1.42	379,000	1.2 U	90.3	1.7 U	8,650	0.45 U	4.03 J	41,000	35,000	0.13 U	1.08 U
IW-03	WBF-GW-IW-3-1515-20250805	8/5/2025	2280	0.57 U	5.16	27.3	0.273 U	6,180	0.127 U*	87,000	1.84 J	1.4	4.79	209	0.45 U	3.44 U	5,170	129	0.13 U	2.3 J
	WBF-GW-IW-3-1025-20250811	8/11/2025	802	0.57 U	6.3	27.1	0.273 U	7,190	0.077 U	98,200 J	2.35 J	2.16	4.79 U*	137	0.45 U	5.01 J	22,700	1,280	0.13 U	1.9 J
	WBF-GW-IW-3-1050-20250819	8/19/2025	37.8 J	0.57 U	0.75 U	46	0.273 U	7,440	0.077 U	180,000	1.2 U	6.37	1.7 U	47 U	0.45 U	7.35 J	46,100	8,150	0.13 U	1.08 U
	WBF-GW-IW03-0925-20250825	8/25/2025	13.6 J	0.57 U	0.828 J	65.6	0.273 U	7,710	0.077 U	259,000	1.2 U	18.2	1.7 U	47 U	0.45 U	7.33 J	60,500	18,600	0.13 U	1.08 U
OBS-2	WBF-GW-OBS-2-1235-20240605	6/5/2024	99.5	0.967 U	1.77	26.8	0.364 J	6,380	0.234 J	441,000	1.53 U	403	1.14 U	16,600	0.376 U	8.06	42,600	42,500	0.134 U*	0.61 U
	WBF-GW-OBS-2-0955-20240618	6/18/2024	171	0.967 U	2.32	24.5	0.41 J	8,750	0.784 J	480,000	1.53 U	497	2.88	15,700	0.392 J	13.8	42,300 J	59,600	0.13 U	0.61 U
	WBF-GW-OBS-2-1235-20240625	6/25/2024	213	0.967 U	2.2	29.4	0.449 J	7,920	0.779 J	448,000 J	1.53 U	575	2.85	12,300	0.749 U*	13	41,700 J	48,600	0.13 U	0.61 U
	WBF-GW-OBS-2-1005-20240702	7/2/2024	217	0.967 U	2.35	24.1 J	0.505 J	6,800	0.658 J	453,000	1.53 U	559	2.87	13,400	0.416 J	15.4	39,200	47,700	0.13 U	0.61 U
	WBF-GW-OBS-2-0940-20240709	7/9/2024	213	0.967 U	1.74	25	0.533 J	7,370	0.754 J	476,000	1.53 U	551	2.07	11,600	0.376 U	27.5 J	35,700	49,200	0.13 U	0.61 U
	WBF-GW-OBS-2-1145-20240716	7/16/2024	242 U*	0.967 U	2.2	25.3	0.715 J	6,790	0.26 J	444,000 J	1.53 U	524 J	1.48 U*	12,700	0.376 U	17.2	39,500	46,400	0.13 U	0.61 U
	WBF-GW-OBS-2-1045-20240723	7/23/2024	310	0.967 U	1.86	25.5	0.81 J	8,480	0.745 J	389,000 J	1.53 U	499 J	8.79 J	11,700	0.508 J	19.2	39,900	53,000 J	0.13 U	0.61 U
	WBF-GW-OBS-2-1135-20240730	7/30/2024	338	0.967 U	2.07	31.6	0.93 J	7,120	0.479 J	417,000	1.53 U	610	1.14 U	12,100	0.376 U	20.3	40,800	47,300	0.13 U	0.61 U
	WBF-GW-OBS-2-1130-20240806	8/6/2024	301	0.967 U	1.5	24.2	0.862 J	7,080	0.366 U*	414,000	1.53 U	531	2.88	12,200	0.376 U	20.5	37,200	46,100	0.13 U	0.61 U
	WBF-GW-OBS-2-1145-20240814	8/14/2024	389	0.967 U	1.13	25.1	1.42	6,990	0.217 U	435,000	1.53 U	580	1.14 U	10,300	0.376 U	18.3	38,200	48,200	0.13 U	0.61 U
	WBF-GW-OBS-2-1415-20240820	8/20/2024	333	0.967 U	1.49	24.9	1.1	7,380	0.317 J	416,000	1.53 U	493	1.18 J	12,600	0.376 U	22.3	36,500	46,400	0.13 U	0.61 U
	WBF-GW-OBS-2-1030-20240904	9/4/2024	1570	0.967 U	2.49	29.4	2.43	6,920	0.794 J	411,000	5.66	521	6.16	11,000	3.86	24	37,800	43,500	0.13 U	1.27 J
	WBF-GW-OBS-2-1425-20240910	9/10/2024	4490	0.57 U	4.93 J	28.4	2.02	6,200 J	1.04	340,000	11.7	428	9.39	11,600	6.42	21.7	32,200	40,100 J	0.13 U	2.14 J
	WBF-GW-OBS-2-1200-20240919	9/19/2024	1230	0.57 U	1.64 J	27.7	5.14	5,870	3.83	369,000	1.22 J	560	3.14	4,980	0.734 J	25.5	32,900	48,400	0.13 U	1.08 U
	WBF-GW-OBS-2-1050-20240924	9/24/2024	715	0.57 U	1.64 J	27.9	3.43	7,620	0.538 J	346,000	1.2 U	415 J	1.7 U	7,420	0.45 U	22.4	29,900	45,900	0.13 U	1.08 U
	WBF-GW-OBS-2-0850-20241008	10/8/2024	1170	0.57 U	1.28 U*	30	6.32	7,130	1.26	407,000	1.2 U	581	2.23	6,320	0.519 U*	27.7	36,200	44,200	0.145 J	1.08 U
	WBF-GW-OBS-2-1100-20241022	10/22/2024	1230	0.57 U	0.936 J	31.4	10.8	9,410	1.71	394,000	1.2 U	585	2.09	4,390	0.45 U	29.6	34,900	59,600	0.13 U	1.08 U
	WBF-GW-OBS-2-0845-20241105	11/5/2024	1030	0.57 U	0.974 J	31	10.3	6,550 J	0.364 U*	356,000	1.2 U	541	1.7 U	5,440	0.45 U	25.3	30,900	38,300 J	0.152 U*	1.08 U
	WBF-GW-OBS-2-0915-20241119	11/19/2024	1300	0.57 U	0.857 J	32.4	13	6,660	1.62	354,000	1.2 U	490	1.7 U	6,530	0.45 U	26.2	29,300	45,200	0.13 U	1.08 U
	WBF-GW-OBS-2-1245-20241125	11/25/2024	1490	0.57 U	0.823 J	31	18.5	7,160	2.93	367,000	1.2 U	585	1.7 U	8,230	0.45 U	24.9	33,900	41,600	0.13 U	1.08 U
	WBF-GW-OBS02-1515-20250610	6/10/2025	2240	0.57 U	0.75 U	17.7	7.33	7,710	7.29	368,000	1.2 U	320	5.65	29,700	1.21	17	32,800	39,800	0.13 U	1.08 U
	WBF-GW-OBS02-1135-20250701	7/1/2025	1600	0.57 U	2.48 J	22.6	3.77	7,130	0.467 J	362,000	1.2 U	274	1.7 U	22,200	0.45 U	10.6	35,400	31,000	0.13 U	1.08 U
	WBF-GW-OBS02-1220-20250715	7/15/2025	20700	0.57 U	11.3	13.9	4.1	6,830	3.33	248,000	5.4	194	8.37	20,500	2.48	9.33	25,500	22,000	0.13 U	2.1 J
	WBF-GW-OBS02-1405-20250722	7/22/2025	21700	0.57 U	9.8	17	4.58	7,170	1.32	248,000	2.3 J	218	2.56	18,700	0.725 J	11.1	25,500	21,900	0.13 U	1.5 J
	WBF-GW-OBS02-1310-20250729	7/29/2025	7460	0.57 U	4.23 J	6.34	1.59	7,090	0.232 J	137,000	1.2 U	67	1.7 U	6,110	0.45 U	9.98	6,320	7,270	0.13 U	1.2 J
	WBF-GW-OBS-2-1015-20250805	8/5/2025	1660	0.57 U	2.1 J	26.8	3.29	6,840	1.77	305,000	1.2 U	225	1.7 U	23,200	0.45 U	10.8	30,400	25,600	0.13 U	1.08 U
	WBF-GW-OBS-2-1340-20250811	8/11/2025	2330	0.57 U	2.89 J	16.7	3.04	6,010	1.39	222,000 J	1.2 U	176	1.7 U	14,800	0.726 J	11.3	21,100	19,300	0.13 U	1.08 U
	WBF-GW-OBS-2-1245-20250819	8/19/2025	636	0.57 U	2.95 J	11	1.3	6,440	0.866 J	166,000	1.2 U	85.5	1.7 U	6,850	0.45 U	7.63 J	18,000	11,900	0.13 U	1.26 J
	WBF-GW-OBS02-1425-20250825	8/25/2025	5800	0.57 U	14.3	16.4	2.7	6,370	1.16	164,000	13.4	122	7.41	13,000	8.27	5.91 J	18,500	15,500	0.13 U	3.6 J

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

			Total Metals									General Chemistry				Anions				Radiological Parameters		
Well ID	Sample ID	Sample Date	Nickel ug/L	Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L	TDS mg/L	Bicarbonate mg/L	Carbonate mg/L	Alkalinity mg/L	Bromide mg/L	Chloride mg/L	Fluoride mg/L	Sulfate mg/L	Radium 226 pCi/L	Radium 228 pCi/L	Radium 226 + 228 pCi/L
Screening Levels			100				100		2	86	5000											5
DUP-01 (IW-2 Duplicate)	WBF-GW-DUP01-20240606	6/6/2024	17.5	1,640 U*	1.53 U	14,600	0.223 U	41,200	0.472 U	0.776 U	20.9 U*	2,090 J	91.8	5 U	91.8	-	7.37	0.0868 J	1,490	0.064 U	0.0102 U	0.0742 U
	WBF-GW-DUP01-20240618	6/18/2024	94.5	6,480	1.53 U	21,600	0.223 U	29,000	0.472 U	0.776 U	340	2,180	70.4	5 U	70.4	-	10.7	0.108	1,370	0.511	0.661 U*	1.17 J
	WBF-GW-DUP01-20240624	6/24/2024	138	11,500	1.53 U	20,700	0.223 U	28,300	0.472 U	0.776 U	514	2,220	34.3	5 U	34.3	-	8.95	0.335	1,330	0.245 U	0.737 U*	0.982 U*
	WBF-GW-DUP01-20240702	7/2/2024	152	16,400	1.53 U	18,400	0.223 U	18,900	0.472 U	0.776 U	544	2,190	6.7	5 U	6.7	-	8.68	1.33	1,320	0.521 J	1.02 U*	1.54 J
	WBF-GW-DUP01-20240709	7/9/2024	105	5,260 J	1.53 U	19,500	0.223 U	37,200	0.472 U	1.27	229 J	2,110	66.3	5 U	66.3	-	9.07	0.151	1,270	0.936	2.65 J	3.59 J
	WBF-GW-DUP01-20240716	7/16/2024	17	1,190	1.53 U	14,400	0.223 U	30,600	0.472 U	0.776 U	21	2,080 J	94.3	5 U	94.3	-	7.14	0.0334 J	1,380	0.802 U	0.651 U*	1.45 U*
	WBF-GW-DUP01-20240723	7/23/2024	102	6,910 J	1.53 U	16,700	0.223 U	48,500 J	0.472 U	1.63	117	2,070	70.5	5 U	70.5	-	9.06	0.204 U*	1,330	0.577 U	0.502 U	1.08 U
	WBF-GW-DUP01-20240729	7/29/2024	151	12,300	1.53 U	21,000	0.223 U	24,100	0.472 U	0.962 J	546	2,190	31.6	5 U	31.6	-	9.31	0.605	1,480	0.432 U	0.982 U*	1.41 U*
	WBF-GW-DUP01-20240805	8/5/2024	138	12,700	1.53 U	22,000	0.223 U	25,400	0.472 U	0.776 U	467	2,230	33.8	5 U	33.8	-	8.78	0.585	1,360	0.265 U	0.574 UJ	0.839 UJ
	WBF-GW-DUP01-20240813	8/13/2024	134	12,900	1.53 U	20,600	0.223 U	24,500	0.472 U	0.776 U	498	2,130	30.3	5 U	30.3	-	9.16	0.547	1,370	0.464 U	0.722 J	1.19 J
	WBF-GW-DUP01-20240819	8/19/2024	127	12,700	1.53 U	19,900	0.223 U	24,100	0.472 U	0.776 U	433	2,160	36.1 J	5 U	36.1 J	1.77	8.28	0.599	686	0.669 J	0.959	1.63 J
	WBF-GW-DUP01-20240904	9/4/2024	95.5	8,800	1.53 U	20,100	0.223 U	89,500	0.472 U	12.6	50.9	2,120	232	5 U	232	5	9.38	0.47 J	1,260	1.34	0.461 U	1.8 J
	WBF-GW-DUP01-20240909	9/9/2024	121	13,100	0.89 U	20,800	0.053 U	23,800	0.508 U	0.82 U	400	2,110	29.2	5 U	29.2	4.77 J	10.3	0.749	1,390	0.163 U	0.461 UJ	0.624 UJ
	WBF-GW-DUP01-20240918	9/18/2024	95.1	6,390	0.89 U	21,300	0.053 U	27,100	0.508 U	0.82 U	188	2,060	53	5 U	53	0.053 U	10.1	0.0623 U*	1,470	0.468 U	0.5 U	0.968 U
	WBF-GW-DUP01-20240924	9/24/2024	17.3	1,160	0.89 U	15,200	0.053 U	25,900	0.508 U	0.82 U	15 U	2,180	94.1	5 U	94.1	4.52	6.7	0.0341 J	1,330	0.901	0.486 U	1.39 J
	WBF-GW-DUP01-20241007	10/7/2024	93.3	4,030	6.32	42,600	0.269 J	2,530,000	0.508 U	337	34.1	5,320	378 J	5 UJ	378 J	0.53 U	8.45 J	4.25	589 J	1.76 J	2.37 J	4.12 J
	WBF-GW-DUP01-20241021	10/21/2024	100	7,170	0.89 U	21,700	0.053 U	29,000	0.508 U	0.82 U	218	2,110	52.1	5 U	52.1	0.053 U	10.1	0.0569 J	1,390	0.269 U	0.532 U	0.801 U
	WBF-GW-DUP01-20241104	11/4/2024	17.1	1,210	0.89 U	16,900	0.053 U	24,700	0.508 U	0.82 U	15 U	2,060	90.5	5 U	90.5	0.053 U	7.08	0.0406 J	1,380	0.556 U	0.416 UJ	0.972 UJ
	WBF-GW-DUP01-20241118	11/18/2024	19	1,160	0.89 U	16,700	0.053 U	25,800	0.508 U	0.82 U	15 U	2,080	95.7	5 U	95.7	0.053 UJ	7.08	0.0445 J	1,330	0.538 UJ	0.48 U	1.02 UJ
	WBF-GW-DUP01-20241125	11/25/2024	33	6,280	2.33 J	15,400 J	0.061 J	1,010,000	0.508 U	78	15 U	3,060	958	5 U	958	3.21 J	11	1.15	1,310	0.782 U	1.08 J	1.86 J
	WBF-GW-DUP01-20250603	6/3/2025	68.4	7,000	0.89 U	21,500	0.053 U	89,000	0.508 U	1.17 J	15 U	2,410	311	5 U	311	-	8.57	0.313	855 J	0.518 U	0.721 U*	1.24 U*
	WBF-GW-DUP01-20250610	6/10/2025	23.9	1,530	0.89 U	17,500	0.053 U	25,300	0.508 U	0.82 U	46.1	2,080	89.9	5 U	89.9	-	7.61 J	0.0707 J	1,400 J	-0.0437 U	0.604 U	0.604 U
	WBF-GW-DUP01-20250617	6/17/2025	89.3	7,160	0.89 U	14,700	0.053 U	352,000	0.508 U	5	15 U	2,230	254	5 U	254	-	10.6	0.0485 J	1,380	1.12	0.981 U	2.1 J
	WBF-GW-DUP01-20250623	6/23/2025	107	11,700	0.89 U	14,800 J	0.053 U	24,200	0.508 U	2.8 J	429	1,900	5 R	5 R	5 R	-	8.96	0.251	1,240	0.925 U	0.266 U	1.19 U
	WBF-GW-DUP01-20250630	6/30/2025	25.3	1,530	0.89 U	15,200	0.053 U	24,700	0.508 U	0.82 U	21.5	2,160	87.4	5 U	87.4	-	7.56	0.0831 J	1,450	0.433 U	0.558 U	0.991 U
	WBF-GW-DUP01-20250707	7/7/2025	28.6	1,800	0.89 U	16,900	0.053 U	173,000	0.508 U	0.82 U	34.2	2,220	134	5 U	134	-	8.9	0.064 J	1,440	0.453 U	0.42 U	0.872 U
	WBF-GW-DUP01-20250714	7/14/2025	57.6	4,870	3.68 J	26,400	0.053 U	1,660,000	0.508 U	146	15 U	5,820	5 U	197 J	391 J	-	1.04	0.113	124 J	-0.15 U	0.246 UJ	0.246 UJ
	WBF-GW-DUP01-20250721	7/21/2025	72.6	4,400	5.11	33,300	0.064 J	2,290,000	0.508 U	165	15 U	6,830	46.7 J	5 U	46.7 J	-	8.52 J	0.906 J	1,090	0.22 U	0.472 U	0.692 U
	WBF-GW-DUP01-20250728	7/28/2025	25.7	1,640	0.89 U	16,600	0.053 U	26,800	0.508 U	0.82 U	28.2	2,170	93 J	5 U	93 J	-	8.05	0.0944 J	1,390	-0.0171 U	1.3 U*	1.3 U*
	WBF-GW-DUP01-20250805	8/5/2025	55.8	6,890	4.13 J	23,100	0.057 J	1,130,000 J	0.508 U	97.9	15 U	3,540	5 U	103 J	688 J	-	8.41	0.649	1,240	-	-	-
	WBF-GW-DUP01-20250811	8/11/2025	45.2	8,400	1.86 J	16,400	0.053 U	677,000	0.508 U	55.9	15 U	2,190 J	5 UR	83.9 J	772 J	-	9.03 J	0.501 J	1,280 J	-	-	-
	WBF-GW-DUP01-20250819	8/19/2025	7.89	7,830	0.89 U	11,400	0.053 U	384,000	0.508 U	3.76 J	15 U	2,120	45.7 J	124 J	170	-	8.62	0.266 J	1,280	-	-	-
	WBF-GW-DUP01-20250825	8/25/2025	26.8	1,870	0.89 U	17,500	0.053 U	126,000	0.508 U	0.82 U	27.7	2,160 J	107	5 U	107	-	8.68	0.0552 J	1,310	-	-	-
IW-03	WBF-GW-IW-3-1515-20250805	8/5/2025	9.53	6,740	1.37 J	13,800 J	0.053 U	1,330,000 J	0.508 U	23.1	15 U	4,380	5 U	60.9	781	-	8.96	0.224 J	1,200	-	-	-
	WBF-GW-IW-3-1025-20250811	8/11/2025	9.81	7,700	1.78 J	20,000	0.053 U	1,180,000	0.508 U	25.8	15 U	3,620 J	5 UR	128 J	827 J	-	8.32 J	0.249 J	1,170 J	-	-	-
	WBF-GW-IW-3-1050-20250819	8/19/2025	7.67	7,740	0.89 U	10,700	0.053 U	357,000	0.508 U	2.94 J	15 U	2,110	123 J	40.3 J	163	-	8.58	0.046 J	1,290	-	-	-
	WBF-GW-IW03-0925-20250825	8/25/2025	11.7	8,390	0.89 U	13,500	0.053 U	241,000	0.508 U	0.82 U	15 U	2,200	241	5 U	241	-	8.49	0.187	1,230	-	-	-
OBS-2	WBF-GW-OBS-2-1235-20240605	6/5/2024	70.9	5,910	1.53 U	16,800	0.262 U*	30,500	0.472 U	0.776 U	213	2,130 J	58.3	5 U	58.3	-	9.37	0.0991 J	1,530	0.0419 U	0.75	0.792 J
	WBF-GW-OBS-2-0955-20240618	6/18/2024	94.4	6,460	1.53 U	23,500	0.223 U	29,000	0.472 U	0.776 U	332	2,150	70.8	5 U	70.8	-	9.33	0.11	1,360	0.552 U	1.01 U*	1.56 U*
	WBF-GW-OBS-2-1235-20240625	6/25/2024	106	6,970	1.53 U	18,500	0.223 U	28,200	0.472 U	0.776 U	312	2,150	64.7	5 U	64.7	-	9.08	0.132	1,290	0.141 U	0.322 U	0.463 U
	WBF-GW-OBS-2-1005-20240702	7/2/2024	103	7,560	1.53 U	18,100	0.223 U	34,600	0.472 U	0.979 J	262	2,180	67.1	5 U	67.1	-	9.09	0.118	1,270	0.00606 UJ	1.05 U*	1.06 U*
	WBF-GW-OBS-2-0940-20240709	7/9/2024	105	5,720 J	1.53 U	20,200	0.223 U	35,200	0.472 U	1.23	261 J	2,130	67.2	5 U	67.2	-	9.11	0.143	1,270	1.08	0.966 U*	2.04 J
	WBF-GW-OBS-2-1145-20240716	7/16/2024	97.5 J	7,330 J	1.53 U	18,300	0.223 U	43,900	0.472 U	1.83	145 J	2,110	65.4	5 U	65.4	-	9.59	0.184	1,330	0.316 U	1.2 U*	1.52 U*
	WBF-GW-OBS-2-1045-20240723	7/23/2024	102	6,750 J	1.53 U	16,500	0.223 U	46,400 J	0.472 U	1.57	117	2,120	69.8	5 U	69.8	-	9.18	0.206 U*	1,320	0.61 U	0.4 U	1.01 U
	WBF-GW-OBS-2-1135-20240730	7/30/2024	114	7,620	1.53 U	18,500	0.223 U	43,700	0.472 U	0.941 J	47.6 U*	2,060	71.9	5 U	71.9	-	9.26	0.295	1,300	0.556 U	0.423 U	0.979 U
	WBF-GW-OBS-2-1130-20240806	8/6/2024	101	8,270	1.53 U	19,800	0.223 U	49,200	0.472 U	0.776 U	36	2,050	72.5	5 U	72.5	-	9.25	0.309	1,300	0.0743 U	0.321 UJ	0.395 UJ
	WBF-GW-OBS-2-1145-20240814	8/14/2024	105	9,070	1.53 U	19,200	0.223 U	42,600	0.472 U	0.776 U	11.4 J	1,960	63.4	5 U	63.4	-	9.03	0.338	1,280	0.113 U	1.04	1.15 J
	WBF-GW-OBS-2-1415-20240820	8/20/2024	92.3	8,830	1.53 U	17,800	0.223 U	54,900	0.472 U	0.776 U	31.4	2,070	81	5 U	81	0.053 U	9.12	0.348	1,260	0.0443 U	0.203 U	0.248 U
	WBF-GW-OBS-2-1030-20240904	9/4/2024	97.8	8,700	1.53 U	20,100	0.223 U	92,000	0.472 U	13.1	51.1	2,120	232	5 U	232	5.52	9.42	0.614 J	1,260	0.62 U	0.364 U	0.984 U
	WBF-GW-OBS-2-1425-20240910	9/10/2024	84.6	8,990	0.89 U	22,400	0.053 U	188,000	0.508 U	42.3	89	2,150	245	5 U	245	4.19	9.15	0.505	1,210	1.57 U*	0.829 U*	2.4 U*
	WBF-GW-OBS-2-1200-20240919	9/19/2024	102	9,970	0.89 U	19,500	0.053 U	76,600 J	0.508 U	6.45	260	1,910	104	5 U	104	4.18	9.05	0.475 U*	1,220	0.294 U	0.616 U	0.91 U
	WBF-GW-OBS-2-1050-20240924	9/24/2024	76.6 J	8,890	0.89 U	15,800	0.053 U	123,000	0.508 U	4.01 J	125	2,030	141	5 U	141	4.1	8.95	0.539	1,230	1.29	1.11 U*	2.4 J
	WBF-GW-OBS-2-0850-20241008	10/8/2024	103	11,300	0.89 U	19,700	0.053 U	121,000	0.508 U	6.43	172	2,070	146	5 U	146	0.208	8.44	0.781	1,310	-0.191 U	0.875	0.875 J
	WBF-GW-OBS-2-1100-20241022	10/22/2024	102	11,800	0.89 U	19,000	0.053 U	70,300	0.508 U	1.91 J	392	418	72.5	5 U	72.5	0.053 U	9.55	0.613	1,300	0.115 U	1.45	1.57 J
	WBF-GW-OBS-2-0845-20241105	11/5/2024	82.8	11,200	0.89 U	19,000	0.053 U	117,000	0.508 U	1.74 J	222	1,990	90.7	5 U	90.7	0.053 U	9.26	0.657	1,320	1.59	0.415 UJ	2 J
	WBF-GW-OBS-2-0915-20241119	11/19/2024	87	11,200	0.89 U	16,500	0.053 U	153,000	0.508 U	2.64 J	242	1,980	116	5 U	116	0.053 UJ	9.13	0.599	1,280	0.849 UJ	0.561	1.41 J
	WBF-GW-OBS-2-1245-20241125	11/25/2024	96	12,700	5.41	15,200 J	0.053 U	102,000	0.508 U	1.43 J	305	2,080	68.1	5 U	68.1	0.053 U	9.94	0.514	1,370	0.713	0.887 J	1.6 J
	WBF-GW-OBS02-1515-20250610	6/10/2025	61.7	9,880	0.89 U	14,200	0.053 U	58,700	0.508 U	4.39 J	243	2,140	9.24 J	5 U	9.24 J	-	8.85 J	0.328 J	1,400 J	1.05	0.48 U	1.53 J
	WBF-GW-OBS02-1135-20250701	7/1/2025	55	11,000	0.89 U	15,200	0.053 U	154,000	0.508 U	8.27	188	2,300	229	5 U	229	-	8.99	0.731	1,600	0.828 U	1.46 U*	2.29 U*
	WBF-GW-OBS02-1220-20250715	7/15/2025	47	10,500	0.89 U	37,700	0.053 U	777,000	0.508 U	117	134	2,770	5 U	232	452	-	9.64	0.643	1,430 J	0.682	0.102 UJ	0.784 J
	WBF-GW-OBS02-1405-20250722	7/22/2025	51.2	11,300	0.89 U	38,300	0.053 U	1,060,000	0.508 U	132	124	3,940	320	5 U	320	-	7.38	0.286 J	964	0.292 U	0.95 U	1.24 U
	WBF-GW-OBS02-1310-20250729	7/29/2025	19.6	10,900	0.89 U	23,600	0.053 U	849,000	0.508 U	26.7	47.7	3,050	5 U	238	1150	-	9.22	0.652	1,260	0.114 UJ	0.852 U	0.966 UJ
	WBF-GW-OBS-2-1015-20250805	8/5/2025	45.7	10,500	0.89 U	14,500	0.053 U	225,000 J	0.508 U	3.01 J	113	2,160	243	5 U	243	-	8.67	0.424	1,340	-	-	-
	WBF-GW-OBS-2-1340-20250811	8/11/2025	38.8	9,920	0.89 U	14,200	0.053 U	365,000	0.508 U	7.1	154	1,990 J	45.6 J	37.7 J	83.3 J	-	8.7 J	0.31 J	1,280 J	-	-	-
	WBF-GW-OBS-2-1245-20250819	8/19/2025	26.5	9,180	0.89 U	19,000	0.053 U	448,000	0.508 U	3 J	62.8	2,120	225	5 U	225	-	8.46	0.301	1,300	-	-	-
	WBF-GW-OBS02-1425-20250825	8/25/2025	42.3	8,100	2.69 J	45,000	0.053 U	741,000	0.508 U	45.5	68.9	2,440	5 U	111	796	-	8.53	0.515	1,320	-	-	-

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Total Metals																	
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100
OBS-3	WBF-GW-OBS-3-1515-20240605	6/5/2024	2590	0.967 U	2.29	26.3	15.8	8,180	9.8	441,000	1.53 U	839	1.14 U	897	0.926 U*	32.8	35,800	53,600	0.14 U*	0.61 U
	WBF-GW-OBS-3-0935-20240619	6/19/2024	3720	0.967 U	7.42	20.4	18.1	9,990	9.4	450,000	1.53 U	795	1.14 U	1,090	1.22	34.2	34,700 J	68,400	0.13 U	0.61 U
	WBF-GW-OBS-3-1340-20240625	6/25/2024	2900	0.967 U	7.82	22.1	16	8,770	10	456,000 J	1.53 U	860	1.14 U	1,130	1.36 U*	31.6	38,400 J	50,500	0.13 U	0.61 U
	WBF-GW-OBS-3-1140-20240702	7/2/2024	2960	0.967 U	7.06	19.7 J	17.1	7,760	8.67	456,000	1.53 U	898	1.14 U	1,390	1.06	34.6	35,600	52,500	0.13 U	0.61 U
	WBF-GW-OBS-3-1100-20240709	7/9/2024	2860	0.967 U	2.59	19.4	14.9	7,470	8.67	427,000	1.53 U	756	1.14 U	1,170	0.947 J	44.2 J	31,600	47,600	0.13 U	0.61 U
	WBF-GW-OBS-3-0855-20240717	7/17/2024	3250	0.967 U	2.74	20.3	21.4	7,540	7.88 J	462,000 J	1.53 U	801 J	1.14 U	1,180	0.842 J	36 J	36,500	49,500	0.13 U	0.61 U
	WBF-GW-OBS-3-1200-20240723	7/23/2024	3450	0.967 U	3.31 J	25.5	24.5	8,330 J	7.97	461,000	1.53 U	795	1.14 U	951	0.718 J	38.5	38,000	57,300 J	0.13 U	0.61 U
	WBF-GW-OBS-3-1245-20240730	7/30/2024	4320	0.967 U	7.83	25.5	28.5	7,810	8.29	418,000	1.53 U	826	1.14 U	967	0.982 J	39.6	38,400	47,500	0.13 U	0.61 U
	WBF-GW-OBS-3-1015-20240806	8/6/2024	4100	0.967 U	3.62	27.6	23.1	7,940	9.4	446,000	1.53 U	838	1.14 U	703	0.912 J	40.3	36,300	49,600	0.13 U	0.61 U
	WBF-GW-OBS-3-1305-20240814	8/14/2024	4540	0.967 U	6.79	27.4	27.3	7,480	9.52	449,000	2.75	773	1.21 J	596	0.826 J	32.8	36,400	48,100	0.13 U	0.61 U
	WBF-GW-OBS-3-1220-20240820	8/20/2024	4690	0.967 U	3.92	25.9	24.1	8,020	8.81	427,000	1.53 U	715	1.15 J	570	0.925 J	41.2	34,200	48,000	0.13 U	0.61 U
	WBF-GW-OBS-3-1225-20240904	9/4/2024	4710	0.967 U	3.47	26.9	27.6	8,130	9.5	446,000	1.53 U	764	1.88 J	715	0.917 J	39.5	36,600	46,900	0.13 U	0.61 U
	WBF-GW-OBS-3-1255-20240910	9/10/2024	4900	0.57 U	0.75 U	21.9	23.9	8,220	7.83	363,000	1.2 U	655	1.7 U	504	0.543 J	37.2	31,900	51,300	0.13 U	1.08 U
	WBF-GW-OBS-3-1040-20240919	9/19/2024	5390	0.57 U	0.75 U	24.9	26.3	6,690	8.28	393,000	1.2 U	647	1.7 U	629	0.62 J	39	33,200	46,400	0.13 U	1.08 U
	WBF-GW-OBS-3-1215-20240924	9/24/2024	4780	0.57 U	0.75 U	27.7	29	8,500	8.96	414,000	1.2 U	674	1.7 U	583	0.729 J	40.6	33,700	49,100 J	0.13 U	1.08 U
	WBF-GW-OBS-3-1025-20241008	10/8/2024	6600	0.57 U	0.75 U	32.1	27.3	7,220	8.5	419,000	1.6 J	720	3.54	1,250	0.867 U*	41.9	34,200	42,600	0.18 J	1.08 U
	WBF-GW-OBS-3-0950-20241022	10/22/2024	5660	0.57 U	0.75 U	28.9	31.6	8,620	9.32	405,000	1.2 U	648	2.49	266	0.604 J	40.2	34,200	49,000	0.13 U	1.08 U
	WBF-GW-OBS-3-1005-20241105	11/5/2024	6030	0.57 U	0.75 U	29.8	31.6	9,430	8.98	392,000	1.2 U	697	2.93	394	0.491 J	38.5	32,200	49,400	0.131 U*	1.08 U
	WBF-GW-OBS-3-1100-20241119	11/19/2024	6420	0.57 U	0.75 U	29.7	27.3	7,430	8.7	397,000	1.2 U	664	3.33	244	0.701 J	41.7	33,700	48,900	0.13 U	1.08 U
	WBF-GW-OBS-3-1415-20241125	11/25/2024	6460	0.57 U	0.75 U	28.1	30.9	8,050 J	8.48	381,000	1.2 U	682	3.33	478	0.83 J	37	32,100	40,000 J	0.13 U	1.08 U
	WBF-GW-OBS03-1550-20250729	7/29/2025	8550	0.57 U	0.75 U	28	25.3	8,450	6.88	406,000	1.2 U	557	8.44	10,000	1.1	34.9	35,800	39,000	0.13 U	1.08 U
OBS-4	WBF-GW-OBS-4-1110-20240606	6/6/2024	721	0.967 U	1.35	32.8	0.381 J	8,010	6.25	472,000	1.53 U	495	1.35 U*	5,250	0.676 U*	4.81 J	40,800	60,700	0.14 U*	0.61 U
	WBF-GW-OBS-4-1140-20240618	6/18/2024	130	0.967 U	1.14	25.4	0.346 J	8,720	5.2 J	478,000	1.53 U	550	1.14 U	3,690	0.376 U	6.05	40,000 J	70,300	0.13 U	0.61 U
	WBF-GW-OBS-4-1510-20240625	6/25/2024	46.7	0.967 U	1	24.5	0.274 U	8,320	5.21	469,000 J	1.53 U	565	1.14 U	3,770	0.431 U*	4.4 J	41,400 J	58,700	0.13 U	0.61 U
	WBF-GW-OBS-4-1255-20240702	7/2/2024	70.4	0.967 U	0.959 J	21.2 J	0.274 U	7,700	4.92	464,000	1.53 U	560	1.14 U	3,040	0.376 U	5.4	37,800	60,700	0.13 U	0.61 U
	WBF-GW-OBS-4-1220-20240709	7/9/2024	38	0.967 U	0.689 J	21	0.274 U	7,970	4.53	471,000	1.53 U	512	1.14 U	2,380	0.376 U	6.53	33,900	60,500	0.13 U	0.61 U
	WBF-GW-OBS-4-1010-20240717	7/17/2024	57.5	0.967 U	1.21	20.4	0.366 J	7,660	4.68	475,000 J	1.53 U	540 J	1.14 U	4,430	0.376 U	5.85	39,500	60,600	0.13 U	0.61 U
	WBF-GW-OBS-4-1305-20240723	7/23/2024	74.4	0.967 U	1.15	22	0.346 J	9,920	4.68	445,000	1.53 U	536	1.14 U	5,010	0.376 U	6.32	43,000	71,300	0.13 U	0.61 U
	WBF-GW-OBS-4-1610-20240729	7/29/2024	58.3	0.967 U	1.98	44.9	0.32 J	7,780	3.57	456,000	1.53 U	572	1.14 U	9,320 J	0.376 U	5.78	43,400	58,700	0.13 U	0.61 U
	WBF-GW-OSB-4-1600-20240805	8/5/2024	41	0.967 U	1.76	23.5	0.274 U	8,000	3.38	473,000	1.53 U	544	1.14 U	10,600	0.376 U	5.67	40,200	58,200	0.13 U	0.61 U
	WBF-GW-OBS-4-1620-20240813	8/13/2024	46	0.967 U	1.31	20.2	0.288 J	7,490	3.21	470,000	1.53 U	561	1.14 U	5,320	0.376 U	4.22 J	39,900	56,600	0.13 U	0.61 U
	WBF-GW-OBS-4-0925-20240820	8/20/2024	46.9	0.967 U	1.47	21.6	0.282 J	8,050	1.77	463,000	1.53 U	528	1.14 U	8,210 J	0.376 U	6.34	39,200	58,900	0.13 U	0.61 U
	WBF-GW-OBS-4-1400-20240904	9/4/2024	51	0.967 U	1.83	22.4	0.471 J	7,900	1.53	482,000	1.53 U	549	1.14 U	10,100	0.376 U	6.22	42,500	56,400	0.13 U	0.61 U
	WBF-GW-OBS-4-1645-20240909	9/9/2024	40.8 J	0.57 U	1.08 J	19.4	0.319 J	8,020	1.06	425,000	1.2 U	489	1.7 U	10,100	0.45 U	5.37 J	39,000	61,500	0.13 U	1.08 U
	WBF-GW-OBS-4-1605-20240918	9/18/2024	77.5	0.57 U	2.01 J	20.5	0.355 J	6,690	1.42	441,000	1.2 U	525	1.7 U	7,830	0.45 U	6.41 J	39,300	61,600	0.13 U	1.08 U
	WBF-GW-OBS-4-1330-20240924	9/24/2024	74.4	0.57 U	1.78 J	21.5	0.336 J	8,740	1.4	443,000	1.2 U	500	1.7 U	8,750	0.45 U	6.71 J	37,600	64,100	0.13 U	1.08 U
	WBF-GW-OBS-4-1140-20241008	10/8/2024	113	0.57 U	1.43 U*	20	0.273 U	7,730	2.77	498,000	1.2 U	626	1.7 U	7,730	0.45 U	6.62 J	42,200	58,500	0.13 U	1.08 U
	WBF-GW-OBS-4-1500-20241021	10/21/2024	63.7	0.57 U	1.13 J	21.4	0.401 U*	7,860	2.97	470,000	1.2 U	583	1.7 U	6,000 J	0.45 U	7.11 J	41,000	59,200	0.13 U	1.08 U
	WBF-GW-OBS-4-1110-20241105	11/5/2024	103	0.57 U	1.78 J	22	0.457 J	9,200	1.73	455,000	1.2 U	632	1.7 U	6,800	0.45 U	6.89 J	38,700	62,800	0.148 U*	1.08 U
	WBF-GW-OBS-4-1220-20241119	11/19/2024	158	0.57 U	2.22 J	22.4	0.453 J	7,010	1.32	427,000	1.2 U	583	1.7 U	8,090	0.45 U	11	37,300	66,400	0.13 U	1.08 U
	WBF-GW-OBS-4-0830-20241126	11/26/2024	151	0.57 U	1.9 J	21.1	0.83 U*	8,340	0.952 J	429,000	1.2 U	631	1.7 U	7,930	0.45 U	6.03 J	37,900	55,800	0.13 U	1.08 U
OBS-5	WBF-GW-OBS-5-1350-20240606	6/6/2024	830	0.967 U	2.73	27.6	7.11	8,120	12.5	463,000	1.53 U	872	1.3 U*	337	0.622 U*	19.6	38,300	57,500	0.137 U*	0.61 U
	WBF-GW-OBS-5-1335-20240618	6/18/2024	981	0.967 U	2.22	22.5	7.62	8,600	12	447,000	1.53 U	828	1.14 U	1,360	0.602 J	22.5	35,300 J	62,100	0.13 U	0.61 U
	WBF-GW-OBS-5-1615-20240625	6/25/2024	867	0.967 U	2.25	22.8	6.53	8,360	12.1	436,000 J	1.53 U	902	1.22 J	1,240	0.913 U*	20.3	38,700 J	53,400	0.13 U	0.61 U
	WBF-GW-OBS-5-1355-20240702	7/2/2024	861	0.967 U	2.36	20.4 J	7.32	7,590	11.4	449,000	1.53 U	955	1.14 U	1,300	0.529 J	21.7	35,600	57,100	0.13 U	0.61 U
	WBF-GW-OBS-5-1400-20240709	7/9/2024	865	0.967 U	1.25	20.9	6.41	7,660	6.09	457,000	1.53 U	840	1.14 U	1,210	0.43 J	32.7 J	32,500	53,100	0.13 U	0.61 U
	WBF-GW-OBS-5-1115-20240717	7/17/2024	1210	0.967 U	2.66	21.2	9.36	7,500	4.96	455,000 J	1.53 U	852 J	1.14 U	1,210	0.447 J	24.9	37,900	57,700	0.13 U	0.61 U
	WBF-GW-OBS-5-1410-20240723	7/23/2024	1340	0.967 U	1.83 J	23.7	12.6	9,200	4.18	414,000 J	1.53 U	780 J	1.14 U	1,330	0.376 U	29.4	37,700	61,700	0.13 U	0.61 U
	WBF-GW-OBS-5-1410-20240730	7/30/2024	1220	0.967 U	2.76	21.8	11.1	7,560	3.54	421,000	1.53 U	899	1.14 U	1,410	0.376 U	27.3	39,300	52,700	0.13 U	0.61 U
	WBF-GW-OBS-5-1735-20240805	8/5/2024	1170	0.967 U	1.72	22.8	10.1	7,330	4.01	424,000	1.53 U	877	1.14 U	1,240	0.376 U	27.3	35,700	52,100	0.13 U	0.61 U
	WBF-GW-OBS-5-1515-20240813	8/13/2024	1610	0.967 U	2.06	23.8	17	7,210	4.98	440,000	1.53 U	849	1.14 U	1,460	0.376 U	25.1	36,400	52,100	0.13 U	0.61 U
	WBF-GW-OBS-5-1045-20240820	8/20/2024	1210	0.967 U	1.7	22.7	11.3	7,390	4.61	420,000	1.53 U	777	1.14 U	1,170	0.475 J	29.1	34,500	50,200	0.13 U	0.61 U
	WBF-GW-OBS-5-1525-20240904	9/4/2024	1310	0.967 U	1.4	22.9	13.2	7,350	6.21	406,000	1.53 U	777	1.14 U	1,150	0.376 U	26.9	34,800	48,800	0.13 U	0.61 U
	WBF-GW-OBS-5-1135-20240910	9/10/2024	1440	0.57 U	0.75 U	20	14.2	9,120	4.48	362,000	1.2 U	743	1.7 U	1,180	0.45 U	25.8	32,700	62,600	0.13 U	1.08 U
	WBF-GW-OBS-5-0915-20240919	9/19/2024	1640	0.739 J	1.86 J	22.1	15.2	6,280	8.07	376,000	1.2 U	694	1.7 U	1,140	0.45 U	28.8	32,600	49,700	0.13 U	1.39 U*
	WBF-GW-OBS-5-1445-20240924	9/24/2024	1470	0.57 U	0.893 J	22.3	14.7 J	7,060	4.04	380,000	1.2 U	686	1.7 U	1,050	0.45 U	28	32,000	45,800	0.13 U	1.08 U
	WBF-GW-OBS-5-1250-20241008	10/8/2024	2000	0.57 U	0.75 U	22.4	17.3	7,280	13.5	411,000	1.2 U	809	1.7 U	1,180	0.45 U	31.6	34,300	47,400	0.13 U	1.08 U
	WBF-GW-OBS-5-0830-20241022	10/22/2024	1380	0.57 U	0.75 U	22.1	13.4	7,410	2.71	375,000	1.2 U	672	1.7 U	1,300	0.45 U	25.3	32,300	50,200	0.13 U	1.08 U
	WBF-GW-OBS-5-1225-20241105	11/5/2024	1390	0.57 U	0.75 U	23.5	14.6	7,020	5.74	363,000	1.2 U	725	1.7 U	1,240	0.45 U	26.4	30,700	41,400	0.147 U*	1.08 U
	WBF-GW-OBS-5-1340-20241119	11/19/2024	1220	0.57 U	0.821 J	19.9	10	6,610	3.69	323,000	1.2 U	645	1.7 U	665	0.45 U	24.2	25,100	49,200	0.143 J	1.08 U
	WBF-GW-OBS-5-1540-20241125	11/25/2024	1490	0.57 U	0.75 U	20.2	13.4	7,550	3.96	331,000	1.2 U	697	1.7 U	854	0.45 U	23.1	29,100	42,600	0.13 U	1.08 U

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

			Total Metals									General Chemistry				Anions				Radiological Parameters		
Well ID	Sample ID	Sample Date	Nickel ug/L	Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L	TDS mg/L	Bicarbonate mg/L	Carbonate mg/L	Alkalinity mg/L	Bromide mg/L	Chloride mg/L	Fluoride mg/L	Sulfate mg/L	Radium 226 pCi/L	Radium 228 pCi/L	Radium 226 + 228 pCi/L
Screening Levels			100				100		2	86	5000											5
OBS-3	WBF-GW-OBS-3-1515-20240605	6/5/2024	139	16,000	1.53 U	21,200	0.24 U*	18,900	0.472 U	0.776 U	615	2,100 J	5 U	5 U	5 U	-	9.2	1.22	1,540	0.34 U	1.15	1.49 J
	WBF-GW-OBS-3-0935-20240619	6/19/2024	133	15,300	1.53 U	27,500	0.223 U	19,100	0.472 U	0.776 U	580	2,150	6.9	5 U	6.9	-	9.09	1.11	1,380	0.902	0.495 UJ	1.4 J
	WBF-GW-OBS-3-1340-20240625	6/25/2024	147	16,100	1.53 U	19,500	0.223 U	20,300	0.472 U	0.776 U	607	2,110	8.75	5 U	8.75	-	8.63	1.17	1,320	0.078 U	1.39 U*	1.47 U*
	WBF-GW-OBS-3-1140-20240702	7/2/2024	157	16,900	1.53 U	18,600	0.223 U	19,300	0.472 U	0.776 U	568	2,110	6.63	5 U	6.63	-	8.69	1.33	1,320	0.0859 UJ	1.06 U*	1.14 U*
	WBF-GW-OBS-3-1100-20240709	7/9/2024	126	14,200	1.53 U	18,500	0.223 U	18,000	0.472 U	0.776 U	531	2,150	6.19	5 U	6.19	-	8.61	1.13	1,310	1.32	1.25 U*	2.57 J
	WBF-GW-OBS-3-0855-20240717	7/17/2024	129 J	15,600 J	1.53 U	19,300	0.223 U	18,300 J	0.472 U	0.776 U	549 J	2,110	6.66	5 U	6.66	-	9.21	1.09	1,410	1.62	1.12 U*	2.74 J
	WBF-GW-OBS-3-1200-20240723	7/23/2024	134	14,000 J	1.53 U	18,100	0.223 U	19,600	0.472 U	0.776 U	582	2,110	6.39	5 U	6.39	-	8.61	1.27	1,380	0.256 U	1.02 U*	1.27 U*
	WBF-GW-OBS-3-1245-20240730	7/30/2024	140	15,400	1.53 U	19,200	0.223 U	24,200	0.472 U	0.776 U	650	2,160	6.69	5 U	6.69	-	8.92	1.35	1,370	0.277 U	0.839 U	1.12 U
	WBF-GW-OBS-3-1015-20240806	8/6/2024	145	16,900	1.53 U	21,300	0.223 U	26,400	0.472 U	0.776 U	575	2,110	5 U	5 U	5 U	-	8.72	1.26	1,350	0.543 U	0.842 J	1.38 J
	WBF-GW-OBS-3-1305-20240814	8/14/2024	128	16,900	1.53 U	18,800	0.223 U	28,500	0.472 U	2.91	592	2,040	5.2	5 U	5.2	-	8.5	1.3	1,340	0.901	0.789	1.69
	WBF-GW-OBS-3-1220-20240820	8/20/2024	118	16,400	1.53 U	18,900	0.223 U	31,100	0.472 U	0.776 U	524	2,080	5.74	5 U	5.74	0.053 U	8.45	1.15	1,450	0.295 U	0.854 U	1.15 U
	WBF-GW-OBS-3-1225-20240904	9/4/2024	129	16,000	1.53 U	19,700	0.223 U	29,500	0.472 U	0.776 U	541	2,090	7.67	5 U	7.67	5.04	9.16	1.25	1,370	0.457 U	1.16	1.62 J
	WBF-GW-OBS-3-1255-20240910	9/10/2024	102	15,500	0.89 U	12,300 J	0.053 U	32,700	0.508 U	0.82 U	431	2,040	5 U	5 U	5 U	4.35	8.75	1.11	1,280	0.524 U*	1.4 U*	1.92 U*
	WBF-GW-OBS-3-1040-20240919	9/19/2024	109	16,400	1.01 J	18,500	0.053 U	36,400	0.508 U	0.82 U	482	1,950	5 U	5 U	5 U	4.33	8.76	1.06	1,270	0.569 U	0.675 U	1.24 U
	WBF-GW-OBS-3-1215-20240924	9/24/2024	114	16,700	0.89 U	12,900	0.053 U	27,900	0.508 U	0.82 U	489	2,020	5 U	5 U	5 U	4.06	8.67	1.23	1,290	0.7 U	0.599 U	1.3 U
	WBF-GW-OBS-3-1025-20241008	10/8/2024	115	17,700	1.32 J	14,000	0.053 U	49,500	0.508 U	1.66 J	511	2,070	5 U	5 U	5 U	0.217	8.67	0.838	1,340	1.33	1.11	2.44
	WBF-GW-OBS-3-0950-20241022	10/22/2024	108	17,600	0.943 J	12,300 J	0.053 U	45,000	0.508 U	0.82 U	542	2,030	5 U	5 U	5 U	0.053 U	9.49	1.14	1,340	0.321 U	0.831 U	1.15 U
	WBF-GW-OBS-3-1005-20241105	11/5/2024	102	16,600	0.89 U	18,500	0.053 U	58,800	0.508 U	0.82 U	463	1,930	5 U	5 U	5 U	0.053 U	9.13	1.09	1,340	0.678 U	1.09 U*	1.77 U*
	WBF-GW-OBS-3-1100-20241119	11/19/2024	111	16,000	1.18 J	12,000 J	0.053 U	54,800	0.508 U	0.82 U	508	1,930	5 U	5 U	5 U	0.053 UJ	9.12	1.08	1,320	1.65 J	0.877	2.52 J
	WBF-GW-OBS-3-1415-20241125	11/25/2024	107	17,800	18.7	11,800 J	0.053 U	57,600	0.508 U	0.82 U	482	2,070	5 U	5 U	5 U	0.053 U	9.78	0.708	1,390	1.94	0.662 J	2.6 J
	WBF-GW-OBS03-1550-20250729	7/29/2025	89	18,500	0.89 U	14,200	0.053 U	26,400	0.508 U	0.82 U	399	2,100	5 U	5 U	5 U	-	9.15	0.874	1,370	-	-	-
OBS-4	WBF-GW-OBS-4-1110-20240606	6/6/2024	96	6,300	1.53 U	20,700	0.224 U*	25,000	0.472 U	0.881 J	232	2,260	48.1	5 U	48.1	-	9.24	0.0876 J	1,550	0.377 U	1.1	1.48 J
	WBF-GW-OBS-4-1140-20240618	6/18/2024	97.5	6,140	1.53 U	22,900	0.223 U	26,800	0.472 U	0.776 U	235	2,200	48	5 U	48	-	8.95	0.046	1,430	0.2 U	1.12 U*	1.32 U*
	WBF-GW-OBS-4-1510-20240625	6/25/2024	100	5,940	1.53 U	19,300	0.223 U	27,600	0.472 U	0.776 U	233	2,240	48.1	5 U	48.1	-	8.53	0.0427 J	1,350	-0.0806 U	0.545 U	0.545 U
	WBF-GW-OBS-4-1255-20240702	7/2/2024	147	6,450 J	1.53 U	19,000	0.223 U	26,100	0.472 U	0.776 U	215	2,250	47.8	5 U	47.8	-	8.58	0.0527 J	1,350	0.338 UJ	0.239 U	0.577 UJ
	WBF-GW-OBS-4-1220-20240709	7/9/2024	88.1	5,780	1.53 U	20,100	0.223 U	25,700	0.472 U	0.776 U	278 J	2,260	47.6	5 U	47.6	-	8.59	0.0399 J	1,340	0.803	0.83 UJ	1.63 J
	WBF-GW-OBS-4-1010-20240717	7/17/2024	91.8 J	5,430 J	1.53 U	19,300	0.223 U	26,600 J	0.472 U	0.776 U	222	2,240	50.9	5 U	50.9	-	9.16	0.026 U	1,450	0.47 U	0.898 U*	1.37 U*
	WBF-GW-OBS-4-1305-20240723	7/23/2024	99.6	5,060	1.53 U	18,800	0.223 U	27,700	0.472 U	0.776 U	221	2,220	53.1	5 U	53.1	-	8.52	0.0538 U*	1,400	0.311 U	0.0562 U	0.367 U
	WBF-GW-OBS-4-1610-20240729	7/29/2024	104	5,980	1.53 U	20,600	0.223 U	25,400	0.472 U	0.776 U	223 J	2,170	60.9	5 U	60.9	-	9.1	0.0387 J	1,480	0.109 U	1.44 U*	1.54 U*
	WBF-GW-OSB-4-1600-20240805	8/5/2024	102	7,080	1.53 U	22,000	0.223 U	26,800	0.472 U	0.776 U	192	2,120	61.4	5 U	61.4	-	8.85	0.0394 J	1,270	-	-	-
	WBF-GW-OBS-4-1620-20240813	8/13/2024	98.3	6,120	1.53 U	20,200	0.223 U	26,500	0.472 U	0.776 U	260 J	2,180	49.7	5 U	49.7	-	8.26	0.0373 J	1,340	0.254 U	0.8 U	1.05 U
	WBF-GW-OBS-4-0925-20240820	8/20/2024	93.8	6,600	1.53 U	20,000	0.223 U	27,200	0.472 U	0.776 U	201	2,210	62.1	5 U	62.1	0.053 U	8.7	0.0313 J	1,380	0.295 U	0.399 U	0.694 U
	WBF-GW-OBS-4-1400-20240904	9/4/2024	98.8	6,460	1.53 U	20,900	0.223 U	29,800	0.472 U	0.776 U	189	2,180	69.6	5 U	69.6	6.26	9.15	0.0427 J	1,390	0.207 U	0.448 U	0.655 U
	WBF-GW-OBS-4-1645-20240909	9/9/2024	92.8	6,870	0.89 U	21,400	0.053 U	27,000	0.508 U	0.82 U	166	2,170	51.4	5 U	51.4	0.053 U	10	0.06 J	1,370	0.15 U	0.425 UJ	0.575 UJ
	WBF-GW-OBS-4-1605-20240918	9/18/2024	96	6,470	1.42 J	21,700	0.053 U	27,200	0.508 U	0.82 U	189	2,030	52.5	5 U	52.5	0.053 U	10.5	0.0617 U*	1,520	-0.0828 U	0.391 U	0.391 U
	WBF-GW-OBS-4-1330-20240924	9/24/2024	92	6,470	0.89 U	20,300	0.053 U	26,800	0.508 U	0.82 U	171	2,150	55.9	5 U	55.9	4.22	8.66	0.0336 J	1,300	1.91	0.862 U	2.77 J
	WBF-GW-OBS-4-1140-20241008	10/8/2024	105	7,010	0.89 U	22,500	0.053 U	26,700	0.508 U	0.82 U	213	2,180	56.8	5 U	56.8	0.222	8.34	0.143	1,420	0.474 U	0.0977 U	0.572 U
	WBF-GW-OBS-4-1500-20241021	10/21/2024	106	7,280	0.89 U	22,400	0.053 U	29,400	0.508 U	0.82 U	244	2,120	49.8	5 U	49.8	0.053 U	9.91	0.0647 J	1,430	0.364 U	1.26 U*	1.62 U*
	WBF-GW-OBS-4-1110-20241105	11/5/2024	103	7,040	0.89 U	23,900	0.053 U	32,100	0.508 U	0.82 U	207	2,050	51.9	5 U	51.9	0.053 U	9.03	0.0555 J	1,390	1.21	0.699 UJ	1.9 J
	WBF-GW-OBS-4-1220-20241119	11/19/2024	111	7,310	0.89 U	21,200	0.053 U	37,900	0.508 U	0.82 U	205	2,090	55.1	5 U	55.1	0.053 UJ	9.26	0.121	1,350	0.434 UJ	0.891	1.32 J
	WBF-GW-OBS-4-0830-20241126	11/26/2024	108	8,210	1.18 U*	19,800 J	0.053 U	38,000	0.508 U	0.82 U	205	2,070	47.4	5 U	47.4	0.053 U	9.8	0.141	1,390	1.37	0.747 J	2.11 J
OBS-5	WBF-GW-OBS-5-1350-20240606	6/6/2024	153	12,800	1.53 U	22,600	0.223 U*	22,200	0.472 U	0.776 U	595	2,180	22	5 U	22	-	9.09	0.581	1,380	0.459 U	0.262 U	0.721 U
	WBF-GW-OBS-5-1335-20240618	6/18/2024	139	12,400	1.53 U	25,000	0.223 U	21,200	0.472 U	0.812 J	567	2,000	23.7	5 U	23.7	-	9.13	0.545	1,370	1.37	1.08 U*	2.45 J
	WBF-GW-OBS-5-1615-20240625	6/25/2024	158	12,900	1.53 U	20,300	0.223 U	21,500	0.472 U	0.776 U	572	2,090	21.8	5 U	21.8	-	8.58	0.532	1,310	0.19 U	0.592 U*	0.782 U*
	WBF-GW-OBS-5-1355-20240702	7/2/2024	149	12,900	1.53 U	20,200	0.223 U	21,700	0.472 U	0.776 U	570	2,150	23.4	5 U	23.4	-	8.69	0.637	1,310	0.0211 UJ	0.837 U*	0.858 U*
	WBF-GW-OBS-5-1400-20240709	7/9/2024	139	12,500	1.53 U	21,300	0.223 U	20,400	0.472 U	0.776 U	619	2,110	23.5	5 U	23.5	-	8.64	0.635	1,290	0.942	0.406 UJ	1.35 J
	WBF-GW-OBS-5-1115-20240717	7/17/2024	142 J	13,100	1.53 U	21,100	0.223 U	24,700 J	0.472 U	0.776 U	579 J	2,100	20.2	5 U	20.2	-	9.19	0.65	1,390	0.692 U	1.53 U*	2.22 U*
	WBF-GW-OBS-5-1410-20240723	7/23/2024	142	11,600	1.53 U	18,500	0.223 U	28,400	0.472 U	0.776 U	571	2,100 J	20.6	5 U	20.6	-	8.51	0.77	1,350	0.649 U	-0.0481 U	0.649 U
	WBF-GW-OBS-5-1410-20240730	7/30/2024	159	12,900	1.53 U	20,700	0.223 U	27,000	0.472 U	0.776 U	639	2,130	22.8	5 U	22.8	-	8.87	0.627	1,340	0.271 U	1.62 U*	1.89 U*
	WBF-GW-OBS-5-1735-20240805	8/5/2024	151	13,300	1.53 U	22,400	0.223 U	29,900	0.472 U	0.776 U	563	2,140	21.9	5 U	21.9	-	8.94	0.694	1,320	0.744	0.43 UJ	1.17 J
	WBF-GW-OBS-5-1515-20240813	8/13/2024	149	14,000	1.53 U	20,700	0.223 U	34,100	0.472 U	0.776 U	687	2,050	15.8	5 U	15.8	-	8.6	0.801	1,270	-0.17 U	0.489 U	0.489 U
	WBF-GW-OBS-5-1045-20240820	8/20/2024	136	13,600	1.53 U	20,500	0.223 U	36,200	0.472 U	0.776 U	555	2,070	23.5	5 U	23.5	0.053 U	8.81	0.675	1,260	0.22 U	0.307 U	0.526 U
	WBF-GW-OBS-5-1525-20240904	9/4/2024	136	12,700	1.53 U	20,900	0.223 U	41,900	0.472 U	0.776 U	529	1,960	23.9	5 U	23.9	5.58	9.19	0.604	1,270	0.219 U	1.02	1.23 J
	WBF-GW-OBS-5-1135-20240910	9/10/2024	122	13,100	0.979 J	17,200	0.053 U	39,500	0.508 U	0.82 U	474	1,950	15.4	5 U	15.4	4.17	8.7	0.714	1,290	0.732 U	0.665 UJ	1.4 UJ
	WBF-GW-OBS-5-0915-20240919	9/19/2024	123	13,500	3.7 J	17,600 J	0.053 U	39,700	0.681 J	0.82 U	503	1,790	12.2	5 U	12.2	0.053 U	10.4	0.761	1,360	1.65	0.827 U*	2.47 J
	WBF-GW-OBS-5-1445-20240924	9/24/2024	123	13,100	1.05 J	17,400	0.053 U	39,600	0.508 U	0.82 U	479	1,810	15.1	5 U	15.1	3.57	8.52	0.629	1,160	1.41	0.814 U*	2.22 J
	WBF-GW-OBS-5-1250-20241008	10/8/2024	135	15,000	0.89 U	17,900	0.053 U	41,100	0.508 U	1.06 J	582	1,890	14.4	5 U	14.4	0.171	8.41	0.943	1,260	0.435 U	0.52 U	0.955 U
	WBF-GW-OBS-5-0830-20241022	10/22/2024	119	13,700	0.89 U	18,200	0.053 U	44,800	0.508 U	0.82 U	534	1,880	14.8	5 U	14.8	0.053 U	10.3	0.657	1,250	0.188 U	1.05	1.24 J
	WBF-GW-OBS-5-1225-20241105	11/5/2024	118	13,300	0.89 U	20,000	0.053 U	65,000	0.508 U	0.82 U	487	1,770	16.2	5 U	16.2	0.053 U	9.03	0.576	1,200	0.0612 U	1.87 U*	1.93 U*
	WBF-GW-OBS-5-1340-20241119	11/19/2024	117	11,200	0.89 U	17,400	0.053 U	57,000	0.508 U	0.82 U	479	1,770	16.5	5 U	16.5	0.053 UJ	8.97	0.631	1,130	1.25 J	0.223 U	1.48 J
	WBF-GW-OBS-5-1540-20241125	11/25/2024	119	13,400	4.61 J	18,200 J	0.053 U	56,900	0.508 U	0.82 U	482	1,760	15.7	5 U	15.7	0.053 U	9.63	0.667	1,360	0.988	0.505 UJ	1.49 J

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Total Metals																	
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100
OBS-6	WBF-GW-OBS-6-1020-20240607	6/7/2024	346	0.967 U	3.63	33.5	0.791 J	7,720	9.44	456,000	1.53 U	721	1.14 U	642	0.521 U*	11.9	37,500	57,600	0.141 U*	0.61 U
	WBF-GW-OBS-6-1605-20240618	6/18/2024	476	0.967 U	1.16	40.2	0.793 J	8,110	9.56	459,000	1.53 U	727	1.22 J	926	0.429 J	15.6	35,700	60,600	0.13 U	0.61 U
	WBF-GW-OBS-6-1530-20240624	6/24/2024	493	0.967 U	1.22	29.8	0.875 J	7,530	9.74	455,000 J	1.53 U	780	1.3 J	1,230	0.961 U*	16.5	40,000 J	56,100	0.13 U	0.61 U
	WBF-GW-OBS-6-1500-20240702	7/2/2024	481	0.967 U	1.38	27.1 J	1.09	7,780	8.67	459,000	1.53 U	825	1.14 U	1,720	0.561 J	17.8	36,300	55,300	0.13 U	0.61 U
	WBF-GW-OBS-6-1505-20240709	7/9/2024	456	0.967 U	0.872 J	26.5	0.979 J	7,650	6.77	457,000	1.53 U	724	1.14 U	1,320	0.388 J	26.4 J	32,800	52,400	0.13 U	0.61 U
	WBF-GW-OBS-6-1230-20240717	7/17/2024	576	0.967 U	1.75	28.4	2	7,960	5.72	497,000	1.53 U	794	1.31 U*	1,700	0.432 J	21.3	37,900	56,100	0.13 U	0.61 U
	WBF-GW-OBS-6-1545-20240723	7/23/2024	577	0.967 U	0.812 J	28.5	2.39	9,760	3.16	447,000	1.53 U	729	1.14 U	1,490	0.376 U	23.8	41,300	58,500	0.13 U	0.61 U
	WBF-GW-OBS-6-1430-20240729	7/29/2024	919	0.967 U	1.75	29.7	3.57	7,780	4.32	445,000	1.53 U	914	1.14 U	2,110	0.676 J	23.9	41,000	52,700	0.13 U	0.61 U
	WBF-GW-OBS-6-1435-20240805	8/5/2024	652	0.967 U	1.52	26.2	3.13	8,020	2.66 J	457,000	1.53 U	789	1.14 U	2,000	0.376 U	22.4	37,700	53,500	0.13 U	0.61 U
	WBF-GW-OBS-6-1350-20240813	8/13/2024	748	0.967 U	1.37	26.9	4.75	7,840	7.57 J	482,000	1.53 U	785	1.14 U	2,130	0.456 J	19.2	39,500	54,300	0.13 U	0.61 U
	WBF-GW-OBS-6-1610-20240819	8/19/2024	666	0.967 U	1.44	26.5	4.18	7,940	3.56	462,000	1.53 U	736	1.14 U	2,080	0.376 U	24.2	37,700	53,400	0.13 U	0.61 U
	WBF-GW-OBS-6-1645-20240904	9/4/2024	1080	0.967 U	0.785 J	31	5.95	8,060	7.97	455,000	1.53 U	754	1.14 U	1,320	0.379 J	29	38,900	50,400	0.13 U	0.61 U
	WBF-GW-OBS-6-1435-20240909	9/9/2024	797	0.57 U	1.57 J	24.7	5.5	7,990	7.04	413,000	1.2 U	716	1.7 U	1,470	0.45 U	23.7	36,300	52,300	0.13 U	1.35 J
	WBF-GW-OBS-6-1425-20240918	9/18/2024	876	0.57 U	1.51 J	28.7	7.03	6,600	5.16	442,000	1.2 U	705	1.7 U	1,700	0.45 U	25.5	37,800	54,100	0.13 U	1.42 U*
	WBF-GW-OBS-6-1655-20240924	9/24/2024	1040	0.57 J	1.34 J	29.1	9.32	8,530 J	5.03	430,000	1.2 U	655	1.7 U	1,610	0.45 U	26.3	35,000	53,000 J	0.13 U	1.08 U
	WBF-GW-OBS-6-1430-20241008	10/8/2024	1040	0.57 U	0.75 U	27.6	10.6	7,910	6.51	474,000	1.2 U	777	1.7 U	1,300	0.45 U	27.8	38,800	50,500	0.145 J	1.08 U
	WBF-GW-OBS-6-1320-20241021	10/21/2024	1100	0.57 U	0.75 U	30.4	12.7	7,740	3.71	453,000	1.2 U	706	1.7 U	1,160	0.45 U	28.2	38,100	50,900	0.13 U	1.08 U
	WBF-GW-OBS-6-1345-20241105	11/5/2024	1410	0.637 J	0.791 J	32.8	16.8	8,780	5.59	451,000	1.2 U	754	1.7 U	796	0.45 U	30	37,400	52,000	0.175 U*	1.08 U
	WBF-GW-OBS-6-1505-20241119	11/19/2024	1560	0.808 U*	1.51 J	29.3	13.3	7,600	5.13	437,000	1.2 U	719	1.7 U	850	0.45 U	27.3	37,200	53,200	0.13 U	1.08 U
	WBF-GW-OBS-6-1035-20241126	11/26/2024	1640	0.57 U	0.75 U	27.7	15.2	7,700 J	4.2	427,000	1.2 U	732	1.7 U	1,060	0.455 J	24.3	36,400	45,800 J	0.13 U	1.08 U
OBS-07	WBF-GW-OBS07-0850-20250604	6/4/2025	347	0.982 J	1.06 J	25.7	0.273 U	6,230 J	1.42	378,000	1.2 U	136	1.7 U	4,590	0.452 J	5.91 J	40,000	36,900	0.13 U	1.08 U
	WBF-GW-OBS07-1030-20250610	6/10/2025	283	0.57 U	0.75 U	23.1	0.273 U	6,590	1	379,000	1.2 U	130	1.7 U	6,330	0.851 J	3.44 U	38,400	38,200	0.13 U	1.08 U
	WBF-GW-OBS07-1000-20250617	6/17/2025	235	0.57 U	0.75 U	20.5	0.273 UJ	5,740	0.735 J	364,000	1.2 U	120	1.7 U	6,880 J	1.06 U*	4.17 J	38,800	34,700	0.13 U	1.08 U
	WBF-GW-OBS07-1315-20250623	6/23/2025	174	0.57 U	0.75 U	19.8	0.273 U	6,840	0.779 J	368,000	1.2 U	111	1.7 U	6,930 J	0.45 U	3.44 U	38,900	37,000	0.13 U	1.08 U
	WBF-GW-OBS07-1605-20250630	6/30/2025	257	0.57 U	1.21 J	19.2	0.273 U	6,300	0.791 J	363,000	1.2 U	103	1.7 U	6,210	0.45 U	3.44 U	39,600	33,700	0.13 U	1.08 U
	WBF-GW-OBS07-1305-20250707	7/7/2025	80.2 J	0.57 U	1.46 J	17.8	0.273 U	7,150	0.414 J	377,000	1.2 U	95.5	1.7 U	10,900 J	0.45 U	3.56 J	41,600	37,600	0.13 U	1.08 U
	WBF-GW-OBS07-1725-20250714	7/14/2025	48 J	0.57 U	1.72 J	17.3	0.273 U	6,020	0.322 J	386,000	1.2 U	91.3	1.7 U	11,200	0.45 U	3.44 U	42,100	32,300	0.13 U	1.08 U
	WBF-GW-OBS07-1205-20250722	7/22/2025	20.1 J	0.57 U	1.24 J	18	0.273 U	6,230	0.303 J	381,000	1.2 U	75.9	1.7 U	13,600	0.45 U	3.5 J	43,000	30,700	0.13 U	1.08 U
	WBF-GW-OBS07-1040-20250729	7/29/2025	30.3 U*	0.57 U	1.03 J	16.7	0.273 U	6,590	0.338 J	354,000	1.2 U	82.1	1.7 U	10,900	0.45 U	3.44 U	40,500	33,600	0.13 U	1.08 U
	WBF-GW-OBS-7-1250-20250805	8/5/2025	31.1 J	0.57 U	1.38 J	17.3	0.273 U	6,760	0.438 U*	381,000	1.2 U	97.8	1.7 U	7,870	0.45 U	3.44 U	41,100	36,000	0.13 U	1.08 U
	WBF-GW-OBS-7-1620-20250811	8/11/2025	26.2 J	0.57 U	0.929 J	16.2	0.273 U	6,690	0.345 J	378,000 J	1.2 U	90.1	1.7 U	10,200	0.45 U	5.14 J	43,000	34,900	0.13 U	1.08 U
	WBF-GW-OBS-7-1430-20250819	8/19/2025	34.2 J	0.57 U	0.982 J	15.8	0.273 U	6,680	0.546 J	374,000	1.2 U	91.2	1.7 U	10,200	0.45 U	3.44 U	40,100	34,200	0.13 U	1.08 U
	WBF-GW-OBS07-1135-20250825	8/25/2025	290	0.57 U	1.13 J	18.7	0.273 U	6,830	1.33	375,000	1.2 U	89.8	1.7 U	8,670	0.764 J	3.52 J	40,600	35,700	0.13 U	1.08 U
OBS-08	WBF-GW-OBS08-1010-20250604	6/4/2025	934	0.57 U	1.02 J	31.9	6.12	7,320	7.79	427,000	1.43 J	694	1.7 U	6,390	1.25	25.1	38,000	49,900	0.13 U	1.08 U
	WBF-GW-OBS08-1145-20250610	6/10/2025	1160	0.57 U	0.75 U	31.9	7.16	7,010	6.05	408,000	1.66 J	643	7.43	8,050	1.45	21.4	34,600	48,900	0.13 U	1.08 U
	WBF-GW-OBS08-1130-20250617	6/17/2025	1190	0.57 U	0.75 U	29.9	9.05 J	7,460	6.09	391,000	1.57 J	630	4.64	10,100 J	1.75 U*	25.2 J	34,800	51,300	0.13 U	1.08 U
	WBF-GW-OBS08-1445-20250623	6/23/2025	2180	0.57 U	0.75 U	35.3	9.58	7,040	7.17	399,000	2.88 J	650	7.4	12,900	2.24	22.7	36,400	46,800	0.13 U	1.08 U
	WBF-GW-OBS08-1010-20250701	7/1/2025	1880	0.57 U	1.02 J	33.7	9.38	6,850	5.58	392,000	2.31 J	586	5.25	15,200	1.8	23.5	36,000	43,900	0.13 U	1.08 U
	WBF-GW-OBS08-1500-20250707	7/7/2025	1440	0.57 U	0.889 J	30	11.2	7,070	6.5	399,000	1.37 J	654	6	15,200	1.81	26.1	35,600	50,400	0.13 U	1.08 U
	WBF-GW-OBS08-0925-20250715	7/15/2025	2150	0.57 U	0.846 J	34.6	11	6,730	7.96	395,000	2.53 J	616	8.1	17,700	2.31	24.9	35,700	43,500	0.13 U	1.08 U
	WBF-GW-OBS08-0820-20250722	7/22/2025	1960	0.57 U	0.844 J	31.9	12.1	7,320	7.15	396,000	1.74 J	620	6.34	18,700	1.95	27.3	36,400	43,700	0.13 U	1.08 U
	WBF-GW-OBS08-1645-20250729	7/29/2025	2180	0.57 U	0.75 U	33.6	14.1	7,110	9.58	376,000	1.98 J	565	4.57	19,500	2.41	26.5	34,900	42,100	0.13 U	1.08 U
OBS-09	WBF-GW-OBS09-1215-20250604	6/4/2025	236	0.57 U	1.28 J	31.1	0.345 J	7,790	0.294 J	425,000	1.58 J	360	1.7 U	38,300	0.45 U	9.08	40,600	49,000	0.13 U	1.08 U
OBS-10	WBF-GW-OBS10-1345-20250604	6/4/2025	315	0.57 U	0.999 J	35	0.473 J	7,540	1.63	393,000	1.53 J	420	1.7 U	14,500	0.485 J	10.1	38,000	50,500	0.13 U	1.08 U

