Environmental Investigation Plan
Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

TVA

March 4, 2019

REVISION LOG

Revision	Description	Date
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1.5	Addresses January 5, 2018 TDEC Review Comments and issued for TDEC Review.	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and issued for TDEC Review	July 20, 2018
3	Addresses Applicable Programmatic Revisions and Public Comments received between October 15, 2018 and January 31, 2019	March 4, 2019

ENVIRONMENTAL INVESTIGATION PLAN
ALLEN FOSSIL PLANT

TITLE AND APPROVAL PAGE

Title of Plan: Environmental Investigation Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Tennessee Valley Authority

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Bryan Wells
TVA Compliance Point of Contact

3/4/19
Date

James R. Gott
TVA Technical Point of Contact

3/1/19
Date

Bradley R Toth
Investigation Project Manager

2/26/2019
Date

Rock J Vitale
QA Oversight Manager

2/26/2019
Date

Charles L. Head
TDEC Senior Advisor

Date

Robert Wilkinson
TDEC CCR Technical Manager

Date

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Abbreviations

ALF	Allen Fossil Plant
BTV	Background Threshold Values
CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
CCR Rule	EPA Final Rule on Disposal of Coal Combustion Residuals from Electric Utilities
CFR	Code of Federal Regulations
DMP	Data Mangement Plan
DPT	Direct Push Technology
EAR	Environmental Assessment Report
EIP	Environment Investigation Plan
EI	Environmental Investigation
EPA	Environment Protection Agency
FEMA	Federal Emergency Management Agency
GPS	Global Positioning System
Harsco Area	Harsco Corporation Area
KMP	Knowledge Management Portal
Lb/day	Pounds per day
LC50	Median Lethal Concentration
mg/L	Milligrams per Liter
MGD	Million Gallons per Day
MLGW	Memphis Light, Gas, and Water
MOA	Memorandum of Agreement
MSL	Mean Sea Level
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
Plant	Allen Fossil Plant
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan (ALF QAPP)

Rev	Revision
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
SPP	Standard Programs and Processes
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order OGC15-0177
TVA	Tennessee Valley Authority
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

1.0 INTRODUCTION

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TVA has prepare this Environmental Investigation Plan (EIP) to provide requested information to TDEC and to outline the investigation that will be performed to meet the requirements of the TDEC Order. Since September 2016, TDEC and TVA have been developing the scope of the EIP for ALF. This version (Rev 3) is based on comments received after public meetings held by TVA. The public comment period ended on January 31, 2019.

1.1 PURPOSE

The purpose of this EIP is to comply with Section VII.A.d. of the TDEC Order, which requires TVA, upon receiving requests for information from TDEC, to develop an EIP for each plant that, when implemented, will provide the information necessary to "fully identify the extent of soil, surface water, and ground water contamination by CCR." The responses and schedule set forth in this EIP correspond to each individual task in TDEC's information request letters for ALF dated February 6, 2017 and October 3, 2017. The Environmental Assessment Report (EAR), to be submitted at a later date following completion of the environmental investigation identified in the EIP, will provide "an analysis of the extent of soil, surface water, and ground water contamination by CCR at the site" and thus will provide the information, analyses, and/or evaluations responsive to TDEC's information requests and the TDEC Order.

1.2 MULTI-SITE ORDER TIMELINE

By way of background, a summary of events related to the TDEC Order is provided below:

- TDEC issued Commissioner's Order OGC15-0177 to TVA on August 6, 2015.
- On September 22, 2015, TDEC and TVA met to discuss the Order. During the meeting, TDEC submitted a list of questions to be addressed at each Investigation Conference.
- On September 16, 2016, TVA provided TDEC with an Investigation Conference Data Transmittal for ALF. This transmittal included electronic and hard copies of supporting information files (and a file directory).
- TVA held the Investigation Conference at ALF on September 28-29, 2016. The Investigation Conference included a site reconnaissance and presentation that addressed the questions provided by TDEC on September 22, 2015.
- On February 6, 2017, TDEC provided an Investigation Conference Response Letter. The letter requested additional data, and the EIP. The list of questions and environmental investigative tasks to be addressed in the EIP is included in the letter. The deadline for submittal of the EIP was established as June 12, 2017.
- TVA submitted ALF EIP Rev 0 to TDEC on June 12, 2017.
- TDEC provided ALF Rev 0 review comments to TVA in a letter dated October 3, 2017. The comments requested TVA include responses to TDEC's General Guidelines for Environmental Investigation Plans (General Guidelines) in the ALF EIP. The General Guidelines are addressed in Section 4 of the EIP. The deadline for submittal of the ALF EIP Rev 1 was set for November 2, 2017.
- On October 16, 2017, TVA issued a response letter to TDEC requesting the EIP submittal deadline be extended to December 8, 2017. TDEC granted the request on October 18, 2017.
- TVA submitted ALF EIP Rev 1 to TDEC on December 8, 2017.
- On January 5, 2018, TDEC provided ALF Rev 1 review comments to TVA. The comments requested that TVA include the Hydrogeological Investigation SAP and Groundwater Investigation SAP; in addition to the Remedial Investigation (RI) work plan.
- TVA submitted ALF EIP Rev 1.5 to TDEC on February 16, 2018.
- On April 10, 2018, TDEC provided ALF Rev 1.5 review comments to TVA. The deadline for the ALF EIP Rev 2 was set for June 1, 2018, and then extended to July 20, 2018.

- On July 20, 2018, TVA submitted ALF EIP Rev 2 to TDEC. At this time the results of the RI were also submitted to TDEC under separate cover.

- On August 28, 2018, TDEC accepted ALF EIP Rev 2 and subsequently held an All Interested Parties meeting on September 24, 2018. A public comment period was opened from October 15 2018, to January 31, 2019, during which time TDEC held public meetings on November 1, 2018, and January 17, 2019.

- This Rev 3 has been prepared to address the comments received during the public comment period and is intended to be the final revision. The responses to specific comments, which are provided in Appenidx U of this document.

1.3 EIP IMPLEMENTATION (INVESTIGATION)

An outline and schdule of the EIP implementation is provided in Appendix A. The following pending activities/milestones are included in the EIP implementation:

- TDEC approval of the EIP

- TVA implementation the Environmental Investigation (EI).

- TVA Submittal of the EAR to TDEC, within 60 days of completion of the EI activities.

Following the EI and approval of the EAR, TVA will submit a Corrective Action/Risk Assessment (CARA) Plan to TDEC.

1.4 ALF BACKGROUND INFORMATION

1.4.1 Site History

Memphis Light, Gas, and Water (MLGW) constructed ALF between 1956 and 1959, commencing generation in 1958. From 1958 to 1960, United States Army Corps of Engineers (USACE) levees were constructed east and west of the ALF plant (Plant), creating the south dike of the West Ash Pond and the north dike of the East Ash Pond. The West Ash Pond was constructed between 1958 to 1963. The East Ash Pond was constructed between 1956 and 1963.

In 1965, TVA began leasing the plant from MLGW and the northeast corner of the East Ash Pond was receiving ash by 1967. The north and west dikes at the West Ash Pond were raised from 7 feet to 10 feet in height in 1968, and raised another 10 feet to EL 228 in 1975.

In 1977, the northeast corner of the original West Ash Pond was redeveloped to create the Chemical Treatment Pond. The East Ash Pond was temporarily taken off-line while a new divider dike was constructed from CCR, creating a stilling pond in 1978. While the divider dike and stilling pond were being constructed at the East Ash Pond, plant discharges were routed into the West Ash Pond. Plant discharges into the West Ash Pond ceased in 1978 when they were rerouted back to the East Ash Pond.

In 1983, a facility was constructed adjacent to the western edge of the East Ash Pond to beneficially re-use the ALF boiler slag, which still currently operates at the plant. In 1984, TVA purchased the Allen Fossil Plant. Between 1991 and 1992, the East Ash Pond was temporarily taken off-line and plant discharges were routed to the West Ash Pond. When the East Ash Pond went back into operation in 1992, plant discharges to the West Ash Pond ceased. The East Ash Pond Dredge Cell was constructed between 2005 and 2006 to facilitate the dredging of material for use as beneficial re-use off-site structural fill. In 2015, stormwater flows were rerouted away from the West Ash Pond and it was retrofitted to not impound stormwater.

1.4.2 Current Operations and Closure Plans

The plant ceased coal-firing operations in 2018 and will subsequently close the ash disposal area. The East Ash Disposal Area formerly received sluiced material that entered the disposal area from the west side of the facility and discharged through a National Pollutant Discharge Elimination System (NPDES) outfall in the northeast corner of the pond. The West Ash Pond, which is also not in use, has not received sluiced ash since 1992, and does not impound water.

1.4.3 Regulatory Framework

Table 1 summarizes relevant permits to this EIP issued by TDEC to TVA for the operation of ALF.

Table 1. Summary of Relevant Permits Issued by TDEC

Permit No.	TDEC Division	Permitted Activities
TN0005355	Water	Discharges via NPDES Outfall

2.0 APPROACH

The following describes TVA's overall approach for planning and conducting the EIP.

2.1 EIP DEVELOPMENT AND STRUCTURE

Responses to each TDEC information request will be developed by:

1. **Stating clear objectives and goals of the EIP Response.**

   This will be accomplished by re-stating each original information request from TDEC and identifying specific objectives for developing the information necessary to satisfy that request.

2. **Focusing on the objectives and desired outcomes of the EIP.**

   Each response will identify specific deliverables or information to respond to the request.

3. **Leveraging existing and ongoing data collection efforts, where available.**

   TVA has conducted numerous studies at ALF and has programs underway for the Environmental Protection Agency (EPA) Final CCR Rule (CCR Rule), TDEC permitting requirements, Federal permitting and program commitments, Capital Projects, normal site operations, inspections, and maintenance that can help address TDEC's information requests. In addition, TVA is currently conducting activities to characterize the hydrogeology and investigate CCR constituents in groundwater at ALF. TVA will describe how, to the extent possible, data from work already completed, ongoing, or planned will be used to meet the objectives of the information requests.

4. **Conducting on-site and/or off-site studies, activities, plans and analyses in support of the EIP tasks as needed.**

   TVA will work with TDEC to develop and execute Sampling and Analysis Plans (SAPs) to develop new data where needed to respond to TDEC's information requests. The SAPs will provide detailed plans for conducting those studies to obtain new data and will describe how it will be used to respond to specific information requests. The SAPs will be structured as independent documents that guide the work of the SAP execution teams. The SAPs will document and communicate:

   - Background information
   - Objectives
   - Health and safety program
   - Plant-specific field investigation approaches and procedures

- Data analysis approaches and procedures
- Reporting approaches and deliverables
- Quality assurance/quality control (QA/QC) objectives and program
- Schedules
- Assumptions and limitations

A brief summary of each SAP will be provided in the response to corresponding information requests. The SAPs are included as appendices to the EIP; therefore, a list of proposed SAPs can be found in the Table of Contents. Field implementation may result in minor modifications of approaches. If this occurs, changes from the procedures specified in SAPs will be communicated to TDEC and documented in the EAR. TVA will notify TDEC of problems that impede the successful completion of the field activities described in the EIP and SAPs.

Where appropriate, a phased approach will be used to execute the EIP and SAP activities. For this approach, existing and ongoing studies will be used to develop additional plans; a broad study or test will then be used to pinpoint the location of a targeted study or test when needed.

5. **Revising the EIP to address TDEC and public comments.**

   TDEC and public comments will be addressed in each EIP revision, as appropriate; however, to maintain clarity, these comments will not be listed in the EIP document. Regulatory correspondence is provided as Appendix B. Public comments will be included in Appendix U. TVA will work with TDEC and revise the EIP until a final version is approved.

Section 3, TDEC Site-Specific Environmental Investigation Requests, addresses 28 site-specific questions from TDEC's Investigation Conference Response Letter. TDEC's information requests are shown in italics. The numbering sequence and format for the requested information provided in TDEC's Letter is provided in its original form. Section 4, TDEC General Guidelines for EIP, was formatted to correlate with TDEC's General Guidelines, which correspond to 36 general information requests. Similar to Section 3, these TDEC information requests are shown in italics. This format will enhance clarity and cross-referencing between the two documents.

During the Investigation and EAR process, TVA will provide monthly progress reports to TDEC. The progress reports will include schedule updates, percent completion on various tasks, and tasks that have been completed. The progress reports will include schedule updates, percent completion on various tasks, and tasks that have been completed. The periodic submittal of schedule and status updates to TDEC is intended to help communication between TVA and TDEC throughout the Investigation.

2.2 PROPOSED SCHEDULE

A proposed EIP schedule is provided in Appendix A that assumes work will begin when TDEC approves the EIP, which will occur after the public comment and resolution period. The schedule numbering matches each information request in the sequence presented in TDEC's Investigation Conference Response Letter and provides the following:

- A timetable for the investigation and EAR submittal
- An outline of the activities required to respond to each information request
- Planned start and finish dates for each activity

Since, in most cases, TVA will use information from ongoing and planned studies for other programs to help respond to TDEC's requests, the EIP schedule incorporates TVA's milestone dates for those studies. Consequently, should postponement of a key milestone date occur for such a study that also is on the EIP critical path, it will impact EIP and EAR schedules. Should that occur, TVA may request a time extension for impacted deadlines. Requests for a time extension will include supporting information to demonstrate appropriate cause, if applicable. Any plans for construction will be subject to the completion of all necessary National Environmental Policy Act (NEPA) reviews.

2.3 QUALITY ASSURANCE PROJECT PLAN

The ALF environmental investigation Quality Assurance Project Plan (ALF QAPP) in Appendix C has been developed to ensure that the ALF investigation objectives are met by TVA and its contractors through the generation of documented, high-quality, and reliable investigative/analytical data. The ALF QAPP describes quality assurance (QA) procedures and quality control (QC) measures to be applied to investigation activities. The ALF QAPP also governs the investigation-specific SAPs and TVA Technical Instructions.

The ALF QAPP describes the QA implementation for the investigation and identifies the obligations of the various entities responsible for generating environmental data. The ALF QAPP describes the generation and use of environmental data associated with the investigation and is applicable to sampling and monitoring programs associated with the project.

The ALF QAPP establishes an overall environmental QA framework for the investigation and provides quantitative quality objectives for analytical data generated under the investigation. Requirements associated with various analyses; data generation, data reduction, and data management; and results reporting are stipulated therein.

The ALF QAPP addresses the following items:

- Project organizational structure, roles, and responsibilities
- QA objectives

- Training requirements
- Field and laboratory documentation requirements
- Sample collection, handling, and preservation
- Chain-of-Custody procedures
- Field and laboratory instrumentation and equipment calibration and maintenance
- Preventive maintenance procedures and schedules
- Laboratory procedures
- Analytical methods requirements
- Sample analysis, data reduction, validation, and reporting
- QC sample types and frequency
- QA performance and system audits
- Data assessment procedures, including processing, interpretation, and presentation
- Corrective actions
- QA reports to management

Additional investigation-specific QC requirements are presented in the associated SAPs. The ALF QAPP appendices present requirements and quantitative objectives for analytical data for each investigation. Analytical data intended for use under the ALF investigation will be managed in a database in accordance with the Data Management Plan for the TVA Multi-Site Order.

2.4 DATA MANAGEMENT PLAN

In order to address the logistics and technical challenges of managing analytical data generated to address the requirements set forth in the TDEC Order, TVA has developed Data Management Plan (DMP). On March 8, 2018, TVA submitted a revised DMP (Appendix D) which responded to comments provided by TDEC in an email dated February 7, 2018. The DMP has been developed to provide structure to support TVA and the EI/EAR Team in the pre-planning, analysis, and reporting activities identified as part of the TDEC Order.

The DMP is intended for use on TVA's seven Tennessee facilities associated with the TDEC Order, and includes the following items:

- Data Management Team structure

- Data Management Process and requirements
- EQuIS Quality and Data Management System
- System Management and Administration

Several datasets will be acquired and generated during the environmental investigations related to the TDEC Order. An EarthSoft EQuIS™ database will provide analytical data control, consistency, reliability, reproducibility and a framework for validating analytical data throughout the life of the TDEC Order. The EQuIS database is the database for analytical chemistry and field parameter data. To support the wide-array of non-analytical data management needs related to the TDEC Order, a SharePoint-based knowledge management portal (KMP) for data access and document management has been developed. The KMP will integrate the EQuIS database, geographic information system database for geospatial data, and various other datasets of historical and EIP generated deliverables. The KMP will thus serve as the central access point for the TDEC Order data including EIPs, the environmental investigation data, and other data necessary for the EAR and Corrective Action/Risk Assessment (CARA) Plan.

3.0 TDEC SITE-SPECIFIC ENVIRONMENTAL INVESTIGATION REQUESTS

TDEC requested that TVA provide responses to the following information requests presented below following the numbering sequence format of the Investigation Conference Response Letter. The information requests from TDEC are printed in italics to distinguish them from TVA's responses.

3.1 GENERAL SITE-WIDE ALF INVESTIGATION CONFERENCE QUESTIONS AND COMMENTS

3.1.1 TDEC General Site-Wide Request No. 1

Document the areas and quantities of CCR material used to construct the impoundment dikes and their foundations.

TVA Response

Exhibit 1 (Appendix E) identifies current impoundments and former disposal areas at ALF. As shown on Exhibit 1, current impoundments at ALF correspond to the West and East Ash Disposal Areas. The West Ash Disposal Area has not impounded water since the mid-1990s and it was dry and covered in vegetation prior to the effective date of the Federal CCR Rule (EPA 2015a). Thus the West Ash Disposal Area is considered closed under the Federal CCR Rule. TVA retrofitted the West Ash Disposal Area in 2015, prior to the effective date of the Federal CCR Rule, to preclude it from impounding stormwater; therefore, it is no longer an active impoundment.

The West Ash Disposal Area was constructed by MLGW from 1958 to 1963. MLGW constructed a starter dike that intersected the USACE Ensley Levee to form the West Ash Disposal Area. The Ensley Levee formed the south dike and the starter dike corresponded to the west and north dikes of the pond. The north dike intersected high ground near the powerhouse. USACE constructed the Ensley Levee using soils borrowed from areas located outside of the footprint of the West Ash Disposal Area (USACE 1958). Boring data from Stantec (2012b and 2016b) indicates the West Ash Disposal Area starter dike was constructed with silty sands and sandy silts. In 1976, the West Ash Disposal Area dikes were raised to the current elevation of 228 feet with the construction of a perimeter dike upstream (inboard) of the starter dike. As shown on TVA Drawing 10N224 in Appendix F, the perimeter dike was constructed with a 10-foot wide core zone and embankments constructed with "shell" materials.

TVA (1975) and boring data Stantec (2012b and 2016b) indicate the core and shell materials consisted of silty sands and sandy silts. Since the perimeter dike was constructed using the upstream method of construction, ash was excavated, and the foundation was stripped to prepare for the construction of the shell and core as noted in Drawing 10N224 in Appendix F. CCR has been encountered in borings advanced through the inboard shell of the perimeter dike; however, the CCR corresponds to remnant ash layers. Therefore, CCR material was not used to construct the West Ash Disposal Area dikes. The remnant ash layers will be accounted for in the CCR volume estimates discussed in Section 3.8.1.

TVA began sluicing slag to the northeast corner of the East Ash Disposal Area in 1967. The area was bounded to the north by another section of the Ensley Levee and higher ground to the east. USACE (1960) and Stantec (2010b) indicate the materials used to construct the levee consisted of low plasticity silts, silty lean clays, silty sands, and sandy silts excavated from the footprint of the East Ash Disposal Area. TVA began construction of the East Ash Disposal Area Stilling Pond and Eastern Perimeter Dike in 1976. TVA Drawings 10W225 and 10W226 in Appendix F indicate the Eastern Perimeter Dike was constructed over natural ground to an approximate elevation of 237 feet with a cross-section incorporating a ten-foot wide core with outer shells. TVA (1975) and boring data (Stantec 2010a, 2010b, and 2011) indicate the Eastern Perimeter Dike was constructed using silty sands.

Interior divider dikes in the East Ash Disposal Area were constructed using CCR (Stantec 2011). CCR used to construct the interior divider dikes will be accounted for in the volume estimates discussed in Section 3.8.1. It should be noted the interior dikes are not perimeter containment dikes and do not impound the pool of the East Ash Disposal Area Stilling Pond pool.

If a proposed boring location is discovered to have accessibility restrictions related to agricultural, cultural, biological, or other such limiting factors, then a replacement boring will be proposed at a location that will meet the study's goals with approval from TDEC

3.1.2 TDEC General Site-Wide Request No. 2

TVA should provide better information on the extent of the clay foundation for each ash pond. Permeability of foundation soil should be provided for areas where granular foundation soils were encountered.

<u>TVA Response</u>

TVA understands the information request is to evaluate the spatial extents (horizontal and vertical) and hydraulic conductivity of the various foundation soils at/near the base of perimeter dikes and CCR in both the East and West Ash Disposal Areas, including the Chemical Treatment Pond.

TVA will use existing and new supplemental data to respond to the information request. The adequacy of existing data to support this response is presented below. TVA also presents a plan for additional field efforts, to be performed as part of the investigation, to supplement existing data.

Evaluating the adequacy of existing data depends on both the type of data and its use. Regarding the spatial extents and hydraulic conductivity of the foundation soils at/near the base of perimeter dikes and CCR, existing data to be considered includes:

1. Borings that encountered foundation soils.
2. Hydraulic conductivity values based on in-situ testing.
3. Hydraulic conductivity values based on laboratory testing.
4. Hydraulic conductivity values based on published values for similar materials.

The basis for evaluating adequacy of each type of data listed above are similar for this subject:

1. Locations of in situ tests and/or samples for each material.
2. Suitability of means and methods used to perform in situ testing, collect samples, and perform laboratory testing. Suitability is evaluated qualitatively, based on how well the methods obtain the necessary data and how the methods compare to the current standard of practice.
3. Potential for relevant changes in subsurface conditions since in situ testing and/or sampling were performed.

TVA plans to use data and evaluations from the following sources to demonstrate the spatial extents and hydraulic conductivity of the foundation soils at/near the base of perimeter dikes and CCR. Refer to Appendix G for detailed evaluation of adequacy of information from each of these data sources:

Geotechnical Reports: TVA provided geotechnical and slope stability evaluation reports for the West Ash Disposal Area (Stantec 2012b and 2016b, MACTEC 2004b, TVA 1975) and East Ash Disposal Area [Geocomp (2013, 2016a)], MACTEC 2004b, Stantec (2010a, 2010b, 2011, 2015c), TVA 1975] to TDEC. This geotechnical work included performing over 100 soil borings, along with slug testing in piezometers and laboratory hydraulic conductivity testing.

Exhibits 2 and 3 (Appendix E) show the locations of existing borings relevant to understanding the spatial extents and hydraulic conductivity of the foundation soils at/near the base of perimeter dikes and CCR. Although the data are suitable for use in answering this information request, TVA recognizes there is limited in-situ and/or laboratory hydraulic conductivity data in the foundation soils at/near the base of perimeter dikes and CCR. Therefore, TVA also proposes targeted borings and laboratory hydraulic conductivity testing to supplement the existing data.

Proposed boring locations are shown on Exhibits 4 and 5 (Appendix E), and details of the proposed borings are in the Exploratory Drilling SAP (Appendix H). A summary of the proposed borings and testing is as follows:

- At the West Ash Disposal Area (including Chemical Treatment Pond), a total of seventeen borings are proposed, to address multiple data needs for the EAR. Thirteen of the proposed borings are primarily for CCR extents and material quantity derivation, and could also provide samples for laboratory hydraulic conductivity testing. The remaining four borings are primarily to provide samples for laboratory hydraulic conductivity testing.

- At the East Ash Disposal Area (including the Harsco Area and Coal Yard Runoff Pond), a total of nineteen borings are proposed, to address multiple data needs for the EAR. Nine of the proposed borings are primarily for CCR extents and material quantity derivation, and could also provide samples for laboratory hydraulic conductivity testing. The remaining ten borings are primarily to provide samples for laboratory hydraulic conductivity testing.

After evaluating the adequacy of the existing and proposed borings and testing presented above and in Appendix G, the data are considered suitable for use in answering this information request.

3.1.3 TDEC General Site-Wide Request No. 3

USACE levees constructed at the Allen Fossil Plant are being used as the Southern Dike for the West Ash Pond and Northern Dike for the East Ash Pond. Please provide a copy of the Agreement between TVA and USACE for these levees to be used as dikes for the ash ponds. Is there a memorandum of agreement between TVA and USACE regarding the levees? If there is an agreement, please include it in the EIP. Is TVA required to coordinate any of the proposed environmental investigation work at the TVA ALF site with the USACE? Is TVA required to submit plans for environmental investigation of this site to USACE for review and approval pursuant to Section 408 of the River and Harbors Act? If yes, please explain the review and approval process.

TVA Response

Due to the age of the levees and CCR unit construction, TVA has not identified a formal agreement (or memorandum of agreement [MOA]) between TVA and USACE regarding the levees. However, the USACE Levee construction drawing for the East Ash Disposal Area (Item No. L-725, Serial 16362, File 153/L-9, 5/02/1960) in Appendix F identifies the ash sluice lines/ditch, and provides a proposed ash fill net grade behind the USACE Levee.

In addition, Section 408 of the Rivers and Harbors Act authorizes USACE to review proposed alterations (temporary or permanent), occupancy, and use of the levees to ensure the proposed activities do not "affect the ability of the USACE project to meet its authorized purpose." Requests to alter, occupy, and use the levees are submitted to USACE via a Section 408 Permit Request Form (Appendix I).

USACE uses guidance provided in Engineer Circular 1165-2-220 to process Section 408 Requests (Appendix J). In the past, TVA has submitted Section 408 Permit Requests to USACE for proposed alterations, environmental and geotechnical investigations on the USACE levee, and any other activity that may impact the levee. The requests included the Section 408 Permit Request Form, a summary of the scope of work, and a boring layout plan (if applicable).

3.2 GENERAL – MEMORANDUM OF AGREEMENT

3.2.1 TDEC Memorandum of Agreement Request No. 1

The City of Memphis and MLGW owns the majority of the West Ash Pond Disposal Area. How will the ownership of this area affect the environmental investigation at the TVA ALF site?

TVA Response

The City of Memphis, Shelby County, the Memphis and Shelby County Port Commission, and MLGW (hereinafter collectively, "Local Entities") entered into a MOA with TVA in 2016 to establish a framework for the management and disposal of coal ash at ALF. This framework addresses compliance with the CCR Rule and TDEC Order, legal responsibilities, coordination, and TVA easement rights.

The MOA states:

1. The Local Entities agree that to meet their potential responsibilities under the CCR Rule and to better ensure that the TDEC Order can be complied with expeditiously and cost effectively, it is necessary that they cooperate with TVA in its implementation of CCR Rule and the TDEC Order activities.

2. Subject to other provisions of this MOA, TVA shall have sole authority to determine what actions are necessary to implement the CCR Rule and the TDEC Order.

Provisions referenced in the second statement above require the following:

- TVA provide quarterly updates to the Local Entities regarding compliance with the TDEC Order and the CCR Rule

- Review and approve proposed actions that impact infrastructure owned by the City of Memphis and MLGW

- TVA alert the Local Entities regarding CCR management information that TVA plans to release to the public
- TVA provide copies of compliance documents associated with the TDEC Order and the CCR Rule including the EIP, EAR, CARA Plan, and the groundwater monitoring plan

The MOA is provided as Appendix K.

3.2.2 TDEC Memorandum of Agreement Request No. 2

The City of Memphis and MLGW owns the majority of the West Ash Pond Disposal Area. How will the complex ownership affect the potential closure? Does TVA have an agreement with the City of Memphis and Shelby County that allows TVA to leave CCR material in place should closure-in-place be an approved corrective action option. If so, please provide the documentation in the TVA ALF EIP.

TVA Response

Please reference the response in Section 3.2.1 of this EIP as it addresses the majority of this information request. Section IV of the MOA states TVA is not required to obtain approval from the Local Entities to take actions to comply with the CCR Rule and the TDEC Order unless such actions affect infrastructure owned by these Local Entities. These actions include operating and closing ash ponds to comply with the CCR Rule and TDEC Order. The MOA is provided as Appendix K.

3.2.3 TDEC Memorandum of Agreement Request No. 3

What are the requirements for closure under the Memorandum of Agreement? Any there restrictions under the agreement?

TVA Response

Restrictions under the MOA (Appendix K) are discussed in Section 3.2.2.

3.2.4 TDEC Memorandum of Agreement Request No. 4

Provide a map and description of the ash fill for each pond contained in the easement and referenced in the Memorandum of Agreement. On the map, please provide the elevations of the impoundments.

TVA Response

As shown in Exhibit 1, the West and East Ash Disposal Areas are located within the easement referenced in the MOA. The normal pool elevation of the East Ash Disposal Area Stilling Pond is 225.39 feet.

The average of the East Ash Disposal Area Stilling Pond water surface elevation measurements collected at 5-minute intervals over the last 12 months is 225.63 feet. No process water has been sluiced to the West Ash Disposal Area since 1992 and TVA retrofitted the disposal unit in 2015 to preclude it from impounding stormwater; therefore, a normal pool elevation is not applicable to the West Ash Disposal Area. Dike and other elevations of the West and East Ash Disposal Areas will be shown on cross sections developed from three-dimensional models as discussed in the Material Quantity SAP (Appendix F).

CCR fill in the West Ash Disposal Area consists of sluiced slag and fly ash. The West Ash Disposal Area has historically been utilized for intermittent CCR disposal during times of maintenance, and has not taken significant CCR disposal since about 1992.

CCR fill in the East Ash Disposal Area consists of sluiced slag and fly ash. As described in Stantec (2011), starting in the late 1960s, slag was sluiced into the East Ash Disposal Area via a discharge point in the northwest corner. In late 1969, the plant began sluicing fly ash via a separate pipe system that also discharged into the northwest corner of the East Ash Disposal Area. In 1983, a private company (now Harsco) obtained a license to use property from TVA and started reclaiming and processing the slag from this area and selling it off-site. The East Ash Disposal Area no longer receives sluiced slag and fly ash from the ALF coal-fired units, which were retired in 2018.

3.2.5 TDEC Memorandum of Agreement Request No. 5

TVA shall notify TDEC of any modifications to the memorandum of agreement between TVA and local governmental entities. TVA shall provide TDEC with quarterly updates to the Local Entities.

TVA Response

If modifications occur in the future, TVA will report modifications to the MOA to TDEC. When TVA updates the Local Entities on either the TDEC Order and/or the CCR Rule, TVA will send any written documentation presented in the quarterly meeting to TDEC.

3.3 GROUNDWATER MONITORING

3.3.1 TDEC Groundwater Monitoring Request No. 1

TVA shall provide TDEC with the opportunity to review and comment on the proposed background well location(s) once the site has been fully characterized and prior to establishing the groundwater monitoring well network.

TVA Response

TVA has completed many studies at ALF and has programs underway for CCR Rule, normal site operations, inspections and maintenance. In addition, TVA completed RI activities to characterize the hydrogeology and investigate CCR constituents in groundwater at the East Ash Disposal Area. A list of documents related to the RI is included in Appendix L. These documents, along with future RI related documents, will be used to support this work. The objectives of the RI activities included potential source area characterization; horizontal and vertical delineation of CCR constituents in the water table aquifer through the installation and sampling of permanent monitoring wells; and characterization of the water table aquifer with a network of shallow, intermediate, and deep permanent monitoring wells to evaluate groundwater quality, elevations and hydraulic conductivity within the water table aquifer. Under the direction of TDEC, TVA is currently completing an Updated RI Report that includes data generated during supplemental RI activities. The supplemental RI was conducted to provide additional information near the East Ash Disposal Area.

The results of the RI activities described above will provide information to address many of TDEC's requests for the TDEC Order EIP. The objectives of the TDEC Order EI for the hydrogeological investigation are to install monitoring wells to characterize vertical and horizontal hydraulic gradients within the water table aquifer, provide groundwater investigation sampling locations, and characterize the hydraulic conductivity at the site. The RI activities included the installation of additional shallow, intermediate and deep monitoring wells within the water table aquifer as shown on Exhibit 6 (Appendix E). This includes a proposed deep background well.

The objectives of the EI for the groundwater investigation are to provide the procedures necessary to characterize existing groundwater quality and evaluate groundwater flow conditions at ALF. The RI activities included four rounds of groundwater level measurement and sample collection for the East Ash Disposal Area. Additional sampling may be conducted as part of the RI work, if needed, to characterize groundwater quality. The results of the sampling conducted as part of the RI activities will be included in the EAR.

Based on the similarities between the RI activities and TDEC Order EI objectives, TVA plans to provide the results of the investigations in the TDEC Order EAR.

If, based on the results of the RI work, data gaps are identified that require additional information to meet the objectives of the TDEC Order, then TVA will propose additional investigations to address the data gaps and submit plans to TDEC for review.

TVA has developed an approach to define the hydrogeological characterization around the West Ash Disposal Area. This approach is an iterative investigation and is a cooperative effort with TDEC. TVA would prefer to complete the initial phase of the investigation and jointly review the results with TDEC to identify data gaps. If data gaps exist, TVA will fill those gaps with additional investigation in collaboration with TDEC.

As part of TVA's ongoing investigations, two new potential background monitoring wells (ALF-210 and ALF-210A) were installed upgradient of the West Ash Disposal Area in the unconsolidated deposits. Monitoring well ALF-210 was installed in the shallow portion of the alluvial aquifer and ALF-210A was installed in the deep portion of the alluvial aquifer immediately above the confining layer between the alluvial aquifer and the underlying Memphis aquifer. Both wells were installed in a similar geological setting as the ALF well network. In addition, six other monitoring wells (ALF-207, ALF-207A, ALF-208, ALF-208A, ALF-209 and ALF-209A) were installed in potential downgradient locations north of the West Ash Disposal Area in the unconsolidated deposits in the shallow and deep portions of the alluvial aquifer. Exhibit 7 (Appendix E) shows the locations of the new monitoring wells. TVA proposes to collect groundwater samples from these existing monitoring wells and review the analytical results as a part of the EI. After the EI is completed, the results of sampling the new potential background wells will be evaluated to determine if they are in suitable background locations. The proposed background well locations will be provided to TDEC for review and comment.

As part of the EI, TVA will install ten additional monitoring wells in the shallow, intermediate and deep portions of the alluvial aquifer to evaluate groundwater flow direction, quality, and vertical gradients within the alluvial aquifer near the West Ash Disposal Area. Monitoring wells will be installed under the supervision of a Tennessee licensed Professional Geologist. One well (ALF-210B) will be installed to serve as a potential background monitoring well for the intermediate portion of the alluvial aquifer. In addition, three wells (ALF-207B, ALF-208B and ALF-209B) will be installed downgradient of the West Ash Disposal Area in the intermediate portion of the alluvial aquifer and co-located with existing wells ALF-207/ALF-207A, ALF-208/ALF-208A and ALF-209/ALF-209A installed within the shallow and deep portions of the alluvial aquifer. Three wells (ALF-218, ALF-218A and ALF-218B) will be installed west and three wells (ALF-219, ALF-219A and ALF-219B) will be installed southeast of the West Ash Disposal Area in the shallow, intermediate and deep portions of the alluvial aquifer. The proposed locations for monitoring wells west and southeast of the unit were constrained by the USACE levee and easement near the southern boundary of the West Ash Disposal Area. In addition, CCR material may be located near the eastern boundary of the West Ash Disposal Area and western boundary of the chemical pond.

The screened intervals for the deep wells are proposed to be placed near the bottom of the alluvial aquifer, immediately above the confining layer between the alluvial aquifer and the underlying Memphis aquifer. The vertical placement near the bottom of the alluvial aquifer was selected to provide a sampling point to characterize groundwater quality at the deepest part of the alluvial aquifer and the potential for CCR constituents to migrate to the Memphis aquifer. The shallow and intermediate well locations will provide additional information to evaluate vertical gradients. Exhibit 7 (Appendix E) shows the proposed monitoring well locations.

Additional monitoring wells are not proposed south of the West Ash Disposal Area because the southern boundary of the West Ash Disposal Area abuts a levee owned by the USACE, who has denied TVA requests to drill through the levee. In addition, TVA does not own the property south of the levee and access has been denied by the property owner due to the implementation of an upgrade project for the T.E. Maxson Wastewater Treatment Facility.

Monitoring wells within the interior of the West Ash Disposal Area are not proposed at this time. The West Ash Disposal Area is no longer in use and installation of monitoring wells within and below the unit would require breaching the bottom of the unit, which could potentially result in vertical migration of CCR constituents.

TVA plans to install and monitor the deeper wells to evaluate groundwater quality prior to determining the need for drilling through the Claiborne confining layer to install monitoring points in the Memphis aquifer. If analytical results from samples collected from the deeper monitoring wells suggest the potential for migration of CCR constituents from the CCR unit to the confining unit, then TVA will develop a plan to characterize the lithology of the confining layer underlying the alluvial aquifer.

Details of the proposed well installations near the West Ash Disposal Area are included in the Hydrogeological Investigation SAP provided in Appendix M. The Hydrogeological Investigation SAP includes descriptions of drilling methods and soil logging procedures necessary to achieve the scope of the exploration and that will comply with local, state and federal standards as well as the requirements within the TDEC EIP request letter. The SAP also includes an implementation schedule, which outlines when the monitoring wells will be constructed and developed to provide representative groundwater samples. The results of the hydrogeological characterization will be provided in the EAR.

The proposed monitoring wells will be used to describe subsurface lithology and collect groundwater levels and samples from the alluvial aquifer. Groundwater samples will be analyzed for the CCR constituents listed in 40 Code of Federal Regulations (CFR) Part 257, Appendices III and IV, along with additional parameters required by the state groundwater monitoring program (copper, nickel, silver, vanadium, and zinc) to evaluate groundwater chemistry. These constituents will be hereafter referred to as “CCR Parameters.”

In addition, groundwater samples will be analyzed for major cations/anions and total alkalinity (magnesium, potassium, sodium, carbonate and bicarbonate). Sampling procedures and parameters are included in the Groundwater Investigation SAP provided in Appendix N. Piper diagrams will be used to classify groundwater samples according to their major ionic composition. Groundwater sample results from background and downgradient monitoring wells will be included in the evaluation. Additional Piper diagram comparisons of individual CCR units or geological formations may be included based on the results of the hydrogeological investigation. If, after completion of the above referenced investigations and others included in this EIP, data gaps exist, then TVA, in communication with TDEC, will perform additional investigations to fill those data gaps. The results of the investigations will be reported in the EAR.

The selection of background and downgradient monitoring wells proposed in this EIP will be finalized after monitoring bimonthly for one year (i.e., six sampling events, one every other month) to evaluate if the wells are appropriate network monitoring wells. TVA will provide this evaluation, including updated groundwater contour maps showing current groundwater flow conditions, to TDEC for input and concurrence prior to finalizing the monitoring well networks for each CCR unit.

3.3.2 TDEC Groundwater Monitoring Request No. 2

The elevation of McKellar Lake should be recorded, on the same datum as the groundwater elevation data, during all groundwater monitoring events. This information should be included with all groundwater monitoring well water levels. This data should also be considered in mapping and identifying the upper most aquifer.

TVA Response

This request is related to work being conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request.

TVA has established a surface water gauging station to measure the elevation of McKellar Lake. This station is currently automated with instrumentation to record the elevation of McKellar Lake in 5-minute intervals. Future groundwater elevation measurements collected near the West Ash Disposal Area will be collected in accordance with schedules included in the Groundwater Investigation SAP in Appendix N. Lake McKellar water levels will be recorded concurrently with groundwater monitoring events to investigate the correlation with groundwater levels in the water table aquifer. McKellar Lake and groundwater elevation data collected during these events will be recorded on the same datum and submitted to TDEC in the EAR.

3.3.3 TDEC Groundwater Monitoring Request No. 3

Sediment samples should be collected from the screened interval during the installation of new groundwater monitoring wells. These samples should be analyzed, utilizing the appropriate LEAF method, for Appendix III and IV of the Federal CCR rules.

TVA Response

TVA has interpreted this request to be for collecting soil samples from the screened interval of new background monitoring wells. In addition, the request for leachability testing is understood to be for soils in the unsaturated zone or near the water table. Leachability objectives can best be achieved by evaluating data from groundwater samples collected from the proposed monitoring well locations which are co-located with existing wells.

Instead of using a predictive leachate model to estimate CCR parameter levels, groundwater samples are more likely to provide representative and real-time levels of parameters that have leached from the native soils. TVA's approach in obtaining the real-time leaching data consists of the following steps:

1. Research and review existing CCR leachability documentation
2. Collect soil samples
3. Collect groundwater samples
4. Analyze samples for CCR Parameters (listed in following paragraph) per the applicable SAPs
5. Review and evaluate existing and new analytical data

Monitoring well installation was conducted as part of the RI activities as discussed in Section 3.3.1. Soil samples were collected from the screened intervals of the new potential background groundwater monitoring wells during installation to evaluate total concentrations of CCR constituents. The soil samples were analyzed for CCR Parameters.

In addition, as discussed in Section 4.1.1, soil samples will be collected from the screened intervals of the proposed background monitoring wells as part of the EI activities. The soil samples will be analyzed for CCR Parameters, and one sample will be analyzed for fraction organic carbon.

The results of the soil and groundwater analyses will be included in the EAR. Should background monitoring areas be impacted by specific CCR Parameters (identified during the environmental investigation), a second phase of sampling and leachability testing of the background groundwater and soils (for those specific CCR Parameters identified from the laboratory analyses) will be implemented for the impacted areas in conjunction and coordination with any other investigative work plans.

3.3.4 TDEC Groundwater Monitoring Request No. 4

TVA shall submit reports for all groundwater monitoring events for each unit to TDEC.

TVA Response

Historical and ongoing groundwater monitoring reports for the East and West Ash Disposal Areas have been and will be submitted to TDEC. Historical data have been collected for a variety of reasons since approximately 1988. TVA may use these historical data for qualitative purposes, but only data evaluated in accordance with the ALF QAPP will be used quantitatively. Report submittals will include voluntary groundwater monitoring by the Utility Solid Waste Activities Group reports, CCR Rule groundwater quality monitoring reports, and reports prepared for the RI activities discussed in Section 3.3.1.

The EAR will include a discussion of the existing and abandoned or closed monitoring wells and the analytical results for samples collected from these sampling points.

3.3.5 TDEC Groundwater Monitoring Request No. 5

TVA shall investigate the hydrogeology in the vicinity of the ash ponds with respect to vertical gradients in the water table aquifer. This investigation shall also evaluate the lithology of the confining unit underlying the water table aquifer and establish monitoring points in the upper portion of the underlying Memphis Sands Aquifer.

TVA Response

This request is related to work being conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request. Hydrogeological characterization activities associated with the evaluation of vertical gradients, the confining unit and Memphis Sand aquifer were completed as part of the RI and additional investigation will be conducted as part of the proposed EI activities discussed in Section 3.3.1. In addition, four stratigraphic borings have been advanced into the Claiborne confining layer. The results of these investigations will be included in the EAR.

3.3.6 TDEC Groundwater Monitoring Request No. 6

TVA shall provide an assessment of the impact pumpage from TVA's newly established water withdrawal wells may have on the potentiometric surface within the Memphis Sands Aquifer and the water table aquifer.

TVA Response

This request is related to work being conducted as part of the RI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request. Hydrogeological characterization and pumpage assessment activities associated with the newly installed production wells was completed as part of the RI activities discussed in Section 3.3.1 and will be provided in the EAR.

3.4 WEST ASH POND

3.4.1 TDEC West Ash Pond Request No. 1

Groundwater monitoring data should be provided for the West Ash Pond to determine the criteria for proper closure, should closure-in-place be an approved Corrective Action measure for the TVA ALF CCR surface impoundments.

TVA Response

This request is related to work being conducted as part of the proposed EI activities for the West Ash Disposal Area as discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request.

3.4.2 TDEC West Ash Pond Request No. 2

TVA should supply the history of seeps discovered on and around the West Ash Pond's dike and the actions taken to repair the seeps. TVA shall also identify any seeps that were repaired but continue to discharge water. For repaired seeps that continue to allow water to discharge TVA shall explain why each seep continues to flow and how the partially treated wastewater flowing from the seep is managed.

TVA Response

TVA has conducted annual dike inspections at ALF since 1970. These inspections focused on stability issues pertaining to seeps. NPDES Permit No. TN0005355 was issued by TDEC to the TVA Allen Fossil Plant on August 4, 2005. The permit expired on August 3, 2010, but because TVA submitted an application for renewal, the permit is administratively continued in accordance with 40 CFR 122.6.

Under the NPDES permit, TVA visually inspects the dikes and toe areas at least quarterly for seepage and submits an annual report to the TDEC Memphis Environmental Field

Office documenting the findings of the inspections and any remedial activities implemented.

A map depicting historical seepage areas is shown on Exhibit 8 (Appendix E), including detailed information from the ALF seepage log which was initiated in 2012. In this log, seeps are identified by a unique number, date of discovery, description, size, mitigation status, and current status.

During the operational period of 1991-1992, seepage was observed in the vicinity of the outlet end of the discharge pipe at the northeast corner of the West Ash Disposal Area. After cessation of pond use in 1992, the seep dried up and has been inactive since. Seep areas were numbered beginning in the 2011 Annual Inspection Program. Seep 3 was located on the exterior of the north slope of the Chemical Treatment Pond and was identified during the removal of trees and underbrush from the dike slope in February of 2010. This wet area was not evident during the following annual inspections after the embankment improvements. On April 22, 2014, it was reported in the ALF Seepage Log that the seep/wet area had been inactive for several inspections. Seep 3 remains dry and inactive.

A summary of the seep history from the ALF West Ash Disposal Area will be included in the EAR.

3.5 EAST ASH POND

3.5.1 TDEC East Ash Pond Request No. 1

TVA has a neighbor adjacent to its TVA ALF site, Reeds Material Harsco Corporation. The Commissioner's Order requires TVA to fully determine the location and amount of CCR material disposed at each TVA Fossil Plant site. Please describe in the TVA ALF EIP how TVA will determine that the Harsco beneficial reuse area and the coal run-off pond are not located over or contain quantities of CCR.

TVA Response

Harsco has a license to use property from TVA located west of the East Ash Disposal Area. Harsco operates a facility on this property where CCR from ALF and other plants is stored in a pile and processed for beneficial reuse in roofing shingles and other products. Harsco is not a utility subject to the CCR Rule, as it is not an owner/operator of an electric utility or independent power producer as defined in NAICS code 221112.

CCR stored in piles prior to off-site transport for beneficial use is regulated under the CCR Rule by EPA (see 80 Fed. Reg. at 21356). However, EPA has stated that as long as CCR has not been discarded, but rather managed as a product, the materials are not regulated as solid wastes and their placement on the land is not considered disposal (see 80 Fed. Reg. at 21348). The CCR stored at Harsco is treated as a valuable raw material into a production process rather than as something that is intended to be discarded.

While the Harsco Area is not a CCR disposal area, TVA will evaluate whether subsurface materials below the Harsco Area and Coal Yard Runoff Pond include CCR placed during historical operations. The scope of work to estimate the location and quantities of CCR (if located) is similar to the scope to respond to the information requested in Section 3.8.1; therefore, the scope to address this information request is addressed in Section 3.8.1.

3.5.2 TDEC East Ash Pond Request No. 2

The NPDES effluent discharge limits for the East Ash Disposal Area for the TVA ALF site should be confirmed in the EIP.

TVA Response

NPDES Permit No. TN0005355 was issued by TDEC to the TVA Allen Fossil Plant on August 4, 2005. The permit expired on August 3, 2010, but because TVA submitted an application for renewal, the permit is administratively continued in accordance with 40 CFR 122.6.

ALF is authorized to discharge ash transport water, treated chemical and nonchemical metal cleaning wastewaters, coal pile runoff, low volume wastes, ammoniated wastewater from selective catalytic reduction NOx removal equipment, and stormwater runoff from Outfalls 001 and 001A (emergency only) to McKellar lake at mile 725.6 of the Mississippi River (Outfall 001) and the Horn Lake cut-off to McKellar Lake (001A). These outfalls discharge effluent from the East Ash Disposal Area.

Outfall 001A shall be limited and monitored by the permittee as specified below only during warranted periods when the Mississippi River is in flood stage or during emergency repairs/modifications of Outfall 001. During non-flood stage periods and periods when there are no emergency repairs/modifications, only Outfall 001 shall be limited and monitored by the permittee as specified below. Table 2 below lists the permit limits for the East Ash Disposal Area found in NPDES Permit No. TN0005355:

Table 2. NPDES Permit Limits for Outfalls 001 and 001A (East Ash Disposal Area)

Effluent Characteristic	Effluent Limitations				Monitoring Requirements	
	Monthly		Daily			
	Avg. Conc. (mg/L)	Avg. Amnt. (lb/day)	Max. Conc. (mg/L)	Max. Amnt. (lb/day)	Msrmnt. Frequency	Sample Type
Flow	Report (MGD)*		Report (MGD)*		1/week	Instantaneous
pH**	Range 6.0 – 9.0				1/week	Grab
Oil and Grease	15.0	------	20.0	------	1/month	Grab
Total Suspended Solids (TSS)	30.0	------	100.0	------	1/month	Grab
Nitrogen, Ammonia Total (Plant Intake)	------	------	Report	Report	2/month	Grab
Nitrogen, Ammonia Total (Effluent)	------	------	Report	Report	2/month	Grab
Nitrogen, Ammonia Total (Net Discharge)	------	------	Report****	Report	2/month	Calculated
Copper, Total	------	------	Report	------	1/year	Grab
Lead, Total	------	------	Report	------	1/year	Grab
Mercury, Total	------	------	Report	------	1/year	Grab
Selenium, Total	------	------	Report	------	1/year	Grab
Cadmium, Total	------	------	Report	------	1/year	Grab
Chromium, Total	------	------	Report	------	1/year	Grab
Iron, Total	------	------	Report	------	1/year	Grab
Manganese, Total	------	------	Report	------	1/year	Grab
Silver, Total	------	------	Report	------	1/year	Grab
48-hour LC50	Survival in 100% Effluent				Annually	Grab***

Note: The permitted shall take reasonable steps to prevent discharge of cenospheres other than in trace amounts from the outfall.

* Flow shall be reported in Million Gallons per Day (MGD)
** pH analyses shall be performed within fifteen (15) minutes of sample collection
*** See part III of permit for methodology
**** If a calculated value for net addition of ammonia as nitrogen exceeds an action concentration value of 1.0 mg/L, the permittee should investigate source(s) of ammonia, and proceed with a corrective action(s), if necessary. Furthermore, notify the Memphis Field Office within 24 hours from the time the permittee receives results indicating that an action value of 1.0 mg/L was exceeded.
mg/L – milligrams per liter
lb/day – pounds per day
LC50 – lethal concentration, 50%

3.5.3 TDEC East Ash Pond Request No. 3

TVA should provide the monthly instrumentation summary that reports the action taken for each of the six water level elevation exceedances referenced in the July 28, 2016 Intermediate Inspection of CCR Facilities.

TVA Response

As part of TVA's compliance with the CCR Rule and as needed for its Dam Safety Program, monthly reports are written [Stantec 2015a, 2015b, 2015d, 2016a, 2016c through 2016g, 2016i] which provide explanations for each of the piezometer exceedances referenced in this information request. These monthly reports will be provided to TDEC under separate cover.

Per TVA's Instrumentation and Monitoring Plan for CCR units (Stantec and AECOM 2016), piezometer readings are reviewed on a specified interval and compared against pre-established threshold, action, and notification levels. These levels are typically established based on long-term drained slope stability analyses and expected piezometric conditions, as well as comparisons to historical data trends. An "exceedance" occurs when a routine piezometer reading is above an established threshold, action, or notification level. When an exceedance occurs, TVA implements a phased response as appropriate:

- Field interpretation (immediate repeat reading, applicable to manual readings only)
- Field response (applicable to manual readings only),
  - 24-hour repeat reading
  - Visual inspection of surrounding area for signs of seepage, instability, etc.
  - Notifications to responsible parties
- Automated data threshold assessment
  - Alert to responsible parties with type of exceedance and current reading
  - Review of recent readings and other pertinent data (river levels, nearby instrument readings, etc.)
  - Increased frequency of monitoring and evaluation of data
  - Site visit (field review of existing conditions)
  - Reanalysis of slope stability and/or seepage concerns, as appropriate

- Increased visual monitoring
- Temporary stability improvements
- Assessment of temporary stability improvements
- Additional instrumentation

For the ALF exceedances referenced in the information request, each was reviewed in accordance with TVA's established Plan. Some exceedances were found to be anomalous readings (i.e., short term spikes) by the automated piezometers. Several of the exceedances were correlated to heavy precipitation in the vicinity. Slope stability analyses (included in the monthly report) were performed that account for the actual piezometer readings (i.e., elevated pore water pressures in the soils and/or CCR) at the time of the exceedance. In each of these cases, the resulting slope stability factors of safety were well above the acceptance criteria and no further action was required. A summary of these events and action taken will be included in the EAR.

3.5.4 TDEC East Ash Pond Request No. 4

Clarify if the minimum depth of CCR material (4.4 feet) reported for the East Ash Disposal Area Intermediate Inspection is located in the east active ash pond or the East Stilling pond.

TVA Response

The minimum depth of CCR reported as 4.4 feet was located within the Stilling Pond of the East Ash Disposal Area and was determined from a recent hydrographic survey.

3.5.5 TDEC East Ash Pond Request No. 5

TVA should supply the history of seeps discovered on and around the West Ash Pond's dike and the actions taken to repair the seeps. TVA shall also identify any seeps that were repaired but continue to discharge water. For repaired seeps that continue to allow water to discharge TVA shall explain why each seep continues to flow and how the partially treated wastewater flowing from the seep is managed.

TVA Response

TVA interprets that this information request was intended to address the seeps associated with the East Ash Disposal Area dike as opposed to the West Ash Disposal Area dike which was addressed in Section 3.4.2. A map depicting historical seepage areas is shown on Exhibit 8 (Appendix E), including detailed information from the ALF seepage log.

Seep 1 was initially identified in the 1997 annual inspection report, and was located on the eastern slope of the East Ash Disposal Area Stilling Pond. This seep was intermittently observed during inspections in the following years. In 2011, TVA lowered the Stilling Pond elevation as documented in Stantec (2012a). This project primarily consisted of constructing a rip-rap blanket along the east side of the internal divider dike and lowering the Stilling Pond elevation from 230 Mean Sea Level (MSL) to 226 MSL. Various non-flowing seeps were observed during the 2012 Annual Inspection on the East and South Embankment. These seeps were not observed during the following 2013 annual inspection. This is most likely a result of the lowering of the Stilling Pond. Seep 1 remains dry and inactive. The Seep SAP will characterize the soil in the vicinity of Seep No. 1 through the collection of surficial soil samples from that area, and analyze the samples for the CCR Parameters. The Seep SAP is located in Appendix O.

Seeps 2 and 4 were identified in 1999 and 2010, respectively, in the vicinity of the Fuel Oil Unloading Ramp abutment. The ALF NPDES permit requires that the plant conduct quarterly red water seep inspections. While this is how the seeps are generically referred to, any seeps are identified regardless of whether they are "red water" or clear water seeps. The 2011 Red water seep inspection report states that two seeps were observed during the quarterly inspections. This report also concluded that the seeps originated from the same source because of their proximity to each other. The 2011 inspection report noted that the seepage is not adjacent to a CCR disposal area and noted that it does increase with McKellar Lake levels. Samples were taken from each seep source and from nearby process water sources. An isotopic analysis was performed on each of the samples. Results of the analyses determined that the source of the seep water is not process water from ALF (TVA 2011).

A graded filter was installed for Seep 2 in 2012 as part of the North Dike Seep Remedial Works Project. The 2013 Annual Inspection noted that a well-defined drainage flow was observed at the toe of the repair area. Subsequent red water seep inspection reports also document the continued seep flow. TDEC recently approved a permit for construction of a reverse graded filter over Seeps 2 and 4 as a mitigation measure. Both seeps continue to flow, with frequent monitoring.

Seeps 5 and 6 are located northeast of the combustion turbine fuel storage tanks. Seep flows are collected in a concrete channel, and pumped to the East Ash Disposal Area. From there, the seepage water is comingled with the East Ash Disposal Area process water and discharged through the NPDES-permitted outfall.

A summary of the seep history from the ALF East Pond will be included in the EAR.

3.6 JUNE 2016 PART II – SITE SPECIFIC NEPA REVIEW: ALLEN FOSSIL PLANT

3.6.1 TDEC Site-Specific NEPA Review Request No. 1

Provide the information and documents used to determine the seismic stability of the West Ash Impoundment referenced in the TVA ALF NEPA Review.

TVA Response

Seismic stability has not been analyzed for the West Ash Disposal Area, but will be analyzed per the Stability SAP (Appendix P). The SAP discusses the existing and proposed seismic slope stability and liquefaction triggering analyses that will be used to support the response in the EAR. Additional discussion regarding the Stability SAP and existing and proposed stability analyses (static and seismic) can be found in Sections 4.4.6 and 4.4.12.

3.6.2 TDEC Site-Specific NEPA Review Request No. 2

Clarify the required quantity of off-site borrow material necessary to grade and cover the site referenced in the NEPA document should closure-in-place be an acceptable Corrective Action measure for the TVA ALF surface impoundments. Is there enough on-site borrow material to complete closure- in-place for the CCR surface impoundments should this be an acceptable Corrective Action measure and if so does TVA plan to use it for this site.

TVA Response

The NEPA programmatic EIS document (TVA 2016b) addressed the closure of the West Ash Disposal Area. This document lists an estimated 15,000 cubic yards of borrow material needed for continued closure of the West Ash Disposal Area. This document also includes proposed off-site borrow areas. TVA is preparing a separate NEPA Environmental Assessment document for the closure of the East Ash Disposal Area. Off-site borrow material will be required for the closure of both CCR units.

TVA will include borrow estimates and report potential off-site borrow locations for the closure of both CCR units in the EAR.

3.7 MISCELLANEOUS

3.7.1 TDEC Miscellaneous Request No. 1

TVA should include in the TVA ALF EIP an updated map with details and cross-sections of soil borings, piezometers, and monitoring well locations that will provide a better understanding of the site subsurface geology (specifically beneath the ponds). The total depth and screen interval should be included in each cross-section.

TVA Response

Maps showing existing soil boring and piezometer locations in the eastern and northern perimeter dike areas of the East Ash Pond and in the northern perimeter dike area of the West Ash Pond are included in Appendix Q. The logs from the previous investigative activities were used to model cross-sections for stability analyses. Weaker zones in these cross-sections may be conservatively modeled (extent, thickness, and strength parameters) for the purposes of evaluating stability. The cross-sections show total depths of soil borings, and groundwater levels encountered during drilling. The cross-sections also include the available soil boring logs and soil moisture content information. The cross-section soil boring logs and associated cross-sections are included in Appendix Q. Updated cross-sections will be prepared to illustrate subsurface geology and hydrogeology with the new soil boring, piezometer, and monitoring well data, including well screen intervals, collected in the investigation and other ongoing investigations will be provided in the EAR.

Cross-section figures from data collected at the eastern perimeter dike area of the East Ash Pond are from Stantec (2010a) and cross-section figures from the northern perimeter dike area of the East Ash Pond are from Stantec (2010b). Cross-section figures from data collected from the northern perimeter dike area of the West Ash Pond are from Stantec (2016b).

3.7.2 TDEC Miscellaneous Request No. 2

For ground water monitoring wells, cross-sections should also include the soil boring logs on the drawing and ground water levels at the time of the boring. Characterization the moisture content of the various soils involved should be shown (if known).

TVA Response

The response to this information request is similar to Miscellaneous Information Request No. 1. The response to this request is included in Section 3.7.1.

3.7.3 TDEC Miscellaneous Request No. 3

TVA should also include USACE soil borings from the Ensley Levee construction documents.

TVA Response

TVA previously requested the referenced soil borings from USACE, but they were unable to provide them. As such, the available information is limited to two USACE drawings, both of which were provided to TDEC through the Investigation Conference data transmittal:

- USACE (1958). "Proposed Levee Work, Item No. L-723, Ensley, Tenn." Drawing No. 1, Serial 15821, File 153/L-46. Includes as built markings.
- USACE (1960). "Levee Work, Item No. L-725, Ensley, Tenn." Drawing No. 1, Serial 16362, File 153/L-9. February.

These drawings include plan views (with boring locations), profiles, graphical boring logs denoting soil types, water elevations during construction/drilling, and levee cross sections.

As part of the Investigation, the USACE boring logs and drawings will be considered for use in the development of cross-sections discussed in Section 3.7.1. Final cross-sections will be provided as part of the EAR.

3.8 ADDITIONAL REQUESTS

3.8.1 TDEC Additional Request No. 1

From our on-site meeting, TDEC is aware that TVA has some information it has collected previously at the TVA ALF site; as an example data from soil borings and analysis of samples collected from ground water monitoring wells. This information provides a good reference when the data was collected, but the soil borings and ground water monitoring wells may not have been installed and constructed to meet the criteria for the environmental investigation of this site per the Order.

TVA should consider proposing additional activities at the TVA ALF site to fully determine the amount and location of CCR material disposed, migration of CCR constituents through soil and ground water, identification of, the upper most aquifer, migration of ground water with CCR constituents into surface, structural stability, etc.

TVA Response

Evaluation of Existing Data

As discussed herein and in the SAPs, TVA proposes the installation of geotechnical borings and background soil borings to supplement existing data to respond to specific TDEC information requests. The ALF QAPP (Appendix C) outlines TVA's proposed processes for evaluating existing data to determine if it meets QA/QC requirements defined in the ALF QAPP and the Investigation objectives outlined in the SAPs.

CCR Location and Quantity

TVA prepared a Material Quantity SAP, provided as Appendix F, to describe the methods TVA will use during the Investigation to answer TDEC's information requests regarding CCR unit geometry, CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions. The objectives and approach for the Material Quantity SAP are summarized below.

Proposed TDEC Order Borings

TVA proposes installing geotechnical borings at the locations shown on Exhibits 4 and 5 (Appendix E) to supplement existing data related to CCR thickness (if encountered) and subsurface materials. A total of 36 geotechnical borings are proposed. Details regarding proposed drilling and sampling activities are provided in the Exploratory Drilling SAP (Appendix H). Table 3 summarizes the number of borings proposed in each facility.

Table 3. Summary of Proposed Geotechnical Borings

CCR Unit	No. of Proposed Geotechnical Borings
West Ash Disposal Area (including Chemical Treatment Pond)	17
East Ash Disposal Area	12
Coal Yard Runoff Pond	4
Harsco Area	3
Total	36

Water Level Monitoring

Monthly water level monitoring will be conducted for 6 months to estimate and monitor piezometric saturation levels in each CCR unit. Manual readings from temporary wells and open standpipe piezometers and readings from automated vibrating wire transducer piezometers will be used to estimate saturation levels in CCR. Details regarding water level monitoring field activities are provided in the CCR Material Characteristics SAP (Appendix S).

Three-Dimensional Model

Three-dimensional models of the West Ash Disposal Area, Chemical Treatment Pond, East Ash Disposal Area (including the Stilling Pond), and the former disposal area consisting of the Coal Yard Runoff Pond and Reed Minerals Division, and Harsco Corporation Area (Harsco Area) will be developed to depict subsurface conditions from the ground surface to the upper foundation soils.