TABLE 4a - Groundwater Analytical Data Summary
Watts Bar Fossil Plant

DRAFT

			Total Metals									General Chemistry				Anions				Radiological Parameters		
Well ID	Sample ID	Sample Date	Nickel ug/L	Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L	TDS mg/L	Bicarbonate mg/L	Carbonate mg/L	Alkalinity mg/L	Bromide mg/L	Chloride mg/L	Fluoride mg/L	Sulfate mg/L	Radium 226 pCi/L	Radium 228 pCi/L	Radium 226 + 228 pCi/L
Screening Levels			100				100		2	86	5000											5
OBS-6	WBF-GW-OBS-6-1020-20240607	6/7/2024	128	11,200	1.53 U	21,400	0.223 U	22,100	0.472 U	0.776 U	377	2,170	41.6	5 U	41.6	-	9.92	0.284	1,540	0.114 U	1.22	1.33 J
	WBF-GW-OBS-6-1605-20240618	6/18/2024	123	11,200	1.53 U	22,400	0.223 U	26,200	0.472 U	0.776 U	430	2,160	30.5	5 U	30.5	-	9.22	0.303	1,420	0.611	1.57 U*	2.18 J
	WBF-GW-OBS-6-1530-20240624	6/24/2024	141	11,500	1.53 U	20,000	0.223 U	27,100	0.472 U	0.776 U	448	2,150	31.5	5 U	31.5	-	8.9	0.33	1,330	0.235 U	-0.193 U	0.235 U
	WBF-GW-OBS-6-1500-20240702	7/2/2024	141	12,500	1.53 U	19,400	0.223 U	25,700	0.472 U	0.776 U	428	2,220	32	5 U	32	-	8.87	0.366	1,330	0.462 J	0.781 U*	1.24 J
	WBF-GW-OBS-6-1505-20240709	7/9/2024	120	11,400	1.53 U	19,700	0.223 U	24,700	0.472 U	0.776 U	457	2,140	31.8	5 U	31.8	-	8.81	0.414	1,330	0.932	0.929 U*	1.86 J
	WBF-GW-OBS-6-1230-20240717	7/17/2024	136	12,100	1.53 U	20,100	0.223 U	26,000	0.472 U	0.776 U	473	2,160	29.4	5 U	29.4	-	9.31	0.447	1,430	0.44 U	0.434 U	0.874 U
	WBF-GW-OBS-6-1545-20240723	7/23/2024	133	10,300	1.53 U	18,500	0.223 U	25,000	0.472 U	0.776 U	466	2,110 J	31.5	5 U	31.5	-	8.72	0.52	1,380	0.576 U	0.508 U	1.08 U
	WBF-GW-OBS-6-1430-20240729	7/29/2024	158	12,600	1.53 U	21,200	0.223 U	24,500	0.472 U	0.776 U	510	2,210	32.7	5 U	32.7	-	9.37	0.593	1,490	0.462 U	1.09 U*	1.56 U*
	WBF-GW-OBS-6-1435-20240805	8/5/2024	145	12,400	1.53 U	22,000	0.223 U	25,000	0.472 U	0.776 U	451	2,140	34.3	5 U	34.3	-	8.83	0.586	1,370	0.73 U	0.971 J	1.7 J
	WBF-GW-OBS-6-1350-20240813	8/13/2024	137	13,100	1.53 U	20,800	0.223 U	25,000	0.472 U	0.776 U	482	2,180 J	30.8 J	5 UR	30.8 J	-	8.58 J	0.581 J	1,370 J	0.286 U	1.62 J	1.91 J
	WBF-GW-OBS-6-1610-20240819	8/19/2024	128	12,800	1.53 U	20,500	0.223 U	24,200	0.472 U	0.776 U	438	2,210	22.8 J	5 U	22.8 J	1.64	8.6	0.617	688	0.00347 UJ	0.402 U	0.406 UJ
	WBF-GW-OBS-6-1645-20240904	9/4/2024	139	12,300	1.53 U	21,200	0.223 U	24,600	0.472 U	0.776 U	485	2,100	29.1	5 U	29.1	5.86	9.28	0.922	1,350	0.88 U	0.852	1.73 J
	WBF-GW-OBS-6-1435-20240909	9/9/2024	120	12,600	3.37 J	20,600	0.053 U	23,000	0.56 J	0.82 U	400	2,160	29.1	5 U	29.1	0.053 UJ	10.1	0.8	1,410	0.333 U	0.0945 UJ	0.427 UJ
	WBF-GW-OBS-6-1425-20240918	9/18/2024	127	13,500	3.04 J	21,100	0.053 U	24,800	0.508 U	0.82 U	431	1,970	27.7	5 U	27.7	4.38	8.75	0.703	1,310	1.24	1.12 U*	2.36 J
	WBF-GW-OBS-6-1655-20240924	9/24/2024	118	12,800	2.33 J	18,800	0.053 U	22,200	0.508 U	0.912 J	402	2,140	25.5	5 U	25.5	4.43	8.7	0.708	1,330	1.94	0.912 U*	2.85 J
	WBF-GW-OBS-6-1430-20241008	10/8/2024	129	14,500	0.89 U	20,400	0.053 U	23,800	0.508 U	0.82 U	493	2,130	27.4	5 U	27.4	0.22	8.54	1.08	1,400	0.658 U	0.903	1.56 J
	WBF-GW-OBS-6-1320-20241021	10/21/2024	127	14,500	1.05 J	19,500	0.053 U	24,300	0.508 U	0.82 U	498	2,060	25.9	5 U	25.9	0.053 U	10.3	0.794	1,470	0.416 U	0.6 U	1.02 U
	WBF-GW-OBS-6-1345-20241105	11/5/2024	121	14,300	1.32 J	19,800	0.067 J	22,600	0.86 U*	0.82 U	475	2,040	23.2	5 U	23.2	0.106 U	9.09	0.786	1,380	0.473 U	0.469 UJ	0.942 UJ
	WBF-GW-OBS-6-1505-20241119	11/19/2024	130	13,300	1.1 J	15,700	0.053 U	21,900	0.508 U	0.82 U	495	2,070	21.7	5 U	21.7	0.053 UJ	8.99	0.849	1,330	0.781 UJ	0.588	1.37 J
	WBF-GW-OBS-6-1035-20241126	11/26/2024	127	15,100	5.51	17,500 J	0.053 U	20,600	0.508 U	0.82 U	475	2,020	21	5 U	21	0.053 U	9.83	0.775	1,370	0.72	0.171 UJ	0.89 J
OBS-07	WBF-GW-OBS07-0850-20250604	6/4/2025	35.2	2,350	0.89 U	16,300	0.053 U	153,000	0.508 U	0.82 U	45.7	2,210	106	5 U	106	-	10.2	0.0462 J	1,300	-0.0222 U	0.576 U	0.576 U
	WBF-GW-OBS07-1030-20250610	6/10/2025	34.6	2,160	0.89 U	16,900	0.053 U	151,000	0.508 U	0.84 J	43.9	2,220	112	5 U	112	-	9.2 J	0.076 J	1,460 J	1.36	0.317 U	1.68 J
	WBF-GW-OBS07-1000-20250617	6/17/2025	32.1	1,990	0.89 U	16,500	0.053 U	156,000	0.508 U	0.82 U	42.3	2,170	95.9	5 U	95.9	-	10.7	0.26 U	1,420	0.561 U	0.906 U	1.47 U
	WBF-GW-OBS07-1315-20250623	6/23/2025	29.9	1,960	0.89 U	15,300	0.053 U	161,000	0.508 U	0.82 U	45.1	2,100	95.6	5 U	95.6	-	8.66	0.026 U	1,360	0.689 U	0.786 U	1.48 U
	WBF-GW-OBS07-1605-20250630	6/30/2025	29.8	1,880	0.89 U	15,000	0.053 U	166,000	0.508 U	0.82 U	34	2,260	107	5 U	107	-	9.32	0.0726 J	1,600	0.778 U	0.718 U	1.5 U
	WBF-GW-OBS07-1305-20250707	7/7/2025	26.4	1,870	0.89 U	17,700	0.053 U	167,000	0.508 U	0.82 U	26.7	2,270	116	5 U	116	-	9.06	0.059 J	1,440	0.515 U	0.493 U	1.01 U
	WBF-GW-OBS07-1725-20250714	7/14/2025	26.2	1,820	0.89 U	17,000	0.053 U	155,000	0.508 U	0.82 U	26.8	2,200	132	5 U	132	-	9.4	0.0631 J	1,530 J	0.156 U	-0.285 UJ	0.156 UJ
	WBF-GW-OBS07-1205-20250722	7/22/2025	21.5	1,990	0.89 U	15,300 J	0.053 U	167,000	0.508 U	0.82 U	15 U	2,200	154	5 U	154	-	9.11	0.0549 J	1,450	0.813 U	0.689 U	1.5 U
	WBF-GW-OBS07-1040-20250729	7/29/2025	23.5	1,850	0.89 U	16,800	0.053 U	145,000	0.508 U	0.82 U	18.6 J	2,230	145	5 U	145	-	9.04	0.0757 J	1,420	0.949 U	0.515 U	1.46 U
	WBF-GW-OBS-7-1250-20250805	8/5/2025	28.6	1,860	0.89 U	15,700	0.053 U	144,000	0.508 U	0.82 U	25.7	2,150	111	5 U	111	-	8.95	0.0641 J	1,410	-	-	-
	WBF-GW-OBS-7-1620-20250811	8/11/2025	25.9	1,990	0.89 U	15,700	0.053 U	134,000	0.508 U	0.82 U	22.2	2,200 J	111 J	5 UR	111 J	-	8.52 J	0.0642 J	1,350 J	-	-	-
	WBF-GW-OBS-7-1430-20250819	8/19/2025	26.7	1,720	0.89 U	15,600	0.053 U	123,000	0.508 U	0.82 U	23.2	2,160	111	5 U	111	-	8.56	0.026 U	1,350	-	-	-
	WBF-GW-OBS07-1135-20250825	8/25/2025	27.1	1,870	0.89 U	16,000	0.053 U	126,000	0.508 U	0.82 U	28.9	2,190 J	108	5 U	108	-	8.67	0.0702 J	1,300	-	-	-
OBS-08	WBF-GW-OBS08-1010-20250604	6/4/2025	121	11,200	0.89 U	19,000	0.053 U	28,000	0.508 U	0.998 J	471	2,050	25.7	5 U	25.7	-	9.92	0.486	1 U	0.355 U	0.117 U	0.473 U
	WBF-GW-OBS08-1145-20250610	6/10/2025	115	11,300	0.89 U	19,000	0.053 U	24,400	0.508 U	0.82 U	444	2,020	26.4	5 U	26.4	-	9.19 J	0.416 J	1,340 J	0.262 U	0.691 U	0.953 U
	WBF-GW-OBS08-1130-20250617	6/17/2025	113	11,400	0.89 U	16,600	0.053 U	24,800	0.508 U	1.54 J	433	2,050	20.3	5 U	20.3	-	9.34	0.524	1,330	0.832 U	0.745 U	1.58 U
	WBF-GW-OBS08-1445-20250623	6/23/2025	110	12,100	0.89 U	19,500 J	0.053 U	24,700	0.508 U	3.33 J	437	1,910	5 R	5 R	5 R	-	9.02	0.347	1,260	1.24	0.632 U	1.87 J
	WBF-GW-OBS08-1010-20250701	7/1/2025	113	12,100	0.89 U	14,000 J	0.053 U	24,700	0.508 U	2.57 J	419	1,990	22.4	5 U	22.4	-	9.22	0.321	1,400	0.97	0.69 U	1.66 J
	WBF-GW-OBS08-1500-20250707	7/7/2025	112	12,900	0.89 U	18,900	0.053 U	24,700	0.508 U	1.83 J	438	1,960	17	5 U	17	-	9.15	0.547	1,290	0.463 U	0.434 U	0.897 U
	WBF-GW-OBS08-0925-20250715	7/15/2025	105	13,000	0.89 U	19,100	0.053 U	26,200	0.508 U	3.31 J	411	1,950	16.8	5 U	16.8	-	9.41	0.416	1,360 J	0.257 U	0.515 UJ	0.772 UJ
	WBF-GW-OBS08-0820-20250722	7/22/2025	106	14,000	0.89 U	17,500	0.053 U	26,800	0.508 U	2.73 J	459	2,000	14.2	5 U	14.2	-	9.18	0.41	1,320	1.27	-0.262 U	1.27 J
	WBF-GW-OBS08-1645-20250729	7/29/2025	101	14,000	0.89 U	17,100	0.053 U	25,300	0.508 U	3.02 J	435	1,890	9.32	5 U	9.32	-	9.03	0.62	1,270	1.17	0.827 U*	2 J
OBS-09	WBF-GW-OBS09-1215-20250604	6/4/2025	65	7,920	0.89 U	17,800	0.053 U	54,100	0.508 U	0.82 U	122	2,100	50.9	5 U	50.9	-	8.78	0.0606 J	1,170	0.346 U	0.46 U	0.806 U
OBS-10	WBF-GW-OBS10-1345-20250604	6/4/2025	62.8	8,700	0.89 U	17,000	0.053 U	123,000	0.508 U	0.82 U	142	2,170	47.7	5 U	47.7	-	8.66	0.0778 J	1,440	0.852 U	1.1 U*	1.95 U*

Notes:

Please note that units have been have ben converted automatically in this table, and significant figures may not have been maintained.
Screening levels are presented for CCR Rule Appendix IV and TDEC Appendix I constituents.

13.4	measured concentration did not exceed the indicated standard
13.4	measured concentration exceeded the indicated screening level
ID	Identification
U	analyte was not detected at a concentration greater than the method detection limit
U*	result should be considered "not detected" because it was detected in an associated field or laboratory blank at a similar level
UJ	this compound was not detected, but the reporting limit should be considered estimated due to a bias identified during data validation
J	quantitation is approximate due to limitations identified during data validation
R	Sample was prepped or analyzed beyond specified holding time. This does not meet regulatory requirements.
mg/L	milligrams per liter
pCi/L	picocuries per liter
µg/L	micrograms per liter
-	parameter not analyzed

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals																		
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L	Nickel ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100	100
OBS-1	WBF-GW-OBS-1-1430-20240617	6/17/2024	23.4 J	0.967 U	2.76	23.8	0.289 J	3,600	0.217 U	436,000	1.53 U	53.8	1.14 U	7,970	0.376 U	4.78 J	60,900	32,000	0.13 U	0.61 U	15.5
	WBF-GW-OBS-1-1010-20240625	6/25/2024	27 J	0.967 U	3.62	22.8	0.274 U	3,290	0.217 U	440,000	1.53 U	60.6	1.14 U	5,600	0.52 U*	3.06 J	67,600 J	28,000	0.13 U	0.61 U	18.6
	WBF-GW-OBS-1-1510-20240701	7/1/2024	28.8 J	0.967 U	2.68	21.4 J	0.274 U	2,650	0.217 U	376,000	1.53 U	56.4	1.14 U	3,760	0.376 U	4.82 J	56,700	22,500	0.13 U	0.61 U	13.7
	WBF-GW-OBS-1-1300-20240708	7/8/2024	21.8 U	0.967 U	3.13	19	0.274 U	3,290	0.217 U	449,000	1.53 U	56.4	1.14 U	5,560 J	0.376 U	3.9 J	58,300	29,100	0.13 U	0.61 U	16.6
	WBF-GW-OBS-1-0905-20240716	7/16/2024	92.1 J	0.967 U	3.22	18.7 J	0.274 U	3,230	0.217 U	426,000	1.53 U	61.2 J	1.14 U	4,470	0.376 U	4.36 J	58,300	27,400	0.13 U	0.61 U	17.5
	WBF-GW-OBS-1-0900-20240723	7/23/2024	21.8 U	0.967 U	3.31 J	19.6	0.274 U	3,310	0.217 U	479,000	1.53 U	67.4 J	1.14 U	5,500	0.376 U	3.87 J	67,100 J	27,100	0.13 U	0.61 U	18
	WBF-GW-OBS-1-0910-20240730	7/30/2024	21.8 U	0.967 U	2.77	18.2	0.274 U	3,440	0.217 U	414,000	1.53 U	62.4	1.14 U	5,490	0.376 U	4.23 J	65,900	25,700	0.13 U	0.61 U	18.4
	WBF-GW-OBS-1-1400-20240806	8/6/2024	21.8 U	0.967 U	2.6	18	0.274 U	3,640	0.217 U	452,000 J	1.53 U	58.8	1.14 U	4,990	0.376 U	3.69 J	65,600	25,900	0.13 U	0.61 U	18.2
	WBF-GW-OBS-1-1505-20240814	8/14/2024	21.8 U	0.967 U	2.33	19	0.274 U	3,390	0.217 U	427,000	1.53 U	53.3	1.14 U	3,710	0.376 U	5.01	66,200	23,300	0.13 U	0.61 U	14.9
	WBF-GW-OBS-1-1705-20240820	8/20/2024	21.8 U	0.967 U	2.62 U*	17.6	0.274 U	4,110	0.217 U	458,000	1.53 U	66.8 J	1.14 U	6,010 J	0.376 U	3.26 J	67,900	26,400	0.14 J	0.61 U	16.8
	WBF-GW-OBS-1-1415-20240903	9/3/2024	21.8 U	0.967 U	2.5	16.8	0.521 J	3,750	0.694 J	473,000	1.53 U	68.9	1.14 U	4,790	0.376 U	4.42 J	66,000	26,600	0.13 U	0.958 J	19.5
	WBF-GW-OBS-1-1625-20240910	9/10/2024	14.8 J	0.606 J	2.1 J	15.7	0.556 J	3,550	0.247 J	410,000	1.2 U	53.8	1.7 U	5,450	0.45 U	3.65 J	63,300	28,300	0.13 U	1.52 J	16.4
	WBF-GW-OBS-1-1505-20240919	9/19/2024	23.6 J	0.57 U	1.91 J	16.4	0.273 U	3,110	0.077 U	428,000	1.2 U	59.7	1.7 U	4,710	0.45 U	3.8 J	65,600	27,200	0.13 U	1.08 U	17.7
	WBF-GW-OBS-1-0905-20240924	9/24/2024	23.5 J	0.57 U	1.54 J	17.1	0.273 U	3,680	0.077 U	440,000	1.2 U	58.1	1.7 U	5,080	0.45 U	4.41 J	66,300	25,900	0.13 U	1.08 U	17.7
	WBF-GW-OBS-1-1445-20241007	10/7/2024	20.7 J	0.57 U	1.36 J	17	0.273 U	3,690	0.077 U	486,000	1.2 U	66.9	1.7 U	5,460	0.45 U	4.1 J	70,900	25,800	0.13 U	1.08 U	19.3
	WBF-GW-OBS-1-1305-20241022	10/22/2024	16.1 J	0.57 U	1.03 J	16.3	0.273 U	3,360	0.077 U	437,000	1.2 U	56.1	1.7 U	3,760	0.45 U	3.44 U	66,500	24,700	0.13 U	1.08 U	16.6
	WBF-GW-OBS-1-1555-20241104	11/4/2024	15 J	0.57 U	0.954 J	16.6	0.273 U	4,200	0.077 U	451,000	1.2 U	67.5	1.7 U	4,400	0.45 U	3.44 U	65,400	27,900	0.13 U	1.08 U	17.5
	WBF-GW-OBS-1-1415-20241118	11/18/2024	25 J	0.57 U	1.64 J	15.7	0.273 U	3,500	0.077 U	429,000	1.2 U	62.2	1.7 U	3,960 J	0.45 U	4.24 J	64,200 J	27,200	0.13 U	1.08 U	17.9
	WBF-GW-OBS-1-0920-20241125	11/25/2024	22.8 U*	0.792 U*	1.76 J	15.9	0.273 U	3,620	0.239 U*	435,000	1.2 U	64.5	1.7 U	4,100	0.45 U	3.77 J	65,400	24,700	0.13 U	1.08 U	19.1
	WBF-GW-OBS01-1445-20250603	6/3/2025	31.5 J	0.57 U	1.09 J	14.6	0.273 U	4,730	0.317 J	470,000	1.2 U	105	1.7 U	4,640	0.45 U	5.7 J	68,600	28,200	0.13 U	1.31 J	26.1
	WBF-GW-OBS01-0855-20250610	6/10/2025	24.8 J	0.57 U	0.75 U	14.8	0.291 J	4,720	0.077 U	415,000	1.2 U	118	1.7 U	5,880	0.45 U	3.83 J	57,700	30,800	0.13 U	1.08 U	26.8
	WBF-GW-OBS01-1355-20250616	6/16/2025	24 J	0.57 U	0.842 J	14.5	0.293 J	4,490	0.077 U	434,000	1.2 U	111	1.7 U	6,870	0.45 U	5.98 J	65,700	26,200	0.13 U	1.08 U	26.5
	WBF-GW-OBS01-0815-20250624	6/24/2025	23 U*	0.57 U	0.75 U	13.4	0.294 J	4,320	0.077 U	440,000	1.2 U	101	1.7 U	5,960	0.45 U	3.44 U	65,400	29,000	0.13 U	1.08 U	24.3
	WBF-GW-OBS01-1320-20250630	6/30/2025	21.2 J	0.57 U	0.94 J	13.2	0.278 J	4,100	0.077 U	436,000 J	1.2 U	97.7	1.7 U	5,740	0.45 U	3.49 J	64,800	27,400	0.13 U	1.08 U	24.6
	WBF-GW-OBS01-0950-20250708	7/8/2025	23.3 J	0.57 U	0.75 U	13.2	0.273 U	4,020	0.077 U	419,000	1.2 U	94.4	1.7 U	5,840	0.45 U	4.13 J	63,000	26,200	0.13 U	1.08 U	24.2
	WBF-GW-OBS01-1305-20250714	7/14/2025	23.6 J	0.57 U	0.983 J	13.5	0.358 J	4,050	0.089 J	425,000	1.2 U	89	1.7 U	5,400	0.45 U	4.21 J	61,800	25,600	0.13 U	1.08 U	23.1
	WBF-GW-OBS01-1340-20250721	7/21/2025	35.9 J	0.57 U	1.4 J	14.3	0.443 J	4,440	0.159 J	426,000	1.2 U	97.1	1.7 U	5,940	0.45 U	4.91 J	63,300	27,200	0.13 U	1.08 U	32.2 J
	WBF-GW-OBS01-1445-20250728	7/28/2025	29.7 U*	0.57 U	0.784 J	14.2	0.295 J	4,390	0.077 U	426,000	1.2 U	102	1.7 U	5,450	0.45 U	4.39 J	64,700	28,200	0.13 U	1.08 U	25.1
IW-2	WBF-GW-IW-2-1655-20240617	6/17/2024	2290	0.967 U	4.37	30.5	0.274 U	6,920	0.217 U	246,000	1.53 U	69.1	14.9	28 U	0.376 U	11.2	24,600	18,200	0.13 U	4.83 J	25.2
	WBF-GW-IW-2-1130-20240625	6/25/2024	33.8	0.967 U	1.97	41.4	0.274 U	7,040	0.217 U	462,000	1.53 U	302	1.14 U	1,040	0.546 U*	11.1	47,600 J	54,200	0.13 U	1.26 J	72.5
	WBF-GW-IW-2-0845-20240702	7/2/2024	62.9	0.967 U	2.31	29.7 J	0.274 U	6,690	0.217 U	460,000	1.53 U	382	1.14 U	5,090	0.376 U	13.3	39,800	57,300	0.13 U	0.708 J	71.9
	WBF-GW-IW-2-0825-20240709	7/9/2024	51.6 U*	0.967 U	2.93	28.6	0.274 U	7,100	0.217 U	476,000	1.53 U	379	1.14 U	6,760	0.376 U	14.6	38,100	52,900	0.13 U	0.61 U	79.3
	WBF-GW-IW-2-1035-20240716	7/16/2024	90.5	0.967 U	3.18	34.1 J	0.418 J	6,650	0.217 U	545,000 J	1.53 U	505 J	1.14 U	6,000	0.376 U	16.9 J	44,300	53,700	0.13 U	0.61 U	102 J
	WBF-GW-IW-2-1410-20240722	7/22/2024	105	0.967 U	3.31 J	28.9	0.502 J	6,970	0.217 U	458,000	1.53 U	535	1.14 U	5,390	0.376 U	16.9 J	45,400 J	58,900 J	0.13 U	0.61 U	88.5
	WBF-GW-IW-2-1010-20240730	7/30/2024	131	0.967 U	3.17	29.8	0.781 J	6,920	0.217 U	431,000	1.53 U	484	1.14 U	6,530	0.376 U	16.8	44,300	52,900	0.13 U	0.61 U	94.9
	WBF-GW-IW-2-1240-20240806	8/6/2024	146 U*	0.967 U	2.81	30	0.866 J	6,840	0.217 U	450,000 J	1.53 U	490	1.14 U	6,060	0.376 U	17.4	41,600	51,000	0.13 U	0.61 U	94.9
	WBF-GW-IW-2-1400-20240814	8/14/2024	200	0.967 U	2.54	29.5	1.3	7,730	0.217 U	445,000	1.53 U	476	1.14 U	5,700	0.376 U	18.5	40,400	51,100	0.13 U	0.61 U	93.2
	WBF-GW-IW-2-1515-20240820	8/20/2024	237	0.967 U	2.47 U*	28.4	1.58	7,180	0.217 U	448,000	1.53 U	492	1.14 U	5,670	0.376 U	18	42,200	52,200	0.13 U	0.61 U	91.3
	WBF-GW-IW-2-0900-20240904	9/4/2024	47.6	0.967 U	1.09	78.3	2.56	7,430	0.722 J	497,000	1.53 U	570	1.14 U	2,020	0.479 J	29.2	43,900	53,100	0.13 U	0.61 U	122
	WBF-GW-IW-2-1510-20240910	9/10/2024	133	0.57 U	0.75 U	40.2	3	7,380	0.077 U	424,000 J	1.2 U	480 J	1.7 U	11,400 J	0.45 U	22.8	37,100 J	54,600	0.13 U	1.08 U	94 J
	WBF-GW-IW-2-1340-20240919	9/19/2024	448	0.57 U	1.08 J	36.6	7.52	6,180	0.101 J	397,000	1.2 U	491	1.7 U	13,400	0.45 U	24.8	36,000	49,100	0.13 U	1.08 U	95.3
	WBF-GW-IW-2-1525-20240923	9/23/2024	579	0.57 U	1.45 J	38.2	10.7	7,430	0.171 J	405,000	1.2 U	494	1.7 U	14,600	0.45 U	26.6	35,300	49,100	0.13 U	1.08 U	95.1
	WBF-GW-IW-2-1600-20241007	10/7/2024	55100	0.57 U	59.8	11.4	0.273 U	5,230	0.077 U	18,100	4.38 J	21.9	69	81 J	0.45 U	3.44 U	61 U	59	0.483 U*	19.8	84.5
	WBF-GW-IW-2-1155-20241022	10/22/2024	1790	0.57 U	2.19 J	27.1	0.273 U	5,510	0.077 U	88,500	1.3 J	1.3	5.31	47 U	0.45 U	3.83 J	61 U	37	0.13 U	2.37 J	5.66
	WBF-GW-IW-2-1405-20241104	11/4/2024	25.9 J	0.57 U	1.14 J	56.4	0.347 J	7,210	0.713 J	352,000	1.58 J	175	1.7 U	301	0.45 U	11.6	50,500	35,700	0.13 U	1.47 J	55.3
	WBF-GW-IW-2-1540-20241118	11/18/2024	9380	0.904 U*	14.1	4.89 J	0.273 U	5,130	0.16 U*	39,200	4.75 J	5.6	28.6	47 U	0.45 U	3.44 U	61 UJ	18	0.13 U	7.11	23
	WBF-GW-IW-2-1055-20241125	11/25/2024	6660	0.57 U	8.37	9.13	0.273 U	6,090	0.077 U	73,800	1.2 U	3.56	10.9	47 U	0.45 U	3.44 U	61 U	177 U	0.13 U	4.74 J	22.7
	WBF-GW-IW02-1305-20250603	6/3/2025	46 J	0.57 U	1.12 J	51.1	0.273 U	7,570	0.077 U	490,000	1.2 U	294	1.7 U	8,940	0.45 U	10	42,900	56,800	0.13 U	1.08 U	65
	WBF-GW-IW02-1615-20250609	6/9/2025	3390	0.725 J	8.1	5.28	0.273 U	6,410	0.108 J	26,900	1.2 U	2.35	1.7 U	47 U	0.45 U	5.52 J	61 U	14	0.144 J	3.71 J	22.2
	WBF-GW-IW02-0835-20250617	6/17/2025	62.9	0.57 U	0.75 U	50.6	0.273 UJ	7,440	0.077 U	342,000	1.2 U	196	1.7 U	98 J	0.577 U*	16.5 J	53,500	40,700	0.13 U	1.08 U	78.3
	WBF-GW-IW02-0900-20250624	6/24/2025	33.7 U*	0.57 U	0.75 U	46.1	0.273 U	7,480	0.078 J	344,000	1.2 U	234	1.7 U	1,830	0.45 U	13.6	45,400	43,900	0.13 U	1.08 U	86.1
	WBF-GW-IW02-1425-20250630	6/30/2025	8000 J	0.57 U	22.1	5.77	0.273 U	5,590	0.158 J	43,300 J	3.56 J	4.58	14.3	47 U	0.45 U	3.44 U	61 U	90	0.13 U	8	33.6
	WBF-GW-IW02-1100-20250708	7/8/2025	154	0.57 U	1.62 J	16.3	0.273 U	135	0.077 U	141,000	1.2 U	5.77	2.19	47 U	0.45 U	10.4	43,600	116	0.13 U	3.55 J	15
	WBF-GW-IW02-1410-20250714	7/14/2025	23700	0.57 U	68.3	4.22 J	0.273 U	6,110	0.077 U	42,600 J	2.68 J	7.28	24.7	47 U	0.45 U	3.58 J	61 U	48	0.13 U	8.06	45.6
	WBF-GW-IW02-1520-20250721	7/21/2025	37300	0.57 U	95.4	2.39 J	0.273 U	5,790	0.118 J	16,600	3.77 J	12.3	50.8	47 U	0.554 J	3.44 U	61 U	61	0.13 U	12	72.4
	WBF-GW-IW02-1550-20250728	7/28/2025	39600	0.692 J	85.7	2.2 J	0.338 J	5,690	0.244 J	10,400	4.66 J	12.4	53	47 U	0.45 U	3.44 U	61 U	28	0.154 J	11.9	79.6
	WBF-GW-IW-2-1410-20250805	8/5/2025	14000	0.57 U	24.9	9.2	0.273 U	6,440	0.077 U	57,600 J	1.2 U	4.79	15.2	47 U	0.45 U	5.18 J	61 U	42	0.13 U	7.97	43.9
	WBF-GW-IW-2-0925-20250811	8/11/2025	1800	0.57 U	5.02	5.21	0.273 U	5,950	0.077 UJ	42,300 J	1.2 U	2.59	6.17	47 U	0.45 U	8.77	283 J	23 J	0.13 U	5.32	24.5
	WBF-GW-IW-2-0955-20250819	8/19/2025	759	0.57 U	6.7	31.7	0.273 U	7,370	0.115 J	185,000	1.2 U	34.1	3.34	47 U	0.45 U	12.3	40,300	15,000	0.13 U	4.64 J	35.5
	WBF-GW-IW02-0835-20250825	8/25/2025	724	0.703 J	7.44	46.6	0.273 U	7,840	0.086 J	230,000	1.2 U	110	1.95 J	793	0.45 U	13.5	46,600	26,200	0.13 U	4.17 J	51.1

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals							
			Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L
Screening Levels						100		2	86	5000
OBS-1	WBF-GW-OBS-1-1430-20240617	6/17/2024	1,420	1.53 U	15,700	0.223 U	36,400	0.472 U	0.776 U	15.8
	WBF-GW-OBS-1-1010-20240625	6/25/2024	1,410	1.53 U	13,900	0.223 U	36,800	0.472 U	0.776 U	26.3 U*
	WBF-GW-OBS-1-1510-20240701	7/1/2024	1,600	1.53 U	13,000	0.223 U	47,000	0.472 U	0.776 U	15.8
	WBF-GW-OBS-1-1300-20240708	7/8/2024	1,280	1.53 U	14,600	0.223 U	30,800	0.472 U	0.776 U	17.1
	WBF-GW-OBS-1-0905-20240716	7/16/2024	1,390	1.53 U	14,400	0.223 U	32,300	0.472 U	0.776 U	27.4
	WBF-GW-OBS-1-0900-20240723	7/23/2024	1,260	1.53 U	13,200	0.223 U	30,000	0.472 U	0.776 U	14.8 J
	WBF-GW-OBS-1-0910-20240730	7/30/2024	1,180	1.53 U	14,100	0.223 U	28,400	0.472 U	0.776 U	13.1 J
	WBF-GW-OBS-1-1400-20240806	8/6/2024	1,270	1.53 U	14,700	0.223 U	30,800	0.472 U	0.776 U	7.86 J
	WBF-GW-OBS-1-1505-20240814	8/14/2024	1,390	1.53 U	13,900	0.223 U	39,000	0.472 U	0.776 U	6 U
	WBF-GW-OBS-1-1705-20240820	8/20/2024	1,250 J	1.53 U	14,500	0.223 U	28,200	0.472 U	0.776 U	10.3 J
	WBF-GW-OBS-1-1415-20240903	9/3/2024	1,220	1.53 U	15,400	0.323 J	28,900	0.472 U	0.776 U	12 J
	WBF-GW-OBS-1-1625-20240910	9/10/2024	1,150	3.53 J	15,300	0.053 U	25,500	0.638 J	0.82 U	15 U
	WBF-GW-OBS-1-1505-20240919	9/19/2024	1,180 U*	0.89 U	15,600	0.053 U	27,100	0.508 U	0.82 U	15 U
	WBF-GW-OBS-1-0905-20240924	9/24/2024	1,170	0.89 U	14,800	0.053 U	26,000	0.508 U	0.82 U	15 U
	WBF-GW-OBS-1-1445-20241007	10/7/2024	1,320	0.89 U	16,100 J	0.053 U	27,400	0.508 U	0.82 U	15 U
	WBF-GW-OBS-1-1305-20241022	10/22/2024	1,270	0.89 U	15,400	0.053 U	28,100	0.508 U	0.82 U	15 U
	WBF-GW-OBS-1-1555-20241104	11/4/2024	1,200	0.89 U	17,200	0.053 U	25,600	0.508 U	0.82 U	15 U
	WBF-GW-OBS-1-1415-20241118	11/18/2024	1,130 J	0.89 U	15,900	0.053 U	24,800	0.508 U	0.82 U	15 U
	WBF-GW-OBS-1-0920-20241125	11/25/2024	1,280	0.89 U	15,400	0.053 U	24,000	0.508 U	0.82 U	21.2
	WBF-GW-OBS01-1445-20250603	6/3/2025	1,590	0.89 U	16,600	0.053 U	26,800	0.508 U	0.82 U	46.7
	WBF-GW-OBS01-0855-20250610	6/10/2025	1,660	0.89 U	17,700	0.053 U	27,300	0.508 U	0.82 U	50.2
	WBF-GW-OBS01-1355-20250616	6/16/2025	1,660	0.89 U	16,700	0.053 U	28,500	0.508 U	0.82 U	55.9
	WBF-GW-OBS01-0815-20250624	6/24/2025	1,520	0.89 U	13,800	0.053 U	26,400	0.508 U	0.82 U	41.4
	WBF-GW-OBS01-1320-20250630	6/30/2025	1,520	0.89 U	14,200	0.053 U	25,300	0.508 U	0.82 U	22
	WBF-GW-OBS01-0950-20250708	7/8/2025	1,450	0.89 U	16,500	0.053 U	24,600	0.508 U	0.82 U	16.8 U*
	WBF-GW-OBS01-1305-20250714	7/14/2025	1,410	0.89 U	17,000	0.053 U	23,800	0.508 U	0.82 U	15 U
	WBF-GW-OBS01-1340-20250721	7/21/2025	1,550	0.89 U	15,900	0.053 U	25,100	0.508 U	0.82 U	20.2
	WBF-GW-OBS01-1445-20250728	7/28/2025	1,630	0.89 U	17,000	0.053 U	26,400	0.508 U	0.82 U	21.2
IW-2	WBF-GW-IW-2-1655-20240617	6/17/2024	8,640	1.53 U	8,690	0.223 U	422,000	0.472 U	32.1	6 U
	WBF-GW-IW-2-1130-20240625	6/25/2024	7,860	1.53 U	15,600	0.223 U	176,000	0.472 U	0.985 J	57.2
	WBF-GW-IW-2-0845-20240702	7/2/2024	5,970	1.53 U	17,000	0.223 U	102,000	0.472 U	0.776 U	75.4
	WBF-GW-IW-2-0825-20240709	7/9/2024	4,230 J	1.53 U	19,200	0.223 U	83,300	0.472 U	0.776 U	136 J
	WBF-GW-IW-2-1035-20240716	7/16/2024	7,130 J	1.53 U	18,400	0.223 U	80,400 J	0.472 U	0.776 U	121 J
	WBF-GW-IW-2-1410-20240722	7/22/2024	6,590	1.53 U	16,100	0.223 U	62,700	0.472 U	0.776 U	139 J
	WBF-GW-IW-2-1010-20240730	7/30/2024	6,880	1.53 U	18,600	0.223 U	56,500	0.472 U	0.776 U	157 J
	WBF-GW-IW-2-1240-20240806	8/6/2024	7,010	1.53 U	18,900	0.223 U	55,000	0.472 U	0.776 U	153
	WBF-GW-IW-2-1400-20240814	8/14/2024	7,230	1.53 U	19,200	0.223 U	49,100	0.472 U	0.776 U	191
	WBF-GW-IW-2-1515-20240820	8/20/2024	7,340	1.53 U	18,900	0.223 U	48,400	0.472 U	0.776 U	221
	WBF-GW-IW-2-0900-20240904	9/4/2024	10,000	1.53 U	19,100	0.223 U	73,500	0.472 U	0.776 U	216
	WBF-GW-IW-2-1510-20240910	9/10/2024	10,100 J	0.89 U	18,700 J	0.053 U	49,100 J	0.508 U	0.82 U	115
	WBF-GW-IW-2-1340-20240919	9/19/2024	10,500	0.89 U	17,400	0.053 U	53,300	0.508 U	0.82 U	114
	WBF-GW-IW-2-1525-20240923	9/23/2024	10,900	0.89 U	16,500	0.053 U	53,100	0.508 U	0.82 U	129
	WBF-GW-IW-2-1600-20241007	10/7/2024	3,650	6.1	39,600	0.053 U	2,590,000	0.508 U	327	15 U
	WBF-GW-IW-2-1155-20241022	10/22/2024	4,910	0.89 U	12,900	0.053 U	1,290,000	0.508 U	26.5	15 U
	WBF-GW-IW-2-1405-20241104	11/4/2024	7,200	1.16 J	17,700	0.059 J	199,000	0.695 J	0.834 J	20.2
	WBF-GW-IW-2-1540-20241118	11/18/2024	3,350 J	2.21 J	12,800	0.053 U	1,400,000	0.509 J	65.7	15 U
	WBF-GW-IW-2-1055-20241125	11/25/2024	6,180	2.03 U*	15,000	0.053 U	1,080,000	0.508 U	63.1	15 U
	WBF-GW-IW02-1305-20250603	6/3/2025	6,840	0.89 U	21,000	0.053 U	94,700	0.508 U	0.82 U	15 U
	WBF-GW-IW02-1615-20250609	6/9/2025	6,090	1.67 J	17,900	0.053 U	1,020,000	0.508 U	74	15 U
	WBF-GW-IW02-0835-20250617	6/17/2025	7,380	0.89 U	14,900	0.053 U	338,000	0.508 U	2.5 J	15 U
	WBF-GW-IW02-0900-20250624	6/24/2025	7,700	0.89 U	15,200	0.053 U	293,000	0.508 U	1.04 J	26.6
	WBF-GW-IW02-1425-20250630	6/30/2025	3,830	2.61 J	14,100	0.053 U	1,600,000	0.508 U	77.6	15 U
	WBF-GW-IW02-1100-20250708	7/8/2025	6,670	0.89 U	8,450	0.053 U	438,000	0.508 U	5.19	15 U
	WBF-GW-IW02-1410-20250714	7/14/2025	5,400	3.21 J	26,000	0.053 U	1,790,000	0.508 U	120	15 U
	WBF-GW-IW02-1520-20250721	7/21/2025	4,490	5.19	36,600 J	0.053 U	2,440,000	0.508 U	169	15 U
	WBF-GW-IW02-1550-20250728	7/28/2025	4,200	6.68	40,100	0.083 J	2,550,000	0.508 U	179	15 U
	WBF-GW-IW-2-1410-20250805	8/5/2025	6,970	2.89 J	21,500	0.053 U	1,160,000	0.508 U	91.4	15 U
	WBF-GW-IW-2-0925-20250811	8/11/2025	7,220	0.89 UJ	14,300 J	0.053 U	606,000	0.508 U	42.4	15 U
	WBF-GW-IW-2-0955-20250819	8/19/2025	8,140	1.27 J	12,700	0.053 U	419,000	0.508 U	23	15 U
	WBF-GW-IW02-0835-20250825	8/25/2025	8,720	1.4 J	15,500	0.053 U	344,000	0.508 U	16.6	15 U

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals																		
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L	Nickel ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100	100
DUP-01 (IW-2 Duplicate)	WBF-GW-DUP01-20240618	6/18/2024	108	0.967 U	2.36	26.2	0.4 J	7,340	0.732 J	467,000	1.53 U	485	1.14 U	15,100	0.376 U	13.2	40,500	53,500	0.13 U	0.61 U	86.6
	WBF-GW-DUP01-20240624	6/24/2024	368	0.967 U	1.19	29.3	0.787 J	7,760	9.71	465,000	1.53 U	802	1.64 J	1,180	0.778 U*	14.7	39,900 J	56,900	0.13 U	0.61 U	138
	WBF-GW-DUP01-20240702	7/2/2024	2860	0.967 U	7.16	18.4 J	16.6	7,600	8.17	451,000	1.53 U	872	1.14 U	1,480	1.04	32.5	35,100	49,400	0.13 U	0.61 U	152
	WBF-GW-DUP01-20240709	7/9/2024	147 U*	0.967 U	1.88	22.2	0.506 J	6,920	0.217 U	417,000	1.53 U	480	1.14 U	11,500	0.376 U	26.1 J	32,800	48,800	0.13 U	0.61 U	92.9
	WBF-GW-DUP01-20240716	7/16/2024	96.1 J	0.967 U	3.13	19.5 J	0.274 U	3,260	0.217 U	456,000	1.53 U	61.2 J	1.14 U	4,640	0.376 U	4.15 J	59,100	28,200	0.13 U	0.61 U	18.3
	WBF-GW-DUP01-20240723	7/23/2024	213	0.967 U	2.25 J	25.9	0.699 J	8,510	0.217 U	442,000	1.53 U	579	1.14 U	12,400	0.376 U	19.2 J	39,000 J	63,100 J	0.13 U	0.61 U	103
	WBF-GW-DUP01-20240729	7/29/2024	587	0.967 U	1.21	25.9	3.55	7,830	2.64	427,000	1.53 U	830	1.14 U	1,980	0.376 U	22.5	40,100	51,700	0.13 U	0.61 U	145
	WBF-GW-DUP01-20240805	8/5/2024	604	0.967 U	1.4	27.9	3.23	7,970	2.29	471,000 J	1.53 U	808	1.14 U	2,090	0.376 U	22.6	40,300	54,700	0.13 U	0.61 U	140
	WBF-GW-DUP01-20240813	8/13/2024	691	0.967 U	1.45	25.9	4.76	7,820	2.37	476,000	1.53 U	764	1.14 U	2,070	0.376 U	19	38,700	54,000	0.13 U	0.61 U	133
	WBF-GW-DUP01-20240819	8/19/2024	685	0.967 U	1.31 U*	25.6	3.94	7,970	2.04	461,000	1.53 U	757	1.85 J	2,000	0.376 U	22.1	38,400	52,400	0.13 U	0.61 U	126
	WBF-GW-DUP01-20240904	9/4/2024	486	0.967 U	1.88	28	2.23	7,280	0.387 J	416,000	1.74 J	507	2.06	9,360	0.622 J	23.3	37,600	43,500	0.13 U	0.955 J	93.7
	WBF-GW-DUP01-20240909	9/9/2024	799	0.57 U	0.75 U	26.1	5.62	7,800	4.11	433,000	1.2 U	746	1.7 U	1,440	0.45 U	25.6	38,600	54,500	0.13 U	1.08 U	123
	WBF-GW-DUP01-20240918	9/18/2024	71.3	0.57 U	1.58 J	19.8	0.294 J	7,170	0.969 J	441,000	1.2 U	539	1.7 U	7,110	0.45 U	6.19 J	39,900	64,100	0.13 U	1.08 U	98.1
	WBF-GW-DUP01-20240924	9/24/2024	23.4 J	0.57 U	1.53 J	17	0.273 U	3,600	0.077 U	441,000	1.2 U	57.4	1.7 U	5,110	0.45 U	4.4 J	66,200	25,700	0.13 U	1.08 U	17.7
	WBF-GW-DUP01-20241007	10/7/2024	55800	0.57 U	61	10.3	0.273 U	5,250	0.077 U	17,500	3.83 J	21.9	69.9	64 J	0.45 U	3.44 U	61 U	53	0.226 U*	20.4	87.4
	WBF-GW-DUP01-20241021	10/21/2024	59.1	0.57 U	1.31 J	21.6	0.376 J	7,800	1.86	456,000	1.2 U	543	1.7 U	7,230	0.45 U	7.03 J	39,600	56,700	0.13 U	1.08 U	100
	WBF-GW-DUP01-20241104	11/4/2024	15.1 J	0.57 U	1.53 J	16.1	0.273 U	4,470	0.077 U	445,000	1.2 U	66.4	1.7 U	4,120	0.45 U	3.44 U	64,600	29,500 J	0.178 U*	1.08 U	17.3
	WBF-GW-DUP01-20241118	11/18/2024	23.1 J	0.57 U	1.38 J	15.8	0.273 U	3,150	0.104 U*	433,000	1.2 U	62.8	1.7 U	3,960 J	0.45 U	4.32 J	66,100 J	28,600	0.13 U	1.08 U	18.2
	WBF-GW-DUP01-20241125	11/25/2024	6670	0.57 U	8.44	9.29	0.273 U	6,590	0.077 U*	75,100 J	1.2 U	3.59	10.5	47 U	0.45 U	3.44 U	61 U	177 U	0.13 U	4.6 J	22.6
	WBF-GW-DUP01-20250603	6/3/2025	42.6 J	0.57 U	0.974 J	51.5	0.273 U	7,670	0.077 U	493,000	1.2 U	291	1.7 U	8,710	0.45 U	10	43,600	57,000	0.13 U	1.08 U	64.6
	WBF-GW-DUP01-20250610	6/10/2025	20.4 J	0.57 U	0.75 U	14.3	0.273 U	4,620	0.077 U	411,000	1.2 U	116	1.7 U	6,110	0.45 U	5.9 J	58,000	30,500	0.13 U	1.08 U	26.2
	WBF-GW-DUP01-20250617	6/17/2025	56.2	0.57 U	0.75 U	49.6	0.273 UJ	7,190	0.077 U	340,000	1.2 U	181	1.7 U	105	0.45 U	16.5 J	53,000	39,400	0.13 U	1.08 U	73
	WBF-GW-DUP01-20250623	6/23/2025	860	0.57 U	0.75 U	27.5	9.88	7,150	5.63	410,000	1.2 U	666	1.7 U	11,700	0.799 J	21	37,000	49,200	0.13 U	1.08 U	110
	WBF-GW-DUP01-20250630	6/30/2025	26.5 J	0.57 U	0.836 J	13.7	0.276 J	4,100	0.077 U	433,000 J	1.2 U	95.7	1.7 U	5,750	0.45 U	3.44 U	64,700	26,500	0.13 U	1.08 U	24.7
	WBF-GW-DUP01-20250707	7/7/2025	17.5 J	0.57 U	1.29 J	15.6	0.273 U	6,000	0.164 J	332,000	1.21 J	90.3	1.7 U	7,670	0.45 U	3.44 U	37,000	30,800	0.13 U	1.08 U	25.9
	WBF-GW-DUP01-20250714	7/14/2025	23900	0.57 U	67.2	3.89 J	0.273 U	5,810	0.077 U	42,000	2.52 J	7.05	23.1	47 U	0.45 U	3.44 U	61 U	47	0.13 U	7.83	44.3
	WBF-GW-DUP01-20250721	7/21/2025	38500	0.57 U	93.9	2.4 J	0.273 U	6,060	0.082 J	17,200	3.88 J	12.2	51.6	47 U	0.45 U	3.44 U	61 U	61	0.13 U	12.1	73.3
	WBF-GW-DUP01-20250728	7/28/2025	31.9 U*	0.57 U	0.833 J	13.9	0.305 J	4,500	0.077 U	429,000	1.2 U	102	1.7 U	5,550	0.45 U	4.96 J	65,800	28,900	0.13 U	1.08 U	25.7
	WBF-GW-DUP01-20250805	8/5/2025	14700	0.57 U	26	9.19	0.273 U	6,940 J	0.077 U	57,200	1.2 U	4.83	15.7	47 U	0.45 U	4.77 J	61 U	42	0.13 U	8.12	45.2
	WBF-GW-DUP01-20250811	8/11/2025	2010	0.57 U	5.73	5.8	0.273 U	7,010	0.077 UJ	43,500 J	1.2 U	2.86	6.85	47 U	0.45 U	9.93	251 J	29 J	0.13 U	5.78	27.1
	WBF-GW-DUP01-20250819	8/19/2025	13.5 J	0.57 U	0.849 J	48.9	0.273 U	7,320	0.077 U	196,000	1.2 U	6.95	1.7 U	47 U	0.45 U	7.37 J	50,100	9,130	0.13 U	1.08 U	7.22
	WBF-GW-DUP01-20250825	8/25/2025	12 U	0.57 U	1.22 J	16.1	0.273 U	6,680	0.539 J	378,000	1.2 U	90.5	1.7 U	8,440	0.45 U	3.44 U	40,700	35,000	0.13 U	1.08 U	26.1
IW-03	WBF-GW-IW-3-1515-20250805	8/5/2025	2100	0.57 U	6.97	24.8	0.273 U	6,580	0.119 J	84,600	1.2 U	0.625 J	3.78	47 U	0.45 U	3.44 U	61 U	4 U	0.13 U	2.3 J	7.57
	WBF-GW-IW-3-1025-20250811	8/11/2025	52.5	0.57 U	3.3 J	16.1	0.273 U	7,070	0.077 UJ	52,100 J	1.2 U	0.561 J	2.34	47 U	0.45 U	5.29 J	61 U	4 U	0.13 U	1.55 J	5.69
	WBF-GW-IW-3-1050-20250819	8/19/2025	17.9 J	0.57 U	0.831 J	48.9	0.273 U	7,870	0.077 U	195,000	1.2 U	6.75	1.7 U	47 U	0.45 U	7.13 J	49,800	9,140	0.13 U	1.08 U	7.43
	WBF-GW-IW03-0925-20250825	8/25/2025	12 U	0.57 U	1.31 J	68.2	0.273 U	8,130	0.077 U	269,000	1.95 J	18.4	1.7 U	47 U	0.45 U	8	61,800	18,600	0.13 U	1.08 U	11.7
OBS-2	WBF-GW-OBS-2-0955-20240618	6/18/2024	110	0.967 U	2.07	23.6	0.424 J	7,430	0.587 J	455,000	1.53 U	490	1.14 U	15,300	0.376 U	12.7	40,200	49,600	0.13 U	0.61 U	85.6
	WBF-GW-OBS-2-1235-20240625	6/25/2024	146	0.967 U	2.14	26.7	0.436 J	7,100	0.292 J	450,000	1.53 U	611	2.18	11,900	0.571 U*	13.8	44,500 J	52,300	0.13 U	0.61 U	111
	WBF-GW-OBS-2-1005-20240702	7/2/2024	161	0.967 U	2.11	23.2 J	0.516 J	7,150	0.217 U	441,000	1.53 U	582	1.14 U	13,100	0.376 U	15.1	38,300	49,300	0.13 U	0.61 U	101
	WBF-GW-OBS-2-0940-20240709	7/9/2024	157 U*	0.967 U	1.81	24	0.546 J	7,340	0.217 U	439,000	1.53 U	524	1.14 U	11,500	0.376 U	27.5 J	35,200	47,600	0.13 U	0.61 U	100
	WBF-GW-OBS-2-1145-20240716	7/16/2024	227	0.967 U	1.8	29.5 J	0.705 J	7,140	0.217 U	535,000 J	1.53 U	664 J	1.14 U	11,500	0.376 U	20.8 J	41,500	47,900	0.13 U	0.61 U	121 J
	WBF-GW-OBS-2-1045-20240723	7/23/2024	222	0.967 U	2.24 J	27.9	0.856 J	8,660	0.217 U	435,000 J	1.53 U	579 J	1.14 U	12,300	0.376 U	19.3 J	40,600 J	62,100 J	0.13 U	0.61 U	101
	WBF-GW-OBS-2-1135-20240730	7/30/2024	266	0.967 U	1.53	24.8	1.01	7,260	0.217 U	413,000	1.53 U	551	1.14 U	12,500	0.376 U	20.5	41,300	48,600	0.13 U	0.61 U	102
	WBF-GW-OBS-2-1130-20240806	8/6/2024	275	0.967 U	1.49	25.9	0.892 J	6,880	0.217 U	433,000 J	1.53 U	553	1.14 U	12,700	0.376 U	20.4	38,900	47,000	0.13 U	0.61 U	103
	WBF-GW-OBS-2-1145-20240814	8/14/2024	392	0.967 U	1.06	24.4	1.36	7,050	0.217 U	431,000	1.53 U	577	1.14 U	9,980	0.376 U	18.1	37,600	48,100	0.13 U	0.61 U	104
	WBF-GW-OBS-2-1415-20240820	8/20/2024	340	0.967 U	1.52 U*	24.9	1.14	7,270	0.217 U	421,000	1.53 U	527	1.14 U	12,700	0.376 U	21.1	38,300	46,900	0.13 U	0.61 U	96.3
	WBF-GW-OBS-2-1030-20240904	9/4/2024	480	0.967 U	1.84	28.8	1.93	7,120	0.475 J	415,000	1.59 J	515	1.34 J	9,380	0.603 J	22.5	37,000	43,200	0.13 U	1.08 J	94.4
	WBF-GW-OBS-2-1425-20240910	9/10/2024	139	0.57 U	2.88 J	18.1	0.613 J	10,400 J	0.077 U	284,000	1.2 U	334	1.7 U	7,110	0.45 U	16.7	26,100	59,800 J	0.13 U	1.12 J	62.6
	WBF-GW-OBS-2-1200-20240919	9/19/2024	433	0.57 U	1.88 J	25.2	3.31	6,060	0.191 J	361,000	1.2 U	534	1.7 U	5,440	0.45 U	23.8	32,000	45,500	0.13 U	1.08 U	97.7
	WBF-GW-OBS-2-1050-20240924	9/24/2024	421	0.57 U	1.77 J	29	3.65	7,340	0.077 U	367,000	1.2 U	465 J	1.7 U	7,880	0.45 U	23.5	32,000	42,600	0.13 U	1.08 U	86.1 J
	WBF-GW-OBS-2-0850-20241008	10/8/2024	603	0.57 U	1.36 J	28.7	5.27	7,330	0.077 U	405,000	1.2 U	566	1.7 U	6,300	0.45 U	27	35,700	43,200	0.13 U*	1.08 U	96.3
	WBF-GW-OBS-2-1100-20241022	10/22/2024	980	0.57 U	0.75 U	31.9	9.94	7,840	0.211 U*	400,000	1.2 U	584	1.7 U	4,490	0.45 U	28.9	35,100	50,500	0.13 U	1.08 U	102
	WBF-GW-OBS-2-0845-20241105	11/5/2024	903	0.57 U	1.33 J	33.3	10.7	8,400 J	0.238 J	374,000	1.2 U	570	1.7 U	5,820	0.45 U	26.8	32,600	48,900 J	0.13 U*	1.08 U	88.2
	WBF-GW-OBS-2-0915-20241119	11/19/2024	904	0.57 U	0.75 U	32.3	11.9	7,150	0.077 U	357,000	1.2 U	487	1.7 U	6,820 J	0.45 U	26.6	28,800 J	45,100	0.13 U	1.08 U	85
	WBF-GW-OBS-2-1245-20241125	11/25/2024	1230	0.57 U	1.11 J	30	17.1	7,340	0.311 U*	363,000	1.2 U	579	1.7 U	8,160	0.45 U	24.5	33,100	41,300	0.13 U	1.08 U	93.6
	WBF-GW-OBS02-1515-20250610	6/10/2025	1240	0.57 U	0.75 U	18.2	5.79	7,520	1.05	379,000	1.2 U	317	1.7 U	27,500	0.45 U	15.6	34,000	39,500	0.13 U	1.08 U	60.2
	WBF-GW-OBS02-1135-20250701	7/1/2025	380 J	0.57 U	1.8 J	22.6	2.74	7,300	0.077 U	364,000 J	1.2 U	269	1.7 U	21,900	0.45 U	10.7	35,100	30,400	0.13 U	1.08 U	53.5
	WBF-GW-OBS02-1220-20250715	7/15/2025	6080	0.57 U	5.52	2.77 J	0.273 U	6,730	0.077 U	117,000	1.2 U	0.295 J	1.7 U	47 U	0.45 U	9.45	151 J	8	0.13 U	1.77 J	7.42
	WBF-GW-OBS02-1405-20250722	7/22/2025	9960	0.57 U	6	3.17 J	0.273 U	6,940	0.077 U	77,300	1.2 U	0.306 J	1.7 U	47 U	0.45 U	10.1	61 U	9	0.13 U	1.5 J	9.45
	WBF-GW-OBS02-1310-20250729	7/29/2025	5300	0.57 U	3.75 J	3.49 J	0.273 U	7,010	0.077 U	90,800	1.2 U	0.382 J	1.7 U	47 U	0.45 U	9.59	98 J	23	0.13 U	1.19 J	6.73
	WBF-GW-OBS-2-1015-20250805	8/5/2025	83.2	0.57 U	1.55 J	24.6	1.49	7,250	0.077 U	280,000	1.2 U	198	1.7 U	20,200	0.45 U	9.79	28,900	22,900	0.13 U	1.08 U	40.7
	WBF-GW-OBS-2-1340-20250811	8/11/2025	172	0.57 U	1.34 J	7.24	0.273 U	6,160	0.077 UJ	155,000 J	1.2 U	2.47	1.7 U	47 U	0.45 U	10.7	13,700	510	0.13 U	1.15 J	7.05
	WBF-GW-OBS-2-1245-20250819	8/19/2025	12 U	0.57 U	1.81 J	9.61	0.273 U	6,630	0.077 U	168,000	1.2 U	47.8	1.7 U	888	0.45 U	9.02	18,500	9,290	0.13 U	1.3 J	20.3
	WBF-GW-OBS02-1425-20250825	8/25/2025	611	0.57 U	8.74	5.91	0.273 U	6,520	0.077 U	104,000	1.2 U	0.729 J	1.7 U	47 U	0.45 U	5.17 J	456 J	24	0.13 U	3.16 J	14

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals							
			Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L
Screening Levels						100		2	86	5000
DUP-01 (IW-2 Duplicate)	WBF-GW-DUP01-20240618	6/18/2024	6,200	1.53 U	19,500	0.223 U	27,800	0.472 U	0.776 U	310
	WBF-GW-DUP01-20240624	6/24/2024	11,600	1.53 U	20,500	0.223 U	27,700	0.472 U	0.776 U	479
	WBF-GW-DUP01-20240702	7/2/2024	14,800	1.53 U	17,800	0.223 U	19,200	0.472 U	0.776 U	556
	WBF-GW-DUP01-20240709	7/9/2024	4,890 J	1.53 U	18,200	0.223 U	34,400	0.472 U	0.905 J	265 J
	WBF-GW-DUP01-20240716	7/16/2024	1,260	1.53 U	14,700	0.223 U	32,700	0.472 U	0.776 U	18.1
	WBF-GW-DUP01-20240723	7/23/2024	7,810 J	1.53 U	16,200	0.223 U	54,300 J	0.472 U	1.15	109 J
	WBF-GW-DUP01-20240729	7/29/2024	11,100	1.53 U	20,500	0.223 U	22,800	0.472 U	0.776 U	474 J
	WBF-GW-DUP01-20240805	8/5/2024	12,900	1.53 U	21,700	0.223 U	26,400	0.472 U	0.776 U	460
	WBF-GW-DUP01-20240813	8/13/2024	12,800	1.53 U	20,600	0.223 U	24,100	0.472 U	0.776 U	482
	WBF-GW-DUP01-20240819	8/19/2024	12,700	1.53 U	21,200	0.223 U	24,000	0.472 U	0.776 U	453
	WBF-GW-DUP01-20240904	9/4/2024	8,700	1.53 U	19,200	0.223 U	87,300	0.472 U	4.32	34.8
	WBF-GW-DUP01-20240909	9/9/2024	13,300	0.89 U	21,600	0.053 U	24,500	0.508 U	0.82 U	418
	WBF-GW-DUP01-20240918	9/18/2024	6,360	0.89 U	22,700	0.053 U	27,400	0.508 U	0.82 U	197
	WBF-GW-DUP01-20240924	9/24/2024	1,160	0.89 U	14,300	0.053 U	26,000	0.508 U	0.82 U	15 U
	WBF-GW-DUP01-20241007	10/7/2024	3,550	4.91 J	39,000	0.053 U	2,460,000	0.508 U	334	15 U
	WBF-GW-DUP01-20241021	10/21/2024	7,470	0.89 U	21,800	0.053 U	29,600	0.508 U	0.82 U	212
	WBF-GW-DUP01-20241104	11/4/2024	1,170	0.89 U	17,000	0.053 U	25,400	0.508 U	0.82 U	15 U
	WBF-GW-DUP01-20241118	11/18/2024	1,140 J	0.89 U	16,200	0.053 U	25,300	0.508 U	0.82 U	15 U
	WBF-GW-DUP01-20241125	11/25/2024	6,240	1.92 J	13,500	0.053 U	1,070,000	0.508 U	63.2	15 U
	WBF-GW-DUP01-20250603	6/3/2025	6,870	0.89 U	21,400	0.053 U	95,500	0.508 U	0.82 U	15 U
	WBF-GW-DUP01-20250610	6/10/2025	1,630	0.89 U	17,300	0.053 U	27,300	0.508 U	0.82 U	49.8
	WBF-GW-DUP01-20250617	6/17/2025	7,320	0.89 U	14,400	0.053 U	338,000	0.508 U	2.42 J	15 U
	WBF-GW-DUP01-20250623	6/23/2025	12,300	0.89 U	13,200 J	0.053 U	25,400	0.508 U	0.82 U	437
	WBF-GW-DUP01-20250630	6/30/2025	1,500	0.89 U	14,500	0.053 U	24,700	0.508 U	0.82 U	26.3
	WBF-GW-DUP01-20250707	7/7/2025	1,600	0.89 U	15,100	0.053 U	156,000	0.508 U	0.82 U	29.6 U*
	WBF-GW-DUP01-20250714	7/14/2025	5,210	2.88 J	22,900	0.053 U	1,630,000	0.508 U	119	15 U
	WBF-GW-DUP01-20250721	7/21/2025	4,660	5.09	35,700	0.053 U	2,450,000	0.508 U	173	15 U
	WBF-GW-DUP01-20250728	7/28/2025	1,640	0.89 U	16,800	0.053 U	26,700	0.508 U	0.82 U	20
	WBF-GW-DUP01-20250805	8/5/2025	6,950	2.94 J	19,600	0.053 U	1,310,000 J	0.508 U	92.6	15 U
	WBF-GW-DUP01-20250811	8/11/2025	8,290	0.89 UJ	9,910 J	0.053 U	707,000	0.508 U	48.4	15 U
	WBF-GW-DUP01-20250819	8/19/2025	7,950	0.89 U	10,500	0.053 U	329,000	0.508 U	2.07 J	15 U
	WBF-GW-DUP01-20250825	8/25/2025	1,820	0.89 U	16,000	0.053 U	126,000	0.508 U	0.82 U	25.7
IW-03	WBF-GW-IW-3-1515-20250805	8/5/2025	6,770	1.51 J	20,400 J	0.053 U	1,610,000 J	0.508 U	27.1	15 U
	WBF-GW-IW-3-1025-20250811	8/11/2025	7,660	1 J	22,700	0.053 U	1,270,000	0.508 U	26	15 U
	WBF-GW-IW-3-1050-20250819	8/19/2025	8,080	0.89 U	10,900	0.053 U	344,000	0.508 U	2.24 J	15 U
	WBF-GW-IW03-0925-20250825	8/25/2025	8,730	0.89 U	14,000	0.053 U	256,000	0.508 U	1.3 J	15 U
OBS-2	WBF-GW-OBS-2-0955-20240618	6/18/2024	6,130	1.53 U	18,800	0.223 U	27,800	0.472 U	0.776 U	315
	WBF-GW-OBS-2-1235-20240625	6/25/2024	6,950	1.53 U	19,200	0.223 U	29,300	0.472 U	0.776 U	341
	WBF-GW-OBS-2-1005-20240702	7/2/2024	6,770	1.53 U	17,700	0.223 U	32,700	0.472 U	0.776 U	252
	WBF-GW-OBS-2-0940-20240709	7/9/2024	5,000 J	1.53 U	19,000	0.223 U	37,100	0.472 U	0.832 J	261 J
	WBF-GW-OBS-2-1145-20240716	7/16/2024	8,540 J	1.53 U	18,500	0.223 U	48,700	0.472 U	1.23 J	176 J
	WBF-GW-OBS-2-1045-20240723	7/23/2024	7,900 J	1.53 U	17,000	0.223 U	53,500 J	0.472 U	1.09	111 J
	WBF-GW-OBS-2-1135-20240730	7/30/2024	8,220	1.53 U	18,700	0.223 U	43,500	0.472 U	0.776 U	29.3 J
	WBF-GW-OBS-2-1130-20240806	8/6/2024	8,620	1.53 U	19,300	0.223 U	50,100	0.472 U	0.776 U	12.4 J
	WBF-GW-OBS-2-1145-20240814	8/14/2024	8,920	1.53 U	18,500	0.223 U	41,200	0.472 U	0.776 U	13.9 J
	WBF-GW-OBS-2-1415-20240820	8/20/2024	8,910	1.53 U	19,000	0.223 U	55,700	0.472 U	0.776 U	15.6
	WBF-GW-OBS-2-1030-20240904	9/4/2024	8,780	1.53 U	19,300	0.223 U	85,500	0.472 U	4.23	37.5
	WBF-GW-OBS-2-1425-20240910	9/10/2024	7,180	0.89 U	16,600	0.053 U	155,000	0.508 U	5.85	32.9
	WBF-GW-OBS-2-1200-20240919	9/19/2024	9,600	0.89 U	18,100	0.053 U	86,500 J	0.508 U	3.35 J	160
	WBF-GW-OBS-2-1050-20240924	9/24/2024	9,580	0.89 U	16,600	0.053 U	125,000	0.508 U	2.02 J	126
	WBF-GW-OBS-2-0850-20241008	10/8/2024	11,100	0.89 U	19,700	0.053 U	129,000	0.508 U	3.41 J	136
	WBF-GW-OBS-2-1100-20241022	10/22/2024	11,900	0.89 U	19,000	0.053 U	73,300	0.508 U	1.2 J	349
	WBF-GW-OBS-2-0845-20241105	11/5/2024	11,800	0.89 U	19,800	0.053 U	121,000	0.508 U	1.45 J	233
	WBF-GW-OBS-2-0915-20241119	11/19/2024	11,200 J	0.89 U	17,300	0.053 U	154,000	0.508 U	1.57 J	216
	WBF-GW-OBS-2-1245-20241125	11/25/2024	12,800	4.63 J	15,900	0.053 U	106,000	0.508 U	0.995 J	268
	WBF-GW-OBS02-1515-20250610	6/10/2025	10,000	0.89 U	13,800	0.053 U	61,400	0.508 U	0.82 U	199
	WBF-GW-OBS02-1135-20250701	7/1/2025	10,900	0.89 U	15,200	0.053 U	168,000	0.508 U	2.52 J	175
	WBF-GW-OBS02-1220-20250715	7/15/2025	10,500	0.89 U	24,100	0.053 U	817,000	0.508 U	60.7	15 U
	WBF-GW-OBS02-1405-20250722	7/22/2025	11,300	0.89 U	27,000	0.053 U	1,150,000	0.508 U	78.5	15 U
	WBF-GW-OBS02-1310-20250729	7/29/2025	10,800	0.89 U	20,800	0.053 U	864,000	0.508 U	12.9	15 U
	WBF-GW-OBS-2-1015-20250805	8/5/2025	10,900	0.89 U	12,900	0.053 U	299,000 J	0.508 U	1.13 J	77.8
	WBF-GW-OBS-2-1340-20250811	8/11/2025	9,850	0.89 UJ	13,200	0.053 U	437,000	0.508 U	2.65 J	15 U
	WBF-GW-OBS-2-1245-20250819	8/19/2025	9,820	0.89 U	16,800	0.053 U	469,000	0.508 U	0.82 U	15 U
	WBF-GW-OBS02-1425-20250825	8/25/2025	8,580	0.89 U	31,700	0.053 U	801,000	0.508 U	18.6	15 U

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals																		
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L	Nickel ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100	100
OBS-3	WBF-GW-OBS-3-0935-20240619	6/19/2024	2930	0.967 U	7.65	19.5	18.1	7,590	9.72	446,000	1.53 U	820	1.14 U	896	1.04	33.1	34,100	53,100	0.13 U	0.61 U	128
	WBF-GW-OBS-3-1340-20240625	6/25/2024	2950	0.967 U	7.56	21.4	15.7	7,490	9.82	444,000	1.53 U	902	1.49 J	1,490	1.43 U*	31.7	38,900 J	52,200	0.13 U	0.61 U	155
	WBF-GW-OBS-3-1140-20240702	7/2/2024	2880	0.967 U	6.89	18.7 J	16.6	7,750	7.94	449,000	1.53 U	900	1.14 U	1,370	0.964 J	32.8	35,100	52,600	0.13 U	0.61 U	129
	WBF-GW-OBS-3-1100-20240709	7/9/2024	2740	0.967 U	2.71	18.9	15.9	8,090	7.8	448,000	1.53 U	769	1.14 U	1,060	0.791 J	44 J	31,300	50,100	0.13 U	0.61 U	126
	WBF-GW-OBS-3-0855-20240717	7/17/2024	3640	0.967 U	2.52	23 J	20.4	8,280	9.93 J	552,000 J	1.53 U	979 J	1.14 U	1,130 J	0.958 J	42.2 J	39,500	52,400	0.13 U	0.61 U	160 J
	WBF-GW-OBS-3-1200-20240723	7/23/2024	3600	0.967 U	8.22 J	27.5	22.3	9,330 J	7.12	463,000	1.53 U	877	1.14 U	849	0.772 J	39.8 J	38,100 J	64,900 J	0.13 U	0.61 U	136
	WBF-GW-OBS-3-1245-20240730	7/30/2024	4170	0.967 U	3.58	26.4	28.1	7,820	8.59	422,000	1.53 U	797	1.14 U	780	0.8 J	40.8	37,800	48,500	0.13 U	0.61 U	134
	WBF-GW-OBS-3-1015-20240806	8/6/2024	3830	0.967 U	3.47	26.7	23.1	7,800	9.7	455,000 J	1.53 U	805	1.14 U	609	0.852 J	40.3	36,400	48,900	0.13 U	0.61 U	134
	WBF-GW-OBS-3-1305-20240814	8/14/2024	4450	0.967 U	3.79	27	27.2	7,750	9.52	456,000	1.53 U	806	1.3 J	526	0.786 J	33.5	36,800	49,100	0.13 U	0.61 U	133
	WBF-GW-OBS-3-1220-20240820	8/20/2024	5050	0.967 U	4.08 U*	26.2	25.1	7,960	9.03	437,000	1.53 U	766	1.46 J	542	0.732 J	39.7	36,200	48,400	0.13 U	0.61 U	120
	WBF-GW-OBS-3-1225-20240904	9/4/2024	4750	0.967 U	3.64	26.9	26.5	7,990	9.53	446,000	1.53 U	763	1.7 J	942 J	0.784 J	39.5	36,500	46,700	0.13 U	0.61 U	129
	WBF-GW-OBS-3-1255-20240910	9/10/2024	4720	0.57 U	0.75 U	20.7	23.3	8,150	7.74	353,000	1.2 U	588	1.7 U	435	0.516 J	34.8	30,500	49,600	0.13 U	1.08 U	98.8
	WBF-GW-OBS-3-1040-20240919	9/19/2024	5510	0.57 U	0.75 U	24.7	26.1	6,650	8.11	391,000	1.2 U	647	1.78 J	552	0.628 J	37.8	33,400	45,700	0.13 U	1.08 U	109
	WBF-GW-OBS-3-1215-20240924	9/24/2024	4870	0.57 U	0.75 U	28.1	30.1	9,390	8.94	421,000	1.2 U	710	1.7 U	506	0.672 J	40.6	34,300	57,300 J	0.13 U	1.08 U	120
	WBF-GW-OBS-3-1025-20241008	10/8/2024	4760	0.57 U	0.75 U	25	26.4	7,620	8.59	419,000	1.2 U	716	2.37 U*	377	0.45 U	40.4	34,000	44,000	0.182 U*	1.08 U	112
	WBF-GW-OBS-3-0950-20241022	10/22/2024	5580	0.57 U	0.75 U	29	31.7	8,490	8.64	404,000	1.2 U	641	2.76	227	0.576 J	40	33,900	47,500	0.13 U	1.08 U	108
	WBF-GW-OBS-3-1005-20241105	11/5/2024	5850	0.57 U	0.75 U	29	31.3	7,250	8.35	393,000	1.2 U	699	2.8	269	0.45 U	38.7	32,100	39,200	0.13 U	1.08 U	101
	WBF-GW-OBS-3-1100-20241119	11/19/2024	6470	0.57 U	0.75 U	30.4	28.3	7,890	8.92	407,000	1.2 U	677	3.24	249 J	0.714 J	42.7	34,400 J	49,000	0.13 U	1.08 U	114
	WBF-GW-OBS-3-1415-20241125	11/25/2024	6650	0.57 U	0.75 U	27.5	31.3	10,300 J	8.81	389,000	1.2 U	692	3.17	365	0.812 J	36	33,100	53,100 J	0.13 U	1.08 U	108
	WBF-GW-OBS03-1550-20250729	7/29/2025	8500	0.57 U	0.75 U	27.9	25.4	8,500	6.95	408,000	1.2 U	561	8.58	10,200	1.1	33.6	36,000	37,800	0.13 U	1.08 U	88.7
OBS-4	WBF-GW-OBS-4-1110-20240606	6/6/2024	763	0.967 U	1.28	32.9	0.344 J	7,940	6.12	469,000	1.53 U	490	1.3 U*	4,880	0.639 U*	4.32 J	40,200	60,600	0.13 U	0.61 U	95.5
	WBF-GW-OBS-4-1140-20240618	6/18/2024	74.3	0.967 U	0.983 J	24.4	0.362 J	7,980	5.8 J	490,000	1.53 U	537	1.14 U	3,770	0.376 U	6.14	39,700	64,900	0.13 U	0.61 U	95.6
	WBF-GW-OBS-4-1510-20240625	6/25/2024	46.2	0.967 U	1.06	26	0.293 J	7,670	5.2	466,000	1.53 U	562	1.14 U	3,760	0.552 U*	4.15 J	42,500 J	62,200	0.13 U	0.61 U	103
	WBF-GW-OBS-4-1255-20240702	7/2/2024	60.7	0.967 U	0.841 J	21.3 J	0.288 J	7,770	4.91	470,000	1.53 U	577	1.14 U	2,460	0.376 U	5.33	38,100	60,000	0.13 U	0.61 U	102
	WBF-GW-OBS-4-1220-20240709	7/9/2024	32.9 U*	0.967 U	0.563 U	21.5	0.274 U	7,750	4.63	475,000	1.53 U	491	1.14 U	2,560	0.376 U	6.3	33,100	58,900	0.13 U	0.61 U	85.4
	WBF-GW-OBS-4-1010-20240717	7/17/2024	41.4	0.967 U	0.8 J	24.2 J	0.303 J	7,740	5.1 J	555,000 J	1.53 U	624 J	1.14 U	4,790	0.376 U	6.77 J	40,900	62,100	0.13 U	0.61 U	107 J
	WBF-GW-OBS-4-1305-20240723	7/23/2024	55.8	0.967 U	1.26 J	22.2	0.341 J	8,770	4.57	460,000	1.53 U	579	1.14 U	5,520	0.376 U	5.79 J	40,200 J	74,300	0.13 U	0.61 U	92.4
	WBF-GW-OBS-4-1610-20240729	7/29/2024	43.9	0.967 U	1.47	21.6	0.274 U	7,660	3.5	435,000	1.53 U	544	1.14 U	10,400 J	0.376 U	5.74	42,000	58,100	0.13 U	0.61 U	98.3
	WBF-GW-OSB-4-1600-20240805	8/5/2024	29.7 U*	0.967 U	1.43	23.3	0.274 U	7,780	3.56	474,000 J	1.53 U	530	1.14 U	9,840	0.376 U	5.63	41,100	59,900	0.13 U	0.61 U	94.2
	WBF-GW-OBS-4-1620-20240813	8/13/2024	55.2	0.967 U	1.34	20.9	0.324 J	7,380	3.23	483,000	2.57	590	1.14 U	5,270	0.376 U	4.49 J	41,200	56,000	0.13 U	0.61 U	103
	WBF-GW-OBS-4-0925-20240820	8/20/2024	39.1	0.967 U	1.54 U*	21.7	0.274 U	7,890	1.73	468,000	1.53 U	545	1.14 U	9,270 J	0.376 U	5.46	39,900	59,600	0.13 U	0.61 U	95.7
	WBF-GW-OBS-4-1400-20240904	9/4/2024	40.6	0.967 U	1.91	23	0.503 J	7,980	0.963 J	474,000	1.53 U	539	1.14 U	10,400	0.376 U	5.99	42,300	57,600	0.13 U	0.61 U	101
	WBF-GW-OBS-4-1645-20240909	9/9/2024	42 J	0.57 U	1.6 J	20.4	0.348 J	7,730	0.66 J	448,000	1.2 U	508	1.7 U	10,400	0.45 U	5.92 J	40,100	60,700	0.13 U	1.08 U	93.5
	WBF-GW-OBS-4-1605-20240918	9/18/2024	73.2	0.57 U	1.91 J	20	0.33 J	6,610	0.906 J	440,000	1.2 U	539	1.7 U	6,830	0.45 U	6.45 J	40,000	59,200	0.13 U	1.08 U	98
	WBF-GW-OBS-4-1330-20240924	9/24/2024	63.2	0.57 U	2.06 J	21.6	0.368 J	7,950	1.35	449,000	1.2 U	517	1.7 U	8,880	0.45 U	6.83 J	38,200	57,300	0.13 U	1.08 U	95
	WBF-GW-OBS-4-1140-20241008	10/8/2024	61.1	0.57 U	1.72 J	20.3	0.273 U	7,930	2	482,000	1.2 U	600	1.7 U	8,370	0.45 U	6.97 J	40,800	58,400	0.13 U	1.08 U	102
	WBF-GW-OBS-4-1500-20241021	10/21/2024	57.1	0.57 U	1.9 J	21.7	0.402 J	7,700	1.8	448,000	1.2 U	535	1.7 U	7,450 J	0.45 U	7.52 J	39,100	56,400	0.13 U	1.08 U	99.6
	WBF-GW-OBS-4-1110-20241105	11/5/2024	85.3	0.57 U	1.59 J	21.4	0.466 J	7,220	1.04	441,000	1.2 U	604	1.7 U	7,540	0.45 U	7.98 J	37,400	49,600	0.147 U*	1.08 U	98.9
	WBF-GW-OBS-4-1220-20241119	11/19/2024	155	0.57 U	2.2 J	22.8	0.493 J	7,320	0.65 J	430,000	1.2 U	584	1.7 U	8,570 J	0.45 U	11	38,100 J	59,100	0.13 U	1.08 U	112
	WBF-GW-OBS-4-0830-20241126	11/26/2024	150	0.57 U	1.83 J	21.1	0.731 U*	8,920	0.994 J	426,000	1.2 U	629	1.7 U	8,190	0.45 U	7.27 J	36,900	58,300	0.13 U	1.08 U	109
OBS-5	WBF-GW-OBS-5-1335-20240618	6/18/2024	825	0.967 U	2.23	22.5	7.88	7,570	12.6	455,000	1.53 U	858	1.14 U	1,120	0.425 J	22.8	36,200	57,300	0.13 U	0.61 U	142
	WBF-GW-OBS-5-1615-20240625	6/25/2024	907	0.967 U	2.58	24.5	6.96	7,620	12.8	456,000	1.53 U	937	1.14 U	1,190	0.96 U*	21.6	40,600 J	57,900	0.13 U	0.61 U	165
	WBF-GW-OBS-5-1355-20240702	7/2/2024	814	0.967 U	2.16	20.4 J	6.98	7,270	10.7	426,000	1.53 U	922	1.14 U	1,260	0.538 J	21.8	33,600	55,700	0.13 U	0.61 U	150
	WBF-GW-OBS-5-1400-20240709	7/9/2024	817	0.967 U	1.43	20.7	6.05	7,960	6.37	457,000	1.53 U	853	1.14 U	1,240	0.376 U	33.7 J	31,700	56,400	0.13 U	0.61 U	140
	WBF-GW-OBS-5-1115-20240717	7/17/2024	1150	0.967 U	1.3	25.3 J	8.32	7,700	4.85 J	535,000 J	1.53 U	1020 J	1.14 U	1,340	0.376 U	29.9 J	39,800	54,500	0.13 U	0.61 U	170 J
	WBF-GW-OBS-5-1410-20240723	7/23/2024	1360	0.967 U	3.27 J	26.4	12.4	8,860	3.68	468,000 J	1.53 U	892 J	1.14 U	1,240	0.376 U	30.7 J	36,400 J	68,300	0.13 U	0.61 U	154
	WBF-GW-OBS-5-1410-20240730	7/30/2024	1150	0.967 U	1.47	24.1	9.61	7,510	2.62	421,000	1.53 U	856	1.14 U	1,360	0.376 U	27.4	38,600	53,200	0.13 U	0.61 U	150
	WBF-GW-OBS-5-1735-20240805	8/5/2024	1100	0.967 U	1.58	24	9.71	7,480	2.41	440,000 J	1.53 U	865	1.14 U	1,220	0.376 U	27.1	37,100	53,500	0.13 U	0.61 U	150
	WBF-GW-OBS-5-1515-20240813	8/13/2024	1540	0.967 U	2.06	23.5	16.1	7,130	2.52	431,000	1.53 U	803	1.14 U	1,340	0.376 U	25.1	35,600	51,900	0.13 U	0.61 U	141
	WBF-GW-OBS-5-1045-20240820	8/20/2024	1340	0.967 U	1.65 U*	22.9	11.1	7,410	3.71	419,000	1.53 U	807	1.14 U	1,150	0.376 U	27.3	35,600	51,300	0.13 U	0.61 U	137
	WBF-GW-OBS-5-1525-20240904	9/4/2024	1280	0.967 U	1.42	22.2	12.6	7,510	2.28	418,000	1.53 U	781	1.14 U	1,160	0.376 U	27.1	35,800	48,800	0.13 U	0.61 U	139
	WBF-GW-OBS-5-1135-20240910	9/10/2024	1400	0.57 U	0.75 U	20.5	13.7	8,370	2.6	375,000	1.2 U	767	1.7 U	1,260	0.45 U	27.4	33,800	57,900	0.13 U	1.08 U	127
	WBF-GW-OBS-5-0915-20240919	9/19/2024	1710	0.71 J	1.69 J	21.5	16.4	6,100	2.63	368,000	1.2 U	694	1.7 U	1,040	0.45 U	28.4	31,900	46,800	0.13 U	1.46 J	124
	WBF-GW-OBS-5-1445-20240924	9/24/2024	1580	0.57 U	1.19 J	22.5	16.4 J	7,200	2.33	379,000	1.2 U	701	1.7 U	994	0.45 U	28.6	31,800	46,100	0.13 U	1.08 U	126
	WBF-GW-OBS-5-1250-20241008	10/8/2024	1920	0.57 U	0.75 U	22.5	16.8	7,080	2.03	402,000	1.2 U	787	1.7 U	1,110	0.45 U	30.4	33,700	46,400	0.13 U	1.08 U	131
	WBF-GW-OBS-5-0830-20241022	10/22/2024	1440	0.57 U	0.75 U	23.8	13.9	7,580	1.64	382,000	1.2 U	685	1.7 U	1,350	0.45 U	26.7	32,900	51,800	0.13 U	1.08 U	123
	WBF-GW-OBS-5-1225-20241105	11/5/2024	1350	0.57 U	0.771 J	22.3	13.5	7,260	2.54	357,000	2.1 J	716	1.7 U	1,280	0.45 U	25.9	30,000	42,300	0.136 U*	1.08 U	119
	WBF-GW-OBS-5-1340-20241119	11/19/2024	1250	0.57 U	1.02 J	20.6	10.4	7,330	2.96	332,000	1.2 U	657	1.7 U	690 J	0.45 U	25.3	25,600 J	50,100	0.13 U	1.08 U	120
	WBF-GW-OBS-5-1540-20241125	11/25/2024	1480	0.57 U	0.75 U	20.4	13.5	7,330	3.75	327,000	1.2 U	691	1.7 U	853	0.45 U	23.3	29,000	43,300	0.13 U	1.08 U	117
OBS-6	WBF-GW-OBS-6-1020-20240607	6/7/2024	285	0.967 U	4.33	36.1	0.798 J	7,550	8.54	457,000	1.53 U	725	1.29 U*	215	0.376 U	11.4	37,000	56,500	0.13 U	0.61 U	129
	WBF-GW-OBS-6-1605-20240618	6/18/2024	348	0.967 U	1.03	28.9	0.964 J	7,740	9.64	465,000	1.53 U	752	1.14 U	568	0.376 U	16.4	37,100	56,900	0.13 U	0.61 U	124
	WBF-GW-OBS-6-1530-20240624	6/24/2024	372	0.967 U	1.23	28.7	0.777 J	7,600	9.18	454,000	1.53 U	794	1.14 U	1,080	0.711 U*	14.7	38,600 J	55,000	0.13 U	0.61 U	134
	WBF-GW-OBS-6-1500-20240702	7/2/2024	408	0.967 U	1.19	26.4 J	0.977 J	7,760	8.47	477,000	1.53 U	835	1.14 U	1,390	0.412 J	16.8	37,500	56,200	0.13 U	0.61 U	137
	WBF-GW-OBS-6-1505-20240709	7/9/2024	399 U*	0.967 U	0.869 J	27.4	0.973 J	8,130	6.98	459,000	1.53 U	768	1.14 U	1,710	0.376 U	21.8	34,600	54,400	0.13 U	0.61 U	129
	WBF-GW-OBS-6-1230-20240717	7/17/2024	458	0.967 U	1.02	26.7 J	1.43	7,530	3.47 J	492,000	1.53 U	798 J	1.14 U	1,610	0.376 U	20.5 J	35,100	59,000	0.13 U	0.61 U	133
	WBF-GW-OBS-6-1545-20240723	7/23/2024	571	0.967 U	1.27 J	30.2	2.45	7,450	3.01	488,000	1.53 U	790	1.14 U	1,480	0.376 U	23.6 J	38,500 J	54,300	0.13 U	0.61 U	136
	WBF-GW-OBS-6-1430-20240729	7/29/2024	612	0.967 U	1.25	28.4	3.25	7,700	2.65	426,000	1.53 U	806	1.14 U	1,970	0.376 U	23.1	39,600	51,500	0.13 U	0.61 U	141
	WBF-GW-OBS-6-1435-20240805	8/5/2024	594	0.967 U	1.38	27.4	3.16	7,570	2.17	466,000 J	1.53 U	793	1.14 U	2,090	0.376 U	22.3	39,200	51,400	0.13 U	0.61 U	138
	WBF-GW-OBS-6-1350-20240813	8/13/2024	691	0.967 U	1.39	27	4.7	7,600	2.52	474,000	1.53 U	776	1.14 U	1,950	0.376 U	19.7	38,400	53,300	0.13 U	0.61 U	135
	WBF-GW-OBS-6-1610-20240819	8/19/2024	779	0.967 U	1.35 U*	26.3	4.06	7,680	2.21	471,000	1.53 U	770	1.14 U	1,960	0.376 U	23	39,100	54,100	0.13 U	0.61 U	129
	WBF-GW-OBS-6-1645-20240904	9/4/2024	986	0.967 U	0.764 J	31.2	6.13	8,310	3.2	477,000	1.53 U	765	1.14 U	1,400	0.376 U	28.5	39,100	50,800	0.13 U	0.61 U	140
	WBF-GW-OBS-6-1435-20240909	9/9/2024	772	0.57 U	0.77 J	25.3	5.76	7,730	4.14	419,000	1.2 U	718	1.7 U	1,380	0.45 U	25	36,700	54,800	0.13 U	1.08 U	120
	WBF-GW-OBS-6-1425-20240918	9/18/2024	834	0.57 U	1.38 J	28	6.85	6,780	3.59	426,000	1.2 U	704	1.7 U	1,570	0.45 U	24.2	37,000	53,100	0.13 U	1.11 J	126
	WBF-GW-OBS-6-1655-20240924	9/24/2024	889	0.712 J	1.05 J	27.6	9.62	10,500 J	1.88	439,000	1.2 U	682	1.7 U	1,440	0.45 U	25.6	35,900	68,300 J	0.13 U	1.08 U	123
	WBF-GW-OBS-6-1430-20241008	10/8/2024	1040	0.57 U	0.75 U	28.1	10.7	7,920	6.19	474,000	1.2 U	781	1.7 U	1,250	0.45 U	28.3	38,700	50,100	0.141 U*	1.08 U	131
	WBF-GW-OBS-6-1320-20241021	10/21/2024	1100	0.57 U	0.75 U	30.3	13.2	8,230	3.68	450,000	1.2 U	684	1.7 U	1,160	0.45 U	27.2	38,100	53,500	0.13 U	1.08 U	122
	WBF-GW-OBS-6-1345-20241105	11/5/2024	1380	0.57 U	0.75 U	32.2	16.1	7,890	5.56	444,000	1.2 U	746	1.7 U	749	0.45 U	28.9	36,700	47,200	0.159 U*	1.08 U	121
	WBF-GW-OBS-6-1505-20241119	11/19/2024	1470	0.57 U	0.981 J	28.7	12.6	7,630	3.28	435,000	1.2 U	709	1.7 U	851 J	0.45 U	26.5	37,300 J	53,300	0.13 U	1.08 U	128
	WBF-GW-OBS-6-1035-20241126	11/26/2024	1620	0.57 U	0.75 U	27	15.2	9,440 J	4.05	426,000	1.2 U	723	1.7 U	1,060	0.45 U	25.1	35,800	53,700 J	0.13 U	1.08 U	124

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals							
			Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L
Screening Levels						100		2	86	5000
OBS-3	WBF-GW-OBS-3-0935-20240619	6/19/2024	15,300	1.53 U	19,300	0.223 U	18,600	0.472 U	0.776 U	572
	WBF-GW-OBS-3-1340-20240625	6/25/2024	16,300	1.53 U	19,200	0.223 U	20,300	0.472 U	0.776 U	616
	WBF-GW-OBS-3-1140-20240702	7/2/2024	15,100	1.53 U	18,500	0.223 U	19,300	0.472 U	0.776 U	552
	WBF-GW-OBS-3-1100-20240709	7/9/2024	14,600	1.53 U	19,300	0.223 U	18,000	0.472 U	0.776 U	589
	WBF-GW-OBS-3-0855-20240717	7/17/2024	18,100 J	1.53 U	19,500 J	0.223 U	21,900 J	0.472 U	0.776 U	676 J
	WBF-GW-OBS-3-1200-20240723	7/23/2024	16,700 J	1.53 U	17,700	0.223 U	21,100	0.472 U	0.776 U	610 J
	WBF-GW-OBS-3-1245-20240730	7/30/2024	15,100	1.53 U	19,400	0.223 U	24,200	0.472 U	0.776 U	611 J
	WBF-GW-OBS-3-1015-20240806	8/6/2024	16,900	1.53 U	20,100	0.223 U	26,400	0.472 U	0.776 U	566
	WBF-GW-OBS-3-1305-20240814	8/14/2024	17,000	1.53 U	19,400	0.223 U	28,600	0.472 U	0.776 U	616
	WBF-GW-OBS-3-1220-20240820	8/20/2024	17,300	1.53 U	19,700	0.223 U	32,600	0.472 U	0.776 U	568
	WBF-GW-OBS-3-1225-20240904	9/4/2024	16,000	1.59 J	20,000	0.231 J	29,300	0.472 U	0.776 U	546
	WBF-GW-OBS-3-1255-20240910	9/10/2024	14,900	0.89 U	15,200 J	0.053 U	31,500	0.508 U	0.82 U	422
	WBF-GW-OBS-3-1040-20240919	9/19/2024	16,500	1.09 J	17,400	0.053 U	36,900	0.508 U	0.82 U	481
	WBF-GW-OBS-3-1215-20240924	9/24/2024	17,100	1.11 J	13,400	0.053 U	29,700	0.508 U	0.82 U	520
	WBF-GW-OBS-3-1025-20241008	10/8/2024	17,400	0.89 U	10,200	0.053 U	48,200	0.508 U	0.82 U	512
	WBF-GW-OBS-3-0950-20241022	10/22/2024	17,600	0.935 J	15,500 J	0.053 U	44,600	0.508 U	0.82 U	539
	WBF-GW-OBS-3-1005-20241105	11/5/2024	16,600	0.89 U	18,400	0.053 U	58,400	0.508 U	0.82 U	459
	WBF-GW-OBS-3-1100-20241119	11/19/2024	16,200 J	1.2 J	17,900 J	0.053 U	53,900	0.508 U	0.82 U	525
	WBF-GW-OBS-3-1415-20241125	11/25/2024	18,200	18.8	11,900 J	0.053 U	60,700	0.508 U	0.82 U	485
	WBF-GW-OBS03-1550-20250729	7/29/2025	18,300	0.89 U	14,200	0.053 U	27,200	0.508 U	0.82 U	405
OBS-4	WBF-GW-OBS-4-1110-20240606	6/6/2024	6,150	1.53 U	20,700	0.223 U	24,100	0.472 U	0.776 U	222
	WBF-GW-OBS-4-1140-20240618	6/18/2024	6,210	1.53 U	19,600	0.223 U	26,900	0.472 U	0.776 U	229
	WBF-GW-OBS-4-1510-20240625	6/25/2024	5,960	1.53 U	19,400	0.223 U	27,300	0.472 U	0.776 U	241
	WBF-GW-OBS-4-1255-20240702	7/2/2024	5,480	1.53 U	18,300	0.223 U	26,800	0.472 U	0.776 U	217
	WBF-GW-OBS-4-1220-20240709	7/9/2024	5,670	1.53 U	19,600	0.223 U	25,400	0.472 U	0.776 U	258 J
	WBF-GW-OBS-4-1010-20240717	7/17/2024	6,380 J	1.53 U	20,000	0.223 U	29,700 J	0.472 U	0.776 U	242
	WBF-GW-OBS-4-1305-20240723	7/23/2024	5,030	1.53 U	18,400	0.223 U	28,800	0.472 U	0.776 U	216 J
	WBF-GW-OBS-4-1610-20240729	7/29/2024	6,310	1.53 U	20,200	0.223 U	24,000	0.472 U	0.776 U	412 J
	WBF-GW-OSB-4-1600-20240805	8/5/2024	6,960	1.53 U	21,000	0.223 U	27,300	0.472 U	0.776 U	198
	WBF-GW-OBS-4-1620-20240813	8/13/2024	6,090	1.53 U	20,100	0.223 U	27,100	0.472 U	0.776 U	418 J
	WBF-GW-OBS-4-0925-20240820	8/20/2024	6,940	1.53 U	21,100	0.223 U	26,800	0.472 U	0.776 U	205
	WBF-GW-OBS-4-1400-20240904	9/4/2024	6,590	1.53 U	20,900	0.223 U	29,200	0.472 U	0.776 U	187
	WBF-GW-OBS-4-1645-20240909	9/9/2024	6,990	0.89 U	21,100	0.053 U	28,200	0.508 U	0.82 U	172
	WBF-GW-OBS-4-1605-20240918	9/18/2024	6,290	0.89 U	22,600	0.053 U	27,600	0.508 U	0.82 U	196
	WBF-GW-OBS-4-1330-20240924	9/24/2024	6,570	0.89 U	19,300	0.053 U	27,200	0.508 U	0.82 U	177
	WBF-GW-OBS-4-1140-20241008	10/8/2024	7,230	0.89 U	20,900	0.053 U	26,000	0.508 U	0.82 U	200
	WBF-GW-OBS-4-1500-20241021	10/21/2024	7,490	0.89 U	20,500	0.053 U	29,400	0.508 U	0.82 U	209
	WBF-GW-OBS-4-1110-20241105	11/5/2024	7,270	0.89 U	23,200	0.053 U	32,400	0.508 U	0.82 U	183
	WBF-GW-OBS-4-1220-20241119	11/19/2024	7,620 J	0.89 U	21,800	0.053 U	39,600	0.508 U	0.82 U	202
	WBF-GW-OBS-4-0830-20241126	11/26/2024	8,280	1.35 U*	22,400 J	0.053 U	38,200	0.508 U	0.82 U	202
OBS-5	WBF-GW-OBS-5-1335-20240618	6/18/2024	12,900	1.53 U	21,100	0.223 U	21,100	0.472 U	0.776 U	569
	WBF-GW-OBS-5-1615-20240625	6/25/2024	13,500	1.53 U	20,600	0.223 U	22,400	0.472 U	0.776 U	592
	WBF-GW-OBS-5-1355-20240702	7/2/2024	12,000	1.53 U	19,600	0.223 U	19,700	0.472 U	0.776 U	553
	WBF-GW-OBS-5-1400-20240709	7/9/2024	13,200	1.53 U	21,800	0.223 U	20,100	0.472 U	0.776 U	594
	WBF-GW-OBS-5-1115-20240717	7/17/2024	14,100	1.53 U	21,200	0.223 U	29,400 J	0.472 U	0.776 U	685 J
	WBF-GW-OBS-5-1410-20240723	7/23/2024	11,700	1.53 U	18,700	0.223 U	29,700	0.472 U	0.776 U	582 J
	WBF-GW-OBS-5-1410-20240730	7/30/2024	12,800	1.53 U	21,200	0.223 U	26,600	0.472 U	0.776 U	612 J
	WBF-GW-OBS-5-1735-20240805	8/5/2024	13,800	1.53 U	22,000	0.223 U	31,000	0.472 U	0.776 U	581
	WBF-GW-OBS-5-1515-20240813	8/13/2024	13,700	1.53 U	20,400	0.223 U	33,300	0.472 U	0.776 U	586
	WBF-GW-OBS-5-1045-20240820	8/20/2024	13,600	1.53 U	21,600	0.223 U	36,700	0.472 U	0.776 U	576
	WBF-GW-OBS-5-1525-20240904	9/4/2024	12,600	1.53 U	21,200	0.223 U	42,200	0.472 U	0.776 U	543
	WBF-GW-OBS-5-1135-20240910	9/10/2024	13,400	0.89 U	18,100	0.053 U	40,900	0.508 U	0.82 U	488
	WBF-GW-OBS-5-0915-20240919	9/19/2024	13,500	3.97 J	19,700 J	0.053 U	38,500	0.7 J	0.82 U	499
	WBF-GW-OBS-5-1445-20240924	9/24/2024	13,400	1.08 J	16,800	0.053 U	39,100	0.508 U	0.82 U	499
	WBF-GW-OBS-5-1250-20241008	10/8/2024	14,800	0.89 U	17,400	0.053 U	40,300	0.508 U	0.82 U	563
	WBF-GW-OBS-5-0830-20241022	10/22/2024	13,900	0.89 U	18,300	0.053 U	45,700	0.508 U	0.82 U	543
	WBF-GW-OBS-5-1225-20241105	11/5/2024	13,000	0.89 U	19,600	0.053 U	63,300	0.508 U	0.82 U	470
	WBF-GW-OBS-5-1340-20241119	11/19/2024	11,500 J	0.89 U	18,900	0.053 U	58,500	0.508 U	0.82 U	487
	WBF-GW-OBS-5-1540-20241125	11/25/2024	13,400	4.68 J	17,500	0.053 U	57,500	0.508 U	0.82 U	482
OBS-6	WBF-GW-OBS-6-1020-20240607	6/7/2024	10,700	1.53 U	21,500	0.223 U	22,100	0.472 U	0.776 U	387
	WBF-GW-OBS-6-1605-20240618	6/18/2024	11,100	1.53 U	20,500	0.223 U	26,800	0.472 U	0.776 U	423
	WBF-GW-OBS-6-1530-20240624	6/24/2024	11,600	1.53 U	19,800	0.223 U	27,100	0.472 U	0.776 U	444
	WBF-GW-OBS-6-1500-20240702	7/2/2024	11,000	1.53 U	19,500	0.223 U	27,000	0.472 U	0.776 U	438
	WBF-GW-OBS-6-1505-20240709	7/9/2024	11,500	1.53 U	21,100	0.223 U	25,500	0.472 U	0.776 U	515
	WBF-GW-OBS-6-1230-20240717	7/17/2024	11,800	1.53 U	22,100	0.223 U	25,800	0.472 U	0.776 U	455
	WBF-GW-OBS-6-1545-20240723	7/23/2024	10,400	1.53 U	18,500	0.223 U	25,400	0.472 U	0.776 U	472 J
	WBF-GW-OBS-6-1430-20240729	7/29/2024	11,400	1.53 U	20,200	0.223 U	22,900	0.472 U	0.776 U	503 J
	WBF-GW-OBS-6-1435-20240805	8/5/2024	12,700	1.53 U	20,800	0.223 U	25,500	0.472 U	0.776 U	460
	WBF-GW-OBS-6-1350-20240813	8/13/2024	12,800	1.53 U	20,400	0.223 U	24,100	0.472 U	0.776 U	481
	WBF-GW-OBS-6-1610-20240819	8/19/2024	12,900	1.53 U	21,600	0.223 U	24,500	0.472 U	0.776 U	464
	WBF-GW-OBS-6-1645-20240904	9/4/2024	12,500	1.53 U	21,500	0.223 U	24,600	0.472 U	0.776 U	490
	WBF-GW-OBS-6-1435-20240909	9/9/2024	12,700	1.21 J	21,000	0.053 U	23,200	0.508 U	0.82 U	403
	WBF-GW-OBS-6-1425-20240918	9/18/2024	13,300	3.49 J	21,700	0.053 U	24,300	0.508 U	0.82 U	430
	WBF-GW-OBS-6-1655-20240924	9/24/2024	13,100	2.66 J	17,200	0.053 U	22,700	0.508 U	0.82 U	428
	WBF-GW-OBS-6-1430-20241008	10/8/2024	14,600	0.89 U	20,400	0.053 U	23,500	0.508 U	0.82 U	499
	WBF-GW-OBS-6-1320-20241021	10/21/2024	14,300	1.19 J	19,100	0.053 U	23,900	0.564 J	0.82 U	506
	WBF-GW-OBS-6-1345-20241105	11/5/2024	13,900	0.89 U	19,500	0.053 U	22,200	0.508 U	0.82 U	474
	WBF-GW-OBS-6-1505-20241119	11/19/2024	13,200 J	0.89 U	17,400	0.053 U	21,600	0.508 U	0.82 U	482
	WBF-GW-OBS-6-1035-20241126	11/26/2024	14,900	5.51	16,100	0.053 U	21,000	0.508 U	0.82 U	467

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals																		
			Aluminum ug/L	Antimony ug/L	Arsenic ug/L	Barium ug/L	Beryllium ug/L	Boron ug/L	Cadmium ug/L	Calcium ug/L	Chromium ug/L	Cobalt ug/L	Copper ug/L	Iron ug/L	Lead ug/L	Lithium ug/L	Magnesium ug/L	Manganese ug/L	Mercury ug/L	Molybdenum ug/L	Nickel ug/L
Screening Levels				6	10	2000	4		5		100	6	1300		15	40			2	100	100
OBS-07	WBF-GW-OBS07-0850-20250604	6/4/2025	22.4 J	0.57 U	0.75 U	24.5	0.273 U	7,000 J	1.28	400,000	1.2 U	147	1.7 U	4,440	0.45 U	3.44 U	42,300	39,100	0.13 U	1.08 U	38.2
	WBF-GW-OBS07-1030-20250610	6/10/2025	14.4 J	0.57 U	0.75 U	21.3	0.273 U	6,660	0.82 J	380,000	1.2 U	127	1.7 U	5,820	0.45 U	3.44 U	38,400	39,900	0.13 U	1.08 U	33.5
	WBF-GW-OBS07-1000-20250617	6/17/2025	15.6 J	0.57 U	0.75 U	18.9	0.273 UJ	6,260	0.532 J	356,000	1.2 U	117	1.7 U	5,820	0.45 U	4.26 J	37,700	36,700	0.13 U	1.08 U	30.9
	WBF-GW-OBS07-1315-20250623	6/23/2025	16.9 U*	0.57 U	0.75 U	18.6	0.273 U	6,560	0.34 J	386,000	1.2 U	113	1.7 U	7,990 J	0.45 U	3.44 U	41,200	36,500	0.13 U	1.08 U	29.5
	WBF-GW-OBS07-1605-20250630	6/30/2025	19 J	0.57 U	0.97 J	17.6	0.273 U	6,430	0.332 J	366,000 J	1.2 U	104	1.7 U	5,910	0.45 U	3.44 U	39,500	34,100	0.13 U	1.08 U	29.3
	WBF-GW-OBS07-1305-20250707	7/7/2025	17.4 J	0.57 U	1.63 J	17	0.273 U	6,520	0.163 J	358,000	1.2 U	98.8	1.7 U	7,880	0.45 U	3.67 J	39,700	34,300	0.13 U	1.08 U	27.9
	WBF-GW-OBS07-1725-20250714	7/14/2025	13 J	0.57 U	1.51 J	17.3	0.273 U	6,210	0.124 J	386,000	1.2 U	92.2	1.7 U	11,400	0.45 U	3.44 U	42,200	33,000	0.13 U	1.08 U	25.6
	WBF-GW-OBS07-1205-20250722	7/22/2025	12 U	0.57 U	1.29 J	18.4	0.273 U	6,640	0.208 J	400,000	1.2 U	77.9	1.7 U	13,800	0.45 U	3.44 U	44,800	31,800	0.13 U	1.08 U	21.8
	WBF-GW-OBS07-1040-20250729	7/29/2025	12 U	0.57 U	0.817 J	15.5	0.273 U	6,700	0.249 J	327,000	1.2 U	74.7	1.7 U	10,400	0.45 U	3.44 U	37,100	32,700	0.13 U	1.08 U	21.5
	WBF-GW-OBS-7-1250-20250805	8/5/2025	12.6 J	0.57 U	1.34 J	16.5	0.273 U	6,510	0.243 J	373,000	1.2 U	96.8	1.7 U	7,220	0.45 U	3.44 U	39,800	34,900	0.13 U	1.08 U	28.7
	WBF-GW-OBS-7-1620-20250811	8/11/2025	12.2 J	0.57 U	1.14 J	14.6	0.273 U	5,870	0.285 J	349,000 J	1.2 U	83	1.7 U	9,520	0.45 U	4.91 J	39,500	31,700	0.13 U	1.08 U	23.8
	WBF-GW-OBS-7-1430-20250819	8/19/2025	12 U	0.57 U	1.36 J	15.8	0.273 U	6,690	0.614 J	381,000	1.2 U	92.9	1.7 U	10,000	0.45 U	3.44 U	40,800	34,600	0.13 U	1.08 U	27.4
	WBF-GW-OBS07-1135-20250825	8/25/2025	12 U	0.57 U	1.17 J	16.2	0.273 U	6,580	0.499 J	377,000	1.2 U	89.8	1.7 U	8,470	0.45 U	3.44 U	40,800	34,900	0.13 U	1.08 U	26.5
OBS-08	WBF-GW-OBS08-1010-20250604	6/4/2025	628	0.57 U	0.75 U	29.4	5.56	7,510	7.29	419,000	1.2 U	710	1.7 U	5,700	0.743 J	21	37,100	49,200	0.13 U	1.08 U	126
	WBF-GW-OBS08-1145-20250610	6/10/2025	685	0.57 U	0.75 U	29.1	6.52	7,260	5.34	408,000	1.2 U	647	1.74 J	8,050	0.835 J	24.9	34,600	49,300	0.13 U	1.08 U	116
	WBF-GW-OBS08-1130-20250617	6/17/2025	777	0.57 U	0.75 U	28.4	8.81 J	7,100	4.86	399,000	1.2 U	641	1.7 U	10,300	1.12 U*	25 J	35,800	48,700	0.13 U	1.08 U	116
	WBF-GW-OBS08-1445-20250623	6/23/2025	853	0.57 U	0.75 U	27.3	9.71	7,110	5.55	406,000	1.2 U	657	1.7 U	11,500	0.778 J	22.5	37,200	48,900	0.13 U	1.08 U	111
	WBF-GW-OBS08-1010-20250701	7/1/2025	843 J	0.57 U	0.771 J	27.3	8.7	6,980	2.55	399,000 J	1.2 U	584	1.7 U	14,600	0.536 J	22.4	35,800	44,000	0.13 U	1.08 U	112
	WBF-GW-OBS08-1500-20250707	7/7/2025	1040	0.57 U	1.24 J	28.4	10.8	7,370	4.67	392,000	1.2 U	646	1.7 U	14,900	1.19	25.3	35,300	51,300	0.13 U	1.08 U	110
	WBF-GW-OBS08-0925-20250715	7/15/2025	962	0.57 U	0.75 U	24.8	9.81	6,020	2.47	353,000	1.2 U	554	1.7 U	14,700	0.771 J	21.7	31,900	38,800	0.13 U	1.08 U	94.2
	WBF-GW-OBS08-0820-20250722	7/22/2025	1260	0.57 U	0.75 U	27.7	11.6	7,040	2.45	392,000	1.2 U	600	1.7 U	17,700	0.871 J	25.5	35,600	42,800	0.13 U	1.08 U	103
	WBF-GW-OBS08-1645-20250729	7/29/2025	1420	0.57 U	0.75 U	27	12.7	7,020	5.37	349,000	1.2 U	530	1.7 U	17,400	1.21	25.6	32,500	41,400	0.13 U	1.08 U	92.8
OBS-09	WBF-GW-OBS09-1215-20250604	6/4/2025	48.5 J	0.57 U	0.75 U	29.4	0.273 U	7,260	0.254 J	408,000	1.2 U	362	1.7 U	36,300	0.45 U	6.79 J	38,800	48,400	0.13 U	1.08 U	65.8
OBS-10	WBF-GW-OBS10-1345-20250604	6/4/2025	45.6 J	0.57 U	0.75 U	32.4	0.39 J	7,420	1.52	386,000	1.2 U	428	2.05	12,800	0.45 U	8.22	37,400	50,100	0.13 U	1.08 U	64.7

TABLE 4b - Groundwater Analytical Data Summary - Dissolved Metals
Watts Bar Fossil Plant

DRAFT

Well ID	Sample ID	Sample Date	Dissolved Metals							
			Potassium ug/L	Selenium ug/L	Silicon ug/L	Silver ug/L	Sodium ug/L	Thallium ug/L	Vanadium ug/L	Zinc ug/L
Screening Levels						100		2	86	5000
OBS-07	WBF-GW-OBS07-0850-20250604	6/4/2025	2,410	0.89 U	12,600	0.053 U	156,000	0.508 U	0.82 U	60.1
	WBF-GW-OBS07-1030-20250610	6/10/2025	2,110	0.89 U	16,800	0.053 U	146,000	0.508 U	0.82 U	41.7
	WBF-GW-OBS07-1000-20250617	6/17/2025	1,910	0.89 U	15,800	0.053 U	155,000	0.508 U	0.82 U	39.8
	WBF-GW-OBS07-1315-20250623	6/23/2025	2,050	0.89 U	16,100	0.053 U	165,000	0.508 U	0.82 U	36.6
	WBF-GW-OBS07-1605-20250630	6/30/2025	1,850	0.89 U	14,600	0.053 U	168,000	0.508 U	0.82 U	35.6
	WBF-GW-OBS07-1305-20250707	7/7/2025	1,730	0.89 U	16,600	0.053 U	169,000	0.508 U	0.82 U	30.6 U*
	WBF-GW-OBS07-1725-20250714	7/14/2025	1,830	0.89 U	17,600	0.053 U	159,000	0.508 U	0.82 U	24.5
	WBF-GW-OBS07-1205-20250722	7/22/2025	2,070	0.89 U	17,100 J	0.053 U	174,000	0.508 U	0.82 U	16.2 J
	WBF-GW-OBS07-1040-20250729	7/29/2025	1,710	0.89 U	16,200	0.053 U	136,000	0.508 U	0.82 U	16.8 J
	WBF-GW-OBS-7-1250-20250805	8/5/2025	1,810	0.89 U	15,100	0.053 U	141,000	0.508 U	0.82 U	24.6
	WBF-GW-OBS-7-1620-20250811	8/11/2025	1,810	0.89 UJ	14,400	0.053 U	126,000	0.508 U	0.82 U	20.5
	WBF-GW-OBS-7-1430-20250819	8/19/2025	1,740	0.89 U	15,300	0.053 U	127,000	0.508 U	0.82 U	25
	WBF-GW-OBS07-1135-20250825	8/25/2025	1,820	0.89 U	16,700	0.053 U	127,000	0.508 U	0.82 U	25
OBS-08	WBF-GW-OBS08-1010-20250604	6/4/2025	10,900	0.89 U	19,000	0.053 U	27,300	0.508 U	0.82 U	484
	WBF-GW-OBS08-1145-20250610	6/10/2025	11,200	0.89 U	18,700	0.053 U	24,400	0.508 U	0.82 U	430
	WBF-GW-OBS08-1130-20250617	6/17/2025	11,600	0.89 U	17,100	0.053 U	25,700	0.508 U	0.82 U	433
	WBF-GW-OBS08-1445-20250623	6/23/2025	12,300	0.89 U	17,800 J	0.053 U	25,000	0.508 U	0.82 U	440
	WBF-GW-OBS08-1010-20250701	7/1/2025	11,900	0.89 U	16,800 J	0.053 U	24,700	0.508 U	0.82 U	401
	WBF-GW-OBS08-1500-20250707	7/7/2025	12,800	0.89 U	17,500	0.053 U	24,600	0.508 U	1.14 J	427
	WBF-GW-OBS08-0925-20250715	7/15/2025	11,500	0.89 U	13,000	0.053 U	23,300	0.508 U	1.01 J	365
	WBF-GW-OBS08-0820-20250722	7/22/2025	13,500	0.89 U	15,000	0.053 U	26,300	0.508 U	1.31 J	436
	WBF-GW-OBS08-1645-20250729	7/29/2025	12,900	0.89 U	15,500	0.053 U	23,400	0.508 U	1.22 J	399
OBS-09	WBF-GW-OBS09-1215-20250604	6/4/2025	7,630	0.89 U	18,100	0.053 U	51,800	0.508 U	0.82 U	122
OBS-10	WBF-GW-OBS10-1345-20250604	6/4/2025	8,530	0.89 U	16,500	0.053 U	121,000	0.508 U	0.82 U	142

Notes:

Please note that listed screening levels are not applicable to dissolved phase metals and are only shown for comparative purposes

Screening levels are presented for CCR Rule Appendix IV and TDEC Appendix I constituents

13.4	measured concentration did not exceed the indicated standard
13.4	measured concentration exceeded the indicated screening level
ID	Identification
U	analyte was not detected at a concentration greater than the method detection limit
U*	result should be considered "not detected" because it was detected in an associated field or laboratory blank at a similar level
UJ	this compound was not detected, but the reporting limit should be considered estimated due to a bias identified during data validation
J	quantitation is approximate due to limitations identified during data validation
µg/L	micrograms per liter

EXHIBITS

Exhibit No.
1

DRAFT

Title
WBF Plant Overview

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2023-12-06
Technical Review by AL on 2023-12-06

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

Legend

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

CCR: Coal combustion residuals

Notes

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

Stantec TVA

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Exhibit No.
2

DRAFT

Title

Pilot Test Well Layout

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2025-10-08
Technical Review by AL on 2025-10-08

0 150 300 450 600 Feet

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

Legend

- Injection Well (IW)
- Groundwater Monitoring Well (OBS) Phase 1
- Groundwater Monitoring Well (OBS) Phase 2
- Groundwater Results Below Groundwater Screening Levels
- Groundwater Results Above Groundwater Screening Levels
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- Injection Trailer Skid and Secondary Containment Staging Area
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Boring locations may be adjusted depending on pH results observed throughout the investigation.

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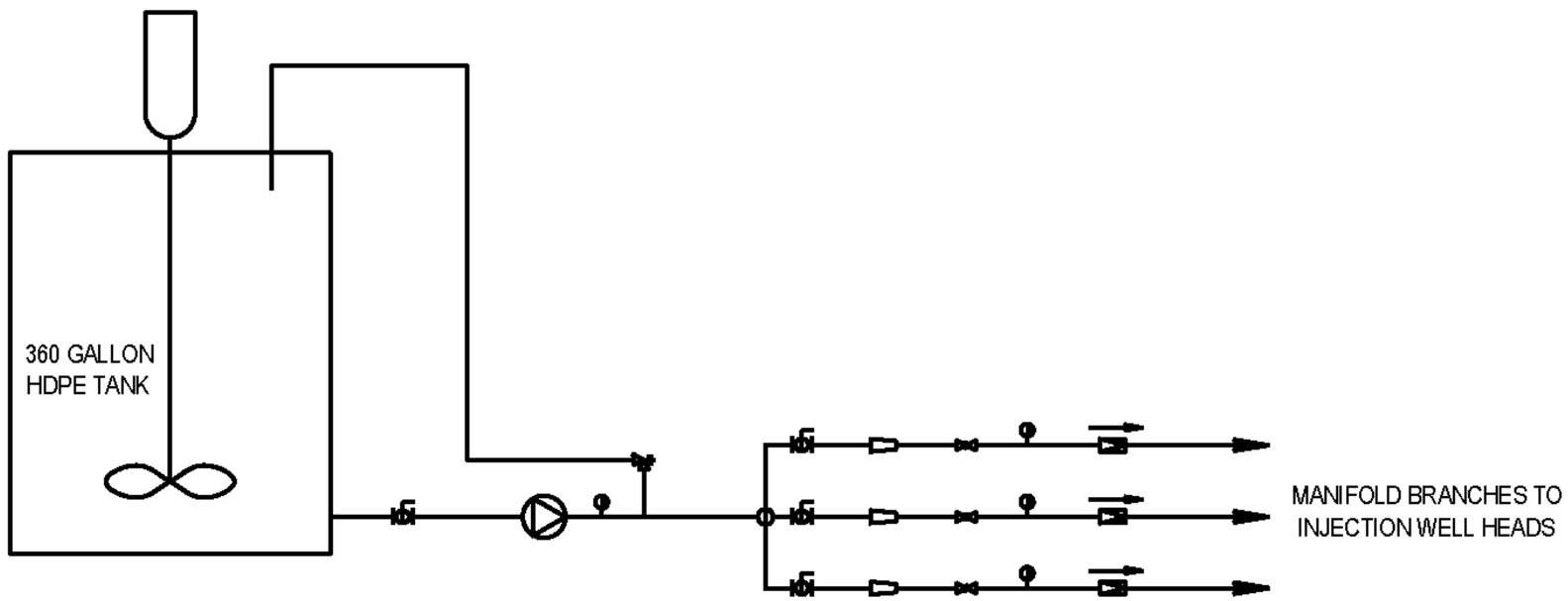

DRAFT

Exhibit No.

3

Title

Injection System Process Flow Diagram

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

ELECTRIC AGITATOR

FLOW METER

FLOW METER

PUMP

PRESSURE GAUGE

Stantec

TVA

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Exhibit No.
4

DRAFT

Title

Grab Groundwater Boring Locations

Client/Project

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

Project Location
Spring City, Tennessee

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

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

Legend

- Grab groundwater boring location
- Injection Well (IW)
- Groundwater Monitoring Well (OBS) Phase 1
- Groundwater Monitoring Well (OBS) Phase 2
- Groundwater Results Below Groundwater Screening Levels
- Groundwater Results Above Groundwater Screening Levels
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- Injection Trailer Skid and Secondary Containment Staging Area
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Boring locations may be adjusted depending on pH results observed throughout the investigation.

Stantec TVA

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B-5	12/12/2024
23-25 ft	no water
26-28 ft	6.9

OBS-1	11/25/2024
~25 ft	5.63

B-4	12/11/2024
23-25 ft	5.79
26-28 ft	5.91

SB-4	12/12/2024
22-24 ft	5.83
25-27 ft	5.91

IW-1	12/10/2024
~25 ft	12.8

IW-2	12/10/2024
~25 ft	13.14

IW-3	12/10/2024
~25 ft	12.8

B-2	12/11/2024
23-25 ft	8.76
26-28 ft	10.63

SB-2	12/11/2024
23-25 ft	11.71
26-28 ft	12.02

B-1	12/10/2024
23-25 ft	10.03
26-28 ft	11.99

OBS-2	11/25/2024
~25 ft	5.53

B-6	12/12/2024
23-25 ft	no water
26-28 ft	5.59

OBS-3	11/25/2024
~25 ft	4.22

SB-3	12/12/2024
23-25 ft	6.6
26-28 ft	6.8

SB-1	12/10/2024
23-25 ft	5.7
26-28 ft	6.6

B-3	12/11/2024
23-25 ft	5.78
26-28 ft	5.26

OBS-5	11/25/2024
~25 ft	4.75

OBS-4	11/26/2024
~25 ft	5.35

OBS-6	11/26/2024
~25 ft	4.93

Exhibit No.
5

DRAFT

Title

Grab Groundwater Investigation Results

Client/Project

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

Project Location
Spring City, Tennessee

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

0 150 300 450 600 Feet
1:1,000,000 (At original document size of 22x34)

Legend

- Primary grab groundwater boring location
- Injection Well (IW)
- Observation Well (OBS)

5.79	= pH (S.U.)
	= No injection influence
	= Limited injection influence
	= Strong injection influence

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Boring locations may be adjusted depending on pH results observed throughout the investigation.

Stantec TVA

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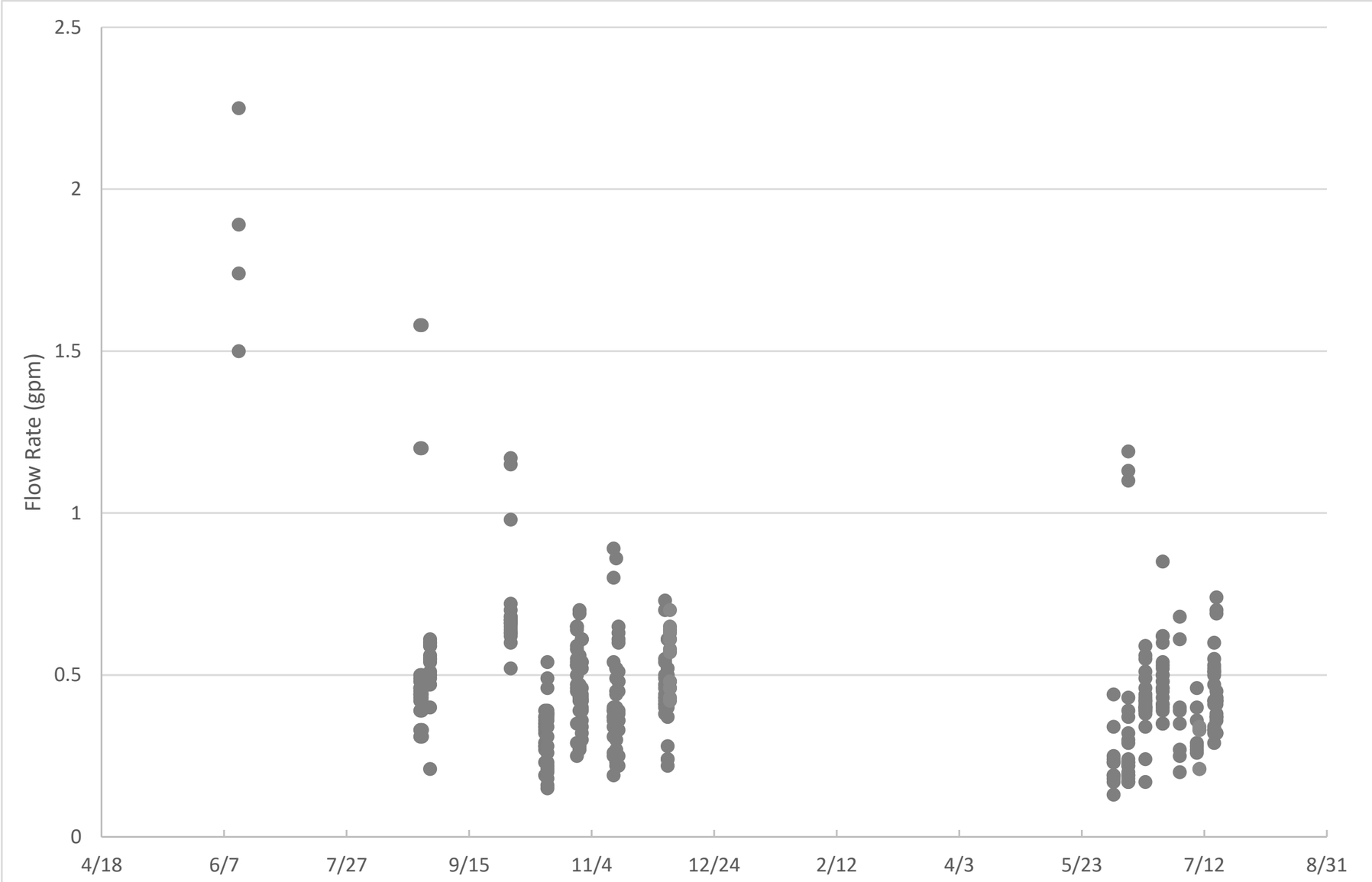

DRAFT

Exhibit No.

6

Title

IW-1 Instantaneous Flow Rates

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

● Instantaneous flow meter measurement

Notes:
1. Instantaneous flow measurements were collected at 10 minute intervals during injections.
2. Only non-zero values are shown.

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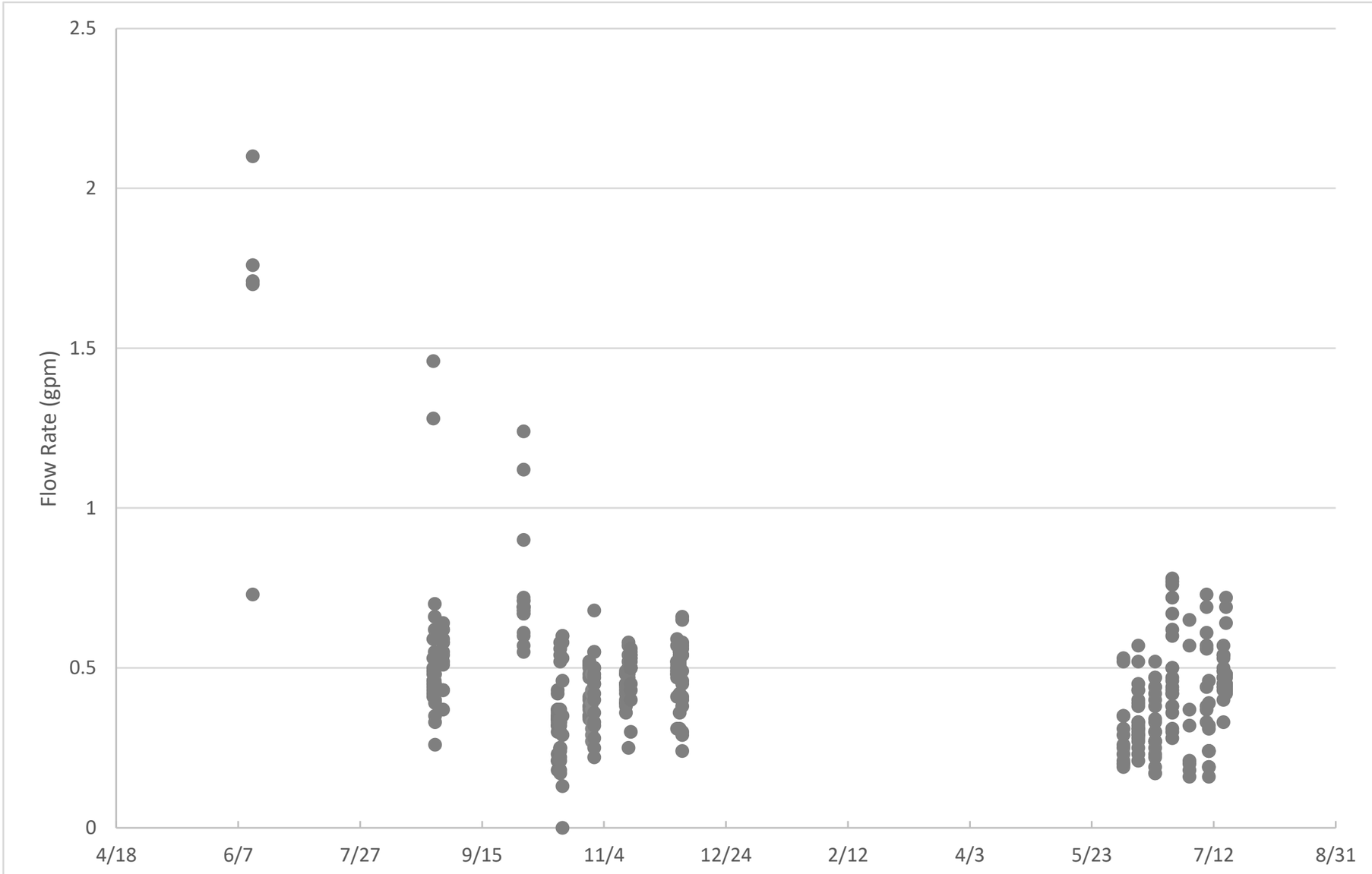

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Exhibit No.

7

Title

IW-2 Instantaneous Flow Rates

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

● Instantaneous flow meter measurement

Notes:
1. Instantaneous flow measurements were collected at 10 minute intervals during injections.
2. Only non-zero values are shown.

Stantec

TVA

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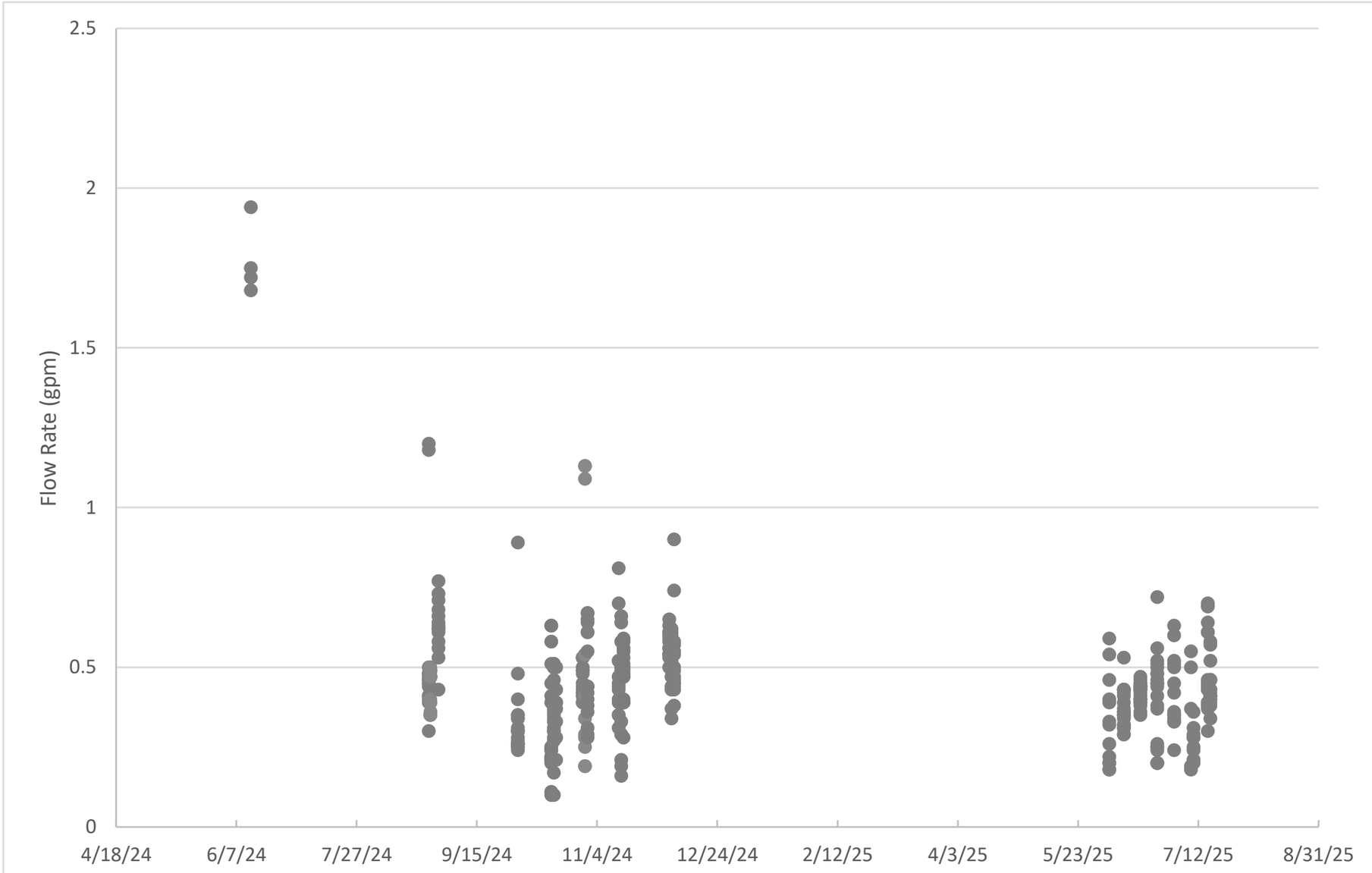
Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.



DRAFT

Exhibit No.

8

Title

IW-3 Instantaneous Flow Rates

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

● Instantaneous flow meter measurement

Notes:
1. Instantaneous flow measurements were collected at 10 minute intervals during injections.
2. Only non-zero values are shown.

Stantec

TVA

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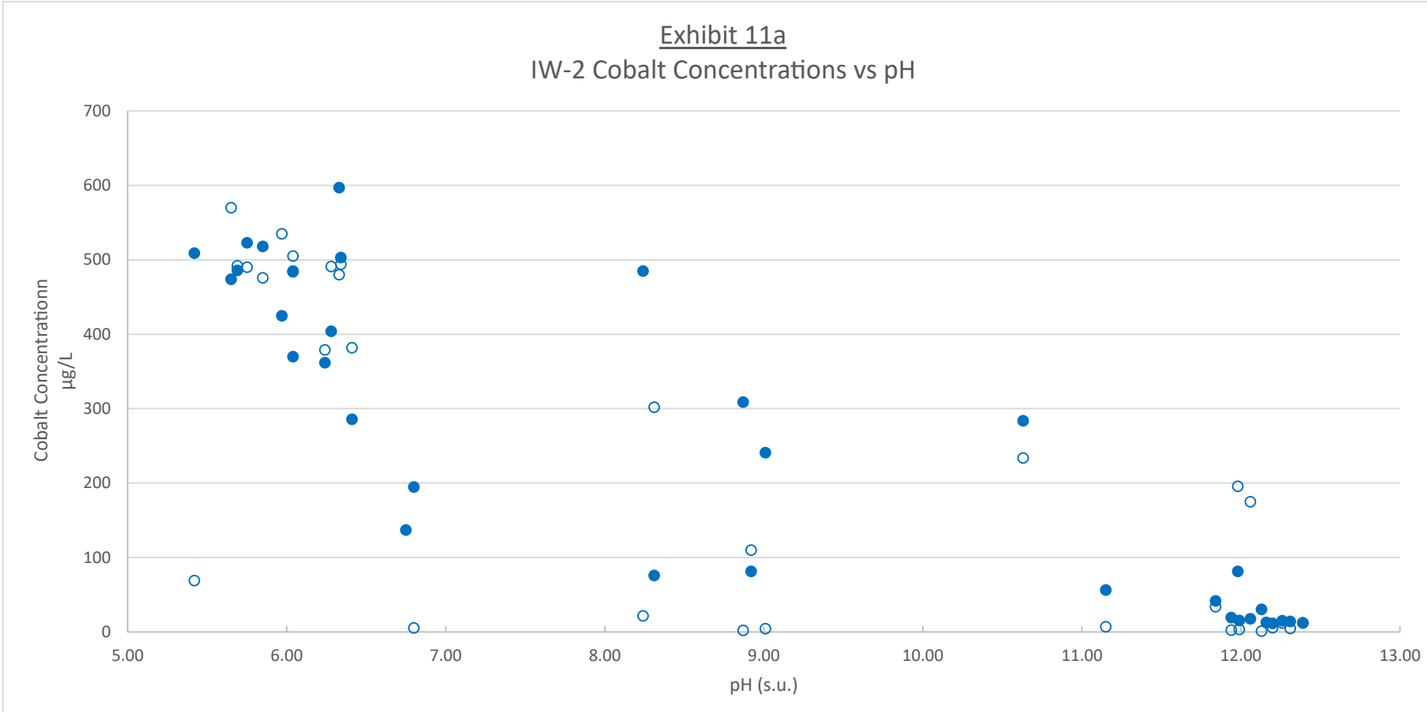
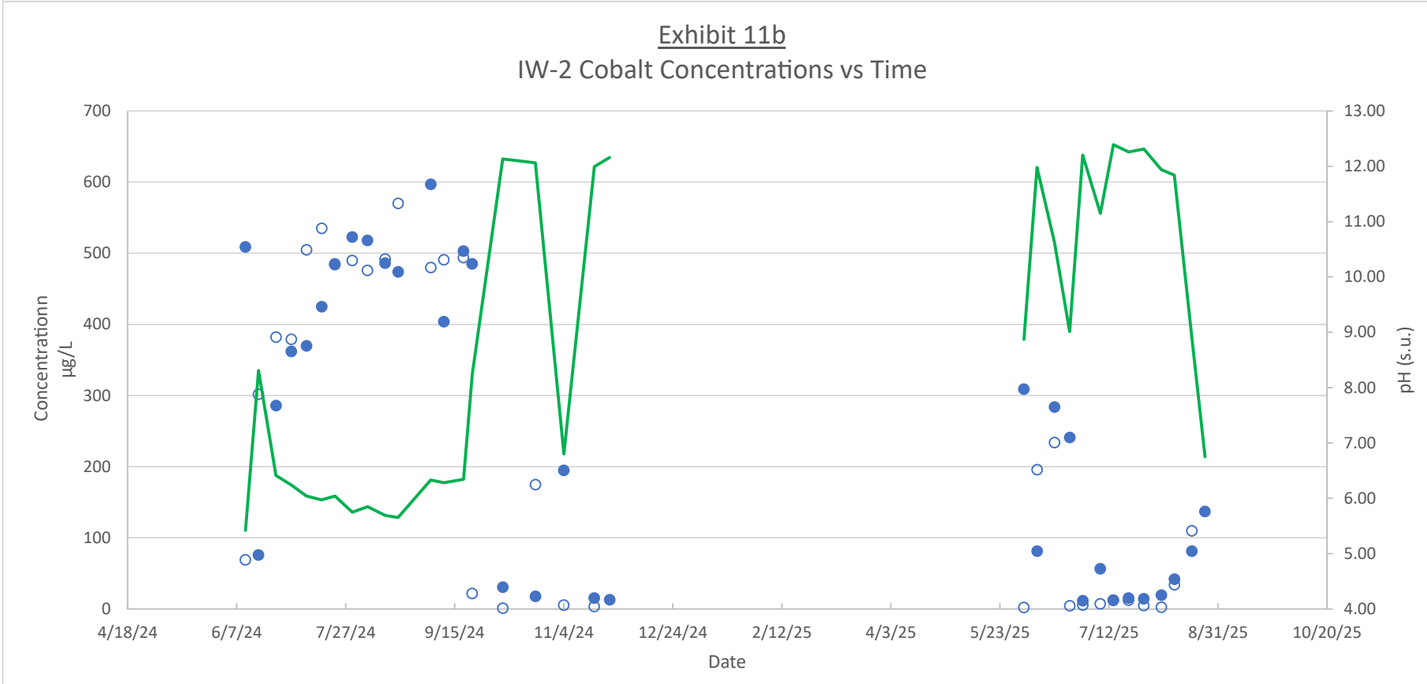
Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.





DRAFT

Exhibit No.
9

Title
IW-2 Cobalt vs pH

Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

- Total Cobalt
- Dissolved Cobalt
- pH
- µg/L micrograms per liter

Stantec

TVA

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Exhibit 12a

OBS-2 Cobalt Concentrations vs pH

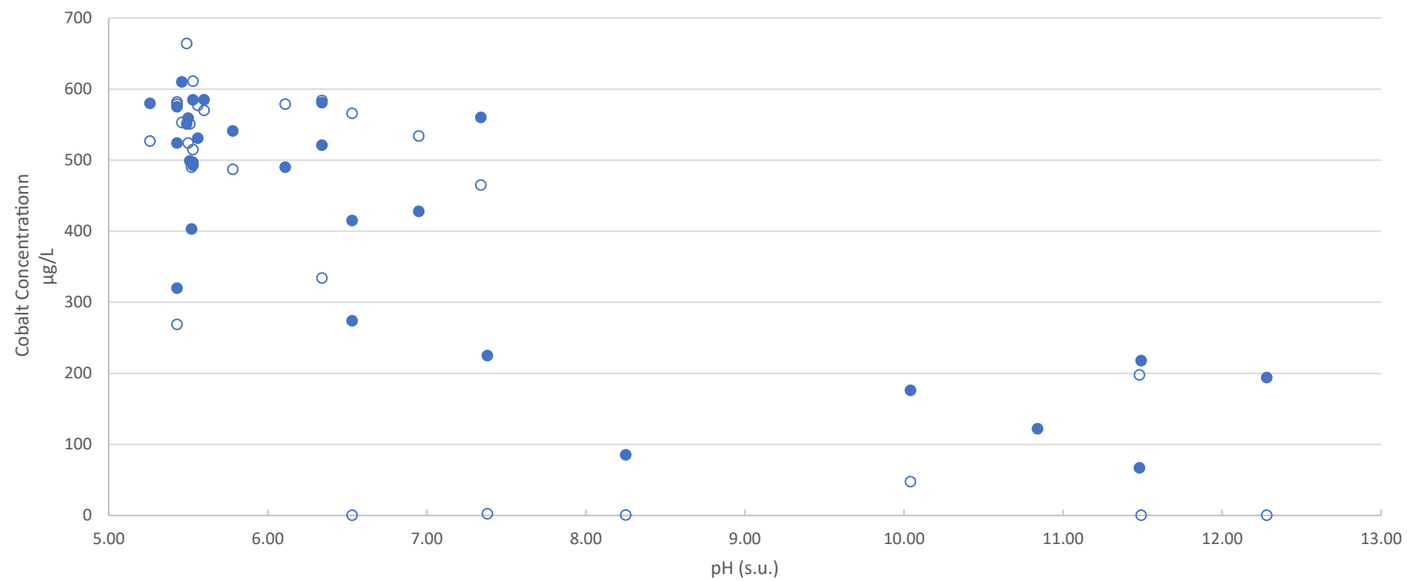
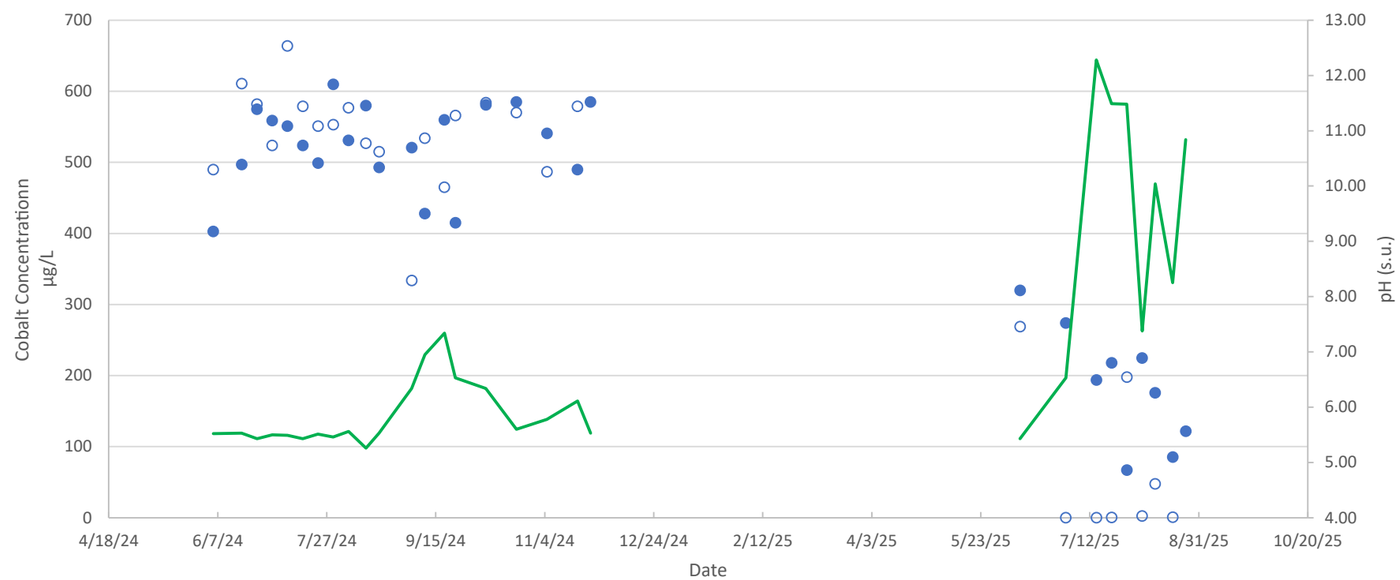


Exhibit 12b

OBS-2 Cobalt Concentrations vs Time



DRAFT

Exhibit No.

10

Title

OBS-2 Cobalt vs pH

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

- Total Cobalt
- Dissolved Cobalt
- pH
- µg/L micrograms per liter

Stantec

TVA

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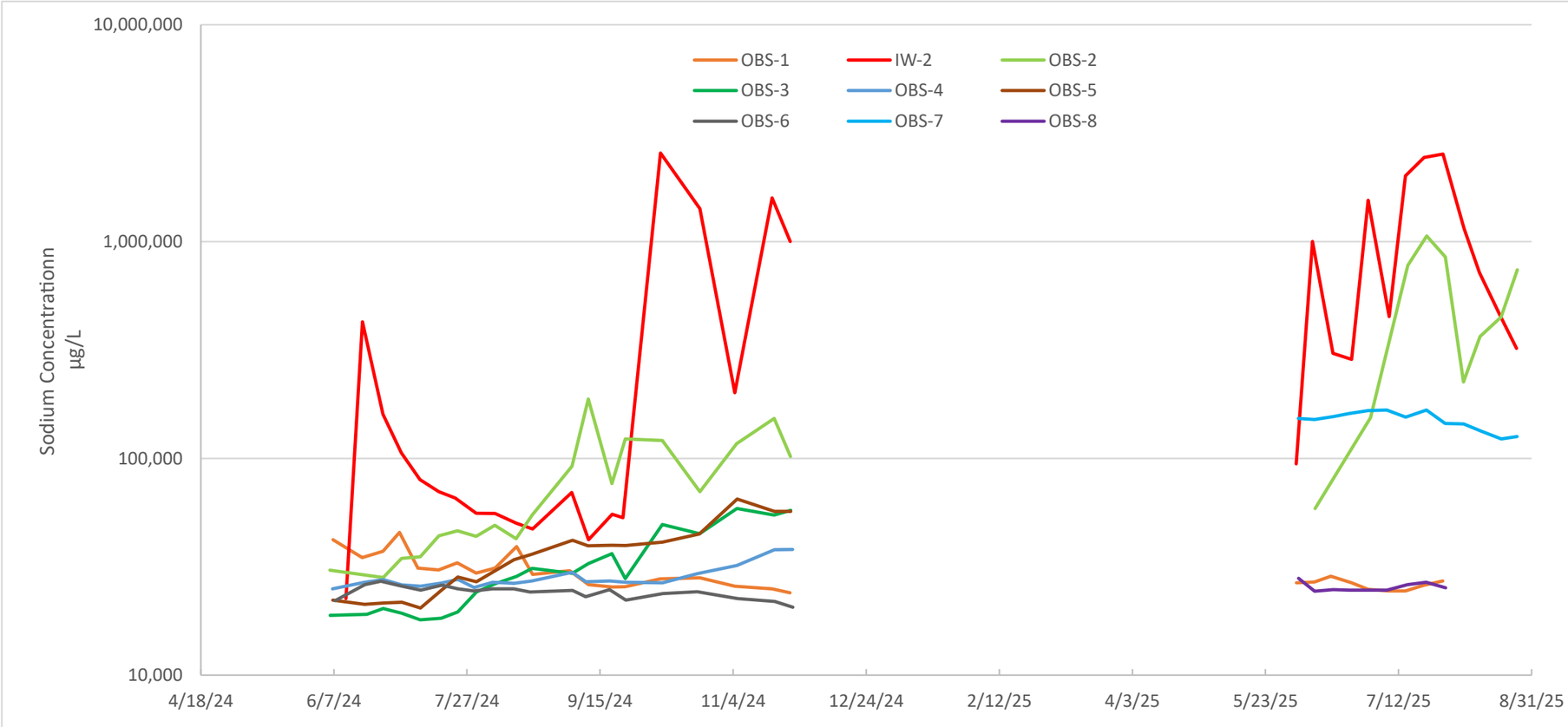

DRAFT

Exhibit No.