The models will be developed using the data summarized below which includes data from the proposed exploratory borings and temporary wells discussed in the Exploratory Drilling SAP (Appendix H), as well as other relevant data collected during the Investigation. The site is underlain by extremely deep alluvial soils within the Mississippi River embayment area. Therefore, no top of bedrock models will be developed.

1. Ground and aerial survey data will be used with record drawings to model features such as a soil cap and riprap.

2. Contour data from the most recent aerial and hydrographic surveys will be used to provide an initial estimate of the upper CCR surface for the West and East Ash Disposal Areas and Harsco Area.

3. Existing and historical aerial and hydrographic survey data, boring data, and construction drawings will be used to estimate the upper CCR surface below the Chemical Treatment Pond.

4. Pre-construction topographic information from USACE Memphis Quadrangle Mapping (1955) and data from existing and proposed borings that penetrated the lower boundary of the CCR surface will be used to provide an initial estimate of the lower CCR surface at each unit (where applicable). USACE (1955) is provided as Exhibit 9 (Appendix E). Exhibits 10 and 11 (Appendix E) show locations of existing borings which penetrated the lower CCR surface. Proposed borings are shown on Exhibits 4 and 5 (Appendix E).

5. Data from proposed and existing borings that encountered CCR (Exhibits 10 and 11 – Appendix E) and foundation soils (Exhibits 2 and 3 – Appendix E) will be used to model foundation soils underlying each unit.

6. TVA surveyed slopes, embankments, and benches to develop stability sections of the West and East Ash Disposal Areas and Chemical Treatment Pond. TVA will use this topographic data with the most recent aerial survey data to model the geometry of the dikes and benches.

7. Estimated piezometric levels of saturation discussed above will be incorporated into the models.

8. Groundwater levels estimated as part of the Hydrogeological Investigation described in the EIP will be incorporated into the models.

The three-dimensional model will be generated using software capable of rendering three-dimensional surfaces and calculating volumes such as Autodesk's AutoCAD Civil 3D or ArcGIS. Environmental Visualization Software may also be used to visualize the three-dimensional model of the CCR units and Harsco Area.

Drawings

After the three-dimensional models are finalized, they will be used to produce drawings of the West and East Ash Disposal Areas, Chemical Treatment Pond, Coal Yard Runoff Pond and Harsco Area showing the following:

- Subsurface material types, properties, elevations, and thickness from the final elevation of the units to the upper foundation soils
- Estimated piezometric saturation levels, contours, and river stage
- Estimated groundwater elevations, contours, and river stage
- Plan views showing areas where CCR is saturated
- Normal operating pool elevations and minimum embankment crest elevations of the Chemical Treatment Pond and East Ash Disposal Area Stilling Pond
- Upper and lower CCR surfaces and CCR thickness for each facility
- Thickness and material types of foundation soils

Cross sections of the facilities that identify materials and material properties are discussed in the Exploratory Drilling SAP (Appendix H).

Volumetric Estimates

The following volumetric estimates will be calculated for each Study Area Unit using three-dimensional modeling software such as Autodesk's AutoCAD Civil 3D or ArcGIS:

- Total volume of CCR
- Volume of CCR below estimated piezometric saturation levels
- Volume of CCR below estimated groundwater elevations
- Volume of CCR above estimated piezometric saturation levels
- Volume of CCR above estimated groundwater elevations

The total volume of CCR for all Study Area Units at ALF will also be estimated. These volumetric estimates will be calculated using two methods to validate the model and results.

Reporting

The EAR will document the field activities as detailed in the Exploratory Drilling SAP (Appendix H) and deviations from those procedures (if any), results, and geologic and hydrogeologic interpretations. The results of the CCR material quantity assessment, including the updated three-dimensional model of the facilities, drawings, and volumetric estimates will be incorporated into the EAR.

Migration of CCR Constituents via Groundwater and Identification of Uppermost Aquifer

This request is related to work conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request. Hydrogeological characterization activities including the migration of CCR constituents in groundwater and identification of the uppermost aquifer were completed as part of the RI and will be conducted as part of the proposed EI activities discussed in Section 3.3.1.

Seismic Stability of Proposed Closure of East and West Ash Disposal Areas

In response to the TDEC Order, TVA will evaluate the seismic stability of the East and West Ash Disposal Areas for the proposed closed configurations. The evaluation will consider topics similar to the CCR Rule seismic safety factor analysis for the existing East Ash Disposal Area (Geocomp 2016b). Refer to the Stability SAP (Appendix P) for additional information. The results of the evaluation will be included in the EAR.

3.8.2 TDEC Additional Request No. 2

The TVA ALF EIP shall include a schedule for activities to be performed to complete the environmental investigation of the TVA ALF site. As an example, it is TDEC's expectation that the schedule for installing, developing and sampling ground water monitoring wells will be specifically described in the TVA ALF EIP and the schedule of activity to perform this work provided. A full description of the methods used to install drill, construct and sample ground water monitoring wells may be included in an appendix to the TVA ALF EIP or if TVA plans to use an established method or protocol, it can be included by reference.

TVA Response

An overall schedule is included in Appendix A for the activities required to respond to each TDEC information request, as well as assumptions on the EIP approval process as the predecessor to start these investigations.

Time durations to complete the additional sampling and analysis work for the environmental investigation are included in the applicable SAPs. The SAPs also include the methods and procedures to complete the specified activities. Prepared environmental investigation SAPs will be subject to their individual schedules.

4.0 TDEC GENERAL GUIDELINES FOR EIP

As per its letter dated June 14, 2016, TDEC divided the General Guidelines for Environmental Investigation Plans, TVA Fossil Plants, into the following five categories:

A. Site Information
B. Water Use Survey
C. Groundwater Monitoring and Mapping
D. TVA Site Conditions
E. Surface Water Impacts

Each category and its related tasks are addressed in the following subsections, and follow the numbering sequence format of the General Guidelines. The information requests are further distinguished from the responses by being printed in italics.

4.1 A. SITE INFORMATION

TVA shall provide information about CCR storage and disposal sites at the TVA Fossil Plant. TDEC expects TVA to include how it will provide the following information about each TVA Fossil Plant site as a part of its EIP:

4.1.1 A.1 TDEC Site Information Request No. 1

All information about the natural chemistry of the soils in the area of the TVA Fossil Plant. This includes the naturally occurring levels of metals and other CCR constituents present in the soil. TVA shall propose, in the EIP, the collection of soil samples within a one-mile radius of the specific fossil plant to supplement the information gained from local soil studies, reports or soil profiles. Of particular interest are all constituents listed in the federal CCR regulations Appendix 3 Detection Monitoring and Appendix 4 Assessment Monitoring found on page 21500 of the Friday, April 17, 2015 Federal Register (Appendices 3 and 4 CCR constituents).

TVA shall report the levels of naturally occurring CCR constituents as reported in existing documents and the results of soil samples collected per a TDEC Approved EIS in the (EAR) for that site. TVA shall submit maps that identify the location of soil samples in proximity to the TVA Fossil Plant when the EAR is submitted.

TVA Response

TDEC has requested the characterization of the local soils in a one-mile radius of ALF to evaluate the background levels of constituents of concern, previously defined as CCR Parameters.

TVA has prepared a Background Soil SAP (Appendix R) to characterize background soils on or adjacent to the TVA ALF site. The approach in characterizing the background soils is to identify locations where naturally occurring, in place, native soils are present, yet unaffected, by CCR material. Soil samples will be analyzed for the CCR Parameters to determine the naturally occurring levels. Additionally, the surficial soil (i.e., top six inches) at each location will be collected and analyzed for percent ash, to determine the presence or absence of windblown CCR.

This Background Soil SAP establishes the procedures necessary to conduct investigation activities associated with the sampling and analysis of background soils. Exhibit 12 (Appendix E) depicts the locations of twelve proposed background soil sampling locations.

Exhibit 13 (Appendix E) shows the locations of the proposed background soil sampling locations overlain by a United States Department of Agriculture soil map, which depicts surficial soil types. The locations were selected based on access, current hydrogeologic knowledge, the sample location criteria previously set forth by TDEC, and when feasible, proximity to existing or proposed background groundwater monitoring wells. The Memorandum of Agreement will be referenced and utilized for any background soil sampled off of TVA property.

Proposed sampling locations were evaluated for past placement of CCR material, and to our knowledge, no CCR materials have been placed in any of these areas. Areas known or expected to be in contact with CCR constituents during rain events, flood events, or currently being influenced by groundwater flow from ALF were additionally excluded.

Prior to mobilization for sample collection, the sampling locations will be verified using the global positioning system (GPS). If necessary, sampling points may be slightly adjusted for safe equipment access. If required, sampling points will be changed to the closest possible location that can be safely accessed.

An initial grab sample, representing the surficial soils, will be collected by hand auger and submitted for laboratory analysis of percent ash by polarized light microscopy. Borings will then be advanced using a direct push technology (DPT) drill rig equipped with five foot, 3.25 inch outside diameter probe rods, or equivalent technology. In collecting soil samples, borings will be extended until refusal. Grab samples will be collected from the mid-point of each five-foot boring interval.

The mid-point for grab samples will be the mid-point based on recovery. Composite samples are not proposed. If soils are expected to be hard to recover during core retrieval core catchers will be used to prevent loss of sample material.

If a change in lithology occurs within a core interval, separate grab samples will be collected from the mid-point of both lithologies in the core. Samples collected by DPT will be sent to the laboratory to be analyzed for CCR Parameters. A complete description of the sampling methods and protocols is provided in the Background Soil SAP (Appendix R).

In addition to the soil data that will be collected from the proposed sampling locations, TVA will collect soil samples through the well screen interval at locations of any new background groundwater monitoring wells.

TVA will review historical soil analytical data previously analyzed for CCR Parameters. This includes analytical data from soil samples collected during the installation of monitoring wells ALF-201, ALF-210, and ALF-212, as well as soil samples collected as part of the RI activities. Soil samples collected previously will be reviewed in accordance with the ALF QAPP and analytical results will be compiled in the EAR, if the quality of the data are acceptable.

Once sampling has been completed and analytical results have been received, the analytical data for background soil will be evaluated and addressed in the EAR. In doing so TVA proposes to utilize Background Threshold Values (BTVs) as the method to statistically evaluate and quantify site specific background concentrations for CCR Parameters. BTVs will be calculated for each soil horizon and/or geologic unit using a statistical population consisting of a minimum of ten soil samples from each unit. If a particular horizon or geologic unit is under represented in the statistical population, additional borings will be installed.

BTVs are calculated using sampling data collected from un-impacted site-specific reference areas and represent an upper threshold of background concentration(s).

The choice of BTV (Upper Confidence Limit, Upper Threshold Limit, Upper Prediction Limits) will be determined based on characteristics of the data (e.g. sample size, statistical distribution). All statistical analyses will be conducted utilizing the latest version of EPA ProUCL software (currently version 5.1.0) and consistent with ProUCL Technical Guidance Document (EPA 2015b).

4.1.2 A.2 TDEC Site Information Request No. 2

TVA shall propose a sampling plan to determine the leachability of CCR constituents from CCR material in surface Impoundments, landfills and non-registered sites at each TVA site. The plan should include sampling points at each disposal area and at different depths in each disposal area. TVA shall describe sample collection methods, sample transport, analytical methodology and the qualifications of the laboratory selected to perform the analyses.

TVA Response

As requested, the proposed leachability study will involve the implementation of a CCR Material Characteristics SAP (Appendix S), and an evaluation of CCR Parameters from pore water samples and CCR material samples.

The CCR Material Characteristics SAP will help determine the leachability of CCR constituents from material in a CCR unit. The approach will include the collection and analysis of both pore water and CCR material from the East Ash Disposal Area and West Ash Disposal Area.

Five temporary wells will be installed at locations proposed in Exhibits 4, and 5 (Appendix _E), then filtered and unfiltered pore water samples will be collected from the phreatic zone at the base of a unit to obtain in-situ leaching information for the material. The pore water analyses will provide real-time measurements of constituents that have leached from the CCR material.

Samples of CCR material will be collected from the soil borings advanced prior to installing the temporary wells from both the saturated and unsaturated zones in the CCR unit. These samples will be analyzed for the CCR Parameters, after application of the most applicable method based on emerging science in the industry, which could include the Synthetic Precipitation Leaching Procedure method. Total organic carbon, iron, and manganese have been added to the CCR Parameters list as specific parameters of interest in this SAP, due to the potential affect of geochemisty and redox conditions on mobility.

The CCR Material Characteristics SAP (Appendix S) will provide procedures necessary to conduct the sampling of pore water and CCR material in the CCR units, and methods to analyze them for the CCR Parameters list. Proposed activities will include the following major tasks:

- Verify proposed sampling locations using GPS
- Develop temporary wells in the ash disposal area (drilling and installation procedures of the temporary wells are outlined in the Exploratory Drilling SAP – Appendix H)

- Collect CCR material samples during installation of the temporary wells
- Collect pore water samples from the temporary wells
- Conduct laboratory testing and analysis

Sample collection methods, sample transport, and analytical methodology will be addressed in the CCR Material Characteristics SAP (Appendix S) and the ALF QAPP. Laboratory qualifications will be addressed in the ALF QAPP. Once sampling is complete and analytical results have been received, the CCR material leaching results will be compared to the pore water data and evaluated for trends. Results, conclusions, and recommendations will be provided in the EAR.

4.1.3 A.3 TDEC Site Information Request No. 3

Information about the area surrounding the TVA Fossil Plant location before the TVA Fossil Plant was constructed. TVA shall provide in its EIP, geologic maps before the impoundment was created; if an impoundment is adjacent to the TVA Fossil Plant site. TVA discuss topographic maps from the pre-embayment time period and how these maps will be used to identify surface water features such as springs, the original flow of surface streams, etc. in the Environmental Assessment Report (EAR);

TVA Response

Plant construction started in 1956, and power generation began with all three units in October 1959. The 1955 USACE Memphis Topographic Quadrangle Mapping provided as Exhibit 9 (Appendix E) shows the area surrounding the plant before the CCR units were constructed. TVA will review the map during the Investigation and discuss surface water features and the flow direction of streams before ALF was constructed in the EAR.

4.1.4 A.4 TDEC Site Information Request No. 4

Discuss if construction design information for original CCR surface impoundments, specifically any construction drawings or engineering plans, are available. It is important to identify the surface elevation and location of surface impoundments, landfills or non-registered disposal areas when originally constructed. TVA should explain if/how the information to identify the materials used to construct these disposal areas.

TVA Response

As part of the Investigation, TVA will review the following documents and summarize the design and materials used to construct the East and West Ash Disposal Areas. TVA will also use this information to estimate the original surface elevation at these locations. TVA will report this information in the EAR.

- **Record Drawings:** TVA will use Record Drawings 10N223 and 10N224 (shown in Appendix F) to estimate the original surface elevation for the West Ash Disposal Area. Record Drawings 10N223 and 10N224 provide plan views and cross sections for the construction of West Ash Disposal Area. TVA will use Record Drawings 10W225 and 10N226 (shown in Appendix F) to estimate the original surface elevation for the East Ash Disposal Area. Record Drawings 10W225 and 10N226 provide plan views and cross sections for the construction of East Ash Disposal Area.

- **Geotechnical Reports:** Boring data from TVA (1975) and Stantec (2012b and 2016b) indicates the West Ash Disposal Area starter dike was constructed with silty sands and sandy silts and provides cross-sections which depict the configuration of the starter dikes as well as material classifications and consistency descriptions. Stantec 2010a, 2010b, and 2011 also provide cross-sections which depict the configuration of the starter dikes and include material classifications and consistency descriptions.

4.1.5 A.5 TDEC Site Information Request No. 5

Discuss the information available and additional information that will be gathered to provide a three-dimensional profile of the CCR materials from the current elevation of all surface impoundments, landfills and/or non-registered disposal sites to the natural occurring surface below each structure. Also discuss how TVA plans to provide an estimated amount of CCR material disposed within each structure and the total amount of CCR material disposed at each site. Discuss the methods that TVA will use to provide drawings (to scale) that illustrate the height, length and breadth of the CCR disposal areas in relation to the naturally occurring features of each site. Comprehensively define the amount and location off CCR material at each site.

TVA Response

TVA prepared a Material Quantity SAP, provided as Appendix F, to describe the methods TVA will use during the Investigation to answer TDEC's information requests regarding CCR unit geometry, CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions. A summary of the Material Quantity SAP is provided in Section 3.8.1 which includes a description of how existing and new data will be used to develop a three-dimensional model of the CCR units and use the model to develop volumetric estimates and drawings; therefore, the scope to address this information request is provided in Section 3.8.1.

4.1.6 A.6 TDEC Site Information Request No. 6

Describe the method TVA shall use to provide a water balance analysis for active surface impoundments at each TVA site. This should include all wastewater and surface water runoff entering the impoundment from the TVA site and the amount of water discharged from the surface impoundment(s) into receiving streams at the NPDES permitted discharge point. TVA shall also describe briefly how it will determine the transpiration rate of water from the surface impoundment(s) into the atmosphere;

TVA Response

This General Guideline request for a water balance analysis for active surface impoundments is not applicable at ALF. The East Ash Disposal Area impoundment was retired in 2018, and the West Ash Disposal Area is currently not in use.

4.2 B. WATER USE SURVEY

As a part of the Environmental Assessment, TVA is required to conduct a water use survey. The purpose of the water use survey is to determine if any surface water or ground water (water wells or springs) are being used by local residents or by TVA as domestic water supplies. TVA shall describe how it will conduct a water use survey within ½ mile of the boundary of the TVA site. TVA shall describe how it will determine the construction, depth and location of private water wells identified in the survey. If TVA determines local surface water and/or ground water is used as a source of domestic water supply within a ½ mile radius of the TVA site, the EIP shall include an offsite ground water and surface water sampling plan as a part of the EIP.

4.2.1 B.1 TDEC Water Use Survey Request No. 1

TVA Response

During the RI, the surrounding area was evaluated for the presence of water wells through a public database search. With the exception of the Harsco wells and TVA's deep production wells, no water wells were identified within ½ mile of ALF. The lack of water wells in this area is consistent with the observed surrounding conditions and property use, which is primarily industrial. Information relevant to the the surrounding property use and water well search is provided in the Draft RI Report. This information will also be included in the EAR.

4.3 C. GROUNDWATER MONITORING AND MAPPING

The EPA CCR rule specify constituents that should be included for analysis for ground water sampling. The constituents for Ground Water Detection Monitoring are listed in Appendix 3 of the EPA CCR regulations and the constituents for Ground Water Assessment Monitoring are listed in Appendix 4 of the EPA CCR regulations. TDEC is requiring TVA to include a description of the ground water monitoring plan it will implement at each TVA site. All ground water samples collected as a part of the Ground Water Monitoring Plan will be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations. Items to include in the EIP are:

4.3.1 C.1 TDEC Groundwater Monitoring and Mapping Request No. 1

A discussion of all ground water monitoring wells TVA has installed/abandoned/closed at the TVA site as well and any springs that have been monitored at the TVA site or adjacent to the TVA site. TVA shall discuss the data it TVA has generated from historical sampling of ground water monitoring wells and springs. TVA shall include all ground water monitoring construction information, location and historical ground water monitoring data in each TVA site's EAR.

TVA Response

TVA has compiled historical groundwater sampling results into a database, including the following categories of parameters:

- Chemical
- Physical
- Groundwater elevation

The database includes wells installed for CCR Rule and closed groundwater monitoring wells at the site. This information (through July 2017) is provided in Appendix T in tabular form. This data have been collected for a variety of reasons since approximately 1988.

TVA may use these historical data for qualitative purposes, but will use such data only after evaluating it in accordance with the ALF QAPP. In addition, a figure showing existing and closed monitoring wells that correspond to the tables is included in Appendix T.

In addition to the analytical data, the construction and location of newly installed and closed groundwater monitoring wells and information will be researched, collected, reviewed and compiled into a report to be provided in the EAR.

Historically, no springs have been located on site and are not currently anticipated to be encountered. If observed, TVA's inspection program will identify and document the new springs around the CCR units. The newly identified springs will be added to the groundwater monitoring plan in the monitoring network, as described in Section 4.3.5.

4.3.2 C.2 TDEC Groundwater Monitoring and Mapping Request No. 2

A discussion of the location of at least two background ground water monitoring wells including the reasons for proposed their proposed location.

TVA Response

This request is related to work being conducted as part of the ongoing RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request. Hydrogeological characterization activities were completed as part of the ongoing RI and will be provided in the EAR. If, based on the results of the RI work, data gaps are identified that require additional information to meet the objectives of the TDEC Order, then TVA will propose additional investigations to address the data gaps and submit plans to TDEC for review.

4.3.3 C.3 TDEC Groundwater Monitoring and Mapping Request No. 3

A discussion of additional ground water monitoring wells that will be installed to complete a ground water monitoring network at the TVA site around all surface impoundments, landfills and/or non-registered disposal sites; including the location of existing or proposed ground water monitoring wells down gradient of all CCR disposal areas on the TVA site. TVA shall propose a ground water monitoring network that will provide data to develop a TVA site wide ground water potentiometric surface map. TVA shall ensure that the ground water monitoring locations (current and proposed) in the EIP will accurately determine groundwater flow and direction.

TVA Response

This request is related to work conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request. Hydrogeological characterization activities including the rationale for placement of groundwater monitoring wells to evaluate groundwater flow conditions and prepare groundwater contour maps were completed as part of the RI and proposed EI activities and will be provided in the EAR. If, based on the results of the ongoing work, data gaps are identified that require additional information to meet the objectives of the TDEC Order, then TVA will propose additional investigations to address the data gaps and submit plans to TDEC for review.

4.3.4 C.4 TDEC Groundwater Monitoring and Mapping Request No. 4

A discussion of the construction methods TVA will use to install additional ground water monitoring wells. This includes drilling method, methods and personnel for logging cuttings and cores, well construction and well development. A scaled diagram of a properly completed monitoring well shall be provided in the EIP.

TVA Response

This request is related to work conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request and the Hydrogeological Investigation SAP (Appendix M) for details on proposed drilling, logging, well construction and well development methods.

4.3.5 C.5 TDEC Groundwater Monitoring and Mapping Request No. 5

A ground-water monitoring plan for sampling all wells and springs included in the monitoring network. This should include the methods TVA shall use to collect ground water samples, the analytical methods to be used for ground water sample analyses, methods for sample transport from point of collection to the laboratory and identification and qualification of the laboratory(ies) that will perform sample analyses.

TVA Response

This request is related to work conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request and the Groundwater Investigation SAP (Appendix N) for the methods that TVA will use to collect groundwater samples, analytical methods, chain-of-custody procedures, packaging, shipping and transportation requirements. Additional information regarding laboratories to be used for analysis of the samples is provided in the ALF QAPP (Appendix C).

Historically, no springs have been located on site and are not currently anticipated to be encountered. If observed, TVA's inspection program will identify and document the new springs that will be added to the groundwater monitoring plan for the groundwater monitoring network.

4.3.6 C.6 TDEC Groundwater Monitoring and Mapping Request No. 6

Describe any existing information available and additional data needed to develop a map which identifies the current ground water surface elevation under the landfill(s), surface impoundment(s) and/or non-registered site(s). If additional data is needed to provide ground water elevations across the TVA site, below the footprint of the landfill(s), surface impoundment(s) and/or non-registered site(s), describe the methods TVA plans to use to collect the data. TVA shall collect sufficient data to create a map that clearly delineates the ground water surface in the ash disposal areas such that (1) the CCR material between the original ground surface and the top of the current ground water table is defined and (2) CCR material between the current ground water surface and the surface elevation of the CCR disposal area is clearly defined. TVA shall also collect pore water samples from CCR material that is below the current ground water surface and from CCR material that is below the projected ground water surface with closure in place. TDEC has not determined that closure in place is a corrective action option at any TVA site; however; this information is needed should TVA propose closure in place.

TVA Response

This request is related to work conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request. Groundwater elevation data were collected as part of the TDEC-approved RI and will be collected as part of the proposed EI activities. The request regarding the estimated amount of CCR material below the groundwater surface is similar to the information requested in Sections 3.3.1, 3.8.1 and 4.1.5. Refer to those sections for preparation of groundwater contour maps and estimating the three-dimensional profile of CCR material.

The request regarding pore water sampling is related to work conducted as part of the RI activities. Refer to Section 3.3.1 for information related to this request. Additional pore water sampling for the West Ash Disposal Area will be conducted in accordance with the CCR Material Characteristics SAP (Appendix S), developed to characterize the leachability of CCR material in the unit, and addressed in greater detail in Section 4.1.2. Pore water sampling will be completed as part of the ongoing RI and proposed EI activities and provided in the EAR. If, based on the results of the ongoing RI and proposed EI work, data gaps are identified that require additional information to meet the objectives of the TDEC Order, then TVA will propose additional investigations to address the data gaps and submit plans to TDEC for review.

4.3.7 C.7 TDEC Groundwater Monitoring and Mapping Request No. 7

Describe how TVA will define groundwater contaminant plumes identified using currently available groundwater monitoring data and new groundwater monitoring data gathered from the installation and sampling of new groundwater monitoring wells. TVA will also discuss its strategy to determine the extent of any CCR constituent plume should the initial groundwater monitoring network not define the full extent of the CCR constituent groundwater plume at the site. This should include the science it will use to extend its groundwater monitoring network.

TVA Response

This request is related to work conducted as part of the RI and proposed EI activities discussed in Section 3.3.1. Refer to Section 3.3.1 for information related to this request. Groundwater data collected as part of the ongoing RI and proposed EI activities will be used to evaluate the vertical and horizontal extent of CCR constituents in groundwater. If, based on the results of the RI and proposed EI work, data gaps are identified that require additional information to meet the objectives of the TDEC Order, then TVA will propose additional investigations to address the data gaps and submit plans to TDEC for review.

4.4 D. TVA SITE CONDITIONS

4.4.1 D.1 TDEC Site Conditions Request No. 1

Discuss all current information available about the geologic lithology (formations, bedding planes, etc.) and their relevance to natural seeps, springs and karst features on the TVA site; including the CCR disposal areas. Some limestone formations are very susceptible to solution channeling, especially when they have been disturbed through natural events or construction activities such as blasting. TVA shall describe the methods it will use to determine whether solution channeling has occurred at and near the soil/rock interface;

TVA Response

Existing geological characterization data of foundation soils, including boring logs from previous geotechnical work and related reports (e.g., United States Geological Survey (USGS) 2016), as well as construction and facility performance records will be reviewed. However, due to the significant depth to bedrock in the region, the geologic lithology had limited influence on the construction and performance of the different units.

Available information indicates that the CCR units at ALF are underlain by thousands of feet of overburden. Because of the significant depth to bedrock, concerns regarding sinkholes or karst features are not applicable at ALF. Further, natural seeps or springs have not been identified at ALF.

A summary of the pertinent existing and new information will be provided in the EAR.

4.4.2 D.2 TDEC Site Conditions Request No. 2

Discuss all current information about the geologic structure below the TVA site and how it may be used to help determine if faults and/or fractures have been identified in the subsurface. TVA shall describe the methods it will use to collect additional data (faults, fractures, bedding planes, karst features, etc.) to determine whether faulting and fracturing has impacted and/or controls groundwater movement.

Describe how TVA will determine if identified faults, fractures, bedding planes, karst features, etc. are filled to the point that they limit or eliminate ground water flow.

TVA Response

The information required for this response is similar to that for D.1 (Section 4.4.1). Because of the significant depth to bedrock, the geologic structure beneath the CCR units as it relates to faults, fractures, and bedding planes in rock has limited influence on groundwater flow.

4.4.3 D.3 TDEC Site Conditions Request No. 3

Discuss existing data available to TVA to map top of bedrock; i.e. existing boring and ground water monitoring well construction data. TVA shall describe the methods (surface geophysics; installation of borings/ground water monitoring wells) it will use to collect additional data to map top of bedrock. The EIP shall include a description of the data collection methods TVA will use to determine the thickness and types of natural material overlying bedrock as well as the top of bedrock contours. For all new soil borings, TVA shall provide the location of the borings, the information used to determine boring location, the drilling method to be used, how the borings will be logged. Logging shall be performed by a Professional Geologist licensed to practice in Tennessee. Logs shall provide the following information when presented in the EAR; soil type, depth and changes, identify geologic formations, depth of formation, karst features, fractures, bedding planes, and any other pertinent information. TVA shall provide an example of a boring log in the EIP.

TVA Response

The geologic setting at the site is unique due to deep alluvium deposits within the Mississippi River embayment. Available USGS geologic mapping indicates that the alluvium deposits exposed at the surface of the Plant are approximately 140 feet in thickness overlying the Memphis Sand formation estimated to be over 500 feet in thickness (USGS 1978). TVA prepared a Material Quantity SAP, provided as Appendix F, to describe the methods TVA will use during the Investigation to answer TDEC's information requests regarding CCR material quantity and subsurface conditions.

4.4.4 D.4 TDEC Site Conditions Request No. 4

When/if TVA divided original Coal Combustion Residual (fly ash, bottom ash and gypsum) surface impoundments into individual units (surface impoundments, non-registered disposal areas and or landfills), TVA shall discuss where this has happened on each TVA site. As a part of the EAR, TVA shall discuss the source of information reviewed to provide the specifications of those structural changes.

Discuss if there are as built drawings or engineering plans for the modifications TVA has made at each site made. If there is not existing information that describes the structural changes in the original surface impoundment(s) or non-registered site(s), TVA shall discuss in the EIP how it will collect the information needed to document structural changes over time. This information is needed in determining the structural and seismic stability of each TVA site.

TVA Response

This information request applies to the West Ash Disposal Area which was divided to construct the Chemical Treatment Pond. TVA will review and summarize the following documents and describe in the EAR how the West Ash Disposal Area and the Chemical Treatment Pond were divided into individual units.

- **Drawings:** Drawings 10N223 and 10N224 in Appendix F depict how the West Ash Disposal Area and the Chemical Treatment Pond were divided into individual units.

- **Annual Inspection Reports:** TVA will review and summarize information from annual inspection reports that describe how the West Ash Disposal Area and the Chemical Treatment Pond were divided into individual units.

- **Geotechnical Data:** Stantec (2012b) provides stability cross sections which depict the configurations of the starter, raised, and CCR dike systems.

4.4.5 D.5 TDEC Site Conditions Request No. 5

Stipulate whether there are any as-built designs for the interface between the originally disposed CCR material and any disposal structures constructed above the original disposal area.

TVA Response

This information request does not apply to the East or West Ash Disposal Areas because disposal structures were not constructed above original disposal areas.

4.4.6 D.6 TDEC Site Conditions Request No. 6

TVA shall discuss any existing stability calculations for final permitted design elevation for all landfills. Unless TDEC specifies otherwise, TVA shall conduct new stability calculations for all landfills, surface impoundments and/or non-registered disposal sites. The EIP shall describe the method TVA will use to determine structural stability.

TVA shall provide stability calculations for each disposal area based upon (1) the permitted final elevation or planned final elevation for each landfill, (2) the current elevation for all surface impoundments and/or (3) the current elevation for all non-registered disposal location.

TVA Response

As described below and in the Stability SAP (Appendix P), new stability analyses will be performed where necessary to address this information request. Otherwise, the existing data are sufficient to establish appropriate shear strengths and stability results for static and seismic load cases. Existing and proposed slope stability analysis cross section locations are shown in Exhibits 14 and 15 (Appendix E). The summaries of existing geotechnical data in Appendix G (Evaluation of Existing Geotechnical Data) demonstrate that existing data are representative and suitable to support the stability analyses.

The load cases to be evaluated in the stability analyses are based on conventional practice and appropriate industry standards for landfills and surface impoundments, as applicable.

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

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

The proposed assessment framework will comply with the overall goals of the TDEC Multisite Order as outlined in several Information Requests in Section D of the General Guidelines for EIPs. In general, the program may consist of geotechnical explorations (field and laboratory), followed by analysis. Data from previous geotechnical explorations (field and laboratory) and existing static/seismic stability analyses are available to fulfill certain components of this information request. Specific data that is available for each unit is described below. Where proposed below, the stability evaluation analysis methodology and acceptance criteria are in the Stability SAP (Appendix P). The analyses will be submitted in the EAR.

Based on the amount and context of data available to support a response, additional field work is anticipated at the East and West Ash Disposal Areas to answer this information request. Refer to the Exploratory Drilling SAP (Appendix H) for more information.

East Ash Disposal Area: Existing analyses are available for the East Ash Disposal Area, from the following sources:

- Stantec (2010a): Seepage and static stability analyses of existing conditions, incorporating results of additional geotechnical exploration
- Stantec (2010b): Seepage analysis, and static and rapid drawdown stability analyses of existing conditions, incorporating results of additional geotechnical exploration
- Stantec (2011): Static stability analyses of existing conditions, incorporating results of additional geotechnical exploration
- Geocomp (2013): Existing conditions evaluated for static and seismic (pseudostatic and post-earthquake) stability, liquefaction triggering, and seismic displacement, incorporating results of additional geotechnical exploration
- Geocomp (2016a): Existing conditions evaluated for static and seismic (pseudostatic and post-earthquake) stability, liquefaction triggering, and seismic displacement, incorporating results of additional geotechnical exploration
- Stantec (2016j): Existing conditions evaluated for static stability, to comply with the Static Safety Factor demonstration for CCR Rule
- Stantec (2016k): Existing conditions evaluated for static stability for sudden drawdown conditions, as part of the Structural Stability demonstration for CCR Rule

- Stantec (2017): Proposed closure conditions evaluated for static long-term, short-term, and rapid drawdown global slope stability, as well as static veneer stability; the closure design is ongoing

Additional analyses will be performed for the final, closed geometry in accordance with the Stability SAP (Appendix P). However, after the closure design is finalized, it will be compared against analyses for the existing conditions. The existing conditions analyses may prove adequate to represent the closed conditions. A summary of these analyses will be included in the EAR.

West Ash Disposal Area: Existing analyses are available for the West Ash Disposal Area, from the following sources:

- Stantec (2012b): Seepage analysis and static and rapid drawdown stability analyses of existing conditions of the North Dike of the Chemical Treatment Pond (adjacent to West Ash Disposal Area), incorporating results of additional geotechnical exploration

- Stantec (2016b): Static and rapid drawdown stability analyses of existing conditions, incorporating results of additional geotechnical exploration

- Stantec (2016h): Proposed closure conditions evaluated for static, long-term global slope stability, as well as static veneer stability; the closure design is ongoing

Preliminary plans for the West Ash Disposal Area closure were submitted to TDEC on October 17, 2016. Additional analyses will be performed for the final, closed geometry in accordance with the Stability SAP (Appendix P). A summary of these analyses will be included in the EAR.

4.4.7 D.7 TDEC Site Conditions Request No. 7

TVA shall specify how it will determine the construction methods and properties of the drainage layers between each "stacked layer" for permitted CCR landfills; including where the drainage layer discharges.

TVA Response

East and West Ash Disposal Areas: The units are not permitted CCR landfills, and do not have a drainage layer within the units; therefore, this information request does not apply to these units. The proposed closure of the units does not include drainage layers within or below CCR in the final configuration.

However, to evaluate phreatic levels within these units, the Exploratory Drilling SAP (Appendix H) includes temporary wells as shown on Exhibits 4 and 5 (Appendix E).

4.4.8 D.8 TDEC Site Conditions Request No. 8

TVA shall review Section VI.D.5 (page 21373) of the section of the Federal CCR Preamble that describes areas of concern regarding overfill at landfills. TVA shall explain how it will determine if there are potential overfill situations for each surface impoundment/landfill at the TVA site.

TVA Response

The East and West Ash Disposal Areas do not meet the definition of an overfill per the CCR Rule, i.e., "a new CCR landfill constructed over a closed CCR surface impoundment," 40 CFR § 257.53. Therefore, this information request does not apply to ALF.

Regarding the West Ash Disposal Area, it should be noted that the EPA excluded from regulation inactive CCR landfills, § 257.50(d), as well as CCR surface impoundments that no longer receive CCR, impound water, and that are "capped or otherwise maintained," 80 Fed. Reg. at 21343. EPA explained in its preamble that these exclusions are due to the lower risk associated with such units. Section VI.A.5 (page 21342) of the preamble states:

> "As noted, EPA's risk assessment shows that the highest risks are associated with CCR surface impoundments due to the hydraulic head imposed by impounded water. Dewatered CCR surface impoundments will no longer be subjected to hydraulic head so the risk of releases, including the risk that the unit will leach into the groundwater, would be no greater than those from CCR landfills."

Throughout its service life, TVA has constructed and operated the West Ash Disposal Area in compliance with the state and/or federal regulatory frameworks in effect at the time.

4.4.9 D.9 TDEC Site Conditions Request No. 9

Discuss current information/data that is available to estimate the shear strength of the CCR materials in the landfill(s), surface impoundment(s) and/or nonregistered sites. If there is not sufficient data available to determine shear strength, describe the methods TVA shall use to collect this data. If there is existing data collected during installation of soil/rock borings or construction of ground water monitoring wells, provide a brief description of this data and how it will be presented for use in the EIP.

TVA Response

East Ash Disposal Area: Recent geotechnical explorations in the East Ash Disposal Area have characterized the CCR materials present in this unit. Shear strengths were developed from laboratory testing on remolded samples of CCR in the Final Summary of Laboratory Testing on Fly Ash (MACTEC 2004a) as described in the Evaluation of Existing Geotechnical Data (Appendix G). Stantec (2010a) also considered prior drilling and testing results in the vicinity of this unit (MACTEC 2004b, TVA 1975), however shear strength of CCR materials was based on laboratory test results and characterization of CCR at the TVA Kingston plant. Stantec (2011) considered results from additional drilling and testing, including direct shear tests on recompacted samples of bottom ash. Geocomp (2013) included drilling, lab testing, and development of soil shear strength parameters. Strength parameters of CCR materials were assigned based on values used in previous studies at the TVA Kingston Fossil Plant. Boring locations from the available studies are shown on multiple figures in Appendix G.

A review of the referenced existing stability analyses shows that due to the location of the Hydraulic Ash in the cross sections, this material did not significantly influence the perimeter slope stability results. When evaluating the suitability of existing stability analyses to address the TDEC Order information requests, the use of shear strengths based on typical/published values will be considered. Factors to be considered include the sensitivity (or lack thereof) of the analysis to the strength and the degree of conservatism of the published value relative to the site-specific material. In addition, because exploratory drilling and sampling is already proposed (see the Exploratory Drilling SAP, Appendix H) due to other information requests, supplemental samples of CCR will be obtained from the West and East Ash Disposal Areas. The samples will be tested in the laboratory for shear strength, and the results considered in the proposed slope stability analyses. The EAR will present a summary of the historical and new data and characterization of the CCR shear strengths for this unit.

West Ash Disposal Area: Recent geotechnical explorations in the West Ash Disposal Area have characterized the CCR materials present in this unit. Shear strengths were developed from laboratory testing on remolded samples of CCR in the Final Summary of Laboratory Testing on Fly Ash (MACTEC 2004a) as described in the Evaluation of Existing Geotechnical Data (Appendix G). Stantec (2016b) also considered prior drilling and testing results in the vicinity of this unit (MACTEC 2004b, TVA 1975, Stantec 2012b), however shear strength of CCR materials was based on laboratory test results and characterization of CCR at the TVA Kingston plant. Boring locations from the available studies are shown on multiple figures in Appendix G.

A review of the referenced existing stability analyses shows that due to the location of the Hydraulic Ash in the cross sections, this material did not significantly influence the perimeter slope stability results. When evaluating the suitability of existing stability analyses to address the TDEC Order information requests, the use of shear strengths based on typical/published values will be considered. Factors to be considered include the sensitivity (or lack thereof) of the analysis to the strength and the degree of conservatism of the published value relative to the site-specific material. In addition, because exploratory drilling and sampling is already proposed (see the Exploratory Drilling SAP, Appendix H) due to other information requests, supplemental samples of CCR will be obtained from the West and East Ash Disposal Areas. The samples will be tested in the laboratory for shear strength, and the results considered in the proposed slope stability analyses. The EAR will present a summary of the historical and new data and characterization of the CCR shear strengths for this unit.

4.4.10 D.10 TDEC Site Conditions Request No. 10

TVA shall provide static, seismic and liquefaction analysis in accordance with 257.63 and 257.73 of the Federal CCR regulations for final permitted design elevations for Landfills that are defined by the Federal Regulations as overfills. If the analyses have not been completed, then TVA shall provide analyses for each landfill based upon either the permitted final elevation for each or for the planned final elevation for each; should TVA decide it does not need to use the entire permitted capacity of any permitted CCR landfill. TVA shall identify and analyze the critical cross section(s) and document that the modeling represents the actual field conditions at the cross-section location(s). TVA shall also address foundation settlement of these Landfills.

TVA Response

As noted in Section 4.4.8, the East and West Ash Disposal Areas do not meet the definition of an overfill per the CCR Rule. Therefore, this information request does not apply to ALF.

4.4.11 D.11 TDEC Site Conditions Request No. 11

TVA shall discuss any current dam safety analysis performed at the TVA site for all landfills, surface impoundments and/or non-registered disposal areas. If dam safety analysis has not been performed for each disposal area or if TDEC determines the dam safety analysis is inadequate, then TVA shall describe the method(s) it will use to determine the "dam safety factor" for all disposal areas at the TVA site.

TVA Response

The West Ash Disposal Area does not constitute a dam, as defined by TVA Standard Programs and Processes (SPPs) manual on Dam Safety (TVA 2016a). Likewise, the unit does not constitute a dam under Federal Emergency Management Agency (FEMA) guidelines, which consider both dam height and impounding capacity (FEMA 2004). The West Ash Disposal Area no longer has the capacity to impound 50 acre-feet or more, thus it does not meet the definition of a dam. Therefore, this information request does not apply to the unit.

The East Ash Disposal Area has historically been included in TVA's Dam Safety Program. TVA has applicable SPPs that govern the safety analysis for dams and impoundments. TVA utilizes procedural standards for managing dam safety activities and support. Objectives of the program include:

- Ensure dams and impoundments are designed, constructed, operated, maintained, and repaired in accordance with the Federal Guidelines for Dam Safety and TVA Procedures

- Maintain a Dam Safety Independent Review Board to provide technical expertise and guidance

- Perform assessments to provide quality assurance

- Prepare programmatic performance metrics and reporting including the biennial report to FEMA

- Provide a forum for dam safety related communications, lessons learned and best practices sharing

- Facilitate consistent and effective administration of dam safety work through management of the Dam Safety Steering Committee, with the goal of efficiently reducing TVA's overall dam safety risk

TVA has completed, or will perform slope stability evaluations for each CCR unit in the Study Area as outlined in Section 4.4.6 of this EIP. These evaluations include the stability of the perimeter dike system, where present, of each unit. TVA has also performed, or will perform assessments of the disposal areas in accordance with Item D.13 of the TDEC General Guidelines, which include structural stability and safety factor assessments. See Section 4.4.13 for a description of these assessments. These assessments will be provided in the EAR.

4.4.12 D.12 TDEC Site Conditions Request No. 12

TVA shall discuss any current information or assessments regarding seismic stability for the TVA site, including existing seismic analysis for each surface impoundment(s), landfill(s) and/or nonregistered site(s) s at the TVA site. TVA shall describe in the EIP the method it will use to determine the size of the seismic event that would cause structural failure for entire area of the surface impoundments, landfills and/or non-registered disposal sites at the TVA site. The seismic analysis method proposed by TVA shall provide seismic data comparable to the requirements for seismic analysis in the federal CCR regulations at CFR 257.63. The seismic analysis plan shall determine the seismic stability of the entire TVA site and any improvements need to ensure seismic stability for the site, as it exists today and for closure in place. Soils below the surface impoundments and landfill shall be evaluated for liquefaction potential. If these soils are found to be susceptible to liquefaction, stability calculations shall be performed which account for liquefaction.

TVA Response

The industry standard practice for seismic analysis during design is to select an earthquake return period that is appropriate for a particular scenario. The design condition is then evaluated for adequate performance under the design earthquake(s). For example, this approach was used for the CCR Rule seismic safety factor assessment of the East Ash Disposal Area (Geocomp 2016b).

As noted in Section 4.4.6, an industry-standard structural stability evaluation will be performed. The program will consider static and seismic slope stability, as well as liquefaction triggering, as applicable. Existing and proposed seismic stability assessments are outlined in Section 4.4.6. Proposed analyses will be performed per the Stability SAP (Appendix P). Existing and proposed slope stability analysis cross section locations are shown in Exhibits 14 and 15 (Appendix E). Results will be presented in the EAR.

4.4.13 D.13 TDEC Site Conditions Request No. 13

TVA shall discuss how the structural integrity of the entire area of CCR disposal (surface impoundment(s), landfill(s) and non-registered sites) shall be determined. TVA shall include in the EIP the methods and models it will use to evaluate structural integrity as discussed in CFR 257.73(d) and (e).

TVA Response

As part of TVA's ongoing efforts to comply with the CCR Rule, structural stability assessments have been performed for the East Ash Disposal Area (Stantec 2016k). With respect to structural integrity, this assessment considered the following aspects:

- Foundation and abutment conditions (cracking, settlement, deformation, erosion, heave due to seepage)
- Slope protection
- Embankment dike compaction
- Vegetation of slopes
- Spillway condition and capacity
- Sudden drawdown assessment (slope stability)

Regarding the proposed closed condition of the East Ash Disposal Area, closure documents (Stantec 2017; others in progress) will address many aspects of structural integrity listed in the CCR Rule CFR 257.73(d) such as settlement, erosion protection, vegetative cover, and spillway adequacy.

The West Ash Disposal Area is not subject to the CCR Rule for active units (see Section 4.4.8). While the unit is not subject to CFR 257.73(d) or (e), closure documents (Stantec 2016h; others in progress) will address many aspects of structural integrity listed in the CCR Rule CFR 257.73(d) such as settlement, erosion protection, vegetative cover, and spillway adequacy.

TVA further promotes structural integrity of the units by performing routine inspections and by evaluating proper abandonment of hydraulic structures and pipe penetrations through the unit perimeter. A summary of the structural evaluations of the East and West Ash Disposal Areas will be presented in the EAR. Additionally, the stability program described in Sections 4.4.6 and 4.4.12 will consider the safety factor aspects of the CCR Rule CFR 257.73(e) such as static and seismic stability.

The Stability SAP (Appendix P) for the Study Area (described in Section 4.4.6) will present the analysis methodology and acceptance criteria for the evaluation.

4.4.14 D.14 TDEC Site Conditions Request No. 14

Discuss any current information available that may be used to determine the ability of the local geology to provide sufficient structural stability for the existing surface impoundments, landfills and/or non-registered disposal areas at the TVA site as well as any disposal area considered for closure in place. TDEC anticipates there will not be sufficient existing structural stability information for this analysis. Describe the methods TVA shall employ to collect data that may be used to determine the capability of the geologic formation at the TVA site to provide structurally sound/load bearing strength for existing CCR disposal areas as well as for those disposal areas should TVA consider closure in place of those areas.

TVA Response

Due to the significant depth to bedrock (see Section 4.4.1), concerns regarding the ability of the geologic formations underlying the Study Area to provide structural stability for these units in their existing condition are not applicable to ALF.

4.5 E. SURFACE WATER IMPACTS

Because of the long operating history of the TVA Fossil Plants, there have been potential opportunities for CCR materials to move into surface water and for dissolved CCR constituents to migrate via ground water flow into surface water. As part of the EIP, TVA shall describe how it will determine if CCR material and/or dissolved CCR constituents have entered surface water at or adjacent to TVA sites. TVA will also describe how it will assess any impact CCR material and/or dissolved CCR constituents may have had on water quality and/or fish and aquatic life.

The requests above are addressed in Items E.1 through E.8 below.

4.5.1 E.1 TDEC Surface Water Impacts Request No. 1

TVA shall discuss any current information it has for the TVA site that identifies CCR deposition on the streambed for surface water on the TVA site or surface water adjacent to the TVA site.

TVA Response

TVA will provide a discussion of any current information identifying CCR deposition on the streambed for surface stream on or adjacent to the site, in the EAR.

4.5.2 E.2 TDEC Surface Water Impacts Request No. 2

TVA shall describe in the EIP the methods it will use to determine if CCR material has moved from the TVA site into surface water on the TVA site or adjacent to the TVA site. TVA shall propose a procedure for sampling the streambed for CCR material. TVA shall describe sample collection methods, sample preservation and sample analysis methods for CCR materials. All samples shall be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations. Further, TVA shall propose how it will test sediment and CCR samples taken from riverbeds to determine if CCR constituents dissolve into surface water.

TVA Response

No sediment SAP is proposed for the site, due to the following water quality concerns in McKellar Lake.

ALF is located on McKellar Lake in a highly-industrialized area with 41 facilities identified. As part of the Mississippi River watershed, McKellar Lake has many water quality issues as described in TDEC's Year 2014 303(d) List. Fishing advisories have been issued for the lake, and the many pollutants exceeding water quality standards include:

- Mercury
- PCBs
- Chlordane
- Dioxin
- Nitrate + Nitrite
- Loss of biological integrity due to siltation

- Low dissolved oxygen
- Escherichia coli

The Nonconnah Creek Basin includes 22 waterbodies impacted by pollutant sources, as described in TDEC's Year 2014 303(d) List. Horn Lake Cutoff, Nonconnah Creek, and Cypress Creek are examples of streams discharging into McKellar Lake. The Horn Lake Cutoff is considered impaired due to low dissolved oxygen, total phosphorus, and the loss of biological integrity due to siltation.

Similarly, portions of Nonconnah Creek are considered impaired due to low dissolved oxygen, total phosphorus, and the loss of biological integrity due to siltation, but also include PCBs, dioxins, chlordane, and escherichia coli. Cypress Creek has been listed as an impaired stream due to low dissolved oxygen, total phosphorus, escherichia coli, and arsenic. Sources of pollution include overflow discharges from sanitary sewer systems (a major sewage leak resulted in a fish kill in 2016), channelization, industrial stormwater discharges, sources outside state borders, farming activities, and contaminated sediment.

There have been no CCR discharges to McKellar Lake due to dike failures, and the groundwater monitoring well network surrounding the CCR units will monitor the groundwater for CCR constituent contamination during the post-closure care period.

4.5.3 E.3 TDEC Surface Water Impacts Request No. 3

TVA shall describe how streambed sample results will be used to develop a map identifying the location of CCR material on the streambed and the depth of the CCR material on the streambed.

TVA Response

If evidence of CCR material is found in historical sediment studies or inspections, a map will be developed identifying the location and depth of the CCR material on the streambed, and placed in the EAR.

4.5.4 E.4 TDEC Surface Water Impacts Request No. 4

TVA shall discuss any current information it has for the TVA site that identifies the movement of ground water with dissolved CCR constituents into surface streams on or adjacent to the TVA site. This includes any surface water analyses TVA has performed for samples taken from the seeps and surface stream(s).

TVA Response

TVA will provide a discussion of any current information identifying the movement of groundwater with dissolved CCR constituents into surface streams on or adjacent to the site, in the EAR. Former seeps have been monitored for structural concerns, but historically have not been sampled for the CCR Parameters.

4.5.5 E.5 TDEC Surface Water Impacts Request No. 5

TVA shall propose a plan to collect and analyze water samples from seeps and surface stream(s) on the TVA site and/or adjacent to the TVA site. This plan shall include sampling locations, sample collection methods, sample preservation and transport and methods for sample analysis. All samples shall be analyzed for the CCR constituents listed in Appendices 3 and 4 of the federal CCR regulations.

TVA Response

Seep Characterization Study and Associated SAP

TDEC has requested a sampling plan to characterize seeps on the TVA site and/or adjacent to the TVA site at ALF, for the CCR Parameters. To this end, TVA will investigate mitigated seeps and areas historically noted as seeps, for current seep activity. Active seeps that are not captured and managed through a permitted unit will be sampled, for soil and water, and analyzed for the CCR Parameters. Analytical results will be evaluated to help develop an assessment of potential movement of groundwater with dissolved CCR Parameters into surface streams on or adjacent to the TVA site, as requested in Section 4.5.4.

The objective of the seep characterization study is to assess the transport potential of CCR constituents from CCR units to surface streams on or adjacent to the TVA site due to seeps. TVA's seep characterization study consists of the following steps:

1. Research and review existing documentation on the location of historical seeps
2. Investigate site for active seeps
3. Identify location of active seeps on a map
4. Implement Seep SAP (Appendix O) based on active seep location map
5. Collect seep soil and water samples from active seeps that are not captured and managed through a permitted unit
6. Record sample location using GPS
7. Analyze seep soil and water samples for CCR Parameters per the Seep SAP in accordance with the ALF QAPP
8. Review and evaluate existing and new analytical data

9. Prepare the EAR

Filtered and unfiltered water samples will be taken. A complete description of the sampling methods and protocols is provided in the Seep SAP (Appendix O).

Once sampling is complete and analytical results have been received, the CCR Parameters analyses for the seep samples will be evaluated in accordance with the ALF QAPP and reported in the EAR.

Surface Stream Characterization

No surface stream SAP is proposed for the site, due to the water quality concerns mentioned in Section 4.5.2.

There have been no discharges to McKellar Lake due to dike failures, and the groundwater monitoring well network surrounding the CCR units will monitor the groundwater for CCR constituent contamination during the post-closure care period. The monitoring protocols will be responsible for the detection, assessment, and corrective action for any identified CCR Parameters in the groundwater.

4.5.6 E.6 TDEC Surface Water Impacts Request No. 6

TVA shall describe how seep and stream sample results will be used to develop a map identifying the location of seep and stream sampling points and the results of the analyses. This map shall also include the location of any public water intakes within 1 mile of the downstream side of the TVA site.

TVA Response

If evidence of existing stream sample results is found, a map will be developed identifying the location of the sampling points, along with the analytical results. The Seep SAP (Appendix O) will include the location of active seep sampling points. Once analytical results have been obtained, a map showing the active seep sampling locations and analytical results will be developed and placed in the EAR.

4.5.7 E.7 TDEC Surface Water Impacts Request No. 7

TVA shall provide a brief discussion of any studies conducted by TVA or any other agency to determine if CCR materials or dissolved CCR constituents have impacted fish and/or aquatic life.

TVA Response

TVA will provide a discussion of any historical studies conducted by TVA or any other agency to determine if CCR materials or dissolved CCR constituents have impacted fish and/or aquatic life, in the EAR.

4.5.8 E.8 TDEC Surface Water Impacts Request No. 8

Upon a determination by TDEC of the need to assess the impact of CCR material in surface streams or migration of ground water containing dissolved CCR constituents, TVA shall provide a plan to study the impact of CCR materials and/or constituents on fish and/or aquatic life in surface streams on the TVA site or adjacent to the TVA site.

TVA Response

No benthic, mayfly, nor fish tissue SAPs are proposed for the site. ALF is not included in TVA's long-term biological monitoring program, due to the water quality concerns mentioned in Section 4.5.2.

There have been no discharges to McKellar Lake due to dike failures, and the groundwater monitoring well network surrounding the CCR units will monitor the groundwater for CCR constituent contamination during the post-closure care period. The monitoring protocols will be responsible for the detection, assessment, and corrective action for any identified CCR Parameters in the groundwater.

5.0 ENVIRONMENTAL ASSESSMENT REPORT

The EIP and EAR process is described in the Order. Within 60 days of completion of the EIP activities, TVA will submit the EAR to TDEC. The EAR will address the list of tasks required by TDEC in its response to the Investigation Conference meeting.

TDEC will review the report to evaluate whether the tasks have been addressed in helping determine whether there are unacceptable risks resulting from the management and disposal of CCR. The EIP and EAR process will be repeated until TDEC concludes that there is sufficient information to adequately characterize the extent of CCR contamination in the soil, surface water, and groundwater at the site.

Upon approval of the EAR by TDEC, TVA will then submit within 60 days, a CARA Plan. The CARA Plan will specify the actions TVA will take at the site and the basis of those actions. Corrective measures may include (1) soil, surface water, and groundwater remediation, (2) risk assessment and institutional controls, or (3) no further corrective action.

6.0 REFERENCES

City of Memphis, et al. 2016. "Memorandum of Agreement Among the City of Memphis, Shelby County, the Memphis and Shelby County Port Commission, the Memphis Light, Gas and Water Division, and the Tennessee Valley Authority." February.

Envrionmental Protection Agency (EPA). 2015a. "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." Federal Register, Vol. 80, No. 74, Part II, Environmental Protection Agency, 40 CFR Parts 257 and 261. April 17.

Envrionmental Protection Agency (EPA). 2015b. ProUCL Version 5.1 User Guide. Statistical Software for Environmental Applications for Data Sets and without Nondetect Observations. "October 2015.

Federal Emergency Management Agency (FEMA). 2004. "Federal Guidelines for Dam Safety." FEMA 93. April.

Geocomp. 2013. "Tennessee Valley Authority, EPA Seismic Assessment, Supplemental Site Exploration, Allen Fossil Plant." Prepared for Tennessee Valley Authority. March.

Geocomp. 2016a. "Tennessee Valley Authority, EPA Seismic Assessment, Supplemental Site Exploration, Allen Fossil Plant, East Ash Disposal Area, Final Report." Volumes 1-4. Prepared for Tennessee Valley Authority. October.

Geocomp. 2016b. "Initial Seismic Safety Factor Assessment, EPA Final CCR Rule, TVA Allen Fossil Plant East Ash Disposal Area, Memphis, Tennessee." Prepared for Tennessee Valley Authority. October 14.

MACTEC. 2004a. "Final Summary of Laboratory Testing on Fly Ash, Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. May.

MACTEC. 2004b. "Report of Geotechnical Exploration, East and West Disposal Areas, Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. August.

Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

Stantec Consulting Services Inc. (Stantec). 2011. "Geotechnical Report for the Evaluation of Dike Stability, Remedial Measures for the Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. May.

Stantec Consulting Services Inc. (Stantec). 2012a. "Construction Certification Report, Allen Fossil Plant, East Stilling Pond, Eastern Perimeter Dike Remedial Improvements, Work Plan 6 (ALF-110510-WP-06), Memphis, Tennessee." Prepared for Tennessee Valley Authority. April.

Stantec Consulting Services Inc. (Stantec). 2012b. "Geotechnical Exploration Report, Northern Perimeter Dike Stability, Chemical Treatment Pond Closure, Allen Fossil Plant, Memphis Tennessee." Prepared for Tennessee Valley Authority. August.

Stantec Consulting Services Inc. (Stantec). 2015a. "October 2015 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. October.

Stantec Consulting Services Inc. (Stantec). 2015b. "November 2015 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. November.

Stantec Consulting Services Inc. (Stantec). 2015c. "Geotechnical Exploration Data Report, East Ash Disposal Area, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. December.

Stantec Consulting Services Inc. (Stantec). 2015d. "December 2015 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. December.

Stantec Consulting Services Inc. (Stantec). 2016a. "January 2016 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. January.

Stantec Consulting Services Inc. (Stantec). 2016b. "Geotechnical Exploration Report, Northern Perimeter Dike Stability, West Ash Pond Closure, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

Stantec Consulting Services Inc. (Stantec). 2016c. "February 2016 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. February.

Stantec Consulting Services Inc. (Stantec). 2016d. "March 2016 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. March.

Stantec Consulting Services Inc. (Stantec). 2016e. "April 2016 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. April.

Stantec Consulting Services Inc. (Stantec). 2016f. "May 2016 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. May.

Stantec Consulting Services Inc. (Stantec). 2016g. "June 2016 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. June.

Stantec Consulting Services Inc. (Stantec). 2016h. "Basis of Design Report (Rev. 1), West Ash Pond Final Closure, Allen Fossil Plant, Memphis, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. June 3.

Stantec Consulting Services Inc. (Stantec). 2016i. "July 2016 – Instrumentation Monitoring Summary, TVA Allen, Bull Run, Cumberland, John Sevier, Johnsonville, Kingston, Shawnee, and Widows Creek Fossil Plants, Kentucky, Tennessee, and Alabama." Prepared for Tennessee Valley Authority. July.

Stantec Consulting Services Inc. (Stantec). 2016j. "Initial Static Safety Factor Assessment, East Ash Disposal Area, EPA Final CCR Rule, TVA Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. October 6.

Stantec Consulting Services Inc. (Stantec). 2016k. "Initial Structural Stability Assessment, East Ash Disposal Area, EPA Final CCR Rule, TVA Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. October 12.

Stantec Consulting Services Inc. (Stantec). 2017. "Basis of Design Report (Rev. 0), East Ash Pond Complex Closure, Allen Fossil Plant, Memphis, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. January.

Stantec Consulting Services Inc. (Stantec) and AECOM. 2016. "Instrumentation and Monitoring Plan (Rev. 4), Tennessee Valley Authority Instrumentation Monitoring Program, Coal

Combustion Product Storage Facilities, Various Plants, Alabama, Kentucky, and Tennessee." Prepared for Tennessee Valley Authority. September.

Tennessee Valley Authority (TVA). 1975. "Allen Steam Plant – Ash Disposal Areas Dikes – Soil Investigation." Memorandum from Gene Farmer to G. L. Buchanan. May.

Tennessee Valley Authority (TVA). 2011. "Red Water Seep Inspections for Allen Fossil Plant NPDES Permit, TN0005355."

Tennessee Valley Authority (TVA). 2016a. "TVA Standard Programs and Processes – Dam Safety." TVA-SPP-27.0, Revision 0001. January 13.

Tennessee Valley Authority (TVA). 2016b. "Final Ash Impoundment Closure Programmatic EIS, Part II – Site Specific NEPA Review: Allen Fossil Plant." June.

United States Army Corps of Engineers (USACE). 1955. "Memphis Quadrangle, Tennessee-Arkansas." Scale1:62,500.

United States Army Corps of Engineers (USACE). 1958. "Proposed Levee Work, Item No. L-723, Ensley, Tenn." Drawing No. 1, Serial 15821, File 153/L-46. Includes as built markings.

United States Army Corps of Engineers (USACE). 1960. "Levee Work, Item No. L-725, Ensley, Tenn." Drawing No. 1, Serial 16362, File 153/L-9. February.