11

Title

Total Sodium Concentration Trend Graph

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

µg/L micrograms per liter

Notes:
1. Analytical data from OBS-9 and OBS-10 are excluded from graph due to lack of data density.

Stantec

TVA

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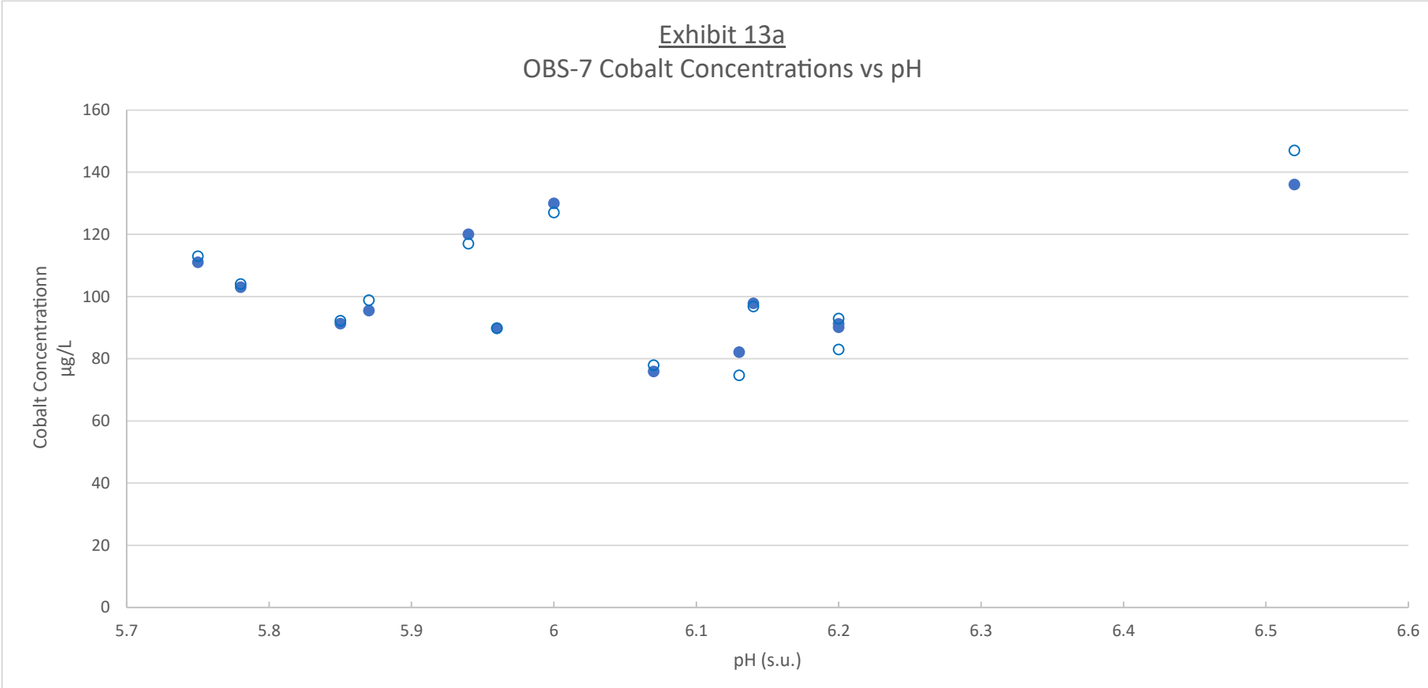
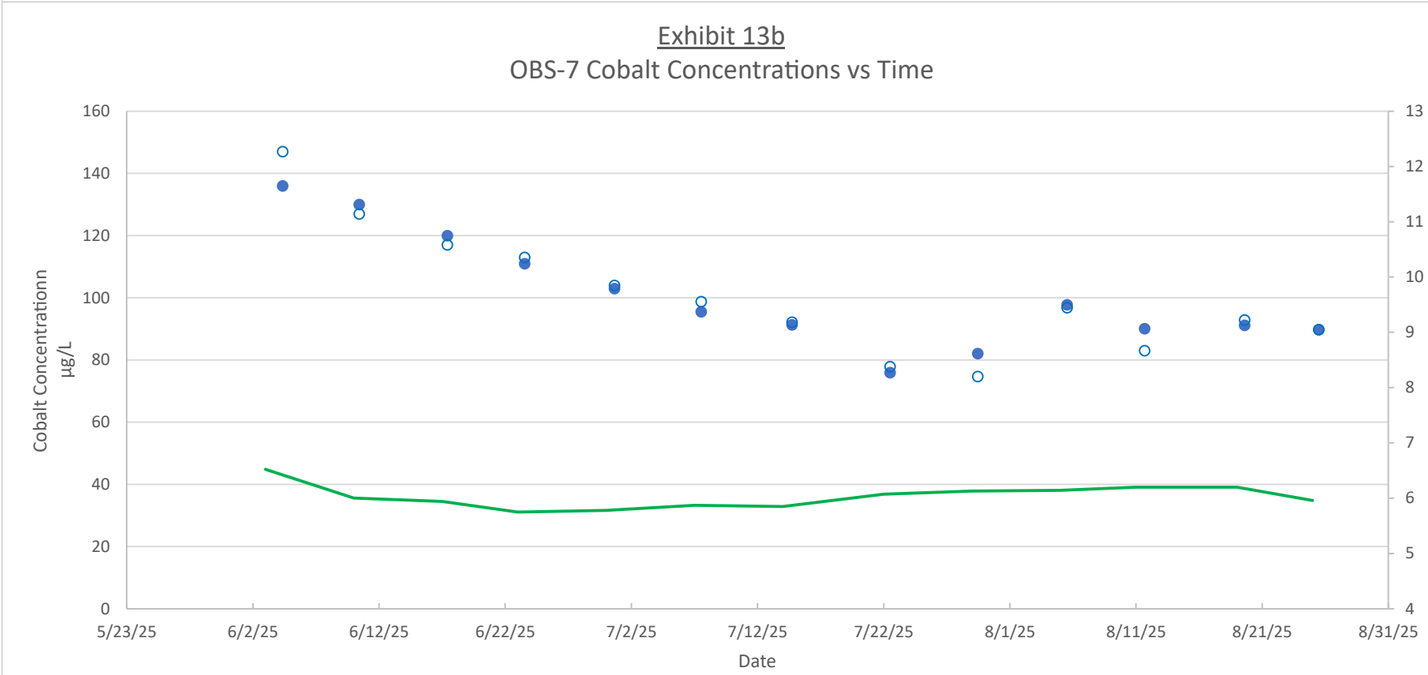




DRAFT

Exhibit No.
12

Title
OBS-7 Cobalt vs pH

Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

Legend

- Total Cobalt
- Dissolved Cobalt
- pH
- µg/L micrograms per liter

Stantec

TVA

U:\TVA_EIP\175668050_WBF_WorkPlans\gis\mxd\CAR\InsituIX3_InSituPilotTest\InSituPilotTest_Exh.aprx 13_WBF_OBS-7_CobaltvspH Revised: 2025-10-23 By: mbough

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

ATTACHMENT A – WELL INSTALLATION LOGS

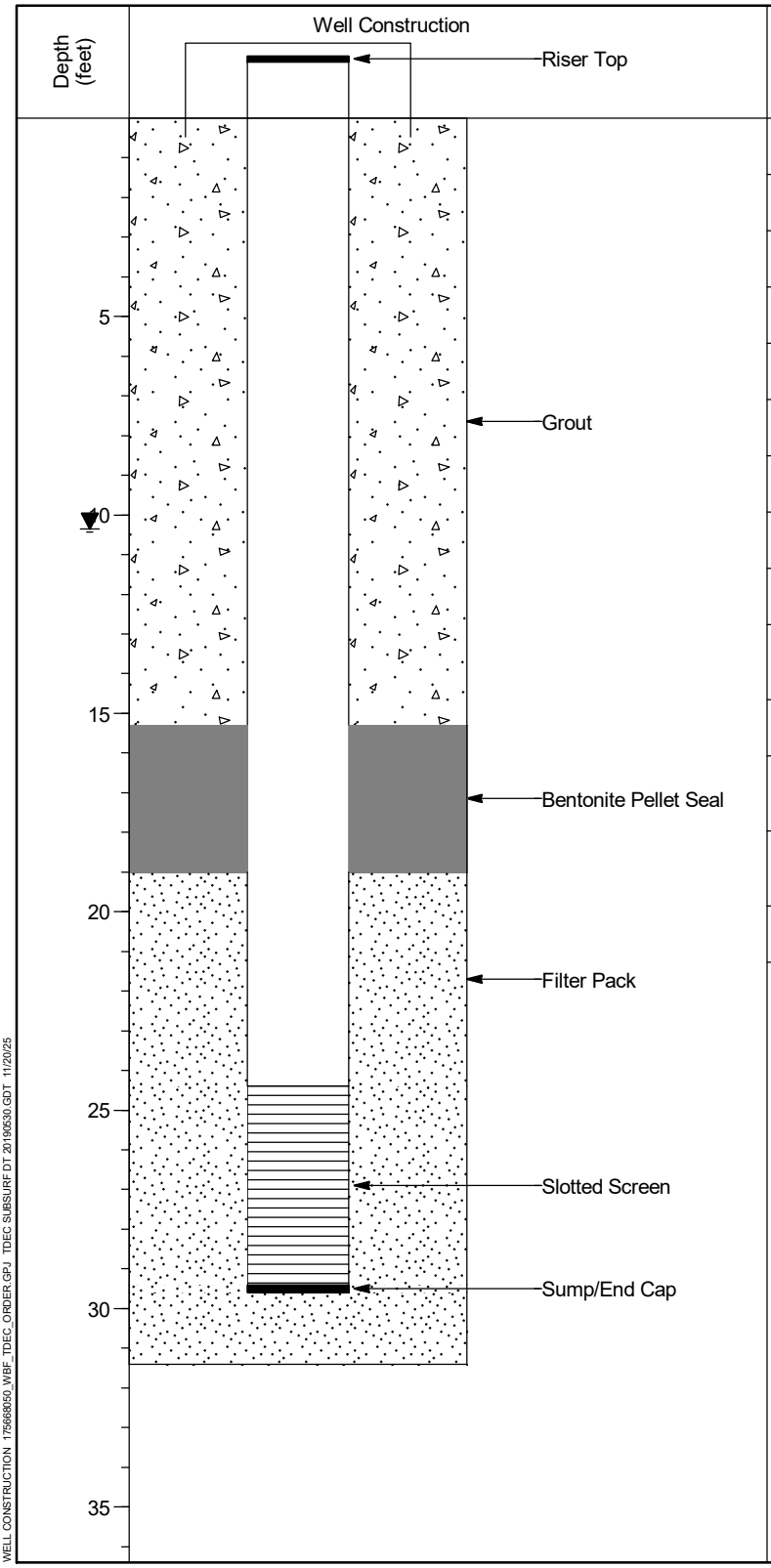
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-IW-1** (Boring WBF-IW-1)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **J. Myer**
REVIEWED BY: **C. Millhollin**
APPROVED BY: **D. Collins**

INSTALLATION: STARTED: **5/9/24** COMPLETED: **5/10/24**
LOCATION: **444,178.51 N; 2,363,086.37 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, TN**
LATITUDE: **35° 36' 21.92"** LONGITUDE: **-84° 46' 42.67"**
GROUND ELEV (ft): **695.9** TOC ELEV (ft): **697.90**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **31.4** WELL DEPTH (ft, bgs): **29.6**
DTW AT COMPLETION (ft, bgs): **10.4**
BOREHOLE DIA. (in): **8.0** WELL DIA. (in): **1.0**



Materials Inventory

RISER TYPE: **1" Sch 40 PVC Riser**

RISER: TOP (AGS): **2.0 ft** BOTTOM (BGS): **24.4 ft**

SCREEN TYPE: **U-Pack - Factory Machine Slotted**

SCREEN SLOT SIZE (in): **0.020**

SCREEN: TOP (BGS): **24.4 ft** BOTTOM (BGS): **29.4 ft**

END CAP: TOP (BGS): **29.4 ft** BOTTOM (BGS): **29.6 ft**

GROUT QUANTITY: **80 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **15.3 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.0** RETURN (lbs/gal): **10.0**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **15.3 ft** BOTTOM (BGS): **19.0 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (FilterSil Industrial Quartz)**

FILTER PACK: TOP (BGS): **19.0 ft** BOTTOM (BGS): **29.6 ft**

NOTES:
Backfill below sand pack.

Well re-augered after well unset.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF.DT 20190530.GDT 11/20/25

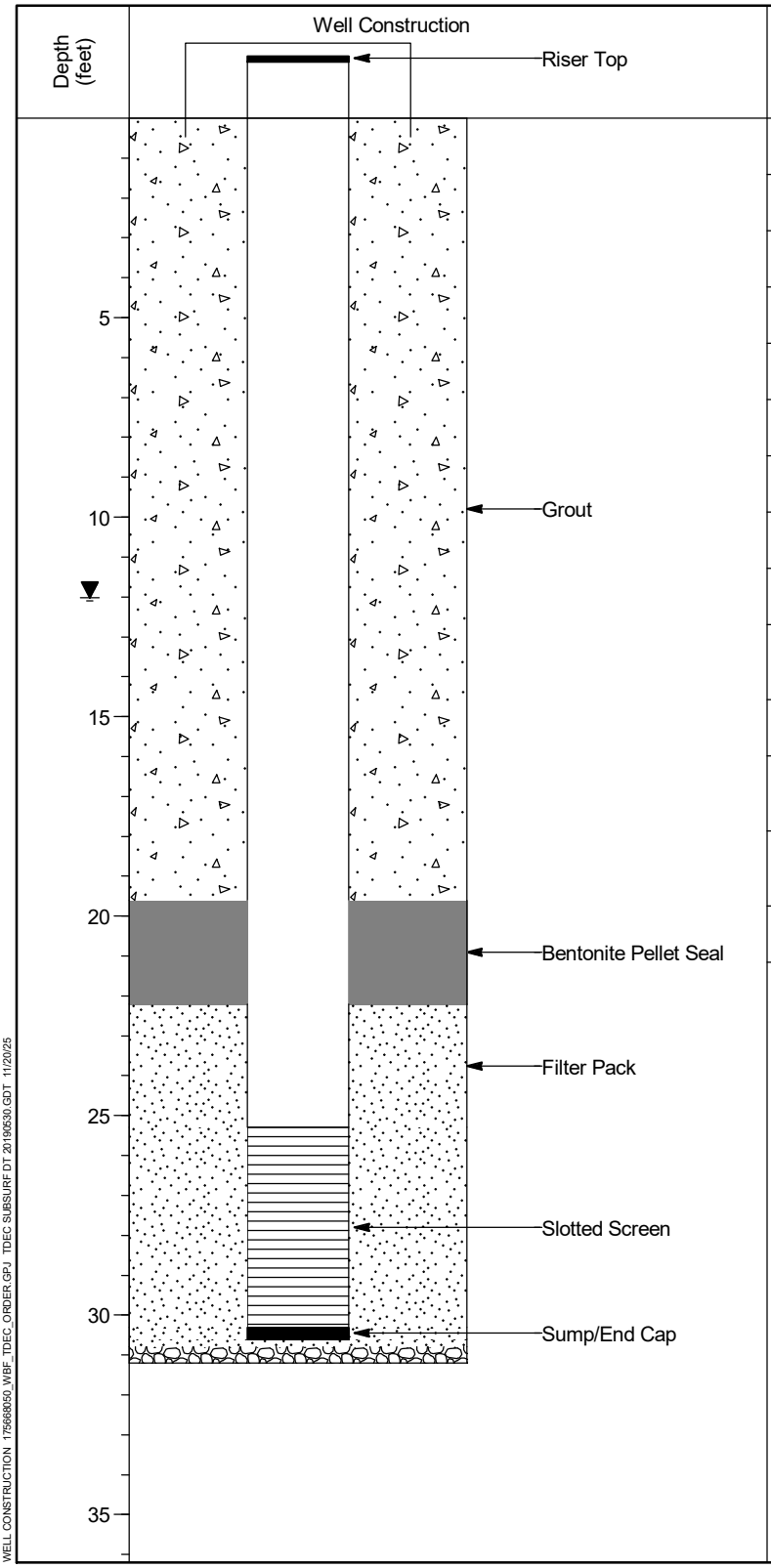
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-IW-2** (Boring WBF-IW-2)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **4-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **A. Stevens**
REVIEWED BY: **C. Millhollin**
APPROVED BY: **D. Collins**

INSTALLATION: STARTED: **5/13/24** COMPLETED: **5/14/24**
LOCATION: **444,183.08 N; 2,363,087.30 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, TN**
LATITUDE: **35° 36' 21.97"** LONGITUDE: **-84° 46' 42.66"**
GROUND ELEV (ft): **695.8** TOC ELEV (ft): **697.44**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **31.2** WELL DEPTH (ft, bgs): **30.6**
DTW AT COMPLETION (ft, bgs): **12.0**
BOREHOLE DIA. (in): **4.3** WELL DIA. (in): **1.0**



Materials Inventory

RISER TYPE: **1" Sch 40 PVC Riser**

RISER: TOP (AGS): **1.7 ft** BOTTOM (BGS): **25.3 ft**

SCREEN TYPE: **U-Pack - Factory Machine Slotted**

SCREEN SLOT SIZE (in): **0.020**

SCREEN: TOP (BGS): **25.3 ft** BOTTOM (BGS): **30.3 ft**

END CAP: TOP (BGS): **30.3 ft** BOTTOM (BGS): **30.6 ft**

GROUT QUANTITY: **60 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **19.6 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.3** RETURN (lbs/gal): **10.1**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **19.6 ft** BOTTOM (BGS): **22.2 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **22.2 ft** BOTTOM (BGS): **30.8 ft**

NOTES:
Backfill below sand pack: natural backfill collapse from 30.8' - 31.2'.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF.DT 20190530.GDT 11/20/25

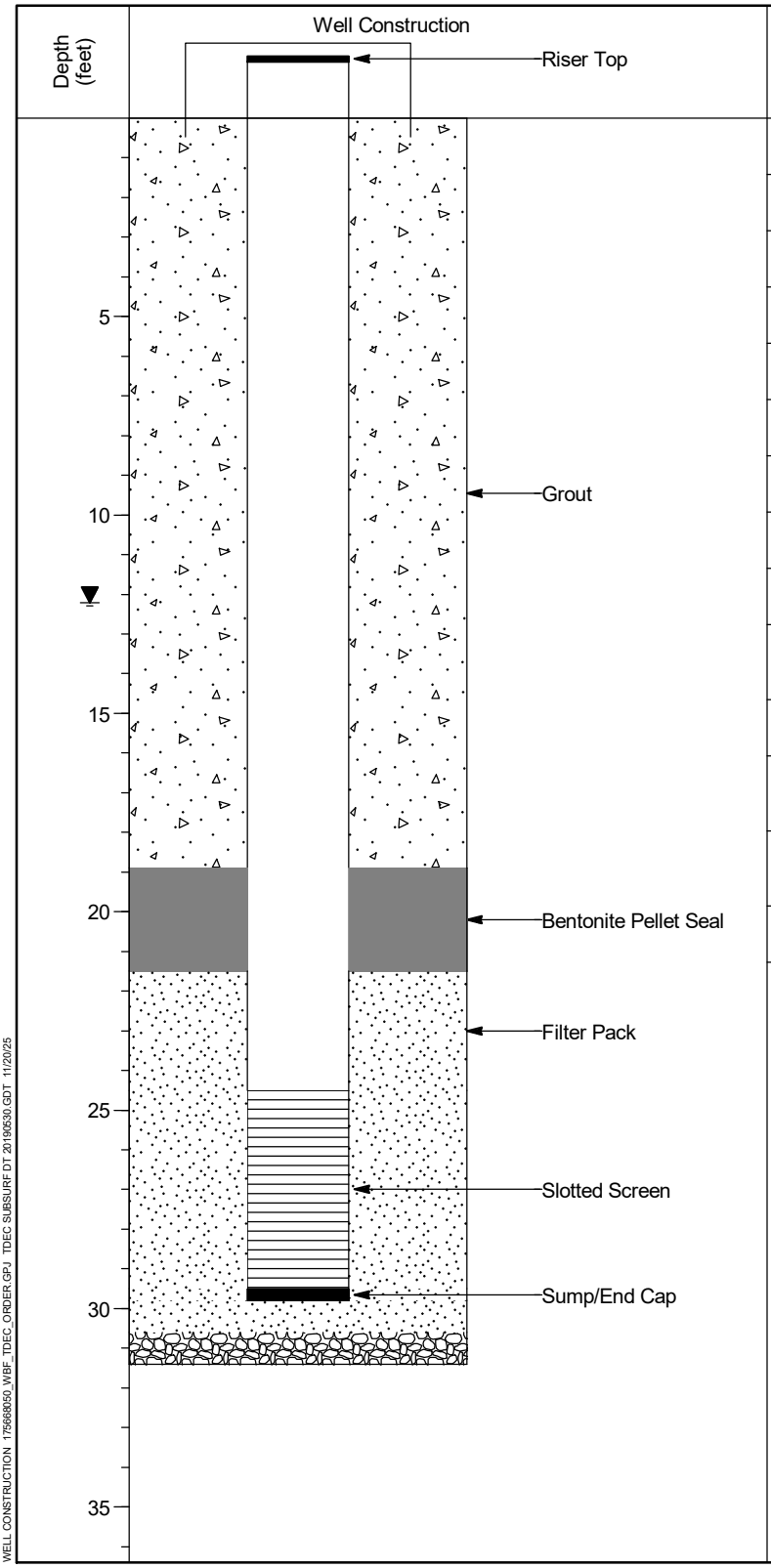
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-IW-3** (Boring WBF-IW-3)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **4-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **A. Stevens**
REVIEWED BY:
APPROVED BY:

INSTALLATION: STARTED: **5/14/24** COMPLETED: **5/15/24**
LOCATION: **444,188.51 N; 2,363,086.75 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, TN**
LATITUDE: **35° 36' 22.02"** LONGITUDE: **-84° 46' 42.66"**
GROUND ELEV (ft): **695.9** TOC ELEV (ft): **697.62**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **31.4** WELL DEPTH (ft, bgs): **29.8**
DTW AT COMPLETION (ft, bgs): **12.2**
BOREHOLE DIA. (in): **4.3** WELL DIA. (in): **1.0**



Materials Inventory

RISER TYPE: **1" Sch 40 PVC Riser**

RISER: TOP (AGS): **1.8 ft** BOTTOM (BGS): **29.8 ft**

SCREEN TYPE: **U-Pack - Factory Machine Slotted**

SCREEN SLOT SIZE (in): **0.020**

SCREEN: TOP (BGS): **24.5 ft** BOTTOM (BGS): **29.5 ft**

END CAP: TOP (BGS): **29.5 ft** BOTTOM (BGS): **29.8 ft**

GROUT QUANTITY: **60 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **18.9 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.1** RETURN (lbs/gal): **10.1**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **18.9 ft** BOTTOM (BGS): **21.5 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **21.5 ft** BOTTOM (BGS): **30.6 ft**

NOTES:
Backfill below sand pack: Natural backfill collapse from 30.6' - 31.4'

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF.DT 20190530.GDT 11/20/25

DRAFT

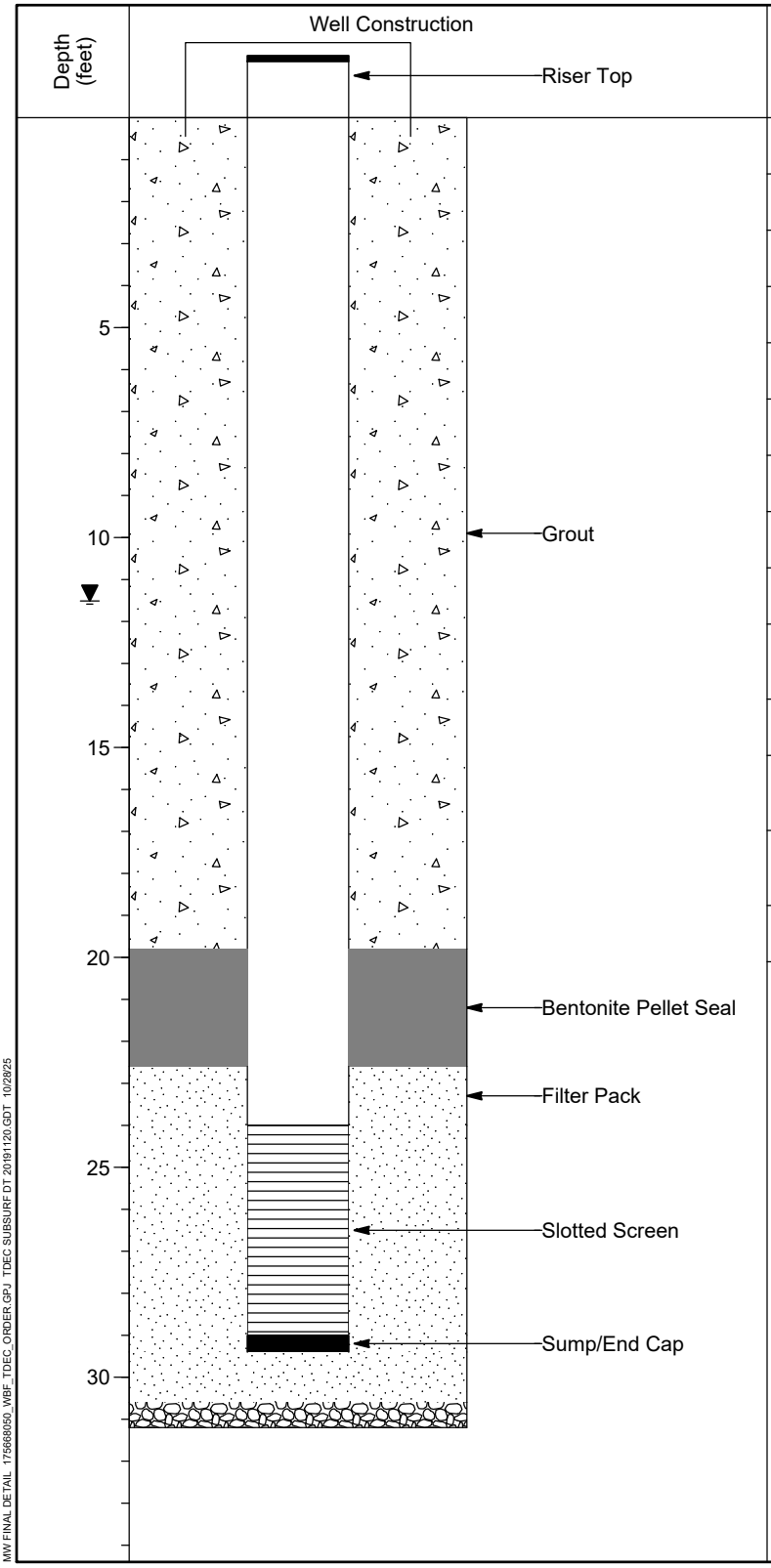
WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-1** (Boring WBF-OBS-1)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **A. Stevens**
REVIEWED BY: **C. Millhollin**
APPROVED BY: **D. Collins**

INSTALLATION: STARTED: **5/15/24** COMPLETED: **5/16/24**
LOCATION: **444,183.30 N; 2,363,081.46 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, Tennessee**
LATITUDE: **35° 36' 21.97"** LONGITUDE: **-84° 46' 42.73"**
GROUND ELEV (ft): **696.5** TOC ELEV (ft): **702.11**
ELEVATION DATUM: **NGVD29**
WELL DEPTH (ft, bgs): **29.4**
DTW AT COMPLETION (ft, bgs): **11.5**
BOREHOLE DIA. (in): **8.3** WELL DIA. (in): **4.0**

Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**	
RISER: TOP (AGS): **5.6 ft**	BOTTOM (BGS): **24.0 ft**
SCREEN TYPE: **5"ID x 4"ID U-Pack**	
SCREEN SLOT SIZE (in): **0.010**	
SCREEN: TOP (BGS): **24.0 ft**	BOTTOM (BGS): **29.0 ft**
END CAP: TOP (BGS): **29.0 ft**	BOTTOM (BGS): **29.4 ft**
GROUT QUANTITY: **90 gal**	
GROUT TYPE: **30% High Solids Bentonite - Cetco**	
GROUT: TOP (BGS): **0.0 ft**	BOTTOM (BGS): **19.8 ft**
GROUT DENSITY: INITIAL (lbs/gal): **10.1**	RETURN (lbs/gal): **10.0**
BENTONITE TYPE: **3/8" PDS TR30 pellets**	
BENTONITE SEAL: TOP (BGS): **19.8 ft**	BOTTOM (BGS): **22.6 ft**
FILTER PACK - PRE-PACK AND ANNULAR SPACE: TYPE: **20/40 Mesh (FilterSil Industrial Quartz)**	
FILTER PACK: TOP (BGS): **22.6 ft**	BOTTOM (BGS): **30.6 ft**

NOTES:
Heaving sands and natural backfill from 30.6-31.2 ft bgs.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

MW FINAL DETAIL 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20191120.GDT 10/2/25

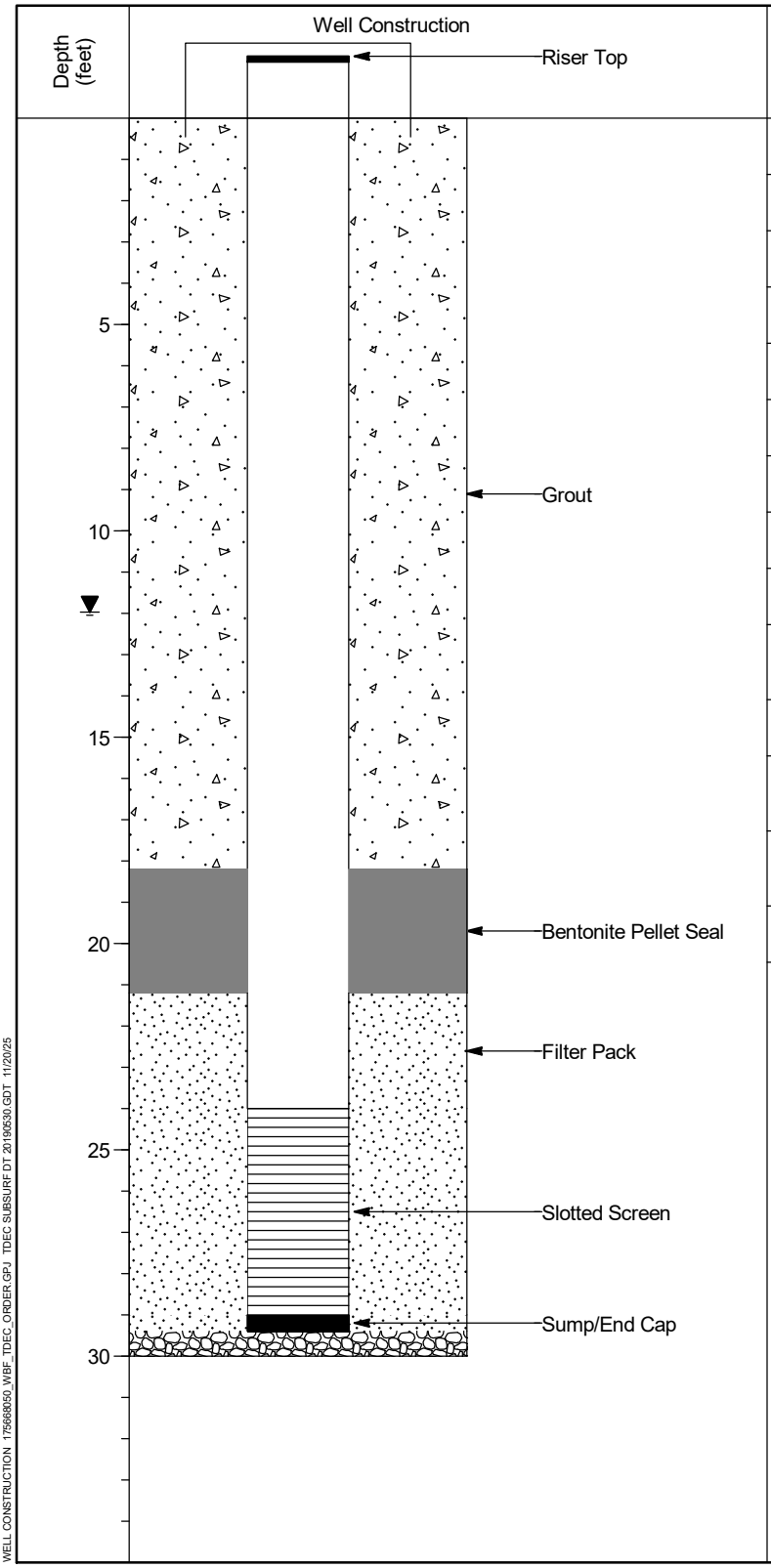
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-2** (Boring WBF-OBS-2)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **J. Myer**
REVIEWED BY:
APPROVED BY:

INSTALLATION: STARTED: **5/6/24** COMPLETED: **5/7/24**
LOCATION: **444,183.15 N; 2,363,092.43 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, TN**
LATITUDE: **35° 36' 21.97"** LONGITUDE: **-84° 46' 42.59"**
GROUND ELEV (ft): **694.8** TOC ELEV (ft): **696.23**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **30.0** WELL DEPTH (ft, bgs): **29.4**
DTW AT COMPLETION (ft, bgs): **12.0**
BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **1.4 ft** BOTTOM (BGS): **29.4 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **24.0 ft** BOTTOM (BGS): **29.0 ft**

END CAP: TOP (BGS): **29.0 ft** BOTTOM (BGS): **29.4 ft**

GROUT QUANTITY: **97 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **18.2 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.1** RETURN (lbs/gal): **10.0**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **18.2 ft** BOTTOM (BGS): **21.2 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (FilterSil Industrial Quartz)**

FILTER PACK: TOP (BGS): **21.2 ft** BOTTOM (BGS): **29.4 ft**

NOTES:
N/A

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF.DT 20190530.GDT 11/20/25

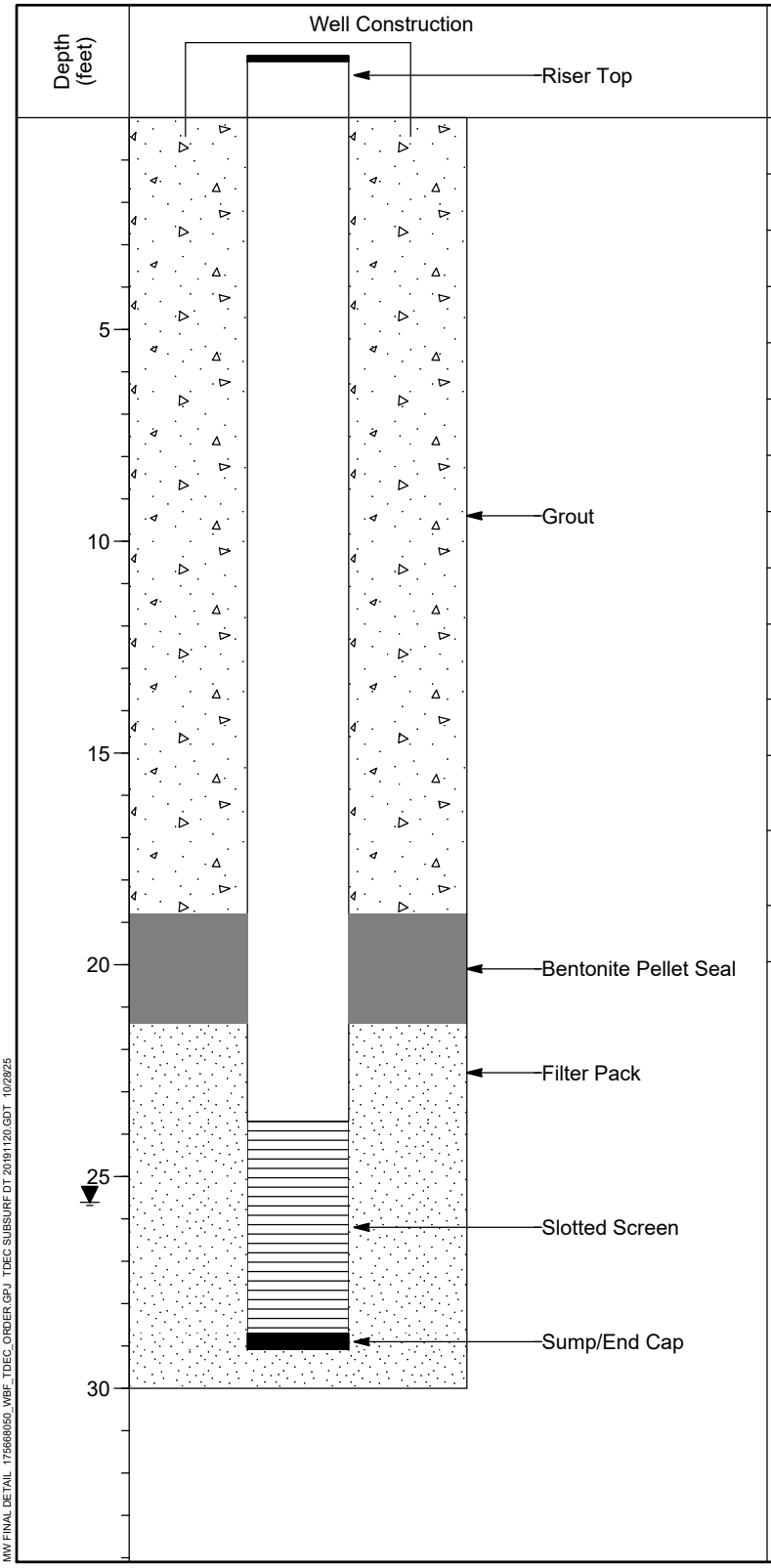
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-3** (Boring WBF-OBS-3)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **J. Myer**
REVIEWED BY: **C. Millhollin**
APPROVED BY: **D. Collins**

INSTALLATION: STARTED: **5/2/24** COMPLETED: **5/3/24**
LOCATION: **444,182.74 N; 2,363,098.16 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, Tennessee**
LATITUDE: **35° 36' 21.96"** LONGITUDE: **-84° 46' 42.53"**
GROUND ELEV (ft): **694.1** TOC ELEV (ft): **696.24**
ELEVATION DATUM: **NGVD29**
WELL DEPTH (ft, bgs): **29.1**
DTW AT COMPLETION (ft, bgs): **25.6**
BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **2.2 ft** BOTTOM (BGS): **23.7 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **23.7 ft** BOTTOM (BGS): **28.7 ft**

END CAP: TOP (BGS): **28.7 ft** BOTTOM (BGS): **29.1 ft**

GROUT QUANTITY: **74 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **18.8 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.0** RETURN (lbs/gal): **10.0**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **18.8 ft** BOTTOM (BGS): **21.4 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (FilterSil Industrial Quartz)**

FILTER PACK: TOP (BGS): **21.4 ft** BOTTOM (BGS): **29.1 ft**

NOTES:
FilterSil Industrial Quartz Sand from 29.1 to 30 ft bgs.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

MW FINAL DETAIL 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20191120.GDT 10/28/25

DRAFT

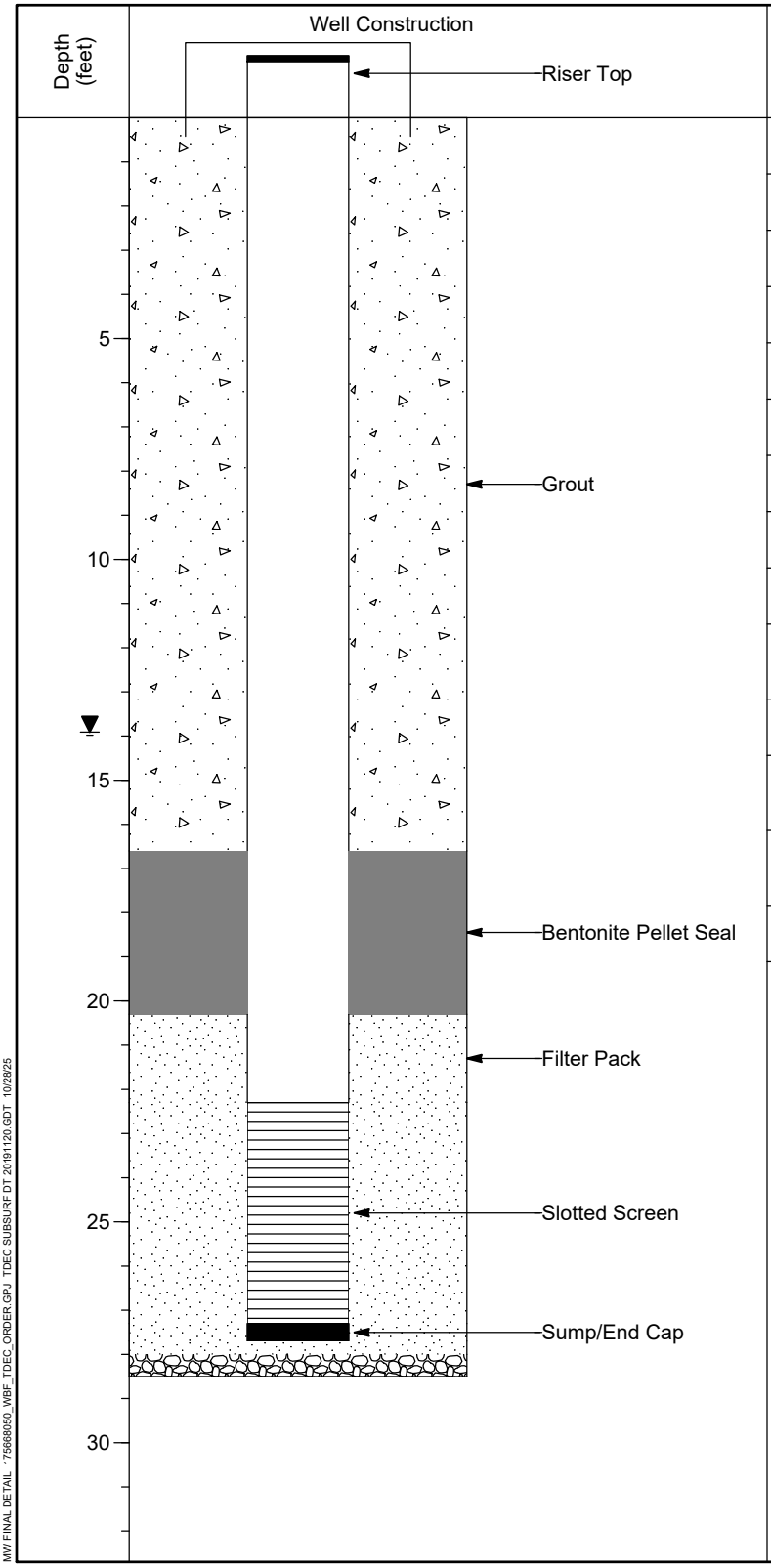
WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-4** (Boring WBF-OBS-4)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **J. Myer**
REVIEWED BY: **C Millhollin**
APPROVED BY: **D. Collins**

INSTALLATION: STARTED: **4/30/24** COMPLETED: **5/1/24**
LOCATION: **444,183.28 N; 2,363,102.62 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, Tennessee**
LATITUDE: **35° 36' 21.97"** LONGITUDE: **-84° 46' 42.47"**
GROUND ELEV (ft): **693.2** TOC ELEV (ft): **696.36**
ELEVATION DATUM: **NGVD29**
WELL DEPTH (ft, bgs): **27.7**
DTW AT COMPLETION (ft, bgs): **13.9**
BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**

Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **3.1 ft** BOTTOM (BGS): **22.3 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **22.3 ft** BOTTOM (BGS): **27.3 ft**

END CAP: TOP (BGS): **27.3 ft** BOTTOM (BGS): **27.7 ft**

GROUT QUANTITY: **40 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **16.6 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.0** RETURN (lbs/gal): **10.0**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **16.6 ft** BOTTOM (BGS): **20.3 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (FilterSil Industrial Quartz)**

FILTER PACK: TOP (BGS): **20.3 ft** BOTTOM (BGS): **27.7 ft**

NOTES:
FilterSil Industrial Quartz sand placed from 28.0' to 27.7' (below sump/end cap). Natural backfill from 28.5 to 28.0 ft bgs.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

MW FINAL DETAIL 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20191120.GDT 10/2/25

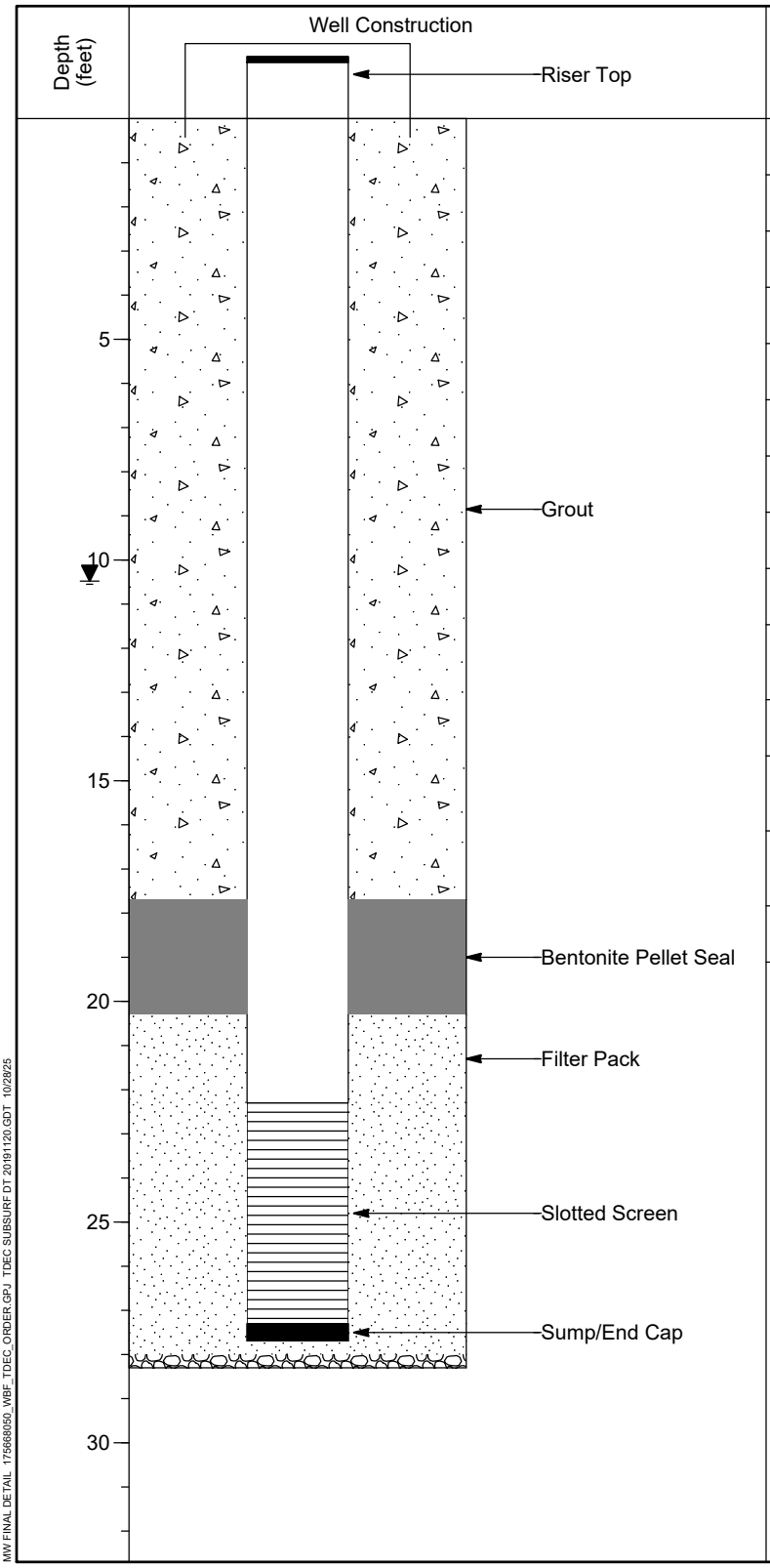
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-5** (Boring WBF-OBS-5)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **J. Myer**
REVIEWED BY: **C. Millhollin**
APPROVED BY: **B. Vinson**

INSTALLATION: STARTED: **5/7/24** COMPLETED: **5/8/24**
LOCATION: **444,173.57 N; 2,363,102.39 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, TN**
LATITUDE: **35° 36 '21.87"** LONGITUDE: **-84° 46' 42.48"**
GROUND ELEV (ft): **693.7** TOC ELEV (ft): **697.26**
ELEVATION DATUM: **NGVD29**
WELL DEPTH (ft, bgs): **27.7**
DTW AT COMPLETION (ft, bgs): **10.5**
BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **3.5 ft** BOTTOM (BGS): **20.3 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **22.3 ft** BOTTOM (BGS): **27.3 ft**

END CAP: TOP (BGS): **27.3 ft** BOTTOM (BGS): **27.7 ft**

GROUT QUANTITY: **84 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **17.7 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.0** RETURN (lbs/gal): **10.0**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **17.7 ft** BOTTOM (BGS): **20.3 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (FilterSil Industrial Quartz)**

FILTER PACK: TOP (BGS): **20.3 ft** BOTTOM (BGS): **27.7 ft**

NOTES:
FilterSil Industrial Quartz sand placed from 28.0' to 27.7' (below sump/end cap). Natural backfill from 28.5 to 28.0 ft bgs.

MW FINAL DETAIL 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20191120.GDT 10/2/925

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

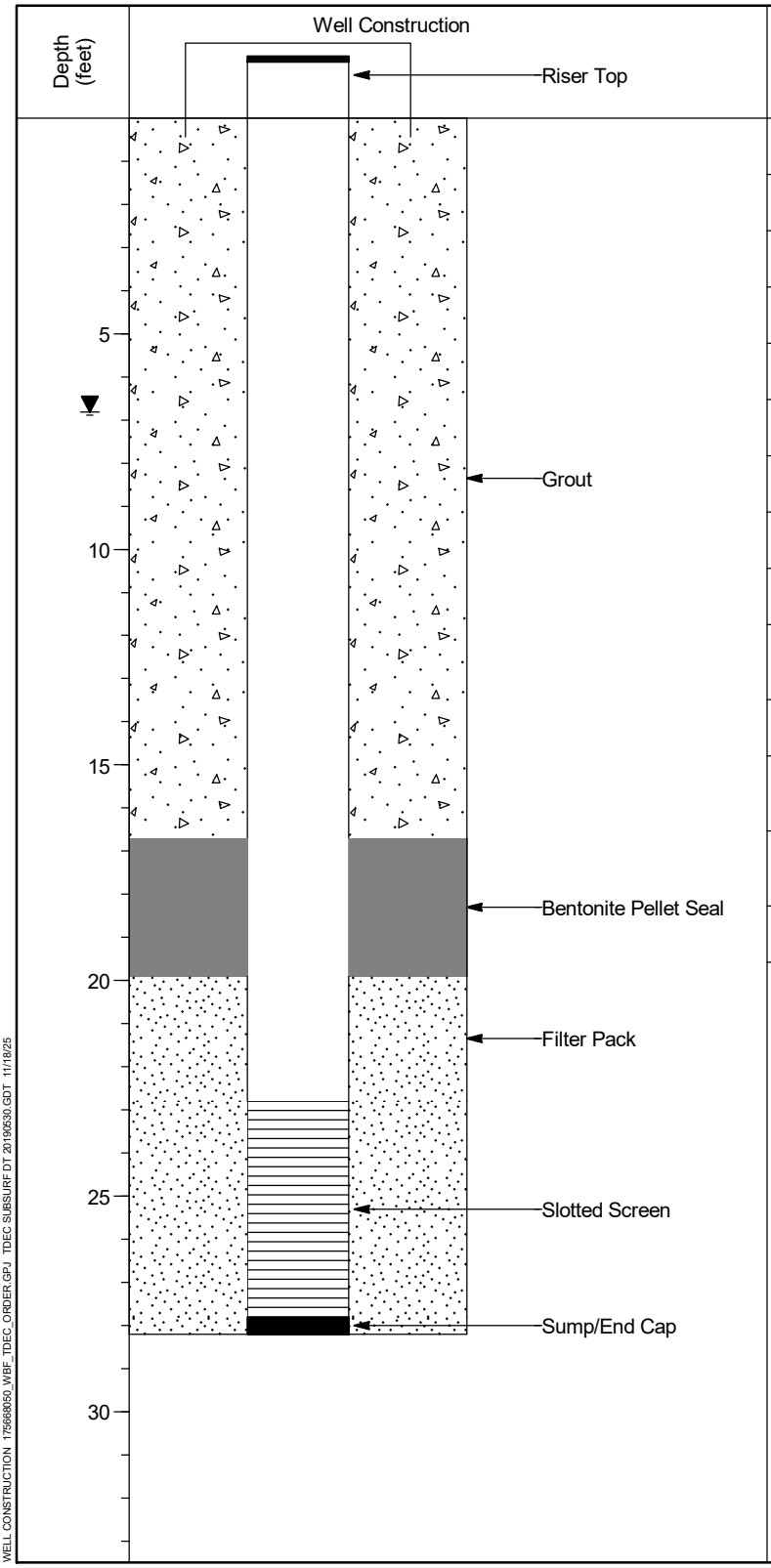
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-6** (Boring WBF-OBS-6)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **Stantec Consulting Services Inc.**
DRILLING EQUIPMENT: **CME 55 LCX**
DRILLING METHOD: **8-1/4" HSA overdrill of boring**
SAMPLING METHOD: **4-1/4" HSA, 2" SS w/o liners**
OBSERVED BY: **J. Myer**
REVIEWED BY: **C. Millhollin**
APPROVED BY: **D. Collins**

INSTALLATION: STARTED: **5/8/24** COMPLETED: **5/9/24**
LOCATION: **444,192.69 N; 2,363,102.64 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **Rhea County, TN**
LATITUDE: **35° 36 '22.06"** LONGITUDE: **-84° 46' 42.47"**
GROUND ELEV (ft): **693.3** TOC ELEV (ft): **696.23**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **28.5** WELL DEPTH (ft, bgs): **28.2**
DTW AT COMPLETION (ft, bgs): **6.8**
BOREHOLE DIA. (in): **13.0** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **3.0 ft** BOTTOM (BGS): **22.8 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **22.8 ft** BOTTOM (BGS): **27.8 ft**

END CAP: TOP (BGS): **27.8 ft** BOTTOM (BGS): **28.2 ft**

GROUT QUANTITY: **80 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **16.7 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **10.0** RETURN (lbs/gal): **10.0**

BENTONITE TYPE: **3/8" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **16.7 ft** BOTTOM (BGS): **19.9 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (FilterSil Industrial Quartz)**

FILTER PACK: TOP (BGS): **19.9 ft** BOTTOM (BGS): **28.2 ft**

NOTES:
Natural backfill from 28.5 to 28.2 ft bgs.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF.DT 20190530.GDT 11/18/25

DRAFT

WELL INSTALLATION DETAIL

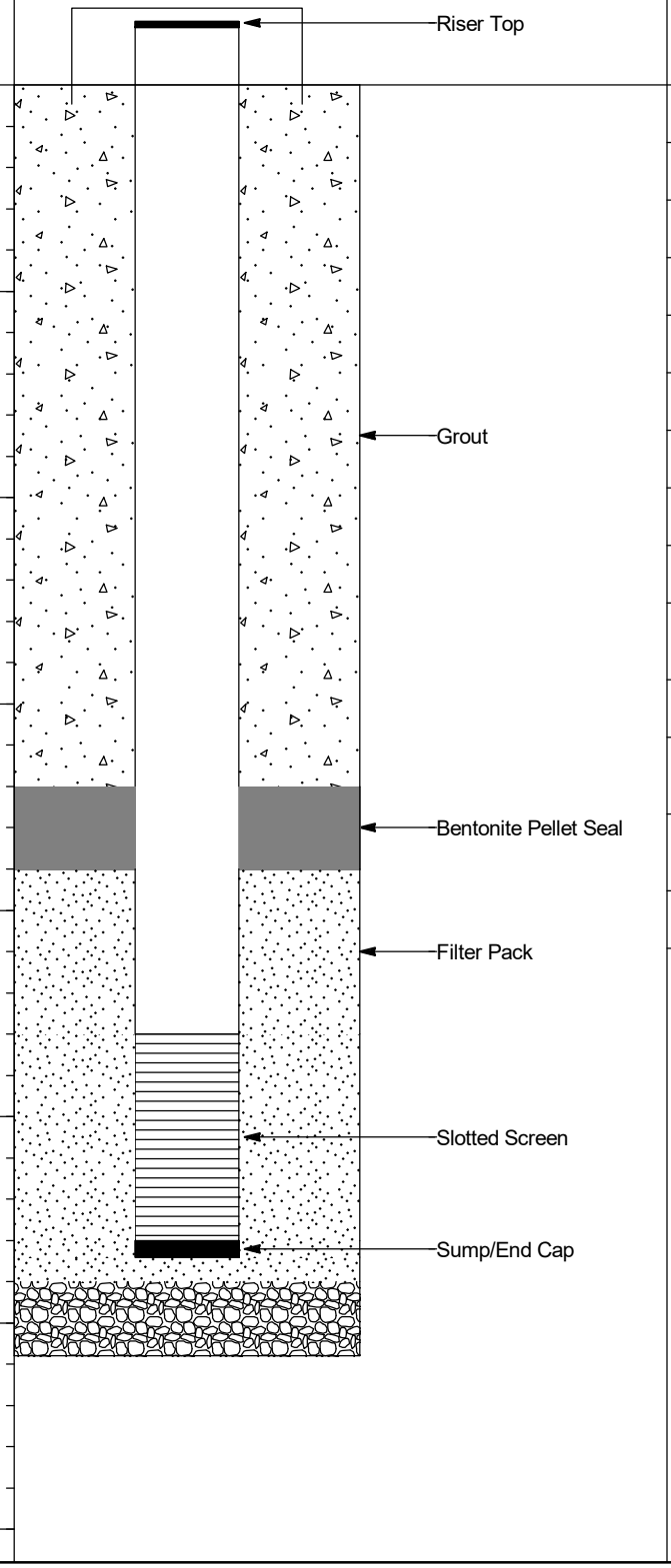
WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-07** (Boring WBF-OBS-07)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **AST**
DRILLING EQUIPMENT: **GeoProbe 7822DT**
DRILLING METHOD: **6-1/4" HSA overdrill of boring**
SAMPLING METHOD: **2.25" OD DPT using DT22 Sampler**
OBSERVED BY: **E. Smith**
REVIEWED BY:
APPROVED BY:

INSTALLATION: STARTED: **5/14/25** COMPLETED: **5/16/25**
LOCATION: **444,178.27 N; 2,363,091.73 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **WBF Pilot Study Area**
LATITUDE: **35° 36' 21.92"** LONGITUDE: **-84° 46' 42.60"**
GROUND ELEV (ft): **694.9** TOC ELEV (ft): **697.55**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **30.8** WELL DEPTH (ft, bgs): **28.4**
DTW AT COMPLETION (ft, bgs): **N/A**
BOREHOLE DIA. (in): **10.5** WELL DIA. (in): **4.0**

Depth (feet)

Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **2.7 ft** BOTTOM (BGS): **23.0 ft**

SCREEN TYPE: **U-Pack - Factory Machine Slotted**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **23.0 ft** BOTTOM (BGS): **28.0 ft**

END CAP: TOP (BGS): **28.0 ft** BOTTOM (BGS): **28.4 ft**

GROUT QUANTITY: **70 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **17.0 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **NR** RETURN (lbs/gal): **NR**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **17.0 ft** BOTTOM (BGS): **19.0 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **19.0 ft** BOTTOM (BGS): **29.0 ft**

NOTES:
Well installed following overdrilling to 29 feet bgs of DPT boring WBF-OBS-07. 2.25" OD DPT boring advanced to a depth of 30.8 feet bgs.

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 11/20/25

DRAFT

WELL INSTALLATION DETAIL

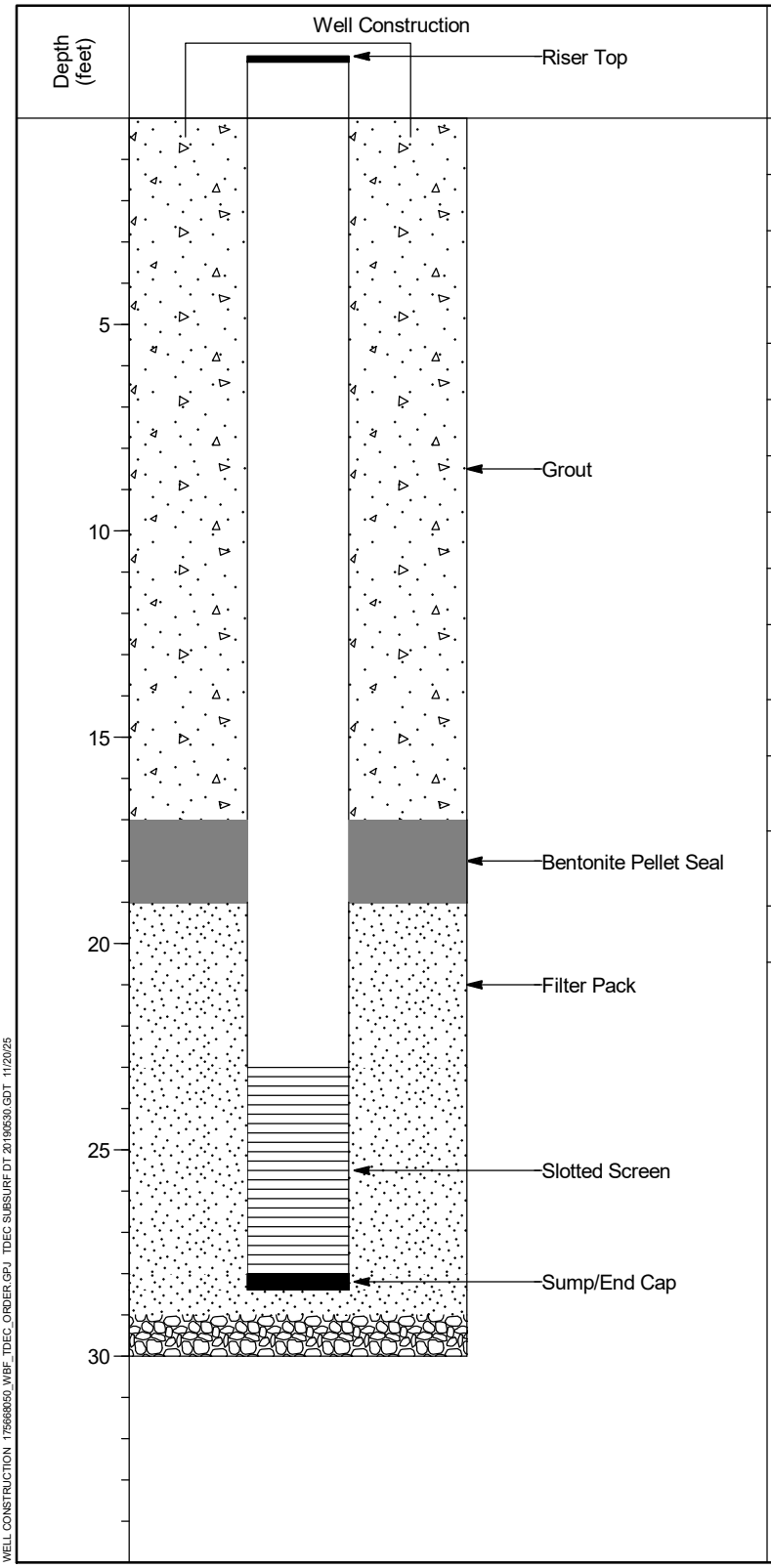
WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-08** (Boring WBF-OBS-08)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **AST**
DRILLING EQUIPMENT: **GeoProbe 7822DT**
DRILLING METHOD: **6-1/4" HSA overdrill of boring**
SAMPLING METHOD: **2.25" OD DPT using DT22 Sampler**
OBSERVED BY: **E. Smith**
REVIEWED BY:
APPROVED BY:

INSTALLATION: STARTED: **5/15/25** COMPLETED: **5/16/25**
LOCATION: **444,167.65 N; 2,363,093.78 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **WBF Pilot Study Area**
LATITUDE: **35° 36' 21.81"** LONGITUDE: **-84° 46' 42.58"**
GROUND ELEV (ft): **694.5** TOC ELEV (ft): **697.40**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **30.0** WELL DEPTH (ft, bgs): **28.4**
DTW AT COMPLETION (ft, bgs): **N/A**
BOREHOLE DIA. (in): **10.5** WELL DIA. (in): **4.0**

Depth (feet)

Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **2.9 ft** BOTTOM (BGS): **23.0 ft**

SCREEN TYPE: **U-Pack - Factory Machine Slotted**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **23.0 ft** BOTTOM (BGS): **28.0 ft**

END CAP: TOP (BGS): **28.0 ft** BOTTOM (BGS): **28.4 ft**

GROUT QUANTITY: **70 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **17.0 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **NR** RETURN (lbs/gal): **NR**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **17.0 ft** BOTTOM (BGS): **19.0 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **19.0 ft** BOTTOM (BGS): **29.0 ft**

NOTES:
Overdrill of DPT boring WBF-OBS-8 installed on 05/14/25 to a depth of 30.0 feet bgs.

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 11/20/25

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

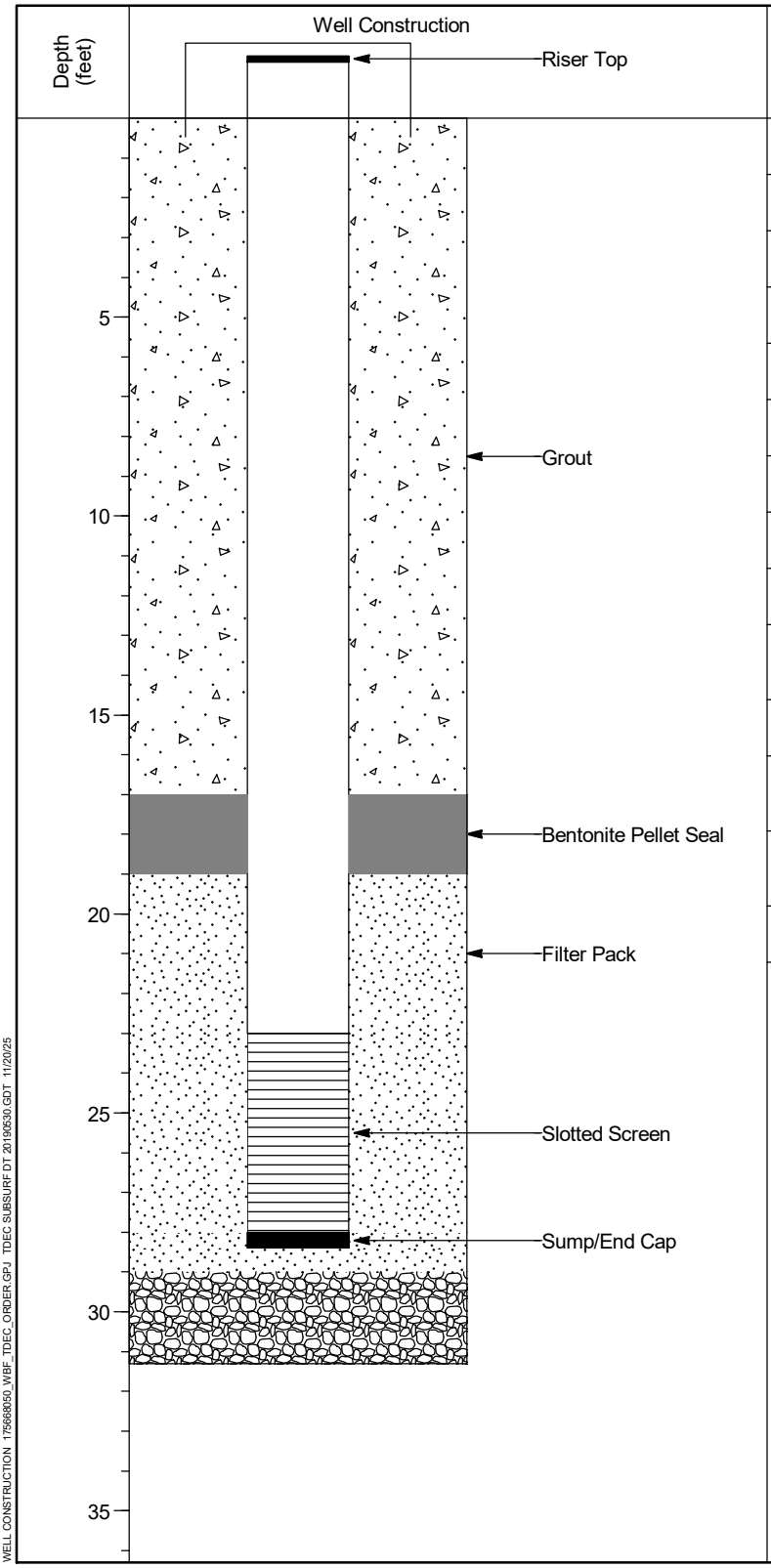
DRAFT

WELL INSTALLATION DETAIL

WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-9** (Boring WBF-OBS-09)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **AST**
DRILLING EQUIPMENT: **GeoProbe 7822DT**
DRILLING METHOD: **6-1/4" HSA overdrill of boring**
SAMPLING METHOD: **2.25" OD DPT using DT22 Sampler**
OBSERVED BY: **E. Smith**
REVIEWED BY:
APPROVED BY:

INSTALLATION: STARTED: **5/15/25** COMPLETED: **5/16/25**
LOCATION: **444,172.81 N; 2,363,086.80 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **WBF Pilot Study Area**
LATITUDE: **35° 36 '21.86"** LONGITUDE: **-84° 46' 42.66"**
GROUND ELEV (ft): **695.8** TOC ELEV (ft): **698.33**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **31.3** WELL DEPTH (ft, bgs): **28.4**
DTW AT COMPLETION (ft, bgs): **N/A**
BOREHOLE DIA. (in): **10.5** WELL DIA. (in): **4.0**



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **2.5 ft** BOTTOM (BGS): **23.0 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **23.0 ft** BOTTOM (BGS): **28.0 ft**

END CAP: TOP (BGS): **28.0 ft** BOTTOM (BGS): **28.4 ft**

GROUT QUANTITY: **70 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **17.0 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **NR** RETURN (lbs/gal): **NR**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **17.0 ft** BOTTOM (BGS): **19.0 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **19.0 ft** BOTTOM (BGS): **29.0 ft**

NOTES:
N/A

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 11/20/25

DRAFT

WELL INSTALLATION DETAIL

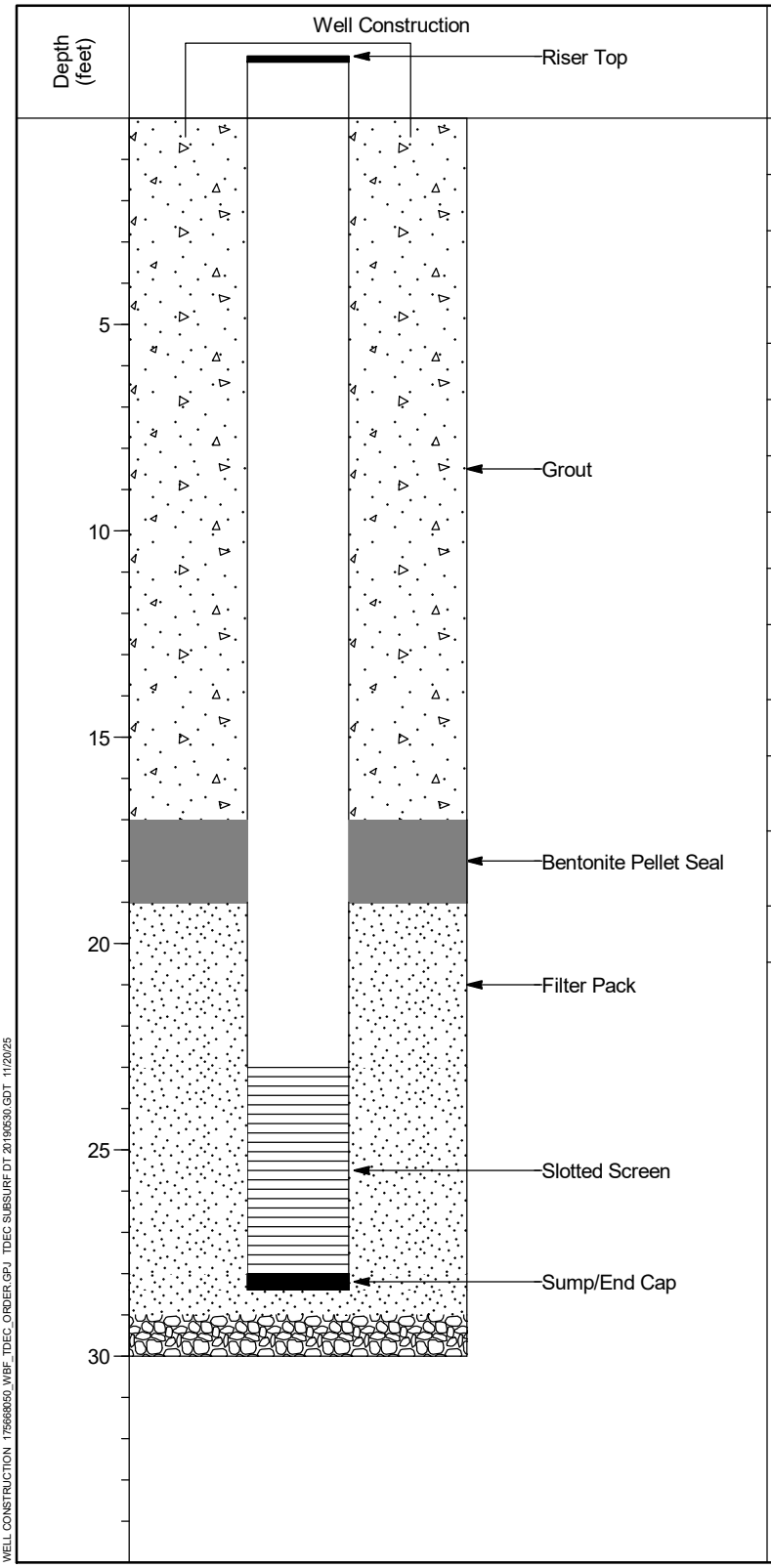
WELL / PROBEHOLE / BOREHOLE NO: **WBF-OBS-10** (Boring WBF-OBS-10)

PROJECT: **WBF TDEC Order**
PROJECT NUMBER: **175668050**
DRILLING COMPANY: **AST**
DRILLING EQUIPMENT: **GeoProbe 7822DT**
DRILLING METHOD: **6-1/4" HSA overdrill of boring**
SAMPLING METHOD: **2.25" OD DPT using DT22 Sampler**
OBSERVED BY: **E. Smith**
REVIEWED BY:
APPROVED BY:

INSTALLATION: STARTED: **5/14/25** COMPLETED: **5/16/25**
LOCATION: **444,173.09 N; 2,363,097.62 E** DATUM: **NAD27 Plant Local**
LOC. DESCRIP: **WBF Pilot Study Area**
LATITUDE: **35° 36' 21.87"** LONGITUDE: **-84° 46' 42.53"**
GROUND ELEV (ft): **694.3** TOC ELEV (ft): **696.47**
ELEVATION DATUM: **NGVD29**
BOREHOLE DEPTH (ft): **30.0** WELL DEPTH (ft, bgs): **28.4**
DTW AT COMPLETION (ft, bgs): **N/A**
BOREHOLE DIA. (in): **10.5** WELL DIA. (in): **4.0**

Depth (feet)

Well Construction



Materials Inventory

RISER TYPE: **4" Sch 40 PVC Riser**

RISER: TOP (AGS): **2.2 ft** BOTTOM (BGS): **23.0 ft**

SCREEN TYPE: **5"ID x 4"ID U-Pack**

SCREEN SLOT SIZE (in): **0.010**

SCREEN: TOP (BGS): **23.0 ft** BOTTOM (BGS): **28.0 ft**

END CAP: TOP (BGS): **28.0 ft** BOTTOM (BGS): **28.4 ft**

GROUT QUANTITY: **70 gal**

GROUT TYPE: **30% High Solids Bentonite - Cetco PureGold**

GROUT: TOP (BGS): **0.0 ft** BOTTOM (BGS): **17.0 ft**

GROUT DENSITY:
INITIAL (lbs/gal): **NR** RETURN (lbs/gal): **NR**

BENTONITE TYPE: **1/4" PDS TR30 pellets**

BENTONITE SEAL:
TOP (BGS): **17.0 ft** BOTTOM (BGS): **19.0 ft**

FILTER PACK - PRE-PACK AND ANNULAR SPACE:
TYPE: **20/40 Mesh (Global #7)**

FILTER PACK: TOP (BGS): **19.0 ft** BOTTOM (BGS): **29.0 ft**

NOTES:
N/A

WELL CONSTRUCTION 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 11/20/25

VERTICAL SCALE: AS SHOWN. HORIZONTAL SCALE: NOT TO SCALE (EXAGGERATED TO SHOW DETAIL)

ATTACHMENT B – SUBSURFACE BORING LOGS

Subsurface Boring Legend

DRAFT

Lithology Graphics

Symbol	Lithology
	Fill
	Top Soil
	Gravel
	Well Graded Gravel (GW)
	Poorly Graded Gravel (GP)
	Silty Gravel (GM)
	Silty, Clayey Gravel (GC-GM)
	Clayey Gravel (GC)
	Well Graded Gravel with Silt (GW-GM)
	Well Graded Gravel with Clay (GW-GC)
	Poorly Graded Gravel with Silt (GP-GM)
	Poorly Graded Gravel with Clay (GP-GC)
	Well Graded Sand (SW)
	Poorly Graded Sand (SP)
	Silty Sand (SM)
	Silty, Clayey Sand (SC-SM)
	Clayey Sand (SC)
	Well Graded Sand with Silt (SW-SM)
	Well Graded Sand with Clay (SW-SC)
	Poorly Graded Sand with Silt (SP-SM)
	Poorly Graded Sand with Clay (SP-SC)
	Silt (ML)
	Silty Clay (CL-ML)
	Lean Clay (CL)
	Organic Silt (OL)
	Elastic Silt (MH)
	Fat Clay (CH)
	Organic Clay (OH)
	Shale
	Siltstone
	Coal
	Limestone
	Sandstone

Lithology Graphics are based on TVA drafting standards.

Other Graphics

Symbol	Description
	Denotes environmental analytical sample interval
	Denotes SS sample interval
	Denotes ST sample interval
	Denotes DP sample interval
	Denotes RS sample interval
	Denotes RC sample interval
	First water level reading
	Second water level reading

Common Abbreviations

Abbreviation	Definition
DP	Direct Push
HA	Hand Auger
HSA	Hollow Stem Auger
N/A	Not Applicable
NR	Not Recorded
RC	Rock Core
RQD	Rock Quality Designation
RS	Rotary Sonic
SS	Split Spoon
ST	Shelby Tube
WH	Weight of Hammer
WR	Weight of Rod

General Notes

The boring logs include sample numbering used during drilling. For assigned Environmental Analytical Sample ID numbers, see relevant Environmental Chain-of- Custody forms from the drilling date range listed on each log.

For pH readings and additional field data, see applicable field documentation (e.g., Soil pH Data Form) from the drilling date range listed on each log.

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-IW-1**
Client	Tennessee Valley Authority	Boring Location	444,178.51 N; 2,363,086.37 E NAD27 Plant Local
Project Number	175668050	Surface Elevation 695.9 ft	Elevation Datum NGVD29
Project Name	WBF TDEC Order	Date Started 5/9/24	Completed 5/9/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water 10.4 ft	Date/Time 5/10/24 08:30
Inspector J. Myer	Logger J. Myer	Depth to Water N/A	Date/Time N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX

Overburden Drilling and Sampling Tools (Type and Size): 4-1/4" HSA, 2" SS w/o liners

Rock Drilling and Sampling Tools (Type and Size): N/A

Overdrill Tooling (Type and Size): 8-1/4" HSA overdrill of boring — Overdrill Depth: 30.2 ft

Sampler Hammer Type: N/A — Weight: N/A — Drop: N/A — Efficiency: N/A

Borehole Azimuth: N/A — Borehole Inclination (from Vertical): N/A

Reviewed By: C. Millhollin — Approved By: P. Dunne

Depth Ft[3]	Elevation	Description	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
0.0	695.9	Top of Hole				
		No Recovery				
5.0	690.9					
5.9	690.0	SILTY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), low plasticity, medium stiff, dry, no odor	SS01aG	5.0 - 5.9	1.2	1-2-2
6.5	689.4	POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 4/6 (dark yellowish brown), fine, very dense, dry, poorly graded	SS01bG	5.9 - 6.5		
		No Recovery				
10.0	685.9					
11.1	684.8	LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, stiff, dry, iron oxide staining	SS02aG	10.0 - 11.1	1.5	1-2-3
11.5	684.4	POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), fine, loose, moist to wet, poorly graded	SS02bG	11.1 - 11.5		
		No Recovery				
15.0	680.9					
		LEAN CLAY, CL, 10YR 3/6 (dark yellowish brown), medium plasticity, very stiff, dry	SS03G	15.0 - 16.5	1.5	WH-3-4
17.3	678.6		SS04aG	16.5 - 17.3	1.5	3-4-5
			SS04bG	17.3 - 18.0		

Overburden: / Rock Core: — RQD %

Run Ft: 5.0 - 6.5; 10.0 - 11.5; 15.0 - 16.5; 16.5 - 18.0

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID: N/A
Stantec Boring No.: **WBF-IW-1**
Client: Tennessee Valley Authority
Boring Location: 444,178.51 N; 2,363,086.37 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 695.9 ft
Elevation Datum: NGVD29

Depth Ft[3]	Elevation	Description	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
18		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), fine, medium dense to loose, moist to wet, iron oxide staining, poorly graded *(Continued)*	SS05G	18.0 - 19.5	1.5	1-3-5
19			SS06G	19.5 - 21.0	1.4	1-2-3
20			SS07G	21.0 - 22.5	1.3	1-1-1
21			SS08aG	22.5 - 23.4	1.5	2-2-3
22			SS08bG	23.4 - 24.0		
23	23.4	672.5	SS09G	24.0 - 25.5	1.5	WH-WH-WH
24		LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown) to 10YR 4/1 (dark gray), medium plasticity, stiff to medium stiff, dry to moist, iron oxide staining, 10YR 4/1 at 24.0 BGS	SS10G	25.5 - 27.0	1.5	WH-1-2
25			SS11aG	27.0 - 27.5	1.5	10-13-10
26			SS11bG	27.5 - 28.5		
27	27.5	668.4	SS12G	28.5 - 30.0	0.4	1-1-3
28		GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very dense, moist	SS13aG	30.0 - 30.5	0.6	7-18-50/5"
29			SS13bG	30.5 - 31.4		
30						
31	31.2	664.7				
	31.4	664.5				

Shale, green gray, soft to moderately hard, thin bedded, moderately weathered, dry to dry, no odor

Refusal /
Bottom of Hole at 31.4 Ft.

Top of Rock = 31.2 Ft.
Top of Rock Elevation = 664.7 Ft.

Pilot Testing Observation Well WBF-IW-1 installed in boring on 5/9/2024 after overdrilling. Refer to WBF-IW-1 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-IW-2**
Client	Tennessee Valley Authority	Boring Location	444,183.08 N; 2,363,087.30 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.8 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/13/24
		Completed	5/13/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	A. Stevens	Logger	A. Stevens
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	4-1/4" HSA overdrill of boring	Overdrill Depth	31.2 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	695.8		Top of Hole						
			No Recovery						
5.0	690.8								
			SILTY LEAN CLAY, CL, 10YR 2/2 (very dark brown) to 10YR 4/4 (dark yellowish brown), low plasticity, medium stiff, dry, no odor		SS01aG	5.0 - 6.1	5.0 - 6.5	1.5	2-4-3
6.1	689.7				SS01bG	6.1 - 6.5			
6.3	689.5								
6.5	689.3		WELL GRADED SAND, SW, 10YR 4/4 (dark yellowish brown), fine to medium, very dense, dry, well graded						
			SILTY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), low plasticity, medium stiff, dry, no odor						
			No Recovery						
10.0	685.8								
			LEAN CLAY, CL, 10YR 2/2 (very dark brown) to 10YR 3/4 (dark yellowish brown), medium to high plasticity, medium stiff, dry to moist, iron oxide staining		SS02G	10.0 - 11.5	10.0 - 11.5	1.5	3-3-4
11.5	684.3								
			No Recovery						
15.0	680.8								
			LEAN CLAY, CL, 10YR 3/6 (dark yellowish brown), medium to high plasticity, dry		SS03aG	15.0 - 15.8	15.0 - 16.5	1.5	3-3-3
15.8	680.0				SS03bG	15.8 - 16.5			
16.5	679.3		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to						

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-IW-2**
Client	Tennessee Valley Authority	Boring Location	444,183.08 N; 2,363,087.30 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.8 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
17			medium, moist, poorly graded		SS04G	16.5 - 18.0	16.5 - 18.0	1.5	1-3-2
18			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, very dense, wet, poorly graded *(Continued)*		SS05G	18.0 - 19.5	18.0 - 19.5	1.5	1-1-1
19									
20					SS06G	19.5 - 21.0	19.5 - 21.0	1.5	2-2-2
21									
22					SS07G	21.0 - 22.5	21.0 - 22.5	1.5	2-3-2
23					SS08G	22.5 - 24.0	22.5 - 24.0	1.5	1-2-1
24									
25					SS09G	24.0 - 25.5	24.0 - 25.5	1.5	0-2-1
26					SS10G	25.5 - 27.0	25.5 - 27.0	1.5	1-1-2
27									
28	28.2	667.6			SS11aG	27.0 - 28.2	27.0 - 28.5	1.5	1-1-2
			LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown) to 10YR 4/1 (dark gray), medium plasticity, soft, dry to moist, iron oxide staining, 10YR 4/1 at 24.0 BGS		SS11bG	28.2 - 28.5			
29	29.7	666.1			SS12aG	28.5 - 29.7	28.5 - 30.0	1.5	1-1-3
30					SS12bG	29.7 - 30.0			
31	31.2	664.6	GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very dense, moist		SS13G	30.0 - 31.2	30.0 - 31.2	1.2	14-19-50/2"

No Refusal /
Bottom of Hole at 31.2 Ft.

Pilot Testing Observation Well WBF-IW-2 installed in boring on 5/13/2024 after overdrilling. Refer to WBF-IW-2 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

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SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-IW-3**
Client	Tennessee Valley Authority	Boring Location	444,188.51 N; 2,363,086.75 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.9 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/14/24
		Completed	5/14/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	A. Stevens	Logger	A. Stevens
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	4-1/4" HSA overdrill of boring	Overdrill Depth	31.4 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	695.9		Top of Hole						
			No Recovery						
5.0	690.9								
			SILTY LEAN CLAY, CL, 10YR 2/2 (very dark brown) to 10YR 4/4 (dark yellowish brown), low plasticity, very soft, dry, no odor		SS01aG SS01bG	5.0 - 6.1 6.1 - 6.5	5.0 - 6.5		2-2-2
6.1	689.8								
6.5	689.4								
			WELL GRADED SAND, SW, 10YR 4/4 (dark yellowish brown), fine to medium, very dense, dry, well graded						
			No Recovery						
10.0	685.9								
			LEAN CLAY, CL, 10YR 2/2 (very dark brown) to 10YR 3/4 (dark yellowish brown), medium to high plasticity, dry to moist, iron oxide staining		SS02aG SS02bG	10.0 - 11.5 11.1 - 11.5	10.0 - 11.5	1.5	3-3-2
11.1	684.8								
11.5	684.4								
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), fine, moist to wet, poorly graded						
			No Recovery						
15.0	680.9								
			LEAN CLAY, CL, 10YR 3/6 (dark yellowish brown), medium plasticity, medium stiff, dry		SS03aG SS03bG	15.0 - 15.8 15.8 - 16.5	15.0 - 16.5		1-2-2
15.8	680.1								
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, very dense, moist, poorly graded		SS04G	16.5 - 18.0	16.5 - 18.0	1.5	2-2-3

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-IW-3**
Client	Tennessee Valley Authority	Boring Location	444,188.51 N; 2,363,086.75 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.9 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
18			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, very dense, moist, poorly graded *(Continued)*		SS05G	18.0 - 19.5	18.0 - 19.5	0.9	NR-1-2
19									
20					SS06G	19.5 - 21.0	19.5 - 21.0	1.2	1-2-3
21									
22					SS07G	21.0 - 22.5	21.0 - 22.5	1.5	2-2-3
23					SS08G	22.5 - 24.0	22.5 - 24.0	1.5	2-1-2
24	24.0	671.9							
25			POORLY GRADED SAND WITH CLAY TRACE SAND, SP-SC, 10YR 3/4 (dark yellowish brown) to 10YR 4/1 (dark gray), medium plasticity, dry to moist, iron oxide staining, 10YR 4/1 at 24.0 BGS		SS09G	24.0 - 25.5	24.0 - 25.5	1.5	2-1-2
26					SS10G	25.5 - 27.0	25.5 - 27.0	1.5	NR-1-3
27									
28	28.1	667.8			SS11aG	27.0 - 28.1	27.0 - 28.5	1.5	2-5-11
	28.5	667.4	GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, moist		SS11bG	28.1 - 28.5			
29	29.2	666.7			SS12aG	28.5 - 29.2	28.5 - 30.0	1.5	2-5-11
30			LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, dry to moist, iron oxide staining, 10YR 4/1 at 24.0 BGS		SS12bG	29.2 - 30.0			
31	31.0	664.9			SS13G	30.0 - 31.4	30.0 - 31.4	1.5	5-15-50/5"
	31.4	664.5	GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, moist						
			Shale, green gray, soft to moderately hard, thin bedded, moderately weathered, dry to dry, no odor						

No Refusal /
Bottom of Hole at 31.4 Ft.

Pilot Testing Observation Well WBF-IW-3 installed in boring on 5/14/2024 after overdrilling. Refer to WBF-IW-3 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-1**
Client	Tennessee Valley Authority	Boring Location	444,183.30 N; 2,363,081.46 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	696.5 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/15/24
		Completed	5/15/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	A. Stevens	Logger	A. Stevens
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	31.4 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	696.5		Top of Hole						
			Blind drill to 5' bgs						
5.0	691.5								
5.5	691.0		SILTY LEAN CLAY, CL, 10YR 2/2 (very dark brown) to 10YR 4/4 (dark yellowish brown), low plasticity, very soft, dry, no odor		SS01aG SS01bG	5.0 - 5.5 5.5 - 6.5	5.0 - 6.5	1.5	2-1-1
			WELL GRADED SAND, SW, 10YR 4/4 (dark yellowish brown), fine to medium, very dense, dry, well graded						
10.0	686.5								
10.6	685.9		LEAN CLAY, CL, 10YR 2/2 (very dark brown) to 10YR 3/4 (dark yellowish brown), medium to high plasticity, very soft, dry to moist, iron oxide staining		SS02aG SS02bG	10.0 - 10.6 10.6 - 11.5	10.0 - 11.5	1.5	2-2-2
			WELL GRADED SAND, SW, 10YR 4/4 (dark yellowish brown), fine to medium, very dense, wet, well graded						
15.0	681.5								
15.2	681.3		LEAN CLAY, OL/OH, 10YR 3/1 (very dark gray), medium to high plasticity, very soft, dry, organic rich layer		SS03aG SS03bG	15.0 - 15.2 15.2 - 16.5	15.0 - 16.5	1.5	2-2-2
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, very dense, moist, poorly graded		SS04G	16.5 - 18.0	16.5 - 18.0	1.5	2-2-2
18.0	678.5				SS05G	18.0 - 19.5	18.0 - 19.5	1.5	3-3-3

TVA EIP BORING LOG_175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-1**
Client	Tennessee Valley Authority	Boring Location	444,183.30 N; 2,363,081.46 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	696.5 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Lithology Elevation	Lithology Graphic	Description	Overburden: / Rock Core:	Sample[1,2]	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
19			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), fine, very dense, moist to wet, iron oxide staining, poorly graded *(Continued)*						
20					SS06G	19.5 - 21.0	19.5 - 21.0	1.5	1-3-4
21									
22					SS07G	21.0 - 22.5	21.0 - 22.5	1.5	WH-2-3
23					SS08G	22.5 - 24.0	22.5 - 24.0	1.5	2-2-3
24					SS09aG	24.0 - 25.1	24.0 - 25.5	1.5	WH-WH-1
25	25.1	671.4			SS09bG	25.1 - 25.5			
			LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, very soft, dry to moist, iron oxide staining, 10YR 4/1 at 24.0 BGS						
26					SS10G	25.5 - 27.0	25.5 - 27.0	1.5	1-1-3
27	27.8	668.7			SS11aG	27.0 - 27.8	27.0 - 28.5	1.5	3-7-11
28	28.5	668.0			SS11bG	27.8 - 28.5			
			LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, very soft, dry to moist, iron oxide staining, 10YR 4/1 at 24.0 BGS						
29					SS12G	28.5 - 30.0	28.5 - 30.0	0.9	2-3-14
30	30.6	665.9	GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very dense, moist		SS13G	30.0 - 31.2	30.0 - 31.2	1.2	7-35-50/2"
31	31.2	665.3	Shale, green gray, soft to moderately hard, thin bedded, moderately weathered, dry to dry, no odor						

No Refusal /
Bottom of Hole at 31.2 Ft.

Top of Rock = 30.6 Ft.
Top of Rock Elevation = 665.9 Ft.

Pilot Testing Observation Well WBF-OBS-1 installed in boring on 5/15/2024 after overdrilling. Refer to WBF-OBS-1 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-2**
Client	Tennessee Valley Authority	Boring Location	444,183.15 N; 2,363,092.43 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.8 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/6/24
		Completed	5/6/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	12.0 ft
		Date/Time	5/7/24 09:52
Inspector	J. Myer	Logger	J. Myer
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	29.4 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	694.8		Top of Hole						
			Blind drill to 5' bgs						
5.0	689.8								
5.8	689.0		SILTY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), low plasticity, medium stiff, dry, no odor		SS01aG	5.0 - 5.8	5.0 - 6.5	1.5	2-2-2
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/6 (dark yellowish brown), fine, very dense, dry, poorly graded		SS01bG	5.8 - 6.5			
10.0	684.8		LEAN CLAY LITTLE SAND, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, medium stiff, dry		SS02G	10.0 - 11.5	10.0 - 11.5	1.5	3-3-3
15.0	679.8				SS03G	15.0 - 16.5	15.0 - 16.5	1.6	WH-WH-2

SUBSURFACE LOG

DRAFT

Client Borehole ID: N/A
Stantec Boring No.: **WBF-OBS-2**
Client: Tennessee Valley Authority
Boring Location: 444,183.15 N; 2,363,092.43 E NAD27 Plant Local
Project Number: 175668050
Surface Elevation: 694.8 ft
Elevation Datum: NGVD29

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
16			LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, medium stiff to stiff, moist, iron oxide staining *(Continued)*		SS04aG	16.5 - 17.4	16.5 - 18.0	1.2	2-2-2
17					SS04bG	17.4 - 18.0			
17.4	677.4		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), fine, loose to medium dense, moist to wet, iron oxide staining, poorly graded Wet at 18.4'		SS05G	18.0 - 19.5	18.0 - 19.5	1.5	1-2-3
18									
19					SS06G	19.5 - 21.0	19.5 - 21.0	1.5	2-2-3
20									
21					SS07aG	21.0 - 21.5	21.0 - 22.5	1.5	WH-2-2
21.5	673.3				SS07bG	21.5 - 22.5			
22			SANDY LEAN CLAY, CL, 10YR 4/4 (dark yellowish brown), medium plasticity, medium stiff, moist, iron oxide staining		SS08aG	22.5 - 23.5	22.5 - 24.0	1.5	WH-1-2
22.5	672.3				SS08bG	23.5 - 24.0			
23			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 4/6 (dark yellowish brown), fine, loose, moist to wet, poorly graded		SS09aG	24.0 - 25.2	24.0 - 25.5	1.5	1-1-1
23.5	671.3				SS09bG	25.2 - 25.5			
24.0	670.8		LEAN CLAY TRACE SAND, CL, 10YR 4/1 (dark gray), medium plasticity, stiff, moist		SS10aG	25.5 - 26.5	25.5 - 27.0	1.5	2-6-11
24					SS10bG	26.5 - 27.0			
25.2	669.6		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 4/6 (dark yellowish brown), fine, very dense, moist to wet, poorly graded		SS11G	27.0 - 28.5	27.0 - 28.5	1.0	3-10-12
25					SS12G	28.5 - 30.0	28.5 - 30.0	0.7	2-6-19
26.5	668.3		LEAN CLAY TRACE SAND, CL, 10YR 4/1 (dark gray), medium plasticity, very soft to very stiff, moist						
26									
27			GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very dense, moist						
28									
29									
30	30.0	664.8							

No Refusal /
Bottom of Hole at 30.0 Ft.

Pilot Testing Observation Well WBF-OBS-2 installed in boring on 5/6/2024 after overdrilling. Refer to WBF-OBS-2 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-3**
Client	Tennessee Valley Authority	Boring Location	444,182.74 N; 2,363,098.16 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.1 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/2/24
		Completed	5/2/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	26.6 ft
		Date/Time	5/3/24 09:50
Inspector	J. Myer	Logger	J. Myer
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	29.1 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	694.1		Top of Hole						
			Blind drill to 5' bgs						
5.0	689.1								
6.0	688.1		SILTY LEAN CLAY, CL, 10YR 3/6 (dark yellowish brown), low plasticity, soft, dry, no odor		SS01aG	5.0 - 6.0	5.0 - 6.5	1.5	1-1-2
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 4/6 (dark yellowish brown), fine, medium dense, dry, poorly graded		SS01bG	6.0 - 6.5			
10.0	684.1		SANDY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, very stiff to hard, dry to wet, Wet		SS02G	10.0 - 11.5	10.0 - 11.5	1.5	2-2-4
15.0	679.1		SANDY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown) to 10YR 4/1 (dark gray), medium plasticity, hard to soft, moist to wet, iron oxide staining, dark brown coloration around 15.2 BGS; transition to dark gray at 16.2 BGS		SS03G	15.0 - 16.5	15.0 - 16.5	1.5	WH-2-3
					SS04G	16.5 - 18.0	16.5 - 18.0	1.5	2-2-2

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-3**
Client	Tennessee Valley Authority	Boring Location	444,182.74 N; 2,363,098.16 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.1 ft
		Elevation Datum	NGVD29

Depth Ft[3]	Elevation	Description	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
18		SANDY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown) to 10YR 4/1 (dark gray), medium plasticity, hard to soft, moist to wet, iron oxide staining, dark brown coloration around 15.2 BGS; transition to dark gray at 16.2 BGS *(Continued)*	SS05G	18.0 - 19.5	1.0	WH-WH-WH
19						
20			SS06aG	19.5 - 20.8	1.5	WH-2-3
20.8	673.3		SS06bG	20.8 - 21.0		
21		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 4/4 (dark yellowish brown), fine, loose, moist to wet, poorly graded	SS07G	21.0 - 22.5	1.5	1-4-4
22						
23			SS08aG	22.5 - 23.5	1.5	2-2-3
23.5	670.6		SS08bG	23.5 - 24.0		
24.0	670.1	LEAN CLAY TRACE SAND, CL, 10YR 4/6 (dark yellowish brown), medium to high plasticity, stiff, moist				
24			SS09G	24.0 - 25.5	1.5	1-3-1
25		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 4/6 (dark yellowish brown) to 10YR 4/1 (dark gray), fine, very dense, moist to wet, poorly graded, transition to dark gray at 26.0-27.0 BGS				
26			SS10G	25.5 - 27.0	1.3	1-3-7
27						
27.5	666.6					
28		GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very dense, moist	SS11G	27.0 - 28.5	1.1	15-15-17
29						
29.3	664.8		SS12G	28.5 - 30.0	0.8	16-21-23
30.0	664.1	Shale, green gray, soft to moderately hard, thin bedded, moderately weathered, dry to dry, no odor				
30						

Overburden:
Rock Core:
RQD %
Run Ft
Rec. %

No Refusal /
Bottom of Hole at 30.0 Ft.

Top of Rock = 29.3 Ft.
Top of Rock Elevation = 664.8 Ft.

Pilot Testing Observation Well WBF-OBS-3 installed in boring on 5/2/2024 after overdrilling. Refer to WBF-OBS-3 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-4**
Client	Tennessee Valley Authority	Boring Location	444,183.28 N; 2,363,102.62 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	693.2 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	4/30/24
		Completed	5/1/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	13.9 ft
		Date/Time	5/1/24 16:25
Inspector	J. Myer	Logger	J. Myer
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	28.0 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	693.2		Top of Hole						
			Blind drill to 5' bgs						
5.0	688.2								
			SILTY LEAN CLAY TRACE SAND, CL, 10YR 4/4 (dark yellowish brown), low plasticity, stiff, dry, no odor		SS01G	5.0 - 6.5	5.0 - 6.5	1.5	2-2-3
10.0	683.2								
10.5	682.7		LEAN CLAY, CL, 10YR 3/3 (dark brown), low plasticity, medium stiff, dry, no odor		SS02G	10.0 - 11.5	10.0 - 11.5	1.5	2-2-3
			SANDY LEAN CLAY, CL, 10YR 3/6 (dark yellowish brown), medium plasticity, medium stiff, moist, Firm						
15.0	678.2								
			LEAN CLAY, CL, 10YR 3/3 (dark brown), medium plasticity, hard, dry, no odor		SS03aG	15.0 - 16.2	15.0 - 16.5	1.5	2-2-3
16.2	677.0				SS03bG	16.2 - 16.5			
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, loose, wet, poorly graded		SS04G	16.5 - 18.0	16.5 - 18.0	1.5	1-2-2
18.0	675.2								

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-4**
Client	Tennessee Valley Authority	Boring Location	444,183.28 N; 2,363,102.62 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	693.2 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. %	Blows/PSI
18			LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown), medium to high plasticity, soft, wet		SS05G	18.0 - 19.5	18.0 - 19.5	1.1	WH-WH-WH
19	19.5	673.7							
20	20.4	672.8	POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, medium dense, wet, poorly graded		SS06aG	19.5 - 20.4	19.5 - 21.0	1.5	WH-1-2
21	21.0	672.2			SS06bG	20.4 - 21.0			
22			LEAN CLAY TRACE SAND, CL, 10YR 3/4 (dark yellowish brown), medium to high plasticity, soft, moist		SS07G	21.0 - 22.5	21.0 - 22.5	1.5	WH-1-1
23			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/6 (dark yellowish brown), very fine to medium, medium dense, wet, iron oxide staining, poorly graded, Iron staining around 24.0 BGS; 10YR 3/1 at 24.6 BGS		SS08G	22.5 - 24.0	22.5 - 24.0	1.5	WH-1-1
24									
25					SS09G	24.0 - 25.5	24.0 - 25.5	1.3	WH-1-3
26	26.0	667.2							
27			GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, loose		SS10G	25.5 - 27.0	25.5 - 27.0	0.9	1-11-18
28	27.9	665.3			SS11G	27.0 - 28.5	27.0 - 28.5	1.0	7-13-26
	28.5	664.7	Shale, green gray, soft to moderately hard, thin bedded, moderately weathered, dry to dry, no odor						

No Refusal /
Bottom of Hole at 28.5 Ft.

Top of Rock = 27.9 Ft.
Top of Rock Elevation = 665.3 Ft.

Pilot Testing Observation Well WBF-OBS-4 installed in boring on 5/1/2024 after overdrilling. Refer to WBF-OBS-4 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-5**
Client	Tennessee Valley Authority	Boring Location	444,173.57 N; 2,363,102.39 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	693.7 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/7/24
		Completed	5/7/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	10.5 ft
		Date/Time	5/8/24 09:08
Inspector	J. Myer	Logger	J. Myer
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	28.0 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	693.7		Top of Hole						
			Blind drill to 5' bgs						
5.0	688.7								
			SANDY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, medium stiff to stiff, dry		SS01G	5.0 - 6.5	5.0 - 6.5	1.4	2-2-2
10.0	683.7								
10.5	683.2		LEAN CLAY, CL, 10YR 3/3 (dark brown), low plasticity, medium stiff, dry, no odor		SS02aG	10.0 - 10.5	10.0 - 11.5	1.5	1-3-3
					SS02bG	10.5 - 11.5			
			SANDY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, medium stiff, moist						
15.0	678.7								
			SANDY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, stiff, dry to moist, no odor		SS03G	15.0 - 16.5	15.0 - 16.5	1.5	1-2-3
16.5	677.2								
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, loose to medium dense, wet, poorly graded		SS04G	16.5 - 18.0	16.5 - 18.0	1.5	3-4-3

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-5**
Client	Tennessee Valley Authority	Boring Location	444,173.57 N; 2,363,102.39 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	693.7 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
18.5	675.2				SS05aG	18.0 - 18.5	18.0 - 19.5	1.5	WH-WH-WH
			LEAN CLAY, CL, 10YR 4/1 (dark gray), medium plasticity, medium stiff to stiff, moist, iron oxide staining		SS05bG	18.5 - 19.5			
20.5	673.2				SS06aG	19.5 - 20.5	19.5 - 21.0	1.5	1-2-2
			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, medium dense to dense, moist to dry, iron oxide staining, poorly graded		SS06bG	20.5 - 21.0			
22.5	671.2				SS07G	21.0 - 22.5	21.0 - 22.5	1.5	2-3-2
23.1	670.6		LEAN CLAY, CL, 10YR 4/1 (dark gray), medium plasticity, very soft to medium stiff, moist		SS08aG	22.5 - 23.1	22.5 - 24.0	1.2	WH-1-1
					SS08bG	23.1 - 24.0			
25.0	668.7		POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, very dense, moist to dry, iron oxide staining, poorly graded		SS09aG	24.0 - 25.0	24.0 - 25.5	1.5	2-3-3
					SS09bG	25.0 - 25.5			
26.1	667.6		SANDY LEAN CLAY, CL, 10YR 4/1 (dark gray), medium plasticity, medium stiff to soft, moist		SS10aG	25.5 - 26.1	25.5 - 27.0	1.2	1-9-22
					SS10bG	26.1 - 27.0			
27.5	666.2		GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very dense, moist		SS11aG	27.0 - 27.5	27.0 - 28.3	1.0	8-31-50/4"
28.3	665.4				SS11bG	27.5 - 28.3			
			Shale, green gray, soft to moderately hard, thin bedded, moderately weathered, dry to dry, no odor						

No Refusal /
Bottom of Hole at 28.3 Ft.

Top of Rock = 27.5 Ft.
Top of Rock Elevation = 666.2 Ft.

Pilot Testing Observation Well WBF-OBS-5 installed in boring on 5/7/2024 after overdrilling. Refer to WBF-OBS-5 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-6**
Client	Tennessee Valley Authority	Boring Location	444,192.69 N; 2,363,102.64 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	693.3 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/8/24
		Completed	5/8/24
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	6.8 ft
		Date/Time	5/9/24 10:13
Inspector	J. Myer	Logger	J. Myer
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME 55 LCX
Overburden Drilling and Sampling Tools (Type and Size)	4-1/4" HSA, 2" SS w/o liners		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	8-1/4" HSA overdrill of boring	Overdrill Depth	28.2 ft
Sampler Hammer Type	N/A	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Depth Ft[3]	Elevation	Description	Sample[1,2]	Depth Ft[3]	Rec. Ft	Blows/PSI
0.0	693.3	Top of Hole				
		Blind drill to 5' bgs				
5.0	688.3	LEAN CLAY WITH SAND, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, medium stiff to stiff, dry	SS01G	5.0 - 6.5	1.5	2-2-2
10.0	683.3	LEAN CLAY, CL, 10YR 3/3 (dark brown), low plasticity, medium stiff to stiff, dry, no odor	SS02G	10.0 - 11.5	1.5	1-2-2
15.0	678.3	SANDY LEAN CLAY, CL, 10YR 3/4 (dark yellowish brown), medium plasticity, medium stiff to stiff, dry to moist	SS03G	15.0 - 16.5	1.5	2-3-3
16.5	676.8	POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, loose, wet, poorly graded	SS04aG SS04bG	16.5 - 17.5 17.5 - 18.0	1.5	WH-1-1
17.5	675.8	LEAN CLAY, CL, 10YR 4/1 (dark gray), medium plasticity, medium stiff to soft, moist, iron oxide	SS05G	18.0 - 19.5	1.2	WH-WH-WH

Overburden:
Rock Core:
RQD %
Run Ft
Rec. %

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-6**
Client	Tennessee Valley Authority	Boring Location	444,192.69 N; 2,363,102.64 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	693.3 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Lithology Elevation	Lithology Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
20									
20.5	672.8		staining		SS06aG	19.5 - 20.5	19.5 - 21.0	1.5	WH-1-3
21			POORLY GRADED SAND WITH CLAY, SP-SC, 10YR 3/4 (dark yellowish brown), very fine to medium, medium dense, moist to dry, iron oxide staining, poorly graded		SS06bG	20.5 - 21.0			
22					SS07G	21.0 - 22.5	21.0 - 22.5	1.3	WH-1-2
23					SS08G	22.5 - 24.0	22.5 - 24.0	1.5	2-2-2
24									
24.9	668.4				SS09aG	24.0 - 24.9	24.0 - 25.5	1.3	WH-1-4
25			LEAN CLAY TRACE SAND, CL, 10YR 4/1 (dark gray) to 10YR 4/6 (dark yellowish brown), medium plasticity, medium stiff, moist		SS09bG	24.9 - 25.5			
26.0	667.3				SS10aG	25.5 - 26.0	25.5 - 27.0	1.5	15-15-16
26					SS10bG	26.0 - 27.0			
27			GRAVELLY WELL GRADED SAND, SW, 10YR 4/1 (dark gray), very fine to coarse, very dense, moist						
27.9	665.4				SS11aG	27.0 - 27.9	27.0 - 28.5	1.0	8-18-21
28									
28.5	664.8		Shale, green gray, soft to moderately hard, thin bedded, moderately weathered, dry to dry, no odor		SS11bG	27.9 - 28.5			

No Refusal /
Bottom of Hole at 28.5 Ft.

Top of Rock = 27.9 Ft.
Top of Rock Elevation = 665.4 Ft.

Pilot Testing Observation Well WBF-OBS-6 installed in boring on 5/8/2024 after overdrilling. Refer to WBF-OBS-6 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-07**
Client	Tennessee Valley Authority	Boring Location	444,178.27 N; 2,363,091.73 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.9 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/13/25
		Completed	5/13/25
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	Edgar Smith	Logger	E. Smith
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	AST	Drill Rig Type and ID	GeoProbe 7822DT
Overburden Drilling and Sampling Tools (Type and Size)	2.25" OD DPT using DT22 Sampler		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	6-1/4" HSA overdrill of boring	Overdrill Depth	29.0 ft
Sampler Hammer Type	Other	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2]	Depth Ft[3]		Rec. Ft	Blows/PSI
					RQD %	Run Ft		Rec. Ft	Rec. %
0.0	694.9		Top of Hole						
0			SILTY POORLY GRADED SAND, SP-SM, dark brown, fine, loose, dry to moist, Micaceous, grainsiz decreases with depth, silt content increases with depth						
1									
2					DP01G	0.0 - 4.0	0.0 - 4.0	1.8	N/A
3									
4									
5									
6					DP02G	4.0 - 8.0	4.0 - 8.0	2.2	N/A
7									
8									
8.5	686.4		CLAYEY SAND, SC, dark brown, very fine to fine, medium dense, moist, poorly graded						
9									
10.0	684.9								
10					DP03G	8.0 - 12.0	8.0 - 12.0	2.9	N/A
10.4	684.5		POORLY GRADED SAND, SP, dark brown black, very fine to fine, loose, no odor, Grains have a platy structure						
11									
12			CLAYEY SAND, SC, light brown and light gray, fine, medium dense, moist, iron oxide staining, poorly graded, Mottled appearance surrounding fime root structures						
13									
14.0	680.9								
14					DP04G	12.0 - 16.0	12.0 - 16.0	3.0	N/A
15.0	679.9		POORLY GRADED SAND, SP, light brown, fine						
15									
16.0	678.9		CLAYEY SAND, SC, light brown and light gray, fine, medium dense to dense, moist to wet, poorly graded						
16									
17.0	677.9		POORLY GRADED SAND, SP, light tan, fine, loose to medium dense, wet, With mica and trace lithics						
17									
18									

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-07**
Client	Tennessee Valley Authority	Boring Location	444,178.27 N; 2,363,091.73 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.9 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. %	Blows/PSI
18			CLAYEY SAND, SC, light tan, fine, medium dense to dense, wet, poorly graded *(Continued)*		DP05G	16.0 - 20.0	16.0 - 20.0	1.8	N/A
18.5	676.4		POORLY GRADED SAND, SP, light tan, fine, loose to medium dense, wet, Lensed						
19									
20.0	674.9		CLAYEY SAND, SP-SC, light tan, fine, dense, wet, Mottled throughout, black staining present at 22.0'						
20									
21									
22					DP06G	20.0 - 24.0	20.0 - 24.0	2.4	N/A
23									
24.0	670.9		POORLY GRADED SAND WITH CLAY, SP-SC, light tan and light gray, fine, loose to medium dense, wet to moist, Stratified, Interbedded poorly graded fine sand and fat clay with trace sand						
24									
25									
26					DP07G	24.0 - 28.0	24.0 - 28.0	3.6	N/A
27									
27.4	667.5		POORLY GRADED SAND TRACE GRAVEL, SP, dark gray to very light gray, fine to medium, loose, wet to moist						
28									
29					DP08G	28.0 - 30.8	28.0 - 30.8	1.6	N/A
29.7	665.2		SANDY WELL GRADED GRAVEL, GW, gray tan, fine to coarse, wet, Gravel lag						
30									
30.8	664.1								

Bedrock Refusal /
Bottom of Hole at 30.8 Ft.

Top of Rock = 30.8 Ft.
Top of Rock Elevation = 664.1 Ft.

Pilot Testing Observation Well WBF-OBS-07 installed in boring on 5/14/25 after overdrilling. Refer to WBF-OBS-7 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-08**
Client	Tennessee Valley Authority	Boring Location	444,167.65 N; 2,363,093.78 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.5 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/15/25
		Completed	5/15/25
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	Edgar Smith	Logger	E. Smith
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	AST	Drill Rig Type and ID	GeoProbe 7822DT
Overburden Drilling and Sampling Tools (Type and Size)	2.25" OD DPT using DT22 Sampler		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	6-1/4" HSA overdrill of boring	Overdrill Depth	29.0 ft
Sampler Hammer Type	Other	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	694.5		Top of Hole						
			SILTY POORLY GRADED SAND, SP-SM, dark brown, fine, loose, dry to moist, Micaceous, grainsiz decreases with depth, silt content increases with depth		DP01G	0.0 - 4.0	0.0 - 4.0	2.5	N/A
					DP02G	4.0 - 8.0	4.0 - 8.0	2.1	N/A
8.5	686.0								
			CLAYEY SAND, SC, dark brown, very fine to fine, medium dense, moist, poorly graded						
10.0	684.5				DP03G	8.0 - 12.0	8.0 - 12.0	2.2	N/A
10.4	684.1		POORLY GRADED SAND, SP, dark brown black, very fine to fine, loose, no odor, Grains have a platy structure						
			CLAYEY SAND, SC, light brown and light gray, fine, medium dense, wet to moist, iron oxide staining, poorly graded, Mottled appearance surrounding fine root structures						
14.0	680.5				DP04G	12.0 - 16.0	12.0 - 16.0	3.0	N/A
			POORLY GRADED SAND, SP, brown, fine						
15.0	679.5								
			CLAYEY SAND, SC, brown, fine, medium dense to dense, moist to wet, poorly graded						

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-08**
Client	Tennessee Valley Authority	Boring Location	444,167.65 N; 2,363,093.78 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.5 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
16			CLAYEY SAND, SC, brown, fine, medium dense to dense, moist to wet, poorly graded *(Continued)*						
17									
18					DP05G	16.0 - 20.0	16.0 - 20.0	3.3	N/A
18.5	676.0								
19			POORLY GRADED SAND, SP, light tan, fine, loose to medium dense, wet, Lensed						
20.0	674.5								
20			CLAYEY SAND, SP-SC, light tan, fine, dense, wet, Mottled throughout, black staining at 23'						
21									
22					DP06G	20.0 - 24.0	20.0 - 24.0	3.1	N/A
23									
24.0	670.5								
24			POORLY GRADED SAND WITH CLAY, SP-SC, light tan brown to dark gray, fine, loose to medium dense, wet to moist, Stratified, Interbedded poorly graded fine sand and fat clay with trace sand. Color change from brown to gray at ~25'						
25									
26					DP07G	24.0 - 28.0	24.0 - 28.0	2.6	N/A
27									
27.4	667.1								
28.0	666.5		POORLY GRADED GRAVELL WITH CLAY, GP-GC, gray, very fine to medium, medium dense						
28									
28.7	665.8		POORLY GRADED SAND WITH CLAY, SP-SC, brown to, fine, loose, wet to moist						
29					DP08G	28.0 - 30.0	28.0 - 30.0	2.0	N/A
30.0	664.5		SANDY WELL GRADED GRAVEL, GW, gray tan, fine to coarse, wet						
30									

Bedrock Refusal /
Bottom of Hole at 30.0 Ft.

Top of Rock = 30.0 Ft.
Top of Rock Elevation = 664.5 Ft.

Pilot Testing Observation Well WBF-OBS-08 installed in boring on 5/15/25 after overdrilling. Refer to WBF-OBS-8 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-09**
Client	Tennessee Valley Authority	Boring Location	444,172.81 N; 2,363,086.80 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.8 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/15/25
		Completed	5/15/25
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	Edgar Smith	Logger	E. Smith
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	AST	Drill Rig Type and ID	GeoProbe 7822DT
Overburden Drilling and Sampling Tools (Type and Size)	2.25" OD DPT using DT22 Sampler		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	6-1/4" HSA overdrill of boring	Overdrill Depth	29.0 ft
Sampler Hammer Type	Other	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
0.0	695.8		Top of Hole						
			SILTY POORLY GRADED SAND, SP-SM, dark brown, fine, loose, dry to moist, Micaceous, grainsize decreases with depth, silt content increases with depth		DP01G	0.0 - 4.0	0.0 - 4.0	1.9	N/A
					DP02G	4.0 - 8.0	4.0 - 8.0	2.2	N/A
8.0	687.8		CLAYEY SAND, SC, dark brown, very fine to fine, medium dense, moist, poorly graded						
10.0	685.8				DP03G	8.0 - 12.0	8.0 - 12.0	2.3	N/A
10.3	685.5		POORLY GRADED SAND, SP, brown, very fine to fine, loose, moist, no odor, Grains have a platy structure						
			CLAYEY SAND, SC, light brown and light gray, fine, medium dense, moist, iron oxide staining, poorly graded, Mottled appearance surrounding fime root structures		DP04G	12.0 - 16.0	12.0 - 16.0	3.0	N/A
15.5	680.3								
16.0	679.8		POORLY GRADED SAND WITH CLAY, SP-SC, light brown, fine, medium dense to dense, moist, poorly graded						

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF.DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-09**
Client	Tennessee Valley Authority	Boring Location	444,172.81 N; 2,363,086.80 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	695.8 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. %	Blows/PSI
17.5	678.3		CLAYEY SAND, SC, light brown, fine *(Continued)*						
18.5	677.3		POORLY GRADED SAND TRACE CLAY, SP, light brown, fine, medium dense to dense, wet, poorly graded		DP05G	16.0 - 20.0	16.0 - 20.0	2.3	N/A
19.5	676.3		CLAYEY SAND, SC, light brown, fine, medium dense to medium dense, wet, Lensed						
20.0	675.8		POORLY GRADED SAND TRACE SILT, SP-SM, brown, fine to medium, loose, wet						
			CLAYEY SAND, SC, brown to orange brown, fine, dense, wet, Mottled		DP06G	20.0 - 24.0	20.0 - 24.0	4.0	N/A
23.6	672.2								
24.0	671.8		POORLY GRADED SAND WITH CLAY, SP, dark gray brown, fine to medium, medium dense, moist						
			CLAYEY SAND, SC, dark gray and olive, fine to medium, dense, moist to wet, Mottled throughout		DP07G	24.0 - 28.0	24.0 - 28.0	3.2	N/A
27.4	668.4								
27.8	668.0		POORLY GRADED SAND, SP, gray, fine to medium, medium dense, moist to wet						
28.0	667.8		CLAYEY SAND, SC, dark gray, fine to medium, dense, moist to wet						
			GRAVELLY WELL GRADED SAND, SW, light gray tan to light olive tan, fine to coarse, wet		DP08G	28.0 - 31.3	28.0 - 31.3	2.1	N/A
31.3	664.5								

Bedrock Refusal /
Bottom of Hole at 31.3 Ft.

Top of Rock = 31.3 Ft.
Top of Rock Elevation = 664.5 Ft.

Pilot Testing Observation Well WBF-OBS-09 installed in boring on 5/15/25 after overdrilling. Refer to WBF-OBS-09 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-10**
Client	Tennessee Valley Authority	Boring Location	444,173.09 N; 2,363,097.62 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.3 ft
		Elevation Datum	NGVD29
Project Name	WBF TDEC Order	Date Started	5/13/25
		Completed	5/13/25
Project Location	Rhea Co, Spring City, Tennessee	Depth to Water	N/A
		Date/Time	N/A
Inspector	Edgar Smith	Logger	E. Smith
Depth to Water	N/A	Date/Time	N/A
Drilling Contractor	AST	Drill Rig Type and ID	GeoProbe 7822DT
Overburden Drilling and Sampling Tools (Type and Size)	2.25" OD DPT using DT22 Sampler		
Rock Drilling and Sampling Tools (Type and Size)	N/A		
Overdrill Tooling (Type and Size)	6-1/4" HSA overdrill of boring	Overdrill Depth	29.0 ft
Sampler Hammer Type	Other	Weight	N/A
Drop	N/A	Efficiency	N/A
Borehole Azimuth	N/A	Borehole Inclination (from Vertical)	N/A
Reviewed By	C. Millhollin	Approved By	P. Dunne

Lithology: Depth Ft[3]	Elevation	Graphic	Description (Overburden: / Rock Core:)	Sample[1,2]	Depth Ft[3]		Rec. Ft	Blows/PSI
				RQD %	Run Ft		Rec. Ft	Rec. %
0.0	694.3		Top of Hole					
8.5	685.8		SILTY POORLY GRADED SAND, SP-SM, dark brown, fine, loose, dry to moist, Micaceous, grain size decreases with depth, silt content increases with depth	DP01G	0.0 - 4.0	0.0 - 4.0	2.0	N/A
				DP02G	4.0 - 8.0	4.0 - 8.0	2.0	N/A
10.0	684.3		CLAYEY SAND, SC, dark brown, very fine to fine, medium dense, moist, poorly graded					
10.5	683.8		POORLY GRADED SAND, SP, light brown, very fine to fine, loose, no odor, Grains have a platy structure	DP03G	8.0 - 12.0	8.0 - 12.0	2.5	N/A
14.0	680.3		CLAYEY SAND, SC, light brown and light gray, fine, medium dense, moist, iron oxide staining, poorly graded, Mottled appearance surrounding fime root structures					
14.5	679.8		POORLY GRADED SAND, SP, light brown, fine	DP04G	12.0 - 16.0	12.0 - 16.0	2.6	N/A
16.0	678.3		CLAYEY SAND, SC, light brown and light gray, fine, medium dense to dense, moist to wet, poorly graded					
16.5	677.8		POORLY GRADED SAND, SP, light tan, fine, loose to medium dense, wet, With mica and trace lithics					
19.0	675.3		CLAYEY SAND, SC, light tan, fine, medium dense to dense, wet, poorly graded	DP05G	16.0 - 20.0	16.0 - 20.0	2.6	N/A

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

SUBSURFACE LOG

DRAFT

Client Borehole ID	N/A	Stantec Boring No.	**WBF-OBS-10**
Client	Tennessee Valley Authority	Boring Location	444,173.09 N; 2,363,097.62 E NAD27 Plant Local
Project Number	175668050	Surface Elevation	694.3 ft
		Elevation Datum	NGVD29

Lithology Depth Ft[3]	Elevation	Graphic	Description	Overburden: / Rock Core:	Sample[1,2] / RQD %	Depth Ft[3] / Run Ft		Rec. Ft / Rec. Ft	Blows/PSI / Rec. %
19									
20.0	674.3		POORLY GRADED SAND, SP, light tan, fine, loose to medium dense, wet, Lensed						
20			CLAYEY SAND, SP-SC, light tan, fine, dense, wet, Mottled		DP06G	20.0 - 24.0	20.0 - 24.0	2.5	N/A
21									
22									
23									
24.0	670.3								
24			POORLY GRADED SAND WITH CLAY, SP-SC, light tan and light gray, fine, loose to medium dense, wet to moist, Stratified, Interbedded poorly graded fine sand and fat clay with trace sand		DP07G	24.0 - 28.0	24.0 - 28.0	3.2	N/A
25									
26									
27.3	667.0								
27			GRAVELLY POORLY GRADED SAND, SP, very light tan gray to gray, fine to medium, wet to moist, Gravel lag						
28									
29.0	665.3				DP08G	28.0 - 30.0	28.0 - 30.0	1.3	N/A
29									
30.0	664.3		WELL GRADED GRAVEL, GW, light tan gray to very light gray, fine to coarse, wet, Weathered shale, top of competent rock at 30'						
30									

Bedrock Refusal /
Bottom of Hole at 30.0 Ft.

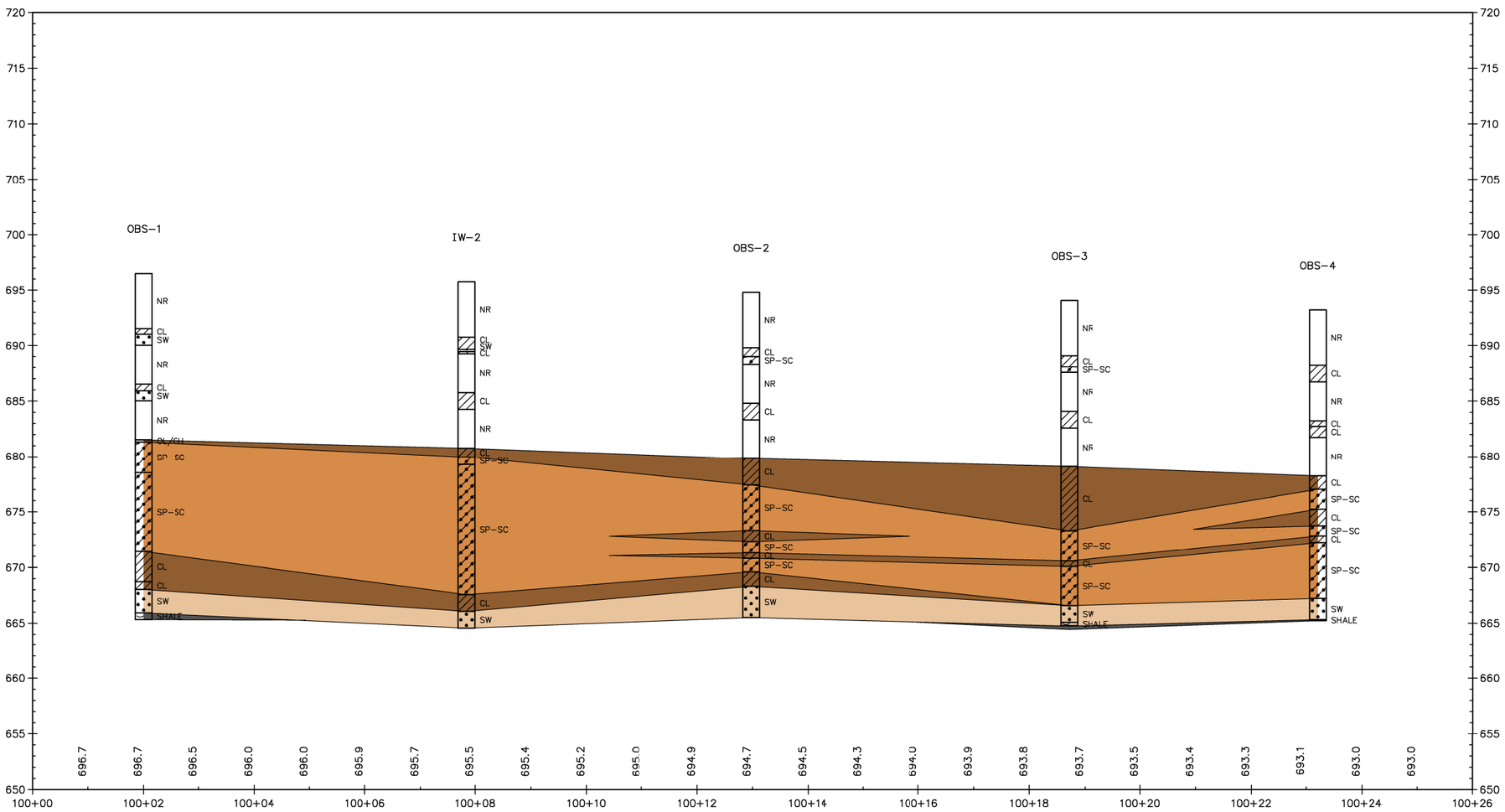
Top of Rock = 30.0 Ft.
Top of Rock Elevation = 664.3 Ft.

Pilot Testing Observation Well WBF-OBS-10 installed in boring on 5/14/25 after overdrilling. Refer to WBF-OBS-10 Well Installation Detail.

1: E = Environmental Sample Custody (two Split Spoons may be required to obtain sufficient sample)
G = Geotechnical Sample Custody
2: a,b,c denote Split Spoon divided between Environmental and Geotechnical Samples
3: Depths are reported in feet below ground surface

TVA EIP BORING LOG 175668050_WBF_TDEC_ORDER.GPJ TDEC SUBSURF DT 20190530.GDT 10/23/25

ATTACHMENT C – CROSS-SECTIONS



DRAFT

Exhibit No.

C.1

Title

Pilot Test Cross Section Transect A-A'

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

N

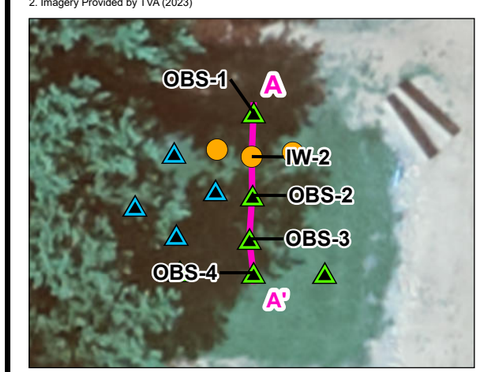
0 20 40 Feet
(At original document size of 11x17)
1:240

Legend

- Injection Well (IW)
- Groundwater Monitoring Wells (OBS) Phase 1
- Groundwater Monitoring Wells (OBS) Phase 2
- Pilot Test Cross Section Transect
- Primarily Sand/Gravel
- Sand/Clay
- Primarily Clay
- Shale/Bedrock

Lithologic interpretations are only shown below 15 feet below ground surface for pilot test wells OBS-1, IW-1, IW-2, IW-3, OBS-2, OBS-3, OBS-4, OBS-5 and OBS-6. Non-continuous lithologic data between 0-15 feet for these wells are excluded from interpretations.

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



Stantec

TVA

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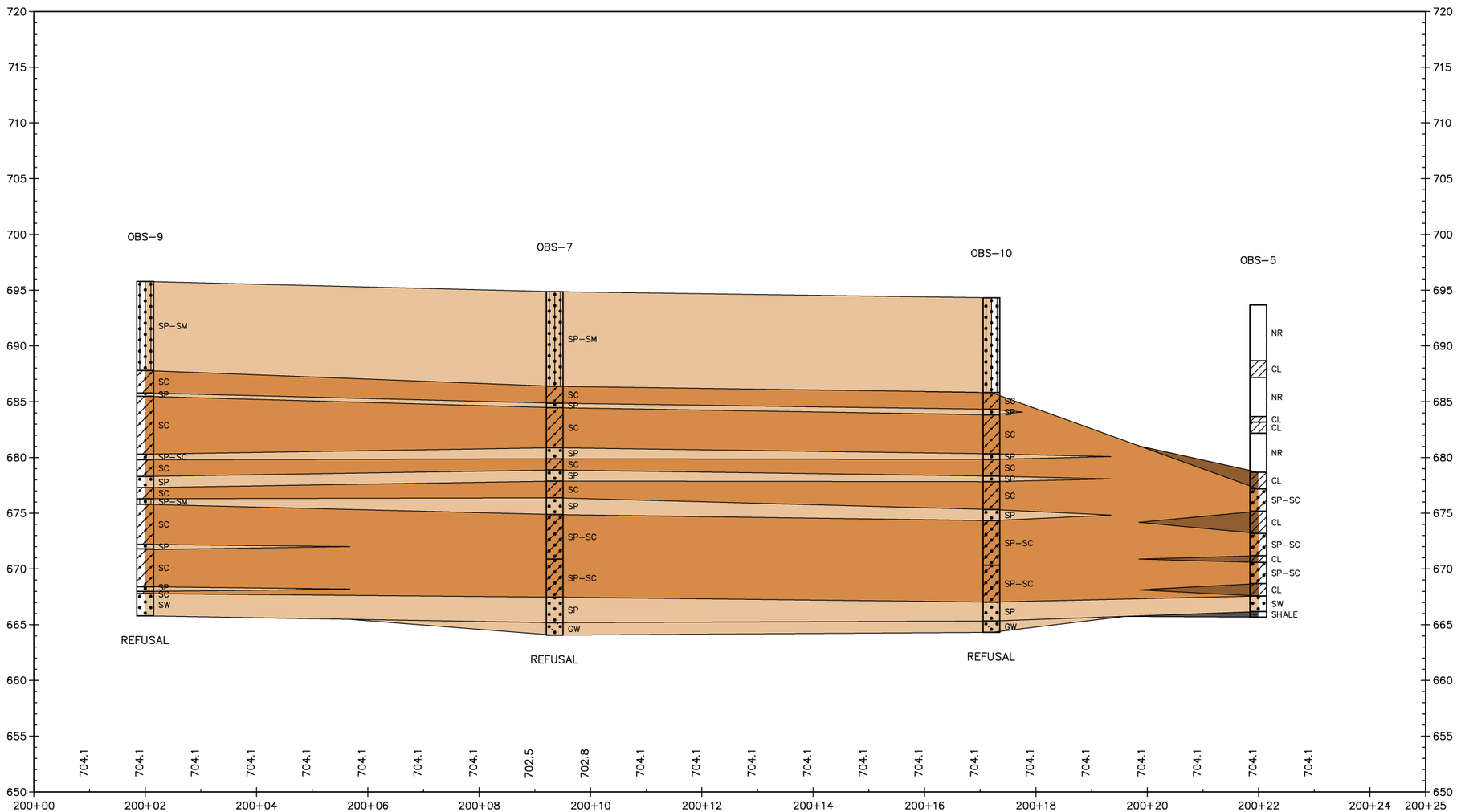


DRAFT

Exhibit No.

C.2

Title

Pilot Test Cross Section Transect B-B'

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

N

0 20 40 Feet

(At original document size of 11x17)
1:240

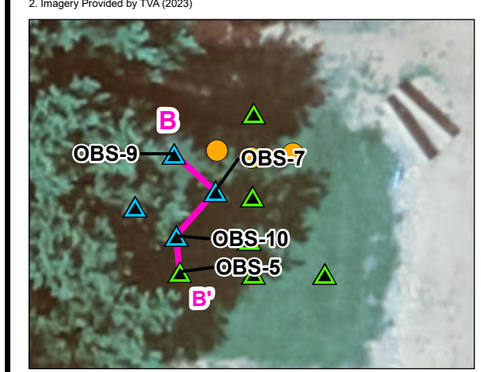
Legend

- Injection Well (IW)
- Groundwater Monitoring Wells (OBS) Phase 1
- Groundwater Monitoring Wells (OBS) Phase 2
- Pilot Test Cross Section Transect
- Primarily Sand/Gravel
- Sand/Clay
- Primarily Clay
- Shale/Bedrock

Lithologic interpretations are only shown below 15 feet below ground surface for pilot test wells OBS-1, IW-1, IW-2, IW-3, OBS-2, OBS-3, OBS-4, OBS-5 and OBS-6. Non-continuous lithologic data between 0-15 feet for these wells are excluded from interpretations.

Notes

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



Stantec

TVA

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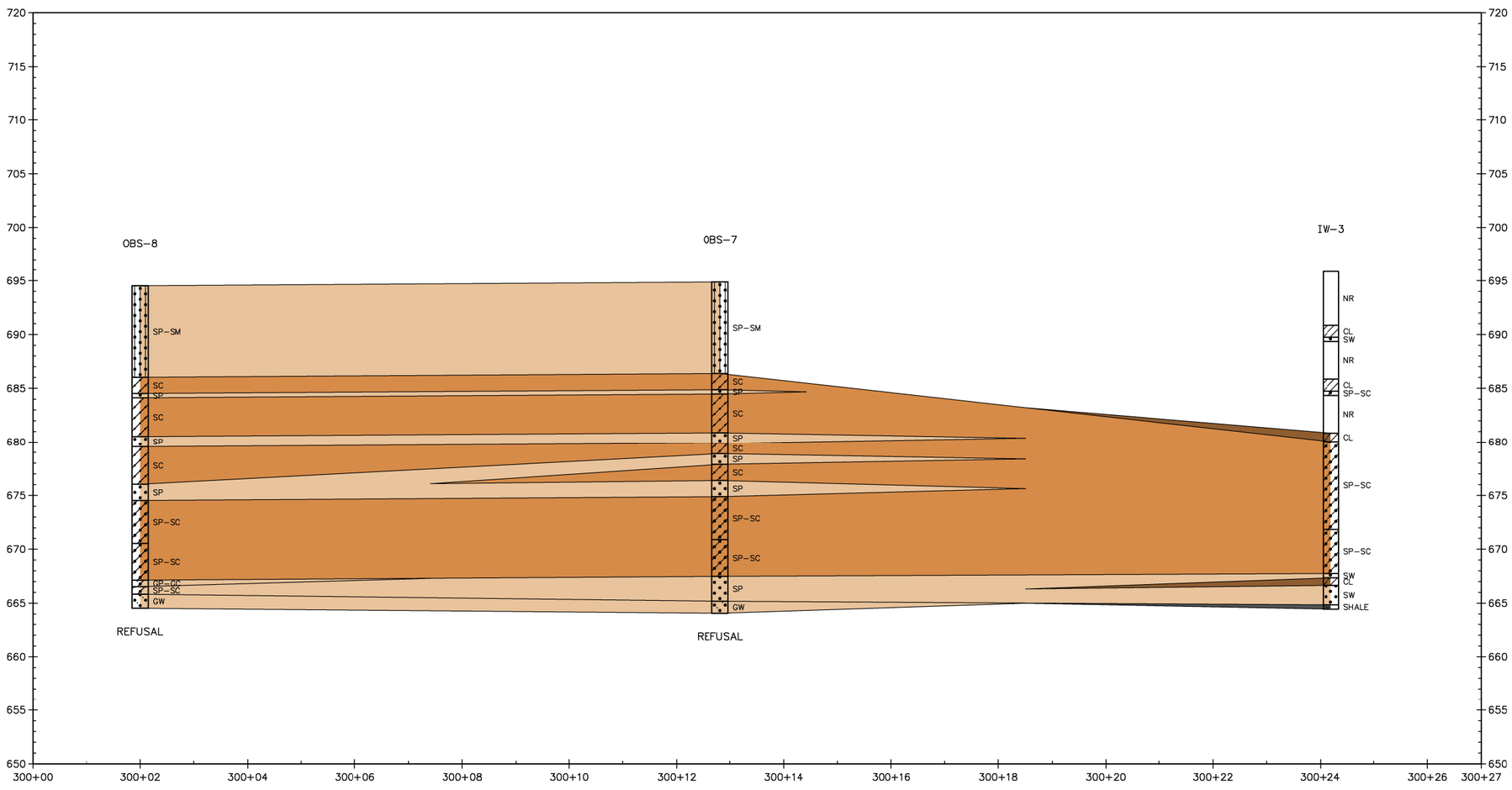


DRAFT

Exhibit No.

C.3

Title

Pilot Test Cross Section Transect C-C'

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2025-10-23
TR by AL on 2025-10-23
IR Review by RB on 2025-10-23

N

0 20 40 Feet

(At original document size of 11x17)
1:240

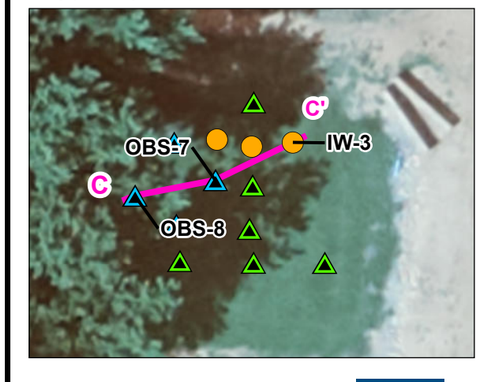
Legend

- Injection Well (IW)
- Groundwater Monitoring Wells (OBS) Phase 1
- Groundwater Monitoring Wells (OBS) Phase 2
- Pilot Test Cross Section Transect
- Primarily Sand/Gravel
- Sand/Clay
- Primarily Clay
- Shale/Bedrock

Lithologic interpretations are only shown below 15 feet below ground surface for pilot test wells OBS-1, IW-1, IW-2, IW-3, OBS-2, OBS-3, OBS-4, OBS-5 and OBS-6. Non-continuous lithologic data between 0-15 feet for these wells are excluded from interpretations.

Notes

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



Stantec

TVA

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APPENDIX J – GROUNDWATER EXTRACTION EVALUATION

Appendix J - Groundwater Extraction Evaluation Technical Memorandum - DRAFT

TDEC Commissioner's Order:
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

Revision Record

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Revisions to Align with CARA Plan and Corrective Measure Alternatives	December 5, 2025

Sign-off Sheet

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

Prepared by _____

Justin Soberaski, Hydrogeologist

Reviewed by _____

Joel Thompson, PG, Senior Hydrogeologist

Approved by _____

Carole Farr, PG, Senior Principal Geologist

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Abbreviations

CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residual
CCR Rule	Title 40, Code of Federal Regulations, Part 257, Subpart D
cm/sec	Centimeters per second
EAR	Environmental Assessment Report
EI	Environmental Investigation
gpm	Gallons per minute
GWPS	Groundwater protection standard
msl	Mean Sea Level
Stantec	Stantec Consulting Services Inc
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order No. OGC15-0177
TM	Technical Memorandum
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this Groundwater Extraction Technical Memorandum (TM) to present the conceptual design for targeted groundwater control at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The information provided in this TM is in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at the TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan is being prepared pursuant to the TDEC Order to evaluate whether unacceptable risks related to management of coal combustion residual (CCR) material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA. This TM is included as an appendix in the CARA Plan to support evaluation of potential corrective actions at the WBF Plant CCR units.

The objective of groundwater extraction is to hydraulically control groundwater in the uppermost aquifer in areas with concentrations of CCR constituents at statistically significant concentrations above a groundwater protection standard (GWPS). This TM presents:

- A summary of the relevant site setting details and hydrogeologic framework used to inform the design of the CCR unit-specific groundwater extraction system (Section 2.0)
- A summary of the design data used to support the evaluation of a groundwater extraction method considered for CCR unit-specific hydraulic groundwater control (Section 3.0)
- A review and relative comparison of the groundwater extraction methods available to provide targeted hydraulic groundwater control (Section 4.0)
- The CCR unit-specific groundwater extraction method and conceptual design for the CCR unit in which groundwater extraction is being considered as a corrective action (Section 5.0).

This TM presents the rationale and conceptual design of groundwater extraction system that may be considered, as necessary, as corrective action elements at the WBF Plant.

Due to the planned seismic stability mitigation along the riverbank included in the CARA Plan, TVA will begin design, permitting, and construction of the groundwater extraction system upon approval of the CARA Plan and following substantial completion of the seismic stability mitigation, cover system actions, and drainage modifications. If warranted based on newer groundwater monitoring results after the above construction activities have been completed, proposed changes to the groundwater corrective action would be coordinated with TDEC.

2.0 BACKGROUND

2.1 SITE DESCRIPTION

There are two CCR units at the WBF Plant: the Ash Pond and the Slag Disposal Area. The WBF Plant including the two CCR units and other plant and adjacent features is presented in Exhibit 1. The WBF Plant was retired in 1982.

The WBF Plant is located on the south-flowing Tennessee River approximately one mile downstream of Watts Bar Dam. Information pertaining to the CCR unit history and land use can be found in Chapter 2.2 of the *Environmental Assessment Report* (EAR) (TVA 2024).

Areas adjacent to the Slag Disposal Area CCR unit including the Drainage Improvements Area are the focus of this TM. Additional details on this CCR unit are discussed below.

As shown on Exhibit 1, the Slag Disposal Area is located along the west bank of the Tennessee River. The Slag Disposal Area is a closed CCR unit that covers about 27 acres and was formed by a railroad embankment and a natural knoll to the west, stacked CCR material to the east, and a dike and spillway to the south constructed to discharge process water (TVA 1969). CCR material present in the Slag Disposal Area is comingled sluiced and stacked fly ash, bottom ash, and slag, and the estimated total volume of CCR material is about 570,000 cubic yards (TVA 2024). During operation of the Slag Disposal Area, process water and CCR material were also sent to the area now identified as the Drainage Improvements Area, which was an extension of the Slag Disposal Area (TVA 1977).

Following the 1982 plant retirement, approximately 161,000 tons of slag were reclaimed for beneficial use in manufacturing products. This activity occurred from 1996 to 2005, until a majority of the material usable at that time was recovered. The Slag Disposal Area was closed with a soil cover system in 2009 under TDEC Permit TNR190741 in accordance with State regulations applicable at the time of closure. The Slag Disposal Area cover consisted of a 1-foot thick vegetative cover over a one-foot thick compacted clay layer.

A separate drainage improvements project was completed in 2015 at the Drainage Improvements Area to place fill, improve drainage, and remove water around the Slag Disposal Area to address historical seepage at the WBF Plant (AECOM 2016). The Drainage Improvements Area is located immediately adjacent to, and upgradient of, the Slag Disposal Area. The Drainage Improvements Area was investigated during the TDEC Order Environmental Investigation (EI), and based on those findings, was recommended for further evaluation in the CARA Plan (see Chapter 3). As such, the Slag Disposal Area and Drainage Improvements Area are discussed together in this TM.

2.2 HYDROGEOLOGIC FRAMEWORK

The hydrogeologic framework has been developed from the history of investigation and monitoring at the WBF Plant, including recent environmental investigations performed to address TDEC Order

requirements. An abbreviated summary of the hydrogeologic framework to support the groundwater extraction system evaluation is provided below. A more robust summary of the hydrogeologic framework is provided in the EAR (TVA 2024).

2.2.1 Geology and Hydrogeology

Various subsurface investigations have been conducted at the WBF Plant to characterize the geology, evaluate slope stability of dikes, monitor groundwater elevations and quality, estimate aquifer properties, and develop potential corrective measures for groundwater impacts. Based upon these investigations, the following general description of the hydrogeology was developed. Exhibit 2 shows a three-dimensional representation of the WBF Plant site.