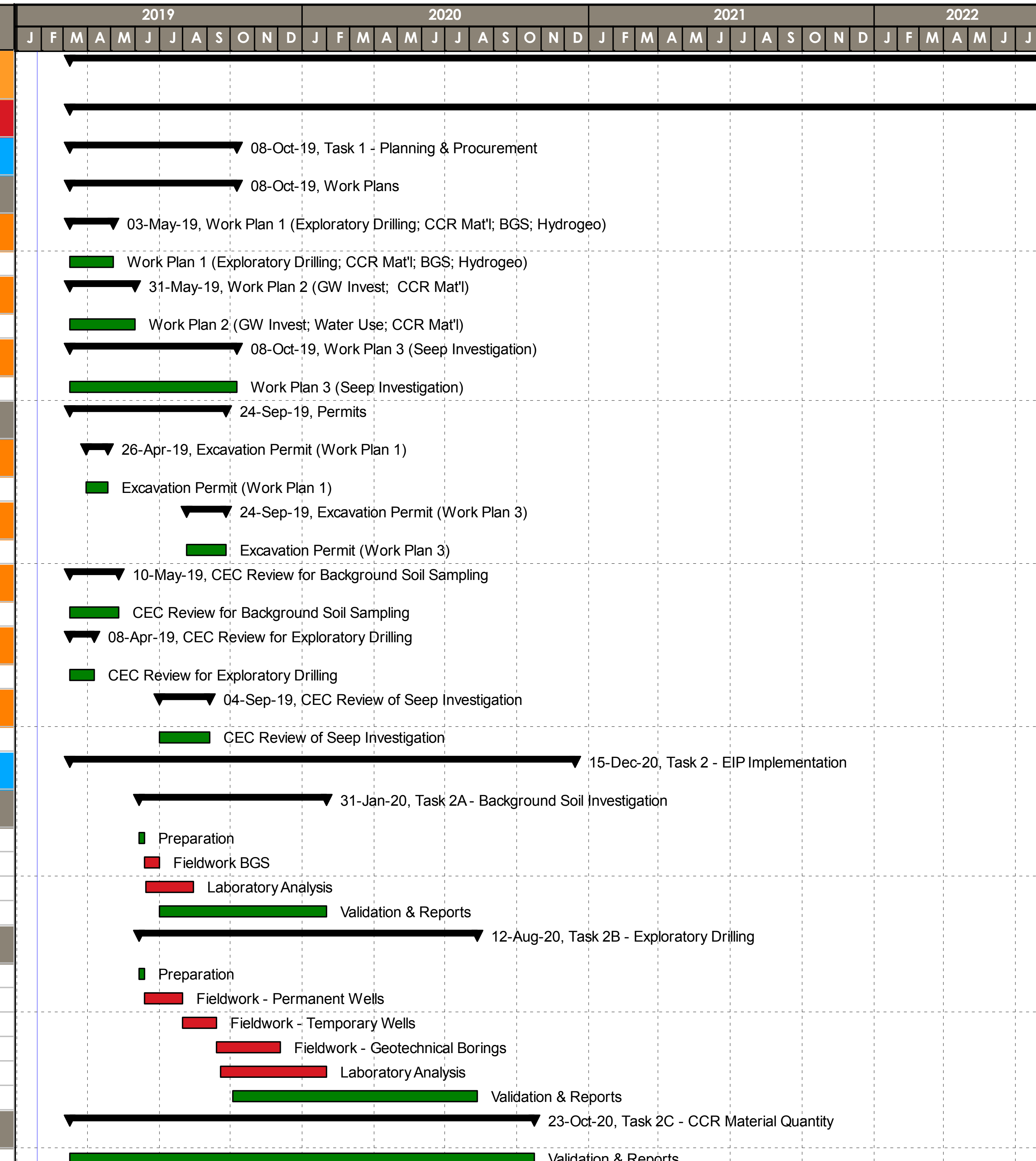
United States Geological Survey (USGS). 1978. "Geologic Map of the Tennessee, Portion of the Fletcher Lake Quadrangle."

United States Geological Survey (USGS). 2016. "Evaluation of Effects of Groundwater Withdrawals at the Proposed Allen Combined-Cycle Combustion Turbine Plant, Shelby County, Tennessee."

APPENDIX A
SCHEDULE

ST612107-006 TDEC Order ALF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
TDEC Order ALF Phase 2		867d	08-Mar-19	17-Aug-22
Environmental Investigation		867d	08-Mar-19	17-Aug-22
Task 1 - Planning & Procurement		150d	08-Mar-19	08-Oct-19
Work Plans		150d	08-Mar-19	08-Oct-19
Work Plan 1 (Exploratory Drilling; CCR Mat'l; BGS; Hydı		41d	08-Mar-19	03-May-19
STN-11015	Work Plan 1 (Exploratory Drilling; CCR Mat'l; BGS; Hydrogeo)	41d	08-Mar-19	03-May-19
Work Plan 2 (GW Invest; CCR Mat'l)		60d	08-Mar-19	31-May-19
STN-11115	Work Plan 2 (GW Invest; Water Use; CCR Mat'l)	60d	08-Mar-19	31-May-19
Work Plan 3 (Seep Investigation)		150d	08-Mar-19	08-Oct-19
STN-11315	Work Plan 3 (Seep Investigation)	150d	08-Mar-19	08-Oct-19
Permits		140d	08-Mar-19	24-Sep-19
Excavation Permit (Work Plan 1)		21d	29-Mar-19	26-Apr-19
STN-12115	Excavation Permit (Work Plan 1)	21d	29-Mar-19	26-Apr-19
Excavation Permit (Work Plan 3)		35d	06-Aug-19	24-Sep-19
STN-12315	Excavation Permit (Work Plan 3)	35d	06-Aug-19	24-Sep-19
CEC Review for Background Soil Sampling		46d	08-Mar-19	10-May-19
TVA-12615	CEC Review for Background Soil Sampling	46d	08-Mar-19	10-May-19
CEC Review for Exploratory Drilling		22d	08-Mar-19	08-Apr-19
TVA-12715	CEC Review for Exploratory Drilling	22d	08-Mar-19	08-Apr-19
CEC Review of Seep Investigation		46d	01-Jul-19	04-Sep-19
TVA-12815	CEC Review of Seep Investigation	46d	01-Jul-19	04-Sep-19
Task 2 - EIP Implementation		447d	08-Mar-19	15-Dec-20
Task 2A - Background Soil Investigation		165d	05-Jun-19	31-Jan-20
STN-21096	Preparation	6d	05-Jun-19	12-Jun-19
STN-21010	Fieldwork BGS	15d	12-Jun-19*	02-Jul-19
TVA-21020	Laboratory Analysis	43d	14-Jun-19	14-Aug-19
STN-21098	Validation & Reports	146d	02-Jul-19	31-Jan-20
Task 2B - Exploratory Drilling		300d	05-Jun-19	12-Aug-20
STN-22096	Preparation	6d	05-Jun-19	12-Jun-19
STN-22010	Fieldwork - Permanent Wells	35d	12-Jun-19*	31-Jul-19
STN-22020	Fieldwork - Temporary Wells	30d	01-Aug-19	12-Sep-19
STN-22030	Fieldwork - Geotechnical Borings	55d	13-Sep-19	03-Dec-19
STN-22040	Laboratory Analysis	93d	17-Sep-19	31-Jan-20
STN-22098	Validation & Reports	216d	03-Oct-19	12-Aug-20
Task 2C - CCR Material Quantity		412d	08-Mar-19	23-Oct-20
STN-23098	Validation & Reports	412d	08-Mar-19	23-Oct-20



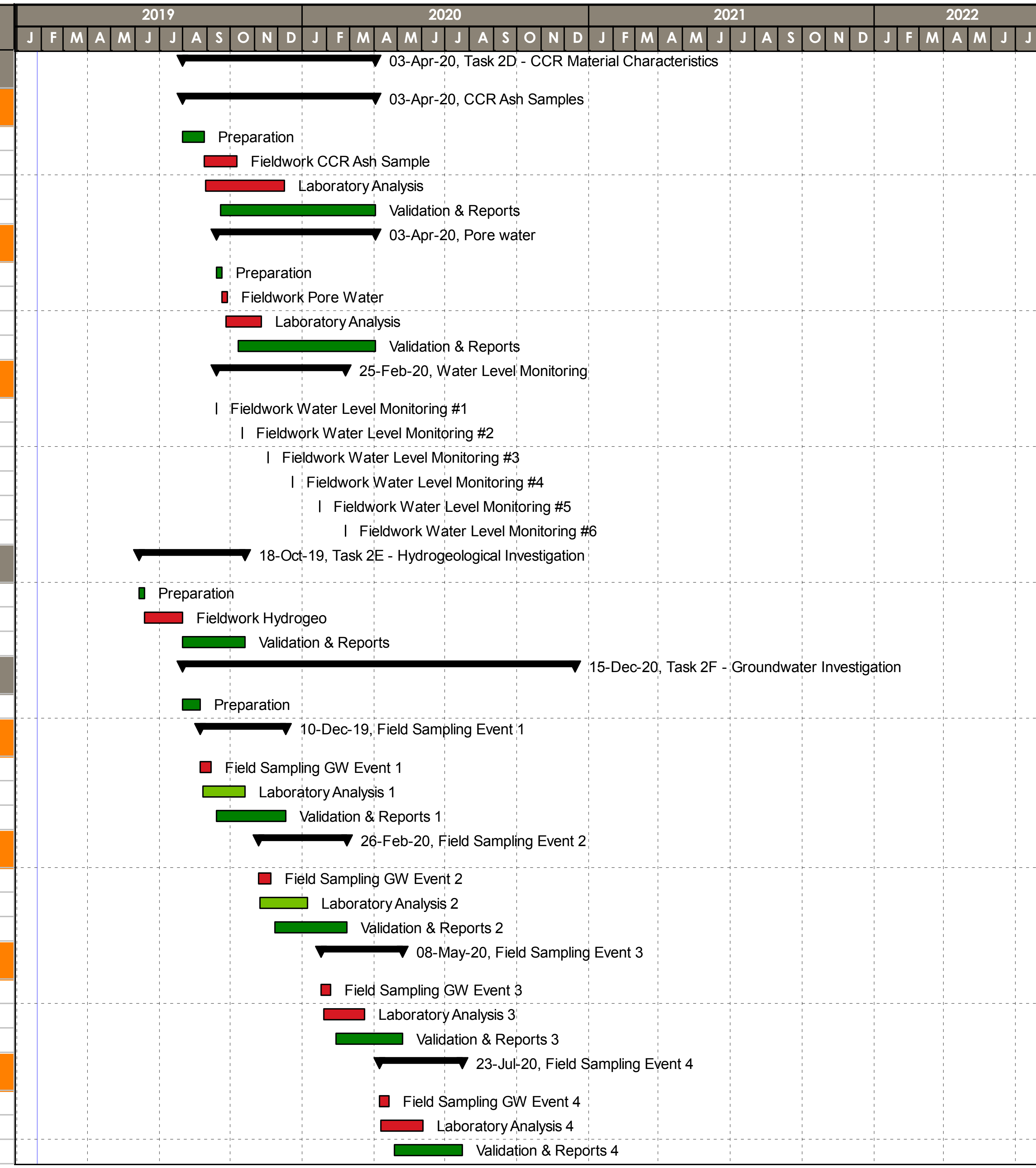
Remaining Level of Effort | Actual Work | Critical Remaining Work
Actual Level of Effort | Remaining Work ◆ | ◆ Milestone

Layout: Execution Schedule EIP (WBS) TDEC

Data Date:26-Jan-19
Print Date:07-Feb-19

ST612107-006 TDEC Order ALF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
Task 2D - CCR Material Characteristics		170d	31-Jul-19	03-Apr-20
CCR Ash Samples		170d	31-Jul-19	03-Apr-20
STN-24096	Preparation	21d	31-Jul-19	28-Aug-19
STN-24010	Fieldwork CCR Ash Sample	30d	28-Aug-19	09-Oct-19
TVA-24020	Laboratory Analysis	68d	30-Aug-19	09-Dec-19
STN-24098	Validation & Reports	136d	18-Sep-19	03-Apr-20
Pore water		139d	13-Sep-19	03-Apr-20
STN-24094	Preparation	6d	13-Sep-19	20-Sep-19
STN-24110	Fieldwork Pore Water	5d	20-Sep-19	26-Sep-19
TVA-24120	Laboratory Analysis	33d	24-Sep-19	08-Nov-19
STN-24099	Validation & Reports	120d	10-Oct-19	03-Apr-20
Water Level Monitoring		111d	13-Sep-19	25-Feb-20
STN-24300	Fieldwork Water Level Monitoring #1	1d	13-Sep-19	13-Sep-19
STN-24310	Fieldwork Water Level Monitoring #2	1d	16-Oct-19	16-Oct-19
STN-24320	Fieldwork Water Level Monitoring #3	1d	18-Nov-19	18-Nov-19
STN-24330	Fieldwork Water Level Monitoring #4	1d	19-Dec-19	19-Dec-19
STN-24340	Fieldwork Water Level Monitoring #5	1d	23-Jan-20	23-Jan-20
STN-24350	Fieldwork Water Level Monitoring #6	1d	25-Feb-20	25-Feb-20
Task 2E - Hydrogeological Investigation		95d	05-Jun-19	18-Oct-19
STN-25096	Preparation	6d	05-Jun-19	12-Jun-19
STN-25010	Fieldwork Hydrogeo	35d	12-Jun-19	31-Jul-19
STN-25098	Validation & Reports	55d	01-Aug-19	18-Oct-19
Task 2F - Groundwater Investigation		345d	01-Aug-19	15-Dec-20
STN-26096	Preparation	16d	01-Aug-19	22-Aug-19
Field Sampling Event 1		75d	22-Aug-19	10-Dec-19
STN-26110	Field Sampling GW Event 1	10d	22-Aug-19	05-Sep-19
TVA-26120	Laboratory Analysis 1	38d	26-Aug-19	18-Oct-19
STN-26145	Validation & Reports 1	61d	12-Sep-19	10-Dec-19
Field Sampling Event 2		75d	06-Nov-19	26-Feb-20
STN-26210	Field Sampling GW Event 2	10d	06-Nov-19	20-Nov-19
TVA-26220	Laboratory Analysis 2	38d	08-Nov-19	06-Jan-20
STN-26245	Validation & Reports 2	61d	27-Nov-19	26-Feb-20
Field Sampling Event 3		75d	24-Jan-20	08-May-20
STN-26310	Field Sampling GW Event 3	10d	24-Jan-20	06-Feb-20
TVA-26320	Laboratory Analysis 3	38d	28-Jan-20	20-Mar-20
STN-26345	Validation & Reports 3	61d	13-Feb-20	08-May-20
Field Sampling Event 4		75d	08-Apr-20	23-Jul-20
STN-26410	Field Sampling GW Event 4	10d	08-Apr-20	21-Apr-20
TVA-26420	Laboratory Analysis 4	38d	10-Apr-20	03-Jun-20
STN-26445	Validation & Reports 4	61d	28-Apr-20	23-Jul-20



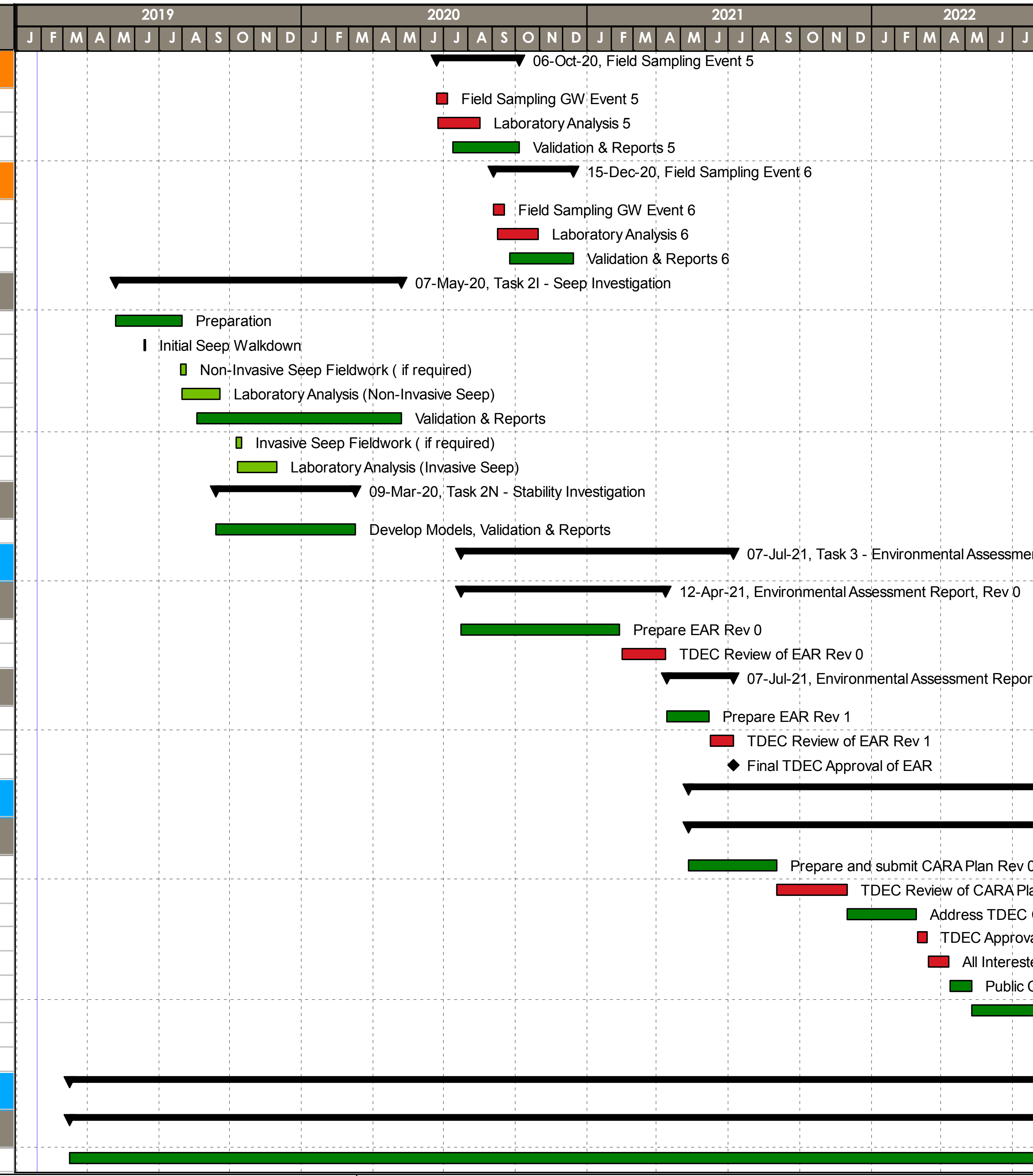
Remaining Level of Effort — Actual Work — Critical Remaining Work
Actual Level of Effort — Remaining Work — ◆ Milestone

Layout: Execution Schedule EIP (WBS) TDEC

Data Date:26-Jan-19
Print Date:07-Feb-19

ST612107-006 TDEC Order ALF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
Field Sampling Event 5		75d	22-Jun-20	06-Oct-20
STN-26510	Field Sampling GW Event 5	10d	22-Jun-20	06-Jul-20
TVA-26520	Laboratory Analysis 5	38d	24-Jun-20	17-Aug-20
STN-26545	Validation & Reports 5	61d	13-Jul-20	06-Oct-20
Field Sampling Event 6		70d	03-Sep-20	15-Dec-20
STN-26610	Field Sampling GW Event 6	10d	03-Sep-20	17-Sep-20
TVA-26620	Laboratory Analysis 6	38d	08-Sep-20	30-Oct-20
STN-26645	Validation & Reports 6	56d	24-Sep-20	15-Dec-20
Task 2I - Seep Investigation		253d	07-May-19	07-May-20
STN-29096	Preparation	59d	07-May-19	30-Jul-19
STN-29108	Initial Seep Walkdown	2d	13-Jun-19*	14-Jun-19
STN-29109	Non-Invasive Seep Fieldwork (if required)	5d	30-Jul-19	05-Aug-19
TVA-29118	Laboratory Analysis (Non-Invasive Seep)	33d	01-Aug-19	17-Sep-19
STN-29098	Validation & Reports	181d	19-Aug-19	07-May-20
STN-29110	Invasive Seep Fieldwork (if required)	5d	09-Oct-19	16-Oct-19
TVA-29120	Laboratory Analysis (Invasive Seep)	33d	11-Oct-19	29-Nov-19
Task 2N - Stability Investigation		120d	13-Sep-19	09-Mar-20
STN-29798	Develop Models, Validation & Reports	120d	13-Sep-19	09-Mar-20
Task 3 - Environmental Assessment Report (EAR)		240d	23-Jul-20	07-Jul-21
Environmental Assessment Report, Rev 0		180d	23-Jul-20	12-Apr-21
STN-31096	Prepare EAR Rev 0	140d	23-Jul-20	12-Feb-21
STN-31150	TDEC Review of EAR Rev 0	40d	16-Feb-21	12-Apr-21
Environmental Assessment Report, Rev 1 (Reserved)		60d	13-Apr-21	07-Jul-21
STN-32096	Prepare EAR Rev 1	39d	13-Apr-21	07-Jun-21
STN-32170	TDEC Review of EAR Rev 1	21d	08-Jun-21	07-Jul-21
STN-32180	Final TDEC Approval of EAR	0d		07-Jul-21
Task 10 - CARA (Reserved)		320d	11-May-21	17-Aug-22
Meetings & Deliverables		320d	11-May-21	17-Aug-22
STN-98254	Prepare and submit CARA Plan Rev 0 for TDEC Review	80d	11-May-21	01-Sep-21
TVA-98255	TDEC Review of CARA Plan Rev 0	60d	02-Sep-21	30-Nov-21
STN-98256	Address TDEC Comments on CARA Plan Rev 0, Prepare and submit Rev 1 to TDEC	60d	01-Dec-21	28-Feb-22
TVA-98295	TDEC Approval of CARA Plan Rev 1	10d	01-Mar-22	14-Mar-22
TVA-98365	All Interested Party Meeting (AIP)	20d	15-Mar-22	11-Apr-22
STN-98296	Public Comment Period	20d	12-Apr-22	09-May-22
STN-98298	Address Public Comments on CARA Plan Rev 1 and Prepare CARA Plan Rev 2 for T	60d	10-May-22	03-Aug-22
TVA-98345	TDEC Final Approval of CARA Plan Rev 2	10d	04-Aug-22	17-Aug-22
TVA-98355	Final TDEC Approval of CARA	0d		17-Aug-22
Task 11 - Project Communications & Reporting		867d	08-Mar-19	17-Aug-22
Task 11A - TDEC Updates		867d	08-Mar-19	17-Aug-22
TVA-96110	TDEC Monthly Progress Reports	867d	08-Mar-19	17-Aug-22



Remaining Level of Effort	Actual Work	Critical Remaining Work
Actual Level of Effort	Remaining Work	Milestone

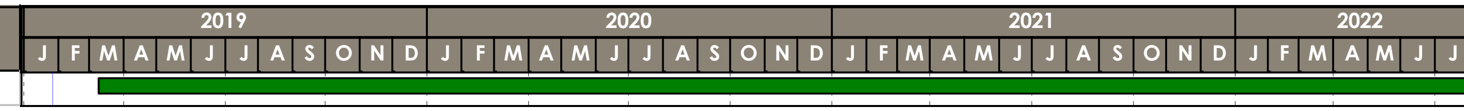
Layout: Execution Schedule EIP (WBS) TDEC

Data Date:26-Jan-19

Print Date:07-Feb-19

ST612107-006 TDEC Order ALF Phase 2-TDEC Reporting

Activity ID	Activity Name	Remaining Duration	Start	Finish
TVA-96120	TDEC Progress Update Meetings (Quarterly)	867d	08-Mar-19	17-Aug-22



Remaining Level of Effort
Actual Level of Effort
Actual Work
Remaining Work
Critical Remaining Work
Milestone

Layout: Execution Schedule EIP (WBS) TDEC

Data Date:26-Jan-19
Print Date:07-Feb-19

APPENDIX B
REGULATORY CORRESPONDENCE

Charles L. Head, Senior Advisor
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243615 532-0998
e-mail: chuck.head@state.tn.us

Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

February 6, 2017

Paul J. Pearman, Project Manager
Tennessee Valley Authority
1101 Market Street, MR 4K
Chattanooga, TN 37402

Subject: TVA Allen Fossil Plant
Environmental Investigation Plan Due Date
June 12, 2017

Dear Paul:

This letter serves as a follow-up to the investigation conference meeting with the Tennessee Valley Authority (TVA) on September 28 & 29, 2016 at the TVA Allen Fossil Plant (ALF). This meeting fulfilled Section VII.A.a of Commissioner's Order OGC15-00177 (the Order). The Tennessee Department of Environment and Conservation (TDEC) appreciates the time and effort made by your staff and consultants presenting a summary of the geologic, hydrologic, analytical, engineering and historic data for the ALF site. TDEC's staff understood the information presented and appreciated the opportunity to ask questions and discuss technical issues. The ALF Site has CCR disposal sites adjacent to McKellar Lake/Mississippi River.

TDEC requests that TVA include site-specific responses to the comments presented below when the TVA GAF ALF Environmental Investigation Plan is submitted to TDEC.

General Site-Wide ALF Investigation Conference Questions and Comments

1. Document the areas and quantities of CCR material used to construct the impoundment dikes and their foundations.

2. TVA should provide better information on the extent of the clay foundation for each ash pond. Permeability of foundation soil should be provided for areas where granular foundation soils were encountered.

3. United States Army Corps of Engineers (USACE) levees constructed at the Allen Fossil Plant are being used as the Southern Dike for the West Ash Pond and Northern Dike for the East Ash Pond. Please provide a copy of the Agreement between TVA and USACE for these levees to be used as dikes for the ash ponds. Is there a memorandum of agreement between TVA and USACE regarding the levees? If there is an agreement, please include it in the EIP. Is TVA required to coordinate any of the proposed environmental investigation work at the TVA ALF site with the USACE? Is TVA required to submit plans for environmental investigation of this site to USACE for review and approval pursuant to Section 408 of the River and Harbors Act? If yes, please explain the review and approval process.

General - Memorandum of Agreement

1. The City of Memphis and Memphis Light Gas and Water (MLGW) owns the majority of the West Ash Pond Disposal Area. How will the ownership of this area affect the environmental investigation at the TVA ALF site?

2. The City of Memphis and MLGW owns the majority of the West Ash Pond Disposal Area. How will the complex ownership affect the potential closure? Does TVA have an agreement with the City of Memphis and Shelby County that allows TVA to leave CCR material in place should closure-in-place be an approved corrective action option. If so, please provide the documentation in the TVA ALF EIP.

3. What are the requirements for closure under the Memorandum of Agreement? Any there restrictions under the agreement?

4. Provide a map and description of the ash fill for each pond contained in the easement and referenced in the Memorandum of Agreement. On the map, please provide the elevations of the impoundments.

5. TVA shall notify TDEC of any modifications to the memorandum of agreement between TVA and local governmental entities. TVA shall provide TDEC with quarterly updates to the Local Entities.

Groundwater Monitoring

1. TVA shall provide TDEC with the opportunity to review and comment on the proposed background well location(s) once the site has been fully characterized and prior to establishing the groundwater monitoring well network.

2. The elevation of McKellar Lake should be recorded, on the same datum as the groundwater elevation data, during all groundwater monitoring events. This information should be included with all groundwater monitoring well water levels. This data should also be considered in mapping and identifying the upper most aquifer.

3. Sediment samples should be collected from the screened interval during the installation of new groundwater monitoring wells. These samples should be analyzed, utilizing the appropriate LEAF method, for appendix III and IV of the Federal CCR rules.

4. TVA shall submit reports for all groundwater monitoring events for each unit to TDEC.

5. TVA shall investigate the hydrogeology in the vicinity of the ash ponds with respect to vertical gradients in the water table aquifer. This investigation shall also evaluate the lithology of the confining unit underlying the water table aquifer and establish monitoring points in the upper portion of the underlying Memphis Sands Aquifer.

6. TVA shall provide an assessment of the impact pumpage from TVA's newly established water withdrawal wells may have on the potentiometric surface within the Memphis Sands Aquifer and the water table aquifer.

West Ash Pond

1. Groundwater monitoring data should be provided for the West Ash Pond to determine the criteria for proper closure, should closure-in-place be an approved Corrective Action measure for the TVA ALF CCR surface impoundments.

2. TVA should supply the history of seeps discovered on and around the West Ash Pond's dike and the actions taken to repair the seeps. TVA shall also identify any seeps that were repaired but continue to discharge water. For repaired seeps that continue to allow water to discharge TVA shall explain why each seep continues to flow and how the partially treated wastewater flowing from the seep is managed.

East Ash Pond

1. TVA has a neighbor adjacent to its TVA ALF site, Reeds Material Harsco Corporation. The Commissioner's Order requires TVA to fully determine the location and amount of CCR material disposed at each TVA Fossil Plant site. Please describe in the TVA ALF EIP how TVA will determine that the Harsco beneficial reuse area and the coal run-off pond are not located over or contain quantities of CCR.

2. The NPDES effluent discharge limits for the East Ash Disposal Area for the TVA ALF site should be confirmed in the EIP.

3. TVA should provide the monthly instrumentation summary that reports the action taken for each of the six water level elevation exceedances referenced in the July 28, 2016 Intermediate Inspection of CCR Facilities.

4. Clarify if the minimum depth of CCR material (4.4 feet) reported for the East Ash Disposal Area Intermediate Inspection is located in the east active ash pond or the East Stilling pond.

5. TVA should supply the history of seeps discovered on and around the West Ash Pond's dike and the actions taken to repair the seeps. TVA shall also identify any seeps that were repaired but continue to discharge water. For repaired seeps that continue to allow water to discharge TVA shall explain why each seep continues to flow and how the partially treated wastewater flowing from the seep is managed.

June 2016 Part II - Site-Specific NEPA Review: Allen Fossil Plant

1. Provide the information and documents used to determine the seismic stability of the West Ash Impoundment referenced in the TVA ALF NEPA Review.

2. Clarify the required quantity of off-site borrow material necessary to grade and cover the site referenced in the NEPA document should closure-in-place be an acceptable Corrective Action measure for the TVA ALF surface impoundments. Is there enough on-site borrow material to complete closure-in-place for the CCR surface impoundments should this be an acceptable Corrective Action measure and if so does TVA plan to use it for this site.

<u>Miscellaneous</u>

1. TVA should include in the TVA ALF EIP an updated map with details and cross-sections of soil borings, piezometers, and monitoring well locations that will provide a better understanding of the site subsurface geology (specifically beneath the ponds). The total depth and screen interval should be included in each cross-section.

2. For ground water monitoring wells, cross-sections should also include the soil boring logs on the drawing and ground water levels at the time of the boring. The moisture content of the various soils involved should be shown (if known).

3. TVA should also include USACE soil borings from the Ensley Levee construction documents.

From our on-site meeting, TDEC is aware that TVA has some information it has collected previously at the TVA ALF site; as an example data from soil borings and analysis of samples collected from ground water monitoring wells. This information provides a good reference when the data was collected, but the soil borings and ground water monitoring wells may not have been installed and constructed to meet the criteria for the environmental investigation of this site per the Order. TVA should consider proposing additional activities at the TVA ALF site to fully determine the amount and location of CCR material disposed, migration of CCR constituents through soil and ground water, identification of, the upper most aquifer, migration of ground water with CCR constituents into surface, structural stability, etc.

The TVA ALF EIP shall include a schedule for activities to be performed to complete the environmental investigation of the TVA ALF site. As an example, it is TDEC's expectation that the schedule for installing, developing and sampling ground water monitoring wells will be specifically described in the TVA ALF EIP and the schedule of activity to perform this work provided. A full description of the methods used to install drill, construct and sample ground water monitoring wells may be included in an appendix to the TVA ALF EIP or if TVA plans to use an established method or protocol, it can be included by reference.

Once TDEC approves the TVA ALF EIP, the environmental investigation activities should provide a very good overall view site conditions within 9 to 12 months. This will allow TVA to prepare an Environmental Assessment Report within 12 to 15 months of approval of the TVA ALF EIP.

The due date for submittal of the draft TVA ALF EIP is on or before the close of business June 12, 2017.

TDEC understands from documents prepared by to meet the National Environmental Policy Act that TVA plans to close the East and West Surface Impoundments in place. Should TVA decide to close the CCR surface impoundments at the TVA ALF site in place before the environmental investigation required under the TDEC Order has been completed, it does so at its own risk. Under the Order, TVA is required to perform a comprehensive environmental assessment. The results of the TVA ALF environmental assessment will determine the appropriate corrective action for soil, ground water and surface water and ensure protection of public health. Corrective action at the TVA ALF site may range from closure in place of the surface impoundments to complete removal of CCR material from the CCR surface impoundments and disposal at a properly permitted landfill and anywhere in between.

TDEC's goal is to work with TVA to ensure the environmental investigation of the ALF site is complete, accurate, and timely. Please contact TDEC with any questions or comments regarding these comments.

Sincerely,

Chuck Head

Chuck Head

CC:			
CC:	Shari Meghreblian, Ph. D.	Tisha C. Benton	Susan Smelley.
	E. Joseph Sanders	Britton Dotson	Paul J. Pearman, P.E.
	Patrick J. Flood, P.E.	Glen Pugh	Scotty Sorrells
	James Clark	Rob Burnette	

Robert Wilkinson, PG, CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

October 3, 2017

Paul J. Pearman
Tennessee Valley Authority
1101 Market Street, MR 4K
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Allen Coal Fired Fossil Fuel Plant
Environmental Investigation Plan Revision 0 Comments

Dear Mr. Pearman:

The Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order OGC 15-0177 (the Order") to the Tennessee Valley Authority (TVA) that required TVA action at seven TVA Coal Fired Fossil Power Plants (active and inactive) located in Tennessee. The Order was signed on August 6, 2015 and included information about TVA's right to appeal the Order. TVA did not appeal the Order and it is now final.

The Order required TVA to perform environmental investigations and to take appropriate corrective action at seven TVA Coal Fossil Power Plants (CCR sites) in Tennessee. The Order is specific to Coal Combustion Residual (CCR) material. Paragraph VII. of the Order provides the sequence of events for environmental investigation at a TVA CCR site as presented below.

1. TVA and TDEC are required to schedule and conduct an initial meeting to discuss each CCR site. At each CCR site meeting, TVA provides the operational history of the CCR site, all geological and hydrogeological information currently available, results of environmental investigations and sampling, etc. This is basically a summary of TVA's current understanding of each CCR site.

2. TDEC reviews the information provided by TVA (historical information, geophysical properties of the site, operational history, etc.) at the on-site meeting and historical CCR site information provided by TVA. After review of the information provided by TVA, TDEC sends a letter to TVA that sets the date for submission of the draft CCR site

Environmental Investigation Plan (EIP) and informs TVA of any additional environmental activities it believes are necessary to complete the CCR site environmental investigation.

3. TVA submits a draft Environmental Investigation Plan for the CCR site. TDEC reviews the draft CCR site EIP and provides TVA with comments that identify opportunities to improve the environmental investigation of the CCR site EIP. This letter also sets a due date for submission of the revised CCR site EIP.

4. TVA submits a revised EIP for the CCR site to TDEC, with a schedule of onsite activities such as installation of ground water monitoring wells, installing soil/rock borings to determine subsurface geological features, methods that will be used to determine the location and amount of disposed CCR material, surface water and ground water monitoring, etc.

5. TDEC provides TVA with its response to the revised EIP. When TDEC finds the CCR site EIP to be complete, TDEC notifies TVA via letter.

6. TVA is required to issue a public notice for the CCR site EIP before it is implemented. The public has 30 days to submit its EIP comments to TDEC. If EIP comments are submitted to TDEC, then TDEC has 30 days to respond to the comments.

7. Once the public comment period has ended, TDEC may provide TVA with CCR site EIP comments as a result of the review of the public comments submitted to TDEC. TVA submits and TDEC approves/disapproves the schedule of activities for environmental investigation at the CCR site. Unless TDEC disapproves the CCR site EIP schedule of activities, TVA proceeds with the environmental investigation, collects and generates data, then prepares an Environmental Assessment Report (EAR).

8. The EAR is submitted to TDEC. TDEC evaluates the EAR and decides if TVA has generated enough environmental investigation data to:

    a. Determine the impact of CCR materials to public health and the environment.
    b. Provide a comprehensive picture of the areas where CCR material disposed.
    c. Assess the structural and seismic stability of the CCR disposal areas.
    d. Determine the extent of CCR constituents in ground water and discharges to surface water.
    e. Determine if CCR material is disposed below the ground water table.

TDEC also determines if there is enough information generated to prepare a comprehensive corrective action plan.

If TDEC determines the EAR is incomplete or deficient, then TDEC informs TVA of its concerns. TVA is then required to further investigate the CCR site, beginning with item 4. above.

<u>Allen CCR site EIP Rev 0 Comments</u>

TVA submitted the EIP Rev 0 for TVA Allen Coal Fired Fossil Power Plant (TVA ALF) on June 12, 2017. TDEC has completed its review of EIP Rev 0 and is providing comments listed in the attached **Table 1 TVA Allen EIP Rev 0 Summary of TDEC Comments**.

Please address the attached comments and submit a revised plan (EIP Rev 1) with a cover letter summarizing TVA's response to each comment and subsequent modifications to TDEC by **November 2, 2017**.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA ALF site is complete, accurate and timely. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

Robert Wilkinson, PG, CHMM

CC:	Susan Smelley	Britton Dotson	James Clark
	Pat Flood	Scotty Sorrells	Rob Burnette
	Tisha Calabrese Benton	Angela Adams	Joseph E. Sanders
	Chuck Head	Peter Lemiszki	Leland Hares
	Herb Nicholson	John Boatright	

Section Number	Section Title	Page	Paragraph	Line	Comment
All	All	All	All	All	General comment - TVA should include an applicability assessment of the TDEC General Guideline for Environmental Investigation Plans, TVA Fossil Plants when preparing the EIP. TDEC understands that not all aspects of the guidelines will be applicable at all TVA facilities, but each line item should be reviewed and assessed for applicability within the EIP. If an item is deemed not applicable to this facility, TVA should provide a written justification for exclusion within the EIP. Applicable items from the guidelines should be incorporated into the next revision of the EIP.
All	All	All	All	All	General comment - All monitor wells, geotechnical borings, and soil borings should be logged by a Tennessee licensed professional geologist.
All	All	All	All	All	General content comment - please give titles to sections that reflect the content of the section - "TDEC Information Request" is not an appropriate section title.
All	All	All	All	All	General comment - TVA should update the EIP to reflect the accelerated groundwater investigation that is currently occurring onsite.
General Admin	NA	NA	NA	NA	The document lacks a signature page that indicates the document has been read and that the various parties (e.g., QA consultant, Investigation Consultant field personal) understand the relevant requirements.
General Admin	NA	NA	NA	NA	The document lacks an approval page, with all stakeholders listed.
General Admin	NA	NA	NA	NA	The document lacks a revision log.
General Admin	NA	NA	NA	NA	The TDEC will be notified immediately by the TVA of any problems related to successful completion of field efforts as outlined in this EIP.
General Admin	NA	NA	NA	NA	Please provide the following TVA TI, "Monitoring Well and Piezometer Installation and Development" (ENV-TI-05.80.25).

Section Number	Section Title	Page	Paragraph	Line	Comment
Global SAPs	NA	NA	NA	NA	The SAPs lack a list of field equipment and critical spare parts (if applicable) related to the specific tasks described in each SAP.
Global SAPs	NA	NA	NA	NA	There needs to be a maintenance form created to document the routine checks and both the regular and special maintenance that will occur for each instrument. This form needs to include the nature of the maintenance the qualified person and dates.
General Technical	NA	NA	NA	NA	Is there a plan to look at the data for trends when common leachate indicators are compared to the total amount of CCR metals in contaminated water samples. It is important to determine if there is a relationship because of the expected geochemical relationships between chloride, other leachate indicators, and the presence of CCR metals, otherwise only CCR metals can be used to reliably indicate leachate-groundwater interaction.
General Technical	NA	NA	NA	NA	Will Piper diagrams be used to compare the hydrochemical facies of EIP groundwater samples? And if so please identify what comparison(s) will be made (e.g., west ash pond versus east ash pond, groundwater discharge to McKellar Lake versus groundwater recharge from McKellar Lake, contaminated wells versus background wells, etc.)?
General Technical	NA	NA	NA	NA	Provide list of historical waste sites (active/closed) with generation process/chemical composition

Section Number	Section Title	Page	Paragraph	Line	Comment
General Technical	NA	NA	NA	NA	Provide geologic information from two ALF wells that were drilled, and later plugged
General Technical	NA	NA	NA	NA	Provide detailed remediation info. regarding historical sewer line ruptures at site
General Technical	NA	NA	NA	NA	Any geologic/completion info. from Harsco well would be appreciated
1.1	Purpose	1	1	2	The purpose of this EIP is to comply with Section VII.A.d. of the TDEC Order., which requires TVA ~~is~~ ~~required,~~ upon receiving any request for additional information from TDEC, to develop an EIP for each site that, when implemented, will provide the information necessary to assess the extent of any soil, surface water, and groundwater contamination by CCR.
2.1	EIP Development and Structure	4	6	1	Please provide a minimum frequency that TVA will be providing progress reports to TDEC.
2.2	Proposed Schedule	All	All	All	Monthly schedule updates will be provided to TDEC depicting progress for all EIP activities. TVA should include explanations for lagging or incomplete EIP tasks.
2.2	Proposed Schedule	4	all	all	Please update schedule to reflect current progression.
2.3	Quality Assurance Project Plan (ALF Quality Plan)	5	1	1	Suggest using common abbreviations for clarity, Appendix C uses ALF QAPP instead of ALF Quality Plan.

Section Number	Section Title	Page	Paragraph	Line	Comment
2.3	Quality Assurance Project Plan (ALF Quality Plan)	6	2	4	Please include as an appendix to the EIP the referenced "*Data Management Plan* ".
3.1	General site-wide ALG IC questions and comments	7	all	all	Add stilling pond to area of this investigation.
3.1.1	TDEC Information Request No. 1	7	2		MSLs be depicted for base of West, Chem, East,(Still, Dredge, Coal Yard) Harsco areas
3.1.1	TDEC Information Request No. 1	7	3	3	TDEC requests further definition of the retrofitting that occurred in 2015 at the West Ash Disposal Area that precludes impoundment of water.
3.1.2	TDEC Information Request No. 2	8	3		West Ash Pond Foundation Soil Analysis Needs to also Specify Chem Pond
3.1.2	TDEC Information Request No. 2	9	3	All	TDEC recommends installing additional borings in both the east and west ash ponds to accurately delineate the clay foundation. There are large areas within the eastern portion of the east ash pond, along the southern perimeter of the east ash pond, and along the southern perimeter of the west ash pond that do not have any supporting or proposed boring locations.
3.2.1	TDEC Information Request No. 1	11	5	4	TDEC requests to be copied on the quarterly updates to the local entities.

Section Number	Section Title	Page	Paragraph	Line	Comment
3.2	General - Memorandum of Agreement	12	all	all	The chemical treatment pond and stilling pond should be included in this narrative.
3.2	General - Memorandum of Agreement	13	2	5	Provide a copy of the lease agreement between Harsco and TVA.
3.2.4	TDEC Information Request No. 4	13	1		Sluiced material to Chem Pond (gen. process, composition of materials)should be here.
3.3.3	TDEC Information Request No. 3	15	2	All	TDEC recommends conducting a leachability characterization study that includes an evaluation of CCR parameters from soil and groundwater samples from locations that would characterize the vertical and lateral distribution of soil leachability characteristics across the facility. Soil samples should be run for total concentrations of CCR parameters, TCLP CCR parameters, and SPLP CCR parameters.
3.3.5	TDEC Information Request No. 5	16	2	5	The Jackson Formation/Claiborne Group is a leaky confining unit with variable thickness and where there are breaches in the aquitard the potential for downward migration of CCR contaminants and/or CCR degraded water is significantly higher. TVA should fully characterize the nature and extent of the clay layer beneath the East and West Ash Ponds and determine if there are breaches that may provide a hydrologic connection between the alluvial/fluvial aquifer and the Memphis Sand aquifer.
3.3.5	TDEC Information Request No. 5	16	2	5	A paper study is not sufficient to evaluate the confining unit. Borings (either as part of soil sampling or monitoring well installation) should be advanced at least 10-15 feet into the Jackson Clay (or other confining unit) to verify a minimum thickness and competency of the clay. This is necessary to determine if the clay unit has the potential to provide adequate protection of the underlying Memphis Sand from any downward contaminant migration.

Section Number	Section Title	Page	Paragraph	Line	Comment
3.3.5	TDEC Information Request No. 5	16	2	13	A map will need to be provided depicting the location of the 5 water supply wells relative to the ALF ash ponds.
3.3	Groundwater Monitoring	17	all	all	Incorporate all investigation and assessment documents of the current remedial action work plan into the EIP required under the Commissioner's Order.
3.4.1	TDEC Information Request No. 4	18	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.
3.4	West Ash Pond	18	NA	NA	Provide geologic information for the wells that were drilled and later plugged on the southern side of the West ash pond.
3.4	West Ash Pond	19	all	all	The narrative seems to suggest Seeps 2 & 4 are unpermitted discharges by the fact analysis of seep water was compared to NPDES limits. TDEC request additional validation for seeps indicated on Figure No. 7 that were deduced or considered to not be CCR related.
3.5.2	IRNo.1	20			Influent/effluent wastewater subject to NPDES Permit should be tested for Arsenic
3.5.5	IRNo. 5	20,21	all	all	Influent and effluent process water subject, to the NPDES Permit, should be tested for Arsenic and PH
3.5	East Ash Pond	23	1	1	The Stilling Pond needs to be added on page 29 of Section 3.8.1 under areas to be included in the three-dimensional model

Section Number	Section Title	Page	Paragraph	Line	Comment
3.5.5	TDEC Information Request No. 5	23	4		Please provide detailed map with all seeps
3.5.5	East Ash Pond	24,25	all	all	The narrative seems to suggest Seeps 2 & 4 are unpermitted discharges by the fact analysis of seep water was compared to NPDES limits. TDEC request additional validation for seeps indicated on Figure No. 7 that were considered to not be CCR related.
3.6	June 2016 part II - Site Specific NEPA Review: ALF	26	1	6	TDEC is concerned that comparisons of the EAST and West ash ponds will not provide an adequate demonstration for seismic stability of the West ash pond. Data presented to date indicate specific impoundment conditions that may not warrant comparison as an acceptable method to satisfy this request.
3.8.1	Migration of CCR Constituents	31	5	2	The conceptual groundwater flow and transport model for the site needs to model both current conditions and future planned pumping conditions.
3.8.1	Migration of CCR Constituents	31	5	12	The soil SAP needs to also address source area identification and delineation of CCR constituents as listed in Appendices III and IV, not just "background". Or the SAP should be renamed Background Soil SAP and the source area soil sampling defined in a different SAP.
3.8.1	Soil SAPs	32	1	1	Since it appears that the Soil SAP is primarily related to background soil sampling suggest it be renamed Background Soil Sampling and Analysis Plan to be consistent with other EIPs.

Section Number	Section Title	Page	Paragraph	Line	Comment
3.8.1	Hydrogeological and Groundwater Investigation SAPs	33	1	2	"*These wells are screened in the upper part of the alluvial aquifer.* " Please provide well construction details. TVA should also include a map with details and cross-sections of soil borings, water level within the ash, observation and monitoring well locations that will provide a better understanding of the site subsurface geology (specifically beneath the ponds). The total depth and screen interval should be included in each cross-section.
3.8.1	Hydrogeological and Groundwater Investigation SAPs	33	2	2	Please align this with the August 2017 RIWP. If a lower confining clay unit is not encountered, what depth interval will be screened?
3.8.1	TDEC Information Request No. 1	32	2	2	TVA Figure 11 Proposed Soil Sample Locations has background soil samples near monitoring well ALF-202 where documented exceedances for arsenic have been detected. TDEC recommends moving background soil locations near wells with MCL exceedances further upgradient (possibly near the new combined cycle unit plant) to properly characterize soil background concentrations.
3.8.1	TDEC Information Request No. 1	33	1	All	Hydrogeological and Groundwater Investigation SAPs - this section should be updated to include the current Remedial Action Investigation that is ongoing at ALF.
3.8.1	TDEC Information Request No. 1	33	5	All	TDEC recommends conducting a leachability characterization study that includes an evaluation of CCR parameters from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics across the facility (TCLP and/or SPLP)
3.8.1	TDEC Information Request No. 1	35	5	5	Add. Samples collected/analy. based on lithologic changes and upon detection of odors

Section Number	Section Title	Page	Paragraph	Line	Comment
4	Environmental Assessment Report	35	3	4	TDEC will not review corrective actions that are deemed to not be in compliance with the Federal CCR rule.
Appendix A	Schedule	NA	NA	NA	General comment - The schedule is considered draft at this time. TDEC will work with TVA to develop a final schedule once the EIP is approved. TDEC will provide a draft schedule for the ALF site for TVA review.
Appendix C, Section 2.2.6	QAPP	12	3	5	Please provide the referenced Data Management Plan for review.
Appendix C, Section 9.1.2	QAPP	23	4	9	Some of the requirements in the QAPP are written as should. The QAPP must be written as what will be done. If multiple coolers are needed, one COC Record ~~should~~ will accompany each cooler that contains the samples identified on the COC.
Appendix C, Section10.0	QAPP	26	1	4	Detectability was not mentioned in the quality objectives and criteria for analytical data
Appendix C, Section 11.1	QAPP	29	4	6	At least 10% of the screening data ~~should~~ will be confirmed using appropriate analytical methods and QA/QC procedures and criteria associated with definitive data.
Appendix C, Section 11.1	QAPP	30	2	2	Based on the procedure outlined in ENV-TI-05.80.46 (Section 3.3.3, bullet [4]) it appears that the pH instrument will be calibrated to the 25degC certified buffer strength, rather than the temperature-adjusted buffer strength. Is this accurate?

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix C, Section 13.1	QAPP	36	2	2	Based on the QAPP and ENV-TI-05.80.46 the DO calibration is an air saturated water calibration which is time consuming and could introduce error if not done properly. Is this the method the field teams are actually using? Most field applications of DO that are not long-term, continuous monitoring applications utilize the water saturated air calibration method. Please clarify which calibration method the sampling teams will be utilizing.
Appendix C, Section 13.1	QAPP	37	1	2	Field pH meters used for collecting data will have to meet the calibration requirements of Method 9040C , which is 0.05 pH units of the bracketing buffer solution values. The QAPP references SESDPROC-100-R3, January 2013 and the TVA TI ENV-TI-05.80.46 which only require calibration to 0.1 SU.
Appendix C, Section 13.1	QAPP	37	2	4	Maintenance ~~should~~ will be performed when the instrument will not adequately calibrate. Maintenance of field equipment ~~should~~ will be noted in an instrument logbook or field notebook.
Appendix C, Section 17.0	QAPP	47	3	2	This audit report ~~should~~ will include a list of observed field activities, a list of reviewed documents, and any observed deficiencies.
Appendix C, Section 19.5	QAPP	54	1	4	By providing specific protocols for obtaining and analyzing samples, data sets ~~should~~ will be comparable regardless of who collects the sample or who performs the sample analysis.
Appendix C, QAPP Appendix A	QAPP Appendix A.1	A-3	1	3	In the event that certain required information is not included on a particular form, the laboratory ~~should~~ will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix C, QAPP Appendix A	QAPP Appendix A.2	A-14	1	3	In the event that certain required information is not included on a particular form, the laboratory ~~should~~ will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.
Appendix C, QAPP Appendix D	QAPP Appendix D	D-2	Table A		Sample matrix codes do not have nomenclature for laboratory supplied deionized water.
Appendix E, Section 3.3.3	Evaluation of Existing Geotechnical Data	11	1	7	The line reads "*Strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, Tennessee.* " TDEC recommends any analysis of stability be completed utilizing site specific data from the ALF, not historic test results from other TVA sites. This data should not be considered for stability assessment of the ash at ALF.
Appendix E, Section 3.3.4	Evaluation of Existing Geotechnical Data	11	All	All	TVA asserts that this data is suitable for use as part of the EIP. Given that the strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, TN, TDEC does not agree that the data is suitable for use as part of the EIP.
Appendix E, Section 3.4.3	Evaluation of Existing Geotechnical Data	14	2	9	The line reads "*Strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, Tennessee.* " TDEC recommends any analysis of stability be completed utilizing site specific data from the ALF, not historic test results from other TVA sites. This data should not be considered for stability assessment of the ash at ALF.
Appendix E, Section 3.4.4	Evaluation of Existing Geotechnical Data	14	All	All	TVA asserts that this data is suitable for use as part of the EIP. Given that the strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, TN, TDEC does not agree that the data is suitable for use as part of the EIP.
Appendix F, Section 4.0	Exploratory Drilling SAP	4	All	All	TDEC recommends additional soil borings be installed within the eastern portion of the East Ash disposal area and along the southern boundary of the West Ash Disposal area to better characterize the CCR material quantity and subsurface materials at the ALF.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix F, Section 5.4.1.3	Exploratory Drilling SAP	16	1	11	Why is the target turbidity for development 10 NTU when the groundwater stabilization criteria listed for turbidity in ENV-TI-05.80.42 is less than 5 NTUs?
Appendix J	Groundwater Investigation SAP	All	All	All	General comment - TVA should update the SAP to reflect the accelerated groundwater investigation that is currently occurring onsite.
Appendix J	Groundwater Investigation SAP	All	All	All	General comment - TVA needs to define what protocol will be utilized to determine selection of background monitoring well locations. TDEC will need to approve any background monitoring well locations prior to utilization for the EIP.
Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.
Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.
Appendix J, Section 2.0	Groundwater Investigation SAP, Objectives	2	1	3	Objectives need to include (but not limited to): determining the horizontal gradient of the shallow, intermediate and deep monitored levels within the alluvial aquifer; determining vertical gradients between the shallow, intermediate, and deep monitored intervals; generating a comprehensive evaluation of groundwater flow direction(s), velocities and gradients; and an evaluation of groundwater quality (geochemical and CCR parameters).
Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Locations	4	1	3	TVA states that monitoring wells that are being sampled as part of other programs will not be sampled as part of this SAP. TDEC recommends all applicable groundwater monitoring wells be sampled as part of the EIP and the data provided to TDEC for review. Or monitoring wells should be installed to fill gaps in characterization.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Frequency	4	6	1	In order to evaluate the multi-level horizontal and vertical extent of CCR parameters the entirety of the monitoring well network (i.e., including existing monitoring wells ALF-201 through ALF-210, ALF-212, ALF-213) will be sampled along with the proposed monitoring wells.
Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Frequency	4	6	3	"*submitted for laboratory analysis of parameters listed in Section* ~~*5.6.2*~~ 5.2.6."
Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Frequency	5	1	1	When installing new groundwater monitoring networks, groundwater quality data from at least eight events is needed, in most cases, to fully assess and compare up gradient versus downgradient groundwater quality. Four quarterly events are not adequate to determine statistical significance or determine groundwater fluctuation (reversals) caused by the rise in pool elevation of McKellar Lake.
Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging	7	2	4	According to TVA's TI document ENV-TI-05.80.42 the turbidity is required to be below 5 NTUs. If the final turbidity after sample collection is greater than 5NTU is there any additional requirements sampling?
Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging	7	2	2	Indicate if specific conductance is measured in mS/cm or µS/cm.
Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging	8	2	1	Will barometric pressure readings be recorded? What will be the frequency and source of the barometric pressure readings? Will ambient air temperature be measured? Will a correlation between a NIST thermometer and the temperature on the multi parameter probe be made and recorded?
Appendix J, Section 5.2.5.1	Groundwater Investigation SAP, Groundwater Sampling	10	2	3	This should be 5NTU according to ENV-TI-05.80.42

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix J, Table 5	Groundwater Investigation SAP	14	Table 5		Field pH meters used for collecting data will have to meet the calibration requirements of Method C , which is 0.05 pH units of the bracketing buffer solution values. There is not a hold time associated with the field measurement of pH by Method 9040C.
Appendix J, Section 5.2.8	Groundwater Investigation SAP	15	4	1	Distribution of cuttings and discharge of water ~~should~~ will be performed in a manner as to not create a safety hazard.
Appendix K	Hydrogeological Investigation SAP	All	All	All	General comment - TVA should update the SAP to reflect the accelerated groundwater investigation that is currently occurring onsite.
Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.
Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.
Appendix K	Hydrogeological Investigation SAP	All	All	All	General comment - TVA needs to define what protocol will be utilized to determine selection of background monitoring well locations. TDEC will need to approve any background monitoring well locations prior to utilization for the EIP.
Appendix K	Hydrogeological Investigation SAP	All	All	All	This SAP is missing a table of the well construction details TVA anticipates for the additional ground water monitoring wells. This includes well ID, latitude and longitude, approximate screen interval below ground surface, anticipated depth of groundwater, purpose.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix K	Hydrogeological Investigation SAP	All	All	All	The SAP needs to reflect the monitoring wells, locations and screen intervals proposed in the August 2017 RIWP
Appendix K, Section 1.0	Hydrogeological Investigation SAP	1	2	3	The hydrogeological SAP purpose is to characterize the groundwater flow direction, install monitoring wells to provide locations to evaluate horizontal and vertical extent of CCR constituents and measure horizontal and vertical groundwater flow gradients within the alluvial aquifer.
Appendix K, Section 1.0	Hydrogeological Investigation SAP	1	2	5	The wells indicated to be installed were called out in Section 3.3.5 to be monitoring wells not observation wells and Section 3.3.5 indicated only 1 background monitoring well would be installed.
Appendix K, Section 2.0	Hydrogeological Investigation SAP	2	1	3	The objectives are to characterize the groundwater flow direction, to install monitoring wells to provide locations to evaluate horizontal and vertical extent of CCR constituents and measure horizontal and vertical groundwater flow gradients within the alluvial aquifer.
Appendix K, Section 2.0	Hydrogeological Investigation SAP	2	1	6	The SAP needs to reflect the monitoring wells, locations and screen intervals proposed in the August 2017 RIWP. As this SAP is currently written the intermediate depth is missing.
Appendix K, Section 2.0	Hydrogeological Investigation SAP	2	1	10	TVA should install additional intermediate and deep wells along the western perimeter of the East Ash pond, downgradient of the former disposal area on the eastern edge of the West Ash pond, and along the western edge of the West Ash pond.
Appendix K, Section 5.1	Hydrogeological Investigation SAP	6	3	1	There are no observation wells proposed.
Appendix K, Section 5.1	Hydrogeological Investigation SAP	7	2	1	Potable water should be used for drilling, installation, and development of all environmental monitoring wells and piezometers. Non potable water may be used for core holes, geotechnical borings, or other boreholes in which monitoring wells are not installed.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix K, Section 5.2	Hydrogeological Investigation SAP	7	2	2	The elevation of the established and documented point on the top of each well casing will be correlated to Mean Sea Level
Appendix K, Section 5.2.1	Hydrogeological Investigation SAP	7	1	1	There are no observation wells proposed.
Appendix K, Section 5.2.5	Hydrogeological Investigation SAP	10	2	1	Distribution of cuttings and discharge of water ~~should~~ will be performed in a manner as to not create a safety hazard.
Appendix K, Section 5.2.6	Hydrogeological Investigation SAP	10	1	1	There are no observation wells proposed.
Appendix K, Section 5.2.6	Hydrogeological Investigation SAP	10	2	1	There are no observation wells proposed.
Appendix K, Section 5.2.6.2	Hydrogeological Investigation SAP	11	1	1	There are no observation wells proposed.
Appendix K, Section 5.2.6.2	Hydrogeological Investigation SAP	12	1	1	Why is the target turbidity for development 10 NTU when the groundwater stabilization criteria listed for turbidity in ENV-TI-05.80.42 is less than 5 NTUs?
Appendix K, Section 6.0	Hydrogeological Investigation SAP	14	1	3	There are no observation wells proposed.

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix K, Section 8.0	Hydrogeological Investigation SAP	14	3	1	There are no observation wells proposed.
Appendix N	Soil SAP	All	All	All	TVA has proposed background soil samples near monitoring well ALF-202 where documented exceedances for arsenic have been detected. TDEC recommends moving background soil locations near wells with MCL exceedances further up gradient (possibly near the new combined cycle unit plant) to properly characterize soil background concentrations. TVA is proposing background soil samples also be collected from background monitoring wells. TDEC will need to approve any background monitoring well locations prior to utilization for the EIP.
Appendix N, Section 3.0	Soil SAP	3	1	5	Field teams should consist of (at a minimum) an experienced TN licensed professional geologist.
Appendix N, Section 5.2.1.1	Soil SAP	7	3	11	Will the mid-point for sampling aliquot be the vertical depth midpoint or the mid-point based on recovery? What is the contingency if recovery is poor? Or is it a composite over the entire 5ft interval? Note: Composite samples are unacceptable.
Appendix N, Section 5.2.1.1	Soil SAP	7	3	16	Grab samples only. The collection of composite soil samples is not acceptable to determine that CCR constituents are not present because the evidence of a release may be diluted.
Appendix O	CCR Material Characteristics SAP	All	All	All	TDEC recommends conducting a leachability characterization study that includes an evaluation of CCR parameters from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics
Appendix O, Section 4	CCR Material Characteristics SAP	4	1	All	Please provide a figure with proposed sampling locations for CCR material characteristic sampling and analysis
Appendix O, Section 5	CCR Material Characteristics SAP	All	All	All	Please provide the sampling methods and protocol for collection of soil material samples for CCR material characteristic sampling and analysis

Section Number	Section Title	Page	Paragraph	Line	Comment
Appendix O, Section 5.2.4	CCR Material Characteristics SAP, Well Purging	8	1	5	According to TVA's TI document ENV-TI-05.80.42 the turbidity is required to be below 5 NTUs.

TVA

Tennessee Valley Authority, 1101 Market Street, BR 4A, Chattanooga, Tennessee 37402-2801

October 16, 2017

Mr. Robert S. Wilkinson
Tennessee Department of Environment
and Conservation
William R. Snodgrass Building TN Tower
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

Dear Mr. Wilkinson:

TENNESSEE VALLEY AUTHORITY (TVA) – EXTENSION REQUEST FOR ALLEN FOSSIL PLANT REVISED ENVIRONMENTAL INVESTIGATION PLAN -- COMMISSIONER'S ORDER NUMBER OGC15-0177

This letter is requesting an extension per Section VII.C of Commissioner's Order OCG015-0177 for the TVA Allen Fossil Plant Revised Environmental Investigation Plan (EIP). This EIP is required by Section VII.A.d of the Order for each site following the initial investigation conference.

The Allen Fossil Plant EIP was submitted to TDEC on June 12, 2017. TVA received TDEC's October 3, 2017 letter which described TDEC's comments on our EIP. This letter stated a due date for the EIP Revision 2 of November 2, 2017.

To ensure TVA accurately and completely addresses all comments on the EIP, TVA proposes an EIP Revision 1 due date of December 8, 2017. This additional time will allow TVA to include the additional information requested in your comments. TVA requests TDEC's response to confirm or deny this requested due date.

Thank you for your consideration of this request. If you have questions regarding this information, please contact Paul Pearman at (423) 751-3972 or by email at pjpearman@tva.gov or me at (423) 751-3304 or by email at sstidwell@tva.gov.