Naturally deposited unconsolidated materials at the WBF Plant consist primarily of alluvium overlying bedrock. The thickness of the unconsolidated material ranges between 0 to 32 feet (TVA 2024), being thickest near the Tennessee River and thinner at greater distances from the Tennessee River. The alluvium can be differentiated into silts, clays, sands, and gravels, which exhibit a coarsening downward sequence. The upper fine-grained alluvium sequence(s) are primarily composed of clay and silty clays, which range in thickness between 0 to 27 feet. The lower coarse-grained alluvial sequence(s) are primarily composed of silty sand, sand, and gravel, which range in thickness between 0 to 20 feet. The unconsolidated materials are underlain by bedrock, which is composed of dark gray-green shale with varying amounts of gray limestone. The uppermost portion (upper few feet) of the bedrock is typically weathered. The bedrock surface slopes east toward the Tennessee River, with elevations ranging from 696 feet above mean sea level (msl) west of the Slag Disposal Area to 664 feet above msl along the Tennessee River.

The coarser alluvium that consists mostly of sand and gravel above bedrock is considered to be the uppermost aquifer. The uppermost aquifer is overlain by less permeable clays that are defined as an aquitard; therefore, the uppermost aquifer is a confined aquifer. Discussion of the uppermost aquifer in the vicinity of the CCR units is provided in Appendix H.1 and Chapter 5.1.3.3 of the EAR (TVA 2024).

During the EI, groundwater levels were measured within the uppermost aquifer prior to six groundwater sampling events to evaluate the direction and rate of groundwater flow.

Groundwater data indicated that groundwater generally flows from the west-northwest to the east-southeast toward the Tennessee River. Physiographic features that affect groundwater flow in the vicinity of the WBF Plant include the steep topography of the ridges to the northwest, the relatively flat floodplain of the Tennessee River, and the Tennessee River. Groundwater flow within the uppermost aquifer in the vicinity of the Slag Disposal Area is bounded to the east by the Tennessee River. Exhibit 3 provides a representative groundwater elevation contour map.

2.2.2 Surface Water and Hydrogeological Boundaries

The most prominent regional surface water drainage feature in proximity to the WBF Plant is the south-flowing Tennessee River. The WBF Plant is situated in a low-lying area along the Tennessee River with

higher elevation ridges to the northwest of the plant. Physiographic features that affect groundwater flow in the vicinity of the WBF Plant include the Tennessee River to the east and ridges which serve as a topographic divide to groundwater flow to the west. In the vicinity of the WBF Plant, flow within the Tennessee River is primarily controlled by regulated releases at the Watts Bar Dam.

3.0 DESIGN DATA

The following sections present a summary of site investigation data used to select and develop the conceptual design of the groundwater hydraulic control system.

3.1 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 the United States Environmental Protection Agency CCR Rule (Title 40, Code of Federal Regulations, Part 257, Subpart D) 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 and Appendices III and IV of the CCR Rule. Additional discussion of the results of the statistical evaluation is provided in Appendix E.3 and Appendix H.1 of the EAR (TVA 2024).

Downgradient of the CCR units, statistically significant concentrations of two constituents were reported above the GWPS in two wells, including cobalt (WBF-104 and WBF-106), and cadmium (WBF-106).

Exhibit 4 shows a summary of groundwater findings near the Slag Disposal Area and Drainage Improvements Area that have statistically significant concentrations above the GWPS. This TM evaluates groundwater extraction to hydraulically control groundwater along the downgradient boundary of the Slag Disposal Area at wells WBF-104 and WBF-106. Groundwater conditions at well MW-1 are evaluated and discussed in Chapter 6.5 and Appendix D of the CARA Plan.

3.2 SURFACE WATER STAGE

A gauge on the Tennessee River at the Watts Bar Dam provides high-temporal-resolution surface water stage elevation data. Exhibit 3 notes the gauge is located on the tailwater side of Watts Barr Dam and is approximately 4,000 feet north of monitoring well WBF-106. Surface water elevation measurements (Watts Bar Dam Tailwater) are continuously recorded at the of Watts Bar Dam as part of TVA's plant operations. Exhibit 5 depicts the recorded surface water elevation measurements between May 2003 and late April 2023, and daily precipitation data. Both the seasonal influence of the operating reservoir levels and influence of large precipitation events are apparent in the Watts Bar Dam Tailwater data

The stage recorded at the Watts Bar Dam gauge ranges between approximately 676 and 696 feet above msl with the majority of the measurements between 680 and 685 feet above msl. The river stage fluctuations appear to correlate with winter and summer pool changes that are part of the management of water levels in Watts Bar Reservoir. The seasonal influence of the operating reservoir levels is apparent, with the lowest stages generally occurring during the late fall through early spring months (approximately 676 through 682 feet above msl) and the highest stages generally occurring during the late spring through early fall months (approximately 682 through 696 feet above msl) with a transition period between seasonal operation levels.

3.3 GROUNDWATER LEVEL MONITORING

Groundwater level measurements collected between August 2019 and July 2020 at monitoring wells WBF-101, WBF-104, WBF-105, and WBF-106 located near the hydraulically down gradient limit of the Slag Disposal Area are shown on Exhibit 6. Higher surface water stage elevations in the Tennessee River generally correlate with higher groundwater elevations measured in these monitoring wells. In general, groundwater elevations measured in the wells WBF-101, WBF-104, WBF-105, and WBF-106 ranged between approximately 681 and 695 feet above msl. Piezometers WBF-B03B, WBF-B12B, WBF-13B, and WBF-14B are located between monitoring wells WBF-104 and WBF-105 (Exhibit 3). High resolution groundwater measurements collected between September 2020 and late March 2023 are shown for these piezometers on Exhibit 6. Groundwater elevations shown on Exhibit 6 generally exhibit groundwater elevation fluctuations that correspond with Tennessee River stage elevation changes.

3.4 TARGET AREA SUBSURFACE LITHOLOGY

A representative cross-section through the Slag Disposal Area (A-A') showing the underlying lithologic units and CCR material are provided in Appendix D of the EAR (TVA 2024). In addition, soil borings WBF-101, WBF-104, WBF- 105, and WBF-106 provide detailed lithology at the Slag Disposal Area hydraulically downgradient of the CCR unit (TVA 2024). In the area targeted for groundwater extraction (hydraulically downgradient of the CCR unit near monitoring well WBF-104 and WBF-106), the subsurface geology generally consists of unconsolidated sequences overlying bedrock. The upper fine-grained alluvium sequence(s) is primarily composed of clay and silty clays, which range in thickness between 0 to 27 feet. The lower coarse-grained alluvial sequence(s) are primarily composed of silty sand, sand, and gravel, which range in thickness between 0 to 20 feet.

The thickness of the lower coarse-grained unconsolidated materials is estimated to be six feet near monitoring well WBF-104 and 10 feet near monitoring well WBF-106. The elevation between the lower coarse-grained unconsolidated materials and bedrock is estimated to be between 664 and 666 feet above msl near monitoring wells WBF-101, WBF-104, WBF-105, and WBF-106.

For the Slag Disposal Area, the saturated lower coarse-grained unconsolidated materials that directly overlie the bedrock is the targeted subsurface lithology for groundwater extraction.

3.5 AQUIFER PROPERTIES

3.5.1 Slug Testing

Slug testing was performed as part of the EI at WBF-101, WBF-104, WBF-105, and WBF-106 installed at the Slag Disposal Area and completed in the unconsolidated materials along the Tennessee River. The estimated hydraulic conductivity results in the wells listed above ranged from 1.91×10^{-4} centimeters per second (cm/sec) to 4.85×10^{-4} cm/sec. The estimated hydraulic conductivity results near the Slag Disposal Area are provided in Table H.1-3 of Appendix H.1 of the EAR (Stantec 2023) and Table 1.

The geometric mean of the hydraulic conductivities results is 2.74×10^{-4} cm/sec.

3.6 GROUNDWATER FLOW MODEL

Stantec constructed a groundwater flow model representing the hydrogeological framework to create a quantitative tool capable of evaluating hydraulic control using groundwater extraction as a corrective action for the WBF Plant. The groundwater flow model constructed to support evaluation of corrective action is documented in the *Groundwater Flow Modeling TM* (Appendix G).

The groundwater flow model was used together with particle tracking analysis to provide a conceptual-level demonstration of the feasibility of implementing hydraulic control. The groundwater extraction method and associated modeling are conceptual but serve to demonstrate that hydraulic control using groundwater extraction is feasible to control the flux of groundwater through the uppermost aquifer at the lateral boundaries of the CCR units in the targeted areas. The extraction method, groundwater extraction rates, water treatment, discharge approach, and associated details would be developed in the final design process following the CARA Plan approval. Modeled pumping scenarios are summarized in Section 5.0 with additional detail provided in Appendix G.

As noted in the *Groundwater Flow Modeling TM* (Appendix G) the modeled scenarios represent a simplified version of the current understanding of hydrogeologic conditions at the WBF Plant using the data and information available at the time of model construction. As the design and implementation of groundwater extraction corrective action advances, it is anticipated that the conceptual extraction layout may be refined.

3.7 ACCESS

The location available for installation of a groundwater extraction system is limited by the relatively steep topographic slopes located between the Tennessee River and the Slag Disposal Area. As a result, it is anticipated that accessibility for system installation is limited to the perimeter access road.

4.0 GROUNDWATER EXTRACTION METHODS

There are several groundwater extraction methods available to support hydraulic control of groundwater. Groundwater extraction systems operate by removing groundwater through pumping, thereby creating a lower groundwater head that induces groundwater from the surrounding aquifer to flow towards the pumping location.

The three groundwater extraction methods considered for hydraulic control at the WBF Plant are: vertical extraction wells, horizontal extraction wells, and extraction trenches. These three groundwater extraction methods are described below:

- **Vertical Extraction Wells**. Vertically-oriented extraction well systems are the most common groundwater extraction method. Construction includes positioning the well screen within the uppermost aquifer along the downgradient portion of the CCR unit, which is targeted for hydraulic control. Vertical extraction wells would be installed at a well spacing interval that is appropriate for the site conditions to meet performance objectives. Vertical wells serving as a hydraulic control system are typically oriented in a line perpendicular to groundwater flow to optimize efficiency.

- **Horizontal Extraction Wells**. This method consists of using specialized horizontal directional drilling equipment capable of installing horizontally-oriented well screen. A single horizontal extraction well would be installed by advancing the well boring by entering the ground surface at an angle until the boring nears the base of the uppermost aquifer. The horizontal well boring would then run horizontally along the top a specified alignment targeted for hydraulic control. The boring would either be terminated at the end of the planned horizontal run (a “single-entry” horizontal well boring) or redirected upward at an angle to exit the ground surface at the top of the CCR unit (“double-entry” horizontal well boring). The horizontal extraction well would then be constructed in the boring, with the screened portion of the well positioned along the horizontal leg of the boring in the targeted hydraulic control zone.

- **Extraction Trench.** This method consists of excavating a trench and backfilling with gravel, perforated pipe, and geotextile fabric, as needed. A single trench would be installed by excavating to the top of bedrock. Due to the relatively deep excavation, specialized equipment may be required. Depending on the construction of the trench, a geotextile fabric could be installed to reduce potential movement of fine sediment into the trench. A gravel bed containing a perforated pipe is placed on the geotextile; this pipe allows groundwater to flow along its length. Groundwater extraction sumps with installed pumps are placed in the low points of the bedrock surface so that water may be collected and pumped. The gravel bed would be extended vertically to extend to the top of the typical saturated zone within the uppermost aquifer. The trench would then be backfilled with a suitable low permeability fill to typical grade to reduce infiltration into the trench.

The identified advantages and potential limitations of each method are summarized in Table 2.

The recommended groundwater extraction method for the Slag Disposal Area is the installation of vertical extraction wells based on the CCR unit-specific features: physical access, depth to groundwater,

geometry of the uppermost aquifer, aquifer properties, and size of the targeted hydraulic control zone. Additional detail related to the conceptual design is presented in Section 5.

5.0 CONCEPTUAL DESIGN

This chapter describes the conceptual design of the hydraulic control system which may be implemented, as appropriate, for the WBF Plant. The system is designed to hydraulically control flow of groundwater in areas with statistically significant concentrations of CCR constituents above a GWPS. Groundwater extraction and treatment may be used to provide hydraulic control until GWPS are achieved.

It is anticipated that the final design will build upon the conceptual plans included with this document and that detailed plans and specifications will be prepared. These documents will be used to continue confirmation of constructability of the corrective action and to support permit applications and construction contract documents. In some cases, additional delineation (installation of additional monitoring wells), groundwater quality monitoring, or additional pumping tests may be performed during the design phase to refine the design of the conceptual extraction systems.

5.1 LOCATION AND EXTENT

The targeted hydraulic control zone is defined by the presence of CCR constituents with statistically significant concentrations above a GWPS. Laboratory analysis of groundwater collected from two monitoring wells (WBF-104 and WBF-106) hydraulically downgradient of the Slag Disposal Area indicated statistically significant concentrations above a GWPS. Exhibit 7 shows the location of the conceptual groundwater extraction layout downgradient of portions of the Slag Disposal Area.

The lateral extents of the targeted hydraulic control zone at the Slag Disposal Area are delineated by the northeastern boundary of the CCR unit near monitoring well WBF-106 (Exhibit 7). Based on no statistically significant concentrations above a GWPS at WBF-101, the area approximately halfway between WBF-101 and WBF-104 is not included in the conceptual groundwater extraction layout downgradient of the Slag Disposal Area and Drainage Improvements Area. Based on no statistically significant concentrations above a GWPS at WBF-105, the areas approximately halfway between WBF-104 and WBF-105 and halfway between WBF-105 and WBF-106 are not included in the conceptual groundwater extraction layout downgradient of the Slag Disposal Area and Drainage Improvements Area.

Based on the groundwater monitoring results, the target control zone is estimated to be approximately 1,450 feet in total length. The Drainage Improvements Area is hydraulically upgradient of the Slag Disposal Area, except along the southern boundary. Much of the conceptual groundwater hydraulic control is integrated into the conceptual groundwater control at the Slag Disposal Area. The approximate location of the conceptual groundwater extraction system shown on Exhibit 7 follows the perimeter access road located between the Slag Disposal Area and the Tennessee River and the perimeter access road located along the south boundary of the Drainage Improvements Area and Slag Disposal Area.

As the design and implementation of groundwater extraction corrective action advances, it is anticipated that the targeted hydraulic control zones will be refined.

Access for installation of the conceptual groundwater extraction layout is limited by the slopes of the CCR unit containment dikes between the Tennessee River and the Slag Disposal Area. As a result, it is anticipated that accessibility for system installation is limited to and conceptually located to follow the perimeter access road. This location facilitates hydraulic control upgradient of the proposed compliance groundwater monitoring system and is located as near as feasible to the limits of the CCR unit.

5.2 EXTRACTION WELL SPACING

Groundwater flow model simulations were performed to evaluate the conceptual operation of a groundwater extraction system positioned hydraulically downgradient of portions of the Slag Disposal Area. A description of the groundwater flow model construction, calibration and unit closure/corrective action simulations completed as part of the CARA is provided in the *Groundwater Flow Modeling TM* (Appendix G).

Simulation of a combination of extraction configurations and pumping rates were utilized in combination with particle tracking to develop a conceptual extraction layout that would provide hydraulic control while avoiding over-pumping and excessive drawdown. Based on the modeling results, hydraulic control was simulated using approximately a 140- to 180-foot variable spacing along the downgradient boundary near well WBF104 and, a 300- to 330-foot variable spacing along the downgradient boundary near WBF-106.

Forward particle tracking was used to demonstrate groundwater capture efficacy. Particles were placed in a line upgradient of the groundwater extraction wells and moved forward in time using the simulated steady-state groundwater flow field. The particle traces were examined to determine if the conceptual well layout and target pumping would capture the particles and demonstrate hydraulic control for the targeted areas.

Exhibit 7 shows the conceptual groundwater extraction layout used in the modeled scenario. The simulated groundwater elevation contours within the uppermost aquifer during groundwater extraction are presented, and the particle traces show hydraulic control by the conceptual groundwater extraction system for the targeted area.

5.3 DESIGN FLOW RATE

Groundwater flow model simulations were also used to support development of a conceptual design flow rate. Modeled steady-state groundwater combined system extraction rates are simulated to be approximately 15 gallons per minute (gpm) for the simulated conceptual extraction system layouts shown on Exhibit 7. Changes in the flow rates could occur over time, depending on groundwater elevations, Tennessee River stage, extraction system operation, and as a direct result of the implementation of additional elements of the closure action, such as installation of a cover system or pore water extraction.

5.4 EXTRACTION WELL DESIGN

Each vertical extraction well will be designed to meet the needs of the pump equipment size, depth setting, and planned operation schedule for the well. The extraction wells are anticipated to have the following design elements:

- Constructed of a four-inch diameter, flush threaded, stainless-steel screen and riser to a depth of the top of bedrock (estimated to be approximately 35 to 45 feet below ground surface)
- Designed with an approximately 10-foot screen to accommodate the variability in seasonal fluctuations of groundwater and maximize production
- Constructed to include a well sump, if feasible, to facilitate a deeper pump placement, maximize the available drawdown within the targeted uppermost aquifer, and improve pump operation efficiency
- The annulus should be filled with a suitable filter sand that extends to an appropriate depth below the screen or sump and above the screen. Appropriate filter pack should be selected based upon screen slot size and grain size analysis of the naturally occurring sediments.

5.5 PUMP SELECTION, ELECTRICAL, AND CONTROLS

Environmental duty pneumatic, top drive piston pump, or electric submersible pumps are proposed for groundwater extraction. Site-specific hydrogeologic conditions, expected sustainable flow rates, and operation and maintenance considerations will be factored in prior to final pump selection. Electric submersible pumps are the most commonly used pumps in vertical well systems. Given the uncertainty of the feasible pumping rate and incorporating a factor of safety, future adaptive management through pump changeout may be required.

Each vertical groundwater extraction well would contain a pump to convey groundwater to a header pipe connected to an extraction manifold. Additional pump, electrical and control selection information, as well as information on the use of pressure transducers, will be provided in subsequent documents prepared as part of the final design after approval of the CARA Plan.

5.6 PERFORMANCE MONITORING SYSTEM

In general, system performance will be evaluated based on the ability of the installed extraction system to achieve and maintain hydraulic control of uppermost aquifer groundwater within the hydraulic control zone. Performance monitoring will likely require the installation of observation piezometers to monitor groundwater levels in the vicinity of the groundwater extraction system. As the design and implementation of groundwater extraction corrective action advances, it is anticipated that a detailed performance monitoring plan will be developed, and the groundwater extraction system will be periodically evaluated. The evaluation will be used throughout the lifecycle of system operation to optimize the performance of the monitoring system and to adapt to/address changing site conditions, if needed. The goals of the

evaluation are to improve the effectiveness and efficiency of the corrective action, conduct maintenance, reduce operational costs, reduce the environmental footprint, and make the corrective action more resilient to environmental changes.

5.7 GEOTECHNICAL CONSIDERATIONS

Geotechnical considerations related to installation, operation, or other long-term effects of the selected groundwater extraction method will be considered as part of the system design. Example geotechnical considerations may include, but may not be limited to, the use of drilling fluids, equipment-induced vibrations during drilling, borehole spacing and layout geometry, backfilling techniques, proximity to existing site infrastructure, and long-term groundwater withdrawals.

Geotechnical considerations for the groundwater extraction methods identified previously are considered manageable and will be evaluated as the design and implementation of groundwater extraction actions evolve.

6.0 REFERENCES

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TABLES

Table 1 - Summary of Hydraulic Conductivity Results from Slug Test Data
Watts Bar Fossil Plant

Monitoring Well ID	Average Hydraulic Conductivity (cm/sec)	Average Hydraulic Conductivity (ft/day)
WBF-101	1.91E-04	0.54
WBF-104	2.26E-04	0.64
WBF-105	4.85E-04	1.37
WBF-106	2.70E-04	0.76
Geometric Mean	**2.74E-04**	**0.78**

Notes:

cm/sec - centimeters per second

ft/day - feet per day

ID - identification

DRAFT

Table 2

Comparative Evaluation of Advantages and Limitations of Hydraulic Control Technologies

	Vertical Wells	Extraction Trench	Horizontal Well
Potential Advantages of the Technology	▪ Conventional technology/readily implementable ▪ Few depth limitations ▪ Decreased soil management, odor mitigation requirements, and construction worker protection controls ▪ Lower soil and limited water management during construction ▪ Readily adaptable to expand system laterally and vertically or eliminate individual wells as needed ▪ Greater spatial and temporal control of groundwater recovery ▪ Higher specific capacity can be obtained with deeper wells ▪ Wide array of conveyance material options, pump types and well construction methods ▪ Operational over large fluctuations of water table	▪ Conventional technology/readily implementable ▪ Longer operational life span ▪ In heterogeneous, anisotropic environments, larger trench surface area increases likelihood of intercepting transmissive zones ▪ Uniform flow field more readily established over time ▪ Lower long-term O&M, and energy costs – fewer pumps, slower fouling due lower entrance velocities	▪ Conventional technology/readily implementable ▪ Reasonable alternative when access is limited by utilities and or other infrastructure ▪ Lower long-term O&M, energy costs, and fewer pumps ▪ Few depth limitations ▪ Decreased soil management, odor mitigation requirements, and construction worker protection controls
Potential Limitations of the Technology	▪ Higher long-term operation and maintenance (O&M) costs based on system complexity ▪ Increased system down time during extraction system repairs/well rehabilitation ▪ In low permeability environments, radius of influence is limited and will require high well density to provide hydraulic control ▪ Low permeability environment likely to increase screen fouling due to pump draw down/cycling ▪ Operationally difficult to maintain a consistent flow field in heterogeneous environments ▪ High total dissolved solids (TDS) waters may increase fouling	▪ Installation depth limited to ~15 feet via conventional methods or ~50 feet via advanced methods (long reach excavator or one pass trenching) ▪ Typically, higher initial capital costs ▪ Low strength of soils may impede construction ▪ Cannot be readily modified to extend deeper into the water bearing material ▪ Higher operational water volumes requiring management at maximum drawdown ▪ Require substantial workplace access to install ▪ Increased soil and water management during construction ▪ Less adaptable to expand system or eliminate individual sections	▪ In low permeability environments, radius of influence is limited and will require high well density to provide hydraulic control ▪ Require long run from starting point for deeper installation ▪ Operationally difficult to maintain a consistent flow field in heterogeneous environments ▪ High TDS waters may increase fouling ▪ Less adaptable to expand system and/or eliminate individual sections

Abbreviations:

O&M Operation & Maintenance

TDS Total Dissolved Solids

DRAFT

EXHIBITS

Exhibit No.

1

Title

WBF Plant Overview

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2025-10-01
Technical Review by JS on 2025-10-01

0 150 300 450 600 Feet

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

Legend

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

DRAFT

CCR: Coal combustion residuals

Notes

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

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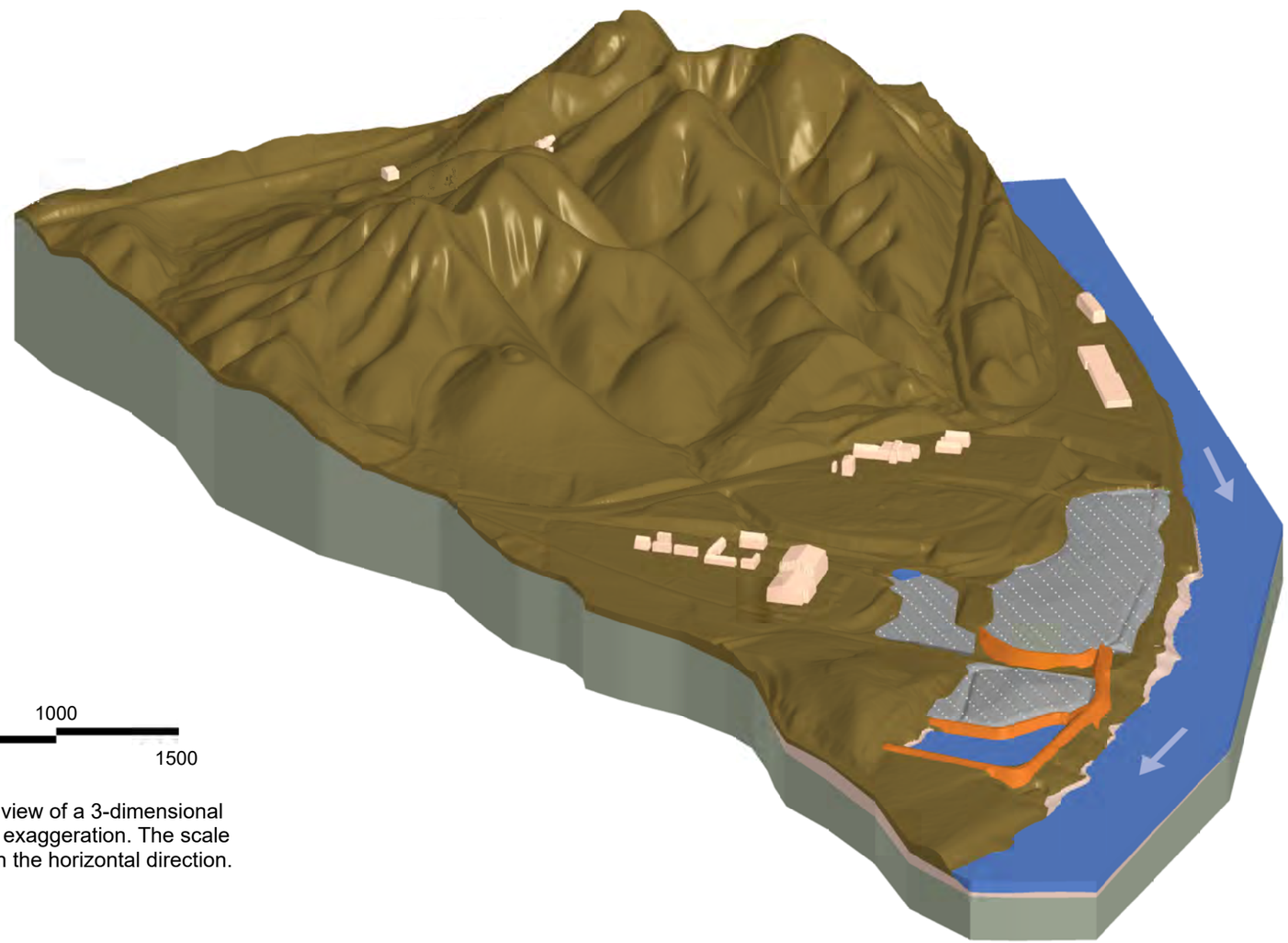

N

0 1000
500 1500

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

DRAFT

Exhibit No.

2

Title

Lithologic Model (Oblique View Looking Northwest)

Client/Project 175668050

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

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-01
TR by MD on 2025-10-01
IR Review by RB on 2025-10-01

Legend

- Building Structure
- CCR Material
- Clay Dike
- Unconsolidated Materials (Primarily Alluvial Silts and Clays)
- Unconsolidated Materials (Primarily Alluvial Sand)
- Waterbody
- Bedrock
- Typical Surface Stream Flow Direction

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CCR: Coal combustion residuals

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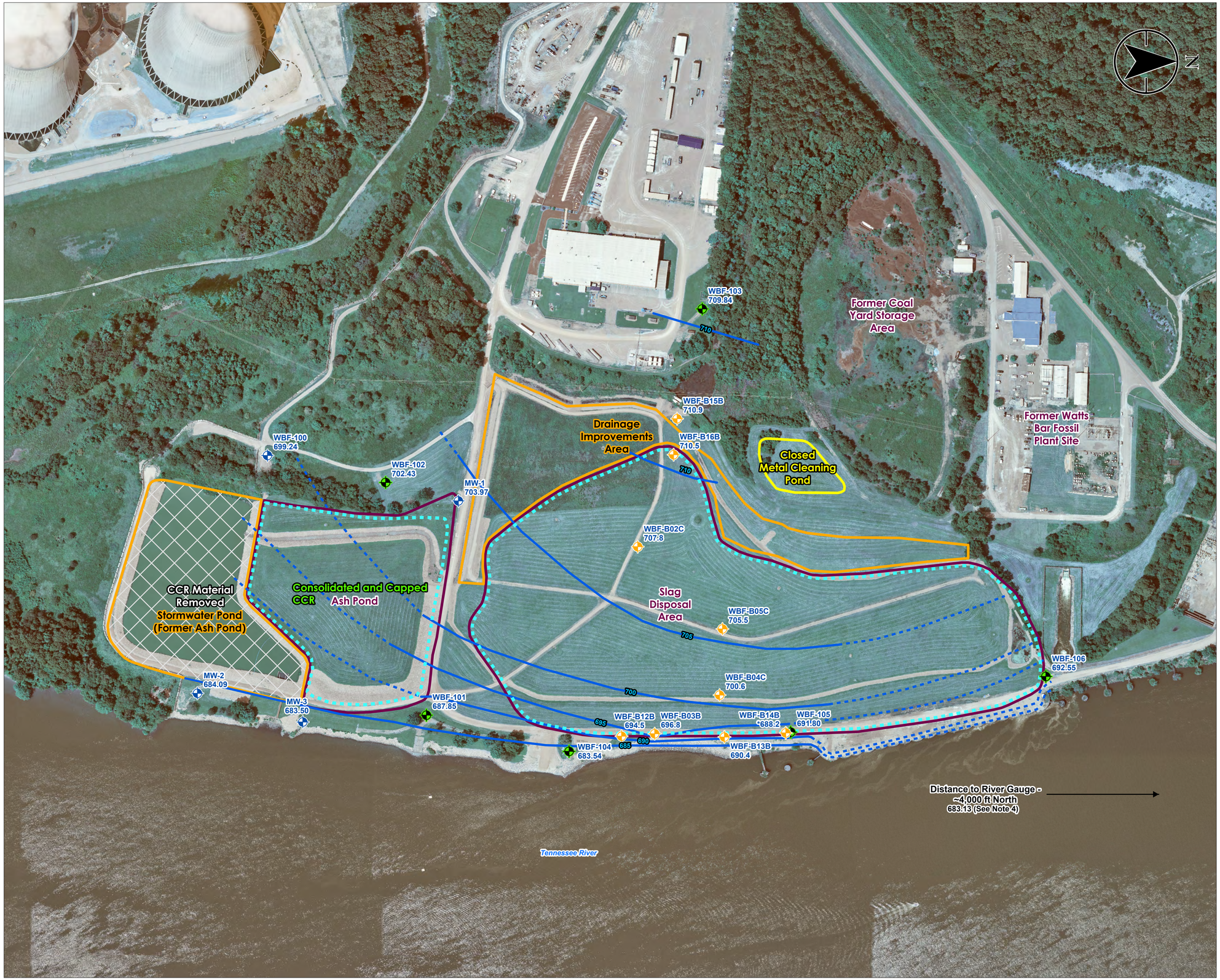

Exhibit No.

3

Title

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

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by DMB on 2025-10-01
Technical Review by MD on 2025-10-01

0 150 300 450 600 Feet

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

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer groundwater elevation in ft amsl
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

DRAFT

CCR: Coal combustion residuals

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

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

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106

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Exhibit No.

4

Title

Groundwater Findings Near WBF Plant CCR Units

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by DMB on 2025-10-01
Technical Review by JS on 2025-10-01

0 150 300 450 600 Feet

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

Legend

- Groundwater Results Below Groundwater Screening Levels
- Groundwater Results Above Groundwater Screening Levels
- Inferred Groundwater Flow
- Interpolated Groundwater Contour (5 ft interval)
- Groundwater Contour (5 ft interval)
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

DRAFT

GW - Groundwater
Cd - Cadmium
Co - Cobalt

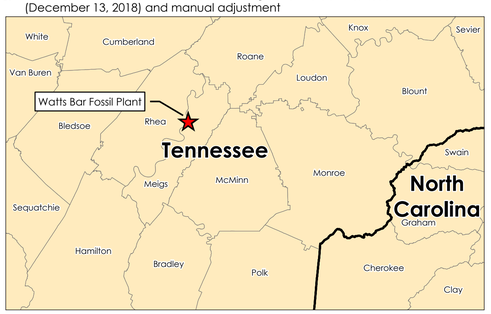
CCR: Coal combustion residuals

Groundwater contours included to illustrate general groundwater flow directions. See Exhibit 4 Groundwater Elevation Contour Map, Event #6 (July 6, 2020) for actual groundwater elevations and groundwater contours.

Groundwater conditions at well MW-1 are evaluated and discussed in Chapter 6.5 and Appendix D of the CARA Plan.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment



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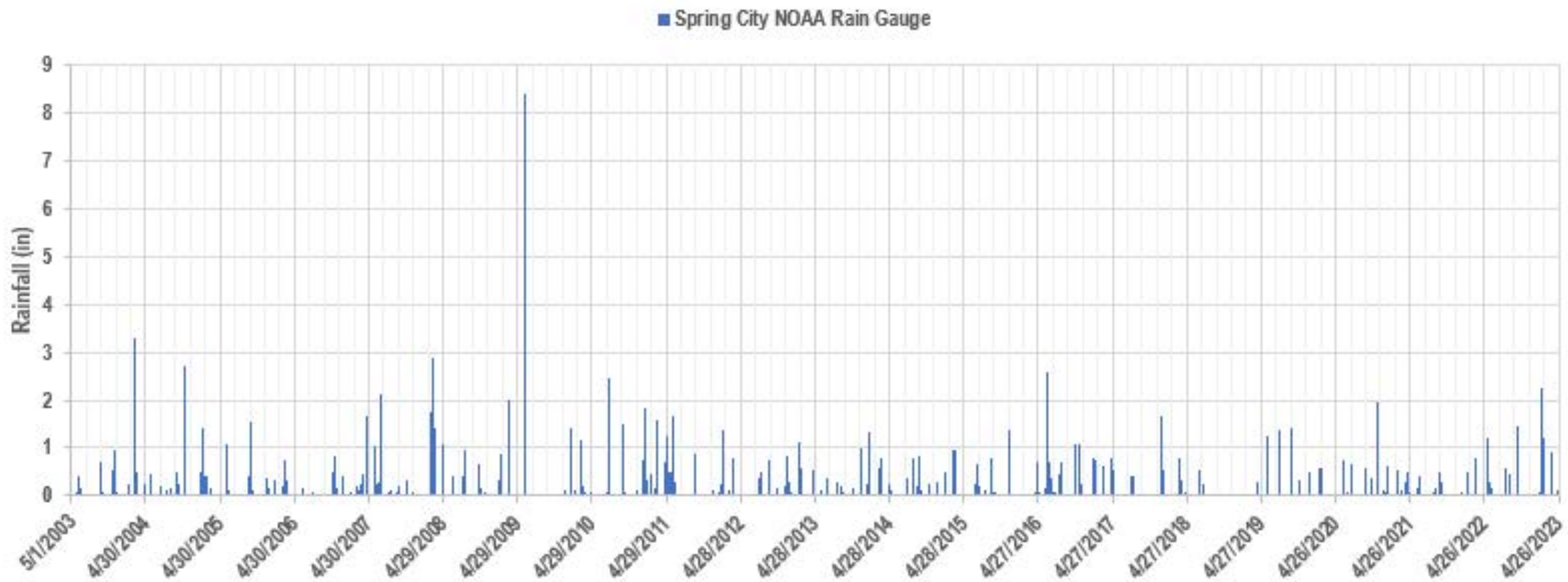

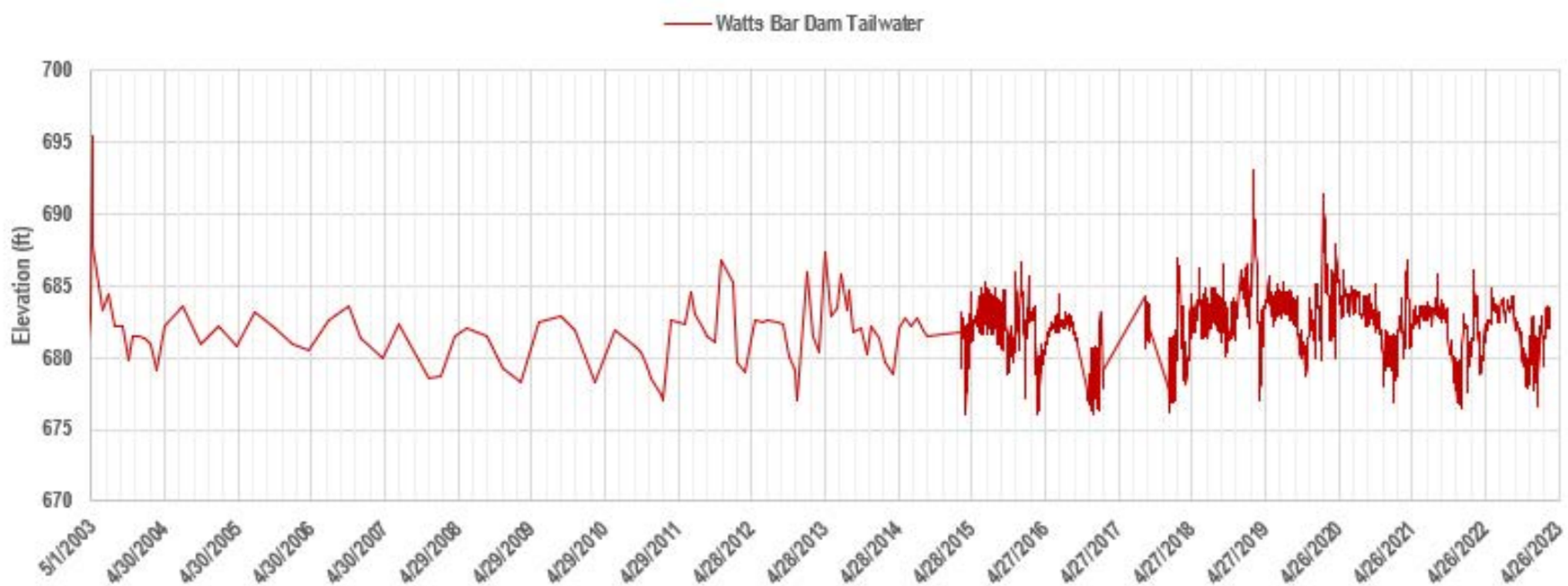

Exhibit No.

5

Title

Surface Water Stage Hydrograph and Daily Precipitation Data

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2025-11-17
TR by JS on 2025-11-17

Notes

1. ft - feet
2. in - inches
3. NOAA - National Oceanic and Atmospheric Administration

DRAFT

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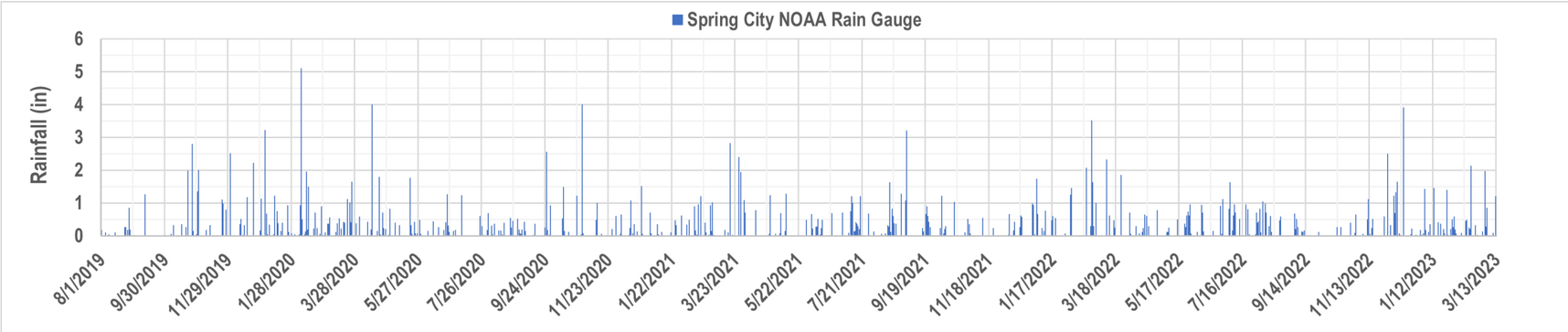

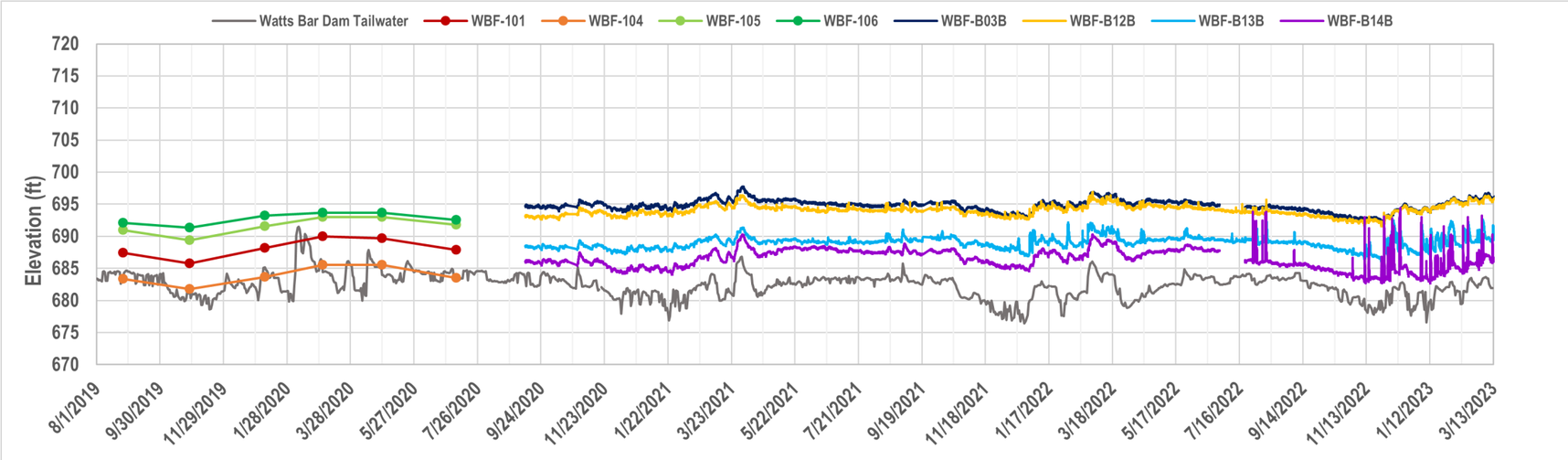

Exhibit No.

6

Title

Hydrographs, Selected Wells – Slag Disposal Area

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2025-10-01
TR by JS on 2025-10-01

Notes

1. ft - feet
2. in - inches
3. NOAA - National Oceanic and Atmospheric Administration

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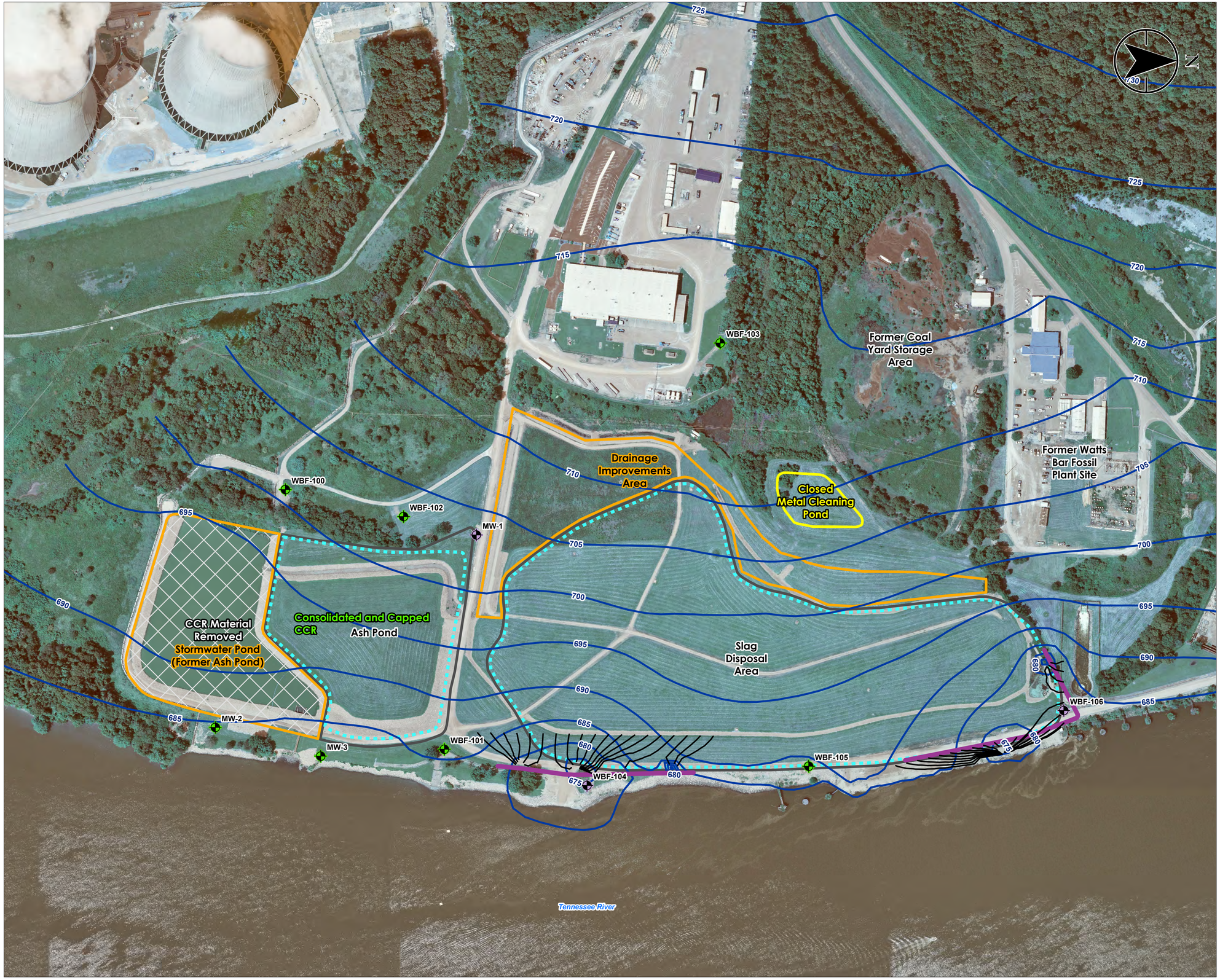

Exhibit No.

7

Title

Conceptual Groundwater Extraction System Layout

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2025-10-06
Technical Review by JS on 2025-10-06

0 150 300 450 600 Feet

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

Legend

- Groundwater Results Below Groundwater Screening Levels
- Groundwater Results Above Groundwater Screening Levels
- Approximate Location of Groundwater Extraction System
- Particle Traces
- Simulated Steady-State Groundwater Elevation Contours with Targeted Groundwater Extraction, Layer 4 (5 foot interval; elevations are in feet above mean sea level)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

DRAFT

CCR: Coal combustion residuals

Groundwater conditions at well MW-1 are evaluated and discussed in Chapter 6.5 and Appendix D of the CARA Plan.

Notes

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

Stantec TVA

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APPENDIX K -
PORE WATER EXTRACTION EVALUATION

Appendix K – Pore Water Extraction Technology Evaluation Technical Memorandum - DRAFT

TDEC Commissioner's Order:
Corrective Action / Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal to TDEC	September 6, 2024
1	Addresses December 17, 2024 TDEC Review Comments and Issued for TDEC	March 17, 2025
2	Date Revised for Reissuance. No other changes made to this Appendix	December 5, 2025

Sign-off Sheet

This document entitled Appendix K – Pore Water Extraction Technology Evaluation Technical Memorandum - DRAFT was prepared by Stantec Consulting Services Inc. (“Stantec”) for the account of Tennessee Valley Authority (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by _____

Patrick W. Dunne, Senior Hydrogeologist

Reviewed by _____

John McInnes, Senior Principal Geologist

Approved by _____

Rebekah Brooks, PG, Senior Principal Hydrogeologist

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LIST OF ATTACHMENTS

Attachment A CCR Unit-specific Considerations Used in Extraction Method Selection and Design

Attachment B Identified Pore Water Extraction Methods

Abbreviations

amsl	Above Mean Sea Level
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
cm/sec	Centimeters Per Second
EAR	Environmental Assessment Report
EI	Environmental Investigation
gpm	Gallons Per Minute
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order OGC15-0177
TM	Technical Memorandum
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION AND OBJECTIVES

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this *Pore Water Extraction Technology Evaluation Technical Memorandum* (TM) to summarize activities and findings related to the evaluation of the pore water removal (extraction) technology at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

The overall objective of this TM is to evaluate the efficacy of differing pore water extraction methods under the site-specific conditions present within the WBF Plant coal combustion residual (CCR) units. The information provided in this TM is in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at the TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan is being prepared pursuant to the TDEC Order to evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA. This TM is included as an appendix in the CARA Plan to support evaluation of potential closure actions at the WBF Plant CCR units.

The location of the WBF Plant and its surroundings is presented on Exhibit 1. There are two closed CCR units at the WBF Plant that are included in the TDEC Order: the Ash Pond and the Slag Disposal Area. An overview of the WBF Plant including the two closed CCR units and other plant and adjacent features is presented on Exhibit 1. The Drainage Improvements Area, located to the immediate west of the closed Slag Disposal Area CCR unit, has been evaluated with the Slag Disposal Area for the pore water extraction technology presented in this memorandum.

Based on the CCR unit closure method evaluation presented in Chapter 5.5 of the CARA Plan, additional closure-in-place actions are planned for the Slag Disposal Area (including Drainage Improvements Area). These actions include cover system modifications, including the installation of a geosynthetic cover system, implementation of two upstream source control projects, and stormwater drainage modifications. TVA is also planning seismic mitigation for both the Slag Disposal Area and Ash Pond to meet post-earthquake stability criteria. However, as the implemented closure actions progress and conditions change, pore water extraction may be applicable for further study and considered for targeted implementation as part of the additional closure actions for the Slag Disposal Area. The future integration of additional closure actions or modifications of the implemented closure action would be completed in coordination with TDEC and in accordance with applicable regulations.

The objective of pore water extraction is to lower the phreatic surface levels within an identified CCR unit by changing the ambient condition within the CCR material to remove pore water. This TM presents a technical evaluation of extraction methods that may be considered for removal of pore water present in the CCR units within a closure action modification framework. These methods were compared to assess which is best suited to meet performance objectives for the pore water extraction technology while also meeting CCR unit-specific constructability and accessibility requirements.

2.0 BACKGROUND AND APPROACH

This technical memorandum presents:

- A summary of the general design considerations used to identify a potential pore water extraction method for a specific CCR unit (Section 3.0 and Attachment A)
- A review and relative comparison of the pore water extraction methods suitable for pore water extraction at the WBF Plant CCR units and an evaluation of the geotechnical considerations associated with the installation and operation of a pore water extraction system(s) (Section 4.0 and Attachment B)
- The CCR unit-specific basis and evaluated pore water extraction method for each of the WBF Plant CCR units if pore water extraction is utilized as part of a closure action (Section 5.0).

The information presented herein was obtained from published sources as well as from established vendors of the referenced extraction methods. The discussed extraction method should be considered “or equivalent,” and no endorsement of a referenced vendor or specific technology method is expressed or implied by Stantec.

For purposes of this TM, 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)
- 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 reference to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material.
- 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 in CCR material. The measured pore water levels are used to infer pore water levels between the wells and piezometers to develop the phreatic surface.

3.0 CCR UNIT-SPECIFIC CONSIDERATIONS

If identified as a closure action, pore water extraction will be conducted only within the CCR material in the CCR unit. The unit-specific conditions considered during the identification of the most appropriate pore water extraction system for a given CCR unit include:

- Current and future use of the CCR unit area – closed or active unit, current or planned CCR material harvesting, and presence of ponds or other surface infrastructure
- Physical features/geometry of the CCR unit – CCR material thicknesses above and below the phreatic surface, foundation soil topography, hydraulic boundary conditions, and volume of CCR material below the phreatic surface
- Hydrogeologic properties of the CCR material below the phreatic surface that will influence pore water movement during pore water extraction – CCR material hydraulic conductivity and thicknesses across the unit, changes in material grain size distributions, and potential presence of stratified layers of differing hydraulic conductivity
- Constructability of each extraction method at the time of system installation – infrastructure presence, space limitations, and extraction system installation equipment access restrictions on top of the CCR unit
- Pore water geochemistry – potential extraction well system operational impacts caused by pore water geochemical changes during pore water extraction, such as sediment accumulation, mineral incrustation (scaling) or corrosion within the extraction well casing and well screen, and its impact on extraction system performance over time.

Additional discussion regarding each of these conditions and how they may influence the selection of a pore water extraction method is provided in Attachment A. Because general and major cation/anion pore water chemistry, which is used to evaluate an extraction system's susceptibility to incrustation/corrosion, can differ markedly between CCR units, Section 1.5 of Attachment A provides a unit-specific evaluation of pore water geochemical conditions at the WBF Plant TDEC Order CCR units.

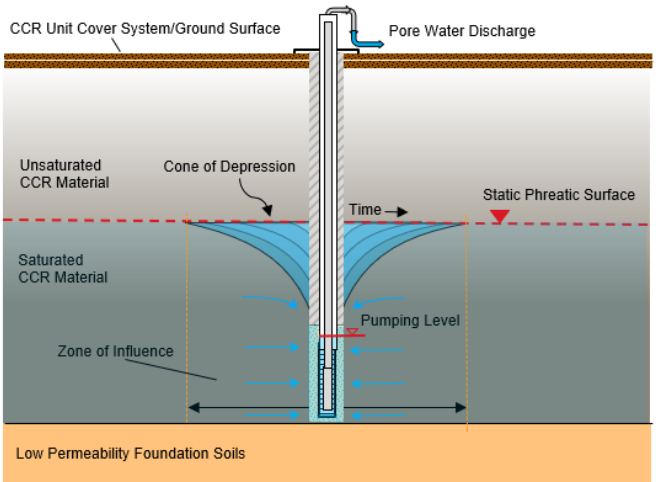
4.0 IDENTIFIED PORE WATER EXTRACTION METHODS

There are a variety of methods available to extract pore water. These methods range from high vacuum (negative pressure) extraction systems to simple passive drains. However, the majority of the evaluated CCR units at TVA fossil plants exhibit several common characteristics (e.g., unit size/volume, fine-grained and lower hydraulic conductivity CCR material, and phreatic surface depths, which are described in more detail in Section 4.1) and operational constraints that make a number of the extraction methods infeasible or impracticable. Those extraction methods deemed inappropriate or infeasible (e.g., high vacuum extraction systems) based on anticipated site conditions or operational constraints were not considered in this evaluation.

The three extraction methods considered for pore water removal and the lowering of phreatic surface elevations within the WBF Plant CCR units are: vertical extraction wells, horizontal extraction wells, and one-pass extraction trenches. These three extraction methods rely on positive pressure pumps to remove pore water at the extraction point. Pumping lowers the phreatic surface near the extraction system, creating a hydraulic gradient that will cause the movement of pore water from the adjacent CCR material toward the extraction system, as described in detail below for each method:

- **Vertical Extraction Wells**. This method consists of installing conventional, vertically oriented extraction wells constructed with the well screen positioned from the base of the CCR material to below the phreatic surface within the CCR unit. Vertical extraction wells would be installed at a well spacing interval that is appropriate for the site conditions (e.g., hydraulic conductivity, phreatic surface elevation) to meet the required performance objectives. When an extraction system begins pumping, it removes pore water radially from the CCR material surrounding the system, which results in lowering of the phreatic surface. The drawdown at a given point is the distance the pore water is lowered after pumping is initiated. The amount of drawdown is represented by the shaded cone of depression in the figure below.

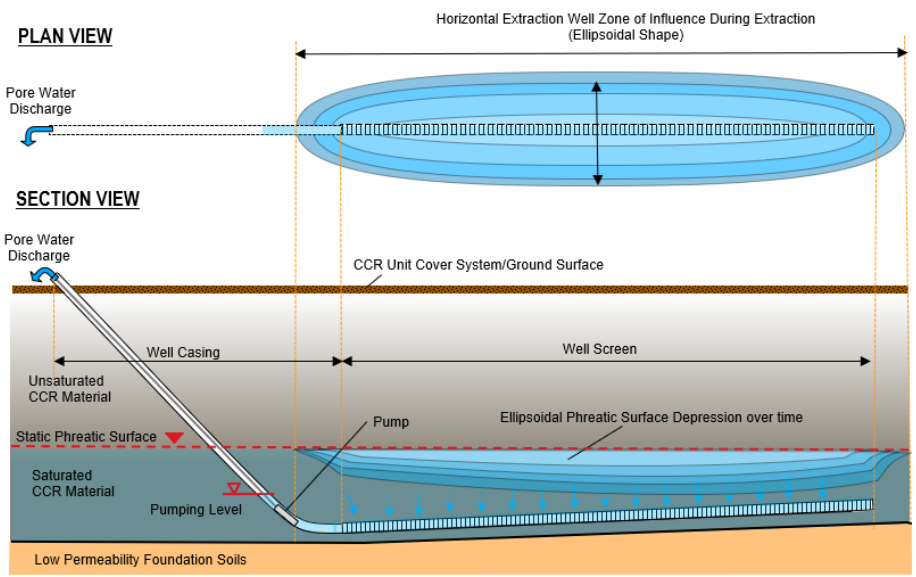
Vertical Extraction Well



A variant of a conventional extraction well is a well with a significantly larger diameter well bore. This type of large diameter vertical well is typically used to extract water in lower hydraulic conductivity environments, where flow rates into a conventional vertical well are expected to be low. The well is constructed by placing a conventionally sized (e.g., four to 12 inches in diameter) extraction well screen and riser within a much larger diameter boring. The annular area within the boring is then filled with a coarse filter pack.

- **Horizontal Extraction Wells**. This method consists of using specialized directional drilling equipment capable of horizontal directional drilling for the installation of a horizontally-oriented well screen along the base of the CCR unit. Each horizontal extraction well would be installed by advancing the well boring by entering the top of the CCR unit (i.e., within the perimeter dikes) at an angle until the boring nears the base of the unit. The direction of the horizontal well boring would then be changed to run horizontally along the base of the CCR unit along a specified alignment targeted for pore water extraction. The boring would either be terminated at the end of the planned horizontal run (a “single-entry” horizontal well boring) or redirected upward at an angle to exit the ground surface at the top of the CCR unit (“double-entry” horizontal well boring). A horizontal extraction well would then be constructed in the boring, with the screened portion of the well positioned along the horizontal leg of the boring below the phreatic surface as shown in the figure below.

Horizontal Extraction Well

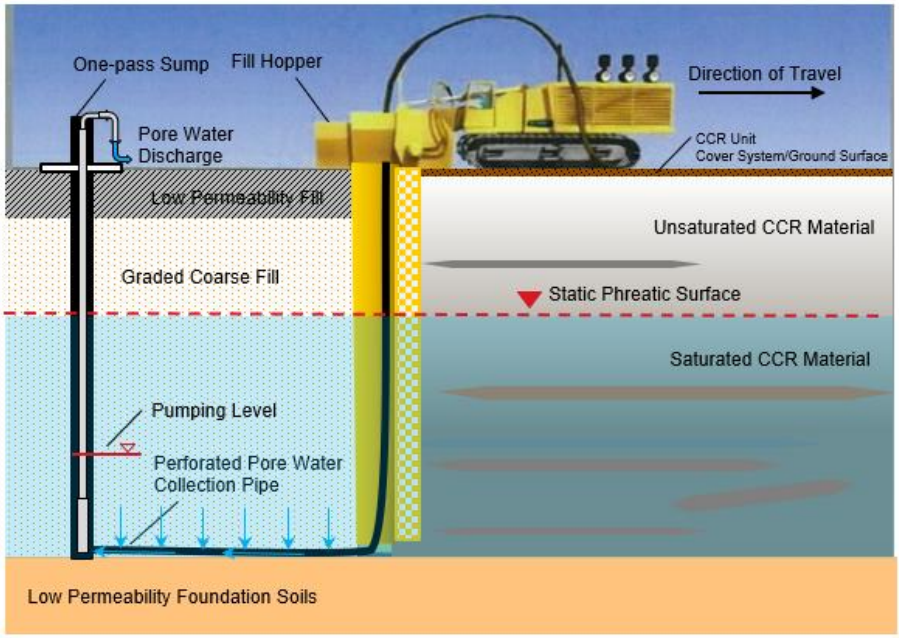


Completed horizontal extraction wells would be installed at a spacing that is appropriate for the site conditions (e.g., hydraulic conductivity, phreatic surface elevation) to meet the required performance objectives.

When installed, pore water extraction from a horizontal extraction well will create an approximately ellipsoidal zone of influence in homogeneous material.

- **One-Pass Extraction Trenches**. This method consists of using specialized trenching equipment capable of concurrently excavating, installing pore water collection piping, and backfilling a pore water extraction trench along an alignment down to the base of most CCR units. This construction method creates a plane of permeable material that fully intersects CCR material below the phreatic surface of the CCR unit. A collector drain at the base of the trench is connected to a sump. A pump is installed in the sump. When the pump is operating, a hydraulic gradient is induced, and pore water intercepted by the trench flows into the collector drain at the base of the trench. Then, the pore water is extracted from the sump by the pump.

One-Pass Extraction Trench



Completed one-pass trenches would be installed at a spacing that is appropriate for the site conditions (e.g., hydraulic conductivity, phreatic surface elevation) to meet the required performance objectives. Where conditions allow, an up to 50-foot-deep pore water extraction trench of the desired length can be installed.

Further descriptions of each of the identified pore water extraction methods as well as the identified advantages and disadvantages of each method are provided in Attachment B.

4.1 COMPARATIVE ANALYSIS OF PORE WATER EXTRACTION METHODS

CCR material, regardless of the CCR unit, typically exhibits several common physical characteristics that affect the selection of pore water extraction methods. These common characteristics are:

- The CCR material within a CCR unit is commonly heterogeneous and/or stratified.
- CCR material is composed of high percentages of fine to very fine (silt to clay-sized) particles. Even coarser (fine to medium sand-sized) coal combustion byproducts (i.e., bottom ash) typically contain a high percentage of fine particles within the coarser matrix. The high percentages of fine particles in CCR material result in lower hydraulic conductivities, which in turn result in lower pore water flow rates to the installed extraction system. The fine-grained composition also results in CCR material retaining or holding a higher percentage of pore water within the very narrow interstitial pore spaces of the CCR material matrix as a result of surface tension and capillary effects. Pore water within these narrow pore spaces is immobile and will not drain from the CCR material under ambient conditions (Woessner and Poeter 2020).
- Availability of drawdown is limited by site conditions. The CCR material thicknesses below the phreatic surface dictate how much drawdown is available to induce a hydraulic gradient toward the point of extraction. This condition is a potential limitation for vertically oriented extraction systems (i.e., vertical wells) because there is less well screen in contact with the low hydraulic conductivity CCR material, which results in smaller zones of influence for each extraction well when pumping.
- Pore water within CCR material contains higher concentrations of major anions (e.g., sulfate) and cations (e.g., calcium). Under certain conditions, these ions may combine as salts and precipitate out of solution. The resultant solids can adhere to extraction system components causing issues such as incrustation and corrosion. These processes can reduce extraction system performance and increase long term operation and maintenance requirements.

One criterion for comparison of extraction methods is the cross-sectional area in contact with CCR material below the phreatic surface. A one-pass extraction trench will initially provide the greatest cross-sectional area and it will also both intersect vertically stratified layers of higher and lower hydraulic conductivity and intercept potential heterogenous zones of higher conductivity along its alignment. However, this advantage decreases over time as the phreatic surface drops. Horizontal extraction well screens will have the next greatest area in contact with CCR material below the phreatic surface. The contact area for horizontal wells is generally expected to remain constant for wells installed at the base of CCR units. Vertical wells have the least contact area and experience the same decreasing contact area as trenches when the phreatic surface declines over time.

However, the cross-sectional area in contact with CCR material below the phreatic surface cannot be used as the only metric used to compare extraction methods for a specific CCR unit. Constructability and site-specific constraints (i.e., accessibility, constructability) were included in the identification of a

recommended pore water extraction method for each CCR unit. For example, one-pass trenching has depth limitations, large construction area requirements, and would require the temporary removal of portions of existing in place geosynthetic liner that may eliminate it as a viable technology for some CCR units. Vertical wells would require a large number of penetrations through geosynthetic cover systems and are expected to require more maintenance. Horizontal wells are expected to have the smallest impact on geosynthetic cover systems. A relative comparison of the technical attributes of each of the considered pore water extraction options is presented in Table 1. The highlighted evaluation criteria in Table 1 pertain to CCR unit-specific conditions that may result in an extraction method being eliminated from further consideration, as discussed in Section 5.0.

4.2 GEOTECHNICAL CONSIDERATIONS

Geotechnical considerations related to installation, operation, or other long-term effects of an installed pore water extraction method will be considered as part of the system design. Example geotechnical considerations may include the use of drilling fluids, equipment-induced vibrations during drilling, borehole spacing and layout geometry, backfilling techniques, proximity to existing site infrastructure, long-term pore water withdrawals, etc.

Geotechnical considerations for the pore water extraction methods identified in Section 5.0 extraction are considered manageable and will be evaluated as the design and implementation of groundwater extraction measures evolves.

5.0 EVALUATED PORE WATER EXTRACTION METHODS

Between 2019 and 2022, TVA and Stantec conducted various environmental investigations at the WBF Plant. The TDEC Order environmental investigation (EI) included characterization of the hydrogeology and investigations of the CCR material and pore water within each WBF Plant CCR unit. The CCR unit data obtained during the EI are presented in the *Watts Bar Plant Environmental Assessment Report* (EAR) (TVA 2024). Stantec used the data presented in the EAR as well as other available information regarding the construction and usage of each CCR unit to identify unit-specific elements relevant to the selection, design, and long-term operation of pore water extraction systems. Because of the presence of CCR material within the Drainage Improvements Area, a pore water extraction system is also discussed for this area.

The following sections provide:

- A summary of the unit-specific conditions used to develop the basis of design for a pore water extraction method at each of the identified TDEC Order CCR units and the Drainage Improvements Area based on information provided in the WBF Plant EAR
- The rationale, details, and predicted performance of the evaluated pore water extraction method for those WBF Plant CCR units or other areas in the event that pore water extraction is implemented as part of a planned closure action at the CCR unit or area.

5.1 ASH POND

5.1.1 CCR Unit Description

The Ash Pond CCR unit was closed in 2015 under TDEC Permit No. TN0005461 in accordance with the *Ash Pond Closure Plan* (TVA 2013). As part of the closure, CCR materials were excavated from the southern portion of the Ash Pond and consolidated in the northern portion of the Ash Pond. The northern portion of the Ash Pond was then completed with a low permeability geosynthetic and soil cover system (CDM Smith 2015). The southern portion of the former Ash Pond was converted into a permitted stormwater pond (Permit No. TNR058427).

The base of the CCR material/top of foundation soil contact (Exhibit 2) and the lateral extent and thickness of CCR material (Exhibit 3) were mapped at the Ash Pond as part of a material quantity assessment under the TDEC Order EI. CCR material thicknesses of up to 30 feet are present in the consolidated Ash Pond CCR unit. The lowest elevation (approximately 687 feet above mean sea level [amsl]) of the contact between the CCR material and top of foundation soil contact (Exhibit 2) indicates that the base of CCR material within the consolidated portion of the Ash Pond footprint is above the range of stage elevations recorded for the adjacent Tennessee River[1].

[1] As shown in the hydrographs provided in Appendix H, Exhibit H.1-12 of the EAR, Watts Bar Dam Tailwater, between 2020 and 2023. Tennessee River elevations near the Plant ranged from 676 to 687 feet amsl between 2020 and 2023.

Two EI temporary pore water monitoring wells, WBF-TW01 and WBF-TW02, were installed within the CCR unit in 2019, approximately six years following the closure of the CCR unit. The screen intervals of these wells were positioned at the base of the CCR material (Exhibit 2). No measurable pore water was detected at WBF-TW01 during six bimonthly pore water level gauging events. Temporary well WBF-TW02 was dry during two of the six pore water gauging events, and the pore water level was less than 0.1 foot above the base of the screen during the other four events.

The evaluations conducted for the EI at the Ash Pond found that no measurable phreatic surface exists within the CCR unit because the CCR material is effectively unsaturated (TVA 2024). This suggests that the low permeability cover system has effectively reduced infiltration of precipitation into the CCR unit and is performing as expected.

5.1.2 Evaluated Pore Water Extraction Method

Pore water extraction methods were not evaluated for the Ash Pond due to the absence of pore water within the unit.

5.2 SLAG DISPOSAL AREA AND DRAINAGE IMPROVEMENTS AREA

5.2.1 Slag Disposal Area

5.2.1.1 CCR Unit Description

The Slag Disposal Area CCR unit (Exhibit 1) received CCR material between 1942 and 1957. CCR material present in the Slag Disposal Area consisted of comingled fly ash, bottom ash, and slag. Between 1996 to 2005, approximately 161,000 tons of slag were harvested from the unit for beneficial use. The Slag Disposal Area was subsequently covered in 2009 with an engineered soil cover system as part of the approved CCR unit closure. The cover system consists of a one-foot-thick vegetative soil layer over a one-foot thick compacted clay layer. TVA has maintained the current soil cover system for the past 15 years.

The base of the CCR material/top of foundation soil contact (Exhibit 2) and the lateral extent and thickness of CCR material (Exhibit 3) were mapped at the Slag Disposal Area as part of a material quantity assessment under the TDEC Order EI. The lowest elevation (approximately 689 feet amsl) of the contact between the base of the CCR material and the top of foundation soil (Exhibit 2) indicates that the base of CCR material within the Slag Disposal Area CCR unit is above the stage elevation of the adjacent Tennessee River[1]. A comparison of pore water phreatic surface elevations to Tennessee River stage elevations over time did not find a strong correlation between transient river stage fluctuations and phreatic surface levels (refer to Exhibit H.1-14 in Appendix H of the EAR).

The clay foundation soils beneath the CCR material consist of two benches that roughly parallel the Tennessee River. The upper (i.e., higher elevation) bench of the foundation soil is present in the western third of the CCR unit. Foundation soil contact elevations of the upper bench are approximately two to nine

feet higher than the foundation soil contact elevations on the lower bench to the east of the upper bench. CCR material along the upper bench area is up to 20 feet thick (Exhibit 3).

The lower bench extends eastward from the upper bench to a raised former embankment along the Tennessee River. The lower bench of the foundation soils is broad and relatively flat, with lowest foundation soil contact elevations within the Slag Disposal Area found along the north-south axis of the lower bench. The greatest CCR thicknesses (up to 25 feet) within the Slag Disposal Area are present along the north-south axis of the lower bench (Exhibit 3).

A 2020 snapshot of the pore water phreatic surface elevations at the CCR unit is shown on Exhibit 4. Pore water phreatic surface elevations during the July 2020 monitoring event ranged from about 703 to 710 feet amsl across the unit. Pore water elevations within the unit are generally stable and exhibit a consistent seasonal fluctuation pattern with lower measured phreatic surface elevations occurring in the late summer and fall, and higher elevations occurring in the late winter early spring. These noted fluctuations suggest pore water elevations correlate with seasonal precipitation events (refer to Exhibit H.1-14 in Appendix H of the EAR). CCR material thicknesses below the phreatic surface range from approximately 0 to 14 feet, with greatest thicknesses present in the center of the CCR unit. Additional CCR unit-specific features and CCR material and foundation soil properties used to develop a basis of design for pore water extraction at the Slag Disposal Area are summarized below:

Slag Disposal Area	
Extraction Method Selection Considerations	**Unit-specific Conditions**
Land Use	27-acre, closed CCR unit with engineered soil cover system
CCR Unit Features	
Phreatic Surface Elevation (July 2020)	703 to 710 feet amsl
Unsaturated Zone Thickness	7 to 13 feet
CCR Material Thickness Below the Phreatic Surface	0 to 14 feet
CCR Material and Soil Properties	
CCR Material Grain Size Distributions	silt to well-graded sand with gravel
CCR Material Horizontal Hydraulic Conductivity	5.5×10^{-5} to 4.0×10^{-2} centimeters per second (cm/sec)
CCR Material Vertical Hydraulic Conductivity	6.9×10^{-6} cm/sec (one result)
Foundation Soil Vertical Hydraulic Conductivity	1.1×10^{-8} to 2.7×10^{-8} cm/sec
Constructability Considerations	Pore water extraction systems must start and end entirely within the diked boundaries of the CCR unit. Maximum CCR material depth is less than 30 feet below grade (i.e., it can be trenched). Foundation soil contact is relatively uniform along north-south axis of lower bench, upper bench foundation soils slope to the east toward lower bench. For one-pass extraction trench option, graded sand/stone source will be required. For horizontal well option, consider north-south alignment with double entry configuration to allow for more efficient well maintenance.
Accessibility Considerations	Interior/top of CCR unit is accessible by heavy equipment. For one-pass extraction trenching method, the construction of a large (80 feet wide) working pad will require extensive site preparation to protect existing cover system. Horizontal wells will require at least 150 feet of entry length (i.e., horizontal distance) to reach base of CCR material.
Pore Water Chemistry	High iron hydroxide incrustation potential in area of WBF-TW05; low carbonate and sulfate mineral incrustation potential; potentially corrosive conditions (refer to Table A-1 of Attachment A)

5.2.1.2 Evaluated Pore Water Extraction Method

The pore water extraction technology was evaluated at the Slag Disposal Area in the event that pore water extraction is implemented as part of a planned closure action. If pore water extraction is implemented, then the currently recommended pore water extraction method for the Slag Disposal Area is horizontal extraction wells. This method was selected based on the CCR unit-specific features, CCR material and foundation soil properties, and phreatic surface levels within this CCR unit.

The Slag Disposal Area is approximately 1,800 feet long, and approximately 400 feet wide in the northern half of the CCR unit and up to 900 feet wide in the southern half. The foundation soil topography is relatively uniform and slopes towards the north-south axis of the CCR unit (Exhibit 2). CCR material thicknesses below the phreatic surface are greatest in the southern half of the unit (Exhibit 3).

Two separate horizontal extraction well alignments, designated SDA-01 and SDA-02, are specified for the Slag Disposal Area. These horizontal well alignments are projected onto the topographic surface at the contact of the base of the CCR material and top of the foundation soil, as shown on Exhibit 5. The horizontal alignments run north-south and are positioned roughly parallel to each other and the Tennessee River. Both horizontal wells should be installed through the top of the CCR unit and not through the engineered dikes on the exterior of the unit.

The longer, approximately 1,600-foot horizontal well alignment (SDA-01), is positioned along the north-south axis of the lower bench of the foundation soils where the lowest foundation soil elevations and greatest thicknesses of CCR material below the phreatic surface have been observed. The SDA-01 horizontal extraction well should be constructed as a double entry well. The pump should be positioned at the south (deepest) end of the well. The second, northern entry can be used to better facilitate periodic cleaning and well development, since pore water analyses suggest that this unit may be susceptible to iron precipitation and potential well screen incrustation.

The shorter, approximately 800-foot horizontal well alignment (SDA-02), is positioned along the north-south axis of the upper bench of the foundation soils within the CCR unit. The SDA-02 horizontal extraction well should be constructed as a single entry well to maximize screen length along the shorter and narrower upper bench and the western margin of the CCR Unit. If pore water extraction in the vicinity of horizontal well SDA-02 results in phreatic surface elevations declining below levels that can be practically extracted from SDA-02, remaining drainable pore water will flow toward SDA-01 following the easterly slope of the base of the CCR material/top of foundation soil contact.

The hydraulic conductivity contrast between the CCR material and underlying foundation soils will promote the horizontal movement of pore water above the contact under the increased hydraulic gradient induced by positioning the horizontal extraction well screens at the CCR material/foundation soil contact. The use of a horizontal extraction well system will increase the amount of available drawdown (based on CCR material thickness below the phreatic surface) along the screened length of each horizontal extraction well.

Pre-construction borings should be advanced along each of the horizontal extraction well alignments to confirm the top of foundation soil elevations prior to system installation and allow for adjustment of the horizontal well boring alignment if required. To the extent practicable, the screened portion of the horizontal extraction wells should be positioned at the contact of the CCR material and the foundation soil along the alignment. During extraction system operation, pore water levels should be maintained at an elevation above the top of the extraction well screen elevation. Maintaining pore water levels above the well screen will minimize the introduction of oxygen into the well. Increased dissolved oxygen levels may affect pore water geochemistry and lead to increased mineral precipitation and incrustation on well components.

The horizontal extraction well alignments described above were incorporated into the calibrated MODFLOW model developed for the WBF Plant (refer to Appendix G for details regarding MODFLOW model construction). Pore water extraction simulations at the Slag Disposal Area were then completed with the current engineered soil cover system. The model was then used to simulate pore water extraction over time along the specified horizontal extraction well alignments. These simulations were completed to:

- Evaluate spatial changes in pore water phreatic surface levels in response to the simulated pore water extraction system operation within the CCR unit
- Predict the effect that the extraction system will have on reducing the overall phreatic surface elevation over time
- Estimate steady state extraction system flow rate from the modeled pore water extraction system configuration.

Transient (time dependent) MODFLOW model runs simulating pore water extraction were completed to predict changes in the phreatic surface elevation over time at the Slag Disposal Area. These phreatic surface elevations were then used to depict CCR material thicknesses below the phreatic surface after 0 (baseline), 1, 5, and 10 years of pore water extraction are shown on Exhibit 6.

MODFLOW model simulations of the horizontal extraction well system within the Slag Disposal Area revealed the following:

- Transient model simulations (Exhibit 6) of pore water extraction from the two horizontal extraction well system show that the greatest phreatic surface level declines occur within the first five years of extraction. Changes in phreatic surface elevations are most evident in the area between the two horizontal extraction wells, with declines of up six to eight feet. Comparison of the baseline (pre-extraction) and five-year simulations also shows that the areal footprint of CCR material below the phreatic surface (i.e., greater than one foot thickness) within the Slag Disposal Area decreases by approximately 25 percent during the first five years of pore water extraction.
- After ten years of operation, model simulations show localized changes (declines) in the thicknesses of CCR material below the phreatic surface beyond those predicted after five years of pore water extraction. CCR material thicknesses below the phreatic surface, in those

areas where the modeled phreatic surface is more than one foot above the foundation soils, range from approximately one to seven feet. Additional, targeted pore water extraction wells may be required to reduce phreatic surface levels further in areas where model predictions show higher CCR material thicknesses below the phreatic surface.

- The model predicted a steady state combined pore water extraction rate of approximately five gallons per minute (gpm) from the SDA-01 and SDA-02 horizontal extraction wells. Predicted, combined average extraction well discharges during the first year of operation are up to 10 gpm (Exhibit 7).

5.2.2 Drainage Improvements Area

5.2.2.1 Area Description

In 2015, earthwork was completed to improve surface drainage and remove standing water along the western limits of the Slag Disposal Area. This area was subsequently referred to as the Drainage Improvements Area (Exhibit 1). The Drainage Improvements Area is triangular in shape measuring approximately 450 feet long by 550 feet wide. Its major below grade feature is a narrow historical stream channel in the foundation soil that runs from the northwest to the southeast through the middle of the southern portion of the Drainage Improvements Area (Exhibit 2). Process water and CCR material were reportedly conveyed into the southern portion of the Drainage Improvements Area during the operation of the Slag Disposal Area between 1942 and 1957.

Stantec advanced four exploratory borings (WBF-B09, WBF-B10, WBF-B11, and WBF-B15 on Exhibit 2) to further characterize the westernmost portion of the Drainage Improvements Area. The lateral and vertical extent of CCR material found in the Drainage Improvements Area was mapped as part of the EI material quantity assessment of the adjacent Slag Disposal Area (Exhibit 3). CCR material thicknesses of up to 16 feet are present in this area. CCR material within the area is currently covered with varying thicknesses of clay fill material placed during surface grading of the area.

The elevation contours of the base of CCR material/top of the foundation soil contact are irregular and range from approximately 691 to 706 feet amsl (Exhibit 2) within the Drainage Improvements Area. The lowest contact elevations are present along the historical stream channel that bisects the southern portion of the Drainage Improvements Area from northwest to the southeast. CCR material is present within the former stream channel but is partially separated from the CCR material in the Slag Disposal Area to the east by a higher elevation area consisting primarily of clay foundation soil and reworked earthen fill. This separating feature is approximately 70 to 200 feet wide and is present up to a maximum elevation of 712 to 714 feet amsl.

The lowest elevation (691 feet amsl) at the base of the CCR/material/top of foundation soil contact within the Drainage Improvements Area is above the range of stage elevations recorded of the Tennessee River[1]. Pore water phreatic surface measurements within the Drainage Improvements Area are limited to elevations recorded at nested piezometer WBF-B15A located at the northern edge of the area (Exhibit 4). Pore water elevations at this piezometer location ranged from approximately 707 to 712 feet amsl

between September 2020 and January 2023. The phreatic surface elevation data from this piezometer showed little correlation between pore water elevations and stage elevation in the Tennessee River and a muted/weak correlation with precipitation events. Pore water level fluctuations at piezometer WBF-B15A showed a strong correlation with recorded groundwater fluctuations at piezometer WBF-B15B completed in the foundation soil (refer to WBF-B15A/B hydrographs in Attachment H.1-A, Appendix H of the EAR). Greatest CCR material thicknesses (up to 16 feet) below the phreatic surface within the Drainage Improvements Area were observed within the historical stream channel and other lower elevation areas of the foundation soil contact in the southeast corner of the Drainage Improvements Area.

Other available features and properties used to develop a basis of design for pore water extraction at the Drainage Improvements Area are summarized below:

Drainage Improvements Area	
Extraction Method Selection Considerations	**Area-specific Conditions**
Land Use	Approximately 4-acre area with CCR material overlain by clayey fill material
Area Features	
Phreatic Surface Elevation (July 2020)	710 to 712 feet amsl (approximate)
Unsaturated Zone Thickness	2 to 9 feet
CCR Material Thickness Below the Phreatic Surface	1 to 14 feet
CCR Material and Soil Properties	
Grain Size Distributions	silty sand to sand with clay
CCR Material Horizontal Hydraulic Conductivity	Not Measured
CCR Material Vertical Hydraulic Conductivity	Not Measured
Foundation Soil Vertical Hydraulic Conductivity	Not Measured
Constructability Considerations	Maximum CCR material depth is less than 20 feet below grade. Greatest thicknesses of CCR below phreatic surface is within narrow area of lower foundation soil elevations and will require tightly spaced pre-construction borings to establish final alignment. For trenching, a local, graded sand/stone source will be required for fill and an off-site disposal location for removed CCR material. Horizontal wells will require at least 100 feet of entry length (i.e., horizontal distance) to reach base of CCR material.
Accessibility Considerations	Top of area is accessible by heavy equipment, but available working area is limited. Installing horizontal well or one-pass extraction trench alignments within a narrow area of lower foundation soil elevations containing the greatest thicknesses of CCR material below the phreatic surface may not be feasible,
Pore Water Chemistry	No water quality data collected

5.2.2.2 Evaluated Pore Water Extraction Method

The pore water extraction technology was evaluated at the Drainage Improvements Area in the event that pore water extraction is implemented as part of a planned closure action. Though not established as a TDEC Order CCR unit prior to the EI, the Drainage Improvements Area has been included in this pore water extraction technology evaluation because it is adjacent to the closed Slag Disposal Area CCR unit and was found to contain CCR material below the phreatic surface.

If pore water extraction is implemented, then the currently recommended pore water extraction method for the Drainage Improvements Area is to extract pore water using a horizontal extraction well aligned roughly along the axis of the historical stream channel along the base of the CCR material in the area (Exhibit 5). The top of the foundation soils in the Drainage improvements Area slopes downward from the east and west towards the northeast to southwest running axis of the historical stream channel. The historical channel floor slopes to the southeast and widens toward the southeast corner of the area. CCR material thicknesses below the phreatic surface are greatest within the historical stream channel (Exhibit 3).

One single-entry horizontal extraction well has been specified for the Drainage Improvements Area. This well configuration is conditioned on the installation of pre-construction characterization (soil borings and pore water gauging) to more fully define the width, depth, and path of the previously discussed historical stream channel and to collect additional pore water levels within the area. The additional subsurface data should be used to determine if the installation of a horizontal extraction well at the base of the historical stream channel is feasible without disturbing the underlying foundation soils.

The Drainage Improvements Area horizontal extraction well alignment, designated DIA-01, is projected onto the topographic surface at the contact of the base of the CCR material/top of the foundation soil, as shown on Exhibit 5. The entry point for the horizontal extraction well should be located at the southeast corner of the Drainage Improvements Area. The horizontal portion of the boring will then be advanced to the northwest and along the former stream channel alignment with the well screen positioned at the base of CCR material/top of foundation soils. This configuration will permit the lowest point of the well to be at the lowest elevation of the contact between the base of the CCR material/top of the foundation soil. The use of a horizontal extraction well system at this position will increase the amount of available drawdown (based on CCR material thickness below the phreatic surface) along the screened length of the extraction well.

Pre-construction borings should be advanced along the alignment of the horizontal extraction well to verify the path of the former stream channel and establish the base of CCR material/top of foundation soil elevations within the former channel. Pre-construction borings will allow for adjustments of the horizontal well boring alignment, or if the former channel does not follow an approximately linear alignment, possible substitution of vertical extraction wells targeting low elevation areas within the Drainage Improvements Area. To the extent practicable, the screened portion of the horizontal extraction well should be positioned at the contact of the CCR material and the foundation soil along the alignment. During extraction system operation, pore water levels should be maintained at an elevation above the top of the extraction well screen elevation. Maintaining pore water levels above the well screen will minimize the introduction of

oxygen into the well. Increased dissolved oxygen levels may affect pore water geochemistry and lead to increased mineral precipitation and incrustation on well components.

The specified horizontal extraction well alignment was incorporated into the calibrated MODFLOW model developed for the WBF Plant (refer to Appendix G for details regarding MODFLOW model construction). Pore water extraction simulations of the Drainage Improvements Area were then completed with existing soil fill cover. The model was then used to simulate to simulate pore water extraction over time along the horizontal extraction well alignment. These simulations were completed to:

- Evaluate spatial changes in pore water phreatic surface levels in response to the simulated pore water extraction system operation in the Drainage Improvements Area
- Predict the effect that the extraction system will have on reducing the overall phreatic surface elevation over time
- Estimate steady state extraction system flow rate from the modeled pore water extraction system configuration.

Transient (time dependent) MODFLOW model runs simulating pore water extraction were completed to predict changes in the phreatic surface elevation over time at the Drainage Improvements Area. These phreatic surface elevations were then used to depict CCR material thicknesses below the phreatic surface after 0 (baseline), 1, 5, and 10 years of pore water extraction are shown on Exhibit 6.

MODFLOW model simulations of the specified pore water extraction system within the Drainage Improvements Area revealed the following:

- Transient model simulations (Exhibit 6) of pore water extraction from the one horizontal extraction well system show that greatest phreatic surface level declines occur within the first five years of extraction. Changes in phreatic surface elevation are most evident in the direct vicinity of the horizontal extraction well, with declines of up 6 to 10 feet within the Drainage Improvements Area. Comparison of the baseline (pre-extraction) and five-year simulations shows that the areal footprint of saturated CCR material (i.e., greater than one foot thickness) within the area does not change appreciably during the first five years of pore water extraction.
- After ten years of operation, model simulations show localized changes (declines) in the maximum thicknesses of CCR material below the phreatic surface beyond those predicted after five years of pore water extraction. CCR material thicknesses below the phreatic surface, in those areas where the modeled phreatic surface is more than one foot above the foundation soils, range from approximately 1 to 12 feet. Additional, targeted pore water extraction wells may be required to reduce phreatic surface levels further in areas where model predictions show higher CCR material thicknesses below the phreatic surface.
- The model-predicted steady state pore water extraction rate is approximately 1.5 gpm from the DIA-01 horizontal extraction well. The predicted extraction well system discharge during the first year of operation is up to two gpm (Exhibit 7).

6.0 REFERENCES

CDM Smith (2015). *Construction Record Documentation Report, Workplan 2: Ash Pond Closure Project, WBF-10W254-WP-2".* March 2015.

Tennessee Department of Environment and Conservation (TDEC). (2015). *Commissioner's Order No. OGC15-0177*. August 6, 2015.

Tennessee Valley Authority (TVA). (2024). *Environmental Assessment Report, Revision 1.* Watts Bar Fossil Plant, Spring City, Tennessee. March 31, 2024.

TVA. (2013). *Ash Pond Closure Plan.* October 3, 2013.

Woessner W. and E. Poeter. (2020). *Hydrogeologic Properties of Earth Materials and Principles of Groundwater Flow* – Section 3.7 Interrelationship of Effective Porosity, Specific Yield and Specific Retention. The Groundwater Project.

TABLES

TABLE 1 – Relative Comparison of Evaluated Pore Water Extraction Methods
Watts Bar Fossil Plant

Evaluation Criteria	Evaluated Pore Water Extraction Method		
	Vertical Extraction Wells	**Horizontal Extraction Wells**	**One-Pass Extraction Trenches**
Primary Evaluation Criteria			
Implementability	Readily Implementable	Implementable (with sufficient installation area space and no large underground facilities [i.e., deep foundations] along alignment)	Implementable (for foundation soils less than 50 feet below grade, sufficient utility-free space, and availability of local drain filter media)
Effectiveness	Partially Effective (generally limited saturated screen interval and available drawdown; high well density requirement due to small radius of influence in low hydraulic conductivity environments; higher susceptibility to incrustation and rapid decrease in well yields)	Moderately Effective (larger saturated screen interval and greater available drawdown than vertical wells, but effectiveness may be hindered by stratified CCR material conditions limiting vertical flow to horizontal screen)	Effective (creates high vertical and horizontal contact area in low hydraulic conductivity, heterogeneous and/or stratified media; increases extraction productivity and reduces extraction duration: lower incrustation potential due to lower flow velocities during extraction)
Estimated Capital Cost	Moderate (based on a greater number of wells required in lower hydraulic conductivity CCR materials)	Moderate (based on specialty drilling method/ tooling, drilling fluid management, and pre-construction design requirements -e.g., borings to establish/verify contact elevation of foundation soils along each alignment)	High (based on specialty trenching equipment and supporting heavy equipment; required material management; and pre-construction design requirements - e.g., borings to establish/verify contact elevation of foundation soils along each alignment)
Operation & Maintenance Costs	High (pump cleaning/replacement, routine well redevelopment/de-fouling for a large number of wells at a greater frequency)	Moderate (pump cleaning/replacement, redevelopment/de-fouling for a reduced number of wells)	Low (pump replacement, bottom drain redevelopment)
Secondary Evaluation Criteria			
Inorganic Incrustation/Scaling Potential	High	Moderate (based on lower entrance velocities and fully saturated condition of screen interval)	Low to Moderate (based on lower entrance velocities and fully saturated condition of trench drain)
Available Drawdown	Low	Moderate	Moderate
Pore Water Extraction Productivity	Low	Low (in stratified CCR material) to Moderate	High (in heterogeneous and stratified CCR material)
Installation/Footprint Requirements for Typical Installation	Small (25 feet wide by 40 feet long for each vertical well)	Moderate (150 feet wide by 150+ feet long) for one or more wells depending on horizontal well alignment requirements)	Large (80 feet wide by 1,000+ feet long)
Construction Rate	30-100 feet per day (after 1/2 day initial mobilization)	200-500 feet per day (after 2-3 day mobilization)	200-300 feet per day (after 8-10 day mobilization)

Notes:
1. Green highlighted pore water extraction method comparisons of the criteria take into consideration the site-specific conditions associated with CCR units. These site conditions include: 1) heterogeneous and/or stratified, lower hydraulic conductivity CCR material, 2) limited available drawdown (i.e., limited CCR material thicknesses below the phreatic surface), and 3) highly mineralized pore water.

DRAFT

EXHIBITS

Exhibit No.
1

DRAFT

Title
WBF Plant Overview

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

Project Location
Spring City, Tennessee

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

0 200 400 600 800 Feet
1:2,400 (At original document size of 22x34)

Legend

- National Pollutant Discharge Elimination System (NPDES) Outfalls (Historical)
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

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

Stantec TVA

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Exhibit No.
2

DRAFT

Title
Bottom of CCR Material/Top of Foundation Soil Elevations

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-02-11
Technical Review by PD on 2025-02-11

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

Legend

- EXD SAR Boring with Bottom of CCR Material Elevation in feet (ft)
- Existing Boring with Bottom of CCR Material Elevation in feet (ft)
- Limit of Existing Cover System (Approximate – 2023)
- Bottom of CCR Material Elevation Contour (2 ft interval)
- Bottom of CCR Material Elevation Contour (10 ft interval)
- Historical Stream Alignment
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)
3. Historical stream alignments digitized from Topographic Map USGS, Decatur Quadrangle, 1942 (edited 1962)
4. Model input and confirmation data used to model and evaluate the bottom of CCR surfaces shown herein are summarized in Table C.2 (Appendix C).

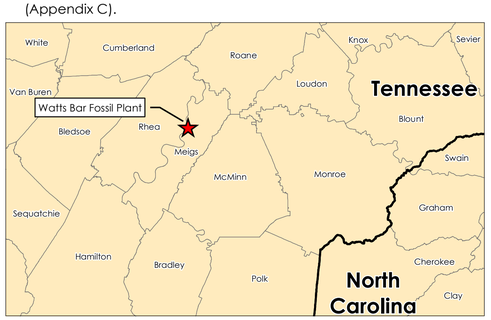

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Exhibit No.
3

DRAFT

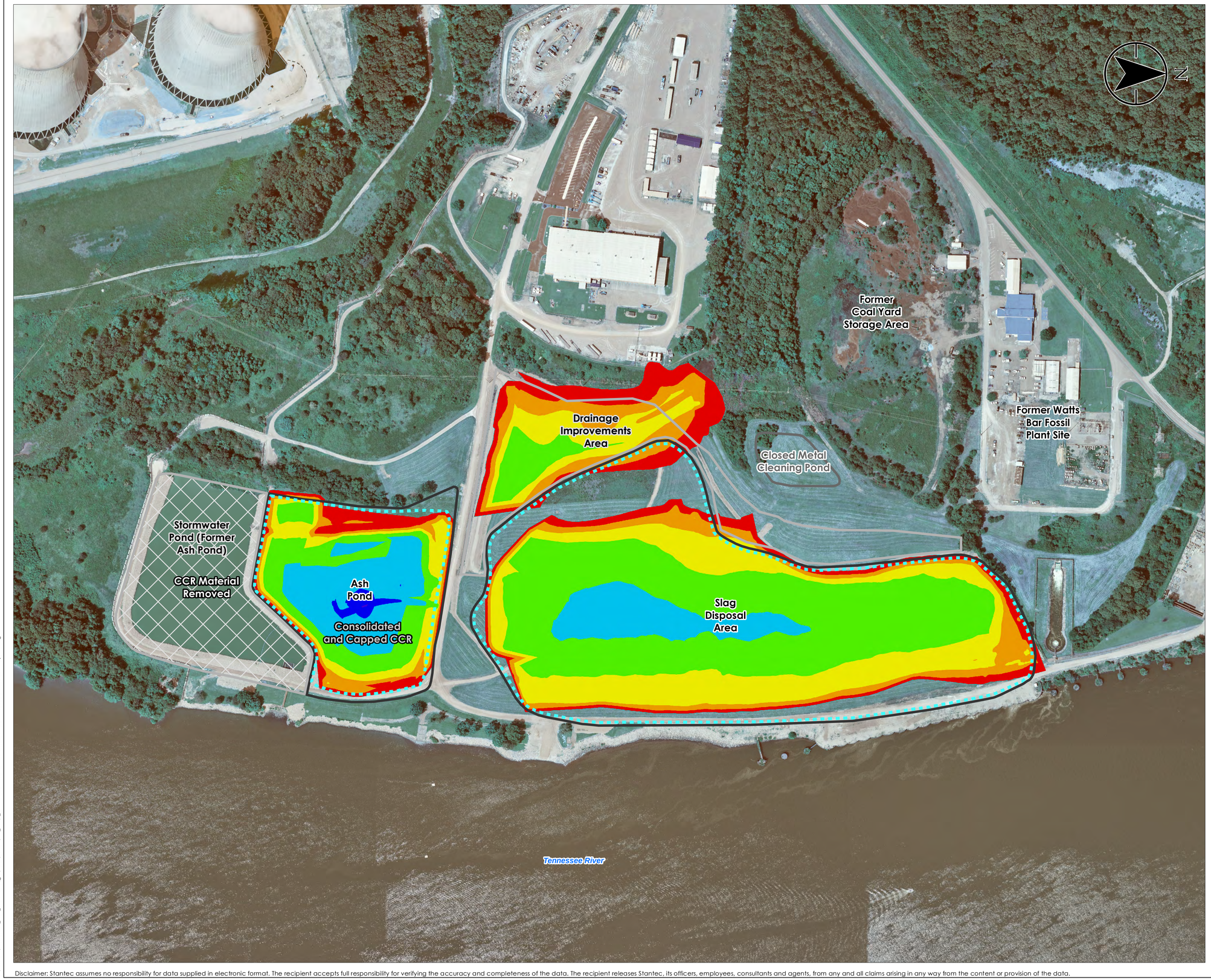
Title
Estimated Limits and Thickness of CCR Material

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

Project Location
Spring City, Tennessee

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

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



Legend

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

CCR: Coal combustion residuals

SUMMARY TABLE				
NUMBER	MIN. THICKNESS (FEET (FT)	MAX. THICKNESS (FEET (FT)	AREA (ACRES (AC))	COLOR
1	0.00	5.00	4.2	
2	5.00	10.00	4.4	
3	10.00	15.00	8.0	
4	15.00	20.00	12.6	
5	20.00	25.00	4.5	
6	25.00	30.00	0.2	

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)

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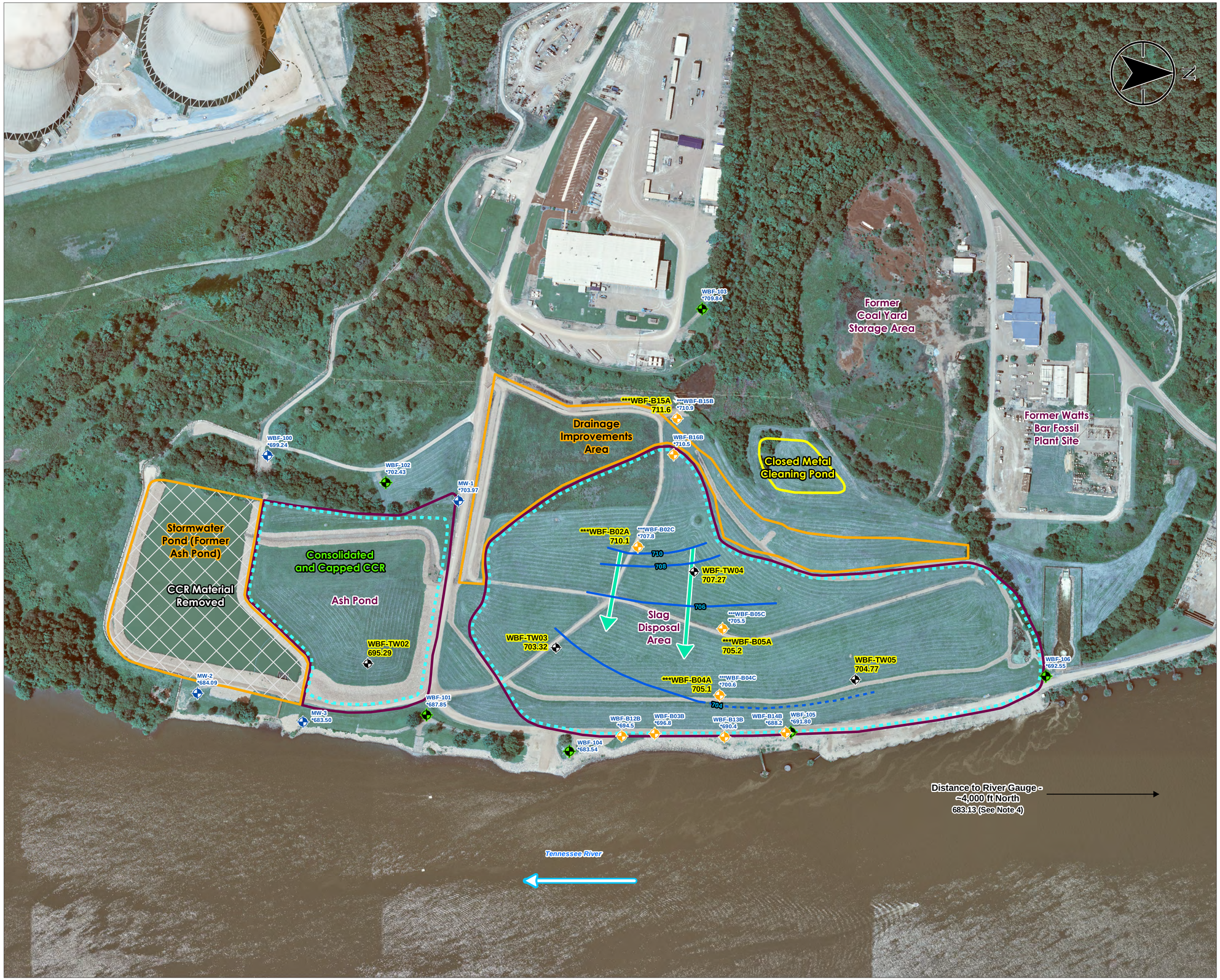

Exhibit No.
4

DRAFT

Title

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

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by DMB on 2024-04-11
Technical Review by PD on 2024-04-11

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

Legend

- Groundwater Investigation Monitoring Well — groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well — groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text — (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR — pore water elevation in ft amsl
- Interpolated Pore water Contour (2 ft interval; elevations are in ft amsl)
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- Limit of Existing Cover System (Approximate – 2023)
- Inferred Pore water Flow
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

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

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

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

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.

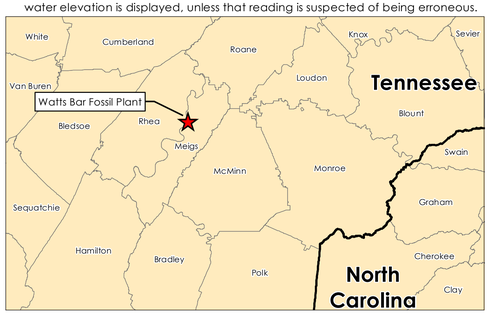

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Exhibit No.
5

DRAFT

Title
Evaluated Pore Water Extraction System Alignments - Slag Disposal Area and Drainage Improvements Area

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-29
Technical Review by PD on 2024-08-29

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

Legend

- Approximate Horizontal Extraction Well Entry Point/Exit Point
- EXD SAR Boring with Bottom of CCR Material Elevation in feet (ft)
- Existing Boring with Bottom of CCR Material Elevation in feet (ft)
- Approximate Well Screen Interval of the Pore Water Horizontal Extraction Well Alignment
- Approximate Diagonal Entry Casing Interval of the Pore Water Horizontal Extraction Well Alignment
- Bottom of CCR Material Elevation Contour (2 ft interval)
- Bottom of CCR Material Elevation Contour (10 ft interval)
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals
SDA-01 is a Double Entry Horizontal Extraction Well and DIA-01 and SDA-02 are Single Entry Horizontal Extraction Well

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (2023)
3. Model input and confirmation data used to model and evaluate the bottom of CCR surfaces shown herein are summarized in Table C.2 (Appendix C).

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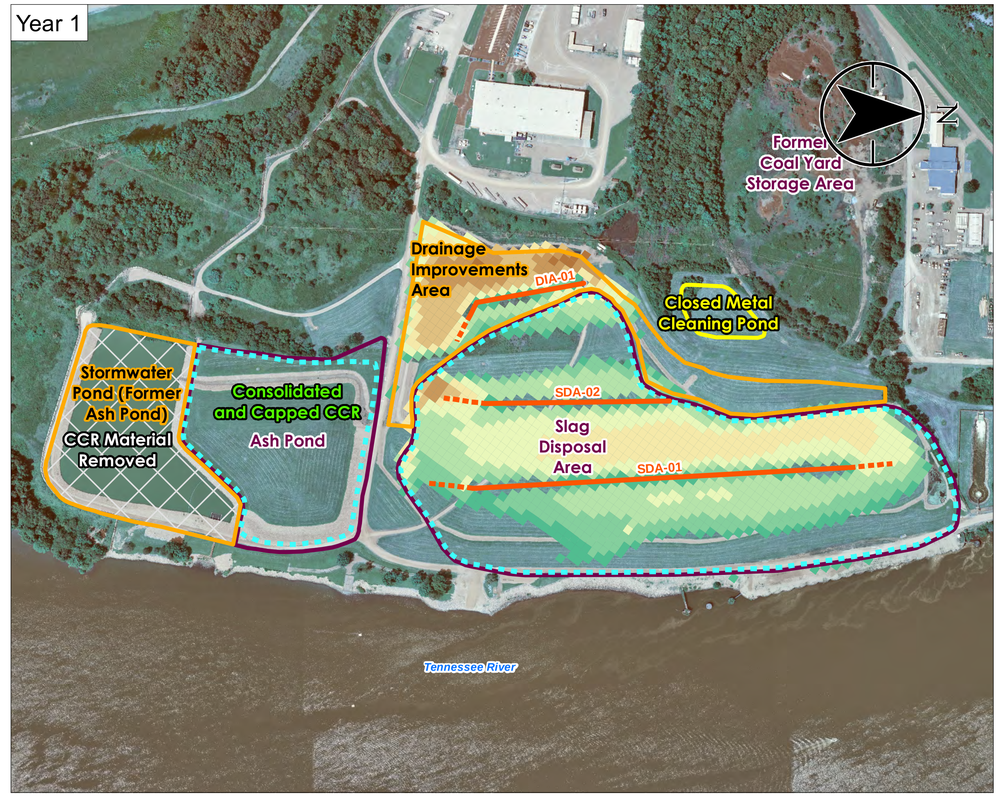


Exhibit No.
6

DRAFT

Title

MODFLOW-Model Simulated Phreatic Surface Change Over Time with Pore Water Extraction

Client/Project

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-08
Technical Review by SW on 2024-08-08

0 250 500 750 1,000 Feet
1:3,000 (At original document size of 22x34)

Legend

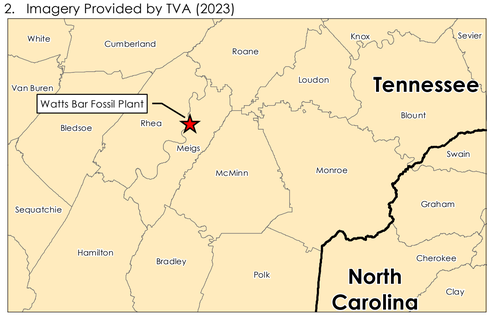
- Approximate Well Screen Interval of the Pore Water Horizontal Extraction Well Alignment
- Approximate Diagonal Entry Casing Interval of the Pore Water Horizontal Extraction Well Alignment
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

MODFLOW-Simulated Thickness of CCR Material below Phreatic Surface in feet

- < 1 (transparent)
- 1 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- 14 - 16
- 16 - 18

CCR: Coal combustion residuals

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



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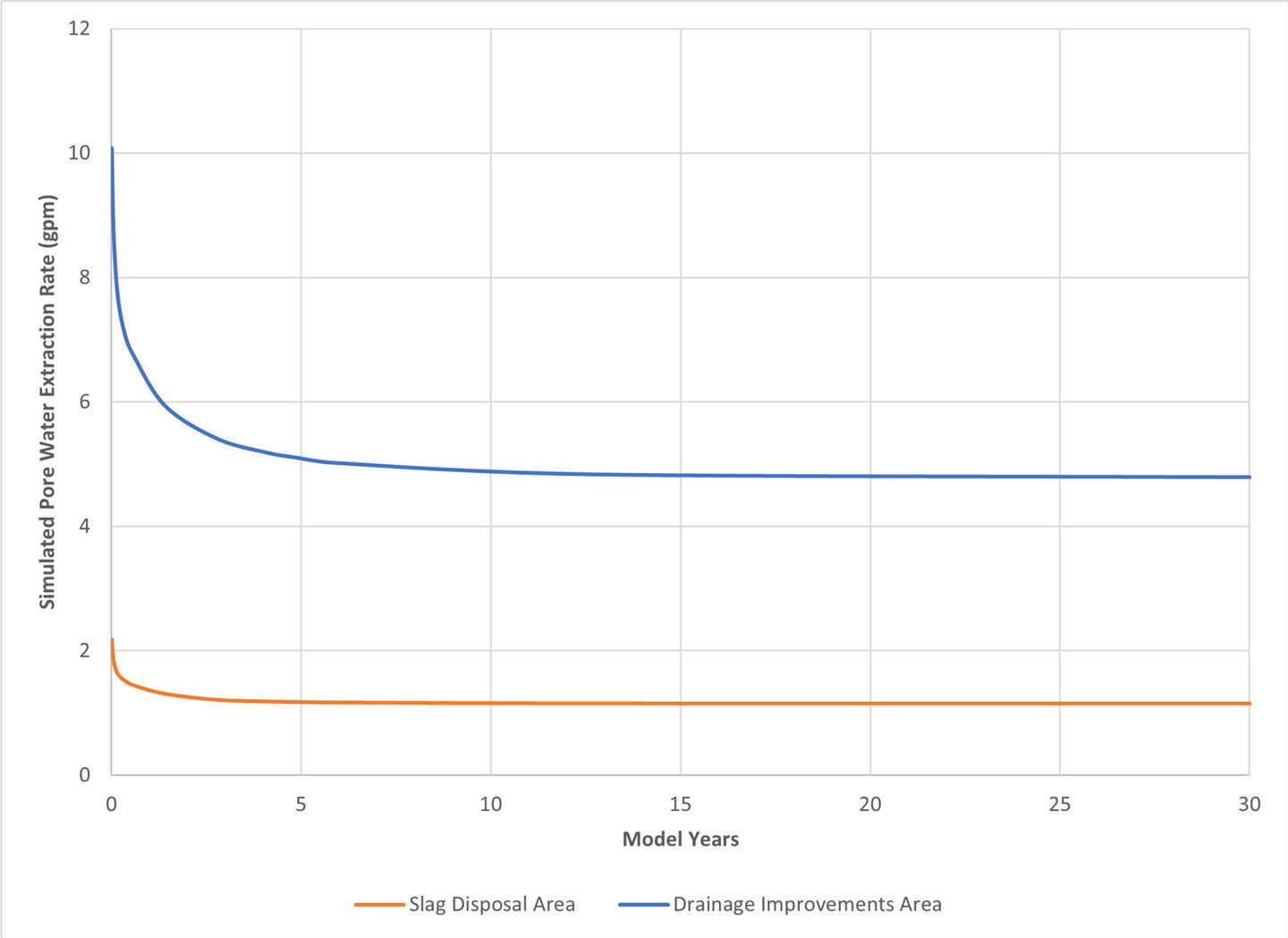

DRAFT

Exhibit No.

7

Title

Simulated Pore Water Extraction Rate over Time

Client/Project 175668050

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

Project Location

Spring City, Tennessee

Prepared by DMB on 2024-08-07
TR by SW on 2024-08-07
IR Review by RB on 2024-08-07

Notes

gpm: gallons per minute

Stantec

TVA

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ATTACHMENT A

CCR UNIT-SPECIFIC CONSIDERATIONS USED IN EXTRACTION METHOD SELECTION AND DESIGN

ATTACHMENT A

CCR UNIT-SPECIFIC CONSIDERATIONS USED IN EXTRACTION METHOD SELECTION AND DESIGN

1.0 CCR UNIT-SPECIFIC CONSIDERATIONS

Additional details regarding the unit-specific considerations summarized in Section 3.0 of the main text of this *Pore Water Extraction Technology Evaluation Technical Memorandum* that were used to identify and develop a recommended pore water extraction method/system for the Watts Bar Fossil Plant (WBF Plant) coal combustion residuals (CCR) units are presented below.

1.1 LAND USE

The current or intended future land use at a CCR unit may make the use of one or more of the evaluated pore water extraction methods impractical. Observed land uses within the footprints of the CCR units include:

- Plant structures including slab on grade buildings, buried or above ground utilities, surface conveyances, permanent laydown/paved areas, and lined basins – if large enough, operational features within a targeted pore water extraction area may dictate the pore water extraction method to be used because of limited physical access from the land surface. Examples of this would be pore water extraction beneath a pond requiring horizontal directionally drilled extraction wells or the presence of surface structures that would physically prevent/obstruct the extraction method from being installed.

- Low permeability geosynthetic cover systems – while the evaluated pore water extraction methods can be installed through geosynthetic cover material, installation would require the cutting and repair of the liner at each penetration. From a liner quality assurance perspective, the pore water extraction method that requires the least amount of liner penetration is preferred to maintain the integrity of the cover system if that method can meet required performance objectives. The presence of a high number of individual, tightly spaced surface completions (e.g., an array of vertical wells) and their associated power and discharge lines may also create cover system maintenance (mowing and surface regrading) challenges following installation.

- Active ash/gypsum harvesting or other beneficial uses – the installation of an array of vertical extraction wells or a one pass extraction trench extending to the actively managed ash/gypsum elevation would interfere with ongoing CCR material management operations. These operations can limit the options for the pore water extraction methods to installing horizontal wells or implementing a phased approach of the other methods in areas where active CCR material management is complete. Installed horizontal well heads and their associated conveyances can be positioned on the margins of the units or outside active material management areas.

1.2 CCR UNIT FEATURES

The selected pore water extraction method must consider the physical features, hydraulic conditions, and operational constraints specific to the CCR unit. Such factors include:

- The footprint dimensions, thickness of CCR material, and foundation soil topography of the CCR unit
- Phreatic surface, foundation soil, and ground surface elevations used to provide estimates of potentially saturated CCR material thickness and its position relative to the ground surface
- The presence of heterogeneous and/or stratified material (e.g., stacked or sluiced CCR material, intermixed zones of bottom ash and fly ash) and their resultant potential influence on pore water flow due to localized variations in vertical and horizontal hydraulic conductivities
- The hydraulic conductivity of foundation soils or bedrock bounding the CCR unit.

An example of a CCR unit feature that would influence the pore water extraction method selection process would be the presence of only a limited amount (e.g., less than 15 feet) of lower hydraulic conductivity CCR material between the phreatic surface and the foundation soils. In terms of extraction productivity, this condition would favor selection of an extraction method that has a larger cross-sectional area in contact with CCR material at the very base of the unit. Extraction systems that have horizontally configured intake areas such as horizontal wells or extraction trenches would be preferred over a series of vertical wells under these conditions.

1.3 HYDROGEOLOGIC PROPERTIES OF CCR MATERIAL

The presented options for long-term pore water extraction methods rely on positive pressure (i.e., pumping) methods. It is therefore necessary to obtain an understanding of how readily pore water will move under pumping conditions from the CCR material to the pore water extraction system.

A site-specific approach to evaluating pore water movement in CCR material is to measure the CCR unit-specific horizontal and vertical hydraulic conductivities of the saturated CCR material. Hydraulic conductivity values are used to quantify the relative ease with which water will move through a porous medium. Saturated media with hydraulic conductivity values below 1.0×10^{-4} centimeters per second (cm/sec) are generally considered low hydraulic conductivity material. The hydraulic conductivity of a material is typically dependent on the percentage of fine-sized particles within the material - the higher the fines percentage and the smaller the fine particulate size, the lower the hydraulic conductivity of the material.

Field-measured saturated horizontal hydraulic conductivity values of CCR material at thirteen TVA TDEC Order CCR units investigated by Stantec range from 2.0×10^{-5} to 4.7×10^{-3} cm/sec. Where collected, laboratory-measured vertical hydraulic conductivity values of the CCR material were one to three orders of magnitude lower than their corresponding measured horizontal hydraulic conductivity values. When vertical hydraulic conductivity values in the CCR material are markedly lower than their corresponding horizontal hydraulic conductivity values, it indicates that pore water is more likely to flow horizontally than vertically, particularly when an extraction system induces an increased hydraulic gradient on the phreatic

surface. This condition has a direct bearing on the relative effectiveness of the selected pore water extraction method.

Vertical extraction wells and vertical/horizontal (planar) one-pass extraction trenches can intersect stratified, higher horizontal hydraulic conductivity zones in stratified material. When an increased hydraulic gradient of the phreatic surface is induced by the drawdown at an active extraction system, pore water within higher horizontal hydraulic conductivity zones of the stratified material will preferentially flow horizontally toward the extraction system and be captured by the extraction system at the elevations where higher horizontal hydraulic conductivity zones are intersected.

Horizontal extraction wells are not ideally suited for pore water extraction in highly stratified material because overlying/underlaying layers of lower hydraulic conductivity can reduce vertical flow to the extraction well. This limitation is often offset by the benefits created by their longer saturated screen length and greater potential for available drawdown above the top of the horizontal well screen. When CCR material is placed into the CCR unit using water, coarser (higher hydraulic conductivity) particles settle out first nearer the point of discharge (i.e., end of the sluice channel within the CCR unit), and the finer (lower hydraulic conductivity) particles settle out more slowly some distance away from the discharge point. Over time, the point of discharge is adjusted, leaving discrete pockets of higher hydraulic conductivity material intermixed with finer, lower hydraulic conductivity material. The long screen length of a horizontal extraction well or a one-pass extraction trench can be oriented to allow more efficient interception of flow and can more adequately intercept these zones of higher conductivity below the present-day phreatic surface than vertical wells resulting in greater pore water extraction rates.

1.4 CONSTRUCTABILITY

CCR unit physical access considerations will influence the design and construction of pore water extraction methods. Access-related factors that may affect the type and constructability of a pore water extraction method include:

- Installation area space limitations
- The presence of buried/overhead utilities or plant structures at the installation location
- Slope stability concerns and soil bearing capacity limitations during extraction system installation
- Work area equipment restrictions on CCR units with existing cover systems
- Phreatic surface depths/base of CCR material depths exceeding the design limitations of pore water extraction methods.

1.5 PORE WATER CHEMISTRY

CCR unit pore water chemistry and its effect on the long-term operation and efficiency of the pore water extraction methods is an important consideration in selection of a CCR unit pore water extraction system method. TVA pore water sample results show that the pore water is mineralized. This in combination with other geochemical factors can make long-term pore water extraction systems potentially susceptible to corrosion and/or inorganic fouling. Either of these conditions can result in reduced extraction system performance and increased long-term maintenance requirements.

Driscoll (1995) provides a list (included below) of various threshold water chemistry concentrations that provide an indication of corrosive or incrusting conditions in water production wells:

Indicators of Corrosive Water	Indicators of Incrusting Water
1. A pH less than 7	1. A pH greater than 7
2. Dissolved oxygen greater than 2 mg/L	2. Total iron greater than 2 mg/L
3. Total dissolved solids greater than 1,000 mg/L (increased potential for electrolytic corrosion)	3. Manganese greater than 1 mg/L in conjunction with high pH and presence of oxygen
4. Hydrogen sulfide greater than 1 mg/L	4. Total carbonate hardness greater than 300 mg/L
5. Carbon dioxide greater than 50 mg/L	
6. Chloride greater than 500 mg/L	

mg/L = milligrams per Liter *(From Driscoll 1995, Table 3-3)*

Temporary wells installed in the capped and consolidated Ash Pond CCR unit were dry and no pore water samples could be collected as part of the EI (TVA 2024). Pore water samples were collected from temporary wells within the Slag Disposal Area CCR unit. These samples were analyzed for the general pore water quality constituents and major cation and anion concentrations used to evaluate the corrosion or incrustation potential of extracted pore water. The obtained concentration ranges are summarized in attached Table A-1. Pore water concentration values that are indicative of a potentially corrosive or incrusting water are identified in red in Table A-1.

Pore water geochemical analyses show that pore water in the Slag Disposal Area has a pH range between 5.5 and 9.5, is mineralized, and exhibits moderate carbonate hardness and high dissolved iron concentrations. These characteristics indicate that both incrusting (via iron precipitation) and potentially corrosive conditions need to be considered in the design and operation of a pore water extraction system should one be installed in the Slag Disposal Area.

Mineral incrustation, or scaling, on extraction system components can occur when high concentrations of dissolved mineral constituents in pore water exceed their solubility equilibrium concentrations for specific mineral phases and precipitate out of solution in response to changes in pore water conditions during extraction. Common cations (positively charged constituents) in pore water are calcium, magnesium, and iron, which can readily combine with anions (negatively charged constituents) such carbonate, sulfate, and chloride to form incrusting mineral salts including calcium carbonate ($CaCO_3$), magnesium carbonate ($MgCO_3$), and calcium sulfate ($CaSO_4$), or in the case of iron and manganese, iron and manganese hydroxides. Under the correct conditions, these salts can precipitate out of solution and adhere to extraction system components. Changes in pore water conditions, such as pressure, temperature, oxygen content, and/or pH that may occur during the pore water extraction can result in the progressive incrustation of various extraction system components including well screen openings, the submersible pump intake, impeller and motor housing, and the extraction well discharge line and associated valving and metering devices.

Pore water carbonate mineral incrustation potential was evaluated using two widely available, industry water quality indices, the Langelier Saturation Index (LSI) (Langelier 1936; Carrier 1965) and the Ryznar Stability Index (RSI) (Ryznar 1944). The indices provide a range of numerical values that are used to evaluate whether a water tends to be corrosive (not incrusting or undersaturated with respect to calcium carbonate), neutral, or scale-forming (incrusting or supersaturated with respect to calcium carbonate).

The indices are based on theoretical vs measured pH carbonate equilibrium models derived from the theoretical concept of saturation and provide an indicator of the degree of saturation of the sampled water with respect to calcium carbonate.

LSI and RSI values were calculated using the measured total alkalinity, calcium (as calcium carbonate). pH, temperature, and total dissolved solids data from the pore water samples collected from each of the CCR units. The resultant LSI and RSI index values, along with the indication the index author assigned to the calculated value are provided in Table A-1.

Using the carbonate LSI and RSI results and other general constituent concentration indicators previously presented in the Driscoll (1995) table, Table A-1 presents a summary of the identified potential incrustation considerations for each of the CCR units. The relative potential for the pore water chemistry to result in some degree of carbonate incrustation on extraction system components is considered to be low at the Slag Disposal Area because the indices suggest that the lower pH conditions present will mitigate the precipitation of carbonate salts; however, the LSI and RSI results also suggest that the extracted pore water will be corrosive.

The recommended extraction system design and system operation should therefore incorporate ways to:

- Minimize pore water/atmospheric mixing to mitigate changes in pore water geochemistry in critical extraction system areas (e.g., well screen, well pump, discharge lines) by not drawing the pore water down below the pore water extraction intake/well screen. This is of particular concern at the Slag Disposal Area due to the high apparent dissolved iron concentrations in the pore water.
- Minimize inflow velocities and resultant potential pressure changes (drops) across the screen interval/pump intake to reduce potential mineral incrustation/scale formation. Transient declines in pressure can lead to a decrease in constituent's (e.g., calcium sulfate) solubility resulting in mineral precipitation.
- Use non-corrosive materials in the design of extraction system design
- Incorporate the anticipated need for more frequent well rehabilitation and pump maintenance due to iron-related fouling.

The potential impacts that pore water chemistry will have on extraction system efficiency and long-term maintenance should be considered in the selection of the method and design of each pore water extraction system. Incrustation and mineral fouling will reduce extraction rates, increase operation and maintenance costs, and potentially, affect the ability of the system to achieve originally established performance objectives.

2.0 REFERENCES

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Table A-1 - Pore Water Chemistry Implications on Extraction System Design and Operation
Attachment A - Unit-Specific Considerations Used in Extraction Method Selection and Design
Watts Bar Fossil Plant

Analyte	Measured Pore Water Concentration Ranges*	
	Ash Disposal Area (TW01, TW02)	**Slag Disposal Area (TW03, TW04, TW05)**
pH	No Data (no pore water)	5.68 – 9.41 SU
Specific Conductance	No Data (no pore water)	535 – 2,365 µS/cm
Dissolved Oxygen	No Data (no pore water)	0.22 – 5.11 mg/L
ORP	No Data (no pore water)	-86.4 – -172.7 mV
Total Dissolved Solids	No Data (no pore water)	363 – 2,490 mg/L
Total Alkalinity, as $CaCO_3$	No Data (no pore water)	<5 – 345 mg/L
Calcium, Total	No Data (no pore water)	71.8 – 484 mg/L
Magnesium, Total	No Data (no pore water)	7.51 – 48 mg/L
Iron, Total	No Data (no pore water)	0.045 – 103 mg/L
Iron, Dissolved	No Data (no pore water)	0.05 – 105 mg/L
Manganese, Total	No Data (no pore water)	0.06 – 31.6 mg/L
Sulfate	No Data (no pore water)	62.6 – 1,430 mg/L
Chloride	No Data (no pore water)	5.56 – 20.7 mg/L
Temperature	No Data (no pore water)	13.1 – 25.3 C
Hardness, as $CaCO_3$	No Data (no pore water)	210 – 1,152 mg/L**
Pore Water Results Evaluation		
Carbonate Saturation/Stability Index* Pore Water Results:**		
LSI:	No value; no pore water	-2.2 - -0.11
RSI:	No value; no pore water	7.4 - 10.1
Index Value Results Descriptors:		
LSI:	N/A	non-scale forming to serious corrosion"
RSI:	N/A	"Significant to Intolerable corrosion"
Other Potential Indicators:	N/A	high reported DO; high dissolved iron
General Unit-Specific Findings for Consideration in Extraction System Desgn:	▪ No pore water	▪ Corrosive condtions at WBF-TW03 ▪ High iron Fe(III) hydroxide incrustation potential at WBF-TW05 ▪ Low CO_3 mineral incrustation potential

Notes:

Pore water concentration values listed in blue are above the concentrations listed as indicators of corrosive or incrusting conditions in water production wells (Driscoll 1995 Table 3-3).

* Compiled from WBF Plant EAR. Appendix G, Table G.1- 4. 2021 field water quality parameters compiled from Programmatic 2021 supplemental sampling event data; *Attachment F Table F09 TVA Pore Water Investigation, Summary Water Quality Parameters Table. Sampling Event and Data Report, Last Sample Date 04/01/2021,TVA Watts Bar Fossil Plant.*

** Hardness values calculated using total calcium & magnesium results, where hardness = 2.497 (Ca) + 4.118 (Mg)

*** "LSI": Langelier Saturation Index (Carrier 1965); "RSI": Ryzner Stability Index (Ryzner 1940).

Unit abbreviations: "SU": Standard (pH) Units; "mg/L": Milligrams per liter; "mV": millivolts; "µS/cm" : microSiemens per centimeter

Constituent abbreviations: "CO3": carbonate; "Cl": chloride; "DO"; dissolved oxygen; "Fe": iron; "Mn": manganese; "SO4": sulfate

References:

Langelier, W.F. (1936). The analytical control of anticorrosion water treatment. Journal of American Water Works Association, 28, 1500.

Carrier Air Conditioning Company (1965). Handbook of air conditioning system design. New York, McGraw-Hill Books.

Ryznar, John. 1944. A new index for determining amount of calcium scale. American Water Works Association.

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ATTACHMENT B

IDENTIFIED PORE WATER EXTRACTION METHODS

ATTACHMENT B

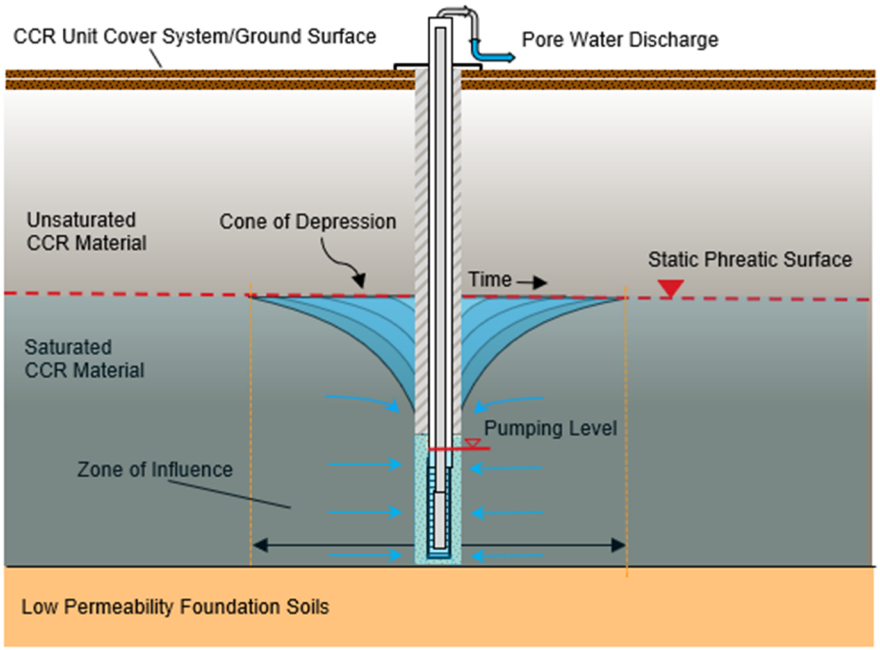
IDENTIFIED PORE WATER EXTRACTION METHODS

1.0 PORE WATER EXTRACTION METHODS

Additional details regarding the pore water extraction methods summarized in Section 4.0 of the main text of this *Pore Water Extraction Technology Evaluation Technical Memorandum* for the Watts Bar Fossil Plant (WBF Plant) coal combustion residuals (CCR) units are presented below.

1.1 VERTICAL EXTRACTION WELLS

The use of vertical wells for shallow and deep groundwater extraction is well-established and the most commonly used method of groundwater extraction for water supply, civil construction (dewatering) and environmental remediation. The methods used for installing vertical extraction wells for groundwater are readily transferrable to the task of removing pore water from CCR units. Accordingly, this option is considered a readily implementable method for pore water extraction under most site conditions.



Shallow vertical extraction wells can be installed using conventional drilling methods. A vertical boring is advanced to the targeted depth (in this case the top of foundation soils within the CCR unit), which is seldom deeper than 100 feet below grade. A vertical well is then constructed in the boring by setting a well screen below the phreatic surface. The installed well diameter is generally dependent on the pump diameter and other required instrumentation. Pore water flow rates for the reviewed CCR units are expected to be low, so an appropriately-sized down hole pump will not likely require a well diameter greater than six inches.

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The extraction well should be constructed with an appropriately sized continuous-wound type screen to maximize the open area of the screen and be comprised of stainless steel. These general screen design requirements are based on the need to extract the highly mineralized pore water found within CCR units. The large open area of this screen type is recommended to reduce pore water entrance velocities at the screen. Maintaining low entrance velocities will minimize the changes in pressure that often result in mineral precipitation and subsequent screen fouling. The use of stainless steel as the screen material permits more aggressive well development techniques to maintain system performance over the operational period.

Most CCR units contain varying but typically higher percentages of fine (silt-sized) to very fine (clay-sized) material below the phreatic surface. The higher the percentage of fine-grained material within the saturated CCR material, the lower its hydraulic conductivity. The hydraulic conductivity of a material provides a general indication of the relative ease with which water will move through a porous medium. When a hydraulic gradient toward the well screen is created during pore water extraction, the lower hydraulic conductivities of the CCR material will cause pore water flow to the well to be slow. This condition will decrease pore water removal rates and limit the extent of measurable phreatic surface lowering to a smaller radial area around the well. If vertical extraction wells are required in low hydraulic conductivity CCR material over a large area, installation of tightly spaced vertical wells over the area will be required.

Other considerations for this extraction method include:

- Vertical extraction wells are better suited for higher hydraulic conductivity, homogeneous CCR material that will provide a larger zone of influence during pumping and allow greater well spacing. However, vertical wells may be useful within CCR units where targeted pore water extraction is required (e.g., isolated topographic low points in the foundation soils), underground utilities/surface structures are present, or if pore water extraction using other methods is not practical.

- If vertical wells are required, flow rates are expected to be low (< 3 gallons per minute [gpm]) for lower hydraulic conductivity CCR material. The lower pumping rates permit the consideration of lower capacity pneumatic pumps. The use of pneumatic pumps should be considered to mitigate pump fouling and to reduce long-term maintenance. Pneumatic pumps do not generate heat during operation, are designed not to run dry, and do not employ high speed impellers used in submersible pumps that can create localized pressure fluctuations (cavitation). These attributes will mitigate the potential incrustation and pump fouling expected with the extraction of highly mineralized pore water. Pneumatic pumps are also easier to service and clean than submersible pumps to maintain extraction efficiency.

- Long-term operation and maintenance costs associated with a vertical well pore water extraction system within CCR units will be high. This is because of the high number of wells required to implement this option and the susceptibility of screen, filter pack, and pump performance issues due to the fine-grained nature of some CCR material and the higher potential for mineral precipitation and incrustation. Well rehabilitation or redevelopment may be required on an annual or more frequent basis to maintain system extraction performance.

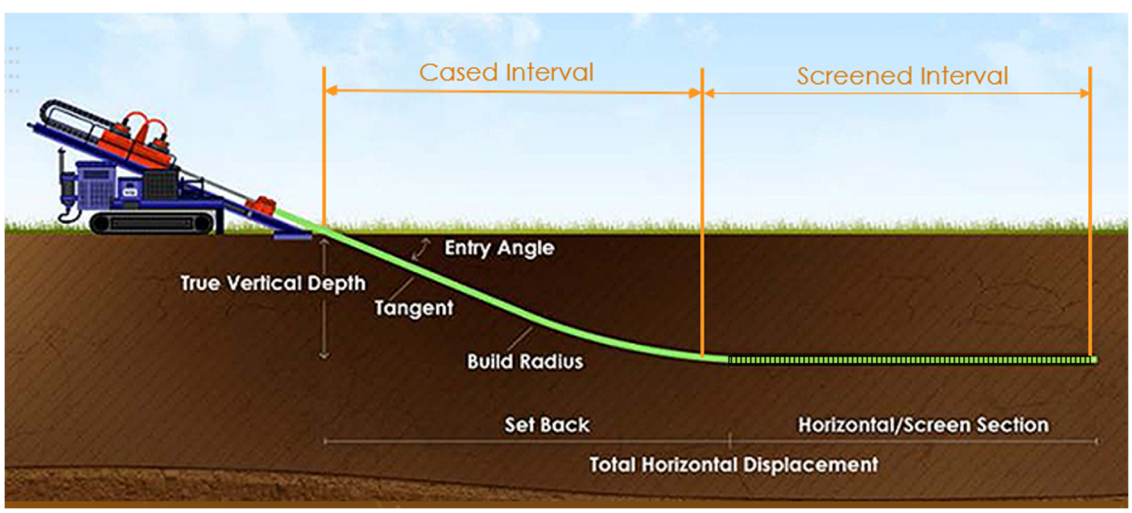
1.2 HORIZONTAL EXTRACTION WELLS

The adaptation of horizontal directionally drilled (HDD) boring technologies to install horizontally-aligned environmental wells has seen increasing wide-spread use over the past 30 years. Although the use of HDD techniques for the installation of horizontal wells is generally more limited because of its higher initial cost relative to the installation of vertical extraction/injection wells, horizontal wells are frequently used to inject air/remedial reagents or extract groundwater in areas where there is no surface access (e.g., beneath landfills, buildings, wetlands) or where remedial design calls for extraction within a discrete water-bearing zone or alignment.

Because of the lower hydraulic conductivities and limited thicknesses of CCR material below the phreatic surface, a properly positioned horizontal well generally has a distinct performance advantage over an equivalent number of vertical wells. This is because: 1) the open screen area of a horizontal extraction well in contact with the targeted saturated material (e.g., CCR material along the base of the CCR units) is greater than that of a vertical well, and 2) a horizontal extraction well positioned at the base of the CCR material has more available drawdown because the vertical height of the horizontal extraction well screen is small, increasing available drawdown and the achievable pumping rate of the well. These conditions should allow the horizontal extraction well to achieve a larger, steady state zone of pore water extraction over a shorter time than an equivalent number of vertical wells.

When installed at TVA CCR units, horizontal extraction wells will be installed from the top of the unit (inside the dike perimeter) and will not extend below the foundation soils of the unit. Horizontal extraction wells can be constructed as single ended (one entry point at ground surface) or double ended (having an entry point and an exit point at ground surface). Where site conditions allow, a double-ended horizontal extraction well is recommended for most applications because well installation, development, and operation and maintenance can be more readily controlled using two access points to the well. However, single end horizontal extraction wells are frequently installed to accommodate subsurface conditions, the presence of surface infrastructure, or operational constraints.

The schematic below (USEPA 2020) depicts the basic components and geometry of a single entry. horizontal directionally drilled well. Horizontal extraction wells are constructed by advancing a diagonal pilot hole (the “tangent”) from a shallow entry pit. The pilot hole is steered to the approximate



(Figure adapted from Bardsley, 2014)

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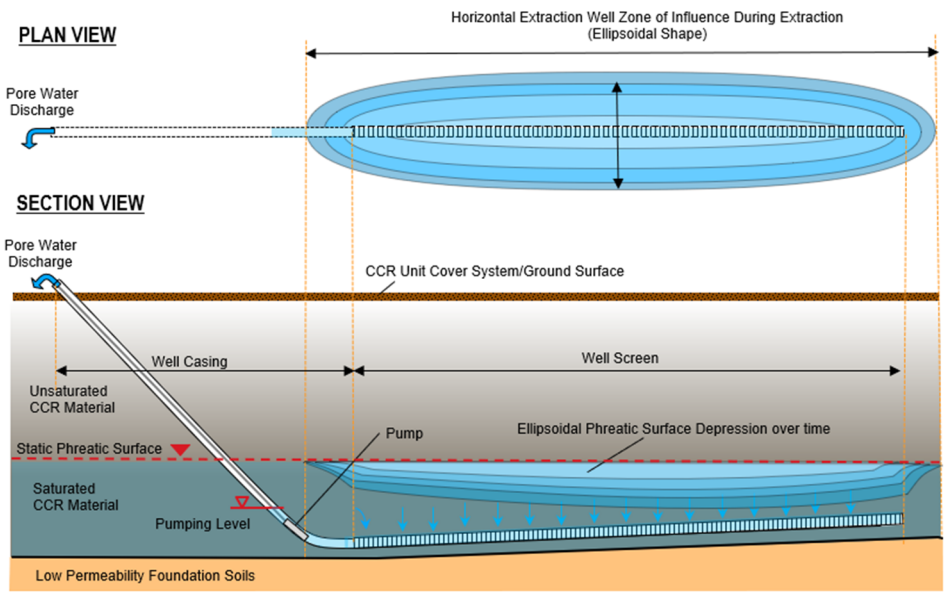
base of the CCR material. The drill head is then remotely reoriented (to form the required “build radius”) to traverse the targeted alignment horizontally. For a single ended horizontal extraction well, the boring is terminated at the end of its horizontal traverse along the targeted extraction interval. The well is installed inside the drilling “carrier” casing with a sacrificial bit. When the boring reaches the end of the alignment, the sacrificial bit is left in the boring to anchor the horizontal extraction well as the carrier casing is removed from the boring.

If a double ended well is being installed, then the drill head is again reoriented along an upward diagonal to an exit pit. The pilot bit at the exit pit is replaced with appropriately sized reaming bit and then rotated back through the pilot hole to enlarge the boring to the correct size to accept the casing. The last step is to pull the well casing and filter pack sleeve into place behind the final reamer pass.

A setback distance approximately five times the well's target depth (i.e., its “True Vertical Depth” shown in the cross-sectional illustration above) is required if the entry point is to be installed at the grade of the extraction area (USEPA 2020). If the well entry point is at the top of the CCR unit, then the screened interval of a horizontal well would begin 150 to 450 feet from the installation point. Depending on CCR material hydraulic conductivity and horizontal extraction well performance requirements, this may necessitate the installation of one or more additional horizontal extraction wells located on an alignment that is perpendicular to the primary well alignment beneath the non-screened, angled cased interval section(s) of the primary horizontal extraction well(s).

When installed, pore water extraction from a horizontal extraction well will create an approximately ellipsoidal zone of influence along its alignment in homogeneous material as depicted below:



Other considerations for using horizontal wells for pore water extraction include:

- Horizontal extraction wells provide an alternative to the installation of conventional vertical wells or pore water extraction trenches, particularly where vertical access to pore water would be restricted as a result of:
    - The presence of an engineered cover system or other site infrastructure

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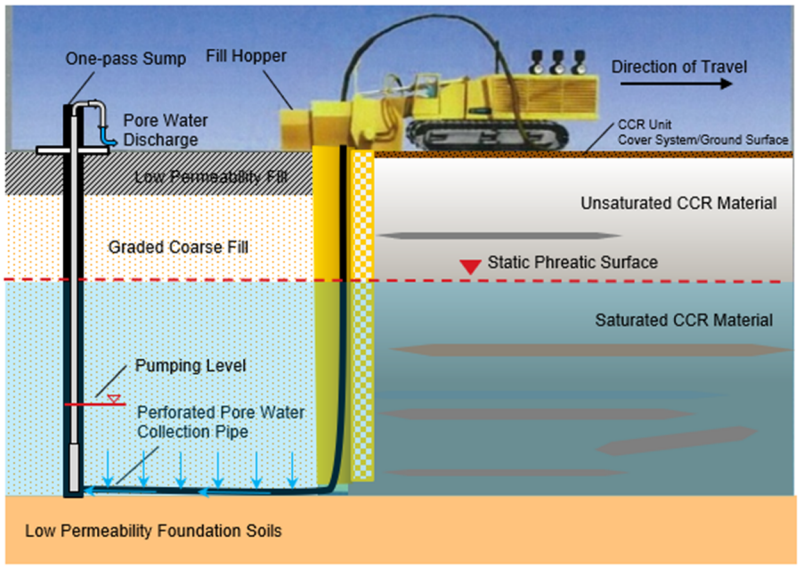
- Ongoing management of CCR material on top of the unit
- Low bearing capacities of surface soils at the CCR unit.

- The HDD boring technology typically uses drilling fluids to maintain the integrity of the boring during advancement, reaming and well installation. A large amount of drilling fluids will be generated and staged in a dug mud pit or mud box. These drilling fluids will need to be managed and dried prior to on-site/off-site disposal. The use of drilling fluids also requires that the installed horizontal well undergo flushing and well development to establish and maintain well screen performance.
- Horizontal extraction wells are typically configured to use one pump within each well, regardless of the installed length of the well. Considering an estimated steady state radius of influence of 40 feet (refer to the previous vertical well discussion) and a theoretical horizontal extraction well length of 1,000 feet, an equivalent vertical well system would require the installation of a minimum of 12 vertical wells and extraction pumps.
- Long term operation and maintenance costs associated with horizontal pore water extraction wells are expected to be lower than comparable vertical well systems because of the reduced number of pumps, instrumentation, and conveyances requiring monitoring, maintenance, and replacement. Maintenance is anticipated to include routine (semiannual) well cleaning/rehabilitation and periodic pump replacement to maintain system extraction efficiency.

1.3 ONE-PASS EXTRACTION TRENCHES

One-pass extraction trenching methods utilize specialized equipment capable of concurrently excavating, installing a drain, and backfilling a water extraction trench. The first one-pass machines capable of installing single flexible drain/collector pipes to depths of 20 feet below grade began to be used in the 1980s. Since that time, specialty trenching vendors have increased the size and capabilities of one-pass trenching equipment. Several specialty contractors are presently capable of installing a 48-inch wide collection trench to depths of 50 feet below grade.



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As the name implies, a one pass machine is used to:

1) Excavate a 12- to 48-inch-wide trench

2) Install a stainless steel sump connected at its base to a flexible slotted trench drainpipe positioned just above the bottom of the excavation

3) Place filter pack backfill around the sump and drain up to or near the ground surface.

Reported one-pass extraction trench installation rates are up to 100 feet/day for a 50-foot deep trench. Trench spoils are discharged on one side of the trenching blade and removed with an excavator for management/disposal. The filter pack fill hopper seen on the top of the trenching blade in the graphic above is continuously filled with the appropriately sized sand/gravel filter pack while the trenching machine advances. At the completion of the trench alignment, the slotted collection line is brought up to surface grade and capped to allow for collection line cleanout. The required depth and grade of the trench along the alignment can be pre-determined and entered in the trench arm controller. The trench can be designed as a wall or a series of overlapping panels to permit the installation of multiple sumps (pump locations) and facilitate drainpipe clean out using shorter trench drainpipe runs.

As discussed in the earlier comparison of vertical and HDD well screen areas in contact with saturated CCR material in Section 1.2, the contact area of a trench drain is roughly an order of magnitude greater than that of a 12-inch horizontal extraction well of equivalent length. This larger open contact area increases the ability of a one-pass trench drain to intercept interbedded zones of higher horizontal hydraulic conductivity both horizontally and vertically across the entire thickness of CCR material below the phreatic surface.

Other considerations for this pore water extraction method include:

- One-pass trenching requires that surface soils have a bearing capacity greater than 20 pounds per square inch (the ground pressure of the trencher), suitable road access for heavy construction vehicles, and an approximately 60- to 80-foot-wide work area around the trencher during operation.

- One-pass trenching backfill material is typically locally sourced and will consist of 50 percent pea gravel and 50 percent sand with a gradation compatible with the soils and drainpipe slot size.

- The maximum depth of a one-pass extraction trench is 50 feet with the currently available trenching technology.

- Trenching activities will generate solid wastes potentially containing CCR material that may require dust mitigation during excavation and on- or off-site disposal following trenching. A 1,000-foot long by 50-foot-deep by 2-foot-wide drain trench will generate approximately 6,700 tons of spoils that will need to be managed.

- An appropriately sized submersible or pneumatic pump will be installed in the sump of each separate one-pass trench alignment. The low setpoint of the pump should be at the highest top of pipe elevation of the trench drain line alignment to keep the drain pump full to minimize incrustation.

- Long-term operation and maintenance costs associated with pore water removal using a one-pass extraction trench are expected to be low due to the limited number of pumps and instrumentation and conveyances requiring monitoring, maintenance, and/or replacement. Operation and maintenance activities would include routine (semiannual) inspection, periodic cleaning and rehabilitation (as required) of the drainpipe, and periodic pump cleaning or replacement to maintain pore water extraction efficiency.

1.4 EXTRACTION METHOD ADVANTAGES AND DISADVANTAGES

A summary of the optimal uses and identified advantages and disadvantages of each of the previously described pore water extraction methods is provided in Table B-1 of this attachment. The identified advantages and disadvantages listed in Table B-1 were developed based on the general attributes of each method as well as how each method would be expected to perform under the site-specific conditions present within a CCR unit.