Sincerely,

M. Susan Smelley

M. Susan Smelley
Director
Environmental Compliance and Operations

cc: Ms. Shari Meghreblian. Ph.D.
Deputy Commissioner, Bureau of Environment
Tennessee Department of Environment
and Conservation
Tennessee Tower William R. Snodgrass Building
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

Mr. Chuck Head
Senior Advisor
Tennessee Department of Environment
and Conservation (TDEC)
Tennessee Tower William R. Snodgrass Building
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

Ms. Jenny Howard
General Council
Tennessee Department of Environment
and Conservation
Tennessee Tower William R. Snodgrass Building
312 Rosa L Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548

Mr. Robert Burnette, P.E.
Tennessee Department of Environment
and Conservation
1301 Riverfront Parkway, Suite 206
Chattanooga, Tennessee 37402

PJP:GRB
cc (Electronic Distribution):

J. A. Birdwell, WT 6A-K
B. E. Brickhouse, MR 6D-C
J. L. Brundige, SP 6B-C
T. E. Cheek, BR 4A-C
R. M. Deacy, Sr., LP 5D-C
B. S. Fowler, BR 4A-C
J. C. Kammeyer, LP 5D-C
P. J. Pearman, BR 4A-C
J. R. Quinn, III, LP 5G-C
T. S. Rudder, BR 4A-C
M. S. Turnbow, LP 5G-C
J. B. Woodward, BR 4D-C
ECM, ENVrecords

Robert Wilkinson, PG, CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

October 18, 2017

M. Susan Smelley
Director
Environmental Compliance and Operations
Tennessee Valley Authority
1101 Market Street, MR 4K
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Allen Coal Fired Fossil Fuel Plant
TVA Extension Request Environmental Investigation Plan

Dear Ms. Smelley:

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 Allen Fossil Plant (ALF) Environmental Investigation Plan (EIP) Revision 1 to **December 8, 2017**. TDEC approves the request for extension.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA ALF site is complete, accurate and timely. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

Robert Wilkinson, PG, CHMM

CC:

Paul Pearman	Britton Dotson	James Clark
Pat Flood	Scotty Sorrells	Rob Burnette
Tisha Calabrese Benton	Angela Adams	Joseph E. Sanders
Chuck Head	Peter Lemiszki	Leland Hares
Herb Nicholson	Jenny Howard	Shari Meghreblian
John Boatright	Shawn Rudder	Winifred Brodie

Robert Wilkinson, PG, CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

January 5, 2018

M. Susan Smelley
Director
Environmental Compliance and Operations
Tennessee Valley Authority
1101 Market Street, MR 4K
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Allen Coal Fired Fossil Fuel Plant
Environmental Investigation Plan Revision 1

Dear Ms. Smelley:

The Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order OGC 15-0177 (the Order) to the Tennessee Valley Authority (TVA) that required TVA action at seven TVA Coal Fired Fossil Power Plants (active and inactive) located in Tennessee. The Order was signed on August 6, 2015 and included information about TVA's right to appeal the Order. TVA did not appeal the Order and it is now final.

TDEC received the TVA Allen Fossil Plant (ALF) Environmental Investigation Plan (EIP) Revision 1 on December 8, 2017. TDEC has completed an initial review of EIP Revision 1. TVA has elected to remove the Groundwater Investigation Sampling and Analysis Plan (SAP), and the Hydrogeological Investigation SAP from the EIP due to the Remedial Investigation (RI) currently being conducted at ALF. TVA has stated that this RI is "separate ongoing investigation activities". TDEC does not agree with this statement. The RI is part of the Order that has been accelerated due to the high levels of arsenic and lead in groundwater near the operational ash surface impoundment.

As such, TDEC requests that the Groundwater Investigation SAP and Hydrogeological Investigation SAP and associated figures be included in an updated EIP Revision 1.5. TVA will update both SAPs with any previous edits or comments by TDEC. TVA will also include the currently approved Remedial Investigation Work Plan (RIWP) as an appendix to the updated EIP Revision 1.5. Please make the requested changes and submit the updated EIP Revision 1.5 to TDEC by **February 16, 2018**.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA ALF site is complete, accurate and timely. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

Robert Wilkinson, PG, CHMM

CC:	Paul Pearman	Britton Dotson	James Clark
	Pat Flood	Scotty Sorrells	Rob Burnette
	Tisha Calabrese Benton	Angela Adams	Joseph E. Sanders
	Chuck Head	Peter Lemiszki	Leland Hares
	Herb Nicholson	Jenny Howard	Shari Meghreblian
	John Boatright	Shawn Rudder	Winifred Brodie
	Jamie Woods	Steve Goins	

Appendix B
TVA Allen EIP Rev 1
Summary of TDEC Comments & TVA Responses
February 16, 2018

Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)
1	All	All	All	All	All	General comment - TVA should include an applicability assessment of the TDEC General Guideline for Environmental Investigation Plans, TVA Fossil Plants when preparing the EIP. TDEC understands that not all aspects of the guidelines will be applicable at all TVA facilities, but each line item should be reviewed and assessed for applicability within the EIP. If an item is deemed not applicable to this facility, TVA should provide a written justification for exclusion within the EIP. Applicable items from the guidelines should be incorporated into the next revision of the EIP.	Comment is acknowledged, and the corresponding change has been made in the document.
2	All	All	All	All	All	General comment - All monitor wells, geotechnical borings, and soil borings should be logged by a Tennessee licensed professional geologist.	TVA proposes that for environmental investigation wells and soil borings, a TN-licensed professional geologist will be present and will log the borings. For geotechnical investigation borings and piezometer installations, a TN-licensed professional geologist or professional engineer will be present and will log the borings. This approach has been used at current investigations at other TVA sites in TN.
3	All	All	All	All	All	General content comment - please give titles to sections that reflect the content of the section - "TDEC Information Request" is not an appropriate section title.	Comment is acknowledged, and the corresponding change has been made in the document.
4	All	All	All	All	All	General comment - TVA should update the EIP to reflect the accelerated groundwater investigation that is currently occurring onsite.	Comment is acknowledged, and the corresponding change has been made in the document. The Remedial Investigation Work Plan (RIWP) is included in Appendix K. The results of the RI work will be included in the EAR.
5	General Admin	NA	NA	NA	NA	The document lacks a signature page that indicates the document has been read and that the various parties (e.g., QA consultant, Investigation Consultant field personal) understand the relevant requirements.	Comment is acknowledged, and the corresponding change has been made in the document.
6	General Admin	NA	NA	NA	NA	The document lacks an approval page, with all stakeholders listed.	Comment is acknowledged, and the corresponding change has been made in the document.
7	General Admin	NA	NA	NA	NA	The document lacks a revision log.	Comment is acknowledged, and the corresponding change has been made in the document.
8	General Admin	NA	NA	NA	NA	The TDEC will be notified immediately by the TVA of any problems related to successful completion of field efforts as outlined in this EIP.	Comment is acknowledged, and the corresponding change has been made in the document.
9	General Admin	NA	NA	NA	NA	Please provide the following TVA TI, "Monitoring Well and Piezometer Installation and Development" (ENV-TI-05.80.25).	The TI was submitted to TDEC on November 9, 2017.
10	Global SAPs	NA	NA	NA	NA	The SAPs lack a list of field equipment and critical spare parts (if applicable) related to the specific tasks described in each SAP.	Comment is acknowledged and the corresponding change has been made in the document. The SAPs have been revised to include a list of field equipment as an Attachment. The QAPP has been revised to state that spare parts will be the responsibility of the contracted equipment provider.
11	Global SAPs	NA	NA	NA	NA	There needs to be a maintenance form created to document the routine checks and both the regular and special maintenance that will occur for each instrument. This form needs to include the nature of the maintenance the qualified person and dates.	Comment is acknowledged, and the corresponding change has been made in the document. The QAPP has been revised to state "field equipment will be maintained under service contract for rapid instrument repair or provision of backup instruments in the case of instrument failure". The contracted equipment provider will be responsible for equipment maintenance.

Appendix B
TVA Allen EIP Rev 1
Summary of TDEC Comments & TVA Responses
February 16, 2018

Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)
12	General Technical	NA	NA	NA	NA	Is there a plan to look at the data for trends when common leachate indicators are compared to the total amount of CCR metals in contaminated water samples. It is important to determine if there is a relationship because of the expected geochemical relationships between chloride, other leachate indicators, and the presence of CCR metals, otherwise only CCR metals can be used to reliably indicate leachate-groundwater interaction.	Following collection of the leachate data from the proposed work in the EI, the data will be evaluated for trends and additional assessment will be performed as necessary. "Leachate" is any liquid that, in the course of passing through matter, extracts soluble or suspended solids, or any other component of the material through which it has passed. "Groundwater" may be defined as the water found in the interstitial spaces within the soil, whereas "pore water" refers to the water in the interstitial spaces within the CCR material (ash) in a CCR unit. Based on its definition, both groundwater and pore water may be considered leachate; however, to clarify its use in the EIP, the term "pore water" will be used to specifically refer to the water contained within a CCR unit, while "groundwater" will refer to subsurface water outside the physical boundaries of the CCR unit.
13	General Technical	NA	NA	NA	NA	Will Piper diagrams be used to compare the hydrochemical facies of EIP groundwater samples? And if so please identify what comparison(s) will be made (e.g., west ash pond versus east ash pond, groundwater discharge to McKellar Lake versus groundwater recharge from McKellar Lake, contaminated wells versus background wells, etc.)?	Piper diagrams will be used to classify groundwater samples according to their major ionic composition. Groundwater sample results from background and downgradient monitoring wells will be included in the evaluation. Additional Piper diagram comparisons of individual CCR units or geological formations may be included based on the results of the hydrogeological investigation.
14	General Technical	NA	NA	NA	NA	Provide list of historical waste sites (active/closed) with generation process/chemical composition	The purpose of the TDEC Order is to investigate the management and disposal of coal combustion residuals (CCR) at the plant site. Investigation into other historical waste sites is outside the scope and intent of the TDEC Order.
15	General Technical	NA	NA	NA	NA	Provide geologic information from two ALF wells that were drilled, and later plugged	TVA intends to provide the requested geologic information regarding the two plugged ALF wells that is in TVA's possession in the EAR.
16	General Technical	NA	NA	NA	NA	Provide detailed remediation info. regarding historical sewer line ruptures at site	TVA is in the process of finalizing a summary of the history of the sewer at the plant site, including ruptures. This summary will be provided to TDEC under separate cover.
17	General Technical	NA	NA	NA	NA	Any geologic/completion info. from Harsco well would be appreciated	At this time, TVA cannot confirm, and thus does not believe, it possesses the requested geologic/completion information that ties to the GPS location of the Harsco well.
18	1.1	Purpose	1	1	2	The purpose of this EIP is to comply with Section VII.A.d. of the TDEC Order., which requires TVA ~~is required,~~ upon receiving any request for additional information from TDEC, to develop an EIP for each site that, when implemented, will provide the information necessary to assess the extent of any soil, surface water, and groundwater contamination by CCR.	Comment is acknowledged, and changes have been made in the document.
19	2.1	EIP Development and Structure	4	6	1	Please provide a minimum frequency that TVA will be providing progress reports to TDEC.	Monthly progress reports and schedule updates will be provided to TDEC. Change will be made in the document.
20	2.2	Proposed Schedule	All	All	All	Monthly schedule updates will be provided to TDEC depicting progress for all EIP activities. TVA should include explanations for lagging or incomplete EIP tasks.	Monthly progress reports and schedule updates will be provided to TDEC. Change will be made in the document.
21	2.2	Proposed Schedule	4	All	All	Please update schedule to reflect current progression.	Comment is acknowledged, and the corresponding change has been made in the document.
22	2.3	Quality Assurance Project Plan (ALF Quality Plan)	5	1	1	Suggest using common abbreviations for clarity, Appendix C uses ALF QAPP instead of ALF Quality Plan.	Comment is acknowledged, and the corresponding change has been made in the document.

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23	2.3	Quality Assurance Project Plan (ALF Quality Plan)	6	2	4	Please include as an appendix to the EIP the referenced "Data Management Plan ".	The Data Management Plan for the TDEC Order environmental investigations has been provided to TDEC separately as a standalone document.
24	3.1	General site-wide ALG IC questions and comments	7	All	All	Add stilling pond to area of this investigation.	Comment is acknowledged and the corresponding changes have been made in the document. The stilling pond is included in the area of investigation as part of the East Ash Pond since they are the same unit.
25	3.1.1	TDEC Information Request No. 1	7	2		MSLs be depicted for base of West, Chem, East, (Still, Dredge, Coal Yard) Harsco areas	In order to align with existing data and allow for comparison of feature elevations, TVA will provide elevation data correlated to one vertical datum which is the vertical datum used by the Plant.
26	3.1.1	TDEC Information Request No. 1	7	3	3	TDEC requests further definition of the retrofitting that occurred in 2015 at the West Ash Disposal Area that precludes impoundment of water.	In the Preamble to the CCR Rule, EPA states that it does not intend to regulate CCR surface impoundments that have closed before the rule's effective date, meaning that the surface impoundment no longer impounds water and is otherwise maintained. TVA evaluated the West Ash Disposal Area and determined that it does not impound water and is otherwise maintained in accordance with the criteria outlined in the CCR Rule. The West Ash Disposal Area has not impounded water since the mid-1990s and it was dry and covered in vegetation prior to the effective date of the rule. Thus, the West Ash Disposal Area is considered closed under the federal CCR Rule. The discharge lines to the West Ash Disposal Area were removed decades ago. In 2015, prior to the effective date of the federal CCR Rule, all plant flows containing CCRs were routed to the East Ash Disposal Area, and stormwater flows were re-routed to a permitted outfall at McKellar Lake.
27	3.1.2	TDEC Information Request No. 2	8	3		West Ash Pond Foundation Soil Analysis Needs to also Specify Chem Pond	Comment is acknowledged, and the corresponding changes have been made in the document. The Chem Pond is included in the area of investigation as part of the West Ash Pond.
28	3.1.2	TDEC Information Request No. 2	9	3	All	TDEC recommends installing additional borings in both the east and west ash ponds to accurately delineate the clay foundation. There are large areas within the eastern portion of the east ash pond, along the southern perimeter of the east ash pond, and along the southern perimeter of the west ash pond that do not have any supporting or proposed boring locations.	For the West Ash Disposal Area, several exploratory borings will be added to provide additional coverage along the southern limits and interior of the CCR fill. The southern perimeter of the unit is the USACE levee, which does not have CCR overlying it; therefore, the added borings are north of the inboard levee toe. For the East Ash Disposal Area, access along the southern perimeter is feasible and several exploratory borings will be added to provide additional coverage. However, access within the interior of the eastern half of the unit is difficult. Drilling from a barge would be needed in the pond and substantial access improvements (i.e., roads) over the sluiced ash would be needed in the "beached" areas above water. An exploratory boring has been added near the middle of the unit, where an access road already exists.
29	3.2.1	TDEC Information Request No. 1	11	5	4	TDEC requests to be copied on the quarterly updates to the local entities.	This request is outside the scope of the TDEC Order. Nevertheless, TVA intends to provide TDEC with any copies of written quarterly updates that are provided to the Local Entities. To avoid unnecessary duplication, TVA does not intend to provide TDEC with copies of information and documents that may be provided to the Local Entities and that TDEC possesses.
30	3.2	General - Memorandum of Agreement	12	All	All	The chemical treatment pond and stilling pond should be included in this narrative.	The chemical treatment pond is outside the area, for which the MOA applies and thus is not included in this section. The stilling pond is included in the East Ash Disposal Area discussed in the EIP. Note that both areas are included in the investigation under the EIP.
31	3.2	General - Memorandum of Agreement	13	2	5	Provide a copy of the lease agreement between Harsco and TVA.	There is not a separate lease agreement. However, there is a license for Harsco to use property which is embedded in a contract that contains proprietary information. TVA is exploring options for providing, under separate cover, non-confidential and non-proprietary portions of the contract.

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32	3.2.4	TDEC Information Request No. 4	13	1		Sluiced material to Chem Pond (gen. process, composition of materials) should be here.	The chemical treatment pond is outside the area, for which the MOA applies, and not a CCR unit. Thus, the Chem Pond is not included in this section. Note that both areas are included in the investigation under the EIP. The chemical pond was constructed over a portion of the original west ash disposal area in 1977. The underlying CCR layer will be quantified in a three-dimensional model using historical geotechnical boring data and historical drawings.
33	3.3.3	TDEC Information Request No. 3	15	2	All	TDEC recommends conducting a leachability characterization study that includes an evaluation of CCR parameters from soil and groundwater samples from locations that would characterize the vertical and lateral distribution of soil leachability characteristics across the facility. Soil samples should be run for total concentrations of CCR parameters, TCLP CCR parameters, and SPLP CCR parameters.	This comment is currently in the Background Soil Section and leachability should not be a consideration for background soils at this time. If this is meant as a more general request, any leachability of soils outside of areas where porewater sampling is planned should be in a second phase of the investigation when any impacted areas have been identified and the testing can be targeted to those areas. Our current approach regarding leachability testing applies to CCR material in the units. The protocol calls for collecting/testing pore water for the CCR parameters, and collecting/testing actual CCR material for the CCR parameters (after being subjected to the most applicable leaching method based on emerging science in the industry which could include the Synthetic Precipitation Leaching Procedure (SPLP). The RIWP proposed the collection of 15 to 20 groundwater samples within the EADA, along with four additional boring locations for the collection of ash samples and pore water samples, for CCR parameter analyses. Soil grab samples will be collected from continuous two-foot depth intervals, with samples selected from two or three depths at each location. Analyses will consist of total constituent measurements, without the use of any extraction procedure.
34	3.3.5	TDEC Information Request No. 5	16	2	5	The Jackson Formation/Claiborne Group is a leaky confining unit with variable thickness and where there are breaches in the aquitard the potential for downward migration of CCR contaminants and/or CCR degraded water is significantly higher. TVA should fully characterize the nature and extent of the clay layer beneath the East and West Ash Ponds and determine if there are breaches that may provide a hydrologic connection between the alluvial/fluvial aquifer and the Memphis Sand aquifer.	Comment is acknowledged. The characterization of the Jackson Formation is being completed as part of the ongoing hydrogeological RI activities, results of which will be included in the EAR. Refer to the RIWP in Appendix K for additional details of the investigation.
35	3.3.5	TDEC Information Request No. 5	16	2	5	A paper study is not sufficient to evaluate the confining unit. Borings (either as part of soil sampling or monitoring well installation) should be advanced at least 10-15 feet into the Jackson Clay (or other confining unit) to verify a minimum thickness and competency of the clay. This is necessary to determine if the clay unit has the potential to provide adequate protection of the underlying Memphis Sand from any downward contaminant migration.	Comment is acknowledged. The characterization of the Jackson Formation is being completed as part of the ongoing hydrogeological RI activities. Four stratigraphic borings have been advanced into the Jackson Formation and the results of which will be included in the EAR. Refer to the RIWP in Appendix K for additional details of the investigation.
36	3.3.5	TDEC Information Request No. 5	16	2	13	A map will need to be provided depicting the location of the 5 water supply wells relative to the ALF ash ponds.	Comment is acknowledged. The five production wells are shown on Appendix D Exhibit 6.
37	3.3	Groundwater Monitoring	17	All	All	Incorporate all investigation and assessment documents of the current remedial action work plan into the EIP required under the Commissioner's Order.	Separate ongoing RI activities are currently in progress to characterize the hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. After the ongoing RI activities have been completed, the associated documents will be finalized and incorporated into the EIP and the results will be included in the EAR.

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38	3.4.1	TDEC Information Request No. 4	18	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	For the West Ash Disposal Area, three monitoring wells (one shallow, one intermediate and one deep) are proposed at one location near the western unit boundary and at another location near the southeastern unit boundary to characterize groundwater flow direction and quality and vertical gradients within the alluvial aquifer. The proposed locations for monitoring wells west and southeast of the unit were constrained by the USACE levee and easement near the southern boundary of the West Ash Disposal Area. In addition, CCR material may be located near the eastern boundary of the West Ash Disposal Area and western boundary of the chemical pond. Additional monitoring wells are not proposed south of the West Ash Disposal Area because the southern boundary of the West Ash Disposal Area abuts a levee owned by the USACE, who has denied TVA requests to drill through the levee. In addition, TVA does not own the property south of the levee and access has been denied by the property owner due to the implementation of an upgrade project for the T.E. Maxson Wastewater Treatment Facility. As a result, background monitoring well locations ALF-210, ALF-210A and ALF-210B were proposed southeast of the West Ash Disposal Area on TVA owned property because monitoring wells could not be installed south of the unit. In addition, shallow monitoring wells (ALF-207 through ALF-209) and corresponding deep monitoring wells (ALF-207A through ALF-209A) were previously installed along the northern boundary of the West Ash Disposal Area. Three additional intermediate monitoring wells are proposed near ALF-207 through ALF-209. Additional monitoring wells within the interior of the West Ash Disposal Area are not proposed at this time. The West Ash Disposal Area is no longer in use and installation of monitoring wells within and below the unit would require breaching the bottom of the unit, which could potentially result in vertical migration of CCR constituents. TVA has developed an approach to define the hydrogeological characterization around the West Ash Disposal Area. This approach is an iterative investigation and is a cooperative effort with TDEC. TVA would prefer to complete the initial phase of the investigation and jointly review the results with TDEC to identify data gaps. If data gaps exist, TVA will fill those gaps with additional investigation in collaboration with TDEC. Monitoring well installation and sampling procedures for the additional wells near the West Ash Disposal Area are included in the updated Hydrogeological Investigation and Groundwater Investigation SAPs, respectively.
39	3.4	West Ash Pond	18	NA	NA	Provide geologic information for the wells that were drilled and later plugged on the southern side of the West ash pond.	TVA intends to provide the requested geologic information regarding the two plugged ALF wells that is in TVA's possession in the EAR.
40	3.4	West Ash Pond	19	All	All	The narrative seems to suggest Seeps 2 & 4 are unpermitted discharges by the fact analysis of seep water was compared to NPDES limits. TDEC request additional validation for seeps indicated on Figure No. 7 that were deduced or considered to not be CCR related.	The comparison of the seep samples to NPDES limits was only to determine if treatment of the seep was necessary. An isotopic analysis was performed on the seep samples in 2011. The results of the analysis determined that the source of the seep was not from any water that the plant produces or water that comes in contact with coal or ash. This analysis was submitted as part of the quarterly red water seep reports in December of 2011. The source of the seep is unknown.

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41	3.5.2	IRNo.1	20			Influent/effluent wastewater subject to NPDES Permit should be tested for Arsenic	Comment is acknowledged. The influent/effluent wastewater discharges are monitored in compliance with applicable NPDES permit. These discharges covered under NPDES permits are subject to conditions and limits administered by the TDEC Water Division.
42	3.5.5	IRNo.5	20,21			Influent and effluent process water subject, to the NPDES Permit, should be tested for Arsenic and PH	Comment is acknowledged. The influent/effluent wastewater discharges are monitoring in compliance with applicable NPDES permit. These discharges covered under NPDES permits are subject to conditions and limits administered by the TDEC Water Division.
43	3.5	East Ash Pond	23	1	1	The Stilling Pond needs to be added on page 29 of Section 3.8.1 under areas to be included in the three-dimensional model	Comment is acknowledged, and the corresponding changes have been made in the document.
44	3.5.5	TDEC Information Request No. 5	23	4		Please provide detailed map with all seeps	Comment is acknowledged, and the corresponding changes have been made in the document.
45	3.5.5	East Ash Pond	24,25	All	All	The narrative seems to suggest Seeps 2 & 4 are unpermitted discharges by the fact analysis of seep water was compared to NPDES limits. TDEC request additional validation for seeps indicated on Figure No. 7 that were considered to not be CCR related.	The comparison of the seep samples to NPDES limits was only to determine if treatment of the seep was necessary. An isotopic analysis was performed on the seep samples in 2011. The results of the analysis determined that the source of the seep was not from any water that the plant produces or water that comes in contact with coal or ash. This analysis was submitted as part of the quarterly red water seep reports in December of 2011. The source of the seep is unknown.
46	3.6	June 2016 part II - Site Specific NEPA Review: ALF	26	1	6	TDEC is concerned that comparisons of the EAST and West ash ponds will not provide an adequate demonstration for seismic stability of the West ash pond. Data presented to date indicate specific impoundment conditions that may not warrant comparison as an acceptable method to satisfy this request.	A Stability SAP will be added to the EIP, which includes an established matrix of load cases (static and seismic) that are appropriate for the CCR units at ALF. The same matrix is being used for each EIP under the TDEC Order. Available existing and ongoing (e.g., closure design, CCR Rule) analyses for West and East Ash Disposal Areas will be compared against the matrix and identified data gaps will be addressed with new analyses during the Investigation. Results will be presented in the EAR.
47	3.8.1	Migration of CCR Constituents	31	5	2	The conceptual groundwater flow and transport model for the site needs to model both current conditions and future planned pumping conditions.	Comment is acknowledged. If needed, the groundwater modeling will be completed as part of the ongoing hydrogeological RI activities. The RIWP is included in Appendix K. The results will be included in the EAR.
48	3.8.1	Migration of CCR Constituents	31	5	12	The soil SAP needs to also address source area identification and delineation of CCR constituents as listed in Appendices III and IV, not just "background". Or the SAP should be renamed Background Soil SAP and the source area soil sampling defined in a different SAP.	Comment is acknowledged, and the corresponding changes have been made in the document with separate Background Soil and Seep SAPs.
49	3.8.1	Soil SAPs	32	1	1	Since it appears that the Soil SAP is primarily related to background soil sampling suggest it be renamed Background Soil Sampling and Analysis Plan to be consistent with other EIPs.	Comment is acknowledged, and the corresponding changes have been made in the document with separate Background Soil and Seep Area Soil SAPs.
50	3.8.1	Hydrogeological and Groundwater Investigation SAPs	33	1	2	*"These wells are screened in the upper part of the alluvial aquifer."* Please provide well construction details. TVA should also include a map with details and cross-sections of soil borings, water level within the ash, observation and monitoring well locations that will provide a better understanding of the site subsurface geology (specifically beneath the ponds). The total depth and screen interval should be included in each cross-section.	Well construction details for ALF-201 through ALF-210 and ALF-212 are included in Appendix L. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities including well construction details, detailed cross-sections and updated maps will be included in the EAR.

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51	3.8.1	Hydrogeological and Groundwater Investigation SAPs	33	2	2	Please align this with the August 2017 RIWP. If a lower confining clay unit is not encountered, what depth interval will be screened?	Monitoring wells installed within the deep portion of the alluvial aquifer will be screened at depths ranging from approximately 110 feet to 165 feet below ground surface.
52	3.8.1	TDEC Information Request No. 1	32	2	2	TVA Figure 11 Proposed Soil Sample Locations has background soil samples near monitoring well ALF-202 where documented exceedances for arsenic have been detected. TDEC recommends moving background soil locations near wells with MCL exceedances further upgradient (possibly near the new combined cycle unit plant) to properly characterize soil background concentrations.	Comment is acknowledged, and the corresponding changes have been made in the document.
53	3.8.1	TDEC Information Request No. 1	33	1	All	Hydrogeological and Groundwater Investigation SAPs - this section should be updated to include the current Remedial Action Investigation that is ongoing at ALF.	The RIWP SAP in Appendix K describes the methods and procedures to conduct the hydrogeological and groundwater RI work associated with the East Ash Disposal Area. The methods and procedures to conduct the hydrogeological and groundwater EI work for the West Ash Disposal Area are included in the EI Hydrogeological Investigation and Groundwater Investigation SAPs found in Appendices L and M respectively. The results of the RI and EI will be included in the EAR.
54	3.8.1	TDEC Information Request No. 1	33	5	All	TDEC recommends conducting a leachability characterization study that includes an evaluation of CCR parameters from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics across the facility (TCLP and/or SPLP)	TVA's initial CCR leachability approach in this EIP followed EPA's language in the preamble to the CCR Rule. EPA has stated "The use of pore water data is still considered the most appropriate approach to estimate constituent fluxes to groundwater for CCR surface impoundments." In addition, "EPA agrees that TCLP and SPLP data are less appropriate for CCR disposal scenarios and no longer uses these data in the revised risk assessment." The TCLP leaching method was developed to simulate the potential for leaching of materials intended to be disposed in a municipal landfill. Since TVA's CCR landfills are not municipal landfills, TCLP would not be an appropriate analysis to complete for future modeling of leachate. Under its Remedial Investigation Work Plan (September 15, 2017), TVA proposed to advance four borings within the accessible portions of the East Ash Disposal Area for the collection of ash samples and and pore water samples. The samples would be analyzed for Appendix III and IV constituents. Under the CCR Material Characteristics SAP, TVA will obtain five pore water samples from the base of the units, to provide real-time measurements of constituents in actual conditions for the CCR material in the units. The CCR material at the base of the unit will have had the greatest opportunity for leaching to occur, due to it having the longest duration of time in an aqueous medium reflecting actual conditions, and will be the closest point to the boundary of the unit, nearest any groundwater. Samples of CCR material will be collected from the temporary wells during their construction (that are to be used for sampling pore water). Saturated and unsaturated CCR material samples will be analyzed for the CCR parameters according to the most applicable method based on emerging science in the industry which could include the Synthetic Precipitation Leaching Procedure (SPLP). Taking saturated and unsaturated samples from each temporary well will provide a vertical distribution of the samples.

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							TVA considers the groundwater monitoring well network as the definitive mechanism to determine releases to groundwater which includes protocols for detection, assessment, and corrective action of contaminants in groundwater, through the groundwater monitoring program. Any leachability of soils outside of areas where porewater sampling is planned should be in a second phase of investigation when any impacted areas have been identified and the testing can be targeted to those areas.
55	3.8.1	TDEC Information Request No. 1	35	5	5	Add. Samples collected/analy. based on lithologic changes and upon detection of odors	Samples will be taken at lithologic changes identified by the PG in the field, as well as if odors are detected, according to the procedures identified in the Soil SAP(s).
56	4	Environmental Assessment Report	35	3	4	TDEC will not review corrective actions that are deemed to not be in compliance with the Federal CCR rule.	Comment is acknowledged. TVA would not propose corrective actions in the CARA Plan that are out of compliance with the CCR Rule.
57	Appendix A	Schedule	NA	NA	NA	General comment - The schedule is considered draft at this time. TDEC will work with TVA to develop a final schedule once the EIP is approved. TDEC will provide a draft schedule for the ALF site for TVA review.	Comment is acknowledged.
58	Appendix C, Section 2.2.6	QAPP	12	3	5	Please provide the referenced Data Management Plan for review.	The Data Management Plan for the TDEC Order environmental investigations has been provided to TDEC under separate cover as a standalone document. Site specific updates to the Data Management Plan, if applicable, will be included in each site specific QAPP.
59	Appendix C, Section 9.1.2	QAPP	23	4	9	Some of the requirements in the QAPP are written as should. The QAPP must be written as what will be done. If multiple coolers are needed, one COC Record should will accompany each cooler that contains the samples identified on the COC.	The word "will" will be replaced with "shall" where a TDEC regulation, rule or the Order is explicitly referenced. In all other uses, the word "will" can be interpreted by TDEC as having the same meaning as "shall" and reflect TVA's commitment to performing the specified task, action, activity, etc.
60	Appendix C, Section10.0	QAPP	26	1	4	Detectability was not mentioned in the quality objectives and criteria for analytical data	Section 10.0 will be updated to indicate that analytical methods will be selected based on the ability to detect constituents of concern at reporting limits. The reporting limits will be sufficient to meet project requirements and quality objectives for precision, accuracy, and sensitivity.
61	Appendix C, Section 11.1	QAPP	29	4	6	At least 10% of the screening data ~~should~~ will be confirmed using appropriate analytical methods and QA/QC procedures and criteria associated with definitive data.	See response to comment 59.
62	Appendix C, Section 11.1	QAPP	30	2	2	Based on the procedure outlined in ENV-TI-05.80.46 (Section 3.3.3, bullet [4]) it appears that the pH instrument will be calibrated to the 25degC certified buffer strength, rather than the temperature-adjusted buffer strength. Is this accurate?	Section 11.1 will be updated to indicate that buffer temperature will be accounted for during pH meter calibration.
63	Appendix C, Section 13.1	QAPP	36	2	2	Based on the QAPP and ENV-TI-05.80.46 the DO calibration is an air saturated water calibration which is time consuming and could introduce error if not done properly. Is this the method the field teams are actually using? Most field applications of DO that are not long-term, continuous monitoring applications utilize the water saturated air calibration method. Please clarify which calibration method the sampling teams will be utilizing.	TVA TI ENV-TI-05.80.46 was drafted to be used by multiple programs within TVA and therefore was not intended to encompass detailed requirements for the wide variety of water quality meters available for use. Section 3.3.4 of ENV-TI-05.80.46 references both air-saturated water and water-saturated air for calibration. Section 13.1 will be updated to indicate that a 1-point water-saturated air method for calibration will be implemented following the manufacturer's recommendations for this procedure.
64	Appendix C, Section 13.1	QAPP	37	1	2	Field pH meters used for collecting data will have to meet the calibration requirements of Method 9040C, which is 0.05 pH units of the bracketing buffer solution values. The QAPP references SESDPROC-100-R3, January 2013 and the TVA TI ENV-TI-05.80.46 which only require calibration to 0.1 SU.	TVA will calibrate field pH meters to meet the requirements of Method 9040C.

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65	Appendix C, Section 13.1	QAPP	37	2	4	Maintenance ~~should~~ will be performed when the instrument will not adequately calibrate. Maintenance of field equipment ~~should~~ will be noted in an instrument logbook or field notebook.	See response to comment 59.
66	Appendix C, Section 17.0	QAPP	27	3	2	This audit report ~~should~~ will include a list of observed field activities, a list of reviewed documents, and any observed deficiencies.	See response to comment 59.
67	Appendix C, Section 19.5	QAPP	24	1	4	By providing specific protocols for obtaining and analyzing samples, data sets ~~should~~ will be comparable regardless of who collects the sample or who performs the sample analysis.	See response to comment 59.
68	Appendix C, QAPP Appendix A	QAPP Appendix A.1	A-3	1	3	In the event that certain required information is not included on a particular form, the laboratory ~~should~~ will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.	See response to comment 59.
69	Appendix C, QAPP Appendix A	QAPP Appendix A.2	A-14	1	3	In the event that certain required information is not included on a particular form, the laboratory ~~should~~ will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.	See response to comment 59.
70	Appendix C, QAPP Appendix D	QAPP Appendix D	D-2	Table A		Sample matrix codes do not have nomenclature for laboratory supplied deionized water.	Table A presents sample nomenclature and includes field QC samples collected using deionized water, which are differentiated for normal samples by "Sample Type". The sample IDs for field QC samples are intentionally reflective of the associated investigatory samples; the matrix code on the COC Record for field QC samples collected using laboratory-supplied deionized water will be "AQ".
71	Appendix E, Section 3.3.3	Evaluation of Existing Geotechnical Data	11	1	7	The line reads "*Strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, Tennessee.* " TDEC recommends any analysis of stability be completed utilizing site specific data from the ALF, not historic test results from other TVA sites. This data should not be considered for stability assessment of the ash at ALF.	A review of the referenced existing stability analyses (performed in 2010) shows that due to the location of the Hydraulic Ash in the cross section, this material did not significantly influence the perimeter slope stability results. When evaluating the suitability of existing stability analyses to address the TDEC Order information requests, the use of shear strengths based on typical/published values will be considered. Factors to be considered include the sensitivity (or lack thereof) of the analysis to the strength and the degree of conservatism of the published value relative to the site-specific material. In addition, because exploratory drilling and sampling is already proposed due to other information requests, supplemental samples of CCR will be obtained from the West and East Ash Disposal Areas. The samples will be tested in the laboratory for shear strength, and the results considered in the proposed slope stability analyses. The EAR will present a summary of the historical and new data and characterization of the CCR shear strengths for this unit.
72	Appendix E, Section 3.3.4	Evaluation of Existing Geotechnical Data	11	All	All	TVA asserts that this data is suitable for use as part of the EIP. Given that the strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, TN, TDEC does not agree that the data is suitable for use as part of the EIP.	See response to comment 71.
73	Appendix E, Section 3.4.3	Evaluation of Existing Geotechnical Data	14	2	9	The line reads "*Strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, Tennessee.* " TDEC recommends any analysis of stability be completed utilizing site specific data from the ALF, not historic test results from other TVA sites. This data should not be considered for stability assessment of the ash at ALF.	See response to comment 71.
74	Appendix E, Section 3.4.43	Evaluation of Existing Geotechnical Data	14	All	All	TVA asserts that this data is suitable for use as part of the EIP. Given that the strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, TN, TDEC does not agree that the data is suitable for use as part of the EIP.	See response to comment 71.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)
75	Appendix F, Section 4.0	Exploratory Drilling SAP	4	All	All	TDEC recommends additional soil borings be installed within the eastern portion of the East Ash disposal area and along the southern boundary of the West Ash Disposal area to better characterize the CCR material quantity and subsurface materials at the ALF.	The eastern portion of the East Ash Disposal Area consists of an active surface impoundment with open water areas that are only accessible by floating drilling platforms/barges. TVA plans to develop CCR material quantity estimates based on the existing and proposed borings, historical topographic mapping, and as-built construction drawings of the perimeter dikes. Several borings are proposed within the western portion of the East Ash Disposal Area and one boring near the center of the unit to determine top and bottom of CCR elevations. These borings can be used to check the accuracy of the historical topographical mapping. If the mapping is confirmed to be reliable, then additional borings within the eastern portion of the East Ash Disposal Area will not be necessary to estimate CCR material quantity to a reasonable degree of accuracy. The extents of the closed West Ash Disposal Area are well defined by the original United States Army Corps of Engineers (USACE) Ensley Levee to the south and by the historical topographic mapping. The existing borings and test pit excavations along the southern boundary confirm relatively thin deposits of CCR materials in this area. Several exploratory borings will be added to provide additional coverage along the southern limits and interior of the CCR fill. The southern perimeter of the unit is the USACE levee, which does not have CCR overlying it; therefore, the added borings are north of the inboard levee toe.
76	Appendix F, Section 5.4.1.3	Exploratory Drilling SAP	16	1	11	Why is the target turbidity for development 10 NTU when the groundwater stabilization criteria listed for turbidity in ENV-TI-05.80.42 is less than 5 NTUs?	The referenced criteria in ENV-TI-05.80.42 (Rev 0001, effective date 3/31/2017) is less than or equal to 10 NTU, not 5. An older version of this TI used different criteria. Ten NTUs is standard practice, and TVA has not identified benefits from sampling to 5 NTUs versus 10 NTUs.
77	Appendix J	Groundwater Investigation SAP	All	All	All	General comment - TVA should update the SAP to reflect the accelerated groundwater investigation that is currently occurring onsite.	Separate ongoing RI activities, which include a SAP, are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The SAP is included in the RIWP in Appendix A. The RIWP SAP describes the methods and procedures to conduct the hydrogeological and groundwater RI work associated with the East Ash Disposal Area. The methods and procedures to conduct the hydrogeological and groundwater EI work for the West Ash Disposal Area are included in the EI Hydrogeological Investigation and Groundwater Investigation SAPs, respectively. The results of the RI and EI will be included in the EAR.
78	Appendix J	Groundwater Investigation SAP	All	All	All	General comment - TVA needs to define what protocol will be utilized to determine selection of background monitoring well locations. TDEC will need to approve any background monitoring well locations prior to utilization for the EIP.	Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. A deep monitoring well, ALF-210A, was installed and sampled as part of the RI. After the ongoing activities have been completed, the results will be evaluated to determine the need for additional background monitoring well locations. The selected background well locations will be provided to TDEC for review and comment before finalizing these locations. In addition, an intermediate potential background monitoring well for the West Ash Disposal Area is proposed near the location of ALF-210. After the EI is completed, the results of sampling the new well will be evaluated to determine if it is suitable as a background monitoring well. The proposed background well locations will be provided to TDEC for review and comment.
79	Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	Refer to TDEC request #38 for the response to this request.

Appendix B
TVA Allen EIP Rev 1
Summary of TDEC Comments & TVA Responses
February 16, 2018

Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)
80	Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.	Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. After the ongoing RI activities have been completed, the results will be used to evaluate the need for additional monitoring wells near the East Ash Disposal Area to characterize groundwater flow and quality. The selected monitoring well locations will be provided to TDEC for review and comment through the RI process before finalizing these additional locations, if needed.
81	Appendix J, Section 2.0	Groundwater Investigation SAP, Objectives	2	1	3	Objectives need to include (but not limited to): determining the horizontal gradient of the shallow, intermediate and deep monitored levels within the alluvial aquifer; determining vertical gradients between the shallow, intermediate, and deep monitored intervals; generating a comprehensive evaluation of groundwater flow direction(s), velocities and gradients; and an evaluation of groundwater quality (geochemical and CCR parameters).	Comment is acknowledged. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities will be included in the EAR.
82	Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Locations	4	1	3	TVA states that monitoring wells that are being sampled as part of other programs will not be sampled as part of this SAP. TDEC recommends all applicable groundwater monitoring wells be sampled as part of the EIP and the data provided to TDEC for review. Or monitoring wells should be installed to fill gaps in characterization.	Data collected from monitoring wells from other programs will be used as applicable in the EI . However, duplicate samples will not be collected as part of the EI if samples have already been or will be collected as part of another program at the same time as proposed in the EI sampling schedule. The data collected for other programs will be utilized in the EAR. Separate ongoing RI activities are in progress to characterize the site-specific groundwater quality for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities will be included in the EAR.
83	Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Frequency	4	6	1	In order to evaluate the multi-level horizontal and vertical extent of CCR parameters the entirety of the monitoring well network (i.e., including existing monitoring wells ALF-201 through ALF-210, ALF-212, ALF-213) will be sampled along with the proposed monitoring wells.	Comment is acknowledged. Monitoring wells associated with the West Ash Disposal Area will be sampled as part of the EI. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities will be included in the EAR.
84	Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Frequency	4	6	3	*"submitted for laboratory analysis of parameters listed in Section 5.6.2 5.2.6."*	Comment is acknowledged. The reference to Section 5.6.2 was corrected to reference the current Section 5.2.7 – Sample Analyses.
85	Appendix J, Section 4.0	Groundwater Investigation SAP, Sampling Frequency	5	1	1	When installing new groundwater monitoring networks, groundwater quality data from at least eight events is needed, in most cases, to fully assess and compare up gradient versus downgradient groundwater quality. Four quarterly events are not adequate to determine statistical significance or determine groundwater fluctuation (reversals) caused by the rise in pool elevation of McKellar Lake.	Bimonthly sampling (6 events) for one year is proposed. According to USEPA Project Summary document "Sampling Frequency for Ground-Water Quality Monitoring" dated September 1989, quarterly and bimonthly groundwater sampling frequencies are sufficient for major, non-reactive chemical constituents. However, more frequent sampling intervals are not recommended due to potential autocorrelation issues.
86	Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging	7	2	4	According to TVA's TI document ENV-TI-05.80.42 the turbidity is required to be below 5 NTUs. If the final turbidity after sample collection is greater than 5NTU is there any additional requirements sampling?	The referenced criteria in ENV-TI-05.80.42 (Rev 0001, effective date 3/31/2017) is less than or equal to 10 NTU, not 5. An older version of this TI used different criteria. Ten NTUs is standard practice.
87	Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging	7	2	2	Indicate if specific conductance is measured in mS/cm or µS/cm.	Specific conductance will be measured and recorded in µS/cm in accordance with ENV-TI-05.80.42 (Rev 0001, effective date 3/31/2017).
88	Appendix J, Section 5.2.2	Groundwater Investigation SAP, Well Purging	8	2	1	Will barometric pressure readings be recorded? What will be the frequency and source of the barometric pressure readings? Will ambient air temperature be measured? Will a correlation between a NIST thermometer and the temperature on the multi parameter probe be made and recorded?	Barometric pressure readings will be recorded daily. TVA plans to use a multi-parameter sensor equipped with an NIST certified temperature sensor.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)
89	Appendix J, Section 5.2.5.1	Groundwater Investigation SAP, Groundwater Sampling	10	2	3	This should be 5NTU according to ENV-TI-05.80.42	The referenced criteria in ENV-TI-05.80.42 (Rev 0001, effective date 3/31/2017) is less than or equal to 10 NTU, not 5. An older version of this TI used different criteria. Ten NTUs is standard practice.
90	Appendix J, Table 5	Groundwater Investigation SAP	14	Table 5		Field pH meters used for collecting data will have to meet the calibration requirements of Method C, which is 0.05 pH units of the bracketing buffer solution values. There is not a hold time associated with the field measurement of pH by Method 9040C.	TVA will calibrate field pH meters to meet the requirements of 9040C.
91	Appendix J, Section 5.2.8	Groundwater Investigation SAP	15	4	1	Distribution of cuttings and discharge of water ~~should~~ will be performed in a manner as to not create a safety hazard.	See response to comment 59.
92	Appendix K	Hydrogeological Investigation SAP	All	All	All	General comment - TVA should update the SAP to reflect the accelerated groundwater investigation that is currently occurring onsite.	Refer to TDEC comments #53 for the response to this request.
93	Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	Refer to TDEC comment #38 for the response to this request.
94	Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.	Refer to TDEC comment #80 for the response to this request.
95	Appendix K	Hydrogeological Investigation SAP	All	All	All	General comment - TVA needs to define what protocol will be utilized to determine selection of background monitoring well locations. TDEC will need to approve any background monitoring well locations prior to utilization for the EIP.	Refer to TDEC comment #78 for the response to this request.
96	Appendix K	Hydrogeological Investigation SAP	All	All	All	This SAP is missing a table of the well construction details TVA anticipates for the additional ground water monitoring wells. This includes well ID, latitude and longitude, approximate screen interval below ground surface, anticipated depth of groundwater, purpose.	Comment is acknowledged. Ongoing RI activities include the installation of monitoring wells near the East Ash Disposal Area. The RIWP is included in Appendix K. After these activities have been conducted, a table with monitoring well installation details including latitude and longitude, approximate screen interval below ground surface and anticipated depth of groundwater will be provided in the EAR. The anticipated well construction details (well ID and approximate screen intervals) for monitoring wells proposed near the West Ash Disposal Area are included in the Hydrogeological Investigation SAP. Additional well construction details (latitude/longitude and depth of groundwater) will be provided in the EAR.
97	Appendix K	Hydrogeological Investigation SAP	All	All	All	The SAP needs to reflect the monitoring wells, locations and screen intervals proposed in the August 2017 RIWP	Comment is acknowledged. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities including monitoring well locations and well screen intervals will be included in the EAR.
98	Appendix K, Section 1.0	Hydrogeological Investigation SAP	1	2	3	The hydrogeological SAP purpose is to characterize the groundwater flow direction, install monitoring wells to provide locations to evaluate horizontal and vertical extent of CCR constituents and measure horizontal and vertical groundwater flow gradients within the alluvial aquifer.	Comment is acknowledged. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities will be included in the EAR.
99	Appendix K, Section 1.0	Hydrogeological Investigation SAP	1	2	5	The wells indicated to be installed were called out in Section 3.3.5 to be monitoring wells not observation wells and Section 3.3.5 indicated only 1 background monitoring well would be installed.	Comment is acknowledged. The corresponding change has been made in the document for the West Ash Disposal Area.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)
100	Appendix K, Section 2.0	Hydrogeological Investigation SAP	2	1	3	The objectives are to characterize the groundwater flow direction, to install monitoring wells to provide locations to evaluate horizontal and vertical extent of CCR constituents and measure horizontal and vertical groundwater flow gradients within the alluvial aquifer.	Comment is acknowledged. Objectives of the Hydrogeological Investigation SAP include characterizing groundwater flow direction and installation of monitoring wells to evaluate horizontal and vertical extents of CCR constituents, and horizontal and vertical flow gradients in the alluvial aquifer.
101	Appendix K, Section 2.0	Hydrogeological Investigation SAP	2	1	6	The SAP needs to reflect the monitoring wells, locations and screen intervals proposed in the August 2017 RIWP. As this SAP is currently written the intermediate depth is missing.	Comment is acknowledged. The corresponding change has been made in the document for the West Ash Disposal Area.
102	Appendix K, Section 2.0	Hydrogeological Investigation SAP	2	1	13	TVA should install additional intermediate and deep wells along the western perimeter of the East Ash pond, downgradient of the former disposal area on the eastern edge of the West Ash pond, and along the western edge of the West Ash pond.	Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. After the ongoing RI activities have been completed, the results will be used to evaluate the need for additional monitoring wells near the East Ash Disposal Area. Refer to TDEC Comment #38 for the response to this request for the West Ash Disposal Area.
103	Appendix K, Section 5.1	Hydrogeological Investigation SAP	6	3	1	There are no observation wells proposed.	Comment is acknowledged.
104	Appendix K, Section 5.1	Hydrogeological Investigation SAP	7	2	1	Potable water should be used for drilling, installation, and development of all environmental monitoring wells and piezometers. Non-potable water may be used for core holes, geotechnical borings, or other boreholes in which monitoring wells are not installed.	Comment is acknowledged. The corresponding change has been made to the document.
105	Appendix K, Section 5.2	Hydrogeological Investigation SAP	7	2	2	The elevation of the established and documented point on the top of each well casing will be correlated to Mean Sea Level	In order to align with existing data, the top of each well casing will be surveyed and correlated to the vertical datum used by the Plant. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing activities will be included in the EAR.
106	Appendix K, Section 5.2.1	Hydrogeological Investigation SAP	7	1	1	There are no observation wells proposed.	Comment is acknowledged.
107	Appendix K, Section 5.2.5	Hydrogeological Investigation SAP	10	2	1	Distribution of cuttings and discharge of water ~~should~~ will be performed in a manner as to not create a safety hazard.	The word “will” will be replaced with “shall” where a TDEC regulation, rule or the Order is explicitly referenced. In all other uses, the word “will” can be interpreted by TDEC as having the same meaning as “shall” and reflect TVA’s commitment to performing the specified task, action, activity, etc.
108	Appendix K, Section 5.2.6	Hydrogeological Investigation SAP	10	1	1	There are no observation wells proposed.	Comment is acknowledged.
109	Appendix K, Section 5.2.6	Hydrogeological Investigation SAP	10	2	1	There are no observation wells proposed.	Comment is acknowledged.
110	Appendix K, Section 5.2.6.2	Hydrogeological Investigation SAP	11	1	1	There are no observation wells proposed.	Comment is acknowledged.
111	Appendix K, Section 5.2.6.2	Hydrogeological Investigation SAP	12	1	1	Why is the target turbidity for development 10 NTU when the groundwater stabilization criteria listed for turbidity in ENV-TI-05.80.42 is less than 5 NTUs?	The referenced criteria in ENV-TI-05.80.42 (Rev 0001, effective date 3/31/2017) is less than or equal to 10 NTU, not 5. An older version of this TI used different criteria. Ten NTUs is standard practice.
112	Appendix K, Section 6.0	Hydrogeological Investigation SAP	14	1	3	There are no observation wells proposed.	Comment is acknowledged.
113	Appendix K, Section 8.0	Hydrogeological Investigation SAP	14	3	1	There are no observation wells proposed.	Comment is acknowledged.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)
114	Appendix N	Soil SAP	All	All	All	TVA has proposed background soil samples near monitoring well ALF-202 where documented exceedances for arsenic have been detected. TDEC recommends moving background soil locations near wells with MCL exceedances further up gradient (possibly near the new combined cycle unit plant) to properly characterize soil background concentrations. TVA is proposing background soil samples also be collected from background monitoring wells. TDEC will need to approve any background monitoring well locations prior to utilization for the EIP.	Comment is acknowledged, and the corresponding changes have been made in the document.
115	Appendix N	Soil SAP	3	1	5	Field teams should consist of (at a minimum) an experienced TN licensed professional geologist.	Comment is acknowledged, and the corresponding change has been made in the document.
116	Appendix N	Soil SAP	7	3	11	Will the mid-point for sampling aliquot be the vertical depth midpoint or the mid-point based on recovery? What is the contingency if recovery is poor? Or is it a composite over the entire 5 ft interval? Note: Composite samples are unacceptable.	The mid-point for grab samples will be the mid-point based on recovery, except in the situation where a core interval includes a lithology change. In the event that soils are expected to be hard to retain during core retrieval, core catchers will be used to prevent loss of sample material. No composite samples are proposed.
117	Appendix N	Soil SAP	7	3	16	Grab samples only. The collection of composite soil samples is not acceptable to determine that CCR constituents are not present because the evidence of a release may be diluted.	Comment is acknowledged, and the corresponding change has been made in the document.
118	Appendix O,	CCR Material Characteristics SAP	All	All	All	TDEC recommends conducting a leachability characterization study that includes an evaluation of CCR parameters from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics	Refer to TDEC comment #54 for the response to this request.
119	Appendix O, Section 4	CCR Material Characteristics SAP	4	1	All	Please provide a figure with proposed sampling locations for CCR material characteristic sampling and analysis	Comment is acknowledged, and the corresponding change has been made in the document.
120	Appendix O, Section 5	CCR Material Characteristics SAP	All	All	All	Please provide the sampling methods and protocol for collection of soil material samples for CCR material characteristic sampling and analysis	See response to tracking numbers 33 and 118. Any leachability of soils outside of areas where porewater sampling is planned should be in a second phase of investigation when any impacted areas have been identified and the testing can be targeted to those areas.
121	Appendix O, Section 5.2.4	CCR Material Characteristics SAP, Well Purging	8	1	5	According to TVA's TI document ENV-TI-05.80.42 the turbidity is required to be below 5 NTUs.	The referenced criteria in ENV-TI-05.80.42 (Rev 0001, effective date 3/31/2017) is less than or equal to 10 NTU, not 5. An older version of this TI used different criteria. Ten NTUs is standard practice, and TVA has not identified benefits from sampling to 5 NTUs versus 10 NTUs.0

Robert Wilkinson, P.G., CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Robert J. Martineau, Jr.
Commissioner

Bill Haslam
Governor

April 10, 2018

M. Susan Smelley
Director
Environmental Compliance and Operations
Tennessee Valley Authority
1101 Market Street, BR 4A-C
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Allen Coal Fired Fossil Fuel Plant
Environmental Investigation Plan Revision 1.5 Comments

Dear Ms. Smelley:

The Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order OGC 15-0177 (the Order") to the Tennessee Valley Authority (TVA) that required TVA action at seven TVA Coal Fired Fossil Power Plants (active and inactive) located in Tennessee. The Order was signed on August 6, 2015 and included information about TVA's right to appeal the Order. TVA did not appeal the Order and it is now final.

The Order required TVA to perform environmental investigations and to take appropriate corrective action at seven TVA Coal Fossil Power Plants (CCR sites) in Tennessee. The Order is specific to Coal Combustion Residual (CCR) material. Paragraph VII. of the Order provides the sequence of events for environmental investigation at a TVA CCR site as presented below.

1. TVA and TDEC are required to schedule and conduct an initial meeting to discuss each CCR site. At each CCR site meeting, TVA provides the operational history of the CCR site, all geological and hydrogeological information currently available, results of environmental investigations and sampling, etc. This is basically a summary of TVA's current understanding of each CCR site.

2. TDEC reviews the information provided by TVA (historical information, geophysical properties of the site, operational history, etc.) at the on-site meeting and historical CCR site information provided by TVA. After review of the information provided by TVA, TDEC

sends a letter to TVA that sets the date for submission of the draft CCR site Environmental Investigation Plan (EIP) and informs TVA of any additional environmental activities it believes are necessary to complete the CCR site environmental investigation.

3. TVA submits a draft Environmental Investigation Plan for the CCR site. TDEC reviews the draft CCR site EIP and provides TVA with comments that identify opportunities to improve the environmental investigation of the CCR site EIP. This letter also sets a due date for submission of the revised CCR site EIP.

4. TVA submits a revised EIP for the CCR site to TDEC, with a schedule of onsite activities such as installation of ground water monitoring wells, installing soil/rock borings to determine subsurface geological features, methods that will be used to determine the location and amount of disposed CCR material, surface water and ground water monitoring, etc.

5. TDEC provides TVA with its response to the revised EIP. When TDEC finds the CCR site EIP to be complete, TDEC notifies TVA via letter.

6. TVA is required to issue a public notice for the CCR site EIP before it is implemented. The public has 30 days to submit its EIP comments to TDEC. If EIP comments are submitted to TDEC, then TDEC has 30 days to respond to the comments.

7. Once the public comment period has ended, TDEC may provide TVA with CCR site EIP comments as a result of the review of the public comments submitted to TDEC. TVA submits and TDEC approves/disapproves the schedule of activities for environmental investigation at the CCR site. Unless TDEC disapproves the CCR site EIP schedule of activities, TVA proceeds with the environmental investigation, collects and generates data, then prepares an Environmental Assessment Report (EAR).

8. The EAR is submitted to TDEC. TDEC evaluates the EAR and decides if TVA has generated enough environmental investigation data to:

    a. Determine the impact of CCR materials to public health and the environment.
    b. Provide a comprehensive picture of the areas where CCR material disposed.
    c. Assess the structural and seismic stability of the CCR disposal areas.
    d. Determine the extent of CCR constituents in ground water and discharges to surface water.
    e. Determine if CCR material is disposed below the ground water table.

TDEC also determines if there is enough information generated to prepare a comprehensive corrective action plan.

If TDEC determines the EAR is incomplete or deficient, then TDEC informs TVA of its concerns. TVA is then required to further investigate the CCR site, beginning with item 4. above.

Allen CCR site EIP Rev 1.5 Comments

TVA submitted the EIP Rev 1.5 for TVA Allen Coal Fired Fossil Power Plant (TVA ALF) on February 16, 2018. TDEC has completed its review of EIP Rev 1.5 and is providing comments listed in the attached **Table 1 TVA Allen EIP Rev 1.5 Summary of TDEC Comments**.

Please address the attached comments and submit a revised plan (EIP Rev 2) with a cover letter summarizing TVA's response to each comment and subsequent modifications to TDEC by **June 1, 2018**.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA ALF site is complete, accurate and timely. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

Robert Wilkinson, P.G., CHMM

CC:	Chuck Head	Britton Dotson	James Clark
	Pat Flood	Angela Adams	Rob Burnette
	Tisha Calabrese Benton	Jamie Woods	Peter Lemiszki
	Steve Goins	Joseph E. Sanders	Caleb Nelson
	Shawn Rudder	Winifred Brodie	Bryan Wells

Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)	TDEC Response
New	General Technical	NA	NA	NA	NA			Hydrologic cross sections through both ash disposal areas should be developed from water level information collected from monitoring wells, vibrating wire piezometers, temporary wells and other available information demonstrating the effects of fluctuating river pool stages of the Mississippi River/McKellar Lake on water levels in the shallow, intermediate, and deep layers of the alluvial aquifer and also determine if the river loses or gains water to the alluvial aquifer.
New	1.4.2	Current Operations and Closure Plans	4	1	All			The purpose of the EIP is to determine appropriate corrective action/closure of the ash disposal areas at ALF. Any closure actions that have occurred or may occur prior to complete characterization of the site as part of the EIP process are considered "at risk". Based on the results of the EIP, TVA may be required to take other and further remedial action at the site.
New	3.3.1	TDEC Groundwater Monitoring Request No. 1	16	2	4			Editorial: a space is needed. "groundwater at the East Ash Disposal Area"
New	3.3.1	TDEC Groundwater Monitoring Request No. 1	16	2	8			Please note that wells identified as "background" are subject to periodic review based on an increased understanding of site chemistry and hydrogeologic conditions. If a well currently identified as background does not represent background conditions it shall be excluded from further consideration as "background"..
New	3.3.3	TDEC Groundwater Monitoring Request No. 3	20	4	5			At least one background location should be sampled for soil sorption (Kd)
New	4.1.2	A.2 TDEC Site Information Request No. 2	40	1	3			Please include arsenic speciation of the pore water samples.
New	4.1.2	A.2 TDEC Site Information Request No. 2	40	5	All			TVA shall provide an explanation for the addition of total organic carbon iron and manganese to the CCR parameters.
New	Appendix N, Seep SAP	5.2	6	1	1			TVA shall conduct a complete seep investigation to confirm the presence or absence of additional seeps at the ALF.
New	Appendix N, Seep SAP	Figure 1	NA	NA	NA			TVA shall sample ALF-01 and ALF-03 for CCR parameters.
New	Appendix N, Seep SAP	Figure 1	NA	NA	NA			TVA shall sample ALF-02, ALF-04, ALF-05, and ALF-06 for CCR parameters to confirm that they are non-CCR related.
New	Appendix O, Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	All	All	All			Provide rational for determining the acceptable (tolerable) displacement performance criteria. Provide documentation that justify the stated correlation of 3 feet to a factor of safety of 1.0.
New	Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	895/1027	Phase 1				Explain the use of Newmark's analysis if FSpseudo > 1.0.
New	Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	897/1027	Phase 4				Work with TDEC to define acceptable performance will need to be established as part of the of Phase 1 Assessment.
New	Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	898/1027	Table 2				Work with TDEC to define acceptable criteria in Phase 1 of the Assessment. Reference comment above.
New	Appendix O - Stability SAP	5.1.3 Basis for Load Cases and Acceptance Criteria	899/1027					TVA embankment dam design guidance (TVA 2016) should be removed from the list of documents used to determine acceptable criteria.
New	Appendix O - Stability SAP	5.1.3.1 Static Loading	899/1027					Flood loading should be considered for CCR units located in the flood plain.
New	Appendix O - Stability SAP	5.1.3.2.1 Pseudo static Stability	901/1027					The West Ash Pond and has a cooling water discharge tunnel and the East Ash Pond has an active force mail line and abandoned 60" sewer line within the impoundment/fill limits. Integrity of these conduits must be considered in the analysis. TDEC's referenced guidance is to be considered to be applicable. The preamble of the Federal CCR rule requires the use of conservative design factors.
17	General Technical	NA	NA	NA	NA	Any geologic/completion info. from Harsco well would be appreciated	At this time, TVA cannot confirm, and thus does not believe, it possesses the requested geologic/completion information that ties to the GPS location of the Harsco well.	TVA's response does not adequately resolve TDEC's concern. TVA needs to determine the screen location, rate of pumping and duration/frequency of pumping to determine what impact this production well may have in relation to groundwater flow. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
28	3.1.2	TDEC Information Request No. 2	9	3	All	TDEC recommends installing additional borings in both the east and west ash ponds to accurately delineate the clay foundation. There are large areas within the eastern portion of the east ash pond, along the southern perimeter of the east ash pond, and along the southern perimeter of the west ash pond that do not have any supporting or proposed boring locations.	For the West Ash Disposal Area, several exploratory borings will be added to provide additional coverage along the southern limits and interior of the CCR fill. The southern perimeter of the unit is the USACE levee, which does not have CCR overlying it; therefore, the added borings are north of the inboard levee toe. For the East Ash Disposal Area, access along the southern perimeter is feasible and several exploratory borings will be added to provide additional coverage. However, access within the interior of the eastern half of the unit is difficult. Drilling from a barge would be needed in the pond and substantial access improvements (i.e., roads) over the sluiced ash would be needed in the "beached" areas above water. An exploratory boring has been added near the middle of the unit, where an access road already exists.	TVA has not adequately responded to the comment. TVA shall propose the requested borings within the eastern portion of the East Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.

Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)	TDEC Response
34	3.3.5	TDEC Information Request No. 5	16	2	5	The Jackson Formation/Claiborne Group is a leaky confining unit with variable thickness and where there are breaches in the aquitard the potential for downward migration of CCR contaminants and/or CCR degraded water is significantly higher. TVA should fully characterize the nature and extent of the clay layer beneath the East and West Ash Ponds and determine if there are breaches that may provide a hydrologic connection between the alluvial/fluvial aquifer and the Memphis Sand aquifer.	Comment is acknowledged. The characterization of the Jackson Formation is being completed as part of the ongoing hydrogeological RI activities, results of which will be included in the EAR. Refer to the RIWP in Appendix K for additional details of the investigation.	TDEC understands that 4 deep stratigraphic borings were advanced to at least 10 ft into the sand of the Memphis aquifer at locations outside of the East Ash Disposal Area. However, there seems to be a substantial data gap in the understanding of subsurface geologic structure around the West Ash Disposal Area and directly beneath East Ash Disposal Area. An inferred fault is identified south of ALF-212C that generally has a southwest-to-northeast trend and may provide a preferential pathway for hydraulic connection between the shallow alluvial aquifer and the deeper Memphis aquifer. TDEC requires that within the footprint of disposal area near proposed borings B09, B11, TW-03 and B12 as well as on the berm near STN-17 (Exhibit 4) that a minimum of two and preferably all locations be drilled to a minimum of 250 ft and logged with downhole geophysical tools to include gamma logging to present a more detailed understanding of geologic structure and stratigraphy beneath the unit. Please provide a structural elevation map and an isopach of the confining unit.
35	3.3.5	TDEC Information Request No. 5	16	2	5	A paper study is not sufficient to evaluate the confining unit. Borings (either as part of soil sampling or monitoring well installation) should be advanced at least 10-15 feet into the Jackson Clay (or other confining unit) to verify a minimum thickness and competency of the clay. This is necessary to determine if the clay unit has the potential to provide adequate protection of the underlying Memphis Sand from any downward contaminant migration.	Comment is acknowledged. The characterization of the Jackson Formation is being completed as part of the ongoing hydrogeological RI activities. Four stratigraphic borings have been advanced into the Jackson Formation and the results of which will be included in the EAR. Refer to the RIWP in Appendix K for additional details of the investigation.	See Comment #34
36	3.3.5	TDEC Information Request No. 5	16	2	13	A map will need to be provided depicting the location of the 5 water supply wells relative to the ALF ash ponds.	Comment is acknowledged. The five production wells are shown on Appendix D Exhibit 6.	On Exhibit 6 it appears that monitoring well ALF-P4S, ALF-210 and ALF-210A are missing, please include them on the figure.
38	3.4.1	TDEC Information Request No. 4	18	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	For the West Ash Disposal Area, three monitoring wells (one shallow, one intermediate and one deep) are proposed at one location near the western unit boundary and at another location near the southeastern unit boundary to characterize groundwater flow direction and quality and vertical gradients within the alluvial aquifer. The proposed locations for monitoring wells west and southeast of the unit were constrained by the USACE levee and easement near the southern boundary of the West Ash Disposal Area. In addition, CCR material may be located near the eastern boundary of the West Ash Disposal Area and western boundary of the chemical pond. Additional monitoring wells are not proposed south of the West Ash Disposal Area because the southern boundary of the West Ash Disposal Area abuts a levee owned by the USACE, who has denied TVA requests to drill through the levee. In addition, TVA does not own the property south of the levee and access has been denied by the property owner due to the implementation of an upgrade project for the T.E. Maxson Wastewater Treatment Facility. As a result, background monitoring well locations ALF-210, ALF-210A and ALF-210B were proposed southeast of the West Ash Disposal Area on TVA owned property because monitoring wells could not be installed south of the unit. In addition, shallow monitoring wells (ALF-207 through ALF-209) and corresponding deep monitoring wells (ALF-207A through ALF-209A) were previously installed along the northern boundary of the West Ash Disposal Area. Three additional intermediate monitoring wells are proposed near ALF-207 through ALF-209. Additional monitoring wells within the interior of the West Ash Disposal Area are not proposed at this time. The West Ash Disposal Area is no longer in use and installation of monitoring wells within and below the unit would require breaching the bottom of the unit, which could potentially result in vertical migration of CCR constituents. TVA has developed an approach to define the hydrogeological characterization around the West Ash Disposal Area. This approach is an iterative investigation and is a cooperative effort with TDEC. TVA would prefer to complete the initial phase of the investigation and jointly review the results with TDEC to identify data gaps. If data gaps exist, TVA will fill those gaps with additional investigation in collaboration with TDEC. Monitoring well installation and sampling procedures for the additional wells near the West Ash Disposal Area are included in the updated Hydrogeological Investigation and Groundwater Investigation SAPs, respectively.	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the interior of the West Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
41	3.5.2	IRNo.1	20			Influent/effluent wastewater subject to NPDES Permit should be tested for Arsenic	Comment is acknowledged. The influent/effluent wastewater discharges are monitored in compliance with applicable NPDES permit. These discharges covered under NPDES permits are subject to conditions and limits administered by the TDEC Water Division.	Without data reporting the levels of CCR constituents discharged into McKellar Lake, it is difficult to determine the amount of CCR material release from the TVA ALF Plant into the lake. TVA shall either collect water samples for CCR Parameter analyses when it collects samples for NPDES monitoring or collect and analyze water samples from the NPDES discharge point in conjunction with groundwater monitoring events. Influent/effluent wastewater discharges should be analyzed for CCR and water quality parameters as requirements of the EIP.
42	3.5.5	IRNo.5	2,021			Influent and effluent process water subject, to the NPDES Permit, should be tested for Arsenic and PH	Comment is acknowledged. The influent/effluent wastewater discharges are monitoring in compliance with applicable NPDES permit. These discharges covered under NPDES permits are subject to conditions and limits administered by the TDEC Water Division.	See Comment #41
44	3.5.5	TDEC Information Request No. 5	23	4		Please provide detailed map with all seeps	Comment is acknowledged, and the corresponding changes have been made in the document.	Based on Exhibit #8 there appear to be two CCR related seeps, ALF-01 and ALF-03, please provide the rationale behind only including seep ALF-01 for sampling in the Appendix N Seep SAP. TDEC also contends that Seeps #2 and #4 have not been proven to be "non CCR related" seeps and therefore should be included in the Seep SAP.
45	3.5.5	East Ash Pond	2,425	All	All	The narrative seems to suggest Seeps 2 & 4 are unpermitted discharges by the fact analysis of seep water was compared to NPDES limits. TDEC request additional validation for seeps indicated on Figure No. 7 that were considered to not be CCR related.	The comparison of the seep samples to NPDES limits was only to determine if treatment of the seep was necessary. An isotopic analysis was performed on the seep samples in 2011. The results of the analysis determined that the source of the seep was not from any water that the plant produces or water that comes in contact with coal or ash. This analysis was submitted as part of the quarterly red water seep reports in December of 2011. The source of the seep is unknown.	TVA's response does not adequately resolve TDEC's concern. TVA will provide a table showing the results of the isotopic analysis that verifies that Seeps 2, 4, 5 and 6 are "not CCR related" and that CCR Parameters do not exceed MCLs. Until a definitive answer can determined for the source of the seep TVA should stop referring to Seeps #2 and #4 as "not CCR related" since the source of the seep could be perched water and/or groundwater. Pore water and groundwater up gradient of the 2 seeps has documented high levels of lead, arsenic, and calcium. Also the area directly south of the seeps is a former disposal area and there is also CCR stored at Harsco. Further investigation is required to determine the source of these two seeps. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
47	3.8.1	Migration of CCR Constituents	31	5	2	The conceptual groundwater flow and transport model for the site needs to model both current conditions and future planned pumping conditions.	Comment is acknowledged. If needed, the groundwater modeling will be completed as part of the ongoing hydrogeological RI activities. The RIWP is included in Appendix K. The results will be included in the EAR.	TDEC wants to clarify that groundwater flow and contaminant transport modeling will be required. If TVA elects to utilize the production wells TVA will need to provide a separate model for both a pumping and non-pumping scenario. Any models produced will have to model both high and low-stage conditions in McKellar Lake. The models also need to take into account the effect of pumping of the Harsco well.

Comment Number	Section Number	Section Title	Page	Paragraph	Line	TDEC Comment (October 3, 2017)	TVA Response (February 16, 2018)	TDEC Response
50	3.8.1	Hydrogeological and Groundwater Investigation SAPs	33	1	2	*"These wells are screened in the upper part of the alluvial aquifer. "* Please provide well construction details. TVA should also include a map with details and cross-sections of soil borings, water level within the ash, observation and monitoring well locations that will provide a better understanding of the site subsurface geology (specifically beneath the ponds). The total depth and screen interval should be included in each cross-section.	Well construction details for ALF-201 through ALF-210 and ALF-212 are included in Appendix L. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities including well construction details, detailed cross-sections and updated maps will be included in the EAR.	Lithologic and stratigraphic cross-sections generated for the EAR will transect (at a minimum) an approximately north-south and east-west profile for both the East Ash Pond and also the West Ash Pond (total of 4 cross sections). These will include representations of well screen intervals, total well depths, potentiometric water levels, ash depth, pore water elevation and indicate whether the confining unit is present or absent. Also a site wide fence diagram or 3-D block visualization that encompasses the entire area from the southern production well area northward to McKellar Lake and including an east-west component that covers both the East Ash Pond, plant area and West Ash Pond. These cross sections and fence diagrams should be based on both geophysical borehole data and core observations and include detailed correlations of sedimentary units across the area.
75	Appendix F, Section 4.0	Exploratory Drilling SAP	4	All	All	TDEC recommends additional soil borings be installed within the eastern portion of the East Ash disposal area and along the southern boundary of the West Ash Disposal area to better characterize the CCR material quantity and subsurface materials at the ALF.	The eastern portion of the East Ash Disposal Area consists of an active surface impoundment with open water areas that are only accessible by floating drilling platforms/barges. TVA plans to develop CCR material quantity estimates based on the existing and proposed borings, historical topographic mapping, and as-built construction drawings of the perimeter dikes. Several borings are proposed within the western portion of the East Ash Disposal Area and one boring near the center of the unit to determine top and bottom of CCR elevations. These borings can be used to check the accuracy of the historical topographical mapping. If the mapping is confirmed to be reliable, then additional borings within the eastern portion of the East Ash Disposal Area will not be necessary to estimate CCR material quantity to a reasonable degree of accuracy. The extents of the closed West Ash Disposal Area are well defined by the original United States Army Corps of Engineers (USACE) Ensley Levee to the south and by the historical topographic mapping. The existing borings and test pit excavations along the southern boundary confirm relatively thin deposits of CCR materials in this area. Several exploratory borings will be added to provide additional coverage along the southern limits and interior of the CCR fill. The southern perimeter of the unit is the USACE levee, which does not have CCR overlying it; therefore, the added borings are north of the inboard levee toe.	TVA has not adequately responded to the comment. TVA shall propose the requested borings within the eastern portion of the East Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
79	Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	Refer to TDEC request #38 for the response to this request.	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the interior of the West Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
80	Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.	Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. After the ongoing RI activities have been completed, the results will be used to evaluate the need for additional monitoring wells near the East Ash Disposal Area to characterize groundwater flow and quality. The selected monitoring well locations will be provided to TDEC for review and comment through the RI process before finalizing these additional locations, if needed.	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the East Ash Disposal Area. There is a significant data gap in groundwater elevations between ALF-212/ALF-201 and wells ALF-203/ALF-204 and also beneath the stilling pond. Currently TVA is proposing to install three temporary wells in the sluiced ash for pore water, geotechnical and piezometric levels. TDEC feels it would be beneficial to evaluate these three well locations for the suitability of installing multi level wells (or multi level vibrating wire PZs) corresponding to the deep, intermediate and shallow depths of the surrounding monitoring wells. The wells in the intermediate and deep levels would have to be cased through the ash to prevent migration of ash downward into the alluvial aquifer. The groundwater hydraulic gradient should be calculated for the two disposal areas using wells surrounding each of the specific units. If required due to the complexity of groundwater flow groundwater vector maps may be appropriate.TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
81	Appendix J, Section 2.0	Groundwater Investigation SAP, Objectives	2	1	3	Objectives need to include (but not limited to): determining the horizontal gradient of the shallow, intermediate and deep monitored levels within the alluvial aquifer; determining vertical gradients between the shallow, intermediate, and deep monitored intervals; generating a comprehensive evaluation of groundwater flow direction(s), velocities and gradients; and an evaluation of groundwater quality (geochemical and CCR parameters).	Comment is acknowledged. Separate ongoing RI activities are in progress to characterize the site- specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities will be included in the EAR.	TVA’s response does not adequately resolve TDEC’s concern. The RI activities only concentrate on the East Ash Pond Area, TVA needs to identify and correlate the lithologic and hydrogeologic units beneath both CCR Units and the Plant. These correlations need to extend out to the production wells and determine the presence, location, and amount of offset on interpreted faulting in the area, and determine how the gradient between the two aquifers vary. Based on the RIWP data gaps in the groundwater assessment of arsenic concentrations between ALF-212 and ALF-213; as well as between ALF-213 and ALF-206 are apparent and need to be addressed as part of this EIP. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
93	Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	Refer to TDEC comment #38 for the response to this request.	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the interior of the West Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.
94	Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.	Refer to TDEC comment #80 for the response to this request.	See comment #80
118	Appendix O,	CCR Material Characteristics SAP	All	All	All	TDEC recommends conducting a leachability characterization study that includes an evaluation of CCR parameters from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics	Refer to TDEC comment #54 for the response to this request.	TVA has not adequately responded to the comment. TVA shall propose the requested sample locations within eastern portion of the interior of the East Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.

Tennessee Valley Authority, 1101 Market Street, BR 4A, Chattanooga, Tennessee 37402-2801

May 25, 2018

Mr. Robert Wilkinson
Coal Combustion Residual (CCR) Technical Manager
Tennessee Department of Environment
and Conservation (TDEC)
Tennessee Tower William R. Snodgrass Building
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

Dear Mr. Wilkinson:

TENNESSEE VALLEY AUTHORITY (TVA) – EXTENSION REQUEST FOR ALLEN FOSSIL PLANT (ALF) ENVIRONMENTAL INVESTIGATION PLAN (EIP) REVISION 2 – COMMISSIONER'S ORDER NUMBER OGC15-0177, SECTION VII.C.

This letter is requesting an extension per Section VII.C. of Commissioner's Order OGC15-0177 for the Allen Fossil Plant EIP Revision 2. The ALF Rev 1.5 EIP was submitted to TDEC on February 16, 2018. TVA received TDEC's comments to this EIP in a letter dated April 10, 2018. The letter stated a due date for the EIP Revision 2 of June 1, 2018.

To ensure TVA accurately and completely addresses the comments on EIP Revision 1.5, TVA proposes an EIP Revision 2 due date of June 22, 2018. This also aligns with TVA's due date for response to TDEC's comments on the ALF Remedial Investigation Report. TVA requests TDEC's response to confirm or deny this requested due date.

Thank you for your consideration of this request. If you have questions regarding this information, please contact Bryan Wells at (423) 751-7393 or by email at wbwells@tva.gov. You may also contact me at (423) 751-3304 or by email at sstidwell@tva.gov.

Sincerely,

For M. Susan Smelley
Director
Environmental Compliance and Operations

cc:

Ms. Angela Adams
CCR Environmental Consultant
TDEC Division of Water Resources
761 Emory Valley Road
Oak Ridge, Tennessee 37830

Mr. Robert Burnette, P.E.
Tennessee Department of Environment
and Conservation
1301 Riverfront Parkway, Suite 206
Chattanooga, Tennessee 37402

Mr. James Clark
Chief Geologist
TDEC Columbia Field Office
1421 Hampshire Road
Columbia, Tennessee 38401

Mr. Britton Dotson
Environmental Fellow
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1548

Ms. Jenny Howard
General Council
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548

Ms. Shari Meghreblian, Ph.D.
Deputy Commissioner, Bureau of Environment
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548

Mr. Chuck Head
Assistant Commissioner
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

WBW:SMF
cc (Electronic Distribution):
J. A. Birdwell, WT 6A-K
B. E. Brickhouse, MR 6D-C
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J. J. Hoagland, WT 9D-K
J. C. Kammeyer, LP 5D-C
T. E. Korth, BR 4A-C
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J. R. Quinn, III, LP 5G-C
T. S. Rudder, BR 4A-C
M. S. Turnbow, LP 5G-C
W. B. Wells, III, BR 4A-C
J. B. Woodward, BR 4D-C
ECM, ENVrecords

Robert Wilkinson, P.G., CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Shari Meghreblian, Ph.D.
Commissioner

Bill Haslam
Governor

May 30, 2018

M. Susan Smelley
Director
Environmental Compliance and Operations
Tennessee Valley Authority
1101 Market Street, BR 4A-C
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Allen Coal Fired Fossil Fuel Plant
TVA Extension Request Environmental Investigation Plan Revision 2

Dear Ms. Smelley:

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 Allen Fossil Plant (ALF) Environmental Investigation Plan (EIP) Revision 2 to **June 22, 2018**. TDEC approves the request for extension.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA ALF site is complete, accurate and timely. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

Robert Wilkinson, P.G., CHMM

CC: Tisha Calabrese-Benton
James Clark
Pat Flood
Caleb Nelson
Shawn Rudder
Chuck Head
Angela Adams
Jennifer Dodd
Joseph E. Sanders
Bryan Wells
Britton Dotson
Rob Burnette
Peter Lemiszki
Jenny Howard

Tennessee Valley Authority, 1101 Market Street, BR 4A, Chattanooga, Tennessee 37402-2801

June 15, 2018

Mr. Robert Wilkinson
Coal Combustion Residual (CCR) Technical Manager
Tennessee Department of Environment
and Conservation (TDEC)
Tennessee Tower William R. Snodgrass Building
312 Rosa L Parks Avenue
Nashville, Tennessee 37243-1548

Dear Mr. Wilkinson:

TENNESSEE VALLEY AUTHORITY (TVA) – EXTENSION REQUEST FOR ALLEN FOSSIL PLANT (ALF) ENVIRONMENTAL INVESTIGATION PLAN (EIP) REVISION 2 – COMMISSIONER'S ORDER NUMBER OGC15-0177, SECTION VII.C.

This letter is requesting an extension per Section VII.C. of Commissioner's Order OGC15-0177 for ALF EIP Revision 2. TVA received TDEC's approval in a letter dated May 30, 2018, to extend the original date for submittal to June 22, 2018. TVA now proposes an EIP Revision 2 due date of July 20, 2018.

This date aligns with TVA's requested due date for the response to TDEC's comments on the ALF Remedial Investigation (RI) Report. Providing responses at the same time will ensure that TVA accurately and completely address the comments received on both the ALF EIP Revision 1.5 and ALF RI Report. TVA requests TDEC's response to confirm or deny this requested due date.

Thank you for your consideration of this request. If you have questions regarding this information, please contact Bryan Wells at (423) 751-7393 or by email at wbwells@tva.gov. You may also contact me at (423) 751-3304 or by email at sstidwell@tva.gov.

Sincerely,

M. Susan Smelley

M. Susan Smelley
Director
Environmental Compliance and Operations

cc: Ms. Angela Adams
CCR Environmental Consultant
TDEC Division of Water Resources
761 Emory Valley Road
Oak Ridge, Tennessee 37830

Mr. Robert Burnette, P.E
Tennessee Department of Environment
and Conservation
1301 Riverfront Parkway, Suite 206
Chattanooga, Tennessee 37402

Mr. James Clark
Chief Geologist
TDEC Columbia Field Office
1421 Hampshire Road
Columbia, Tennessee 38401

Mr. Britton Dotson
Environmental Fellow
Tennessee Department of Environment
and Conservation
William R. Snodgrass Tennessee Tower
12 Rosa L Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1548

Ms. Jenny Howard
General Council
Tennessee Department of Environment
and Conservation
William R. Snodgrass Tennessee Tower
312 Rosa L Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548

Ms. Shari Meghreblian, Ph.D
Deputy Commissioner, Bureau of Environment
Tennessee Department of Environment
and Conservation
William R. Snodgrass Tennessee Tower
312 Rosa L Parks Avenue, 2nd Floor
Nashville, Tennessee 37243-1548

Mr. Caleb Nelson
Tennessee Department of Environment
and Conservation
Columbia Field Office
1421 Hampshire Road
Columbia, Tennessee 38401

Mr. Jamie A. Woods, P.G.
Memphis Field Office
Division of Remediation
Tennessee Department of Environment
and Conservation (TDEC)
8383 Wolf Lake Drive
Bartlett, TN 38133-4119

WBW:SMF
cc (Electronic Distribution):
W. N. Brodie, BR 4A-C
T. E. Cheek, BR 4A-C
S. M. Connors, LP 3K-C
A. B. Fisher, BR 4A-C
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K. A. Love, SP 6B-C
J. R. Quinn, III, LP 5G-C
T. S. Rudder, BR 4A-C
M. S. Turnbow, LP 5G-C
W. B. Wells, III, BR 4A-C
ECM, ENVrecords

Robert Wilkinson, P.G., CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Shari Meghreblian, Ph.D.
Commissioner

Bill Haslam
Governor

June 19, 2018

M. Susan Smelley
Director
Environmental Compliance and Operations
Tennessee Valley Authority
1101 Market Street, BR 4A-C
Chattanooga, TN 37402

RE: TDEC Commissioner's Order OGC 15-1077
TVA Allen Coal Fired Fossil Fuel Plant
TVA Extension Request Environmental Investigation Plan Revision 2

Dear Ms. Smelley:

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 Allen Fossil Plant (ALF) Environmental Investigation Plan (EIP) Revision 2 to **July 20, 2018**. TDEC approves the request for extension.

TDEC's goal is to work with TVA to ensure the environmental investigation of the TVA ALF site is complete, accurate and timely. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

Robert Wilkinson, P.G., CHMM

CC: Tisha Calabrese-Benton
James Clark
Pat Flood
Caleb Nelson
Shawn Rudder
Chuck Head
Angela Adams
Jennifer Dodd
Joseph E. Sanders
Bryan Wells
Britton Dotson
Rob Burnette
Peter Lemiszki
Jenny Howard

Appendix B – Table 1
TVA Allen EIP Rev 1.5

Summary of TDEC Comments & TVA Responses

July 20, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	TDEC Comment (10/3/2017)	TVA Response (2/16/2018)	TDEC Response (4/10/2018)	Responses to ALF EIP Rev 1.5 TDEC Comments
1A	General Technical	NA	NA	NA	NA	NA	NA	Hydrologic cross sections through both ash disposal areas should be developed from water level information collected from monitoring wells, vibrating wire piezometers, temporary wells and other available information demonstrating the effects of fluctuating river pool stages of the Mississippi River/McKellar Lake on water levels in the shallow, intermediate, and deep layers of the alluvial aquifer and also determine if the river loses or gains water to the alluvial aquifer.	Comment is acknowledged, and the information will be provided in the EAR.
2A	1.4.2	Current Operations and Closure Plans	4	1	All	NA	NA	The purpose of the EIP is to determine appropriate corrective action/closure of the ash disposal areas at ALF. Any closure actions that have occurred or may occur prior to complete characterization of the site as part of the EIP process are considered "at risk". Based on the results of the EIP, TVA may be required to take other and further remedial action at the site.	Comment is acknowledged.
3A	3.3.1	TDEC Groundwater Monitoring Request No. 1	16	2	4	NA	NA	Editorial: a space is needed. "groundwater at the East Ash Disposal Area"	Comment is acknowledged, and the change has been made in the EIP.
4A	3.3.1	TDEC Groundwater Monitoring Request No. 1	16	2	8	NA	NA	Please note that wells identified as "background" are subject to periodic review based on an increased understanding of site chemistry and hydrogeologic conditions. If a well currently identified as background does not represent background conditions, it shall be excluded from further consideration as "background".	Comment is acknowledged.
5A	3.3.3	TDEC Groundwater Monitoring Request No. 3	20	4	5	NA	NA	At least one background location should be sampled for soil sorption (Kd)	One soil sample will be collected and analyzed for fraction organic carbon (foc) from the background monitoring well location. The foc result will be used to calculate soil sorption (Kd). The Background Soil SAP has been updated accordingly.
6A	4.1.2	A.2 TDEC Site Information Request No. 2	40	1	3	NA	NA	Please include arsenic speciation of the pore water samples.	Per Sections 5.2.1 and 5.2.6 of Appendix S (CCR Material Characteristics Sampling and Analysis Plan), CCR and pore water samples will be analyzed for arsenic and arsenic species (i.e., arsenate and arsenite).

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7A	4.1.2	A.2 TDEC Site Information Request No. 2	40	5	All	NA	NA	TVA shall provide an explanation for the addition of total organic carbon iron and manganese to the CCR parameters.	The mobility of CCR parameters can be affected by geochemistry and redox conditions. To obtain further information about these conditions and potential influencing factors, total organic carbon, iron, and manganese were added to the list of analytes. These analytes will be collected for informational purposes.
8A	Appendix N, Seep SAP	5.2	6	1	1	NA	NA	TVA shall conduct a complete seep investigation to confirm the presence or absence of additional seeps at the ALF.	TVA will conduct a seep investigation to evaluate the presence of active seeps. The Seep SAP (Appendix O) has been updated accordingly.
9A	Appendix N, Seep SAP	Figure 1	NA	NA	NA	NA	NA	TVA shall sample ALF-01 and ALF-03 for CCR Parameter.	TVA will collect samples from active seeps identified during the seep investigation. Samples will be analyzed for CCR Parameter.
10A	Appendix N, Seep SAP	Figure 1	NA	NA	NA	NA	NA	TVA shall sample ALF-02, ALF-04, ALF-05, and ALF-06 for CCR Parameter to confirm that they are non-CCR related.	TVA will collect samples from active seeps identified during the seep investigation. Samples will be analyzed for CCR Parameter.
11A	Appendix O, Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	All	All	All	NA	NA	Provide rational for determining the acceptable (tolerable) displacement performance criteria. Provide documentation that justify the stated correlation of 3 feet to a factor of safety of 1.0.	Text will be added in Section 5.1.3.2.1 of the Stability SAP to explain the technical basis for this correlation.
12A	Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	895/1027	Phase 1		NA	NA	Explain the use of Newmark's analysis if FSpseudo > 1.0.	As noted in Section 5.1.3.2.1 of the Stability SAP, TVA has developed a method whereby the pseudostatic coefficient is correlated to a site-specific tolerable displacement. This correlation is developed by performing a series of Newmark displacement analyses. This method is consistent with that used in TVA's CCR Rule demonstrations for seismic slope stability.

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13A	Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	897/1027	Phase 4		NA	NA	Work with TDEC to define acceptable performance will need to be established as part of the Phase 1 Assessment.	During the Phase 1 stability assessment, TVA will work with TDEC to define criteria for acceptable performance that would be utilized during a potential Phase 4 (the final phase) of the proposed phased stability assessment. The factors that contribute to defining acceptable performance will be site-specific and related to the consequences of the predicted deformations. As more site-specific information becomes available after Phase 1, TVA and TDEC may need to revisit the acceptable performance criteria in light of the additional information.
14A	Appendix O - Stability SAP	5.1.2 Phased Assessment and Acceptance Criteria	898/1027	Table 2		NA	NA	Work with TDEC to define acceptable criteria in Phase 1 of the Assessment. Reference comment above.	During the Phase 1 stability assessment, TVA will work with TDEC to define criteria for acceptable performance that would be utilized during a potential Phase 4 (the final phase) of the proposed phased stability assessment. The factors that contribute to defining acceptable performance will be site-specific and related to the consequences of the predicted deformations. As more site-specific information becomes available after Phase 1, TVA and TDEC may need to revisit the acceptable performance criteria in light of the additional information.
15A	Appendix O - Stability SAP	5.1.3 Basis for Load Cases and Acceptance Criteria	899/1027			NA	NA	TVA embankment dam design guidance (TVA 2016) should be removed from the list of documents used to determine acceptable criteria.	TVA has a significant portfolio of embankment dams, and its design guidance is one of several relevant industry standards that were considered to help inform the proposed load cases and acceptance criteria. The proposed criteria in the Stability SAP do not rely solely on the TVA guidance document. Further, the TVA analysis load cases and acceptance criteria are based upon and generally consistent with other industry standards, such as the dam safety criteria of the U.S. Army Corps of Engineers and the Federal Energy Regulatory Commission. The text will be clarified to emphasize these similarities.
16A	Appendix O - Stability SAP	5.1.3.1 Static Loading	899/1027			NA	NA	Flood loading should be considered for CCR units located in the flood plain.	For existing landfills or surface impoundments that no longer impound water, a flood event would only influence units with outboard slopes along the adjacent river/reservoir. For ALF, this would include the East and West Ash Disposal Areas. (Per Section 4.0 of the Stability SAP, evaluation is focused on closed conditions). However, the temporarily elevated river levels during a flood only provide additional stabilizing (i.e., resisting) force with respect to slope stability. Such a load case would have a higher factor of safety than the static, long-term case that is already being considered. Therefore, separate consideration of a flood load case is not necessary.

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17A	Appendix O - Stability SAP	5.1.3.2.1 Pseudo static Stability	901/1027			NA	NA	The West Ash Pond and has a cooling water discharge tunnel and the East Ash Pond has an active force mail line and abandoned 60" sewer line within the impoundment/fill limits. Integrity of these conduits must be considered in the analysis. TDEC's referenced guidance is to be considered to be applicable. The preamble of the Federal CCR rule requires the use of conservative design factors.	As noted in several sections of the Stability SAP, the tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes. The referenced tunnel and pipes beneath the East and West Ash Disposal Areas are good examples of site-specific features that will require consideration when selecting an appropriate tolerable displacement. The justification for the selected tolerable displacement will be documented as part of the analyses in the EAR.
17	General Technical	NA	NA	NA	NA	Any geologic/completion info. from Harsco well would be appreciated	At this time, TVA cannot confirm, and thus does not believe, it possesses the requested geologic/completion information that ties to the GPS location of the Harsco well.	TVA's response does not adequately resolve TDEC's concern. TVA needs to determine the screen location, rate of pumping and duration/frequency of pumping to determine what impact this production well may have in relation to groundwater flow. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	As part of the Remedial Investigation (RI), two Harsco wells were evaluated by TVA: Harsco's primary production well; and a second well that is only intermittently used by Harsco (referred to as the "abandoned" well). The screen locations of the wells were evaluated through down-hole video surveys. The screen length and depth information for each well is provided in Appendix I of the RI Report (draft submitted to TDEC on March 6, 2018). Based on information provided by a Harsco site representative, the Harsco production well operates at approximately 300 gallons per minute, 8 to 9 hours per day, 5 or 6 days per week. The Harsco "abandoned" well is only used for irrigation a couple times per year. TVA will consider this information when evaluating groundwater flow patterns.
28	3.1.2	TDEC Information Request No. 2	9	3	All	TDEC recommends installing additional borings in both the east and west ash ponds to accurately delineate the clay foundation. There are large areas within the eastern portion of the east ash pond, along the southern perimeter of the east ash pond, and along the southern perimeter of the west ash pond that do not have any supporting or proposed boring locations.	For the West Ash Disposal Area, several exploratory borings will be added to provide additional coverage along the southern limits and interior of the CCR fill. The southern perimeter of the unit is the USACE levee, which does not have CCR overlying it; therefore, the added borings are north of the inboard levee toe. For the East Ash Disposal Area, access along the southern perimeter is	TVA has not adequately responded to the comment. TVA shall propose the requested borings within the eastern portion of the East Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	The Exploratory Drilling SAP has been updated to include two additional geotechnical borings and to relocate two temporary wells in the East Ash Disposal Area. These four locations will provide additional data for CCR material characterization, CCR material quantity, water levels, and the uppermost foundation soils in the eastern portion of the unit. Performance of some borings and/or installation of some temporary wells may be unnecessary following review of the data collected during the RI program. Further, data from within the footprint of the ash disposal area would likely not alter TVA's preferred alternative of closure by removal, pending NEPA review. After evaluation of the preliminary data, and after the East Ash Disposal Area is dewatered, TVA will confer and collaborate with TDEC during the investigation phase about whether a well within the footprint of the East Ash Disposal Area is needed, and if so, the location of the well will be informed by the preliminary data.

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							feasible and several exploratory borings will be added to provide additional coverage. However, access within the interior of the eastern half of the unit is difficult. Drilling from a barge would be needed in the pond and substantial access improvements (i.e., roads) over the sluiced ash would be needed in the "beached" areas above water. An exploratory boring has been added near the middle of the unit, where an access road already exists.		

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34	3.3.5	TDEC Information Request No. 5	16	2	5	The Jackson Formation/Claiborne Group is a leaky confining unit with variable thickness and where there are breaches in the aquitard the potential for downward migration of CCR contaminants and/or CCR degraded water is significantly higher. TVA should fully characterize the nature and extent of the clay layer beneath the East and West Ash Ponds and determine if there are breaches that may provide a hydrologic connection between the alluvial/fluvial aquifer and the Memphis Sand aquifer.	Comment is acknowledged. The characterization of the Jackson Formation is being completed as part of the ongoing hydrogeological RI activities, results of which will be included in the EAR. Refer to the RIWP in Appendix K for additional details of the investigation.	TDEC understands that 4 deep stratigraphic borings were advanced to at least 10 ft into the sand of the Memphis aquifer at locations outside of the East Ash Disposal Area. However, there seems to be a substantial data gap in the understanding of subsurface geologic structure around the West Ash Disposal Area and directly beneath East Ash Disposal Area. An inferred fault is identified south of ALF-212C that generally has a southwest-to-northeast trend and may provide a preferential pathway for hydraulic connection between the shallow alluvial aquifer and the deeper Memphis aquifer. TDEC requires that within the footprint of disposal area near proposed borings B09, B11, TW-03 and B12 as well as on the berm near STN-17 (Exhibit 4) that a minimum of two and preferably all locations be drilled to a minimum of 250 ft and logged with downhole geophysical tools to include gamma logging to present a more detailed understanding of geologic structure and stratigraphy beneath the unit. Please provide a structural elevation map and an isopach of the confining unit.	On the east side of the pond boundary, TVA is planning to install an intermediate and deep well at the ALF-213 location, and a shallow, intermediate, and deep well between the ALF-213 and ALF-212 locations. The deep wells will extend to the top of the Claiborne Formation, and arrangements will be made with the USGS for borehole logging of the deep wells. After evaluation of the preliminary data, and after the East Ash Disposal Area is dewatered, TVA will confer and collaborate with TDEC during the investigation phase about whether a well within the footprint of the East Ash Disposal Area is needed, and if so, the location of the well will be informed by the preliminary data. At the West Ash Disposal Area, TVA is proposing to install nine new wells, including two which will be deep wells. These deeps wells will extend to the Claiborne unit, to provide information on stratigraphy near the West Ash Disposal Area. Borehole logging will also be performed at these deep wells. After evaluating this preliminary data, TVA will confer and collaborate with TDEC during the investigation phase about whether a well within the footprint of the West Ash Disposal Area is needed, and if so, the location of the well will be informed by the preliminary data.
35	3.3.5	TDEC Information Request No. 5	16	2	5	A paper study is not sufficient to evaluate the confining unit. Borings (either as part of soil sampling or monitoring well installation) should be advanced at least 10-15 feet into the Jackson Clay (or other confining unit) to verify a minimum thickness and competency of the clay. This is necessary to determine if the clay unit has the potential to provide adequate protection of the underlying Memphis Sand from any downward contaminant migration.	Comment is acknowledged. The characterization of the Jackson Formation is being completed as part of the ongoing hydrogeological RI activities. Four stratigraphic borings have been advanced into the Jackson Formation and the results of which will be included in the EAR. Refer to the RIWP in Appendix K for additional details of the investigation.	See Comment #34	See response to Comment #34.

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36	3.3.5	TDEC Information Request No. 5	16	2	13	A map will need to be provided depicting the location of the 5 water supply wells relative to the ALF ash ponds.	Comment is acknowledged. The five production wells are shown on Appendix D Exhibit 6.	On Exhibit 6 it appears that monitoring well ALF-P4S, ALF-210 and ALF-210A are missing, please include them on the figure.	Comment is acknowledged, and the change has been made to the figure.
38	3.4.1	TDEC Information Request No. 4	18	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	For the West Ash Disposal Area, three monitoring wells (one shallow, one intermediate and one deep) are proposed at one location near the western unit boundary and at another location near the southeastern unit boundary to characterize groundwater flow direction and quality and vertical gradients within the alluvial aquifer. The proposed locations for monitoring wells west and southeast of the unit were constrained by the USACE levee and easement near the southern boundary of the West Ash Disposal Area. In addition, CCR material may be located near the eastern boundary of the West Ash Disposal Area and western boundary of the chemical pond. Additional monitoring wells are not proposed south of the West Ash Disposal Area because the southern boundary of the West Ash Disposal Area abuts a levee owned by the USACE, who has denied TVA requests to drill through	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the interior of the West Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	Currently, three shallow and three deep co-located groundwater monitoring wells are located downgradient of the West Ash Disposal Area. These wells were installed as part of TVA's ongoing investigations and will also be evaluated as downgradient monitoring points for the EI. Since November 2016, TVA has conducted 5 rounds of groundwater sampling from the three shallow downgradient wells for laboratory analysis of CCR Parameters. The data has indicated no concentrations above TDEC or U.S.EPA MCLs, except for one arsenic detection of 11.5 ug/L in ALF-208 in November 2017. The February 2018 sample from ALF-208 was less than the MCL; therefore, an exceedance was not confirmed. As part of the EI, TVA will install ten additional monitoring wells in the shallow, intermediate and deep portions of the alluvial aquifer to further evaluate groundwater flow direction, groundwater quality and vertical gradients within the alluvial aquifer near the West Ash Disposal Area (discussed in Section 3.3.1). These wells will be installed around the perimeter of the unit and at a potential background location. Groundwater samples from these wells will provide data to evaluate the groundwater quality around the West Ash Disposal Area at multiple depths within the alluvial aquifer. The screened intervals for the deep wells are proposed to be placed near the bottom of the alluvial aquifer, immediately above the confining layer between the alluvial aquifer and the underlying Memphis aquifer. At this time, no CCR Parameters have been confirmed to have been detected in groundwater at concentrations above TDEC or U.S.EPA MCLs in samples from the West Ash Disposal Area downgradient wells. TVA is installing a robust groundwater monitoring system consisting of three well sets (shallow, intermediate and deep) at five locations to evaluate groundwater quality around the West Ash Disposal Area. After evaluating this preliminary groundwater data, TVA will confer and collaborate with TDEC during the investigation phase about whether a well drilled through and beneath the West Ash Disposal Area is needed to evaluate groundwater conditions around the West Ash Disposal Area, and if so, the location of the additional well will be informed by the preliminary groundwater data.

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							the levee. In addition, TVA does not own the property south of the levee and access has been denied by the property owner due to the implementation of an upgrade project for the T.E. Maxson Wastewater Treatment Facility. As a result, background monitoring well locations ALF-210, ALF-210A and ALF-210B were proposed southeast of the West Ash Disposal Area on TVA owned property because monitoring wells could not be installed south of the unit. In addition, shallow monitoring wells (ALF-207 through ALF-209) and corresponding deep monitoring wells (ALF-207A through ALF-209A) were previously installed along the northern boundary of the West Ash Disposal Area. Three additional intermediate monitoring wells are proposed near ALF-207 through ALF-209. Additional monitoring wells within the interior of the West Ash Disposal Area are not proposed at this time. The West Ash Disposal Area is no longer in use and installation of monitoring wells within and below the unit would require breaching the bottom of the unit, which could potentially result in vertical migration of CCR		

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							constituents. TVA has developed an approach to define the hydrogeological characterization around the West Ash Disposal Area. This approach is an iterative investigation and is a cooperative effort with TDEC. TVA would prefer to complete the initial phase of the investigation and jointly review the results with TDEC to identify data gaps. If data gaps exist, TVA will fill those gaps with additional investigation in collaboration with TDEC. Monitoring well installation and sampling procedures for the additional wells near the West Ash Disposal Area are included in the updated Hydrogeological Investigation and Groundwater Investigation SAPs, respectively.		
41	3.5.2	IRNo.1	20			Influent/effluent wastewater subject to NPDES Permit should be tested for Arsenic	Comment is acknowledged. The influent/effluent wastewater discharges are monitored in compliance with applicable NPDES permit. These discharges covered under NPDES permits are subject to conditions and limits administered by the TDEC Water Division.	Without data reporting the levels of CCR constituents discharged into McKellar Lake, it is difficult to determine the amount of CCR material release from the TVA ALF Plant into the lake. TVA shall either collect water samples for CCR Parameter analyses when it collects samples for NPDES monitoring or collect and analyze water samples from the NPDES discharge point in conjunction with groundwater monitoring events. Influent/effluent wastewater discharges should be analyzed for CCR and water quality parameters as requirements of the EIP.	TVA will collect and analyze effluent water samples from the East Ash Disposal Area discharge point (i.e., Outfall 001) in conjunction with groundwater monitoring events during the Environmental Investigation.

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42	3.5.5	IRNo.5	2,021			Influent and effluent process water subject, to the NPDES Permit, should be tested for Arsenic and PH	Comment is acknowledged. The influent/effluent wastewater discharges are monitoring in compliance with applicable NPDES permit. These discharges covered under NPDES permits are subject to conditions and limits administered by the TDEC Water Division.	See Comment #41	See response to Comment No. 41.
44	3.5.5	TDEC Information Request No. 5	23	4		Please provide detailed map with all seeps	Comment is acknowledged, and the corresponding changes have been made in the document.	Based on Exhibit #8 there appear to be two CCR related seeps, ALF-01 and ALF-03, please provide the rationale behind only including seep ALF-01 for sampling in the Appendix N Seep SAP. TDEC also contends that Seeps #2 and #4 have not been proven to be "non CCR related" seeps and therefore should be included in the Seep SAP.	TVA will collect samples from active seeps identified during the seep investigation. Samples will be analyzed for CCR parameters.
45	3.5.5	East Ash Pond	2,425	All	All	The narrative seems to suggest Seeps 2 & 4 are unpermitted discharges by the fact analysis of seep water was compared to NPDES limits. TDEC request additional validation for seeps indicated on Figure No. 7 that were considered to not be CCR related.	The comparison of the seep samples to NPDES limits was only to determine if treatment of the seep was necessary. An isotopic analysis was performed on the seep samples in 2011. The results of the analysis determined that the source of the seep was not from any water that the plant produces or water that comes in contact with coal or ash. This analysis was submitted as part of the quarterly red water seep reports in December of 2011. The source of the seep is unknown.	TVA's response does not adequately resolve TDEC's concern. TVA will provide a table showing the results of the isotopic analysis that verifies that Seeps 2, 4, 5 and 6 are "not CCR related" and that CCR Parameters do not exceed MCLs. Until a definitive answer can determined for the source of the seep TVA should stop referring to Seeps #2 and #4 as "not CCR related" since the source of the seep could be perched water and/or groundwater. Pore water and groundwater up gradient of the 2 seeps has documented high levels of lead, arsenic, and calcium. Also, the area directly south of the seeps is a former disposal area and there is also CCR stored at Harsco. Further investigation is required to determine the source of these two seeps. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	TVA will collect samples from active seeps identified during the seep investigation. Samples will be analyzed for CCR parameters. TVA will stop referring to Seeps No. 2 and No. 4 as "not CCR related."

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47	3.8.1	Migration of CCR Constituents	31	5	2	The conceptual groundwater flow and transport model for the site needs to model both current conditions and future planned pumping conditions.	Comment is acknowledged. If needed, the groundwater modeling will be completed as part of the ongoing hydrogeological RI activities. The RIWP is included in Appendix K. The results will be included in the EAR.	TDEC wants to clarify that groundwater flow and contaminant transport modeling will be required. If TVA elects to utilize the production wells TVA will need to provide a separate model for both a pumping and non-pumping scenario. Any models produced will have to model both high and low-stage conditions in McKellar Lake. The models also need to take into account the effect of pumping of the Harsco well.	Groundwater modeling will be performed as part of the RI. The model will focus on the alluvial aquifer and will consider site-specific features such as McKellar Lake and the Harsco well. Because TVA is not planning to operate the deep production wells at this time, these wells will not be incorporated into the groundwater flow modeling.
50	3.8.1	Hydrogeological and Groundwater Investigation SAPs	33	1	2	*"These wells are screened in the upper part of the alluvial aquifer."* Please provide well construction details. TVA should also include a map with details and cross-sections of soil borings, water level within the ash, observation and monitoring well locations that will provide a better understanding of the site subsurface geology (specifically beneath the ponds). The total depth and screen interval should be included in each cross-section.	Well construction details for ALF-201 through ALF-210 and ALF-212 are included in Appendix L. Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities including well construction details, detailed cross-sections and updated maps will be included in the EAR.	Lithologic and stratigraphic cross-sections generated for the EAR will transect (at a minimum) an approximately north-south and east-west profile for both the East Ash Pond and also the West Ash Pond (total of 4 cross sections). These will include representations of well screen intervals, total well depths, potentiometric water levels, ash depth, pore water elevation and indicate whether the confining unit is present or absent. Also, a site wide fence diagram or 3-D block visualization that encompasses the entire area from the southern production well area northward to McKellar Lake and including an east-west component that covers both the East Ash Pond, plant area and West Ash Pond. These cross sections and fence diagrams should be based on both geophysical borehole data and core observations and include detailed correlations of sedimentary units across the area.	Comment is acknowledged, and the information will be provided in the EAR.

Appendix B – Table 1
TVA Allen EIP Rev 1.5
Summary of TDEC Comments & TVA Responses
July 20, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	TDEC Comment (10/3/2017)	TVA Response (2/16/2018)	TDEC Response (4/10/2018)	Responses to ALF EIP Rev 1.5 TDEC Comments
75	Appendix F, Section 4.0	Exploratory Drilling SAP	4	All	All	TDEC recommends additional soil borings be installed within the eastern portion of the East Ash disposal area and along the southern boundary of the West Ash Disposal area to better characterize the CCR material quantity and subsurface materials at the ALF.	The eastern portion of the East Ash Disposal Area consists of an active surface impoundment with open water areas that are only accessible by floating drilling platforms/barges. TVA plans to develop CCR material quantity estimates based on the existing and proposed borings, historical topographic mapping, and as-built construction drawings of the perimeter dikes. Several borings are proposed within the western portion of the East Ash Disposal Area and one boring near the center of the unit to determine top and bottom of CCR elevations. These borings can be used to check the accuracy of the historical topographical mapping. If the mapping is confirmed to be reliable, then additional borings within the eastern portion of the East Ash Disposal Area will not be necessary to estimate CCR material quantity to a reasonable degree of accuracy. The extents of the closed West Ash Disposal Area are well defined by the original United States Army Corps of Engineers (USACE) Ensley Levee to the south and by the historical topographic mapping. The existing borings and test pit	TVA has not adequately responded to the comment. TVA shall propose the requested borings within the eastern portion of the East Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	The Exploratory Drilling SAP has been updated to include two additional geotechnical borings and to relocate two temporary wells in the East Ash Disposal Area. These four locations will provide additional data for CCR material characterization, CCR material quantity, water levels, and the uppermost foundation soils in the eastern portion of the unit. Performance of some borings and/or installation of some temporary wells may be unnecessary following review of the data collected during the RI program. Further, data from within the footprint of the ash disposal area would likely not alter TVA's preferred alternative of closure by removal, pending NEPA review. After evaluation of the preliminary data, and after the East Ash Disposal Area is dewatered, TVA will confer and collaborate with TDEC during the investigation phase about whether a well within the footprint of the East Ash Disposal Area is needed, and if so, the location of the well will be informed by the preliminary data.

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							excavations along the southern boundary confirm relatively thin deposits of CCR materials in this area. Several exploratory borings will be added to provide additional coverage along the southern limits and interior of the CCR fill. The southern perimeter of the unit is the USACE levee, which does not have CCR overlying it; therefore, the added borings are north of the inboard levee toe.		
79	Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	Refer to TDEC request #38 for the response to this request.	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the interior of the West Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	See response to Comment No. 38.

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80	Appendix J	Groundwater Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.	Separate ongoing RI activities are in progress to characterize the site-specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. After the ongoing RI activities have been completed, the results will be used to evaluate the need for additional monitoring wells near the East Ash Disposal Area to characterize groundwater flow and quality. The selected monitoring well locations will be provided to TDEC for review and comment through the RI process before finalizing these additional locations, if needed.	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the East Ash Disposal Area. There is a significant data gap in groundwater elevations between ALF-212/ALF-201 and wells ALF-203/ALF-204 and also beneath the stilling pond. Currently TVA is proposing to install three temporary wells in the sluiced ash for pore water, geotechnical and piezometric levels. TDEC feels it would be beneficial to evaluate these three well locations for the suitability of installing multi level wells (or multi level vibrating wire PZs) corresponding to the deep, intermediate and shallow depths of the surrounding monitoring wells. The wells in the intermediate and deep levels would have to be cased through the ash to prevent migration of ash downward into the alluvial aquifer. The groundwater hydraulic gradient should be calculated for the two disposal areas using wells surrounding each of the specific units. If required due to the complexity of groundwater flow groundwater vector maps may be appropriate. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	See response to Comment No. 34.

Summary of TDEC Comments & TVA Responses

July 20, 2018

Comment Number	Section Number	Section Title	Page	Para-graph	Line	TDEC Comment (10/3/2017)	TVA Response (2/16/2018)	TDEC Response (4/10/2018)	Responses to ALF EIP Rev 1.5 TDEC Comments
81	Appendix J, Section 2.0	Groundwater Investigation SAP, Objectives	2	1	3	Objectives need to include (but not limited to): determining the horizontal gradient of the shallow, intermediate and deep monitored levels within the alluvial aquifer; determining vertical gradients between the shallow, intermediate, and deep monitored intervals; generating a comprehensive evaluation of groundwater flow direction(s), velocities and gradients; and an evaluation of groundwater quality (geochemical and CCR parameters).	Comment is acknowledged. Separate ongoing RI activities are in progress to characterize the site- specific hydrogeology for the East Ash Disposal Area. The RIWP is included in Appendix K. The results of the ongoing RI activities will be included in the EAR.	TVA's response does not adequately resolve TDEC's concern. The RI activities only concentrate on the East Ash Pond Area, TVA needs to identify and correlate the lithologic and hydrogeologic units beneath both CCR Units and the Plant. These correlations need to extend out to the production wells and determine the presence, location, and amount of offset on interpreted faulting in the area and determine how the gradient between the two aquifers vary. Based on the RIWP data gaps in the groundwater assessment of arsenic concentrations between ALF-212 and ALF-213; as well as between ALF-213 and ALF-206 are apparent and need to be addressed as part of this EIP. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	Based on recent discussions between TVA and TDEC, additional investigation activities associated with the East Ash Disposal Area will be addressed as part of the supplemental RI activities. Additional monitoring wells are proposed west, north and southeast of the West Ash Disposal Area to provide a monitoring well network within the shallow, intermediate and deep portions of the alluvial aquifer. Groundwater data collected from this network will provide information to evaluate horizontal and vertical gradients, groundwater flow direction, velocities and groundwater quality for the West Ash Disposal Area. The lithologic and hydrogeologic units beneath the East Ash Disposal Area, West Ash Disposal Area, the plant, and area of the production wells will be identified and evaluated for correlations. Four deep wells are proposed around the East Ash Disposal Area and the West Ash Disposal Area, each of which will extend to the top of the Claiborne Formation. Borehole logging of each well will be performed by USGS to provide further stratigraphic information.
93	Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells on the western, southern, and eastern boundary as well as within the interior of the West Ash Pond to accurately characterize groundwater flow and chemistry beneath the West Ash Pond.	Refer to TDEC comment #38 for the response to this request.	TVA has not adequately responded to the comment. TVA shall propose the requested monitoring wells within the interior of the West Ash Disposal Area. TVA has agreed to conduct an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	See response to Comment No. 38.
94	Appendix K	Hydrogeological Investigation SAP	All	All	All	TDEC recommends installing monitoring wells within the interior of the East Ash Pond to accurately characterize groundwater flow and chemistry beneath the East Ash Pond.	Refer to TDEC comment #80 for the response to this request.	See comment #80	See response to Comment No. 34.
118	Appendix O,	CCR Material Characteristics SAP	All	All	All	TDEC recommends conducting a leachability characterization study	Refer to TDEC comment #54 for the response to this request.	TVA has not adequately responded to the comment. TVA shall propose the requested sample locations within eastern portion of the interior of the East Ash Disposal Area. TVA has agreed to conduct	The Exploratory Drilling SAP has been updated to include two additional geotechnical borings and to relocate two temporary wells in the East Ash Disposal Area. These four locations will provide additional data for CCR material characterization, CCR material

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						that includes an evaluation of CCR parameters from pore water and solid material samples from locations that would characterize the vertical and lateral distribution of leachability characteristics		an environmental investigation at the TVA ALF as required in the Commissioner's Order it received and did not appeal. It is TVA's responsibility to submit an Environmental Investigation Plan for TDEC's review and make changes to the EIP as requested by TDEC. When there are questions concerning any part of the EIP, TVA should discuss their concerns with TDEC and TDEC shall consider TVA's concerns. However, if TDEC and TVA disagree on any matter, TVA shall perform investigative activities as specified by TDEC.	quantity, water levels, and the uppermost foundation soils in the eastern portion of the unit. Performance of some borings and/or installation of some temporary wells may be unnecessary following review of the data collected during the RI program. Further, data from within the footprint of the ash disposal area would likely not alter TVA's preferred alternative of closure by removal, pending NEPA review. After evaluation of the preliminary data, and after the East Ash Disposal Area is dewatered, TVA will confer and collaborate with TDEC during the investigation phase about whether a well within the footprint of the East Ash Disposal Area is needed, and if so, the location of the well will be informed by the preliminary data.

Robert Wilkinson, P.G., CHMM CCR Technical Manager
2nd Floor TN Tower, W.R. Snodgrass Building
312 Rosa L. Parks Avenue
Nashville, TN 37243
Office: (615) 253-0689
e-mail: Robert.S.Wilkinson@tn.gov

Shari Meghreblian, Ph.D.
Commissioner

Bill Haslam
Governor

August 28, 2018

Amanda Garcia
Southern Environmental Law Center
1033 Demonbreun St, Ste. 205
Nashville, TN 37203

RE: TDEC Commissioner's Order OGC 15-1077
TVA Allen Coal Fired Fossil Fuel Plant
All Interested Parties Meeting

Dear Ms. Garcia:

The Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order OGC 15-0177 (the Order) to the Tennessee Valley Authority (TVA) requiring TVA action at seven TVA Coal Fired Fossil Power Plants (active and inactive) located in Tennessee. The Order was signed on August 6, 2015 and included information about TVA's right to appeal the Order. TVA did not appeal the Order and it is now final. The Order requires TVA to perform environmental investigations and to take appropriate corrective action at seven TVA Coal Fossil Power Plants in Tennessee. The Order is specific to Coal Combustion Residual (CCR) material.

On July 20, 2018, TVA submitted the Environmental Investigation Plan (EIP) Revision 2 for the TVA Allen Coal Fired Fossil Power Plant (TVA ALF) located in Memphis, TN. TDEC has completed its review of the submittal and found it to be acceptable.

In a letter dated September 28, 2015 from TDEC to the Southern Alliance for Clean Energy (SACE), TDEC added an additional opportunity for public involvement prior to the public notice and comment period stipulated in Section 7 of the Order.

TDEC will hold an All Interested Parties (AIP) meeting to discuss the TVA ALF EIP Revision 2 on September 24, 2018, 1:00 PM CST at the TDEC Memphis Environmental Field Office located at 8383 Wolf Lake Drive, Bartlett, TN 38133.

If your organization will be attending the AIP meeting, please respond no later than September 17, 2018. TDEC requests that each organization limit attendees to three personnel. Please provide at least one valid email address, if you have not already done so, to allow for file sharing of a digital copy of the TVA ALF EIP Revision 2 to review prior to the AIP meeting.

TDEC appreciates your continued interest in this issue and looks forward to meeting with you. Should you have any questions, please do not hesitate to contact me via email at Robert.S.Wilkinson@tn.gov or phone at (615) 253-0689.

Sincerely,

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

CC:	Shari Meghreblian	Chuck Head	James Clark
	Tisha Calabrese-Benton	Jennifer Dodd	Pat Flood
	Brooke Barrett	Britton Dotson	Rob Burnette
	Jenny Howard	Angela Adams	Joseph E. Sanders
	Ronne Adkins	Susan Smelley	Shawn Rudder
	Bryan Wells		

APPENDIX C
QUALITY ASSURANCE PROJECT PLAN

Setting the Standards for Innovative Environmental Solutions

QUALITY ASSURANCE PROJECT PLAN

FOR THE TENNESSEE VALLEY AUTHORITY

ALLEN FOSSIL PLANT

ENVIRONMENTAL INVESTIGATION

Revision 4

February 2019

Prepared by:

ENVIRONMENTAL STANDARDS, INC.
1140 Valley Forge Road
P.O. Box 810
Valley Forge, PA 19482-0810

Prepared for:

TENNESSEE VALLEY AUTHORITY
1101 Market Street
Chattanooga, TN 34702-2801

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2.0 QUALITY ASSURANCE PROJECT PLAN DESCRIPTION

2.1 Background

The primary goal of this Tennessee Valley Authority (TVA) Allen Fossil Plant (ALF) Environmental Investigation Quality Assurance Project Plan (ALF QAPP) is to confirm that the ALF environmental investigation objectives are met by TVA consultants and contractors generating documented, high-quality, reliable investigative/analytical data. This document describes the quality assurance (QA) requirements for work performed under the *TVA Allen Fossil Plant Environmental Investigation Plan*, *Revision 3* (ALF EIP; February 2019) and provides QA procedures and quality control (QC) measures to be applied to associated sampling and monitoring activities. This ALF QAPP will govern the quality aspects of the investigation-specific Sampling and Analysis Plans (SAPs).

This ALF QAPP describes the QA implementation for the ALF EIP and identifies the obligations of the various entities responsible for generating environmental data. Specific details on the various sampling programs and project-specific quality objectives are presented in this ALF QAPP and/or the associated SAPs, with TVA Technical Instructions (TIs) or standard operating procedures (SOPs) guiding the specific activities performed under these plans. The ALF QAPP describes the generation and use of environmental data associated with the ALF EIP and is applicable to current sampling and monitoring programs associated with the project. Data generated under the ALF EIP will be managed in accordance with the Data Management Plan for the TVA Multi-Site Order.

2.2 Quality Assurance Program Organization, Management, and Responsibilities

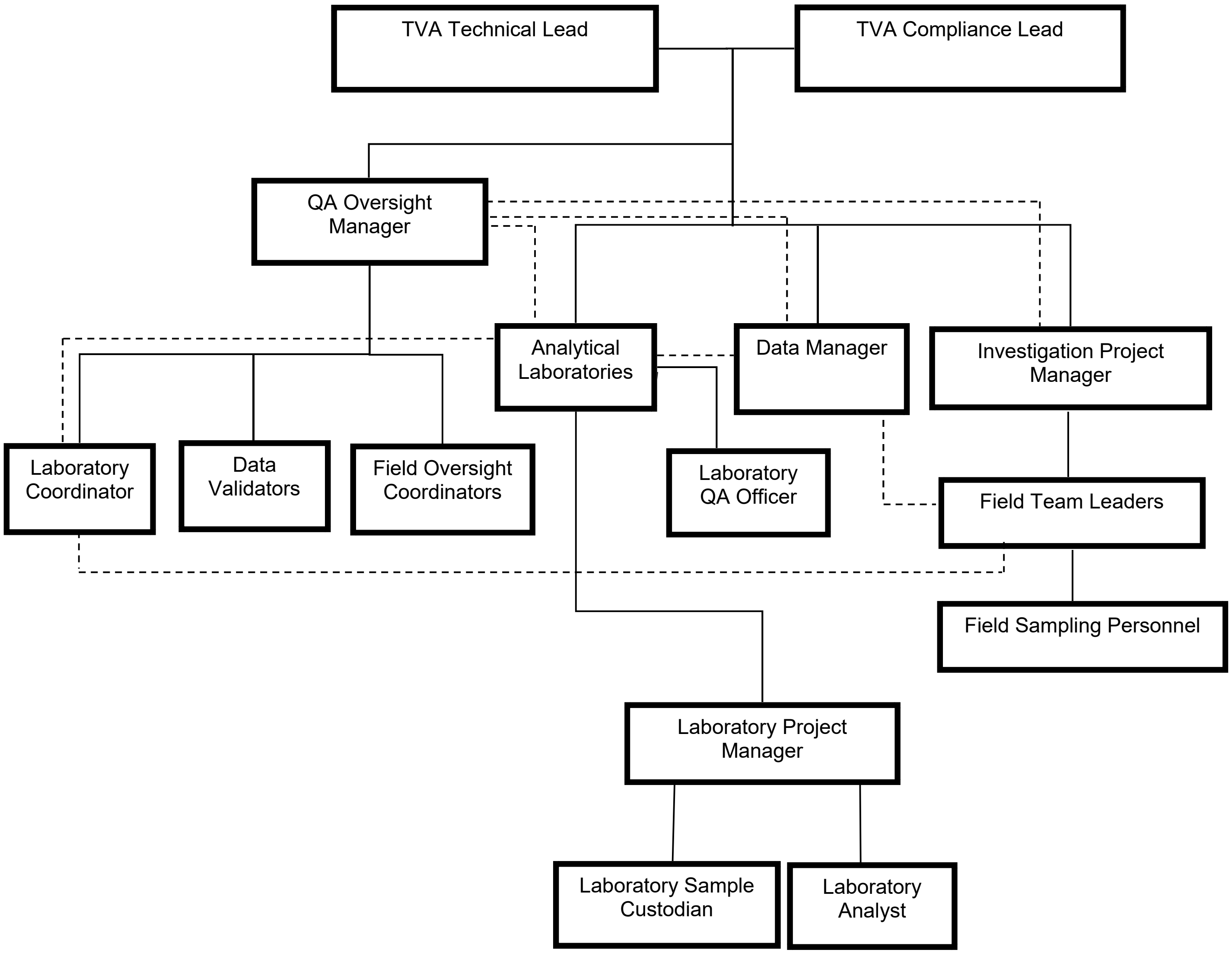
Successful implementation of a QA Program requires clear lines of reporting and authority, along with defined responsibilities for key individuals implementing and administrating the QA Program. This section describes the organizational structure, lines of authority, and responsibilities of key individuals accountable for the implementation and administration of the ALF EIP requirements. Project activities are performed within the framework of the organization and functions described in this section.

The organizational structure showing relationships of individuals with key responsibilities is presented in Figure 2-1. The organizational structure in Figure 2-1 represents a subset of the overall organizational structure for the project as directly related to implementation of the ALF QAPP. The QA oversight consultant provides independent QA support to TVA including QA oversight of field and laboratory personnel. The organizational structure is designed to provide clear lines of responsibility and authority, regardless of the individuals filling particular roles. This organizational structure encompasses the following activities:

- Identifying lines of communication and coordination.
- Monitoring project schedules and performance.
- Managing technical resources.
- Providing periodic progress reports.
- Coordinating support functions such as laboratory analysis and data management.
- Rectifying deficiencies and issues that could impact data quality.

Field and laboratory personnel providing services in support of project efforts must perform work in compliance with the appropriate technical specifications for the activity.

Figure 2-1. Organization Chart and Lines of Communication for the ALF EIP



The sections below detail the roles and responsibilities for the positions involved in the ALF EIP.

2.2.1 TVA Compliance Lead

The TVA Compliance Lead is responsible for the coordination and direction of the ALF EIP. The TVA Compliance Lead is ultimately responsible for design and implementation of the ALF EIP. The TVA Compliance Lead interfaces with TVA Legal Counsel as necessary and provides reports to TVA Senior Management.

TVA Compliance Lead's responsibilities and duties include:

- Identifying lines of communication and coordination.
- Managing key technical resources.
- Providing periodic progress reports to TVA Senior Management.
- Reviewing and approving the ALF EIP strategy.
- Reviewing and approving ALF EIP quality objectives.
- Reviewing and approving SAPs.
- Rectifying deficiencies and issues.
- Participating in meetings with Tennessee Department of Environment and Conservation (TDEC).
- Providing compliance support to TVA Technical Lead.