2.0 REFERENCES

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Table B-1 - Identified Advantages and Disadvantages of Recommended Pore Water Extraction Methods

Watts Bar Fossil Plant

Characteristics	Vertical Extraction Wells	Horizontal Extraction Wells	One-Pass Extraction Trenches
Uses	▪ Targeted pore water extraction areas ▪ Depths of 30 feet to more than 100 feet below ground surface ▪ Areas of higher hydraulic conductivity ▪Areas with high underground utility densities or limited surface access	▪ Targeted extraction within laterally continuous pore water bearing zones ▪ Depths of 40 feet to more than 100 feet below ground surface ▪ Areas of higher hydraulic conductivity ▪ Shallow, high density utility areas ▪ Beneath restricted surface access areas	▪ Pore water extraction over large areas/interceptor trenches ▪ Areas of lower hydraulic conductivity, heterogeneous and stratified CCR material ▪ Depths less than 50 feet below ground surface ▪ Utility free areas ▪ Undeveloped, open site areas with few surface structures
Derivative Methods	▪ Ejector (>25 feet below ground surface) vertical well point systems ▪ Vacuum (<20-25 feet below ground surface) vertical well point systems ▪ Large diameter collector wells/Ranney wells (<100 feet below ground surface)	▪ Pre-packed horizontal well screens installed in double entry horizontal directionally drilled boring ▪ Vacuum-enhanced horizontal extraction well systems	▪ Conventional trench excavation (to depths less than 30 feet below ground surface)
Method Advantages/Disadvantages			
Method Advantages	▪ Conventional technology; readily implementable ▪ Short mobilization time and small work area ▪ Limited spoils and water management requirements during installation ▪ Less difficult to expand extraction system laterally and vertically in areas with engineered cover systems (site-specific) ▪ Greater spatial flexibility for targeted pore water extraction (e.g., within closed topographic low points at foundation soil contact) ▪ Vertical well orientation permits well screen to intersect more transmissive (higher hydraulic conductivity) layers in stratified CCR material. ▪ Constructed with readily available materials ▪ Per well replacement costs are lower than other pore water extraction options. ▪ Well location can be adjusted in the field to accommodate encountered site conditions. ▪ Will not require pre-construction investigation borings to establish top of foundation soil elevation (target elevation for bottom of well screen); value can be determined as part of extraction well installation.	▪ Demonstrated technology; implementable with specialty contractor ▪ Longer life span and higher unit extraction (production) rates compared to an equivalent number of vertical wells ▪ Greater spatial and temporal control of total pore water recovery ▪ Can be positioned within thin laterally continuous higher hydraulic conductivity zones along alignment ▪ Can be configured to maintain fully saturated screen conditions during pumping to limit fouling ▪ Requires one pump per horizontal extraction well ▪ Double-entry configuration allows cleanout of well from both ends of horizontal extraction well during well construction ▪ Reduced groundwater entrance velocities into the well reduce potential for fouling of the well screen ▪ Greater screen area and larger zone of influence than equivalent number of vertical wells	▪ Demonstrated technology (both conventional and one-pass applications); implementable using specialty contractor ▪ Longer operational life span compared to other extraction methods ▪ Better suited for low hydraulic conductivity, heterogenous, and stratified conditions ▪ Typically does not use high viscosity muds to maintain trench integrity during installation ▪ Uniform flow field more readily established over time ▪ Lower long-term O&M and energy costs ▪ Reduced groundwater entrance velocities into the trench reduce potential for fouling ▪ Continuous bottom drain line allows for clean-out of bottom collector drain
Method Disadvantages	▪ Limited thickness of CCR material below phreatic surface limits available drawdown if screen interval in contract with CCR material is maximized ▪ Fine-grained nature of CCR material presents challenges in screen and filter pack design ▪ Low hydraulic conductivity conditions or small thicknesses of saturated CCR material will require close well spacing on the order of tens of feet ▪ Higher long-term operation & maintenance (O&M) costs based on required well densities and potential fouling ▪ Low hydraulic conductivity conditions or small thicknesses of saturated CCR material may increase screen fouling due to introduction of oxygen if drawdown of the phreatic surface is allowed below the top of the well screen. ▪Higher groundwater entrance velocities into the well may increase the potential for fouling of the well screen ▪ If well discharge/air lines are installed below grade, they may be difficult to access/repair below a permitted engineered cover system	▪ Requires site preparation at entry point ▪ Fine-grained nature of CCR material presents challenges in screen and filter pack design ▪ Horizontal orientation and length makes filter pack placement difficult; method commonly relies on natural collapse and well development to form filter pack - not an optimal design for uniformly fine CCR material ▪ Placement of annular seal/grout in horizontal extraction well around angled riser is difficult and susceptible to seal failure ▪ Longer well development durations (days) ▪ Heterogeneous and stratified nature of CCR material along horizontal extraction well alignment will affect expected (uniform) flow field ▪ Installation will generate bentonite-based drilling fluids (wet wastes requiring solidification before disposal). ▪ Requires pre-construction investigation to establish top of foundation soil elevation along proposed alignment	▪ High mobilization and site prep costs ▪ High capital construction costs ▪ Trenching cannot exceed 50 feet below ground surface ▪ One-pass trenching requires 60 to 80 foot-wide, level work space and land must be able to support 20 pounds per square inch heavy equipment ▪ Higher expected discharge rates may require high capacity treatment system ▪ Increased soil management/disposal costs during installation ▪ Difficult to expand laterally if an engineered cover system is placed over the trench ▪ No effective way to develop trench at filter pack/soil interface ▪ Will require low ground pressure equipment to avoid cap damage ▪ Requires pre-construction investigation to establish top of foundation soil elevation along proposed alignment.

Notes:
CCR - Coal Combustion Residuals
O&M - Operation & aintenance

APPENDIX L –
WATER TREATMENT AND DISCHARGE EVALUATION

Appendix L - Water Treatment and Discharge Evaluation Technical Memorandum - DRAFT

TDEC Commissioner's Order:
Corrective Action/Risk Assessment Plan
Watts Bar Fossil Plant
Spring City, Tennessee

December 5, 2025

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

REVISION LOG

Revision	Description	Date
0	DRAFT Submittal to TDEC	December 5, 2025

Sign-Off Sheet

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

Prepared by _____

Bella Triolet, Chemical Engineering EIT

Reviewed by _____

Josh Kopp, Principal Engineer, PE

Approved by _____

Carole Farr, Senior Principal Geologist

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Abbreviations

CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residual
cfs	Cubic feet per second
EI	Environmental Investigation
gpm	Gallons per minute
NPDES	National Pollutant Discharge Elimination System
Stantec	Stantec Consulting Services, Inc
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order OGC15-0177
TM	Technical Memorandum
TMSP	Tennessee Multi-Sector Permit
TVA	Tennessee Valley Authority
WBF Plant	Watts Bar Fossil Plant

1.0 INTRODUCTION AND OBJECTIVES

Stantec Consulting Services Inc. (Stantec), on behalf of the Tennessee Valley Authority (TVA), has prepared this *Water Treatment and Discharge Evaluation Technical Memorandum* (TM) to summarize activities and findings related to the evaluation of extraction, conveyance, treatment, and discharge options at TVA's Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

The overall objective of this TM is to evaluate a remedial strategy of groundwater extraction, conveyance, treatment, and discharge at the WBF Plant. The information provided in this TM is in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at the TVA coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan is being prepared pursuant to the TDEC Order to evaluate whether unacceptable risks related to management of coal combustion residuals (CCR) material exist at the WBF Plant, specify the actions TVA plans to take at the CCR units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA. This TM is included as an appendix in the CARA Plan to support evaluation of potential corrective measures at the WBF Plant CCR units.

There are two closed CCR units at the WBF Plant that are included in the TDEC Order: the Ash Pond and the Slag Disposal Area. An overview of the WBF Plant including the two closed CCR units, other plant features, and adjacent properties is presented on Exhibit 1.

This TM presents an evaluation of options for groundwater treatment and discharge and presents initial plans for groundwater extraction and conveyance at the WBF Plant. Groundwater extraction is currently proposed at the Slag Disposal Area.

2.0 BACKGROUND AND APPROACH

Industrial stormwater discharges from the former WBF Plant site are currently regulated under the Tennessee Multi-Sector Permit (TMSP) for stormwater discharges. Stormwater collected at the WBF Plant is routed to the stormwater ponds that are covered under the TMSP for the Watts Bar Facility, TNR058427. The ponds and outfalls are shown on Exhibit 1 and are listed as F02 and F03.

The WBF Plant has been investigated and monitored to meet multiple hydrogeological, geotechnical, environmental, and engineering objectives. Datasets from recent environmental investigations and monitoring programs relevant to the evaluations presented herein are discussed below.

Between 2019 and 2022, TVA and Stantec conducted various environmental investigations at the WBF Plant. The TDEC Order Environmental Investigation (EI) included characterization of groundwater at the WBF Plant which is presented in the WBF Plant Environmental Assessment Report (TVA 2024). Groundwater samples collected during the EI were analyzed for the CCR-related constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 (referenced collectively herein as “CCR Parameters” and listed in Table 1). Exhibit 2 presents the groundwater sampling locations.

Supplemental investigations were conducted as part of other WBF Plant investigative activities to supplement the dataset collected during the EI. These activities included groundwater flow modeling, which is documented in CARA Appendix G *Groundwater Flow Modeling Technical Memorandum*. A groundwater extraction pumping test and the collection and analysis of groundwater quality samples were not conducted at the WBF Plant. Therefore, only water samples from existing groundwater wells were analyzed for CCR Parameters.

The WBF Plant was demolished and the National Pollutant Discharge Elimination System (NPDES) permit for process water at the WBF Plant was terminated in 2015. Since the WBF Plant is retired, recent outfall monitoring data for NPDES reporting requirements is unavailable. Because there is not a current NPDES permit, river flow rates were obtained from TVA’s River Operations group for the 1Q10 and the 30Q5 low flow cases. The lower of the two flow rate values (3,289 cubic feet per second [cfs]), was used for the receiving stream low flow. This appears to be consistent with other TDEC NPDES permits using the same flow rate value for both the 1Q10 and 30Q5 flow types. Because there is no current NPDES background data for the WBF Plant, stream background concentrations from the Kingston Fossil Plant (NPDES Permit TN0005452, dated August 30, 2022) were used to approximate background concentrations. The Kingston Fossil Plant is upstream of the WBF Plant.

This TM presents:

- An evaluation of historical groundwater analytical data to determine projected effluent characteristics (Section 3.0).
- A description of the extraction, collection, and conveyance systems being considered and a summary of geotechnical considerations related to groundwater extraction (Section 4.0).

- The water treatment and discharge system being considered if groundwater extraction were to be utilized as part of one or more of the considered corrective action alternatives (Section 5.0).

2.1 HYDROGEOLOGICAL TERMS

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

- Groundwater – subsurface water that occurs in pore spaces of unconsolidated or geologic materials (e.g., soil, bedrock).

3.0 PROCESS WATER POND EVALUATION

3.1 GROUNDWATER EXTRACTION SYSTEM

An initial groundwater extraction system layout is shown on Exhibit 3. Groundwater extraction is currently proposed at the Slag Disposal Area. The unit includes proposed vertical groundwater extraction wells spaced at various intervals. More information regarding the initial groundwater extraction system layout and proposed vertical groundwater extraction wells is presented in Section 4.1 of this TM.

3.2 GROUNDWATER INFLUENT CHARACTERISTICS

In lieu of additional groundwater extraction pumping and groundwater quality data collection, historical groundwater analytical data compiled from the Slag Disposal Area was used to identify groundwater characteristics from the proposed groundwater extraction areas. Historical groundwater analytical data for CCR parameters (listed in Table 1) was compiled from August 2019 through October 2022 for groundwater wells located within the proposed groundwater extraction areas.

Exhibit 2 shows the locations of the existing groundwater wells (WBF-104 and WBF-106) where the sampling data was obtained. Estimated flow rates were derived from the supplemental investigation groundwater model. Further information related to the groundwater model is documented in CARA Appendix G *Groundwater Flow Modeling Technical Memorandum.* Table 2 summarizes the existing wells, sampling time range, number of sample points for each well and CCR units. Table 3 presents the average and maximum concentrations of groundwater parameters and modeled anticipated extraction flow rates from each groundwater extraction area.

3.3 PROJECTED EFFLUENT CHARACTERISTICS

Stormwater at the WBF Plant discharges from the stormwater ponds via outfalls F02 and F03 under the site's TMSP. Historical discharge information for metals, CCR parameters, etc., is not available for the WBF Plant because the NPDES process water permit was terminated in 2015. The projected effluent water quality, is therefore, derived only from historical information using the average values from monitoring wells WBF-104 and WBF-106.

4.0 PROPOSED EXTRACTION, COLLECTION, AND CONVEYANCE SYSTEMS

4.1 GROUNDWATER EXTRACTION SYSTEM

The initial groundwater extraction system layout is shown on Exhibit 3. Groundwater extraction is proposed along the eastern edge and in the northeast corner of the Slag Disposal Area centered around wells WBF-104 and WBF-106. Modeled steady-state groundwater extraction rates are predicted to be approximately 17 gallons per minute (gpm).

The proposed vertical groundwater extraction wells would be screened in the uppermost aquifer and contain pressure transducers that connect to motors that drive either electrically- or pneumatically powered pumps to convey groundwater to a header pipe connected to a groundwater extraction manifold.

4.1.1 Geotechnical Considerations

Geotechnical considerations related to installation, operation, or other long-term effects of the selected groundwater extraction methods will be considered as part of the system design. Example geotechnical considerations may include, but may not be limited to, the use of drilling fluids, equipment-induced vibrations during drilling, borehole spacing and layout geometry, backfilling techniques, proximity to existing site infrastructure, and long-term groundwater withdrawals.

Geotechnical considerations for the groundwater extraction methods identified previously are considered manageable and will be evaluated as the design and implementation of groundwater extraction measures evolve.

4.2 COLLECTION PIPING & CONVEYANCE

The groundwater extraction system would be pumped in a configuration to be determined based on the treatment needs described in Section 3.0 and 5.0. A conveyance and header system would discharge to a new equalization tank as noted on Exhibit 3. Depending upon the criteria imposed at the final discharge, treatment design and location will be implemented as necessary to meet those criteria. Conveyance from the equalization tank to a future permitted NPDES discharge would be determined during future design phases. The header systems will include cleanout pipes. Refer to *Appendix F.1 Design Drawings* for additional details on collection piping and conveyance.

5.0 RECOMMENDED WATER TREATMENT AND DISCHARGE SYSTEM

Groundwater that is extracted at the WBF Plant will be pumped to an aboveground equalization tank prior to treatment.

Depending upon the treatment required (if any) the location of the treatment components will be determined as necessary. A 12,000-gallon, single-agitator equalization tank is expected to accommodate an average flow from the extraction streams with a 12-hour detention time and peak flow with a four-hour detention time. Peak flow is calculated using a safety factor of 3x the average flow. After equalization in the tank, effluent will be combined in the stormwater pond that discharges via F03. See Exhibit 4 for a preliminary process flow diagram and mass balance.

An NPDES Permit will be required to allow for discharges of extracted groundwater. Groundwater discharges are not currently addressed in the TMSP for stormwater. Based on the evaluation of groundwater and the assumed background water quality information, presented in Section 3.0, the proposed introduction of treated groundwater extraction flows is expected to have a negligible impact on receiving water quality.

If regulations require additional treatment of groundwater, then a system that consists of physical-chemical treatment, with the flexibility for advanced treatments could be added to the existing water management strategy.

Dependent on proposed TDEC discharge limit requirements, the system could include:

- Equalization tank(s) with lamella-style initial solids separation equipment and chemical precipitation/treatment
- Clear well tank(s)
- Filtration/Polishing media (sand filters, bag filters)
- Adsorption media filters.

6.0 REFERENCES

Tennessee Department of Environment and Conservation (TDEC). (2015). Commissioner's Order No. OGC15-0177. August 6, 2015.

TDEC. (2022). National Pollutant Discharge Elimination System (NPDES) Permit No. TN0005452. Tennessee Valley Authority (TVA) Kingston Fossil Plant August 30, 2022.

TVA. (2023). *Environmental Assessment Report*. Watts Bar Fossil Plant. Revision 1. March 31, 2024.

TABLES

Table 1 - Sampling Parameters
Watts Bar Fossil Plant

DRAFT

CCR Parameter*	Method
Aluminum, total	SW-846 6020A
Antimony, total	SW-846 6020A
Arsenic, total	SW-846 6020A
Barium, total	SW-846 6020A
Beryllium, total	SW-846 6020A
Boron, total	SW-846 6020A
Cadmium, total	SW-846 6020A
Calcium	SW-846 6020A
Chromium, total	SW-846 6020A
Cobalt, total	SW-846 6020A
Copper, total	SW-846 6020A
Iron, total	SW-846 6020A
Lead, total	SW-846 6020A
Lithium	SW-846 6020A
Magnesium, total	SW-846 6020A
Manganese, total	SW-846 6020A
Mercury	SW-846 7470A
Molybdenum, total	SW-846 6020A
Nickel, total	SW-846 6020A
pH	SW-846 9040C (field measurement)
Selenium, total	SW-846 6020A
Silver, total	SW-846 6020A
Thallium, total	SW-846 6020A
Total Suspended Solids (TSS)	SM 2540 D-2011
Zinc, total	SW-846 6020A

***CCR Parameters referenced as CCR-related constituents listed in Appendices III and IV of 40 CFR 257 and the five organic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.01**

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Table 2 - Extraction Areas
Watts Bar Fossil Plant

DRAFT

CCR Management Unit	Extraction	Existing Groundwater Well	Data Time Range	Number of Samples
Slag Disposal Area	Groundwater	WBF-104	August 2019 - October 2022	10
	Groundwater	WBF-106	August 2019 - October 2022	10

Notes:

CCR - Coal Combustion Residuals

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Table 3 - Groundwater Influent Characteristics
Watts Bar Fossil Plant

DRAFT

Constituent	Units	Slag Disposal Area		
			Average	Max*
Flow	MGD		0.024	0.072
Flow	gpm		16.7	50.1
Aluminum	ppb	<, <	22.0	27.0
Antimony	ppb	<	0.402	0.510
Arsenic	ppb	<, <	0.725	1.72
Barium	ppb		30.3	51.4
Beryllium	ppb	<	0.248	0.642
Boron	ppb	<	1,970	5,320
Cadmium	ppb	<, <	4.15	11.0
Calcium	ppb	<	308,000	604,000
Chromium	ppb	<	1.56	1.96
Cobalt	ppb		215	608
Copper	ppb	<	1.09	3.89
Iron	ppb		11000	30500
Lead	ppb	<	0.174	0.348
Lithium	ppb	<	3.78	7.07
Magnesium	ppb		41,330	73,100
Manganese	ppb	<	49,000	83,100
Mercury	ppb	<	0.110	0.130
Molybdenum	ppb	<	0.610	0.610
Nickel	ppb	<	38.4	106
Selenium	ppb	<	1.37	1.51
Silver	ppb	<	0.186	0.223
Thallium	ppb	<	0.241	0.570
Zinc	ppb	<	76.5	245
Hardness**	ppm		939	1,810
pH (range)			5.32 - 5.78	
TSS	ppm		-	-

Notes:

All results reported with < qualifier

One or more results reported with < qualifier

All results reported as <, J, UJ, or U* qualifier

One or more results reported with J, UJ, or U* qualifier

*Max flows calculated using a safety factor of 3x

**Hardness calculated using formula: 2.497 * [Ca (mg/l)] + 4.118 * [Mg (mg/l)]

MGD = million gallons per day
gpm = gallons per minute
ppb = parts per billion
ppm = parts per million
1 ppm = 1 mg/L
mg/L = milligrams per liter

Lab Qualifiers:

<	Analyte was not detected at a concentration greater than the Method Detection Limit.
J	Quantitation is approximate due to limitations identified during data validation.
U*	Result should be considered “not detected” because it was detected in an associated field or laboratory blank a
UJ	This compound was not detected, but the reporting or detection limit should be considered an estimate due to a

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Table 4 - Combined Effluent Characteristics
Watts Bar Fossil Plant

DRAFT

Parameters	Units	Qualifier	Combined Existing Groundwater Effluent Concentration	Lowest Allowable Discharge Criteria
Flow	MGD		0.024	NA
Aluminum	ppb	<, <	22.0	NA
Antimony	ppb	<	0.402	26,521
Arsenic	ppb	<, <	0.725	220,994
Barium	ppb		30.3	87,954,574
Beryllium	ppb	<	0.248	NA
Boron	ppb	<	1,970	NA
Cadmium	ppb	<, <	4.15	13,780
Calcium	ppb	<	308,000	NA
Chromium	ppb	<	1.56	3,535,872
Cobalt	ppb		215	NA
Copper	ppb	<	1.09	511,277
Iron	ppb		11,000	NA
Lead	ppb	<	0.174	61,981
Magnesium	ppb		41,300	NA
Manganese	ppb	<	49,000	NA
Mercury	ppb	<	0.110	33,878
Molybdenum	ppb	<	0.610	NA
Nickel	ppb	<	38.4	3,369,093
Selenium	ppb	<	1.37	795,570
Silver	ppb	<	0.186	NA
Thallium	ppb	<	0.241	44,199
Zinc	ppb	<	76.5	11,912,581
Cyanide**	ppb		NA	8,842

Notes:

All results reported with < qualifier

One or more results reported with < qualifier

All results reported as <, J, UJ, or U* qualifier

One or more results reported with J, UJ, or U* qualifier

**Cyanide data not available for Ash Disposal Area J Groundwater and Porewater and Highway 70 Borrow Area Porewater

MGD = million gallons per day

NA = not applicable (i.e., no promulgated instream criterion)

ppb = parts per billion

Lab Qualifiers:

<	Analyte was not detected at a concentration greater than the Method Detection Limit
J	Quantitation is approximate due to limitations identified during data validation
U*	Result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
UJ	This compound was not detected, but the reporting or detection limit should be considered an estimate due to a bias identified during data validation

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EXHIBITS

Exhibit No.

1

Title

WBF Plant Overview

Client/Project

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

DRAFT

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2025-11-12
Technical Review by BL on 2025-11-12

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- National Pollutant Discharge Elimination System (NPDES) Outfalls
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

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

Stantec TVA

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U:\TVA-EIP\175668050_WBF_WastePlan\gis\mxd\CARA\Ex1_PlantOverview\WBF_PlantOverview.aprx 1_WBF_Plant_OverviewWT Revised: 2025-11-12 By: mbough

Exhibit No.

2

Title

Groundwater Influent Characteristics Sampling Network

Client/Project

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

DRAFT

Project Location

Spring City, Tennessee

175668050

Prepared by MB on 2025-09-22
Technical Review by BL on 2025-09-22

0 150 300 450 600 Feet

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

Legend

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

CCR: Coal combustion residuals

Notes

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

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U:\TVA-EPI\175668050_WBF WorkPlans\gis\mxd\CARA\WaterTreatment\WBF_WaterTreatment_Exh.aprx WBF_Ex2_GroundwaterInfluentCharacteristicsSamplingNetwork Revised: 2025-09-22 By: mbough

Exhibit No.

3

Title

Initial Extraction and Conveyance Layout

Client/Project

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

DRAFT

Project Location

Spring City, Tennessee

175668050

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

0 150 300 450 600 Feet

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

Legend

- Groundwater Well
- Approximate Location of Groundwater Extraction System
- Limit of Existing Cover System (Approximate – 2023)
- Water Treatment Pipeline
- Water Treatment System
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

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

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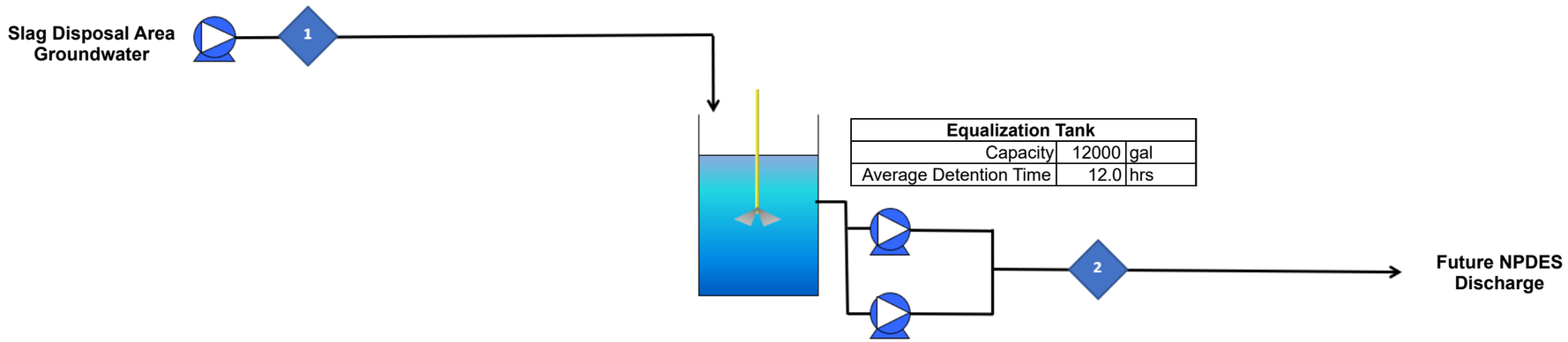
U:\TVA-EPI\175668050_WBF_WorkPlans\gis\mxd\CAR\A1WaterTreatment\WBF_WaterTreatment_Exh.aprx WBF_Ex3_InitialExtraction_and_ConveyanceLayout Revised: 2025-10-08 By: mbough



Equalization Tank		
Capacity	12000	gal
Average Detention Time	12.0	hrs

Stream number		1	2
CCR Unit		SDA	-
Fluid type		GW	Combined GW/PW*
pH		5.3 - 5.7	
Volumetric Flow			
Flow rate	MGD	0.024	0.024
Flow rate	GPM	16.7	16.7
Mass flow			
TSS	lb/day	TBD	TBD
Oil & grease	lb/day	TBD	TBD
Aluminum	lb/day	0.004	TBD
Antimony	lb/day	8.06E-05	TBD
Arsenic	lb/day	1.45E-04	TBD
Barium	lb/day	0.006	TBD
Beryllium	lb/day	4.98E-05	TBD
Boron	lb/day	0.395	TBD
Cadmium	lb/day	0.001	TBD
Calcium	lb/day	61.8	TBD
Chromium	lb/day	3.14E-04	TBD
Cobalt	lb/day	0.043	TBD
Copper	lb/day	2.19E-04	TBD
Cyanide	lb/day	TBD	TBD
Iron	lb/day	2.21	TBD
Lead	lb/day	3.50E-05	TBD
Lithium	lb/day	0.001	TBD
Magnesium	lb/day	8.28	TBD
Manganese	lb/day	9.83	TBD
Mercury	lb/day	2.20E-05	TBD
Molybdenum	lb/day	1.22E-04	TBD
Nickel	lb/day	0.008	TBD
Selenium	lb/day	2.74E-04	TBD
Silver	lb/day	3.72E-05	TBD
Thallium	lb/day	4.84E-05	TBD
Zinc	lb/day	0.015	TBD

Stream number			1	2
CCR Unit			SDA	-
Fluid type			GW	Combined GW/PW*
pH			5.3 - 5.7	
Volumetric Flow				
Flow rate	MGD		0.024	0.024
Flow rate	GPM		16.7	16.7
Concentration				
TSS	ppm		TBD	TBD
Oil & grease	ppm		TBD	TBD
Aluminum	ppb	<, <	22.0	TBD
Antimony	ppb	<	0.402	TBD
Arsenic	ppb	<, <	0.725	TBD
Barium	ppb		30.3	TBD
Beryllium	ppb	<	0.248	TBD
Boron	ppb	<	1970	TBD
Cadmium	ppb	<, <	4.15	TBD
Calcium	ppb	<	308000	TBD
Chromium	ppb	<	1.56	TBD
Cobalt	ppb		215	TBD
Copper	ppb	<	1.09	TBD
Cyanide	ppb		TBD	TBD
Iron	ppb		11000	TBD
Lead	ppb	<	0.174	TBD
Lithium	ppb	<	3.78	TBD
Magnesium	ppb		41300	TBD
Manganese	ppb	<	49000	TBD
Mercury	ppb	<	0.110	TBD
Molybdenum	ppb	<	0.610	TBD
Nickel	ppb	<	38.4	TBD
Selenium	ppb	<	1.37	TBD
Silver	ppb	<	0.186	TBD
Thallium	ppb	<	0.241	TBD
Zinc	ppb	<	76.5	TBD

All results reported with < qualifier

One or more results reported with < qualifier

All results reported as <, J, UJ, or U* qualifier

One or more results reported with J, UJ, or U* qualifier

* if treatment is required, location and type to be determined

Abbreviations	
Slag Disposal Area	SDA
Groundwater	GW

Exhibit No.
4

Title
Groundwater Treatment System Process Flow Diagram and Mass Balance Flow Diagram

Client/Project 175668050
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

Prepared by DMB on 2025-10-16
TR by BL on 2025-10-16
IR Review by RB on 2025-10-16

DRAFT

Stantec

TVA

U:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\CARA\WaterTreatment\WBF_WaterTreatment_Exh.aprx WBF_Ex4_MassBalance Revised: 2025-10-16 By: mbough

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

APPENDIX M –
SEISMIC STABILITY MITIGATION EVALUATION

DRAFT

Appendix M – Seismic Stability Mitigation Evaluation Technical Memorandum

Watts Bar Fossil (WBF) Plant Ash Pond and Slag Disposal Area, Spring City, TN

Submitted to:
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402

Submitted by:
GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801
781-721-4000

December 5, 2025
Project 2301728

Alex M. Juliano, P.E.
Project Engineer

Christopher T. Keenan, P.E.
Project Manager

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2. Ash Pond and Slag Disposal Area Plan

Attachments

A. Conceptual Slope Stability Results

AMJ/CTK:jam
B:\Working\TVA\2301728 TVA Watts Bar Seismic Design Alternatives\06_Phase 1\Alternatives Report\WBF Tech Memo for CARA\WBF Seismic Stability Mitigation Evaluation Technical Memo.docx

1. Background

1.1 Project Objectives

GEI Consultants, Inc. (GEI), on behalf of Tennessee Valley Authority (TVA), has prepared this *Seismic Stability Mitigation Technical Memorandum* (TM) to present a seismic Mitigation solution to improve the post-earthquake stability factor of safety at the Slag Disposal Area and Ash Pond at the Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee.

The objective of this TM is to evaluate technically feasible seismic mitigation solutions, meeting the TVA specified criteria of 1.20 post-earthquake factor of safety (per TVA's internal design criteria for this modified structure), and where possible, reduce the potential impacts to the facility operations and environment. The information provided in this TM is in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA on August 6, 2015.

The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at the TVA's coal ash disposal sites in Tennessee. The Corrective Action/Risk Assessment (CARA) Plan is being prepared pursuant to the TDEC Order process to evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant, specify the actions TVA plans to take at the coal combustion residual (CCR) units and the basis of those actions, and incorporate other operational changes planned or in progress by TVA.

1.2 Site History

The WBF Plant site is owned by the TVA and located in eastern Tennessee approximately 7.3 miles southeast to Spring City (Plate 1). The Slag Disposal Area and Ash Pond are located along the western bank of the Tennessee River/Lake Chickamauga. Watts Bar Nuclear Plant is to the southwest and Watts Bar Hydro Plant (dam and lock) is located to the north (~0.75 miles). The WBF Plant operated from the early 1940s until 1957 and then again from 1970 to about 1982 when it was retired. There are two CCR units at the site: the Slag Disposal Area and the Ash Pond (Plate 2).

The Slag Disposal Area was constructed in the 1940s and was the original CCR unit which received sluiced fly ash, bottom ash, and boiler slag. It was closed with a soil cover system in 2009 (MACTEC 2009). In 2014, riprap and crushed stone were placed at the toe of the perimeter slope adjacent to the Tennessee River for shoreline protection (TVA 2015).

In 2015, the following maintenance activities were implemented (AECOM 2016):

- Add topsoil to the surface of the existing Slag Disposal Area and Closed Metal Cleaning Pond and re-establish vegetative cover.
- Construct storm water enhancements and conveyance modifications to manage the 25-year/24-hour storm, reducing the potential for damage to Old Ferry Road in the event of overtopping.
- Fill the Non-Jurisdictional Wetlands and relocate the perimeter ditch to minimize surface water infiltration in areas adjacent to the slag disposal area closure. An un-named tributary to the Tennessee River exists west of this area, referred to as the "Blue Line Stream."
- Eliminate seep #1 by excavating an interceptor trench adjacent to the slag disposal area closure.
- Abandon the inactive 30-inch diameter storm drain beneath the slag disposal area.

The northeast portion of the Slag Disposal Area perimeter is formed by an approximately 765-foot-long barge loading dock which was constructed between 1943 and 1945. We understand that the dock is constructed of continuous steel sheet piling arches (closed on the river side and open on the land side). The 1949 Technical Report No. 8 states "*At the intersection of each arc* [every 40 feet]*, a vertical anchor wall ties the front wall to a sector-shaped anchor cell driven in deep overburden of the river bank. Slag from the steam plant was used as fill for the dock. […] circular earth-filled, steel sheet-piling mooring cells were installed on 75-foot centers. Ten cells were installed upstream and three cells downstream from the present dock"* (TVA 1949).

The Ash Pond was constructed in 1974 as an extension of the Slag Disposal Area. CCR Material handling operations formed two separate sub-areas: a wet ash area (southern portion) and a dry ash area (northern portion). In 2015, the eastern perimeter containment dike was breached for a new spillway installation and the dry ash area was consolidated with material from the southern portion and capped with a geosynthetic cover system (CDM Smith 2015). The southern portion of the Ash Pond footprint was converted into a stormwater pond. In 2016, riprap and crushed stone were placed at the toe of the perimeter dike adjacent to the Tennessee River for shoreline protection (TVA 2016).

1.3 Subsurface Information and Seismic Analysis

The Slag Disposal Area and the Ash Pond are underlain by unconsolidated alluvial deposits consisting of a mixture of sand, silt, and clay with some gravel. Explorations within both areas encountered alluvial deposits between 10 ft and 35 ft thick, overlying bedrock. Liquefaction triggering analyses performed by Geocomp found that a portion of the

sandy alluvial materials were susceptible to strength loss under the design earthquake (Geocomp 2023).

There are three soil borings and fifteen CPTs that were performed within 100 feet behind the existing sheet pile wall forming the barge loading dock. CPTs through the wall backfill encountered low strength materials at depths between 15 ft and 30 ft.

Seismic slope stability analyses performed by Geocomp found that the sandy alluvial material is the critical layer for seismic stability.

Geocomp performed post-earthquake stability analyses of the critical cross sections at the Slag Disposal Area (Cross Section SD-SD′) and the Ash Pond (Cross Section EW-EW′) to assess the stability after the design-level ground motion has occurred. The post-earthquake stability analyses evaluated failure surfaces that could potentially lead to loss of containment of the CCR materials. The post-earthquake stability of the CCR materials was evaluated using "post-earthquake" strengths for materials that could potentially liquefy or undergo cyclic softening.

At Cross Section SD-SD′, Geocomp's liquefaction triggering analyses, using SPT- and CPT-based correlations, and advanced laboratory strength testing showed all the Alluvial Sand sublayers (Alluvial Sand 2, 3, 3-1, 4, and 4-1) could potentially liquefy, except the Alluvial Sand 1. Sluiced Ash 1 is above the phreatic surface and would not liquefy. Sluiced Ash 2 is below the phreatic surface and may liquefy, but based on Geocomp's evaluation of lab data, the layer will not lose strength. In addition, Geocomp concluded the Bottom Ash and Slag present at Cross Section SD-SD′ would be expected to liquefy only at select locations.

Geocomp modeled the liquefied materials with their residual strengths. Figure 1-1 shows the failure surfaces under post-earthquake conditions at the Slag Disposal Area. The post-earthquake minimum factor of safety that intercepted CCR material was 0.6, at a slip surface that went through the Alluvial Sand.

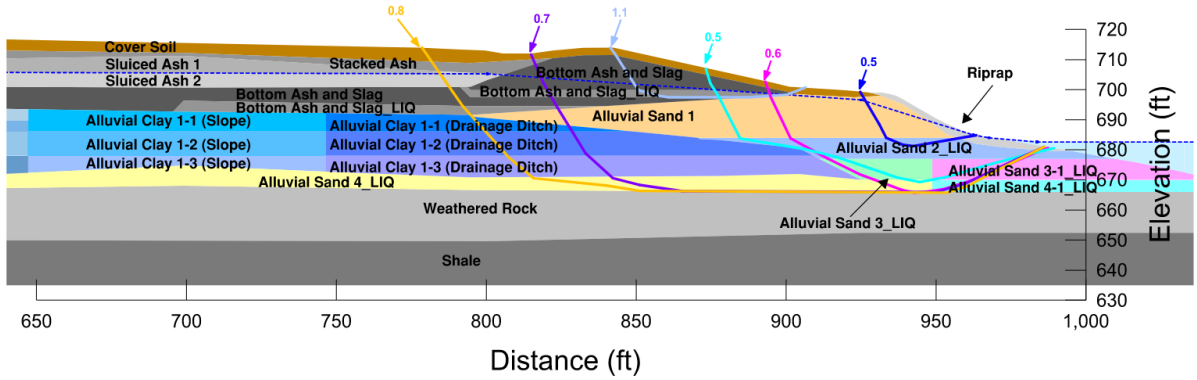

Figure 1-1 Slag Disposal Area – Cross Section SD-SD' Post Earthquake Stability Failure Surfaces (Geocomp, 2023)

At Cross Section EW-EW', Geocomp's liquefaction triggering analyses, using field correlations, showed that liquefaction would be triggered in each of the sublayers of Alluvial Sand (i.e., Alluvial Sand 1, 1-1, 2, and 2-1). Geocomp modeled the liquefied, sub-layered materials with their residual strengths. Figure 1-2 shows the failure surfaces under post-earthquake conditions. The post-earthquake minimum factor of safety that intercepted CCR material at the Ash Pond was 0.9. This critical global slip surface went through the Alluvial Clay and Alluvial Sand and intercepted a small portion of CCR material.

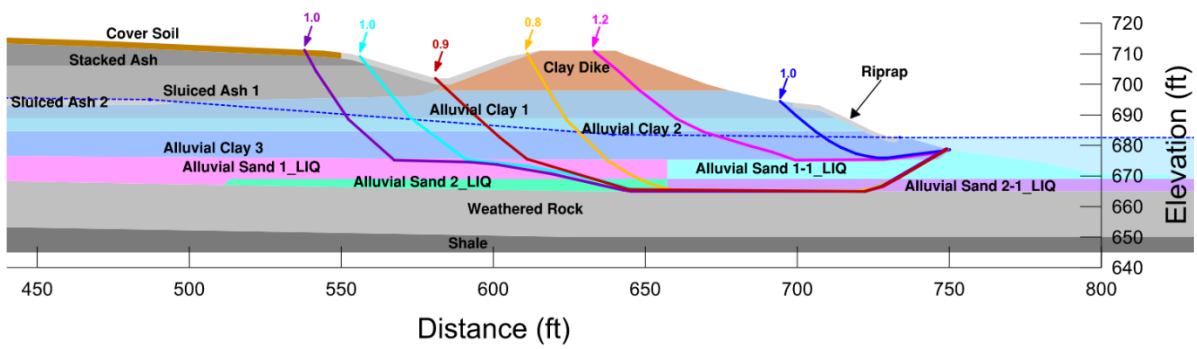

Figure 1-2 Ash Pond – Cross Section EW-EW' Post Earthquake Stability Failure Surfaces (Geocomp, 2023)

1.4 Site Constraints

The Watts Bar Fossil plant was retired in 1982, but Watts Bar Nuclear Plant, Watts Bar Dam/Hydro Plant, and TVA's Equipment Support Services (ESS) facilities are actively used and operated by TVA today and are within about 1 mile of the Slag Disposal Area and Ash Pond boundaries.

Site constraints at the Slag Disposal Area include the 8-foot diameter nuclear cooling intake and discharge pipes on the western side of the unit, the existing access road along the embankment parallel to the Tennessee River/Lake Chickamauga, the existing sheet pile wall

forming the barge loading dock, and the boat ramp. We understand that some of these features are actively used by the TVA Dam Safety, ESS, and Nuclear groups. The impacts of these site constraints should be considered for the selection and design of the seismic mitigation solution, but are not necessarily constraints that are untouchable. Figure 1-3 shows these primary site constraints and existing key site features.

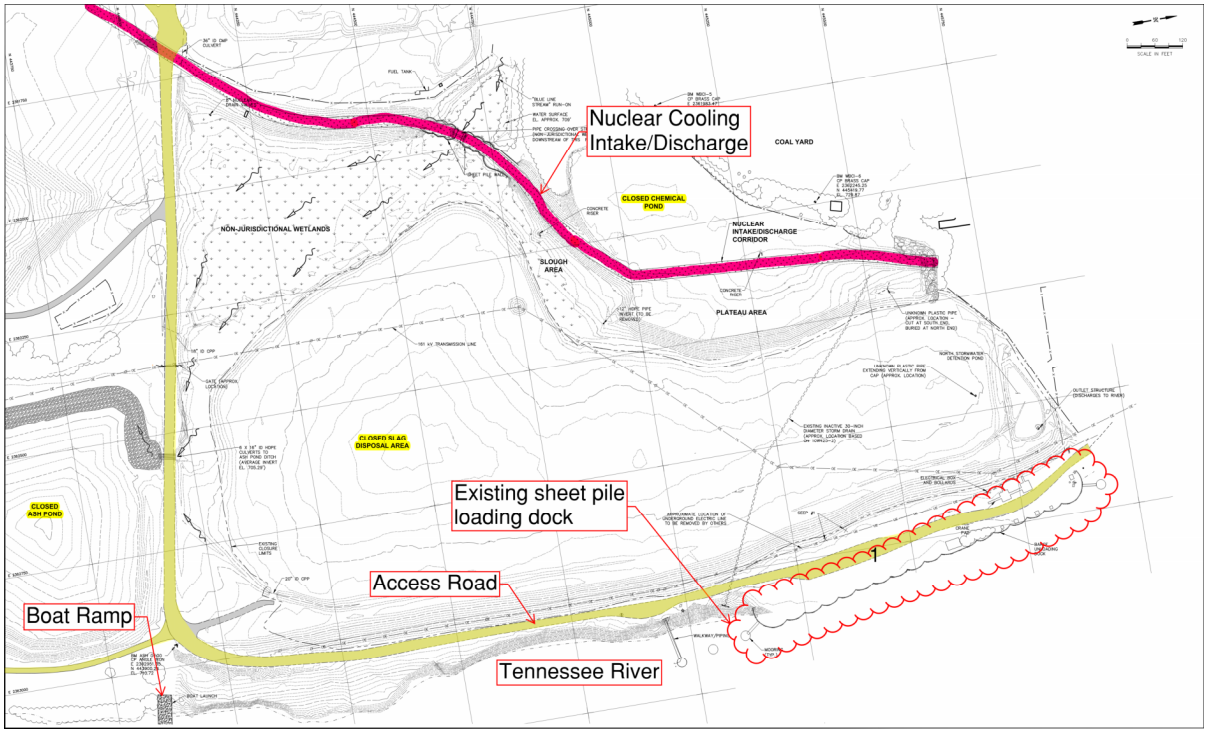

Figure 1-3 Plan View of Site Constraints and Key Features at Slag Disposal Area. Plan from AECOM (2016)

At the Ash Pond, site constraints include the Stormwater Pond, the outlet to the Tennessee River/Lake Chickamauga from the Stormwater Pond, and archaeological areas of concern (Fig. 1-4 and 1-5). The CDM Smith (2015) Ash Pond spillway drawings (Fig. 1-4) show the archaeological sites and direct to protect at all times. The Stormwater Pond has an approximate water elevation of El. 698. Similarly to the Slag Disposal Area, the impacts of these site constraints will need to be considered for the selection and design of the seismic mitigation solution, but are not necessarily constraints that are untouchable.

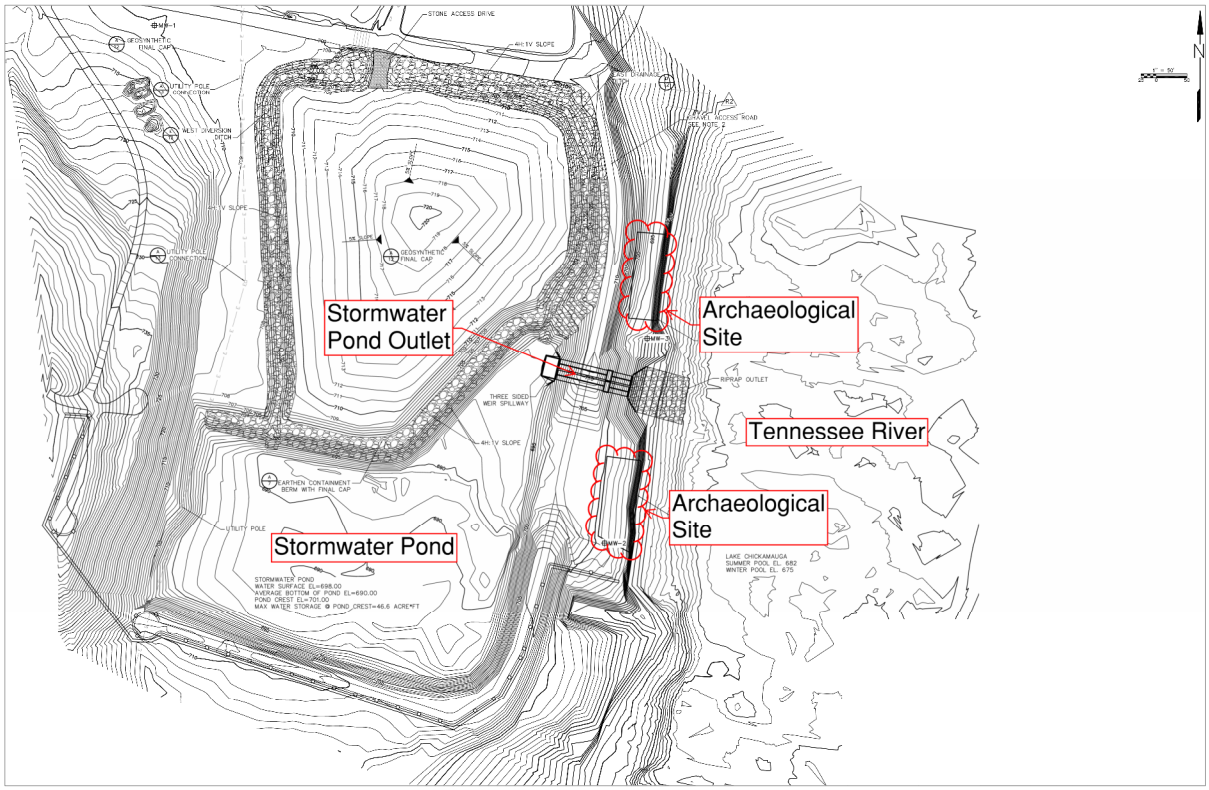

Figure 1-4 Plan View of Site Constraints and Key Features at Ash Pond. Plan from CDM Smith (2015)

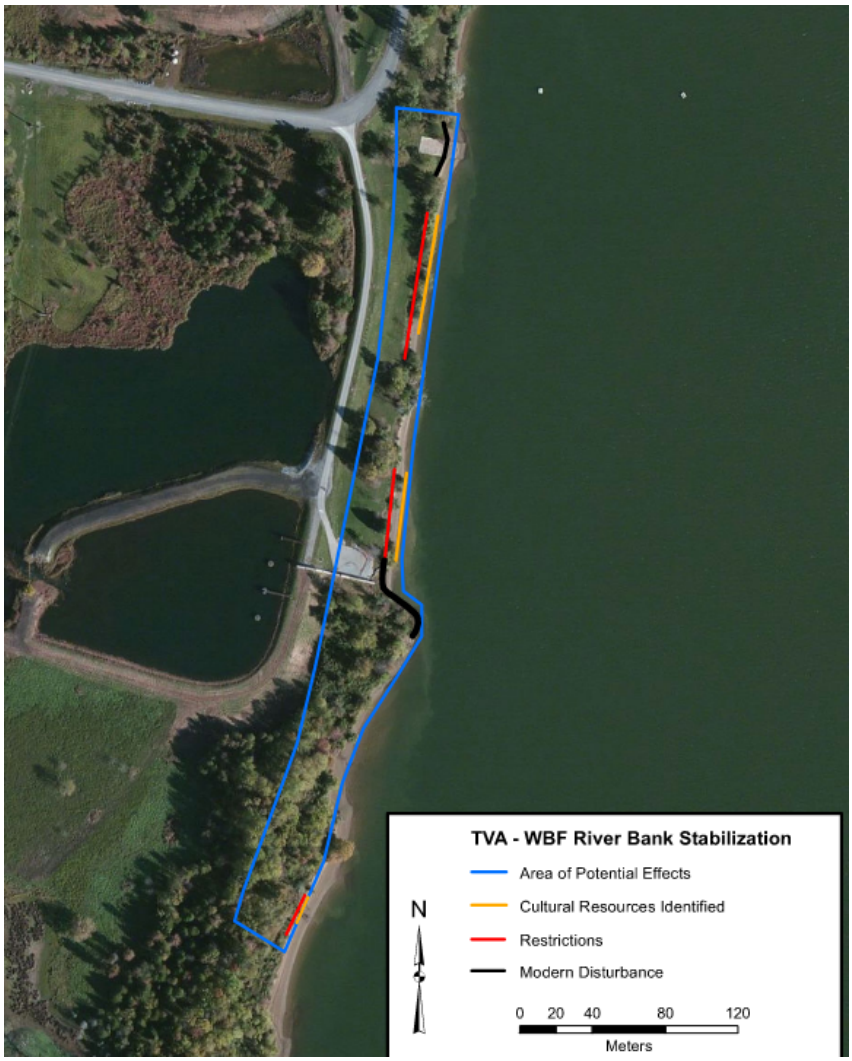

Figure 1-5 Potential Archaeological Areas of Concern. Plan from TVA (2013)

2. Identified Seismic Stability Mitigation Measure Alternatives

2.1 Seismic Stability Mitigation Measure Alternatives Considered

There are a variety of seismic mitigation solutions available to improve the post-earthquake factor of safety of the CCR units at the WBF Plant. Numerous seismic mitigation alternatives were evaluated but many solutions were deemed not-practical or infeasible based on the anticipated site conditions, anticipated design life, and operational constraints.

The four conceptual solutions considered for seismic Mitigation are presented below. The conceptual seismic mitigation solutions are all technically feasible, meeting the TVA specified criteria of 1.20 post-earthquake factor of safety (per TVA's internal design criteria for this modified structure).

1. Setback and Re-grade CCR Materials – This alternative would involve excavating, relocating, and consolidating CCR material from along the riverbank of the Slag Disposal Area and behind the clay dike of the Ash Pond, to the west, away from the Tennessee River/Lake Chickamauga. The slopes will be regraded to meet minimum post-EQ factor of safety. After regrading, a new soil cover system or geosynthetic/turf cover system would be installed, and grading would be coordinated with other improvements to stormwater/drainage at the site.
2. Outboard Toe Berm Buttress – This alternative would involve constructing a berm of rockfill/large riprap at the waterside slope of the Slag Disposal Area and Ash Pond to provide additional weight at the toe (resisting force) to help improve the overall stability in the post-earthquake case. The berm would likely require dredging a portion of the alluvial sand layer and replacement with rockfill/large riprap material and necessary bedding materials. Temporary cofferdams may be needed to facilitate dredging. Alternately, depending on the thickness and stiffness of the alluvial sand (or muck) deposits over rock in the river, it may be possible to push large riprap through the alluvial sand/ muck without dredging. It is not possible to build a berm large enough to adequately improve stability without placing part of the berm within the Tennessee River.
3. Deep Mixing Method (DMM) Shear Walls – This alternative would increase post-earthquake factor of safety by constructing a series of shear walls perpendicular to the dike axis. Seismic loads would be transferred to the walls in shear. Deep soil mixing (DSM) or auger-cast mixing columns to form transverse shear walls with low mobility grout would be recommended to reduce the risk of grout and spoils spilling

into the river. This alternative will allow porewater and groundwater water to pass between the soil reinforcement walls. GEI and TVA have implemented this method with success on similar projects.

4. Ground Improvement – This alternative would provide a zone of improved (densified) soil parallel to the river (perpendicular to the failure surface). A number of technologies are available to achieve the required densification and typically require installation of a working platform, with the elements being installed in a grid pattern. Vibro-compaction methodologies for improvement (e.g., vibrating probe and vibro-flotation) are less preferable because to achieve the desired results, temporary, localized liquefaction is part of the installation process. Rammed aggregate piers (e.g., Geopiers), vibro stone columns (VSC), auger cast piles, and controlled modulus columns (i.e., Rigid inclusions) are potential options to consider. The elements would likely be keyed into the rock. This alternative may alter the permeability and groundwater flow.

3. Recommended Seismic Mitigation Solution

3.1 Outboard Toe Berm Buttress

The recommended seismic Mitigation solution is to construct an Outboard Toe Berm Buttress for both CCR units. This conceptual solution would involve constructing a berm of rockfill/large riprap at the waterside slope of the Slag Disposal Area and Ash Pond to form a buttress that provides additional weight at the outboard toe (resisting force) to help improve the overall stability in the post-earthquake case.

This recommendation is based on the favorable aspects that CCR material is not exposed in the construction process, straightforward construction effort and low construction risk, and the anticipated design life. In addition, it complements most groundwater correction measures at the CCR units since work is downgradient.

The Outboard Toe Berm Buttress solution was advanced to 10% design, which included plan and typical cross section drawings, slope stability analyses, and construction cost estimates.

The design drawing plan was based on a 2018 LIDAR survey provided by TVA. Typical cross sections were based on those developed by Geocomp (Geocomp 2023). For detailed design, bathymetry data may be required, and additional cross sections may need to be developed.

Slope/W, a limit equilibrium program, was used to evaluate post-earthquake factors of safety. Slope stability models were based on Geocomp's evaluations at Slag Disposal Area, Cross Section SD-SD′, and the Ash Pond, Cross Section EW-EW′ (Geocomp 2023). The stratigraphy, soil properties, and phreatic surface were not modified from Geocomp's sections. For detailed design, additional cross sections may need to be evaluated and soil properties, stratigraphy, and/or phreatic surface be updated.

Similar to Geocomp's analyses, a water elevation of 682.6 feet was used in the analyses at both the Slag Disposal Area and Ash Pond units for the Tennessee River/Lake Chickamauga. Although not used in the analyses, the Stormwater Pond has an approximate water elevation of 698 feet.

3.2 Preliminary Buttress Design

We performed slope stability analyses with the addition of the toe berm buttress. We modelled the berm as if it were constructed of riprap and the bottom portion of the berm is founded on rock. We varied the size and dimensions of the toe berm to achieve a post-earthquake factor of safety of 1.20, per TVA's internal design criteria for this modified

structure. The geometry of the berm can be optimized in detailed design. The dimensions of the toe berm will likely be different at each CCR unit, and a transition zone will need to be designed. Conceptual design drawings are provided in Appendix F.1 of the CARA and slope stability results are provided as Attachment A of this TM.

At the Slag Disposal Area, a berm may consist of a 70-foot-wide bench at El. 704, a 2.5H:1V slope to a 15-foot-wide bench at El. 695, a 3H:1V slope to a 15-ft-wide bench at El. 686, and a 2H:1V slope to existing top of weathered rock and would include a 30-ft key into existing alluvial sand. In plan, the total width of the berm is approximately 180 feet.

At the Ash Pond, a berm may consist of a 40-foot-wide bench at El. 694, a 3.5H:1V slope to a 25-foot-wide bench at El. 685, and a 2.5H:1V slope to existing top of weathered rock with a 43-foot-wide key into alluvial sand. In plan, the total width of the berm is approximately 140 feet.

We estimated 109,000 cubic yards of riprap fill will be required for the toe berm at the Slag Disposal Area (not including at the existing sheet pile wall portion) and 25,500 cubic yards of riprap fill will be required for the toe berm at the AP, for a total of 190,000 tons of riprap fill. An additional 95,000 tons of riprap fill is required if the buttress were to replace the existing sheet pile wall. At this 10% design, we assumed a one-third to two-third split between the quantity of exterior and interior material sizes, respectively. We also assumed 150 lb average riprap size for the interior buttress material and 300 lb average riprap size for the exterior material.

3.3 Archaeological Constraint Considerations

Note that at the Ash Pond, there are potential conflicts with the archaeological sites along the riverbank, as shown in Figs. 1-4 and 1-5. Initial guidance from TVA is that these sensitive areas should be protected and that removing existing riprap is likely acceptable, but excavation is not. Any work impacting these archaeological sites will require a review period with TVA Archaeology.

3.4 Sheet Pile Wall Considerations

The existing sheet pile wall, forming the barge loading dock, at the north portion of the Slag Disposal Area will present unique challenges and may need to be evaluated specifically, in conjunction with the selected seismic mitigation solution.

We have not evaluated the internal stability of the wall, and this will need to be considered in detailed design. Based on the observations at our site visit, we recommend performing field investigations of the sheet pile wall to observe its integrity. This may include test pits or trenches behind the wall to observe the condition of steel elements and connections,

collecting steel coupon samples for strength testing, and/or pH and corrosivity testing on the fill behind the wall. Further evaluation to identify a historical analysis of the wall or performing an updated analysis with properties adjusted for the current conditions of the wall should be performed in detailed design.

Two options for addressing the existing sheet pile wall are: A) Replacing the sheet pile wall with the buttress, and B) Replacing with a new sheet pile wall.

If the existing sheet pile wall is removed or modified, Option A may also provide TVA the benefit of a staging or offloading area, and could be constructed at any location along the buttress rather than just at the existing sheet pile wall footprint. If selected, the toe berm geometry may need to be adjusted for this in detailed design.

3.5 Considerations for Detailed Design

Recommended future engineering and design items include:

- Collect and review bathymetry data in the general location of proposed berm.
- Perform subsurface investigation from a barge to collect information on alluvial sand and any muck layer present over rock beneath the footprint of the berm. Investigation may consist of probing, vane shear tests, and soil borings.
- Consider permitting process and any hydrology and hydraulic (H&H) calculations related to the fill placed in the Tennessee River/Lake Chickamauga.
- Consider how Tennessee River/Lake Chickamauga 100-yr flood and PMF levels may impact design.
- Consider permitting process and construction controls for archaeological sites.
- Evaluate stability of the sheet pile wall forming the barge loading dock. Determine detail of transition from toe berm to existing sheet pile dock wall or if toe berm will replace sheet pile dock.
- Consider the feasibility of removing the Stormwater Pond and spillway structure.

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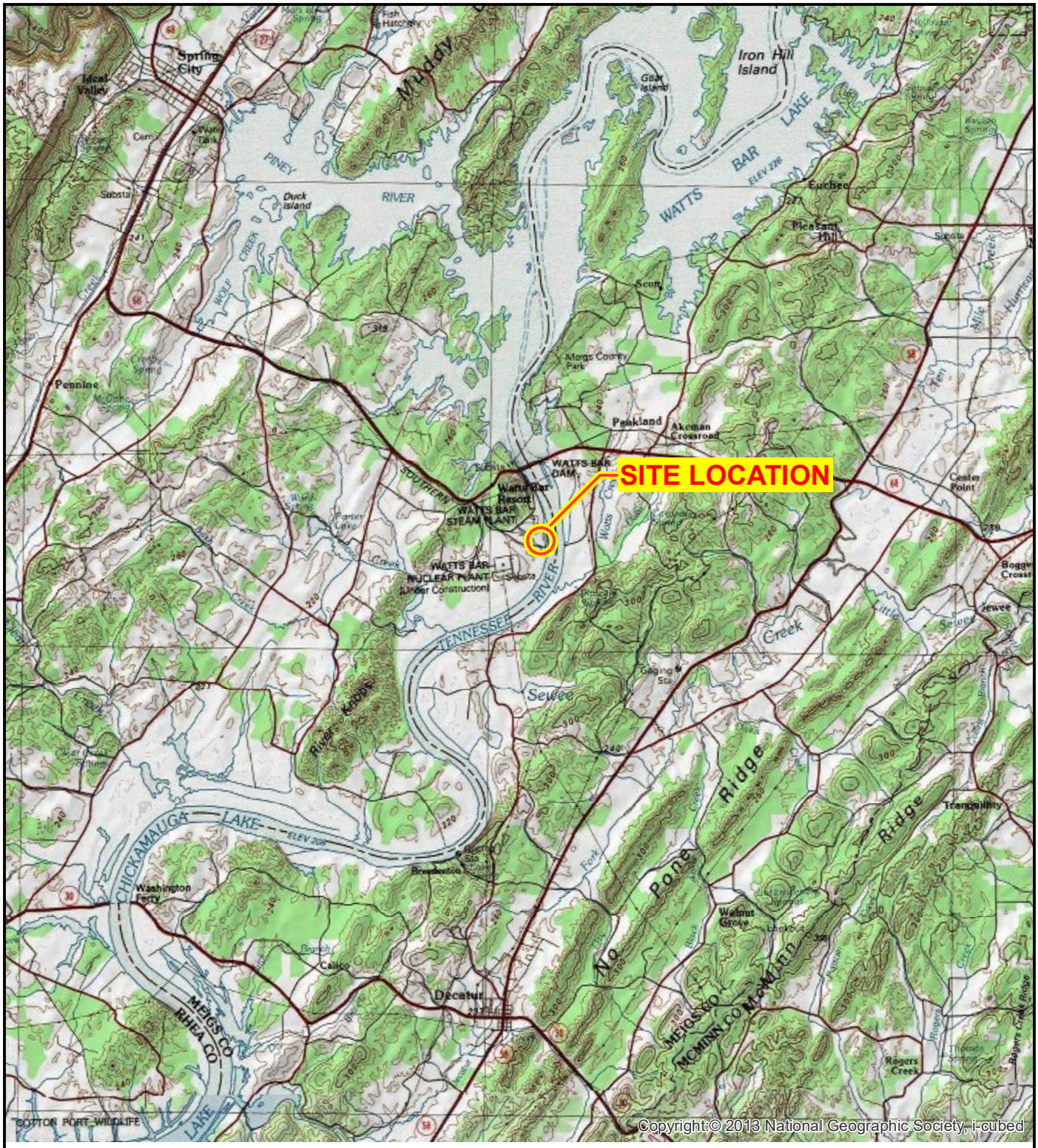
Plates



0 5,000 10,000 20,000

Feet

N

WATTS BAR SEISMIC DESIGN ALTERNATIVES SPRING CITY, TN	GEI Consultants	SITE LOCATION MAP
TENNESSEE VALLEY AUTHORITY CHATTANOOGA, TN	Project 2301728	September 2024 Plate 1

B:\Working\TVA\2301728 TVA Watts Bar Seismic Design Alternatives\05_GIS\FIGURE 1 - USGS SITE LOCATION MAP.mxd

DRAFT

Plate 2, prepared by Stantec

Exhibit No.

2-1

Title

WBF Plant Overview

Client/Project

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

Project Location

Spring City, Tennessee

175668050

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

0 200 400 600 800 Feet

1:2,400 (At original document size of 22x34)

Legend

- National Pollutant Discharge Elimination System (NPDES) Outfalls (Historical)
- Limit of Existing Cover System (Approximate – 2023)
- Surface Stream Flow
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

Notes

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

Stantec TVA

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Attachment A

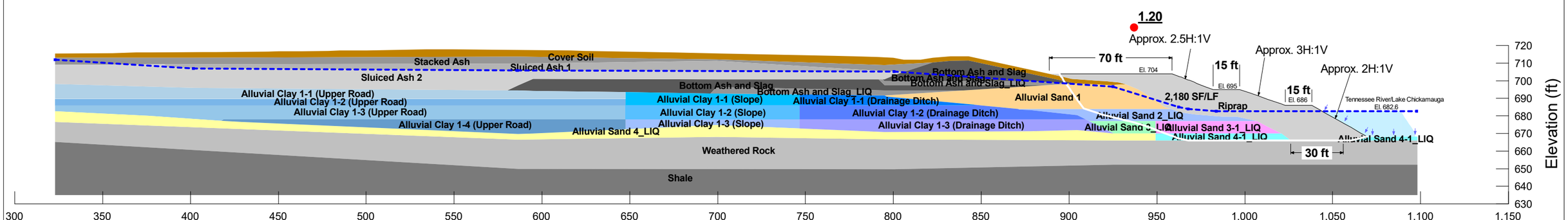
Conceptual Slope Stability Results

Watts Bar Fossil Plant
Seismic Design Alternatives Evaluation
Section SD-SD' Post-EQ Stability Results
Circular Slip Surface
Slip Surface thru CCR

Notes:
1.) Stratigraphy and soil properties are from GeoStudio file provided by Geocomp on 5/19/23. Geocomp performed the seismic analyses for the TDEC Order presented in the Seismic Stability Sampling and Analysis Report Rev. 2.

2.) GEI has adjusted geometry, porewater elevation and/or added improved soil zones to perform proof-of-concept evaluations of conceptual design solutions. Minimum required Post-EQ Strength for design is FS=1.20, per TVA's internal design criteria for this modified structure.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Tau/Sigma Ratio	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	Alluvial Clay 1-1 (Drainage Ditch)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-1 (Slope)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-1 (Upper Road)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-2 (Drainage Ditch)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-2 (Slope)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-2 (Upper Road)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-3 (Drainage Ditch)	SHANSEP	126		0.37			
	Alluvial Clay 1-3 (Slope)	SHANSEP	126		0.46			
	Alluvial Clay 1-3 (Upper Road)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-4 (Upper Road)	SHANSEP	126		0.4			
	Alluvial Sand 1	Mohr-Coulomb	124			0	32	0
	Alluvial Sand 2_LIQ	SHANSEP	124		0.07			
	Alluvial Sand 3_LIQ	SHANSEP	124		0.07			
	Alluvial Sand 3-1_LIQ	Undrained (Phi=0)	124	369				
	Alluvial Sand 4_LIQ	SHANSEP	124		0.07			
	Alluvial Sand 4-1_LIQ	Undrained (Phi=0)	124	369				
	Bottom Ash and Slag	Mohr-Coulomb	118			0	37	0
	Bottom Ash and Slag_LIQ	SHANSEP	118		0.11			
	Cover Soil	Mohr-Coulomb	119			0	29	0
	Riprap	Mohr-Coulomb	150			0	40	0
	Shale	Bedrock (Impenetrable)						
	Sluiced Ash 1	Mohr-Coulomb	108			0	27	0
	Sluiced Ash 2	SHANSEP	108		0.34			
	Stacked Ash	Mohr-Coulomb	108			0	39	0
	Weathered Rock	Bedrock (Impenetrable)						



Section SD-SD'

Watts Bar Seismic Design Alternatives Watts Bar Fossil Plant Spring City, Tennessee	GEI Consultants	Slag Disposal Area Toe Berm Buttress Post-EQ Slope Stability Results
Tennessee Valley Authority Chattanooga, Tennessee	Project 2301728	March 2024 Fig. 1a

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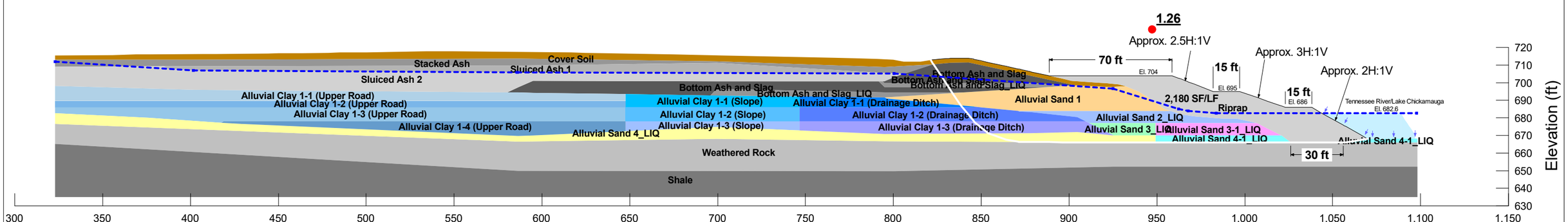
Watts Bar Fossil Plant
Seismic Design Alternatives Evaluation
Section SD-SD' Post-EQ Stability Results
Wedge Slip Surface
Slip Surface thru CCR

Notes:
1.) Stratigraphy and soil properties are from GeoStudio file provided by Geocomp on 5/19/23. Geocomp performed the seismic analyses for the TDEC Order presented in the Seismic Stability Sampling and Analysis Report Rev. 2.

2.) GEI has adjusted geometry, porewater elevation and/or added improved soil zones to perform proof-of-concept evaluations of conceptual design solutions. Minimum required Post-EQ Strength for design is FS=1.20, per TVA's internal design criteria for this modified structure.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Tau/Sigma Ratio	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	Alluvial Clay 1-1 (Drainage Ditch)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-1 (Slope)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-1 (Upper Road)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-2 (Drainage Ditch)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-2 (Slope)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-2 (Upper Road)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-3 (Drainage Ditch)	SHANSEP	126		0.37			
	Alluvial Clay 1-3 (Slope)	SHANSEP	126		0.46			
	Alluvial Clay 1-3 (Upper Road)	Mohr-Coulomb	126			0	25	0
	Alluvial Clay 1-4 (Upper Road)	SHANSEP	126		0.4			
	Alluvial Sand 1	Mohr-Coulomb	124			0	32	0
	Alluvial Sand 2_LIQ	SHANSEP	124		0.07			
	Alluvial Sand 3_LIQ	SHANSEP	124		0.07			
	Alluvial Sand 3-1_LIQ	Undrained (Phi=0)	124	369				
	Alluvial Sand 4_LIQ	SHANSEP	124		0.07			
	Alluvial Sand 4-1_LIQ	Undrained (Phi=0)	124	369				
	Bottom Ash and Slag	Mohr-Coulomb	118			0	37	0
	Bottom Ash and Slag_LIQ	SHANSEP	118		0.11			
	Cover Soil	Mohr-Coulomb	119			0	29	0
	Riprap	Mohr-Coulomb	150			0	40	0
	Shale	Bedrock (Impenetrable)						
	Sluiced Ash 1	Mohr-Coulomb	108			0	27	0
	Sluiced Ash 2	SHANSEP	108		0.34			
	Stacked Ash	Mohr-Coulomb	108			0	39	0
	Weathered Rock	Bedrock (Impenetrable)						



Section SD-SD'

Watts Bar Seismic Design Alternatives Watts Bar Fossil Plant Spring City, Tennessee	GEI Consultants	Slag Disposal Area Toe Berm Buttress Post-EQ Slope Stability Results
Tennessee Valley Authority Chattanooga, Tennessee	Project 2301728	March 2024 Fig. 1b

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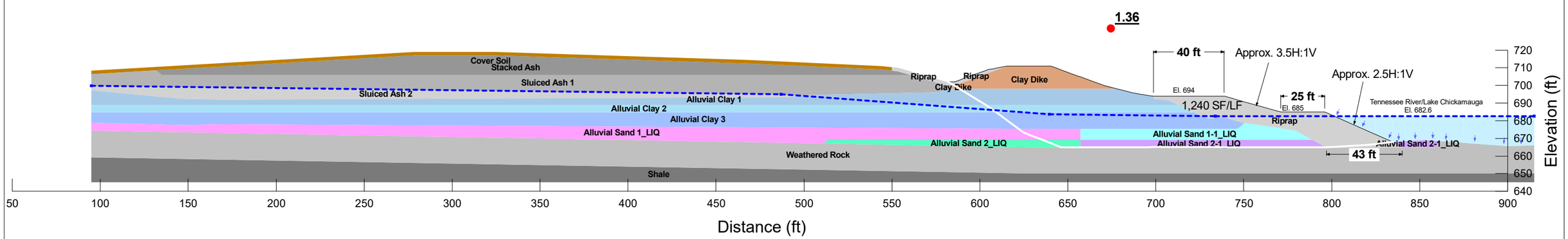
Watts Bar Fossil Plant
Seismic Design Alternatives Evaluation
Section EW-EW' Post-EQ Stability Results
Circular Slip Surface
Slip Surface thru CCR

Notes:
1.) Stratigraphy and soil properties are from GeoStudio file provided by Geocomp on 5/19/23. Geocomp performed the seismic analyses for the TDEC Order presented in the Seismic Stability Sampling and Analysis Report Rev. 2.

2.) GEI has adjusted geometry, porewater elevation and/or added improved soil zones to perform proof-of-concept evaluations of conceptual design solutions. Minimum required Post-EQ Strength for design is FS=1.20, per TVA's internal design criteria for this modified structure.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Tau/Sigma Ratio	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	Alluvial Clay 1	Mohr-Coulomb	124			0	25	0
	Alluvial Clay 2	SHANSEP	124		0.38			
	Alluvial Clay 3	SHANSEP	124		0.3			
	Alluvial Sand 1_LIQ	SHANSEP	122		0.07			
	Alluvial Sand 1-1_LIQ	Undrained (Phi=0)	122	369				
	Alluvial Sand 2_LIQ	SHANSEP	122		0.07			
	Alluvial Sand 2-1_LIQ	Undrained (Phi=0)	122	369				
	Clay Dike	Mohr-Coulomb	128			0	27	0
	Cover Soil	Mohr-Coulomb	119			0	29	0
	Riprap	Mohr-Coulomb	150			0	40	0
	Shale	Bedrock (Impenetrable)						
	Sluiced Ash 1	Mohr-Coulomb	108			0	27	0
	Sluiced Ash 2	SHANSEP	108		0.34			
	Stacked Ash	Mohr-Coulomb	110			0	39	0
	Weathered Rock	Bedrock (Impenetrable)						



Section EW-EW'

Watts Bar Seismic Design Alternatives Watts Bar Fossil Plant Spring City, Tennessee	GEI Consultants	Ash Pond Toe Berm Buttress Post-EQ Slope Stability Results
Tennessee Valley Authority Chattanooga, Tennessee	Project 2301728	Martch 2024 Fig. 2a

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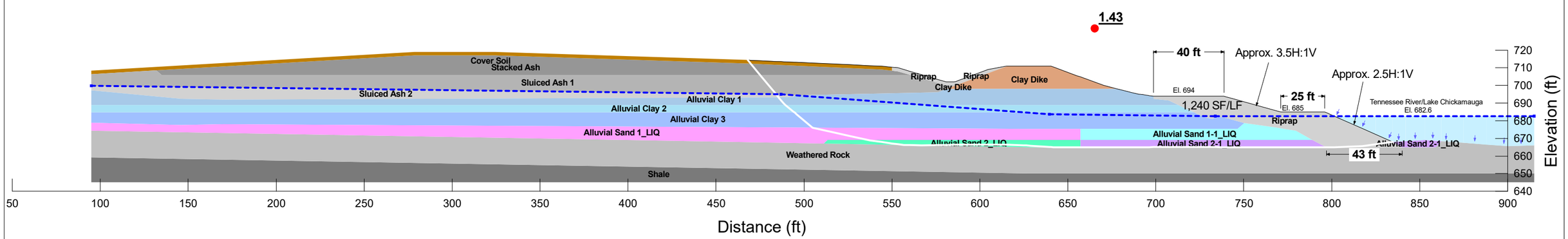
Watts Bar Fossil Plant
Seismic Design Alternatives Evaluation
Section EW-EW' Post-EQ Stability Results
Wedge Slip Surface
Slip Surface thru CCR

Notes:
1.) Stratigraphy and soil properties are from GeoStudio file provided by Geocomp on 5/19/23. Geocomp performed the seismic analyses for the TDEC Order presented in the Seismic Stability Sampling and Analysis Report Rev. 2.

2.) GEI has adjusted geometry, porewater elevation and/or added improved soil zones to perform proof-of-concept evaluations of conceptual design solutions. Minimum required Post-EQ Strength for design is FS=1.20, per TVA's internal design criteria for this modified structure.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Tau/Sigma Ratio	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	Alluvial Clay 1	Mohr-Coulomb	124			0	25	0
	Alluvial Clay 2	SHANSEP	124		0.38			
	Alluvial Clay 3	SHANSEP	124		0.3			
	Alluvial Sand 1_LIQ	SHANSEP	122		0.07			
	Alluvial Sand 1-1_LIQ	Undrained (Phi=0)	122	369				
	Alluvial Sand 2_LIQ	SHANSEP	122		0.07			
	Alluvial Sand 2-1_LIQ	Undrained (Phi=0)	122	369				
	Clay Dike	Mohr-Coulomb	128			0	27	0
	Cover Soil	Mohr-Coulomb	119			0	29	0
	Riprap	Mohr-Coulomb	150			0	40	0
	Shale	Bedrock (Impenetrable)						
	Sluiced Ash 1	Mohr-Coulomb	108			0	27	0
	Sluiced Ash 2	SHANSEP	108		0.34			
	Stacked Ash	Mohr-Coulomb	110			0	39	0
	Weathered Rock	Bedrock (Impenetrable)						



Section EW-EW'

Watts Bar Seismic Design Alternatives Watts Bar Fossil Plant Spring City, Tennessee	GEI Consultants	Ash Pond Toe Berm Buttress Post-EQ Slope Stability Results
Tennessee Valley Authority Chattanooga, Tennessee	Project 2301728	Martch 2024 Fig. 2b

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