2.2.2 TVA Technical Lead

The TVA Technical Lead is responsible for providing technical guidance for the ALF EIP. The TVA Technical Lead directs the Investigation Project Manager and independent QA Oversight Manager and is ultimately responsible for design and implementation of the ALF EIP. The TVA Technical Lead interfaces with TVA Legal Counsel as necessary and provides reports to TVA Senior Management.

TVA Technical Lead's responsibilities and duties include:

- Developing and reviewing the ALF EIP strategy.
- Developing and reviewing ALF EIP quality objectives.
- Reviewing and approving SAPs.
- Reviewing and analyzing overall task performance relative to planned QA requirements.
- Managing support functions such as laboratory analysis and data management.
- Rectifying deficiencies and issues.
- Providing technical support to the TVA Compliance Lead.
- Overseeing the budget.
- Monitoring project schedules and performance.

2.2.3 Investigation Project Manager

The Investigation Project Manager plans, coordinates, and oversees the performance of all investigation and sample collection activities. Investigation Project Manager's responsibilities include:

- Developing SAPs.
- Planning and coordinating Field Sampling Personnel for investigation and sampling events.
- Reviewing field logbooks for completeness, consistency, and accuracy.
- Managing and reviewing field sample Chain-of-Custody (COC) Records and associated documentation.
- Obtaining the appropriate field gear and supplies.
- Notifying management of situations requiring corrective action.
- Responding to, and implementing corrective action, as described in Section 16.0.

2.2.3.1 Field Team Leaders

The Field Team Leaders are the primary contacts in the field and are responsible for field activities, as listed below.

- Provide coordination and management of Field Sampling Personnel and subcontractors involved in field investigation, sampling, or calibration activities.
- Submit analytical requests to the Laboratory Coordinator.
- Ensure Field Sampling Personnel are familiar with field procedures and that these procedures are followed to achieve the data objectives.
- Review field logbooks and field data sheets for completeness, consistency, and accuracy.
- Conduct QA review of field data and coordinate submittal of field data to the Data Manager.

2.2.3.2 Field Sampling Personnel

Field Sampling Personnel are responsible for the performance of field activities as required by the program-specific SAPs and associated field TIs. Field Sampling Personnel document compliance with project requirements by recording field activities and observations in a field logbook at the time of the activity or observation. In addition, Field Sampling Personnel are responsible for collecting samples, submitting them to laboratories, and maintaining COC Records.

Field Sampling Personnel are responsible for field activities, including:

- Plan investigation and sample events and interface with the Laboratory Coordinator.
- Collect, label, and package samples.
- Ensure field procedures are followed to achieve the data objectives.
- Review field notebooks/logbooks for completeness, consistency, and accuracy.

- Provide coordination of sample delivery to project laboratories for analysis.

If there are problems encountered during any field activities, Field Sampling Personnel will inform the appropriate Field Team Leader and/or the Investigation Project Manager.

2.2.4 Analytical Laboratories

The functional roles for project analytical laboratories are described in this subsection. From the Project perspective, the structure is designed to facilitate information exchange about planning, technical requirements, schedules, and QA measures among the laboratories, Investigation personnel, QA Oversight personnel, and TVA personnel. Project information exchange specifically includes sample identification; preservation procedures; sample container requirements; sample collection procedures; decontamination protocols; and sample labeling, packing, holding times, and shipping.

Although internal laboratory structures may differ depending on the specific contractor, key functional roles include division management, technical direction, subcontracting coordination, data review, and data management.

The responsibilities of the analytical laboratories include, but are not limited to:

- Preparing and analyzing samples in a manner consistent with the analytical request, the ALF QAPP, and any applicable TVA TIs or other work instructions.
- Communicating with the QA Oversight team.
- Adhering to the laboratory QA Program.
- Implementing QC procedures for each test parameter.
- Reviewing analytical results, including raw data, calculations, and laboratory logbooks.
- Monitoring proper documentation and maintenance records.
- Identifying and implementing training requirements for the laboratory analytical personnel.
- Identifying QA problems and recommending appropriate corrective action.
- Preparing status reports (progress, problems, and recommended solutions).
- Preparing reports documenting completion of corrective actions.
- Providing electronic data deliverables (EDDs) in a format consistent with project requirements.

Laboratories will be selected based on a number of factors including capability, capacity, and ability to generate quality data that meet project objectives. The primary contracted laboratories may subcontract samples for special studies or non-routine analyte lists. In the event that samples are subcontracted, the primary laboratory is responsible for ensuring that analyses conform to the ALF QAPP requirements and the associated investigation-specific SAP. Data for subcontracted analyses will be reported through the primary contracted laboratory, which remains responsible for data quality.

The primary analytical laboratories expected to analyze samples associated with the ALF EIP are presented on Table 2-1.

Table 2-1. Analytical Laboratories for ALF EIP

Parameter/ Sample Type	Laboratory	Facility Address	Laboratory Contact
Metals, General Chemistry Parameters	TestAmerica Laboratories, Inc.	2960 Foster Creighton Drive Nashville, TN 38204[1]	Ms. Gail Lage (gail.lage@testamericainc.com)
		301 Alpha Drive Pittsburgh, PA 15237[2]	
Arsenic Speciation		4955 Yarrow Street Arvada, CO 80002-4517[2]	
Radiological Parameters		13715 Rider Trail North Earth City, MO 63045[2]	
Percent Ash	R.J. Lee Group	50 Hochberg Road, Monroeville, PA 15146	Ms. Monica Carse (MCarse@rjleegroup.com)
Geotechnical Characteristics	Stantec Consulting Services Inc.	3052 Beaumont Centre Circle Lexington, KY 40513-1703	Ms. Ryan Jones (ryan.jones@stantec.com)

Notes:

1 Primary analytical laboratory
2 Support analytical laboratory

2.2.4.1 Laboratory QA Officer

The Laboratory QA Officer ensures conformance with authorized policies, procedures, and sound laboratory practices as necessary. The Laboratory QA Officer will inform the Laboratory Project Manager of any non-conformances, introduce control samples into the sample train, and establish testing lots. In addition, the Laboratory QA Officer approves laboratory data before reporting or transmitting to permanent storage and is responsible for retention of supporting information such as control charts and other performance indicators to demonstrate that the systems that produced the data were in control. The Laboratory QA Officer also reviews results of internal QA audits and recommends corrective actions and schedules for their implementation.

The responsibilities of the Laboratory QA Officer include, but are not limited to:

- Administering the laboratory QA Program.
- Implementing QC procedures for each test parameter.
- Reviewing analytical results, including raw data, calculations, and laboratory log books.
- Monitoring proper documentation and maintenance of the records.
- Identifying and implementing training requirements for the laboratory analytical personnel.
- Overseeing QA implementation at the laboratory on a daily basis.
- Identifying QA problems and recommending appropriate corrective action.
- Preparing status reports (progress, problems, and recommended solutions).
- Preparing reports documenting completion of corrective actions.

2.2.4.2 Laboratory Project Manager

The Laboratory Project Manager is the primary contact for the Project Team at the analytical laboratory. A primary responsibility of the Laboratory Project Manager is to schedule analytical work within the laboratory, ensure that project-specific analytical requirements are communicated to staff, monitor analytical status/deadlines, approve laboratory reports, coordinate data revisions/corrections and re-submittal of data packages as necessary, and communicate sample preparation and analysis issues to the QA Oversight Manager and TVA Technical Lead on a real-time basis. The Laboratory Project Manager provides direction and support for laboratory administrative and technical project staff, interfaces with laboratory project staff on technical issues, and performs QA oversight of analytical data. The Laboratory Project Manager contacts the QA Oversight Manager and TVA Technical Lead if, at any point, there is a need to deviate from the ALF QAPP or other cited published materials. Any problems or inconsistencies identified at any time after laboratory sample receipt will be documented on a nonconformance report initiated by the Laboratory Project Manager and forwarded to the TVA Technical Lead and the Laboratory Coordinator.

The Laboratory Project Manager will provide sample receipt confirmations to the Laboratory Coordinator and Investigation Project Manager within one business day of sample login.

2.2.4.3 Laboratory Sample Custodian

The Laboratory Sample Custodian receives samples from TVA or its contractors, signs and dates COC Records, records the date and time of receipt, and records the condition of shipping containers and sample containers.

The Sample Custodian will verify and record agreement or non-agreement of information on sample custody documents. If there is non-agreement, the Sample Custodian will record the problems/inconsistencies for the case file and will inform the Laboratory Project Manager.

The Sample Custodian will also label sample containers with laboratory sample numbers, place sample containers and spent sample containers into the appropriate storage and/or secure areas, and monitor storage conditions.

2.2.4.4 Laboratory Analyst

The Laboratory Analyst is responsible for preparing and/or analyzing samples in accordance with this document and/or the applicable analytical methods. If there are problems encountered during sample preparation or analysis, the Laboratory Analyst will inform the Laboratory QA Officer and Laboratory Project Manager.

2.2.5 QA Functions

QA oversight activities will be performed by a third-party, independent contractor. The QA oversight consultant is an independent third-party QA organization and reports directly to the TVA Technical Lead.

2.2.5.1 QA Oversight Manager

The QA Oversight Manager develops, implements, and administers the overall QA Program for the ALF EIP. The QA Oversight Manager holds overall authority for the project QA and maintains that authority independently from the operational/production aspects of the project. The QA Oversight Manager also holds the authority to communicate at any level of the project organization in order to be effective.

The QA Oversight Manager's responsibilities and duties include:

- Establish a documented quality system for the project.
- Identify QA problems through periodic auditing and validation procedures.
- Initiate, recommend, or provide solutions to QA problems through designated channels.
- Ensure that project activities, including processing of information, delivery of products, and installation or use of equipment, are reviewed in accordance with QA objectives.
- Ensure that deficiencies or non-conformances are corrected.
- Ensure that further processing, delivery, or use of deficient or non-conforming data is controlled until correction of the non-conformance, deficiency, or unsatisfactory condition has occurred.
- Review and analyze overall task performance with respect to planned requirements.
- Perform general oversight of corrective action processes.
- Initiate and direct internal audits, inspections, surveillances, and observation of quality-related activities.
- Serve as point of contact for audits, inspections, surveillances, data management, and observation activities.
- Ensure deficiencies and non-conformances are corrected.
- Maintain QA documentation and records, including this ALF QAPP.

2.2.5.2 Laboratory Coordinator

The Laboratory Coordinator serves as a liaison between Field Team Leaders and the analytical laboratories for all work conducted under the ALF EIP. The Laboratory Coordinator's responsibilities include:

- Review analytical requests to verify consistency with project SAPs.
- Submit analytical requests to the Laboratory Project Manager.
- Schedule sample submission and transportation (as needed).
- Review and approve laboratory bottleware orders.
- Review COC Records submitted to the laboratories and sample receipt documentation provided by the laboratories.
- Serve as the point of contact for questions and issues arising during laboratory analysis.

2.2.5.3 Data Validators

Data Validators are responsible for performing review and validation of project data generated by the laboratories in accordance with the ALF QAPP and data specifications, producing data validation reports, and notifying the QA Oversight Manager of any specific issues or concerns.

2.2.5.4 Field Oversight Coordinators

Field Oversight Coordinators are independent from field sampling activities and work with the Field Team Leaders to ensure compliance with the ALF QAPP, program-specific sampling plans, and the associated project TIs. The Field Oversight Coordinators are responsible for training personnel involved in field sampling activities (if training is required), sample handling procedures, and sample custody as detailed in project TIs and the investigation-specific SAPs, and for periodically overseeing their performance of these functions. The Field Oversight Coordinators perform quality oversight of the Field Teams during sample collection and assess the procedures and performance of the Field Teams relative to the requirements in the ALF QAPP, TIs, and investigation-specific SAPs. As part of the quality oversight, the Field Oversight Coordinators will review COCs prior to submission of samples to the analytical laboratories.

2.2.6 Data Manager

The Data Manager is responsible for managing the project EQuIS™ database, which includes analytical data from the project laboratories, field data from the Field Team Leaders and historical data of known quality used as part of the ALF EIP. The Data Manager is the main point-of-contact for data-related issues. The Data Manager is responsible for ensuring compliance with the ALF QAPP and the Data Management Plan for the TVA Multi-Site Order (Data Management Plan). The Data Manager or designee receives EDDs directly from the project laboratories after sample analysis and formats the deliverables such that they can be used during the validation/verification process. Field data is collected and submitted to the Data Manager from the Field Team Leader utilizing field EDDs and is loaded and managed in the project database. A complete description of the Data Manager's responsibilities and responsibilities of Data Management support staff is provided in the Data Management Plan.

3.0 PROJECT DESCRIPTION AND APPLICABILITY

On August 6, 2015, TDEC issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA, setting forth a process for the investigation, assessment, and remediation of unacceptable risks at TVA's coal ash disposal sites in Tennessee. The TDEC Order is limited to the purposes and processes set forth in the Order. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the ALF on September 28, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management activities at ALF. TDEC submitted a follow-up letter dated February 6, 2017 to TVA which provided specific questions and tasks to be addressed in the Environmental Investigation Plan (EIP). TVA submitted Rev 1.5 on February 16, 2018. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

The purpose of the ALF EIP is to characterize the hydrology and geology of the ALF, identify the extent of soil and groundwater impact by CCR , and assess the quantities and characteristics of CCR materials currently onsite. At the conclusion of the investigation, an Environmental Assessment Report (EAR) analyzing results of these investigations will be prepared and submitted to TDEC. The EAR will support the development of an appropriate corrective action plan, if necessary, for ALF.

To support the ALF EIP objectives, a QA program has been implemented to ensure the environmental data generated for use in decision making is of high-quality and is legally defensible. The project's environmental data have been and continue to be used for purposes such as, but not limited to, operational decisions; delineation of the extent of contamination and transport of ash by river flows; and demonstration of achievement of project objectives.

On behalf of TVA, Environmental Standards, Inc., an independent QA firm, has prepared this ALF QAPP. The requirements of the ALF QAPP are applicable to project environmental personnel, support staff, consultants, and subcontractors.

3.1 Purpose and Scope

The ALF QAPP is intended to establish an overall environmental QA framework for the ALF EIP and to provide quantitative quality objectives for analytical data generated under the ALF EIP. Requirements associated with various analyses; data generation, reduction, and management; and results reporting are stipulated herein. Additional specific requirements are described in the program-specific SAPs.

The scope of this document is to describe the QA requirements developed for the ALF EIP and provide the appropriate QA procedures and QC measures to be applied to the associated sampling and monitoring activities. The ALF QAPP addresses the following items:

- Project organizational structure, roles, and responsibilities.
- QA objectives.
- Training requirements.
- Field and laboratory documentation requirements.
- Sample collection, handling, and preservation.
- COC procedures.
- Field and laboratory instrumentation and equipment calibration and maintenance.
- Preventive maintenance procedures and schedules.
- Laboratory procedures.
- Analytical methods requirements.
- Sample analysis, data reduction, validation, and reporting.
- QC sample types and frequency.
- QA performance and system audits.
- Data assessment procedures, including processing, interpretation, and presentation.
- Corrective actions.
- QA reports to management.

Investigation-specific SAPs have been developed to address program-specific sampling requirements to provide data sufficient to address the objectives of the particular investigation. QC requirements and quantitative objectives for analytical data are presented in Attachments E through H of this ALF QAPP.

3.2 Schedule

Investigation-specific sampling schedules are addressed in each associated SAP.

In general, the anticipated schedule of activities related to analytical data generated from chemical analyses is presented below.

- The laboratory will provide analytical results and EDDs to TVA within its standard turn-around time (TAT) approximately 10 business days for chemical analyses and approximately 40 days for radiological analyses) from sample receipt (or sooner when expedited TAT is requested).
- The QA oversight consultant will screen the EDD for acceptability to the database and complete the initial verification within 2 business days of EDD receipt and successful EDD loading. Verified data will be available to TVA and Investigation personnel for internal use and reporting.
- The laboratory will provide full data deliverable packages to TVA and the QA oversight consultant within its standard TAT (approximately 20 business days for chemical analyses and approximately 45 days for radiological analyses) from sample receipt.
- The QA oversight consultant will complete data validation as requested by TVA, generate reports following receipt of the complete data package, and add data validation qualifiers to the database as appropriate.

The overall schedule for the ALF EIP is presented in the EIP. Schedules for the various sampling activities associated with each environmental investigation (EI) are addressed in the investigation-specific SAPs.

3.3 QAPP Distribution and Revision

The ALF QAPP will be distributed to each consultant and contractor responsible for the collection, generation, and interpretation of field and analytical data. The TVA Technical Lead, QA Oversight Manager, or designee will be responsible for ensuring that necessary revisions are made so that the ALF QAPP is up-to-date with actual practices and will ensure that revisions and updates are distributed to necessary users. The document control format used in the ALF QAPP will identify the ALF QAPP revision number and revision date. A revision history that identifies each revision and a summary of the revision will be maintained.

4.0 DATA QUALITY OBJECTIVES PROCESS

The data quality objectives (DQO) process is a series of planning steps based on a scientific method to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended application. In general, DQOs provide a qualitative and quantitative framework around which data collection programs can be designed. The qualitative aspect of DQOs seeks to encourage good planning for field investigations. The quantitative aspect of DQOs involves designing an efficient field investigation that reduces the possibility of incorrect decision-making.

The DQO process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA, its QA oversight consultant, and investigation personnel considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts at the ALF EIP.

5.0 SPECIAL TRAINING/CERTIFICATIONS

Field Sampling Personnel performing sample collection activities will be properly trained in equipment use and procedures necessary for each task prior to entering the field. Training will be conducted by TVA, the QA oversight consultant, the Investigation Project Manager, and/or other subcontractors. Any proposed training not provided by the QA oversight consultant will be reviewed and approved by the Field Oversight Coordinator before training is conducted. Field Sampling Personnel training will be fully documented and the documentation will be maintained as part of the Project Record.

Individuals who plan to participate in field activities must have current health and safety training prior to commencement of sample collection activities. The Field Team Leader will verify that participants who arrive on site have provided evidence of health and safety training. It will be the responsibility of the Field Team Leader to ensure that Field Sampling Personnel understand and comply with the applicable requirements for their individual tasks.

Field Sampling Personnel will be trained on applicable field QC measures associated with a particular sampling program during program-specific training. Training received by Field Sampling Personnel will be documented. In addition, Field Sampling Personnel will receive training based on field oversight activities and additional training sessions on applicable project TIs.

Personnel who are responsible for performing laboratory analyses will be properly trained by the Laboratory Director or her/his designee to conduct the various laboratory analyses described in the ALF QAPP. Each laboratory shall assure sufficient personnel with the necessary education, training, technical knowledge, and experience for their assigned functions. Laboratory personnel training will be documented in accordance with the laboratory’s Quality Program requirements.

Data verification and validation will be conducted under the direction of the QA Oversight Manager, who will be experienced with the production, reporting, verification, and validation of analytical data.

Additional QA training will be conducted at the discretion of the TVA Technical Lead and the QA Oversight Manager. Generally, the need for QA training for project personnel will be identified through systems and performance audits and training will be conducted as part of the corrective action process. Any QA training provided to project personnel will be documented.

6.0 DOCUMENTATION AND RECORDS

Appropriate records will be maintained in a secure project file to provide adequate documentation of the entire data generation process, including field sampling and laboratory analysis. Field records will include maintaining field logs, field data sheets, and sample COC documentation. Field QC samples will be documented in both the field logbook and sample COC Records.

The Project File will be the central repository for documents relevant to sampling and analysis activities as described in the ALF QAPP and in the investigation-specific Work Plans and/or SAPs. The TVA Technical Lead will hold overall responsibility for maintenance of documentation associated with the project, including relevant records, correspondence, reports, logs, data, field records, pictures, subcontractor reports, analytical data, and data reviews. The file will include the following information, if generated:

- Field records.
- Field data and data deliverables.
- Photographs.
- Drawings.
- Sample logs.
- Laboratory data deliverables.
- Data validation reports.
- Field and laboratory audit reports.
- Reports (*e.g.,* progress reports, QA reports).
- Custody documentation.

Electronic and hardcopy analytical data will be archived for a minimum of 10 years from the date of report. TVA will maintain a complete project file and will archive hardcopy and electronic data in accordance with TVA records retention rules as delineated by TVA's records management documents. Electronic or hardcopy data associated with the ALF EIP will not be discarded, deleted, or destroyed by any party without the written consent of TVA Legal Counsel.

6.1 Field Data Documentation

Field data collected during the EI will be evaluated for usability by conducting a QA review, which will consist of checking the procedures used by field staff and comparing the data to previous measurements. Field QC samples will be used to verify that field measurements and sampling protocols have been observed and followed. The field data will be reviewed by the Field QA Oversight Coordinator or designee for the following:

- Compliance with TIs.
- Compliance with SAPs.
- Field equipment calibration method and frequency.
- Field calibration standard lot numbers and expiration dates.
- Date and time sampled.
- Preservation.
- Sampler collection procedures.
- COC Records.
- Date sample shipped.

Any deviations from applicable TIs or the investigation-specific SAPs will be approved and documented in the field logbook during sampling and data collection operations. The Field Team leader or designee will be notified of deviations.

The original COC Records will accompany samples to the analytical laboratories. Upon receipt and login of the samples at the laboratory, the remaining sections of the COC Record (such as description of the sample condition at the time of receipt, assigned laboratory identification number, and any special conditions) will be completed. The original COC Record will be archived at the analytical laboratory in accordance with the laboratory's document retention requirements and the requirements herein.

6.2 Laboratory Data Documentation

Analytical laboratories performing work on this project will retain records of the analytical data for a minimum of 10 years after project completion. Analytical data will not be disposed of without TVA's consent. In addition, laboratory data will be provided to TVA in hardcopy or approved electronic form. TVA will retain data in accordance with TVA records management requirements. Laboratory data will not be disposed without specific approval from the TVA Legal Counsel and the TVA Technical Lead.

6.2.1 Laboratory Data Reporting/Deliverable Package

Analytical laboratories will report data at their standard TAT; generally, 10 business days from sample receipt at the laboratory for all chemical parameters. In some cases, expedited TATs are required. Results of sample chemical analyses are completed and results reported to TVA and the QA oversight consultant as a Level II report and EDD within 10 business days (refer to Attachment A for data deliverables requirements). Level IV data packages (refer to Attachment A for data deliverables requirements), in a hardcopy and/or electronic Adobe® Acrobat® portable document format (.pdf), will be submitted to TVA and the QA oversight consultant within approximately 20 business days from sample receipt at the laboratory. Radiological analysis results are completed and reported to TVA and the QA oversight consultant as a Level IV report and EDD within 45 business days.

Laboratories performing chemical analyses will be responsible for providing an EDD consistent with the Data Management Plan, as well as a Level II report and/or Level IV data package (see Attachment A). The deliverable package will contain final results (uncorrected for blanks and recoveries except where required by the referenced method), analytical method reference, sample results and detection limits, and results of field and laboratory QC samples. In addition, special analytical problems and/or any modifications of referenced methods will be noted in the Case Narrative of the laboratory report/data package. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method.

As a general statement, chemical analytical data will typically be reported as follows:

- Concentrations for aqueous samples are expressed in terms of weight per unit volume (such as milligrams per liter [mg/L] or micrograms per liter [µg/L]).
- Concentrations for chemical analyses of solid samples are expressed in terms of weight per unit weight of sample (such as milligrams per kilogram [mg/kg] or micrograms per kilogram [µg/kg]). Unless specifically directed otherwise, solid sample chemical analysis results will be reported on a dry-weight basis. The reporting basis for solid samples will be clearly indicated in the laboratory data package.
- Radiological activities are expressed in terms of picocuries per unit volume or weight (such as pCi/L or pCi/g). For solid samples, radiological activities are not corrected for sample moisture content.

Chemical analytical data will be reported in the units specified in the Method Analyte Groups (MAGs) to ensure consistent reporting among the contracted laboratories.

Chemical analytical laboratory data will be provided in the Level II report and Level IV data package formats presented in Attachment A. In general, the Level IV data package will include summary forms and raw data for calibrations, QC, and sample analyses. QC results reported will include a method blank, matrix spike/matrix spike duplicate (MS/MSD) samples, field QC samples, and laboratory control samples (LCSs). Sample chemical analyses data (both field and laboratory QC sample results) will also be provided in EDDs. The laboratory is responsible for reviewing the electronic data to ensure that these data are consistent with those presented in the laboratory report/data package. Data discrepancies between the EDD submission and laboratory report/data package, if any, will be reconciled at validation; the data validators will notify the contract laboratory and TVA so that the laboratory deliverables may be revised by the contract laboratory. In the event that revisions to Level II or Level IV data packages are required based on data validation, complete revised deliverables clearly stamped with revision number and date will be provided by the contract laboratory so that a final complete data package is archived for each sample submittal.

6.3 Record Keeping

Written and/or electronic records generated under the ALF EIP, including but not limited to notes, logbooks, reports, draft and final documents, and forms, are maintained by the originator for inclusion in the project file as appropriate. In addition, electronic files, including but not limited to draft and final documents, and laboratory analytical reports are maintained as part of the electronic project file.

Chemical analytical data for this project will be reported in both an EDD and an analytical data package. An EarthSoft EQuIS database will be used for processing, storage, and reporting of all data (historical and investigatory) to be used as part of the ALF EIP. To maintain uniformity and consistency among analytical laboratories, the EDD format for the transfer of data associated with the ALF EIP will be a complex EDD specification compatible with EQuIS. A simple EDD specification may be substituted for laboratories that do not possess the capabilities to generate a complex EDD or for analyses for which automated data review is not applicable (*e.g.*, percent ash analyses by polarized light microscopy). The EQuIS data transfer parameters are discussed further in the Data Management Plan. The EDD will be generated by the laboratories and will be used to facilitate loading the analytical data into the EQuIS Project Database.

Field data generated during the ALF EIP will also be stored in the EQuIS Project Database. A simple EDD specification will be utilized by the Field Team Leader (or designee) to submit field data to the EQuIS Project Database.

Analytical data packages will be prepared by the laboratory for sample analyses performed. A Limited data deliverable (Attachment A) in Adobe Acrobat .pdf and EQuIS EDD will be provided by the contract laboratory within the laboratory’s standard TAT for limited deliverables (approximately 10 business days from sample receipt for chemical analyses and approximately 40 business days from sample receipt for radiological analyses). Full deliverables (Attachment A) will be provided by the laboratory in an Adobe Acrobat .pdf electronic format for all analyses within the laboratory’s standard TAT for Full data deliverables (approximately 20 business days from sample receipt for chemical analyses and approximately 45 business days from sample receipt for radiological analyses).

6.4 Data Archival

Applicable electronic field and laboratory data collected during sampling will be archived electronically. Backup tapes containing databases and programs or software utilities will be maintained in a secure location. Hardcopy data, including but not limited to field logbooks, laboratory data deliverables, and data validation reports, will be archived in accordance with TVA's Document Control protocols. Formal records custody procedures will be maintained in accordance with TVA's Records Custody procedures.

7.0 SAMPLING PROCESS DESIGN

This section briefly outlines field investigation procedures for the ALF EIP. Detailed discussions of field protocol are provided in the various TIs developed for the project. In addition, detailed descriptions of field activities are provided in the investigation-specific SAPs.

Aqueous and solid samples may be collected in association with the ALF EIP. These samples will be subject to a variety of chemical, radiological, and physical analyses to support the objectives outlined in the EIP and associated investigation-specific SAPs.

Field investigation and sampling procedures will be conducted such that samples are representative of the media sampled and the resultant data can be compared to other data sets. Sampling schemes (as described in the associated investigation-specific SAPs) are designed to provide a statistically meaningful number of field sampling points and the rationale for the collection of these samples. A sufficient number of samples will be collected for each sampling program to adequately characterize the area and provide a sufficiently large data set such that statistical analyses can be performed. Field investigation and sampling methods will be conducted in accordance with the investigation-specific SAPs and associated TVA TIs, which include equipment requirements and decontamination procedures to meet the objectives of the project.

The investigative rationale for a specific sampling and analytical program is addressed in the investigation-specific SAPs. Sampling and monitoring activities are subject to the requirements set forth in the TVA TIs and this ALF QAPP. Investigation-specific SAPs will describe specific sampling and monitoring activities when QA requirements, more stringent than those presented herein, are required to support the sampling and monitoring projects.

The sampling design and execution for monitoring activities associated with the ALF EIP are described in the various program-specific SAPs. For some investigations it is anticipated that the sampling and monitoring activities will evolve in a phased approach as data are gathered under the planned investigations. As the sampling and monitoring programs are developed, additional SAPs and investigation-specific TIs may be prepared.

As the project progresses, the data generated will be used to evaluate sampling and analytical needs. Subject to regulatory approval, adjustments may be made to sampling schedules, analyte lists, and requested methods when supported by the results of field investigations.

Investigation-specific SAPs will present Site maps, including sampling locations (when applicable), for the various sampling and monitoring programs performed at the Site. Detailed descriptions of sampling process design and field sampling activities are provided in the investigation-specific SAPs. Field investigations will be addressed in investigation-specific SAPs.

8.0 SAMPLING METHODS REQUIREMENTS

Descriptions of the procedures for the sampling, identification, packaging, and handling of project samples; the decontamination of sampling equipment; and the calibration and maintenance of sampling equipment are presented in the associated TIs and the investigation-specific SAPs. An overview of sample identification, documentation, and custody as related to data collection activities is presented in Section 9.0.

8.1 Sample Containers, Preservation, and Holding Times

Sample container/media, preservation, and holding time requirements will be presented in the investigation-specific SAPs. Samples will be stored in accordance with the requirements set forth in the referenced analytical method and/or laboratory TIs.

Field samples will be contained and preserved in accordance with appropriate United States Environmental Protection Agency (US EPA) analytical method specifications which are cited in each SAP. Sampling containers and preservatives will be provided by the laboratory. In most cases, the supplied sampling containers will be pre-preserved by the laboratory prior to shipment. On an investigation-specific basis, samples may be filtered and/or preserved at the analytical laboratory. For chemical analyses, sample containers provided will be new pre-cleaned I-Chem® Series 300 (or equivalent). Samples will be placed in individual pre-cleaned containers for shipment to the laboratory.

Sample container orders, when shipped by the laboratory, will include a packing list that details the number and type of bottles shipped, the bottle lot numbers, chemical preservatives, and the packer’s signature. The COC Records will be completed by Field Sampling Personnel and returned to the laboratory with the samples. Sample containers will be individually custody-sealed and placed inside the sample cooler. After the cooler is sealed, sampling personnel will attach signed/dated custody seals to the outside of the cooler as described in TVA *Sample Labeling and Custody* TI (ENV-TI-05.80.02).

Samples will be stored according to the applicable storage criteria from the time of collection until the time of analysis by the laboratory. Field Sampling Personnel will keep samples cold by placing ice in the coolers in which samples will be stored until delivery to the analytical laboratory personnel. After receipt of the samples, it is the laboratory’s responsibility to store the applicable samples according to the applicable preservation conditions until preparation and analysis has been initiated.

Samples have a finite holding time (the time between sample collection, sample digestion, and sample analysis) to limit the potential for degradation of the analytes. The holding times for required analyses are measured from the verified time of sample collection. When possible, samples will be shipped by overnight carrier or delivered by same-day courier to minimize the time between collection and laboratory receipt.

8.2 Decontamination

Tools and equipment decontamination procedures are implemented to prevent cross-contamination of samples and to control potential inadvertent transport of hazardous constituents. Disposable sampling equipment will be utilized to the extent possible in an effort to limit the potential for cross-contamination. The non-disposable equipment will be decontaminated using the procedures described in the TVA *Field Sampling Equipment Cleaning and Decontamination* TI (ENV-TI-05.80.05) and/or the investigation-specific SAP.

9.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Field Sampling Personnel are responsible for the collection, description, documentation, labeling, packaging, storage, handling, and shipping of samples obtained in the field. These practices are necessary to ensure sample integrity from collection through laboratory analysis and data reporting. To demonstrate and document sample integrity aspects, information relative to the collected project samples will be described and thoroughly documented. Samples will be labeled, packaged, preserved, and shipped to the laboratories for analysis in appropriate sample containers, under the recommended temperature conditions with a COC Record documenting the time and day of sample collection.

Laboratory-supplied sample kits with custody seals, packing materials, sample containers, and preservatives will be used for project samples during sample collection and transport to the TVA-contracted laboratories. The sample containers and preservation requirements for samples collected under each investigation will be presented in Attachments E through H to this ALF QAPP.

COC Records will be assigned standardized identification numbers and task codes describing the intended purpose of the sampling event. Attachment D provides specific requirements for sample nomenclature for the ALF EIP.

Samples will be assigned identifications using the sample nomenclature scheme identified in Attachment D of this document. As additional site sampling and monitoring plans are developed, nomenclature will be developed in accordance with the sample locations and naming codes (when necessary) will be generated.

9.1 Sample Documentation

Field activity evidentiary files will be maintained by the Investigation personnel and will include information that defines the Project in its entirety, including but not limited to, the information below.

- Field logbooks.
- Field data sheets.
- Raw data.
- QC information.
- COC Records.
- Airbills (when used) for sample shipments.

- Photographs.

Field documentation procedures are described in the *Field Record Keeping* TI (ENV-TI-05.80.03) and in the investigation-specific SAPs.

9.1.1 Chain-of-Custody Record

A primary consideration for environmental data is the ability to demonstrate that samples have been obtained from specific locations and have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody while samples are in the laboratory's possession will be documented by maintaining a COC that records each sample and the individuals responsible for sample collection, shipment, and receipt at the project laboratory. Samples that are collected will be accompanied by a COC Record. An example COC Record is included in Attachment C. The following information will be recorded on the COC Record:

- Project name and number.
- Name of sampler.
- Sample identifier/name, location, date and time collected, and sample type.
- Analyses requested.
- Special instructions and/or sample hazards, if applicable.
- Signature of sampler in the designated blocks, including date, time, and company.
- Sample condition (including temperature) upon receipt as reported by the analytical laboratory.
- Signature of the laboratory receipt personnel in the designated blocks, including date, time, and company affiliation.

Original COC Records are transferred to the analytical laboratories such that sample custody is maintained through analysis and reporting. Copies of COC Records are maintained on site by the Field Team Leaders. Duplicates of COC Records are retained by the TVA Technical Lead and .pdf versions of COC Records are maintained by the Data Management Team as part of the Project File.

COC Records will reference defined MAGs to communicate sample analysis requirements to the analytical laboratories. MAGs identify the required analytical methods, parameter lists, and reporting units to ensure consistent reporting of data among multiple laboratories. In addition, MAGs enable automated data completeness evaluation and data verification upon receipt of electronic data. An overview of the data management process is provided in Section 15.0.

For samples collected for chemical, optical, or radiological analyses, field COCs are provided to the QA oversight consultant's Data Manager by the Field Sampling Personnel performing the sample collection. EQuIS field sample EDDs are subsequently created to facilitate completeness review upon laboratory submittal of the associated analytical data.

9.1.2 Sample Custody in the Field

The purpose of sample custody procedures is to document the history of samples (and sample extracts or digestates) from the time of sample collection through shipment and sample receipt, analysis, and disposal. A sample is considered to be in one's custody if one of the following conditions applies:

- The sample is in an individual's actual possession.
- The sample is in view after being in an individual's physical possession.
- It was in the physical possession of an investigator and then they secured it to prevent tampering; and/or
- It is placed in a designated secure area.

Each individual field sampler is responsible for the care and custody of the samples he/she collects until the samples are properly transferred to temporary storage or are shipped to the laboratory. The following COC procedures will be followed for samples submitted to the laboratory for analyses:

- Each individual field sampler is responsible for the care and custody of samples he/she collects until the samples are properly transferred (relinquished on the COC by Field Team Sampling Personnel) to another person ("acceptor" of the samples) or are shipped to the laboratory.
- A COC Record will be completed at the time of sample collection by the Field Sampling Personnel for each batch of samples submitted to the laboratory in accordance with the *Sample Labeling and Custody* Technical Instruction (ENV-TI-05.80.02). Field sampling logs may be used in the place of formal COCs in the field.
- If multiple coolers are needed, one COC Record will accompany each cooler that contains the samples identified on the COC.
- Sample coolers will be packed and sealed with custody seals for transport from field and shipment to laboratory in accordance with the *Handling and Shipping of Samples* Technical Instruction (ENV-TI-05.80.06).
- Each time a sample batch is transferred (Field Sampling Personnel relinquish custody to the laboratory or other sampling team personnel), signatures of the individuals relinquishing and receiving the sample batch, as well as the date and time of transfer, will be documented on the COC or courier documentation form. Note that commercial courier custody is tracked by commercial courier records and not by COC.
- A copy of the carrier air bill will be retained as part of the permanent COC documentation record.
- The laboratory will record the condition of the sample containers, and cooler temperature upon receipt, and record this information on a combination of sample receipt documentation including a sample receipt confirmation checklist and the COC. Documentation of sample preservation checks (where applicable) will be recorded in the sample preparation documentation.

Changes or corrections to the information documented by the COC Record (including, but not limited to, field sample ID or requested analyses) must be changed by marking through the incorrect information with a single strike through line and, dating, and initialing the change in accordance with the *Field Record Keeping* Technical Instruction (ENV-TI-05.80.03). If the request for a change or correction comes from the Field Team after the COC Records have been relinquished to the laboratory, a copy of the COC Record will be revised, initialed, and forwarded to the laboratory, where the revised version will supersede the original COC Record.

This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the Project File.

Sample coolers with appropriate custody seals will be shipped to the contract laboratory in a timely fashion to ensure proper thermal preservation and meet analytical method holding times.

9.2 Sample Packaging and Shipment

Samples will be packed and shipped to the laboratory in accordance with applicable U.S. Department of Transportation (US DOT) regulations, consulting corporate guidelines, and International Air Transport Association (IATA) standards (as detailed in the most current edition of *IATA Dangerous Goods Regulations* for hazardous materials shipments), as applicable.

Samples that are to be stored at a temperature < 6 degrees Celsius (°C) (not frozen) will be placed on wet ice within 15 minutes of sample collection and packaged with additional wet ice for shipment to the analytical laboratory. Samples that are shipped to the laboratory frozen will be packed with blue ice or dry ice for shipment to the analytical laboratory.

9.3 Sample Custody in the Laboratory

The following subsections describe the COC procedures associated with sample receipt, storage, tracking, and documentation by the laboratory.

9.3.1 Sample Receipt

A designated Laboratory Sample Custodian will be responsible for samples received at the laboratory. The Laboratory Sample Custodian will be familiar with custody requirements and the potential hazards associated with environmental samples. In addition to receiving samples, the Laboratory Sample Custodian will also be responsible for documenting sample receipt, maintaining samples at < 6 °C (or < -10°C for frozen samples) during the sample log-in process, storage at < 6 °C (or < -10°C for frozen samples) before and after sample analysis, and the proper disposal of samples. Upon sample receipt, the Laboratory Sample Custodian will:

- Inspect the sample containers for integrity and ensure that custody seals are intact on the shipping coolers. The temperature of the samples upon receipt and the presence of leaking or broken containers will be noted on the COC Record/sample receipt forms.
- Sign (with date and time of receipt) the COC/sample analysis request forms, thereby assuming custody of the samples and assign the laboratory sample identification numbers.
- Compare the information of the COC Record/sample receipt with the sample labels to verify sample identity. Any inconsistencies will be resolved through the Laboratory Coordinator before sample analysis proceeds.
- Store samples in accordance with Section 9.3.2.

The QA Oversight Manager and Laboratory Coordinator must be notified immediately via e-mail or documented telephone call when samples are received broken or improperly preserved. Samples received in a condition that may potentially impact results will be placed on hold pending direction from the QA Oversight Manager or Laboratory Coordinator. In the event that aqueous samples for metals analyses are received at pH > 2, acid preservative will be added in the originally received sample bottleware by the laboratory and the pH of the samples will be allowed to equilibrate in the originally received bottleware for a minimum of 24 hours prior to digestion. Sample preservation and equilibration will be fully documented via laboratory logbooks.

9.3.2 Sample Storage

Analytical samples will be stored in a locked facility and maintained within the appropriate temperature range as specified in US EPA SW-846 Chapter 3, or Table II of 40 CFR 136.3 sample storage requirements. The temperature will be monitored and recorded daily by laboratory personnel.

Required sample storage conditions are presented in Attachments E through H of this ALF QAPP.

9.3.3 Sample Tracking

Each sample will receive a unique laboratory sample identification number at the laboratory when the sample is logged into the laboratory information management system (LIMS).

Sample preparation/digestion records will be generated to fully document sample handling prior to analysis. Laboratory data will be entered on the sample digestion form and permanently recorded in a laboratory logbook.

The laboratory will maintain a sample tracking system that documents the following:

- Organization/individual who performed sample analyses.
- Date of sample receipt, extraction or digestion, and analysis.
- Names of Analysts.
- Sample preparation procedures.
- Analytical methods used to analyze the samples.
- Calibration and maintenance of instruments.
- Deviations from established analytical procedures, if applicable.
- QC procedures used to ensure that analyses were in control during data generation (instrument calibration, precision checks, method standards, method blanks, *etc*.).
- Procedures used for the calculation of precision and accuracy for the reported data.
- Statement of quality of analytical results.

9.4 Sample Archive

Upon request, unused portions of samples may be requested by TVA from the laboratory for archival. Archived samples will be shipped under COC and relinquished to the TVA Technical Lead or designee. The sample archive will be equipped to properly maintain thermal preservation of the samples and will be locked or in an access controlled locations such that sample custody is maintained.

Unused portions of samples collected in association with the ALF EIP may be returned to TVA for archive or disposal or may be disposed of by the contract laboratories. Archived samples will be cataloged and stored in an organized manner. In the event that project objectives are not met for a sample, any remaining portion with preparation/analytical holding time remaining may be retrieved and submitted to a TVA contracted laboratory for additional analysis.

10.0 ANALYTICAL METHODS REQUIREMENTS

Analytical methods cited in this ALF QAPP reference US EPA's *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846); US EPA Clean Water Act Test Methods; and *Standard Methods for the Examination of Water and Wastewater*. These and potentially other methods, constituents, and reporting limits for samples collected under this EI are presented in Attachments E through H of this ALF QAPP. Analytical methods will be selected based on the ability to detect constituents of concern at reporting limits sufficient to meet project requirements and quality objectives for precision, accuracy, and sensitivity.

10.1 Field Analysis

Field analyses will be conducted in accordance with the associated field sampling TIs and/or published field method as applicable. The results from field analysis are reviewed and stored electronically.

Detailed descriptions of field monitoring activities, the field analytical equipment, and the sampling equipment utilized to perform the field activities are provided in the investigation-specific SAPs and/or in the associated TVA TIs.

10.2 Laboratory Analysis

To support the objectives of the ALF EIP, the collected samples will be tested for the methods, constituents, and reporting limits presented in Attachments E through H of this ALF QAPP. Individual sample reporting limits may vary from the laboratory's routinely reported limits; this variance may be a result of dilution requirements, sample weight or volume used to perform the analysis, dry-weight adjustment for solid samples, the presence of analytical background contaminants, or other sample-related or analysis-related conditions. Additional analytical needs may be identified based on future project needs, and as such, the ALF QAPP and SAPs will be modified to document the QC requirements associated with these additional analyses.

Dissolved metals analysis of aqueous samples shall be performed on field-filtered (0.45-µm filter) select water samples. Alternatively, dissolved metals analysis of aqueous samples may be performed on a sample that has been filtered in the laboratory. In the event that laboratory filtration is required, sample aliquots collected for dissolved metals analyses will be preserved after filtration and these preserved aqueous samples will be allowed to equilibrate a minimum of 24 hours between sample preservation and digestion.

For some investigations, a filtered and nonfiltered sample aliquot may be submitted for all requested analytical parameters. In the event that the filtered and nonfiltered aliquots are not assigned distinct sample identifications (IDs), each parameter will be identified as either "total" (*i.e.*, nonfiltered) or "dissolved" (*i.e.*, filtered) in the project database.

The reporting limits indicated in Attachments E through H of this ALF QAPP shall represent the maximum reporting limits (not adjusted for sample weight/volume, dilution factors, and percent moisture for non-aqueous samples).

All analytical methods performed by the TVA-contracted laboratory must have valid method detection limit (MDL) studies and MDL verifications by matrix type, by preparation method, and by analytical method. MDL studies must include all preparatory and analytical processes used for the preparation and analysis of investigative samples. Formal MDL evaluations must be performed at the frequency dictated by the current US EPA-promulgated procedures or the current The NELAC Institute (TNI) laboratory accreditation standard or the frequency dictated below, whichever is more frequent. TVA's contracted laboratories will conduct MDL studies in accordance with the current TNI laboratory accreditation standard as described below.

The initial MDL study will include a minimum of seven spiked replicates prepared and analyzed in a minimum of three separate batches, spaced over the course of three separate calendar days. If an MDL is to be determined over more than one instrument, each instrument must have at least two analyses on two different calendar days. For an analyte to be considered detected during an MDL study it must meet the analytical method's qualitative identification criteria without any manual searching routines. Only analyses associated with acceptable initial calibration, continuing calibration, and batch QC can be used. The MDL based on spiked replicates will be calculated as follows:

$$MDL_s = t_{(n-1,1-\alpha=0.99)}S$$

Where: MDL_s = MDL based on analysis of replicate spikes,
t = Students 99th percentile single-tailed t-value and
S = the sample standard deviation of the replicate analyses.

If the calculated MDL_s for any analyte is less than 10% the concentration of the spiked concentration, repeat the study for that analyte at a lower spike concentration. If the calculated MDL_s is higher than the spiked concentration, the study must be repeated at a higher spike concentration from the original study.

In addition to the spiked samples, an MDL will be determined using method blank results (MDL_b). The initial MDL_b determined using the method blanks will be a minimum of seven method blanks prepared and analyzed in at least three separate batches, spaced over the course of three separate calendar days. If an MDL_b is to be determined over more than one instrument, each instrument must have at least two analyses on two different calendar days. For an analyte to be considered detected during an MDL study it must meet the analytical method qualitative identification criteria without any manual searching routines. Only analyses associated with acceptable initial calibration, continuing calibration, and batch QC can be used.

If the analytical system for which the MDL_b is being determined gives numeric results for every analysis, the MDL_b will be calculated as follows:

$$MDL_b = \overline{X} + t_{(n-1,1-\alpha=0.99)}S$$

Where: $\overline{X}$ = the mean of the method blank results,
t = Students 99th percentile single-tailed t-value and
S = the sample standard deviation of the replicate analyses.

If the analytical system for which the MDL_b is being determined gives censored results or otherwise gives numeric results for some, but not all method blanks:

- If fewer than 101 numeric method blank results are available, set the MDL_b to the highest method blank result.

- If more than 100 numeric method blank results are available, set the MDL_b to the level that is no less than the 99th percentile of the method blank results.

MDL_s and MDL_b must be compared and the higher value utilized for MDL reporting.

The MDL is to be verified annually through the quarterly analysis of standards spiked at the same concentration used to determine MDL_s. For verification analyses for a pooled MDL for more than one instrument, each instrument must have at least two analyses, prepared in different batches and analyzed on separate days. MDL verification analyses must meet the analytical method qualitative identification criteria, again without any manual searching routines. Only analyses associated with acceptable initial calibration, continuing calibration, and batch QC can be used.

On an annual basis, the MDL calculation is to be repeated using the results from the quarterly spiked samples and method blanks. The resulting MDL is to be compared to the initially derived MDL. If the repeated MDL is within a factor of 0.5 to 2.0 of the existing MDL, and fewer than 3% of the method blank results have numerical results above the existing MDL, then the initially derived MDL may be left unchanged. Otherwise, adjust the MDL to the new repeated MDL.

To add a new instrument, the new instrument must have at least two spike analyses and at least two method blanks. The new spike results would be combined with the existing results and a new MDL_s would be calculated. If the new MDL_s is within a factor of 0.5 to 2.0 of the existing MDL, then the initially derived MDL_s may be left unchanged. If all method blank analyses are below the existing MDL and the MDL_s meets the criteria described above, the MDL may be left unchanged. Otherwise, adjust the MDL to the new MDL. Once 6-months of blank data have been generated on a new instrument, MDLs will be evaluated to assess the need for adjustment.

The laboratory will perform a percent moisture analysis on solid samples where possible. Chemical analysis results for solid samples will be reported on a dry-weight basis unless specifically requested otherwise. Radiological activities and physical/optical analysis results will not be corrected for sample moisture. The reporting basis (wet-weight, dry-weight, *etc*.) will be maintained as an attribute of the result in the database.

11.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

This section describes the data objectives and associated data quality indicators used for the project. QA procedures are designed to ensure high quality for all environmental data associated with this project.

The subsections below are intended to provide an introduction to site-wide QA objectives and protocols and set forth minimum requirements for the ALF EIP. Specific quantitative QA objectives for each investigation are presented in Attachments E through H of this ALF QAPP.

11.1 General

There are four levels of data quality that have been developed for this project. The data quality levels defined below provide general indications of measurement defensibility. The data quality level of a particular measurement is used to determine whether that measurement is sufficient to meet the program-specific DQOs.

Field Screening – This level is characterized by the use of portable analytical instruments (such as temperature probe) which can provide real-time data to assist in the optimization of sampling locations and health and safety support. Data can be generated regarding the presence or absence of certain contaminants at sampling locations.

Field Analyses – This level is characterized by the use of portable analytical instruments, which can be used on site (such as Hydrolab® instrument) or in a mobile laboratory stationed near a site. Depending on the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.

Screening Data with Definitive Confirmation – These data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provides analyte identification and quantitation, although the quantitation may be relatively imprecise. At least 10% of the screening data will be confirmed using appropriate analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data is not considered to be data of known quality.

Definitive Data – These data are generated using rigorous analytical methods, such as approved US EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. These methods produce tangible raw data (such as chromatograms, spectra, or digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated by an on-site or off-site laboratory, as long as the QA/QC requirements are satisfied. To be definitive, either the analytical or total measurement error must be determined.

Field Screening data will be obtained with portable instruments, such as conductivity meters, temperature probes, and may be used for health and safety and field operational monitoring. In addition, these instruments and field test kits may be used to produce Field Analysis data to determine where to collect a sample to assess impacts and identify which samples are to be designated for laboratory confirmation analyses.

Field pH measurements for aqueous samples will be performed in accordance with TVA TI *Field Measurement Using a Multi-Parameter Sonde* (ENV-TI-05.80.46), U.S. EPA SW-846 Method 9040C, and the associated investigation-specific SAP. Field pH meters used for collecting aqueous sample data will also meet the calibration requirements of these procedures including calibration adjustment to account for buffer temperature during calibration. Field-collected pH measurements for aqueous samples will be considered field analysis data and are appropriate for quantitative use. Field pH measurements for soil samples will be conducted using pH kits or equivalent with confirmation samples submitted to the fixed-base analytical laboratory for definitive analysis.

Attainment of qualitative data indicators is assessed by monitoring QA measures, such as precision, accuracy, representativeness, comparability, and completeness, as discussed in Section 19.0. Specific qualitative criteria for the chemical analyses to be performed in association with the ALF EIP are presented in Attachments E through H of this ALF QAPP. The objectives associated with accuracy and precision of laboratory results are assessed through an evaluation of the results of QC samples. The accuracy of field measurements will be assessed by calibration, as described in the associated field TIs.

11.2 Field and Laboratory Quality Control Samples

The quality of data collected in the field will be controlled, monitored, and verified by maintaining site logs, by documenting field activities, and by collecting and analyzing of QC samples concurrently with investigative samples. Field and laboratory QC samples will be used to assess accuracy and precision for chemical analyses to gauge both field and laboratory activities. Further discussion and equations for determining precision and accuracy may be found in Section 19.0 of the ALF QAPP. In addition, specific requirements for comparability, completeness, and representativeness of field and laboratory QC samples may be found in Section 19.0 of the ALF QAPP. QC samples will be used to assess laboratory performance and gauge the likelihood of cross-contamination associated with both field and laboratory activities.

The subsections below apply to chemical analyses performed on aqueous and solid samples associated with the ALF EIP.

QC samples will be collected and analyzed in conjunction with samples designated for laboratory analysis. The QC checks that may be instituted by field and laboratory personnel may include, but not be limited to, the following:

- Equipment Rinsate Blanks.
- Field Blanks
- Filter Blank Samples
- Field Duplicate Samples.
- MS/MSD Samples.
- Laboratory Method Blanks.
- LCSs/Laboratory Control Sample Duplicates (LCSDs).
- Laboratory Duplicate Samples.

These types of QC samples are discussed in the following subsections. Field QC samples will be submitted to the laboratory using the same information as the associated investigative samples.

Field QC samples will be collected at the frequency specified on Table 11-1. Laboratory QC samples will be analyzed at the frequency specified in the associated laboratory SOPs and referenced analytical methods. The analysis frequencies specified below are considered the minimum required frequencies; investigation-specific Work Plans and/or SAPs and/or TIs may require more frequent collection of field QC samples.

Table 11-1. Field Quality Control Sample Minimum Frequency

Field QC Sample	Aqueous Sampling Frequency	Solids Sampling Frequency
Equipment Rinsate Blank	1 per sampling event	1 per 20 field samples
Field Blank	1 per day of sampling activity per sampling team	N/A
Filter Blank[c]	1 per sampling event when dissolved parameters are collected for analysis and 1 per lot of filters used	N/A
Field Duplicate[a]	1 per 20 field samples; minimum of 1 per sampling event	1 per 20 field samples; minimum of 1 per sampling event
MS/MSD or Laboratory Duplicate[b]	1 per 20 field samples; minimum of 1 per sampling event	1 per 20 field samples; minimum of 1 per sampling event

N/A Not Applicable

[a] True field duplicate samples are not feasible for whole ash/sediment cores (depending on volume recovered); consequently, co-located samples will be collected when possible.

[b] Laboratory duplicate analyses will be performed in lieu of MS/MSD for parameters not amenable to spiking (*e.g.*, pH, total dissolved solids [TDS]).

[c] Filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

11.2.1 Equipment Rinsate Blanks

Collection and analysis of equipment rinsate blanks are performed to assess the efficiency of field equipment decontamination procedures in preventing cross-contamination between samples. Laboratory-supplied analyte-free reagent water will be poured into/through/over clean (decontaminated) sampling equipment used in the collection of investigative samples and subsequently collected into prepared sample bottles. The rinsate blank will be analyzed for the same parameters as the investigative samples.

11.2.2 Field Blanks

Field blanks are used to assess the potential for cross-contamination of aqueous samples during the sampling process due to ambient conditions and to validate the cleanliness of sample containers. The collection of field blanks is recommended if known or suspected sources of contamination are located within close proximity to the sampling activities. Field blank samples will be generated using laboratory-supplied deionized water.

11.2.3 Filter Blank Samples

Filter blanks are samples of laboratory-supplied deionized water passed through in-line filters used in the collection of dissolved metals (and other analytes requested on a filtered basis).

11.2.4 Field Duplicate Samples

Field duplicate samples are used to check for sampling and analytical error, reproducibility, and homogeneity. For soil samples, the duplicate will be obtained by collecting a sample from an area adjacent to the routine sample (that is, co-located sample), or by collecting a separate aliquot of homogenized soil from within the same core, whichever is more appropriate for the type of sample/sampling technique (surface or subsurface sediment sample). Duplicates will be analyzed for the same parameters as the associated investigative samples.

11.2.5 Matrix Spike/Matrix Spike Duplicate

MS/MSD samples are investigative samples to which known amounts of compounds are added in the laboratory before extraction/digestion and analysis. The recoveries for spiked analytes can be used to assess how well the method used for analysis recovers target analytes in the site-specific sample matrix, a measure of accuracy. Additionally, the relative percent difference (RPD) between the results of the MS and MSD provide a measure of precision. In the event that sufficient sample volume to perform MS/MSD analyses is not provided, the laboratory may substitute LCS/LCSD analyses (see Section 11.2.7).

For parameters that are not amenable to spiking (*e.g.*, pH, total dissolved solids [TDS]), a laboratory duplicate (see Section 11.2.8) will be used to demonstrate matrix-specific precision.

11.2.6 Laboratory Method Blanks

Method blanks consist of analyte-free materials (such as reagent water) and reagents (such as sodium sulfate) that are prepared in the same manner as the associated samples (digested, extracted, *etc*.) and that are analyzed and reported in the same manner as the associated investigative samples. Laboratory method blanks will be performed as indicated in the analytical method and in the associated laboratory SOPs.

11.2.7 Laboratory Control Samples/Laboratory Control Sample Duplicates

An LCS is a sample of laboratory certified material that is fortified (spiked) with the analytes of interest or a certified reference material that is prepared and analyzed in the same manner as investigative samples. The LCS must be from a source that is different from the source of the initial calibration standards (that is, second-source). LCS data are used to monitor analytical accuracy and laboratory performance. LCSs are prepared and analyzed with each preparation batch of 20 (or less) field samples. In the event that insufficient sample volume to perform MS/MSD analyses (Section 11.2.5) is received, an LCSD will be prepared to assess laboratory precision. LCS will be performed at a minimum frequency of 1 per batch of 20 (or fewer) field samples or as required by the referenced analytical method and as specified in the associated laboratory SOPs.

11.2.8 Laboratory Duplicate Samples

A laboratory duplicate (LD) sample is obtained by splitting a field sample into two separate aliquots and performing separate preparation and analysis on the respective aliquots. The analysis of laboratory duplicate samples monitors precision; however, precision may be affected by sample homogeneity, particularly in the case of solid samples. Laboratory duplicates will be analyzed and reported with every batch of 20 (or fewer) field samples. MSDs (see Section 11.2.5) may be substituted for laboratory duplicates for inorganic analyses. The laboratory will utilize a project sample for the laboratory duplicate in every batch that includes project samples.

12.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

12.1 Field Equipment

Equipment failure will be minimized by routinely inspecting field equipment to ensure that it is operational and by performing preventive maintenance procedures. Field sampling equipment will be inspected prior to sample collection activities by the Field Sampling Personnel and necessary repairs will be made prior to use of the sampling equipment. Routine preventive maintenance procedures, at a minimum, will include removal of foreign debris from exposed surfaces of the sampling equipment, storage of equipment in a cool dry place protected from the elements, inspections of the equipment each day prior to use, and verification of instrument calibrations as described in Section 13.0.

Field equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be obtained from a contracted equipment supplier. All equipment will be serviced in accordance with the manufacturer's specified recommendations or written procedure based on the manufacturer's instructions or recommendations. Maintenance will be performed in accordance with the schedule specified by the manufacturer to minimize the downtime of the measurement system. Maintenance work will be performed by qualified personnel.

Field equipment will be maintained in good working order to minimize downtime while fieldwork is in progress. Field equipment will be maintained under service contract for rapid instrument repair or provision of backup instruments in the case of instrument failure.

Non-routine maintenance procedures require field equipment be inspected prior to initiation of fieldwork to determine whether or not the equipment is operational. If not operational, the equipment will be serviced or replaced by a contracted equipment provider. Batteries will be fully charged or new, as applicable.

The ability to collect valid samples requires that field equipment be appropriately cleaned and maintained. The elements of an effective maintenance program are identified below.

- Pre-cleaned or certified-clean equipment.
- Spare parts or service contract for equipment repair or replacement.
- Contingency plan.
- Maintenance and repair of non-dedicated equipment.

12.2 Supplies and Consumables

Field supplies and consumable items (including, but not limited to, pre-cleaned containers, preserved containers, tubing, and filters) will be inspected upon receipt. Certificates of cleanliness for consumables provided by the laboratory will be retained on file at the laboratory. Chemical preservatives provided in pre-preserved containers will be certified by the laboratory prior to use. Certificates of cleanliness for supplies and lot numbers of supplies obtained by the Field Team will be retained by Investigation personnel as part of the project records. All supplies and consumable materials will be certified clean to levels sufficient to meet data objectives for the associated investigation.

12.3 Laboratory Equipment

The ability to generate valid analytical data requires that analytical instrumentation be properly maintained. The laboratory will be responsible for appropriate maintenance for major instruments. The elements of an effective maintenance program are identified below and discussed in the following subsection:

- Instrument maintenance logbooks.
- Instrument maintenance and repair.
- Available spare parts.
- Contingency plans.

Periodic preventive maintenance is required for sensitive equipment. Instrument manuals will be kept on file for reference when equipment needs repair. The troubleshooting sections of factory manuals may be used to assist personnel in performing maintenance tasks.

Major instruments in the laboratory are covered by annual service contracts with manufacturers or other qualified personnel (internal or external). Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument.

The calibration and maintenance sections of the laboratories' SOPs will establish the schedule for servicing critical items to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule and will promptly arrange any necessary service. Qualified personnel will perform the required service.

12.3.1 Instrument Maintenance Logbooks

In the laboratory, each analytical instrument will be assigned an instrument logbook. Maintenance activities will be recorded in the instrument logbook and the information entered will include:

- Date of service.
- Person performing the service.
- Type of service performed and reason for service.
- Replacement parts installed (if applicable).
- Miscellaneous information.

If service is performed by the manufacturer or its representative, a copy of the service record will be inserted into the page immediately following the logbook page where the above-cited information has been entered.

12.3.2 Instrument Calibration and Maintenance

An overview of the routine calibration procedures used for analytical instrumentation is presented in Section 13.0. Preventive maintenance and calibration by manufacturer service representatives will be provided on a routine basis.

In addition to maintenance by manufacturer service representatives, procedures for routine maintenance in accordance with manufacturer specifications for each analytical instrument will be followed by the laboratory. These procedures will include maintaining inventories of spare parts used routinely (such as spare torches for inductively coupled plasma/mass spectrometry [ICP/MS] instruments). Instrument operators have the responsibility to ensure that an acceptable inventory of spare parts is maintained.

Instrument calibration and maintenance procedures will be conducted in accordance with the laboratory's QA Program and the specific calibrations sections of the laboratory's analytical SOPs.

13.0 INSTRUMENT CALIBRATION AND FREQUENCY

This section provides the requirements for calibration of measuring and test equipment/instruments used in field sampling and laboratory analysis. The calibration procedures stipulated in the ALF QAPP are designed to ensure that field equipment and instrumentation are calibrated to operate within manufacturer specifications and that the required traceability, sensitivity, and precision of the equipment/instruments are maintained. Measurements that affect the quality of an item or activity will be taken only with instruments, tools, gauges, or other measuring devices that are accurate, controlled, calibrated, adjusted, and maintained at predetermined intervals to ensure the specified level of precision and accuracy.

In general, instrument calibration will be conducted in accordance with manufacturer's recommendations, method requirements, and field TIs or laboratory SOPs.

13.1 Field Equipment Calibration and Procedures

Field instruments that may be used include, but are not limited to, the following:

- Multi-parameter Sonde Water Quality Meter.
- Oxidation Reduction Potential Meter.

- Dissolved Oxygen Meter.
- Water Flow Meter.
- Depth-to-Water Level Meter.
- Turbidimeter.

All field analytical equipment used to conduct monitoring will be calibrated/standardized daily prior to use. The calibration/standardization procedures for field instrumentation are described in the calibration section of the applicable field TIs. The calibration/standardization acceptance criteria for field instruments are provided in the applicable TVA TIs.

Personnel performing instrument calibrations/standardizations shall be trained in its proper operation and calibration. Records of instrument calibration/standardization will be maintained by the Field Team Leader and will be subject to audit by the Field Oversight Coordinator or designee. The Field Team Leader will maintain copies of the instrument manuals on site.

The calibration records will include documentation of the following information:

- Instrument name and identification number.
- Name of person performing the calibration.
- Date of calibration.
- Calibration points.
- Results of the calibration.
- Manufacturer lot number of the calibration standards.
- Expiration dates for the calibration standards, when applicable.

Field equipment will be properly inspected, charged, and in good working condition prior to the beginning of each working day. Prior to the start of each working day, the Field Team Leader will inspect equipment to ensure its proper working condition. If equipment is not in the proper working condition, the Field Team Leader must repair or replace the equipment prior to the start of field activities. Field equipment and instruments will be properly protected against inclement weather conditions during the field work. At the end of each working day, field equipment and instruments will be properly decontaminated, taken out of the field, and appropriately placed for overnight storage and/or charging.

Field-collected pH measurements for aqueous samples will be considered field analysis data and are appropriate for quantitative use. Field-collected pH measurements for solid samples will be considered field screening data. Field pH measurements for aqueous samples will be conducted using calibrated instrumentation sufficient to meet the requirements of SW-846 Method 9040C. In addition to the TVA and method requirements, post-calibration checks will be performed on pH 4.0 and pH 10.0 buffer solutions. All post-calibration checks (pH 4.0, 7.0, and 10.0) will be subject to an acceptance criterion of ±0.05 pH units. Aqueous sample pH measurements will not be conducted until the pH meter is calibrated within these acceptance criteria. Field pH measurements for solid samples will be conducted using pH test kits or equivalent; samples will be subsequently submitted to a fixed-base laboratory for definitive pH analysis.

Dissolved oxygen meter calibration will be conducted using a single-point water-saturated air method in accordance with the instrument manufacturer’s recommendations.

Calibration checks may suggest the need for maintenance or calibration by the manufacturer. Field instruments that do not meet the calibration requirements will be taken out-of-service until acceptable performance can be verified. Maintenance will be performed when the instrument will not adequately calibrate. Maintenance of field equipment will be noted in an instrument logbook or field notebook.

Field equipment calibration is addressed in greater detail in the TIs associated with each field investigation or monitoring activity.

13.2 Laboratory Equipment Calibration

Instruments and equipment used in the laboratory will be controlled by a formal calibration program as described in the laboratory's Quality Assurance Manual. The program will verify that the equipment has the proper calibration range, accuracy, and precision to generate data comparable with specific requirements. Calibration will be performed by laboratory personnel experienced in the referenced methods for the analysis of project samples for the constituents of concern.

Instrument calibration procedures and corrective actions are described in the calibration section of the associated laboratory SOP. At a minimum, laboratory instrument calibration will be performed in accordance with the associated technical and quality control requirements specified in the method applicable to the associated SAPs.

The laboratory will provide all data and information to demonstrate that the analytical system was properly calibrated at the time of analysis, including: calibration method, required frequency, source of standards, response factors, linear range, check standards, and applicable control limits, as part of the data deliverables.

Before any instrument is used as a measuring device, the instrument's response to reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. Preparation of reference materials used for calibration will be documented in a laboratory notebook.

The two types of laboratory instrument calibration are initial calibration and continuing calibration verification. Initial calibration procedures establish the calibration range of the instrument. Typically, multiple analyte concentrations are used to establish the calibration range and calibration data. The laboratory evaluates the resulting calibration data as detailed in the calibration section of the associated SOP.

Continuing calibration verification usually measures the instrument's response to fewer calibration standards and requires instrument response to fall within certain limits of the initial measured instrument response. Continuing calibration verification may be used within an analytical sequence to verify stable calibration throughout the sequence and/or to demonstrate that instrument response did not drift during a period of non-use of the instrument.

The QA measures in the calibration section of the associated laboratory SOP will be used for calibration, calibration verification, and subsequent sample analyses. In addition, the following procedures will be used for the calibration of balances and thermometers.

Laboratory balances will be calibrated and serviced annually by a certified contractor. Balances will undergo a calibration check prior to use each day using multiple S-Class or equivalent class weights that bracket the usage range. A record of calibrations and daily checks will be documented.

Oven and refrigerator thermometers will be calibrated annually against a National Institute of Standards and Technology- (NIST-) certified thermometer in the range of interest. Annual calibrations will be documented. Daily oven and refrigerator readings will be recorded. Thermometers must be tagged with any applicable correction factors.

Records will be maintained as evidence of required calibration frequencies, and equipment will be marked suitably to indicate calibration status. If marking on the equipment is not possible, records traceable to the equipment will be readily available for reference.

14.0 DATA ACQUISITION REQUIREMENTS FOR NON-DIRECT MEASUREMENTS

Historical and legacy data will be gathered and evaluated for acceptability prior to use in the ALF EIP and inclusion in the EAR. Historical and legacy data may be procured from several sources, including TVA and TDEC records or TVA-led investigations performed outside the scope of the ALF EIP. Historical and legacy chemical data of known quality/defensibility may be used quantitatively as supplemental information to design specific investigation or for human health and ecological risk assessments. Chemical data are considered of known quality/defensibility if sample collection information and data deliverables are available to substantiate the reported analytical results. Historical and legacy data of unknown quality may be used for qualitative purposes.

Historical and legacy geotechnical data of known quality/defensibility may be used quantitatively as supplemental information to planned investigations under the ALF EIP. The quality/defensibility of geotechnical data will be determined by qualified personnel (*i.e.*, Professional Engineer or Professional Geologist) depending on the type of data requiring evaluation. Generally, these data will be compared against changes in site conditions, changes in the state of practice (*e.g.,* revisions/updates to standard methods), and changes in governing standards (*e.g.*, technical standards or professional guidelines) since the data were generated and also will be compared to more recently collected data for consistency of results.

Historical and legacy data will be transmitted in its original format whenever possible. In addition, raw data and other supporting documentation is acquired and may be validated if appropriate or feasible.

Historical and legacy data that are determined to be intended for quantitative use will be subjected to a formal critical review process. Historical data will minimally be subjected to a reasonability review to identify potentially suspect data, apparent anomalies, or data that are not representative of current site conditions. Additional evaluation and/or validation may be conducted following the reasonability review; the level of review and validation conducted will be dependent on the data type, availability of supporting documentation, and criticality of the dataset for completing project objectives. In the event that historical or legacy data cited in the EIP cannot be substantiated, the data may not be suitable to support certain aspects of the investigation, and new data may be collected to supplement the historical/legacy data.

TVA, QA Oversight, and Investigation personnel subject-matter experts will cooperatively develop formal criteria for evaluating historical data sets for potential quantitative use in the EAR.

15.0 DATA MANAGEMENT

A comprehensive Data Management Plan will be developed for all data generated and used under the TVA Multi-Site Order. Consolidated management of data related to the Order will ensure that environmental data associated with the project are appropriately maintained and accessible to data end users. The Data Management Plan will provide a basis for supporting a full technical data management business cycle from pre-planning of sampling events to reporting and analysis with a particular emphasis on ensuring completeness, data usability, and most importantly defensibility of the data.

Historical data and data generated from EI collection events at each facility addressed in the Order will be consolidated in the single EQuIS database. The EQuIS database will implement QA procedures at each step in the data transfer process to ensure that a complete, correct data set is maintained. A detailed description of the various elements of the data management program is presented in the Data Management Plan. In addition, the Data Management Plan describes sample planning and tracking process and details the flow of field and laboratory data into the project database. Finally, the Data Management Plan describes the process by which errors in data already reported in the project database are rectified and how those changes are managed and documented.

16.0 ASSESSMENTS AND RESPONSE ACTIONS

The primary goal of the ALF EIP is to ensure that project data objectives are met and that defensible, high-quality, analytical data are generated for use decision-making processes. The ALF EIP includes systems and performance audits to ensure that established QA procedures are properly implemented.

The ALF QAPP will be distributed to each consultant and contractor responsible for the collection, generation, and interpretation of field and analytical data. The QA Oversight Manager or designee will be responsible for ensuring that necessary revisions are made so that the QAPP is up-to-date with actual practices and will ensure that revisions and updates are provided to everyone on the distribution list. The document control format used in the ALF QAPP will identify the revision number and revision date. A revision history that identifies each revision and a summary of the revision will be maintained.

16.1 Field Activities

Field QA will include (but not be limited to) the following:

- Instrument calibration.
- Documentation of sample collection and field conditions.
- Adherence to COC procedures.
- Adherence to the ALF QAPP, the investigation-specific SAPs, and the associated field TIs.
- Collection of field QC samples.

The QA review for usability of objective field data will be performed at two levels. For the first level, data will be reviewed at the time of collection by following SAPs and TVA TIs. For the second level, after data reduction to table format or arrays, the data will be reviewed for inconsistent values.

Any inconsistencies identified during data review will be investigated by the Field Team Leader. When possible, the Field Team Leader will seek clarification from the Field Sampling Personnel responsible for collecting the data. Resolution of discrepancies will be documented using the corrective action process detailed in Section 16.4.

Field data will be reviewed for reasonableness and completeness. In addition, random checks of sampling and field conditions will be made to check recorded data at that time to confirm the recorded observations. Whenever possible, peer review will also be incorporated into the QA review process in order to maximize consistency among Field Sampling Personnel.

Any observed discrepancies between the COC Record and the samples received will be documented by the laboratory, and the TVA Technical Lead, QA Oversight Manager, and the Field Team Leader will be contacted for resolution.

The field COC Record information will be initially keyed into and maintained in the laboratory's database. A copy of the laboratory's COC Record, referred to as sample receipt confirmation, will be sent to the QA Oversight Manager and Data Manager following sample login for verification of properly entered and COC Record requests and information such as sample identification numbers, analyses requested, and the quantity of samples. In case of discrepancies between the COC Record and the sample receipt confirmation, the appropriate revisions will be communicated to the laboratory for the appropriate COC Record corrections. Corrected information on the COC Record will be recorded into the project data management system.

16.2 Laboratory Analysis

Internal laboratory QA will consist of the following:

- Instrument performance checks.
- Instrument calibration and calibration verification.
- Retrieval of documentation pertaining to instrument standards, samples, and data.
- Adherence to the ALF QAPP and the associated laboratory SOPs.
- Documentation of sample preservation, transport, and analytical methodology.
- Adherence to the analytical methodology (at a minimum).
- Analysis of QC samples (discussed in Section 11.2).

The samples received by the laboratory will be handled in accordance with internal laboratory QC procedures. The laboratory's deliverables, on submission to Data Validators, will be verified and/or validated with guidance from the National Functional Guidelines. Data package completeness will be assessed and missing or incomplete information will be obtained from the laboratory. Any incorrect data will be corrected. Data usability will be evaluated and appropriate qualifiers will be added to the database. Any data deemed unreliable by data validation efforts due to imprecision, holding time exceedances, and failure of relevant QC measures will be qualified appropriate and/or not utilized for the project.

16.2.1 Data Reduction

Data reduction is performed by the individual Analysts and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. Data reduction complexity is dependent upon the specific method and the number of discrete operations (extractions/digestion, dilutions, and levels/concentrations) involved in obtaining a sample that can be measured.

For analytical methods, sample response will be applied to the average response factor or the regression line to obtain an initial raw result, which will then be factored into equations to obtain the estimate of the concentration in the original sample. Rounding will not be performed until after the final result has been obtained to minimize rounding errors; results will not normally be expressed in more than three significant figures.

Copies of raw data and calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

The laboratory data reduction process is described in detail in the associated laboratory SOPs.

16.2.2 Laboratory Data Review

System reviews are performed at all levels. The individual analyst continuously reviews the quality of data through calibration checks, QC sample results, and performance evaluation (PE) samples. These reviews will be performed prior to submission to the Laboratory Project Manager or designee.

Criteria for analytical data review/verification include checks for internal consistency, transmittal errors, laboratory protocol, and laboratory QC. QC sample results and information documented in field notes will be used to interpret and evaluate laboratory data. The Laboratory QA Department will independently conduct a complete review of selected reports to confirm analytical results.

The laboratory will complete data verification procedures, including:

- Verifying analyses requested were analyses performed.
- Preliminary data proofing for inconsistencies; investigation and corrections, where possible.
- Reviewing laboratory data sheets for reporting/detection limits, holding times, surrogate recovery performance, and spike recovery performance.
- Double-checking computerized data entry, if applicable.

The Laboratory Project Manager or designee will review data for consistency and reasonableness with other generated data and determine whether project requirements have been satisfied. Selected hardcopy output of data will be reviewed to ensure that results have been interpreted correctly. Unusual or unexpected results will be reviewed, and a determination will be made as to whether the analyses will be repeated. In addition, the Laboratory Project Manager or designee may recalculate selected results to verify the calculation procedure.

The Laboratory QA Officer will independently conduct a review of the Project data to determine project requirements have been met. Discrepancies will be reported to the Laboratory Project Manager or designee for resolution.

Prior to final review/signoff by the Laboratory Project Manager or designee, the laboratory personnel will verify that the report deliverable is complete and in proper format, screen the report for compliance to laboratory and ALF QAPP requirements, and ensure that the Case Narrative addresses any noted deficiencies. The Laboratory Project Manager or designee will perform the final laboratory review prior to reporting the results to the QA oversight consultant and TVA. Any discrepancy noted during laboratory review that results in sample reanalysis or data correction must be documented using the corrective action procedure addressed in Section 16.4.

16.3 Performance and System Audits

Internal audits will be initiated by the QA Oversight Manager at the discretion of the TVA Technical Lead. Internal audits may be conducted based upon issues identified during various other assessment activities. The internal systems and performance audits will be planned and conducted by the QA Oversight Manager or designee or other appropriate QA Program personnel with the experience and competency to perform the audits/assessments. As part of the planning process for conducting internal audits, internal audits or assessments will first be scheduled. Next, the Audit Team will be identified, and the pertinent documentation and procedures relevant to the audit will be obtained and reviewed by the Audit Team. Internal audits may be announced or unannounced. The Audit Team members will hold a minimum of a Bachelor’s degree in a scientific discipline and have 5 or more years of QA and on-site laboratory auditing experience. As indicated in Section 2.0, the QA Oversight Manager holds overall authority for the project QA Program and maintains that authority independently from the operational/production aspects of the project.

Documentation of systems and performance audits and any resulting corrective actions will be maintained as part of the Project File. Audit documentation will be reported to the TVA Technical Lead.

16.3.1 Performance Audits

Performance audits are quantitative evaluations of data quality produced by a particular activity or function. Performance audits of the participating laboratories performing chemical analyses of project samples may be conducted through the submission and analysis of performance evaluation samples.

The QA Oversight Manager or designee will coordinate the manufacture and submission of performance audit samples to the laboratory. A TNI-approved performance testing sample provider will be used to obtain the performance evaluation samples. PE sample studies will be conducted at the discretion of the TVA Technical Lead for TVA contract laboratories analyzing aqueous and solid samples associated with the ALF EIP. The performance evaluation sample matrices and requested analytes will be determined based on the nature of the work performed by that laboratory for the project.

Upon receipt of results from the performance evaluation study analyses, the QA Oversight Manager or designee will evaluate the data relative to the certified “true values” and will prepare a comprehensive report (including a discussion of non-analytical issues, such as data package preparation and presentation). If multiple laboratories are included in the performance evaluation study, a statistical evaluation of the results will be performed and a simple fencepost test will be conducted for each analyte to determine outliers; a set of warning limits and acceptance limits (based on the set of data excluding outliers) will be generated for the analytes. The performance evaluation study report will contain a detailed account of any results that are outside of the established acceptance limits. Laboratories will be contacted to explain discrepancies between the reported concentrations and the “known” (true) concentrations of the analytes in the performance evaluation samples and to provide corrective actions in accordance with the corrective action process described in Section 16.4. Performance evaluation sample documentation, inclusive of corrective action responses, will be maintained as part of the Project File.

16.3.2 System Audits

System audits entail on-site observation and evaluation of participating laboratories and field sampling activities for compliance with the ALF QAPP, TIs, and/or investigation-specific Work Plans and/or SAPs. Prior to conducting an on-site audit, the Auditor will conduct a thorough examination of procedures and records. These on-site audits will also include verification of effectiveness of implemented corrective actions.

The system audits will address both field and laboratory activities, including a review of personnel qualifications, equipment, documentation, sampling techniques, analytical methods, and adherence to QA procedures. Each laboratory has its own QA Plan; therefore, the laboratory audit activities under the QAPP will entail a general review of laboratory QA practices.

Systems audits of laboratories conducting chemical analyses of project samples will be performed by the QA Oversight Manager or designee. Field audits will be conducted by the Field Oversight Coordinator or designee.

On-site audits of laboratories analyzing samples associated with the ALF EIP will be conducted at the discretion of the TVA Technical Lead. Each laboratory will be audited on an annual basis or more frequently as directed by the TVA Technical Lead. Field activities will be subjected to assessments and/or surveillances on a regular basis as new Field Sampling Personnel, new procedures, or new sampling activities are performed. In addition, the Field Oversight Coordinator may observe sampling events as appropriate given the sensitivity of the samples collected.

16.4 Feedback and Corrective Action

In general, feedback and corrective action processes for the ALF EIP will be conducted in accordance with TVA’s *Corrective Action Program*. TVA’s Corrective Action Program includes various pathways depending on the nature and severity of the issue identified. Issues will be resolved using the lowest-level pathway that adequately identifies and addresses the cause of the non-conformance or deficiency and prevents recurrence.

16.4.1 Feedback Mechanism

There are mechanisms within the project structure that allow for the identification, feedback, and control of any non-conformances or deficiencies. In general, the technical personnel involved with the project are responsible for reporting suspected technical non-conformances through standard communication channels established by the organizational structure. In the same manner, project personnel are responsible for reporting suspected QA non-conformances.

Feedback will be provided to laboratory personnel and the field team by the TVA Technical Lead, QA Oversight Manager, and/or Investigation Project Manager. Laboratories may receive feedback based on systems and performance audits and ongoing data validation. In addition, laboratories may provide feedback to the QA Oversight Manager. Documentation of feedback will be maintained in the Project File.

16.4.2 Corrective Action for Field Activities

Field Sampling Personnel have the initial responsibility to monitor the quality of field measurements and observations. The Field Team Leader is responsible for verifying that QC procedures are followed. This responsibility requires the Field Team Leader to assess the correctness of field methods and the ability to meet QA objectives. If a problem occurs that might jeopardize the integrity of the project or that might cause a specific QA objective not to be met, the Field Team Leader will notify the TVA Technical Lead and QA Oversight Manager. An appropriate corrective action will then be determined and implemented. The Field Team Leader will document the problem, the corrective action, and the results. A copy of the documentation form will be provided to the TVA Technical Lead.

Field auditing is a recognized technique for evaluating the performance of Field Sampling Personnel and assessing how team performance may affect data quality. Field audits will be conducted by the Field Oversight Coordinator to ensure that sampling, handling, and transportation to project laboratories provide assurance that such procedures meet QA protocols and that field documentation is sufficient to produce data of satisfactory quality, to provide a “defense” in the event that field procedures are called into question. Field audits will be conducted at a minimum of once (for one-time field collection activity) or semi-annually (for reoccurring field activities), or as directed by the TVA Technical Lead or designee to verify that corrective actions have been implemented if deficiencies were identified in prior field audits or as requested by the TVA Technical Lead.

16.4.3 Laboratory Corrective Action

Corrective action within the laboratory will be performed in accordance with the laboratory’s formal QA Program.

The laboratory has the responsibility to monitor the quality of the analytical system and to provide a corrective action process adequate to address problems encountered in laboratory analysis of samples. The laboratory will verify that QC procedures are followed and that the analytical results of QC samples are within the acceptance criteria. The verification requires that the laboratory assess the correctness of the following items, as appropriate:

- Sample preparation procedure.
- Initial calibration.
- Calibration verification.
- Method blank result.
- Laboratory control sample.
- Laboratory duplicate analysis.
- Fortified sample result.
- Internal standard performance.

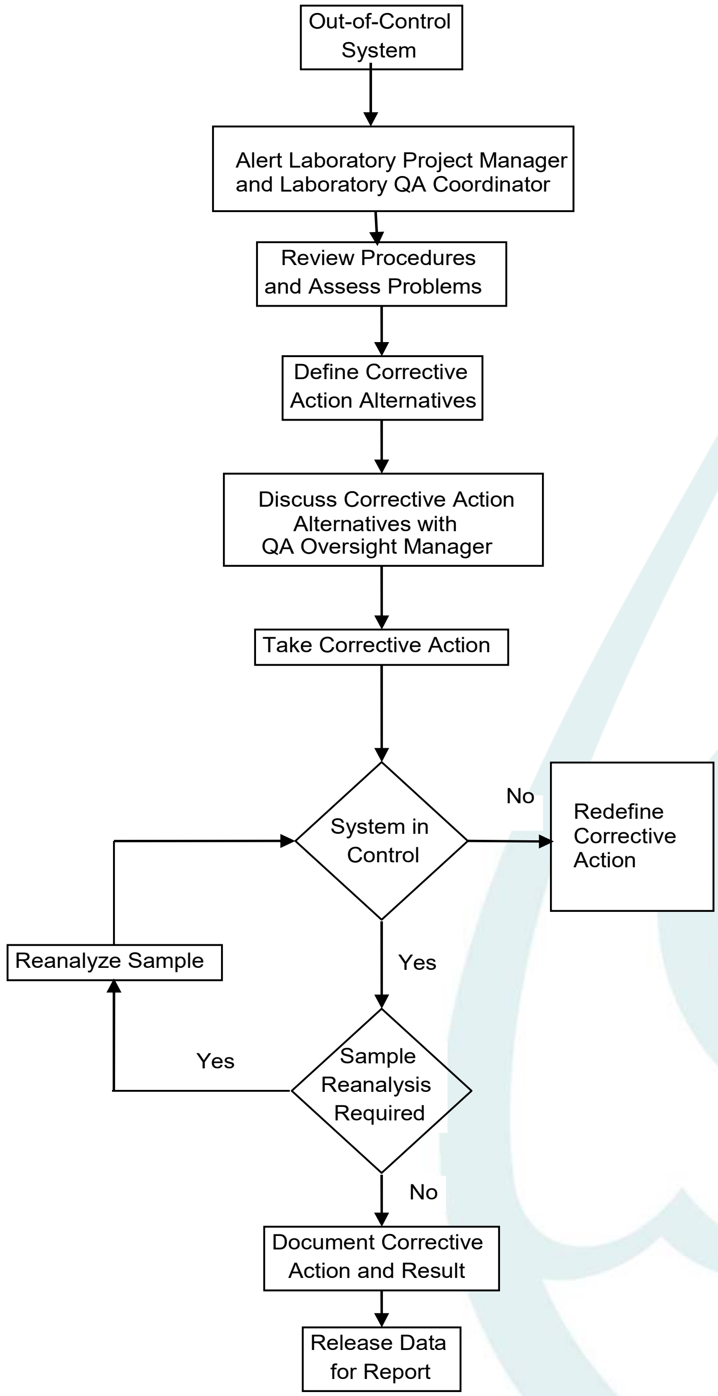
If the assessment reveals that the QC acceptance criteria are not met, the laboratory must immediately evaluate the analytical system and correct the problem. The Laboratory Analyst will notify the Laboratory Project Manager and Laboratory QA Officer of the problem and, if possible, will identify potential causes and suggest correct action.

When the appropriate corrective action measures have been implemented and the analytical system is determined to be “in control,” the Laboratory Analyst will document the problem, the corrective action taken, and resultant data demonstrating that the analytical system is in control. Copies of the documentation will be provided to the Laboratory Project Manager and the Laboratory QA Officer.

Data generated concurrently with an out-of-control system will be evaluated for usability relative to the nature of the deficiency. If the deficiency does not adversely impact the usability of the results, data will be reported and the deficiency will be addressed in the Case Narrative. If sample results are adversely impacted, the Laboratory Project Manager will be notified and appropriate corrective action (such as reanalysis) will be taken.

Figure 16-1 presents the critical pathway for laboratory corrective actions.

Figure 16-1. Critical Path for Laboratory Corrective Action



17.0 REPORTS TO MANAGEMENT

The QA activities performed by laboratories conducting analyses of ALF EIP samples will be monitored by the TVA Technical Lead and the QA Oversight Manager.

Communication among TVA, QA personnel, the Field Team Leader, and laboratory personnel is important to ensure that problems are remedied and that solutions are documented in an informed and timely manner.

After the completion of a performance and systems audit, the QA Oversight Manager will submit an audit report to the TVA Technical Lead. This audit report will include a list of observed field activities, a list of reviewed documents, and any observed deficiencies. The TVA Technical Lead and QA Oversight Manager or designee will meet with the laboratory Project Managers of any area with observed deficiencies to review the audit findings, confirm the observations, and resolve misunderstandings. In the event that inadequacies are identified, corrective actions will be undertaken as outlined in Section 16.4.

17.1 Field QA Reports

The Field Team Leader and Investigation Project Manager will provide the TVA Technical Lead with routine field progress reports. Compiled field data sets will be provided to the Data Manager for inclusion in the project EQuIS database. The TVA Technical Lead and QA Oversight Manager or designee will be immediately notified about field QA situations that require corrective action. Corrective action will be performed and documented in accordance with the protocol set forth in Section 16.4.

17.2 Laboratory QA Reports

The Laboratory QA Officer may provide periodic summary reports specific to the project to the QA Oversight Manager. These reports may summarize QA activities for the reporting period, including results of performance audits (external and internal), results of system audits (external and internal), summaries of corrective action to remedy out-of-control situations, and recommendations for revisions of laboratory procedures to improve the analytical systems. The Laboratory Project Manager will notify the QA Oversight Manager and Laboratory Coordinator about laboratory QA situations that appear to systematically impact data quality.

The Laboratory QA Officer will immediately notify the QA Oversight Manager and the Laboratory Coordinator of any laboratory QA situations that require corrective action and ascertain if such measures meet the DQOs of the project. Corrective action will be performed and documented in accordance with the protocol set forth in Section 16.4 or internal laboratory corrective action tracking system, as appropriate.

17.3 Internal Performance and System Audit/Assessment Reports

Documentation of systems and performance audits and any resulting corrective actions will be maintained as part of the Project File. Audit documentation will be reported to the TVA Technical Lead.

18.0 DATA REVIEW, VERIFICATION, AND VALIDATION

The Data Validators will verify or validate data generated by the laboratories for chemical analyses of project samples. Any issues observed during data validation will be brought to the attention of the QA Oversight Manager and TVA Technical Lead; the Laboratory Project Manager will be contacted to determine and implement an appropriate corrective action.

The purpose of analytical data verification and validation is to ensure data completeness, correctness, and method compliance/conformance, and identify data quality, including unusable data that would not be sufficient to support environmental decisions. In addition to the laboratory QA review, the data presented in Level IV data packages will be verified and validated by the Data Validators for the following:

- Compliance with requested testing requirements.
- Completeness.
- Reporting accuracy (including hardcopy to EDD).
- Confirmation of receipt of requested items.
- Traceability, sensibility, and usability of the data.

In addition to the above criteria, data will be validated with guidance from the following documents:

- US EPA CLP National Functional Guidelines (NFG) for Inorganic Data Review (October 2004);
- US EPA Region 4 Data Validation SOPs for CLP Inorganic Data by Inductively Coupled Plasma – Atomic Emission Spectroscopy (September 2011);
- US EPA Region 4 Data Validation SOPs for CLP Mercury Data by Cold Vapor Atomic Absorption (September 2011);
- US EPA Region 4 Environmental Investigations SOPs and Quality Assurance Manual (November 2001).

It should be noted that data validation guidelines specified above were developed for work conducted under the US EPA Contract Laboratory Program; therefore, these guidelines are not completely applicable to the Clean Water Act (CWA), Standard Methods, and SW-846 methods referenced for the ALF EI. Professional judgment will be used as necessary to adapt the guidelines for use in evaluating usability of data generated in accordance with CWA, Standard Methods, and SW-846 methodology.

Analytical data from off-site, commercial laboratories will be qualified with guidance from the National Functional Guidelines previously referenced. The data validation qualifiers listed below will be used for project samples:

- Organic Data Validation Qualifiers

U*	This result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level.
R	Unreliable positive result; compound may or may not be present in sample.
UR	Unreliable reporting or detection limit; compound may or may not be present in sample.
J	Quantitation is approximate due to limitations identified during data validation.
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.

- Inorganic Data Validation Qualifiers

U*	This result should be considered “not detected” because it was detected in a rinsate blank or laboratory blank at a similar level.
R	Unreliable positive result; analyte may or may not be present in sample.
UR	Unreliable reporting or detection limit; analyte may or may not be present in sample.
J	Quantitation is approximate due to limitations identified during data validation.
UJ	This analyte was not detected, but the reporting or detection limit may or may not be higher due to a bias identified during data validation.

The EDD and Full data packages for data generated from the chemical analysis of project samples will summarize the deviations from approved protocols and significant data findings in the Case Narratives. Analytical reports will be submitted to TVA and the QA oversight consultant as separate documents and will be transmitted in an electronic (.pdf and EDD) and/or hardcopy formats. The Data Manager will maintain a database of TVA data for data validation and/or verification. The Data Validators will complete data validation and generate reports for TVA. Data validation and project reports will be submitted to the TVA Technical Lead. Electronic validated data will be submitted upon approval from the TVA Technical Lead. The Data Management Plan details the process for appending data qualifiers in the EQuIS database and submitting verified and validated data to data users.

In addition to the validation qualifiers, qualifier reason codes will be maintained in the database. The reason codes below will be used to describe the usability issue(s) associated with results qualified during data review. Additional reason codes may be added as needed to address recurring usability issues.

Reason Code	Explanation
BE	Equipment blank contamination. The result should be considered “not-detected.”
BF	Field blank contamination. The result should be considered “not-detected.”
BL	Laboratory blank contamination. The result should be considered “not-detected.”
BN	Negative laboratory blank contamination.
C	Initial and/or continuing calibration issue, indeterminate bias.
C+	Initial and/or continuing calibration issue. The result may be biased high.
C-	Initial and/or continuing calibration issue. The result may be biased low.
FD	Field duplicate imprecision.

Reason Code	Explanation
FG	Total versus Dissolved Imprecision.
H	Holding time exceeded.
I	Internal standard recovery outside of acceptance limits.
L	LCS and LCSD recoveries outside of acceptance limits, indeterminate bias.
L+	LCS and/or LCSD recoveries outside of acceptance limits. The result may be biased high.
L-	LCS and/or LCSD recoveries outside of acceptance limits. The result may be biased low.
LD	Laboratory duplicate imprecision.
LP	LCS/LCSD imprecision.
M	MS and MSD recoveries outside of acceptance limits, indeterminate bias.
M+	MS and/or MSD recoveries outside of acceptance limits. The result may be biased high.
M-	MS and/or MSD recoveries outside of acceptance limits. The result may be biased low.
MP	MS/MSD imprecision.
P	Post-digestion spike recoveries outside of acceptance limits, indeterminate bias.
P+	Post-digestion spike recovery outside of acceptance limits. The result may be biased high.
P-	Post-digestion spike recovery outside of acceptance limits. The result may be biased low.
Q	Chemical preservation issue.
R	RL standards outside of acceptance limits, indeterminate bias.
R+	RL standard(s) outside of acceptance limits. The result may be biased high.
R-	RL standard(s) outside of acceptance limits. The result may be biased low.
RL	Result reported between the MDL and QL.
S	Radium-226+228 flagged due to reporting protocol for combined results.
SD	Serial dilution imprecision.
T	Temperature preservation issue.
X	Percent solids < 50%.
Y+	Chemical yield outside of acceptance limits. The result may be biased high.
Y-	Chemical yield outside of acceptance limits. The result may be biased low.
Z	ICP/MS interference.
ZZ	Other.

19.0 VERIFICATION AND VALIDATION METHODS

The overall QA objective for field activities, laboratory analyses, and data assessment is to produce data of sufficient and known quality to support the investigation-specific objectives and to produce high-quality, legally defensible data.

This data assessment activity is an ongoing coordinated process with data production and is intended to ensure that data produced during the ALF EIP are acceptable for use in subsequent evaluations. Both statistical and qualitative evaluations will be used to assess the quality of the data. The primary evaluation of the data will be based upon the control samples. The blank samples will be used to evaluate whether or not the laboratory and/or field sample handling represent a possible source of sample contamination. Duplicate sample results will be used to evaluate data precision.

All data submitted to the project EQuIS database will undergo data verification. Analytical data will be available for preliminary internal use after verification. Initially, 100% of the all chemical and physical analysis data will be reported in fully documented (Level IV) data packages for full independent data validation. If after the percentage of full data validation has decreased, a trend in frequency of reporting issues, method non-compliances, or data usability issues is identified, data validation will be conducted for specific data points or the percentage of full data validation percentage may be increased until the issues have been minimized to their initial frequency.

Data verification includes the review of laboratory deliverables for completeness, correctness, and compliance with applicable methods. The validation of data presented in a Level IV data package includes the review of commercially-available raw data and associated QC summary forms for compliance with the applicable methods and for data usability with respect to the appropriate guidance documents. The nature and extent of the data package available for review is dependent on the analytical method used (such as US EPA methods, SW-846, *etc*.) and the reporting and deliverables requirements defined in the ALF QAPP and investigation-specific SAPs. After completion of either full or limited data validation, a QA report will be prepared. The QA report will address ALF QAPP and method non-compliance issues, reporting errors, data usability issues, and include summary tables with qualified sample results. The QA report will also address laboratory calculation errors (*i.e*., the reported value is more than 10% different than the value calculated from the raw data by the data validator). The summary tables will include reported sample results and the associated data qualifiers. The QA report will be fully supported by photocopied pages of the laboratory data showing deficiencies identified in the review, as an attachment to the report.

The data produced during the sampling tasks included in the field investigation will be compared with the defined QA objectives and criteria for precision, accuracy, representativeness, completeness, and comparability (PARCC) and sensitivity. The primary goal of these procedures is to ensure that the data reported are representative of actual conditions at the Site.

Standard procedures are used so that known and acceptable levels of PARCC are maintained for each data set. Descriptions of these criteria are presented in the following subsections.

Specific quantitative QA objectives for chemical analyses associated with the ALF EIP are presented in Attachments E through H of this ALF QAPP.

19.1 Precision

The degree of agreement between the numerical values of a set of duplicate samples performed in an identical fashion constitutes the precision of the measurement.

During the collection of data using field methods and/or instruments, precision is checked by reporting measurements at one location and comparing results. For example, soil measurements are taken in pairs at a certain point and depth and the values compared. The measurements are considered sufficiently precise only if the values are within a specified percentage of each other.

Analytical precision is calculated by expressing, as a percentage, the RPD between results of analyses of laboratory duplicate samples for a given analyte. Precision is expressed as an RPD when both results are greater than 5× the reporting limit as calculated by the following formula:

$$RPD = abs\left[\frac{\mathrm{A}-\mathrm{B}}{\left(\frac{A+B}{2}\right)}\right] \times 100$$

Where: A = Value of original sample
B = Value of duplicate sample

When at least one result is less than 5× the reporting limit, the difference between the results is used to evaluate precision.

Analytical precision for radiological analyses is calculated as the relative error ratio (RER) using the following formula:

$$RER = abs\left[\frac{ACT_s - ACT_d}{\sqrt{(TPU_s)^2 + (TPU_d)^2}}\right]$$

Where:
Abs = Absolute Value
ACT_s = Sample Activity
ACT_d = Duplicate Activity
TPU_s = Total Propagated Uncertainty of Sample
TPU_d = Total Propagated Uncertainty of Duplicate

Specific precision and difference objectives for field duplicate samples and laboratory duplicate samples (including MSDs) are presented in Attachments E through H of this ALF QAPP.

19.2 Accuracy

Accuracy is the degree of agreement of a measurement, X, with an accepted reference or true value, T. Accuracy is usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100(X-T)/T; accuracy is also sometimes expressed as a ratio X/T. Accuracy, which is a measure of the bias in a system, is assessed by means of reference samples and percent recoveries. Error may arise due to personal, instrumental, or method factors.

The two types of analytical check samples used are LCSs and MSs. Analytical accuracy is expressed as the percent recovery (%R) of an analyte that has been added to the control sample or a standard matrix (such as blank soil) at a known concentration prior to analysis.

The formula used to calculate accuracy for the LCS is:

$$\%\,R = \left(\frac{A_T}{A_F}\right) \times 100$$

Where:
A_T = Total concentration of the analyte measured or recovered
A_F = Concentration of the analyte spiked

When calculating accuracy for the MS analysis, a correction for background concentration found in the unspiked sample must be made. MS recovery is calculated using the following formula:

$$\%\,R = \left(\frac{A_T - A_O}{A_F}\right) \times 100$$

Where: A_T = Concentration of the analyte measured or recovered
A_0 = Unspiked concentration of the analyte
A_F = Concentration of the analyte spiked

In general, the accuracy objectives are based on the requirements set forth in the referenced analytical method and in Attachments E through H of this ALF QAPP.

19.3 Representativeness

Representativeness expresses the degree to which sample data are accurate and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter associated with the proper design of the sampling program. The representativeness criterion can, therefore, be met through the proper selection of sampling locations, the collection of a sufficient number of samples and the use of standardized sampling procedures (*viz*., TVA TIs) to describe sampling techniques and the rationale used to select sampling locations to ensure representativeness of the sample data.

Representativeness will also be measured by the collection of field duplicates or co-located samples, as appropriate given the sample matrix. Comparison of the analytical results of field duplicates will provide a direct measure of individual sample representativeness.

19.4 Completeness

Completeness is a measure of the degree to which the amount of sample data collected meets the needs of the sampling program and is quantified as the relative number of analytical data points that meet the acceptance criteria (including accuracy, precision, and any other criteria required by the specific analytical method used). Completeness is defined as a comparison between actual numbers of usable data points expressed as a percentage of expected number of points.

Difficulties encountered while handling samples in the laboratory, as well as unforeseen complications regarding analytical methods, may affect completeness during sample analysis. The minimum goal for completeness is 90%; the ability to exceed this goal is dependent on the applicability of the analytical methods to the sample matrix analyzed. If data cannot be reported without qualifications, project completion goals may still be met if the qualified data (data of known quality, even if not perfect) are suitable for specified project goals. Percent completeness will be expressed as the ratio of the total number of usable results relative to the total number of analytical results. The total number of usable analytical results will be total number of results minus any results deemed unusable (or rejected) at validation.

19.5 Comparability

Comparability is a qualitative parameter used to express the confidence with which one data set can be compared with another. The comparability of the data, a relative measure, is influenced by sampling and analytical procedures. By providing specific protocols for obtaining and analyzing samples, data sets will be comparable regardless of who collects the sample or who performs the sample analysis.

The laboratory will be responsible providing the following controls to allow assessment of comparability:

- Adherence to current, standard US EPA-approved methodology for sample preservation.
- Compliance with holding times and analysis consistent with ALF QAPP.
- Consistent reporting units for each parameter of similar matrices.
- US EPA-traceable or NIST-traceable standards, when applicable.

20.0 RECONCILIATION OF DATA TO PROJECT OBJECTIVES

The QA Oversight Manager, in conjunction with the TVA Technical Lead, will determine whether field and validated analytical data or data sets meet the requirements necessary for decision-making. The results of measurements will be compared to the objectives set forth in the program-specific SAPs.

Generally, data assessment begins with verification and validation of project data to ensure that the sampling and analysis protocols specified in the associated TVA TIs and SAPs were followed, and that the measurement systems were performed in accordance with the criteria specified in these documents and this ALF QAPP. Data limitations identified during data verification and validation are communicated to the project team via reports and qualification in the project database.

Following data assessment, statistical analysis is performed to determine if the investigation and project objectives were achieved. As data are evaluated, anomalies in the data or data gaps may become apparent to the data users. Data that do not meet the data users' needs will be identified and appropriately noted so that decision-makers are aware of data limitations.

Data that are determined not to meet the investigation and project objectives may be used qualitatively or may be rejected depending on the program-specific requirements and the intended use of the data. The TVA Technical Lead, with the support of the QA Oversight Manager or designee and Data Validators, will assist data end users in evaluating data limitations identified and determining whether data are acceptable for their intended use.

21.0 REFERENCES

American Public Health Association, American Water Works Association, Water Environmental Federation. *Standard Methods for the Examination of Water and Wastewater,* 21st Edition, September 2005.

ASTM. Various procedures for analytical methods.

TVA. *Field Sampling Equipment Cleaning and Decontamination,* ENV-TI-05.80.05. March 2017

TVA. *Field Sampling Quality Control,* ENV-TI-05.80.04. March 2017.

TVA. *Sample Labeling and Custody,* ENV-TI-05.80.02, March 2017.

TVA. *Field Record Keeping,* ENV-TI-05.80.03. March 2017

TVA. *Handling and Shipping of Samples,* ENV-TI-05.80.06. March 2017.

TVA. *Field Measurement Using a Multi-Parameter Sonde,* ENV-TI-05.80.46. March 2017.

US EPA. *Data Quality Objectives Process for Superfund, Interim Final Guidance,* EPA540-R-93-071, September 1993.

US EPA Region 4. *Data Validation SOPs for CLP Mercury Data by Cold Vapor Atomic Absorption.*

US EPA Region 4. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual,* November 2001.

US EPA Region 4. *Field pH Measurement,* SESDRPOC-100-R3, January 2013.

US EPA. *National Functional Guidelines for Inorganic Data Review,* October 2004.

US EPA. *QA Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations,* 1995.

US EPA. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd Edition including Final Update IV, November 2000.

US EPA. 40 CFR Part 136, *Final Methods Update Rule*, March 2008.

ATTACHMENT A

DATA PACKAGE DELIVERABLE REQUIREMENTS

Required Data Deliverables Elements

All Sample Data Packages will include data for analyses of all samples in one sample delivery group (SDG), including field samples, reanalyses, secondary dilutions, blanks, laboratory control samples (LCS), laboratory control sample duplicates (LCSD), matrix spikes (MS), matrix spike duplicates (MSD), and/or laboratory duplicates. A fraction-specific unit is not a required deliverable if the analysis of that fraction was not required for samples in the SDG. The Sample Data Package must be complete before submission and must be consecutively paginated. The Sample Data Package will be arranged in the following order:

- Cover Letter/Letter of Transmittal signed by Technical Project Manager or designee
- Title Page
- Table of Contents
- SDG Narrative

The SDG Narrative will be clearly labeled "SDG Narrative" and will contain laboratory name; SDG number; TVA sample identifications; laboratory sample numbers; and detailed documentation of any QC, sample, shipment, and/or analytical problems encountered in processing (preparing and analyzing) the samples reported in the data package. A glossary of qualifier codes used in the SDG must also be provided.

The laboratory must also include reference to preparation and analytical methods performed and applicable project documents (*e.g.,* approved work plans), any problems encountered, both technical and administrative, corrective actions taken and resolution, and an explanation of all flagged edits (*i.e.*, exhibit edits) on quantitation reports (including results flagged due to storage blank contamination).

The SDG Narrative must be signed and dated by the Laboratory Manager or designee. The SDG Narrative must include a statement or statements relative to compliance with this document and any applicable project documents and description of any deviations from these documents:

- Field and Internal (Laboratory) Chain-of-Custody Records
- Sample Receipt Documentation Log, and all Project Correspondence

Copies of both the external and internal Chain-of-Custody Records for all samples within the SDG must be included in the deliverables. The Chain-of-Custody Records will list all temperature and pH measurements for all samples requiring pH adjustment for preservation.

A.1 Inorganic and General Chemistry Deliverables Requirements

The following subsections provide detailed requirements for the information presented on each of the deliverables elements referenced in Table A-1. In the event that certain required information is not included on a particular form, the laboratory will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.

A.1.1 Target Analyte Results Summaries

Target analyte results summaries are required for all MS/MSD samples, laboratory duplicate samples, LCS/LCSDs, and preparation blanks and will be arranged in increasing alphanumeric order by laboratory sample number.

The target analyte results summary must include:

- SDG Number
- TVA sample number
- laboratory sample identifier
- matrix of the TVA sample
- date of sample collection
- sample percent solids (if applicable)
- name and CAS number for each target analyte
- concentration or project-required detection limit (PRDL) for each target analyte
- any applicable flags for target analyte results (e.g., “U” to designate a “not-detected” result)
- concentration units

A.1.2 Initial and Continuing Calibration Verification Summary

The initial and continuing calibration verification summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- names for all target analytes
- instrument identifier

- start and end dates and times of the analytical sequence
- true concentrations for all target analytes for the ICV and CCV standards
- observed concentrations for all target analytes for each ICV and CCV analyses
- calculated percent recoveries for all target analytes for each ICV and CCV analyses
- control limits for ICV and CCV
- percent recoveries
- concentration units

A.1.3 PRDL Standard Summary

The PRDL standard summaries will be arranged in chronological order, by instrument and must include the following:

- SDG number
- names for all target analytes
- instrument identifier
- dates and times for the PRDL standard analyses
- true concentrations for all target analytes
- observed concentrations for all target analytes for each PRDL standard analysis
- calculated percent recoveries for all target analytes for each PRDL
- standard analysis
- control limits for PRDL standard recoveries
- concentration units

A.1.4 Initial and Continuing Calibration Blank Summary

The initial and continuing calibration blank summaries will be arranged in chronological order, by instrument and must include the following:

- SDG number
- names for all target analytes
- instrument identifier
- start and end dates and times of the analytical sequence
- observed concentration or PRDL for each target analyte for each initial calibration blank (ICB) or continuing calibration blank (CCB) analysis
- acceptance limits for ICB and CCB analyses
- concentration units

A.1.5 Preparation Blank Analytical Summary

The preparation blank analytical summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- preparation blank sample identifier
- names for all target analytes
- instrument identifier
- observed concentration or PRDL for each target analyte
- acceptance limits
- concentration units

A.1.6 ICP and/or ICP/MS Interference Check Sample Summary

The ICP and/or ICP/MS interference check sample summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- names for all target analytes
- instrument identifier
- dates and times for the ICP interference check standard analyses

- true concentrations for all target analytes
- observed concentrations for all target analytes observed in each ICP interference check standard analysis
- calculated percent recoveries for all target analytes for each ICP interference check standard analysis
- control limits for ICP interference check standard recoveries
- concentration units

A.1.7 Matrix Spike /Matrix Spike Duplicate Summary

The MS/MSD summaries will be arranged in alphanumeric order by laboratory sample number and must include:

- SDG number
- TVA sample number for the spiked sample
- percent solids for the TVA sample (if applicable)
- names for all target analytes
- analyte concentration observed in the non-spiked sample aliquot
- true concentrations for all target analytes in the spike solutions
- observed concentrations for all target analytes in the spike sample/spike sample duplicate analyses
- calculated percent recoveries for all target analytes
- control limits for spike sample/spike sample duplicate recoveries
- calculated RPD between spike sample/spike sample duplicate results
- RPD limit for each analyte
- concentration units

A.1.8 Post-Digestion Spike Sample Recovery Summary (if applicable)

The post-digestion spike sample recovery summaries will be arranged in alphanumeric order by laboratory sample number and must include:

- SDG number
- TVA sample number for the post-digestion spike parent sample
- percent solids for the TVA sample (if applicable)
- names for all target analytes
- analyte concentration observed in the non-spiked sample aliquot
- true concentrations for all target analytes in the post-spike solution
- observed concentrations for all target analytes in the post-spike sample analysis
- calculated percent recoveries for all target analytes
- control limits for post-spike sample recoveries
- concentration units

A.1.9 Duplicates Precision Summary

The duplicate precision summaries will be arranged in alphanumerical order by TVA sample number and must include:

- SDG number
- TVA sample number for the duplicate sample
- percent solids for the TVA sample (if applicable)
- names for all target analytes
- analyte concentration observed in the original sample aliquot
- observed concentrations for all target analytes in the duplicate sample analysis
- calculated RPD for all target analytes
- control limits for RPD
- concentration units

A.1.10 LCS/LCSD Recovery Summary

The LCS/LCSD recovery summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- LCS/LCSD identification number
- names for all target analytes
- true concentrations for all target analytes in the LCS/LCSD solution
- observed concentrations for all target analytes in the LCS/LCSD analysis
- calculated percent recoveries for all target analytes
- control limits for LCS/LCSD recoveries
- concentration units
- RPD between LCS/LCSD results
- RPD limit for each analyte

A.1.11 Standard Addition Results Summary (where applicable) must include:

- SDG number
- TVA sample number for the sample that underwent the standard additions procedure
- names for all target analytes
- analyte concentration or absorbance observed in the non-spiked sample aliquot
- true concentrations for all target analytes for each standard addition analysis
- observed concentration or absorbance for each standard addition analysis
- calculated concentration for each target analyte
- calculated correlation coefficient for each target analyte

- concentration units

A.1.12 ICP and/or ICP/MS Serial Dilution Summary

The ICP and/or ICP/MS serial dilution summaries will be arranged in alphanumeric order by laboratory sample number and must include:

- SDG number
- TVA sample number for the ICP serial dilution sample
- names for all target analytes
- analyte concentration observed in the original sample aliquot
- observed concentrations for all target analytes in the ICP serial dilution analysis
- calculated RPD for all target analytes
- control limits for RPD
- concentration units

A.1.13 PRDL and MDL Summary

The PRDL and MDL summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- instrument identifier
- date the MDL determination was performed
- names for all target analytes
- determined MDL for all target analytes
- PRDL for all target analytes
- concentration units

A.1.14 ICP Interelement Correction Factors Summary

The ICP interelement correction factors summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- instrument identifier
- date the ICP interelement correction factors determination was performed
- names for all target analytes
- determined ICP interelement correction factors concentrations for all target analytes
- concentration units

A.1.15 ICP and/or ICP/MS Linear Range Summary

The ICP and/or ICP/MS linear range summaries will be arranged in chronological order, by instrument and must include:

- SDG number
- instrument identifier
- date the ICP linear range determination was performed
- names for all target analytes
- determined ICP linear range concentrations for all target analytes
- concentration units

A.1.16 Preparation Logs

- TCLP or SPLP Preparation Logs (if TCLP or SPLP extraction was performed)
- TVA sample and QC sample digestion logs

A.1.17 Analytical Sequence Form

The analytical sequence forms will be arranged in chronological order, by analyte, by instrument and must include:

- SDG number
- instrument identifier
- TVA sample numbers associated with the sequence
- QC sample identifiers associated with the sequence
- analysis date and time for each TVA sample and QC sample associated with the sequence
- identification of all target analytes reported from each TVA sample and
- QC sample analysis
- dilution factor for each TVA sample and QC sample analysis
- start and end dates and times for the sequence

A.1.18 ICP/MS Additional Forms

ICP/MS Data Packages will include the following forms in addition to the requirements listed above.

- ICP/MS Tune Summary
- ICP/MS Internal Standards Relative Intensity Summary

A.1.19 Raw Data for Metals/Mercury

- For each reported value, the laboratory will provide all raw data used to obtain that value. This requirement applies to all required QA/QC measurements and instrument standardization as well as all sample analysis results. This statement does not apply to the Quarterly Verifications Parameters submitted as part of each data package. Raw data must contain all instrument readouts used for the sample results. Each exposure or instrumental reading must be provided, including those readouts that may fall below the PRDL. All ICP, ICP/MS, and AA instruments must provide a legible hardcopy of the direct real-time instrument readout (e.g., strip-charts, printer tapes, etc.). A photocopy of the instrument’s direct sequential readout must be included. A hardcopy of the instrument’s direct instrument readout for cyanide must be included if the instrumentation has the capability.
- Raw data must include instrument calibration and calibration curves/equations.

A.1.20 Raw Data for General Chemistry Parameters

- For each reported value, the laboratory will provide all raw data (instrument printouts or logbook pages) used to obtain that value. This requirement applies to all required QA/QC measurements and instrument standardization, as well as all sample analysis results. Raw data must contain all instrument readouts/logbooks pages used for the sample results. Each exposure or instrumental reading must be provided, including those readouts/logbook pages that may fall below the quantitation limit. A photocopy of the instrument's direct sequential readout must be included if the instrumentation has the capability.

- Raw data must include instrument calibration and calibration curves/equations as applicable.

- Wet Chemistry Preparation Logs (by parameter)

Table A-1: Required Deliverables for Inorganic and General Chemistry Analyses

	Section	ICP/MS Metals	Mercury	General Chemistry Parameters
Cover Letter/Letter of Transmittal	n/a	X	X	X
Case Narrative	n/a	X	X	X
Field and Internal (Laboratory) COC Records	n/a	X	X	X
Sample Receipt Documentation Log	n/a	X	X	X
Project Correspondence	n/a	X	X	X
Target Analyte Results Summary	A.1.1	X	X	X
ICP/MS Tune Summary	A.1.18	F		
Initial Calibration Summary	A.1.19 A.1.20	F	F	F
Initial and Continuing Calibration Verification (ICV/CCV) Summary	A.1.2	F	F	F
PRDL Standard Summary	A.1.3	F	F	
Initial and Continuing Calibration Blank Summary	A.1.4	F	F	F[A]
Preparation Blank Summary	A.1.5	X	X	X
Interference Check Sample Summary	A.1.6	F		
MS/MSD Duplicate Summary	A.1.7	X	X	X[A]
Post-Spike Sample Recovery Summary	A.1.8	F	F	
Duplicates Precision Summary	A.1.9	X	X	X
LCS/LCSD Recovery Summary	A.1.10	X	X	X
ICP and/or ICP/MS Serial Dilution Summary	A.1.12	F		
PRDL and MDL Summary	A.1.13	F	F	F[A]
Standard Additions Summary	A.1.11	F[A]	F[A]	
ICP Interelement Correction Factors Summary	A.1.14	F		
ICP and/or ICP/MS Linear Range Summary	A.1.15	F		
ICP/MS Internal Standards Relative Intensity Summary	A.1.18	F		
TCLP or SPLP Preparation Logs	A.1.16	F[A]	F[A]	
Digestion Logs	A.1.16	F	F	
General Chemistry Preparation Logs	A.1.20			F
Analytical Sequence Form	A.1.17	F	F	F
Raw Data	A.1.19	F	F	F

Notes:
X Required element for all deliverables Levels
F Required additional element for full deliverables (in addition to elements required for all deliverables levels)
[A] Required element for associated deliverable level when applicable to the analyses performed

A.2 Radiological Deliverables Requirements

The following subsections provide detailed requirements for the information presented on each of the deliverables elements referenced in Table A-2. In the event that certain required information is not included on a particular form, the laboratory will provide additional documentation (e.g., preparation logs or analytical runlogs) to ensure that the minimum required level of documentation is supplied.

The radiological data will be arranged in the following order by individual parameter requested for the samples in the SDG.

A.2.1 Target Analyte Results Summaries: Target analyte results summaries are required for all samples and will be arranged in increasing alphanumeric order by TVA sample number. The target analyte results summary must include the following:

- SDG Number
- TVA sample number
- laboratory sample identifier
- matrix of the TVA sample
- date of sample collection
- date of sample analysis
- sample activity, uncertainty, and the sample-specific minimum detectable concentration (MDC). The sample-specific MDC will be based on the background of the detector that the sample was counted on. The sample activity (positive or negative), uncertainty, and sample-specific MDC will be reported for positive and "not-detected" results
- any applicable flags for target analyte results (e.g., "U" to designate a "not-detected" result)
- concentration units

A.2.2 Chemical Yield (Tracer/Carrier) Recovery Summary that must include the following:

- SDG number
- TVA sample number
- Method blank sample number

- Laboratory Duplicate sample number
- LCS identification number
- LCSD identification number (if performed)
- percent recovery for all tracers/carriers
- applicable recovery limits for each tracer/carrier

A.2.3 Method Blank Summary: The method blank summaries will be arranged in chronological order, by instrument and method and must include the following:

- SDG number
- names for all target analytes
- observed activity, uncertainty, and MDC for each target analyte for each method blank analysis
- concentration units

A.2.4 Duplicates Precision Summary: The duplicate precision summaries will be arranged by instrument and method and must include the following:

- SDG number
- TVA sample number for the duplicate sample
- names for all target analytes
- analyte activity, uncertainty, and MDC observed in the original sample aliquot
- observed activity, uncertainty, and MDC for all target analytes in the duplicate sample analysis
- calculated RPD/Replicate Error Ratio (RER) for all target analytes
- control limits for RPD/RER
- concentration units

A.2.5 LCS Recovery Summary: The LCS recovery summaries will be arranged by instrument and method and must include the following:

- SDG number

- LCS identifier
- names for all target analytes
- true concentrations for all target analytes in the LCS solution
- observed concentrations for all target analytes in the LCS analysis
- calculated percent recoveries for all target analytes
- control limits for LCS recoveries
- concentration units

A.2.6 Calibration Verification Summary: The calibration verification summaries will be arranged by instrument and method and must include the following:

- SDG number
- names for all target analytes
- instrument identifier
- date the calibration verification was performed. For each method and analyte, the Contracted Laboratories will provide Calibration Verification summaries that include or bracket the analysis dates of the field and QC samples.
- acceptance limits for the calibration verification
- the following calibration verification summaries will be provided for Gas Flow Proportional Counter data

  a. Efficiency Checks
  b. Background Checks

- the following calibration verification summaries will be provided for Alpha Spectroscopy data

  a. Energy Calibration Checks
  b. Efficiency Checks
  c. Background Checks
  d. Resolution (FWHM) Checks

- the following calibration verification summaries will be provided for Alpha Scintillation data

a. Daily Instrument Performance Checks
b. Background Checks

A.2.7 Raw Data

For each reported value, the Contracted Laboratories will provide all raw data (instrument printouts) used to obtain that value. This applies to all required QA/QC measurements (including tracer/carrier recoveries) as well as all sample analysis results. Raw data must contain all instrument readouts and worksheets used for the sample results. An exhibit work sheet per method (including example calculations showing how sample activity, total propagated uncertainty [TPU] and minimum detectable activity [MDA] are calculated) will be provided.

A.2.8 Preparation Logs (by method)

A.2.9 Traceability Documents (by method)

Table A-2: Required Deliverables for Radiological Analyses

	Section	Radiological Parameters
Cover Letter/Letter of Transmittal	n/a	X
Case Narrative	n/a	X
Field and Internal (Laboratory) COC Records	n/a	X
Sample Receipt Documentation Log	n/a	X
Project Correspondence	n/a	X
Target Analyte Results Summary	A.2.1	X
Chemical Yield (Tracer/Carrier) Recovery Summary	A.2.2	X
Method Blank Summary	A.2.3	X
Duplicates Precision Summary	A.2.4	X
LCS Recovery Summary	A.2.5	X
Calibration Verification Summary	A.2.6	X
Raw Data	A.2.7	F
Preparation Logs	A.2.8	F
Traceability Documents	A.2.9	F

Notes:
X Required element for all deliverables levels
F Required additional element for full deliverables (in addition to elements required for all deliverables

ATTACHMENT B

SAMPLING PROCEDURES LIST

The TVA Technical Instructions (TIs) and/or standard operating procedures (SOPs) associated with the ALF EIP are identified on Table B-1. Current versions of these documents are maintained on TVA's Accellion Workspace.

Table B-1: Applicable TIs and SOPs

Document Number	**Document Title**
ENV-TI-05.80.02	*Sample Labeling and Custody*
ENV-TI-05.80.03	*Field Record Keeping*
ENV-TI-05.80.04	*Field Sampling Quality Control*
ENV-TI-05.80.05	*Field Sampling Equipment Cleaning and Decontamination*
ENV-TI-05.80.06	*Handling and Shipping of Samples*
ENV-TI-05.80.42	*Groundwater Sampling*
ENV-TI-05.80.44	*Groundwater Level and Well Depth Measurement*
ENV-TI-05.80.46	*Field Measurements Using a Multi-Parameter Sonde*

ATTACHMENT C

EXAMPLE CHAIN OF CUSTODY RECORD

TVA

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed and accurate.

Page: _____ of _____
Cooler # _____ of _____

COC #

Task

Required Ship to Lab:		Required Project Information:		Required Sampler Information:	
Lab Name:		Site ID #:		Sampler	
Address:	#N/A	Project #	#N/A	Sampling Company	
				Address:	
		Site Address	#N/A	City/State	Phone #:
Lab PM:	#N/A	City #N/A	State, Zip #N/A	Reimbursement project?	Non-reimbursement / Mark one
Phone/Fax:	#N/A	Site PM Name	#N/A	Send EDD to	
Lab PM email	#N/A	Phone/Fax:		CC Hardcopy report to	
Applicable Lab Quote #:		Site PM Email:		CC Hardcopy report to	

TAT: Standard | Rush | Mark One

Filtered | Preserve | Analysis

ITEM #	SAMPLE ID Samples IDs MUST BE UNIQUE	SAMPLE LOCATION	Sample Depth: Depth Unit: Start Depth	End Depth	MATRIX CODE	G=GRAB C=COMP	SAMPLE TYPE	SAMPLE DATE	SAMPLE TIME	#OF CONTAINERS	Comments/Lab Sample I.D.
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Additional Comments/Special Instructions:

RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	Sample Receipt Conditions			
							Y / N	Y / N	Y / N
							Y / N	Y / N	Y / N
							Y / N	Y / N	Y / N
							Y / N	Y / N	Y / N

SHIPPING METHOD: (mark as appropriate)
UPS COURIER \ FEDEX
US MAIL

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER:
SIGNATURE of SAMPLER:

Temp in OC | Samples on Ice? | Sample Intact? | Trip Blank?

ATTACHMENT D

SAMPLE NOMENCLATURE

Table A: TVA - TDEC Order Sample Naming Conventions - Allen Fossil Plant

TVA - TDEC Order Sample Naming Conventions - Allen Fossil Plant

Table A

Site (Plant) Name	Site Acronym	Sample Type (Matrix)	Matrix Sample Type Acronym	Location	Location ID	Depth Interval (If Applicable)	Quality Control/Quality Assurance Sample Type	QA/QC Sample Type Acronym	Date of Sample	Example
Allen Fossil Plant	ALF	Background Soil	BS	Soil Boring Number	BGXX	Feet/Feet	Equipment Rinsate Blank	EBXX	Year/Month/Day	ALF-BS-BGXX-6.0/8.0-20180511 ALF-BS-EBXX-20180511 ALF-BS-FBXX-20180511 ALF-BS-DUPXX-20180511
		Coal Combustion Residuals	CCR	Temporary Well Number	TWXX	Feet/Feet	Field Blank	FBXX	Year/Month/Day	ALF-CCR-TWXX-6.0/8.0-20180511 ALF-CCR-EBXX-20180511 ALF-CCR-FBXX-20180511 ALF-CCR-DUPXX-20180511
		Groundwater	GW	Monitoring Well Number	MWXX or Existing Name	Feet Below Top of Casing	Filter Blank	FLBXX	Year/Month/Day	ALF-GW-MWXX-35-20180511 ALF-GW-ALFXXX-35-0180511 ALF-GW-EBXX-20180511 ALF-GW-FBXX-20180511 ALF-GW-FLBXX-20180511 ALF-GW-DUPXX-20180511
		Pore Water	PW	Temporary Well Number	TWXX	Feet Below Top of Casing	Field Duplicate	DUPXX	Year/Month/Day	ALF-PW-TWXX-35-20180511 ALF-PW-EBXX-20180511 ALF-PW-FBXX-20180511 ALF-PW-FLBXX-20180511 ALF-PW-DUPXX-20180511
		Seep Soil	SeS	Seep Number	XX	NA	Matrix Spike/Matrix Spike Duplicate *Note applicable sample on COC	MS/MSD	Year/Month/Day	ALF-SeS-XX-20180511 ALF-SeS-EBXX-20180511 ALF-SeS-FBXX-20180511 ALF-SeS-DUPXX-20180511
		Seep Water	SeW	Seep Number	XX	NA			Year/Month/Day	ALF-SeW-XX-20180511 ALF-SeW-EBXX-20180511 ALF-SeW-FBXX-20180511 ALF-SeW-FLBXX-20180511 ALF-SeW-DUPXX-20180511

ATTACHMENT E

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

BACKGROUND SOIL SAMPLING

Table E-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation	Holding Time
Soil	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	16-oz glass	20 g	NA	180 days
	Anions (Chloride, Fluoride, and Sulfate)	4-oz glass	5 g	Cool to < 6°C	28 days
	pH				NA*
	Fractional Organic Carbon (FOC)	4-oz glass	5 g	Cool to < 6°C	28 days
	Percent Ash	4-oz glass	5 g	NA	NA
Aqueous Blanks	Metals	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days

*Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

Notes:

oz	-	ounce
g	-	grams
mL	-	milliliter
L	-	liter
HDPE	-	High Density Polyethylene
NA	-	Not applicable

Table E-2: Analytes, Methods, and Reporting Limits – Solid Matrices

Parameter	CAS No.	Method	Reporting Limit[1]	Units
Antimony	7440-36-0	SW-846 6020A	0.200	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Barium	7440-39-3	SW-846 6020A	1.00	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.100	mg/kg
Boron	7440-42-8	SW-846 6020A	8.0	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.100	mg/kg
Calcium	7440-70-2	SW-846 6020A	50.0	mg/kg
Chromium	7440-47-3	SW-846 6020A	0.200	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.0500	mg/kg
Copper	7440-50-8	SW-846 6020A	0.200	mg/kg
Lead	7439-92-1	SW-846 6020A	0.100	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.500	mg/kg
Mercury	7487-94-7	SW-846 7471B	0.0330	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.500	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.100	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.500	mg/kg
Silver	7440-22-4	SW-846 6020A	0.100	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.100	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.100	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.500	mg/kg
Radium-226	13982-63-3	EPA 901.1	1.00	pCi/g
Radium-228	15262-20-1	EPA 901.1	1.00	pCi/g
Radium-226+228	RA226/228	CALC	1.00	pCi/g
Percent Ash	%ASH	R.J. Lee SOP OPT23.02	1	%
Chloride	16887-00-6	SW-846 9056A Modified	10.0	mg/kg
Fluoride	16984-48-8	SW-846 9056A Modified	1.0	mg/kg
Sulfate	14808-79-8	SW-846 9056A Modified	10.0	mg/kg
pH[2]	PH	SW-846 9045D Modified (laboratory-based definitive analysis)	0.1	pH units
Fractional Organic Carbon (FOC)	FOC	ASTM D2974-87D	0.1	%

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
CALC - Parameter determined by calculation.

1 Samples will be reported on a dry-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

2 Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time (15 minutes following creation of soil paste).

Table E-3: Quantitative QA Objectives – Soil Samples

Analyte/ Parameter Group	Method	Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals	SW-846 6020A	NA	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471B	NA	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Radium-226	EPA 901.1	30-110	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 901.1	30-110	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Anions	SW-846 9056A Modified	NA	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Percent Ash	R.J. Lee SOP OPT23.02	NA	< RL	NA	NA	NA	NA	±10%	RPD < 35% difference < 2× the RL
pH	SW-846 9045D Modified (laboratory-based definitive analysis)	NA	pH 6-8 for laboratory-supplied deionized water	NA	NA	NA	NA	±0.2 pH units	±0.5 pH units
Fractional Organic Carbon	ASTM D2974-87D	NA	< RL	NA	NA	NA	NA	35	RPD < 35% difference < 2× the RL

Notes:
[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS/MSD - Matrix Spike/Matrix Spike Duplicate
NA - Not Applicable
RPD - Relative Percent Difference
RER - Relative Error
RL - Reporting Limit
%R - Percent Recovery

ATTACHMENT F

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

GROUNDWATER INVESTIGATION SAMPLING

Table F-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
Groundwater	Metals (Total)	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury (Total)				28 days
	Metals (Dissolved)	250-mL HDPE	250 mL	HNO_3 to pH < 2 after filtration Cool to < 6°C	180 days
	Mercury (Dissolved)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	Total Dissolved Solids (TDS)[1]	250-mL HDPE	100 mL	Cool to < 6°C	7 days
	Alkalinity (Total, Carbonate, and Bicarbonate)	250 mL HDPE	50-mL	Cool to < 6°C	14 days
	pH (field measurement)	NA	NA	NA	15 minutes

Notes:

mL	-	milliliters
L	-	Liters
HDPE	-	High Density Polyethylene
NA	-	Not applicable

[1] TDS will be performed for unfiltered sample volume only.

Table F-2: Analytes, Methods, and Reporting Limits – Groundwater Samples

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
Total Suspended Solids	TSS	SM2540D	10.0	mg/L
pH	pH	SW-846 9040C	0.1	pH units
Antimony (Total and Dissolved)	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenic (Total and Dissolved)	7440-38-2	SW-846 6020A	1.00	µg/L
Barium (Total and Dissolved)	7440-39-3	SW-846 6020A	10.0	µg/L
Beryllium (Total and Dissolved)	7440-41-7	SW-846 6020A	1.00	µg/L
Boron (Total and Dissolved)	7440-42-8	SW-846 6020A	80.0	µg/L
Cadmium (Total and Dissolved)	7440-43-9	SW-846 6020A	1.00	µg/L
Calcium (Total and Dissolved)	7440-70-2	SW-846 6020A	500	µg/L
Chromium (Total and Dissolved)	7440-47-3	SW-846 6020A	2.00	µg/L
Cobalt (Total and Dissolved)	7440-48-4	SW-846 6020A	0.500	µg/L
Copper (Total and Dissolved)	7440-50-8	SW-846 6020A	2.00	µg/L
Lead (Total and Dissolved)	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium (Total and Dissolved)	7439-93-2	SW-846 6020A	5.00	µg/L
Magnesium (Total and Dissolved)	7439-95-4	SW-846 6020A	500	µg/L
Mercury (Total and Dissolved)	7487-94-7	SW-846 7470A	0. 200	µg/L
Molybdenum (Total and Dissolved)	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel (Total and Dissolved)	7440-02-0	SW-846 6020A	10.0	µg/L
Potassium (Total and Dissolved)	7440-09-7	SW-846 6020A	500	µg/L
Selenium (Total and Dissolved)	7782-49-2	SW-846 6020A	5.00	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Silver (Total and Dissolved)	7440-22-4	SW-846 6020A	1.00	µg/L
Sodium (Total and Dissolved)	7440-23-5	SW-846 6020A	500	µg/L
Thallium (Total and Dissolved)	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium (Total and Dissolved)	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc (Total and Dissolved)	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1.0	pCi/L
Radium-228	15262-20-1	EPA 904.0	1.0	pCi/L
Radium-226+228	RA226/228	CALC	1.0	pCi/L
Alkalinity, Total	ALK	SM2320B	5.0	mg/L
Alkalinity, Carbonate	CARB	SM2320B	5.0	mg/L
Alkalinity, Bicarbonate	BICARB	SM2320B	5.0	mg/L

Notes:

CAS No.	-	Chemical Abstracts Service registry number
mg/L	-	milligrams per liter
µg/L	-	micrograms per liter
pCi/L	-	picoCuries per liter
CALC	-	Parameter determined by calculation.

Table F-3: Quantitative QA Objectives – Groundwater

Analyte/ Parameter Group	Method	Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals (Total and Dissolved)	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (Total and Dissolved)	SW-846 7470A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Alkalinity (Total, Carbonate, and Bicarbonate)	SM2320B	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:
[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS/LCSD	-	Laboratory Control Sample/Laboratory Control Sample Duplicate
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
RPD	-	Relative Percent Difference
RER	-	Relative Error
RL	-	Reporting Limit
%R	-	Percent Recovery

ATTACHMENT G

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

CCR MATERIAL CHARACTERISTIC SAMPLING

Table G-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
CCR Material	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	16-oz glass	20 g	NA	180 days
	Arsenic Speciation (arsenate and arsenite)	4-oz glass	5 g	Cool to < 6°C	28 days
	Anions (Chloride, Fluoride, and Sulfate)	4-oz glass	5 g	Cool to < 6°C	28 days
	pH				NA*
	Total Organic Carbon	8-oz glass	10 g	Cool to <6°C	28 days
SPLP Leachates	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	8-oz glass	20 g	Cool to < 6°C	180 days
	Arsenic Speciation (arsenate and arsenite)	4-oz glass	5 g	Cool to < 6°C	28 days
Pore Water	Metals	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Arsenic Speciation (arsenate and arsenite)	250-mL HDPE	250 mL	Disodium EDTA, Acetic Acid Cool to <6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	Total Dissolved Solids (TDS)[2]	250-mL HDPE	100 mL (unfiltered)	Cool to < 6°C	7 days
	Total Organic Carbon	2x 40-mL VOA Vial	40-mL	Cool to ≤ 6°C HCl to pH < 2	28 days
	pH (field measurement)	NA	NA	NA	15 minutes
Aqueous Blanks	Metals	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
	Mercury				28 days
	Metals (Dissolved)	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury (Dissolved)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	Total Dissolved Solids (TDS)	250-mL HDPE	100 mL (unfiltered)	Cool to < 6°C	7 days
	Total Organic Carbon	250-mL amber glass or 2x 40-mL VOA Vial	250 mL or 80 mL	Cool to ≤ 6°C H2SO4 to pH < 2	28 days

Notes:

mL - milliliters
L - Liters
HDPE - High Density Polyethylene
NA - Not applicable

* Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time (15 minutes following creation of soil paste).

Table G-2: Analytes, Methods, and Reporting Limits – CCR Material

Parameter	CAS No.	Method	Reporting Limit [1]	Units
Antimony	7440-36-0	SW-846 6020A	0.200	mg/kg
Arsenate	As5	SW-846 6020A	0.0005	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Arsenite	As3	SW-846 6020A	0.0005	mg/kg
Barium	7440-39-3	SW-846 6020A	1.00	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.100	mg/kg
Boron	7440-42-8	SW-846 6020A	8.0	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.100	mg/kg
Calcium	7440-70-2	SW-846 6020A	50.0	mg/kg
Chromium	7440-47-3	SW-846 6020A	0.200	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.0500	mg/kg
Copper	7440-50-8	SW-846 6020A	0.200	mg/kg
Iron	7439-89-6	SW-846 6020A	5.00	mg/kg
Lead	7439-92-1	SW-846 6020A	0.100	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.500	mg/kg
Mercury	7487-94-7	SW-846 7471B	0.0330	mg/kg
Manganese	7439-96-5	SW-846 6020A	0.500	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.500	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.100	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.500	mg/kg
Silver	7440-22-4	SW-846 6020A	0.100	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.100	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.100	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.500	mg/kg
Radium-226	13982-63-3	EPA 901.1	1.00	pCi/g
Radium-228	15262-20-1	EPA 901.1	1.00	pCi/g
Radium-226+228	RA226/228	CALC	1.00	pCi/g
Total Organic Carbon	7440-44-0	Lloyd Kahn or SW-846 9060A	1000	mg/kg
Chloride	16887-00-6	SW-846 9056A Modified	10.0	mg/kg
Fluoride	16984-48-8	SW-846 9056A Modified	1.0	mg/kg
Sulfate	14808-79-8	SW-846 9056A Modified	10.0	mg/kg

Parameter	CAS No.	Method	Reporting Limit [1]	Units
pH	PH	SW-846 9045D Modified (laboratory-based definitive analysis)	0.1	pH units

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
CALC - Parameter determined by calculation

1 Samples will be reported on a dry-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

Table G-3: Analytes, Methods, and Reporting Limits – SPLP Leachates

Parameter	CAS No.	Method	Reporting Limit	Units
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
pH	pH	SW-846 Method 9040C	0.05	pH units
Antimony	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenate	As5	SW-846 6020A	2.00	µg/L
Arsenic	7440-38-2	SW-846 6020A	1.00	µg/L
Arsenite	As3	SW-846 6020A	2.00	µg/L
Barium	7440-39-3	SW-846 6020A	10.0	µg/L
Beryllium	7440-41-7	SW-846 6020A	1.00	µg/L
Boron	7440-42-8	SW-846 6020A	80.0	µg/L
Cadmium	7440-43-9	SW-846 6020A	1.00	µg/L
Calcium	7440-70-2	SW-846 6020A	500	µg/L
Chromium	7440-47-3	SW-846 6020A	2.00	µg/L
Cobalt	7440-48-4	SW-846 6020A	0.500	µg/L
Copper	7440-50-8	SW-846 6020A	2.00	µg/L
Iron	7439-89-6	SW-846 6020A	50.0	µg/L
Lead	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium	7439-93-2	SW-846 6020A	5.00	µg/L
Manganese	7439-96-5	SW-846 6020A	5.00	µg/L
Mercury	7487-94-7	SW-846 7470A	0.200	µg/L
Molybdenum	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel	7440-02-0	SW-846 6020A	10.00	µg/L
Selenium	7782-49-2	SW-846 6020A	5.00	µg/L
Silver	7440-22-4	SW-846 6020A	1.00	µg/L
Thallium	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc	7440-66-6	SW-846 6020A	5.00	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Radium-226	13982-63-3	EPA 903.0	1	pCi/L
Radium-228	15262-20-1	EPA 904.0	1	pCi/L
Radium-226+228	RA226/228	CALC	1	pCi/L
Total Organic Carbon	7440-44-0	SM 5310C	1.00	mg/L

Notes:

CAS	No.	-	Chemical Abstracts Service registry number
	mg/L	-	milligrams per liter
	µg/L	-	micrograms per liter
	pCi/L	-	picoCuries per liter
	CALC	-	Parameter determined by calculation.

Table G-4: Analytes, Methods, and Reporting Limits – Pore Water Samples

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids	TDS	SM2540C	10.0	mg/L
pH	pH	SW-846 9040C	0.05	pH units
Antimony (Total and Dissolved)	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenate	As5	SW-846 6020A	2.00	µg/L
Arsenic	7440-38-2	SW-846 6020A	1.00	µg/L
Arsenite	As3	SW-846 6020A	2.00	µg/L
Barium (Total and Dissolved)	7440-39-3	SW-846 6020A	10.0	µg/L
Beryllium (Total and Dissolved)	7440-41-7	SW-846 6020A	1.00	µg/L
Boron (Total and Dissolved)	7440-42-8	SW-846 6020A	80.0	µg/L
Cadmium (Total and Dissolved)	7440-43-9	SW-846 6020A	1.00	µg/L
Calcium (Total and Dissolved)	7440-70-2	SW-846 6020A	500	µg/L
Chromium (Total and Dissolved)	7440-47-3	SW-846 6020A	2.00	µg/L
Cobalt (Total and Dissolved)	7440-48-4	SW-846 6020A	0.500	µg/L
Copper (Total and Dissolved)	7440-50-8	SW-846 6020A	2.00	µg/L
Iron (Total and Dissolved)	7439-89-6	SW-846 6020A	50.0	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Lead (Total and Dissolved)	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium (Total and Dissolved)	7439-93-2	SW-846 6020A	5.00	µg/L
Manganese (Total and Dissolved)	7439-96-5	SW-846 6020A	5.00	µg/L
Mercury (Total and Dissolved)	7487-94-7	SW-846 7470A	0.200	µg/L
Molybdenum (Total and Dissolved)	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel (Total and Dissolved)	7440-02-0	SW-846 6020A	10.0	µg/L
Selenium (Total and Dissolved)	7782-49-2	SW-846 6020A	5.00	µg/L
Silver (Total and Dissolved)	7440-22-4	SW-846 6020A	1.00	µg/L
Thallium (Total and Dissolved)	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium (Total and Dissolved)	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc (Total and Dissolved)	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1.0	pCi/L
Radium-228	15262-20-1	EPA 904.0	1.0	pCi/L
Radium-226+228	RA226/228	CALC	1.0	pCi/L
Total Organic Carbon	7440-44-0	SM 5310C	1.00	mg/L

Notes:

Filtered samples will be collected for metals and mercury only.

CAS No.	-	Chemical Abstracts Service registry number
mg/L	-	milligrams per liter
µg/L	-	micrograms per liter
pCi/L	-	picoCuries per liter
CALC	-	Parameter determined by calculation.

Table G-5: Quantitative QA Objectives – CCR Material

Analyte/ Parameter Group	Method	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Arsenic Speciation	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471B	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Radium-226	EPA 901.1	< RL	75-125	NA	RER<2	NA	RER<2	RER<2
Radium-228	EPA 901.1	< RL	75-125	NA	RER<2	NA	RER<2	RER<2
Total Organic Carbon	Lloyd Kahn or SW-846 9060A	< RL	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
pH	SW-846 9045D Modified	pH 6-8 for laboratory-supplied deionized water	NA	NA	NA	NA	±0.2 pH units	±0.5 pH units

Notes:

[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
MS/MSD - Matrix Spike/Matrix Spike Duplicate
RPD - Relative Percent Difference
RER - Relative Error

Table G-6: Quantitative QA Objectives – SPLP Leachates

Analyte/ Parameter Group	Method	Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Arsenic Speciation	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury	SW-846 7470A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Total Organic Carbon	SM 5310C	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 Method 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:
[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS/MSD - Matrix Spike/Matrix Spike Duplicate
NA - Not Applicable
RPD - Relative Percent Difference
RER - Relative Error
RL - Reporting Limit
%R - Percent Recovery

Table G-5: Quantitative QA Objectives – Pore Water

Analyte/ Parameter Group	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals (Total and Dissolved)	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (Total and Dissolved)	SW-846 7470A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Organic Carbon	SM 5310C	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 Method 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:
[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS/MSD - Matrix Spike/Matrix Spike Duplicate
NA - Not Applicable
RPD - Relative Percent Difference
RER - Relative Error
RL - Reporting Limit
%R - Percent Recovery

ATTACHMENT H

INVESTIGATION-SPECIFIC QUALITY CONTROL REQUIREMENTS

SEEP SAMPLING

Table H-1. Sample Containers, Mass, Preservation, and Holding Time Requirements

Matrix	Parameter(s)	Container Type	Recommended Sample Mass/Volume	Preservation[1]	Holding Time
Seep Water	Metals (total)	250-mL HDPE	250 mL	HNO_3 to pH < 2 Cool to < 6°C	180 days
	Mercury (total)				28 days
	Metals (total)	250-mL HDPE	250 mL	HNO_3 to pH < 2 after filtration Cool to < 6°C	180 days
	Mercury (total)				28 days
	Anions (Chloride, Fluoride, and Sulfate)	250-mL HDPE	250 mL	Cool to < 6°C	28 days
	Radiological Parameters	3× 1-L HDPE	3000 mL	HNO_3 to pH < 2	180 days
	pH (field measurement)	NA	NA	NA	15 minutes
	Total Dissolved Solids (TDS)[2]	250-mL HDPE	100 mL (unfiltered)	Cool to < 6°C	7 days
	Total Suspended Solids (TSS)[2]	1 L HDPE	1000 mL (unfiltered)	Cool to < 6°C	7 days
Seep Soil	Metals	4-oz glass	5 g	Cool to < 6°C	180 days
	Mercury				28 days
	Radiological Parameters	16-oz glass	20 g	NA	180 days
	Anions (Chloride, Fluoride, and Sulfate)	4-oz glass	5 g	Cool to < 6°C	28 days
	pH				NA*
	Percent Ash	4-oz glass	5 g	NA	NA

Notes:

HDPE - High Density Polyethylene.
g - grams
mL - milliliters
L - liters
NA - Not applicable.

1 Filtered samples requiring chemical preservation will be preserved after field filtration.
2 TDS and TSS will be performed using unfiltered sample volume.

*Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

Table H-2: Analytes, Methods, and Reporting Limits – Seep Soil

Parameter	CAS No.	Method	Reporting Limit[1]	Units
Antimony	7440-36-0	SW-846 6020A	0.200	mg/kg
Arsenic	7440-38-2	SW-846 6020A	0.100	mg/kg
Barium	7440-39-3	SW-846 6020A	1.00	mg/kg
Beryllium	7440-41-7	SW-846 6020A	0.100	mg/kg
Boron	7440-42-8	SW-846 6020A	8.0	mg/kg
Cadmium	7440-43-9	SW-846 6020A	0.100	mg/kg
Calcium	7440-70-2	SW-846 6020A	50.0	mg/kg
Chromium	7440-47-3	SW-846 6020A	0.200	mg/kg
Cobalt	7440-48-4	SW-846 6020A	0.0500	mg/kg
Copper	7440-50-8	SW-846 6020A	0.200	mg/kg
Lead	7439-92-1	SW-846 6020A	0.100	mg/kg
Lithium	7439-93-2	SW-846 6020A	0.500	mg/kg
Mercury	7487-94-7	SW-846 7471B	0.0330	mg/kg
Molybdenum	7439-98-7	SW-846 6020A	0.500	mg/kg
Nickel	7440-02-0	SW-846 6020A	0.100	mg/kg
Selenium	7782-49-2	SW-846 6020A	0.500	mg/kg
Silver	7440-22-4	SW-846 6020A	0.100	mg/kg
Sodium	7440-23-5	SW-846 6020A	50.0	mg/kg
Thallium	7440-28-0	SW-846 6020A	0.100	mg/kg
Vanadium	7440-62-2	SW-846 6020A	0.100	mg/kg
Zinc	7440-66-6	SW-846 6020A	0.500	mg/kg
Radium-226	13982-63-3	EPA 901.1	1.00	pCi/g
Radium-228	15262-20-1	EPA 901.1	1.00	pCi/g
Radium-226+228	RA226/228	CALC	1.00	pCi/g
Percent Ash	%ASH	R.J. Lee SOP OPT23.02	1	%
Chloride	16887-00-6	SW-846 9056A Modified	10.0	mg/kg
Fluoride	16984-48-8	SW-846 9056A Modified	1.0	mg/kg
Sulfate	14808-79-8	SW-846 9056A Modified	10.0	mg/kg
pH	PH	SW-846 9045D Modified (laboratory-based definitive analysis)	0.1	pH units

Notes:

CAS No. - Chemical Abstracts Service registry number
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram
CALC - Parameter determined by calculation

1 Samples will be reported on a dry-weight basis; sample-specific reporting limits will vary based on sample mass, dilution factors, and percent moisture.

Table H-3: Analytes, Methods, and Reporting Limits – Seep Water Samples

Parameter	CAS No.	Method	Reporting Limit	Units
Chloride	7647-14-5	EPA 300.0/ SW-846 9056	1.00	mg/L
Fluoride	16984-48-8	EPA 300.0/ SW-846 9056	0.10	mg/L
Sulfate	7757-82-6	EPA 300.0/ SW-846 9056	1.00	mg/L
Total Dissolved Solids[1]	TDS	SM2540C	10.0	mg/L
Total Suspended Solids	TSS	SM2540D	10.0	mg/L
pH	pH	SW-846 9040C	0.05	pH units
Antimony (Total and Dissolved)	7440-36-0	SW-846 6020A	2.00	µg/L
Arsenic (Total and Dissolved)	7440-38-2	SW-846 6020A	1.00	µg/L
Barium (Total and Dissolved)	7440-39-3	SW-846 6020A	10	µg/L
Beryllium (Total and Dissolved)	7440-41-7	SW-846 6020A	1.00	µg/L
Boron (Total and Dissolved)	7440-42-8	SW-846 6020A	80	µg/L
Cadmium (Total and Dissolved)	7440-43-9	SW-846 6020A	1.00	µg/L
Calcium (Total and Dissolved)	7440-70-2	SW-846 6020A	500	µg/L
Chromium (Total and Dissolved)	7440-47-3	SW-846 6020A	2.00	µg/L
Cobalt (Total and Dissolved)	7440-48-4	SW-846 6020A	0.5	µg/L
Copper (Total and Dissolved)	7440-50-8	SW-846 6020A	2.00	µg/L
Lead (Total and Dissolved)	7439-92-1	SW-846 6020A	1.00	µg/L
Lithium (Total and Dissolved)	7439-93-2	SW-846 6020A	5.00	µg/L

Parameter	CAS No.	Method	Reporting Limit	Units
Mercury (Total and Dissolved)	7487-94-7	SW-846 7470A	0.200	µg/L
Molybdenum (Total and Dissolved)	7439-98-7	SW-846 6020A	5.00	µg/L
Nickel (Total and Dissolved)	7440-02-0	SW-846 6020A	10	µg/L
Selenium (Total and Dissolved)	7782-49-2	SW-846 6020A	5.00	µg/L
Silver (Total and Dissolved)	7440-22-4	SW-846 6020A	1.00	µg/L
Thallium (Total and Dissolved)	7440-28-0	SW-846 6020A	1.00	µg/L
Vanadium (Total and Dissolved)	7440-62-2	SW-846 6020A	1.00	µg/L
Zinc (Total and Dissolved)	7440-66-6	SW-846 6020A	5.00	µg/L
Radium-226	13982-63-3	EPA 903.0	1	pCi/L
Radium-228	15262-20-1	EPA 904.0	1	pCi/L
Radium-226+228	RA226/228	CALC	1	pCi/L

Notes:

CAS No.	-	Chemical Abstracts Service registry number
mg/L	-	milligrams per liter
µg/L	-	micrograms per liter
pCi/L	-	picoCuries per liter
CALC	-	Parameter determined by calculation

[1] TDS will be performed on unfiltered sample volume only.

Table H-4: Quantitative QA Objectives – Seep Soil Samples

Analyte/ Parameter Group	Method	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Percent Ash	R.J. Lee SOP OPT23.02	< RL	NA	NA	NA	NA	±10%	RPD < 35% difference < 2× the RL
Metals	SW-846 6020A	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471B	< RL	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Radium-226	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 901.1	< RL	75-125	NA	RER < 2	NA	RER < 2	RER < 2
Anions	SW-846 9056A Modified	< RL	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
pH	SW-846 9045D Modified (laboratory-based definitive analysis)	pH 6-8 for laboratory-supplied deionized water	NA	NA	NA	NA	±0.2 pH units	±0.5 pH units

Notes:
[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS/MSD - Matrix Spike/Matrix Spike Duplicate
NA - Not Applicable
RPD - Relative Percent Difference
RER - Relative Error
RL - Reporting Limit
%R - Percent Recovery

Table H-5: Quantitative QA Objectives – Seep Water Samples

Analyte/ Parameter Group	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	Equipment Rinsate Blank, Field Blank, Method Blank	LCS Accuracy (% R)	MS/MSD Accuracy (% R)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision[1]
Metals (Total and Dissolved)	SW-846 6020A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Mercury (Total and Dissolved)	SW-846 7470	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Total Suspended Solids	SM 2540D	NA	< RL	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Anions (Chloride, Fluoride, Sulfate)	SW-846 9056A	NA	< RL	80-120	75-125	20	20	20	RPD < 20% difference < the RL
pH	SW-846 9040C	NA	NA	NA	NA	NA	NA	NA	±0.5 pH units
Radium-226	EPA 903.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2
Radium-228	EPA 904.0	30-110	< RL	80-120	NA	RER < 2	NA	RER < 2	RER < 2

Notes:
[1] When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL

LCS - Laboratory Control Sample
MS/MSD - Matrix Spike/Matrix Spike Duplicate
RPD - Relative Percent Difference
RER - Relative Error

APPENDIX D
DATA MANAGEMENT PLAN

TENNESSEE VALLEY AUTHORITY

MULTI-SITE ORDER ENVIRONMENTAL INVESTIGATIONS

DATA MANAGEMENT PLAN

Revision 1

March 2018

Prepared by

ENVIRONMENTAL STANDARDS, INC.
1140 Valley Forge Road
P.O. Box 810
Valley Forge, PA 19482-0810

Prepared for

TENNESSEE VALLEY AUTHORITY
1101 Market Street
Chattanooga, TN 34702-2801

Revision Log MULTI-SITE ORDER ENVIRONMENTAL INVESTIGATIONS DATA MANAGEMENT PLAN (TVA EI DMP)		
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Revision 1, March 2018	2.1.2	Updated responsibilities to align with QA Program definitions.
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APPENDICES

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1.0 INTRODUCTION

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (Multi-Site Order), to the Tennessee Valley Authority (TVA), setting forth a process for the investigation, assessment, and remediation of unacceptable risks at TVA's coal ash disposal sites in Tennessee. In response to the Multi-Site Order, TVA is initiating Environmental Investigations (EIs) at each of the TVA facilities in Tennessee addressed in the Multi-Site Order. The primary goal of this TVA EI Data Management Plan (TVA EI DMP) is to address the logistics and technical challenges of managing analytical data generated by environmental laboratories and Field Sampling Personnel in support of activities intended to address the requirements set forth in the Multi-Site Order. This TVA EI DMP is intended to provide a basis for supporting a full technical data management business cycle from pre-planning of sampling events to reporting and analysis with a particular emphasis on completeness, data usability, and most importantly, defensibility of the analytical data.

Typical environmental Quality Assurance Project Plans (QAPPs), Sampling and Analysis Plans (SAPs), and Data Management Plans (DMPs) predominately focus on analytical chemistry data from the environmental investigations of various media (air/vapors, soil, sediment, surface water, and groundwater) and receptors (ecological and human). Due to the comprehensive nature of the Coal Combustion Residuals (CCR) Rule and the Multi-Site Order, the over-arching disciplines requiring data management are:

- Civil/Mapping;
- Environmental/Surface Water;
- Geotechnical; and
- Hydrogeology.

The work products of these disciplines will produce a wide-range of data and deliverables needing management. In addition, the Multi-Site Order requires a timely distribution of information to TDEC as well as public involvement.

TVA has decided that the best way to support the wide-array of data management needs related to the Multi-Site Order, is to build a SharePoint-based knowledge management portal (KMP) where data and deliverables will be housed and accessible. The KMP will integrate the EarthSoft® EQuIS™ (EQuIS) database for analytical chemistry and field parameter data, geographic information system (GIS) database for geospatial data, and various other databases for historical and current deliverables. The KMP will thus serve as the central access point for the Environmental Investigation Plans (EIPs), the EI data, and other data necessary for the Corrective Action/Risk Assessment (CARA).

To support the TVA Multi-Site Order response objectives, a Quality Assurance (QA) program has been implemented to verify that environmental data generated for use in decision-making is of high quality and is legally defensible. The QA program is documented in the QAPPs developed as part of each site-specific EIP. The sampling design and execution for monitoring activities associated with each EI are described in the site-specific EIP and investigation-specific SAPs.

Environmental data have been and will continue to be used for purposes such as, but not limited to, operational decisions, ecological and human health risk assessments; delineation of the extent of contamination and ash transport; and to demonstrate the achievement of project objectives. Accordingly, it is imperative that the data are subjected to a formal data management process.

On behalf of TVA, Environmental Standards, an independent QA firm, has prepared this TVA EI DMP. The requirements of the TVA EI DMP are applicable to TVA environmental personnel, TVA information technologies personnel, support staff, contractors, and analytical laboratories.

1.1 Historical and Recent Data

Environmental data associated with surface water, groundwater, sediment, biological, CCR, and soil samples have been collected by TVA during previous operational periods. For the purpose of this TVA EI DMP, "historical" data on this project is defined as analytical data collected by TVA or its contractors prior to the institution of this data management plan. Historical analytical data sets intended for use under the TVA Multi-Site Order response will be included in TVA's project database as requested by TVA. Historical data migration efforts will be detailed in one or more separate Data Migration Plans, at such time that the scope of the migration has been developed. TVA will conduct environmental sampling under the EIPs developed in response to the Multi-Site Order, resulting in the generation of a significant amount of environmental analytical and related field data; these data are referred to as "Recent" data in this TVA EI DMP.

1.2 Existing Project Database General Structure

TVA and its designated contractors will use an existing EQuIS database (TVA EI database) to store recent data, as well as any historical data requiring migration. The TVA EI database will be separated into distinct facilities to store data associated with each site-specific EIP. The database will use common valid values, data qualifier definitions, and management processes across all TVA facilities. Reference value files (RVF) containing lists of valid values used in the database will be provided to analytical laboratories, Field Team Leaders, and other appropriate parties, as needed.

1.3 Objectives

The major objectives for the TVA Multi-Site Order Data Management Program are to:

- Maintain data control, consistency, reliability, and reproducibility throughout the life of the EIs;
- Establish the framework for consistent documentation of the quality and validity of field and laboratory data compiled during investigations;
- Describe in detail the data management procedures for EI-related data;
- Include procedures and timelines for sharing data with stakeholders as well as procedures for providing both electronic and hardcopies to specified recipients of each type of data; and
- Enable the use of EI data in a consistent and easily shared format among appropriate parties.

2.0 DATA MANAGEMENT TEAM

This section describes the key roles and responsibilities associated with the Data Management Program and processes for managing data.

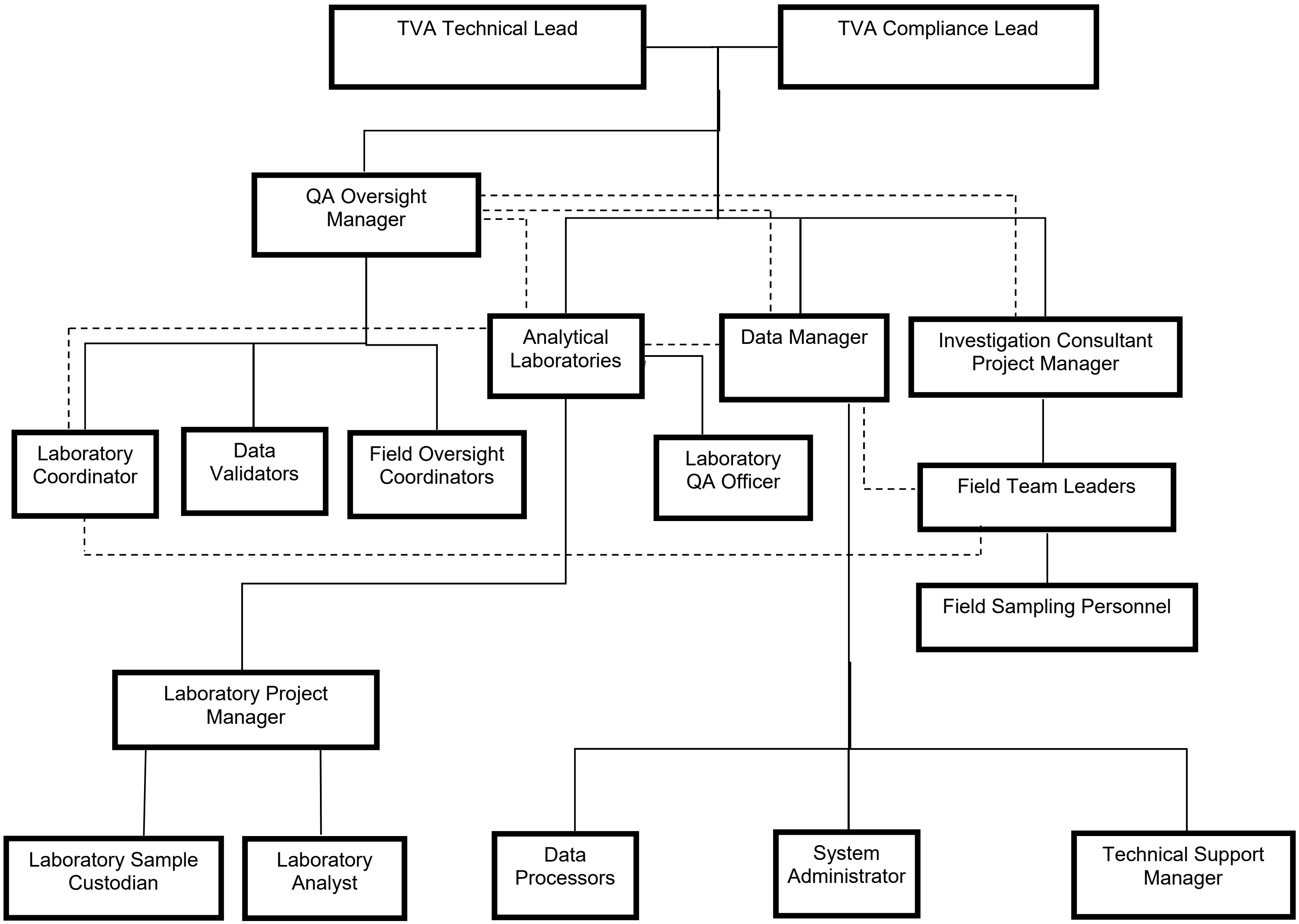
Users of the EQuIS Quality and Data Management System (EQDMS) primarily consist of technical and project staff that are assumed to have a general understanding of the environmental data and the EIs being conducted at each TVA facility. Some users are also required to have an advanced understanding of the EQDMS and relational database architecture.

The data management team consists of the following positions.

- Data Manager
- Data Processors
- Technical Support Manager
- System Administrator
- Data Analysts and Other Data Users
- Field Team Leaders
- Field Sampling Personnel
- Laboratory Coordinator

The organization chart for the TVA EI Data Management Program is presented in Figure 2-1. The Data Management Team is a component of the overall QA Program for each plant-specific EI. The roles and responsibilities for the TVA Technical Lead, TVA Compliance Lead, Investigation Consultant Project Manager and subordinate roles, Analytical Laboratory and subordinate roles, and QA Oversight Manager and subordinate roles are detailed in the QAPP developed for each of the plant-specific EIs. The relationship between the TVA Technical Lead and the TVA Compliance Lead is reflected in Part VII.F of the Multi-Site Order. Descriptions of data management personnel roles and responsibilities, and additional responsibilities of project personnel specific to the data management program, are provided in the sections below.

Figure 2-1. Organization Chart and Lines of Communication for TVA Multi-Site Order EI Data Management



2.1 Data Managers

Data Managers are responsible for managing the project EQuIS database, which includes analytical data from the project laboratories, field data from the investigation consultant, and historical data of known quality that is intended for use under the TVA Multi-Site Order. The Data Manager acts as the single point of contact for TVA for data management and for data-related issues. Data Managers are responsible for ensuring compliance with the plant-specific EI QAPP and the TVA EI DMP. Data Managers make certain that adequate Data Management Team members are available and properly trained, and that adequate software and hardware are available. Data Managers perform periodic audits on components of the data management system including access and security controls, system documentation, and data backup procedures. Data Managers have an intimate knowledge of the data management process, relational database concepts, and the architecture of the EQDMS.

Data Managers are typically the most knowledgeable and active user of the EQDMS and performs or directs the majority of the data updates or changes. A Data Manager or designee receives electronic data deliverables (EDDs) directly from the project laboratories after sample analysis and formats the deliverables such that they can be used during the validation/verification process. Field data is collected and submitted to a Data Manager from the Field Team Leaders utilizing field EDDs and is loaded and managed in the project database. Data Managers work directly with the Investigation Consultant Project Managers and field staff members to perform checks that the data are complete and accurate, as well as with data analysts, and other data users to provide queries, tables, graphs, and data exports. Data Managers are responsible for updating and implementing the TVA EI DMP and other quality documentation pertaining to data management.

2.1.1 Data Processors

Data Processors log in and load data delivered to the system. Data Processors are responsible for first-level activities and report any exceptions encountered in a standard process to the Data Manager for review and action. Data Processors are responsible for deliverable tracking, standard data loading, and providing standard EQDMS reports. Data Processors update or modify data in the database at the direction of the Data Manager in support of QA activities.

2.1.2 Technical Support Manager

The Technical Support Manager is responsible for any programming or database schema change required to support the operation of the EQDMS for this project. The Technical Support Manager is typically involved in the planning and implementation phases of the project and, once the system is operational, acts primarily as a technical advisor to the project team for any contemplated change in functionality. The Technical Support Manager sets user authentication and controls access to the data, maintains data tables necessary for the EQDMS to run, and generally manages EQDMS usage. The Technical Support Manager has a strong background in information systems and relational database hardware, software design and programming, detailed understanding of the EQDMS architecture, and familiarity with the data management business process.

2.1.3 System Administrator

The System Administrator will be responsible for the operation and maintenance of the EQDMS. The System Administrator will back up the data and confirm that the system is available for users. The System Administrator has a strong background in network support, information systems, and hardware and software maintenance.

2.2 Field Team Leaders

The Field Team Leaders are the primary contacts in the field and are responsible for field activities, as listed below.

- Provide coordination and management of field personnel and subcontractors.
- Provide coordination of field sampling and calibration activities.
- Submit analytical requests to the Laboratory Coordinator.
- Verify field-sampling personnel are familiar with field procedures and that these procedures are followed to achieve the data objectives.
- Review field logbooks and field data sheets for completeness, consistency, and accuracy.
- Conduct QA review of field data and coordinate submittal of field data to the Data Manager

Field Team Leaders are responsible for implementing the investigation-specific SAPs that describe data collection requirements and activities to be conducted. Field Team Leaders are responsible for overall coordination between field activities and the data management process. Field Team Leaders understand the data management process and interactions between field and data management staff.

2.2.1 Field Sampling Personnel

Field Sampling Personnel are responsible for the performance of field activities as required by the investigation-specific SAPs and associated field TIs. Field Sampling Personnel document compliance with project requirements by recording field activities and observations in a field logbook at the time of the activity or observation. In addition, Field Sampling Personnel are responsible for collecting samples, submitting them to laboratories, and maintaining COC Records.

2.3 Laboratory Coordinator

The Laboratory Coordinator serves as a liaison between Field Team Leaders and the analytical laboratories. The Laboratory Coordinator's responsibilities include:

- Review analytical requests to verify consistency with project SAPs.
- Submit analytical requests to the Laboratory Project Manager.
- Schedule sample submission and transportation (as needed).
- Review and approve laboratory bottleware orders.

- Review Chain of Custody (COC) Records submitted to the laboratories and sample receipt documentation provided by the laboratories.
- Serve as the point of contact for questions and issues arising during laboratory analysis.

2.4 Data Analysts and Other Data Users

Data analysts and other data users may be any project team members who require access to analytical data for reporting, interpretation, or decision-making. Data analysts and other data users use the EQDMS to evaluate data that have completed the verification/validation process. Analysts and Users can run standard reports in EQDMS and do not update or modify data in the database.

3.0 DATA MANAGEMENT PROCESS

Optimal control of data is enforced by rigorous pre-planning of sampling activities. The EQDMS provides the functionality to support the creation of COC forms and bottle labels, auto loading of laboratory-generated analytical chemistry data, automated correctness checking, detailed completeness checking, data verification, support for data validation reporting and editing, and technical data reporting and presentation. This functionality exists so that the stages of data management are efficient and performed as accurately as possible. Appendix A presents workflow diagrams illustrating the overall data management process and the detailed data verification/validation process.

3.1 Planning

The data management process starts with preparation of the investigation-specific SAP. This planning phase gives consideration for appropriate levels of documentation specific to the individual data collection process and details any appropriate field measurements and/or other event-related data. Based on the field-planning document, the Data Manager configures the EQDMS for the investigation to support the data collected on the required COC forms. Configuration of the system may involve defining Method Analyte Groups (MAGs) in the database that include the methods used by laboratories to analyze samples and the analytes to be reported by those methods, as well as setting up standard forms and reports to meet the needs of the project team. The EQDMS supports storage of the information on the COC form, including the laboratory, shipping information, sample identifications (IDs), type and quantity of containers, preservatives, analytical tests, sample date, and sampler. At the time of sample collection, the Field Sampling Personnel fill out the remaining information including the sampler's initials, sample collection date, and time, shipping information and sample IDs. Some deviation from this approach may be acceptable if it is fully documented and approved in investigation-specific SAPs.

3.2 Field Measurements and Sample Collection

The process continues with Field Sampling Personnel collecting environmental samples and field measurements, and documenting field activities. Field documents must be recorded and stored electronically in accordance with project requirements. The EQDMS provides the functionality to create the electronic COCs (eCOCs), or COCs may be manually populated by the Field Sampling Personnel, at the discretion of TVA and its designated contractor(s). The COC form, whether generated as an eCOC or hand-written, will serve as the legal document of sample handling and transfer. The COC form is provided to the Data Project Manager to enter technical data into the EQDMS and could possibly include additional sampling event information, coordinate data and field measurements. The details for the specific data to be collected during sampling or other activities are contained in investigation-specific SAPs and related TIs.

3.3 Sample Tracking

Sample tracking begins when the COC is created. Events tracked in the EQDMS include: sample shipment, laboratory sample receipt, data package receipt, EDD receipt, and any rejection or resubmission dates, as needed.

Data Processors update the sample tracking records in EQDMS upon receiving a deliverable. The laboratory receives and evaluates the samples for proper COC procedures and sample handling. The laboratory assigns unique laboratory sample IDs and a Sample Delivery Group (SDG) number. To confirm that samples were received and that the correct analyses will be performed, the laboratory then provides the Data Processors with a sample receipt confirmation (SRC) that specifies the following.

- Sample receipt quantities and condition of containers (such as broken/leaking, temperature, hold time, custody maintained).
- Sample preparation (such as compositing and filtration) and analyses to be conducted.
- Date that analyses will be completed.
- Laboratory sample IDs and SDG number.

A copy of the SRC is provided to Data Processors who update the database with the sample receipt information and continue to track sample/data reporting progress until all data are delivered and review completed.

3.4 Laboratory Analysis and Reporting

The laboratory personnel analyze the samples as specified on the COC Record and according to the published method and project-specific requirements outlined in the associated plant-specific EI QAPP. Once the samples are analyzed, an electronic copy of the laboratory data package and an EDD are produced and forwarded to an electronic mailbox established specifically for the project. A Data Processor monitors the project mailbox for deliverables received and processes the data for testing against project specifications as described in the following sections.

3.5 Data Loading and Review

Data are assigned status values based on progression through the data loading and review process. There are currently three status levels for data that have been reviewed. These status levels are “VERIFIED”, “FINAL-VERIFIED”, and “VALIDATED”. Data are automatically unclassified and assigned no status upon initial load to the database. After an automated chemistry data verification and second-level review, data are manually assigned a state of “VERIFIED” by a Data Processor. If automated verification is the only level of review required, the Data Processor sets the data to a stage of “FINAL-VERIFIED”. Upon completion of data validation inclusive of senior reviews, data are assigned a status of "VALIDATED" by a Data Processor.

3.5.1 Initial Data Loading

EDDs are received in an electronic mailbox established specifically for the project. EDDs are loaded by a Data Processor and data are automatically unclassified. The first test of the EDD is for correctness against the project specifications. Correctness testing is a review of the EDD format against structural rules. Correctness determines if data are delivered using the correct file layout, data types, and adherence to project specific values. The full list of requirements can be found in the EDD specification in Appendix B. When an error is identified during testing for correctness, an e-mail containing a report of the deficiency is created and reviewed by a Data Manager and sent to the laboratory with the request for resubmission. Typical problems found in this review are missing or incorrect valid values, incorrectly formatted data, duplicate rows, and missing Parent/Child sample relationships.

After successfully passing the correctness testing and subsequent loading to the database, data completeness is checked by comparing the planned sampling data associated with the COC form to the actual sample, analytical method and analyte delivered by the laboratory. When an error is identified during testing for completeness, an e-mail containing a report of the deficiency is created and reviewed by the Data Manager and sent to the laboratory requesting resubmission, with a copy to the QA Oversight Manager.

Once data have passed correctness and completeness processing, the data are ready for automated data verification processing.

3.5.2 VERIFIED Status

Automated electronic data verification is only performed on data that has been deemed to be correct and complete. A verification report is produced for review by the Data Validator. Data verification activities are conducted according to the associated plant-specific QAPP. The criteria used to assess accuracy and precision of the data are detailed in the associated plant-specific QAPP. The data are reviewed from a usability perspective using screening software; the qualification assigned by the screening software are subsequently reviewed by a Data Validator. A Data Processor will make any needed edits identified by the Data Validator. All edits are reviewed by the initial Data Validator, as well as peer reviewed by the QA Oversight Manager. After review and approval of the data verification report and related results by the Data Validator, the data are assigned a status of "VERIFIED" by a Data Processor.

3.5.3 FINAL-VERIFIED Status

Data that are not going to be subjected to data validation are set to a status of "FINAL-VERIFIED" by a Data Processor once the verification process as detailed above is complete.

3.5.4 VALIDATED Status

Validation will occur after automated verification has been completed. The decision to perform data validation on any given data set will be determined based upon the data quality objectives for that data set. Data validation is supported by reporting and edit functionalities in the EQDMS. Data tables are provided to the Data Validator, who will manually annotate those tables with validation edits. A Data Processor will make any needed edits; edited data tables are returned to the initial Data Validator for review and approval. Once all edits have been confirmed, final validation tables will be prepared for inclusion in reports. All edits are reviewed by the initial Data Validator, as well as peer reviewed by the QA Oversight Manager. This stage also reveals and resolves any EDD to hardcopy data discrepancies. After review and approval of the final data validation tables by the QA Oversight Manager, the data are assigned a status of “VALIDATED” by a Data Processor.

The associated plant-specific QAPP and/or the investigation-specific SAPs detail the sample program specific goals for the timeline of activities such as validation.

3.6 EQuIS Reports

Reports are available to users through EQuIS Professional or EQuIS Enterprise. Standard EQuIS reports and a summary of their purposes are detailed in Appendix C.

3.7 Management of Historical Data

As indicated in Section 1.2, there have been prior sampling events at TVA facilities that generated historical data. Managing historical data from these investigations is complicated by the fact that the agencies and contractors performing the investigations used different methods for sampling and analysis. In addition, the historical data may not have complete laboratory reports that allow proper verification/validation of the data. To manage historical data in a manner that addresses the variety of types, sources, and formats, as well as concerns regarding data validation, the following procedures will be implemented.

Electronic data received from other consultants may be migrated to EQDMS. The migration steps include matching up the historical fields with the fields in EQDMS, appending the historical data into the previously determined EQDMS fields, and running error checks on the newly appended data. If questions arise, the previous consultants are contacted for data clarifications. The data migration steps, such as field matching and changes made, are documented for future reference.

If only hardcopy files exist for desired results, these files may be used to perform manual entry of data into EQDMS. Any data requiring manual entry are checked by a second person for correctness of the entry.

Depending on the source and reliability of the historical data, data will be marked reportable or non-reportable. Reportable data are data deemed appropriate for quantitative use. Non-reportable data are deemed to be of unknown quality and may be used for qualitative purposes only. Historical data will be reviewed and assessed for potential quantitative or qualitative use following the procedures described in Section 14.0 of the associated plant-specific QAPP. Data are loaded into the database with an unclassified status, and updated to a status of “FINAL-NOT QCd” or another relevant status based upon the data quality and review.

Historical and legacy data that are determined to be intended for quantitative use will be subjected to a formal critical review process. Historical data will minimally be subjected to a reasonability review to identify potentially suspect data, apparent anomalies, or data that are not representative of current site conditions. Additional evaluation and/or validation may be conducted following the reasonability review; the level of review and validation conducted will be dependent on the data type, availability of supporting documentation, and criticality of the dataset for completing project objectives. In the event that historical or legacy data cited in the EIP cannot be substantiated, the data may not be suitable to support certain aspects of the investigation, and new data may be collected to supplement the historical/legacy data. After undergoing the review process described in the plant-specific QAPP, the data are marked appropriately within the EQDMS (*i.e.*, data deemed appropriate for quantitative use are marked as reportable and data deemed of unknown quality and or appropriate for qualitative use only are marked as non-reportable. Non-reportable results remain in EQDMS and can be queried, but are not included in standard reports. Custom reports can be created for non-reportable historical data, but users are cautioned about the undetermined reliability of the data.

3.8 Documenting and Communicating Changes to Reported Data

3.8.1 Communication of Issue

Errors in reported data are typically found by the data user or an individual working as part of the data management team. It is the responsibility of the individual to correctly identify and report an error in data stored in the EQDMS. An individual on the project team (a stakeholder) who identifies a need to change data must send an e-mail to a Data Manager describing the requested data change and providing supporting documentation. Any individual requesting a changed to data in the EQDMS is referred to as the Data Change Requestor in the subsequent sections. The Data Change Request Workflow Diagram presented in Appendix D illustrates the process for managing changes to reported data.

3.8.2 Completion of the Data Change Request Form

A Data Manager is responsible for reviewing the request and initiating a Data Change Request Form. An example Data Change Request Form is presented in Appendix E. Completion of the Data Change Request Form is essential to ensuring that the appropriate procedures and approvals are in place prior to initiating any changes and/or updates to the data reported in the EQDMS. The form contains essential information pertaining to the request itself, the origin of the request, the solution applied, contact information and signatures upon the approval and completion of the task. The Data Change Request Form shall be completed by the Data Manager with information from the Data Change Requestor. Additionally, the Data Change Request Form requires signatures by the QA Oversight Manager, the Data Manager, and the Data Change Requestor.

The Data Manager shall complete the Data Change Request Form prior to the approval and initiation of any changes and/or updates to the data already loaded to the EQDMS. The following sections of the Data Change Request Form shall be completed in full:

- Date: Date of the request as initiated by the Data Change Requestor
- Proposed Completion Date: Tentative date of completion as identified by the Data Requestor

- Name: Data Change Requestor
- Company: Data Change Requestor's company
- Phone/E-mail: Contact information of the Data Change Requestor
- Description of Request: A detailed summary outlining the request along with its origin and purpose
- Required Signatures: the printed name, signature and date signed of the:
  - Data Manager
  - QA Oversight Manager
  - Data Change Requestor

3.8.3 Communication and Approval Process for Data Change Request Form

The following steps are performed when communicating and approving the Data Change Request Form.

- The Data Manager complete the Data Change Request Form in its entirety as detailed above. A brief description of the resolution shall be provided in the section for use by the Data Project Manager.
- The Data Manager shall then request the review and confirmation of the Data Change Request Form by the Data Change Requestor.
- Upon approval of the Data Change Request Form, the Data Requestor will sign and date the form.
- The Data Manager will submit the Data Change Request Form to the QA Oversight Manager for review and signature.
- The Data Manager shall coordinate or perform the data change or update as requested. Upon resolution, the Data Manager shall sign and date the form.
- Once the Data Change Request Form is signed by all necessary parties, the Data Manager shall e-mail the approved Data Change Request Form, along with a report or query to confirm appropriate changes, to all stakeholders.
- Completed Data Change Request Forms will be posted on the KMP.

4.0 EQDMS DATA MANAGEMENT SYSTEM

This section provides an overview of the EQDMS and its components. This section also describes the specification for laboratory data submission and valid values.

4.1 EQDMS Overview

The EQDMS is composed of a commercially available environmental data management software suite, EQuIS, and can be supplemented and expanded using purpose-built QA Modules to work with the EQuIS software. The EQDMS has been configured to support project-specific requirements. The EQuIS software suite, which has been in use and continuously improved since 1994, is used on many environmental projects by industrial clients, consultants, and regulatory agencies at the state and federal levels. Functionality is provided on the internet for casual users and on the desktop for power users.

Software modules used on this project are described below.

4.1.1 EQuIS Enterprise Database

Analytical data, field data, and water level measurements are stored and hosted in a Microsoft® SQL database using the EQuIS Enterprise SQL server data schema. EQuIS connects to and accesses data using industry standard methodology. Security of the data is maintained using SQL server roles and assigning users appropriately.

4.1.2 COC Forms

COC forms for this project may be hand-written or generated utilizing an eCOC generator, if desired. The eCOC generator creates a unique COC ID and enables the Field Sampling Personnel to print COC forms. The eCOC is provided to the Data Project Manager to enter technical data into the EQDMS and could possibly include additional sampling event information, coordinate data and field measurements. The data generated from the eCOC are used to test analytical laboratory data for completeness and support status reports. The details for the specific data to be collected during sampling or other activities are detailed in investigation-specific SAPs, and related TIs.

4.1.3 EQuIS Enterprise Electronic Data Processor

The Enterprise electronic data processor (EDP) functionally enables loading of EDDs, testing against project specifications, and reporting the results of the testing to users. The rules and criteria built into the selected EDP Format are used to verify the correctness of EDDs.

4.1.4 Completeness Processor

The Completeness Processor assesses laboratory data within an SDG for the existence of project-specified data such as target analyte lists. Each SDG should represent a set of samples based on a COC form, each sample represents a set of analytical methods, and each analytical method represents a particular list of target analytes. MAGs are used to define required methods, analytes, fractions, and units. Completeness checks performed on data loaded into the EQDMS include:

- Confirming that all samples, analytical methods, and analytes requested on the COC/MAG are provided by the laboratory
- Confirming that no additional samples, analytical methods, or analytes are provided by the laboratory that were not planned
- Confirming that the following fields match identically between the planned and laboratory data:
    - Sample Names
    - Sample Matrix
    - Analytical Method
    - Fraction
    - Chemical Abstract Service (CAS) Registry Number
    - Result Units

4.1.5 Data Verification Module

The Environmental Standards Data Verification Module assesses loaded, correct, and complete data against project-specific QC limits for field and lab blank contamination, holding times, accuracy, precision, and surrogates. This functionality supports the project goals by automating a significant amount of manual effort in the quantitative assessment of analytical data.

4.1.6 EQuIS Enterprise

Enterprise is a web-based portal for visualization and generating pre-defined reports on demand. This function is ideally suited for casual users with a need to access project data in a simplified way and build simple reports. Users may run reports with defined parameters selected and save those settings for future uses as a "Pick Report." Pick Reports can be scheduled for automated processing based on pre-defined triggers, the arrival of an EDD, or on a schedule such as a day of the week. Output from this reporting function can be a spreadsheet, a PDF, or a complex formatted deliverable such as an Excel® file that auto-formats based on selections.

4.1.7 EQuIS Professional

EQuIS Professional is a desktop application that is designed for more technical users. It has the capability to perform the same reporting functions as seen in Enterprise, but can additionally design, build, and publish Enterprise reports. This application enhances decision support by enabling links to analysis and visualization functions that can create crosstab tables, graphs, and statistical output. EQuIS Professional can also interface with third-party tools such as gINT®, Rockworks®, EVS®, Visual Modflow®, and Excel.

4.2 Electronic Data Deliverable Specification

The EQDMS can import EDDs in a wide variety of formats. The standard EQuIS EQEDD is used for submittal of all recent data by analytical laboratories. Laboratories are required to submit EDDs in accordance with the EQEDD Format provided in Appendix B.

5.0 SYSTEMS MANAGEMENT AND ADMINISTRATION

This section describes how the EQDMS is managed and administrated. Database Administration includes:

- Adding, altering, and deleting users, roles, and privileges; and
- Providing for routine backup of the database.

5.1 Access and Security

The EQDMS uses application-level and database-level security to limit access to system functionality. Users are required to log onto the system in order to gain entry into the application. The Data Management team has defined privileges based on roles while other users, such as data analysts and other data users have read-only privileges to the project data and read/write privileges to their personal reports. User accounts and privileges are maintained by the Technical Support Manager and approved by a Data Manager.

5.2 Data Backup

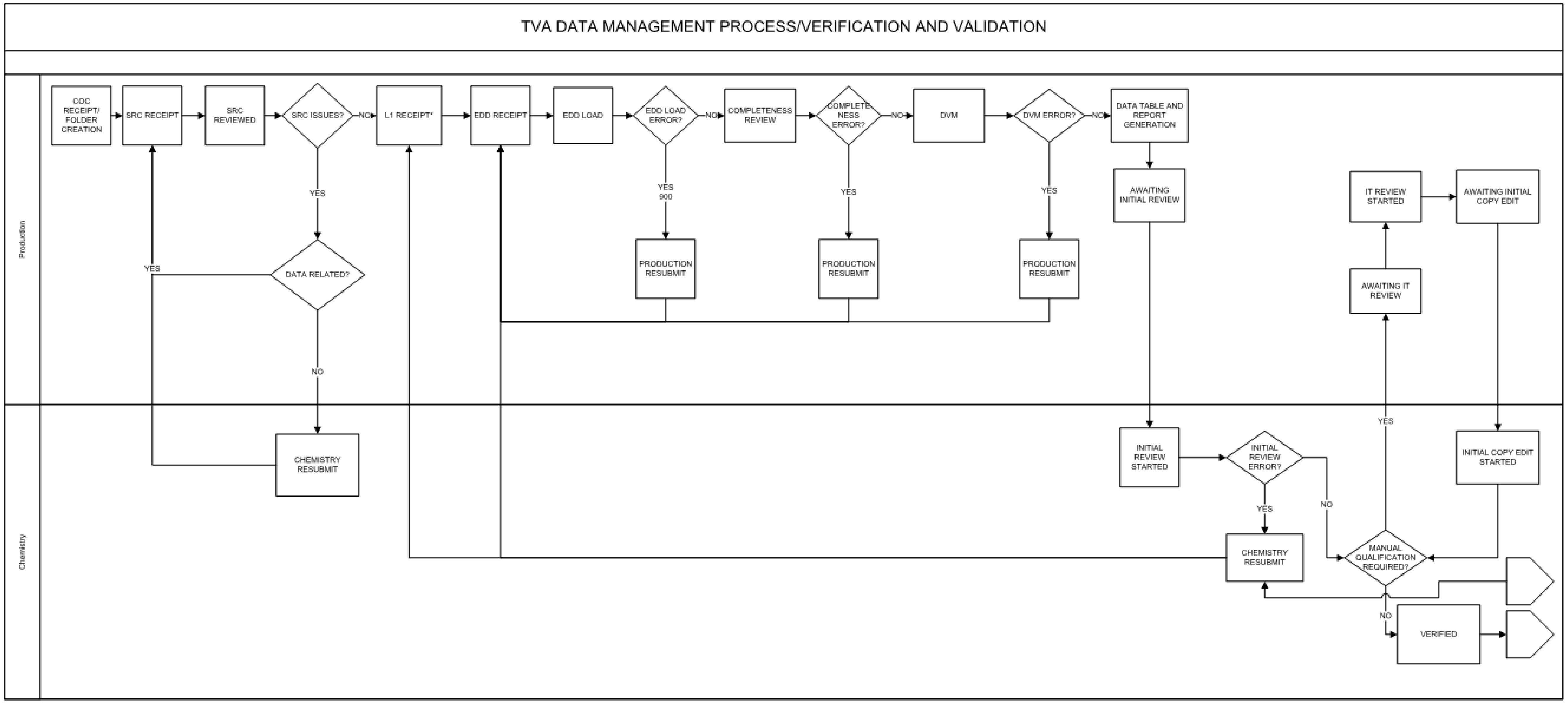
Automated full backups of the EQDMS are performed daily, and automated incremental backups of transactions are performed every 15 minutes to safeguard that any potential data loss is limited. An incremental daily backup is archived every night and retained for 30 days. A full weekly backup is archived and retained for 2 months. Monthly full backups are archived and retained for 40 years. Backups are written to digital tapes and are stored the next business day in an off-site environmentally controlled storage facility.

6.0 REFERENCES

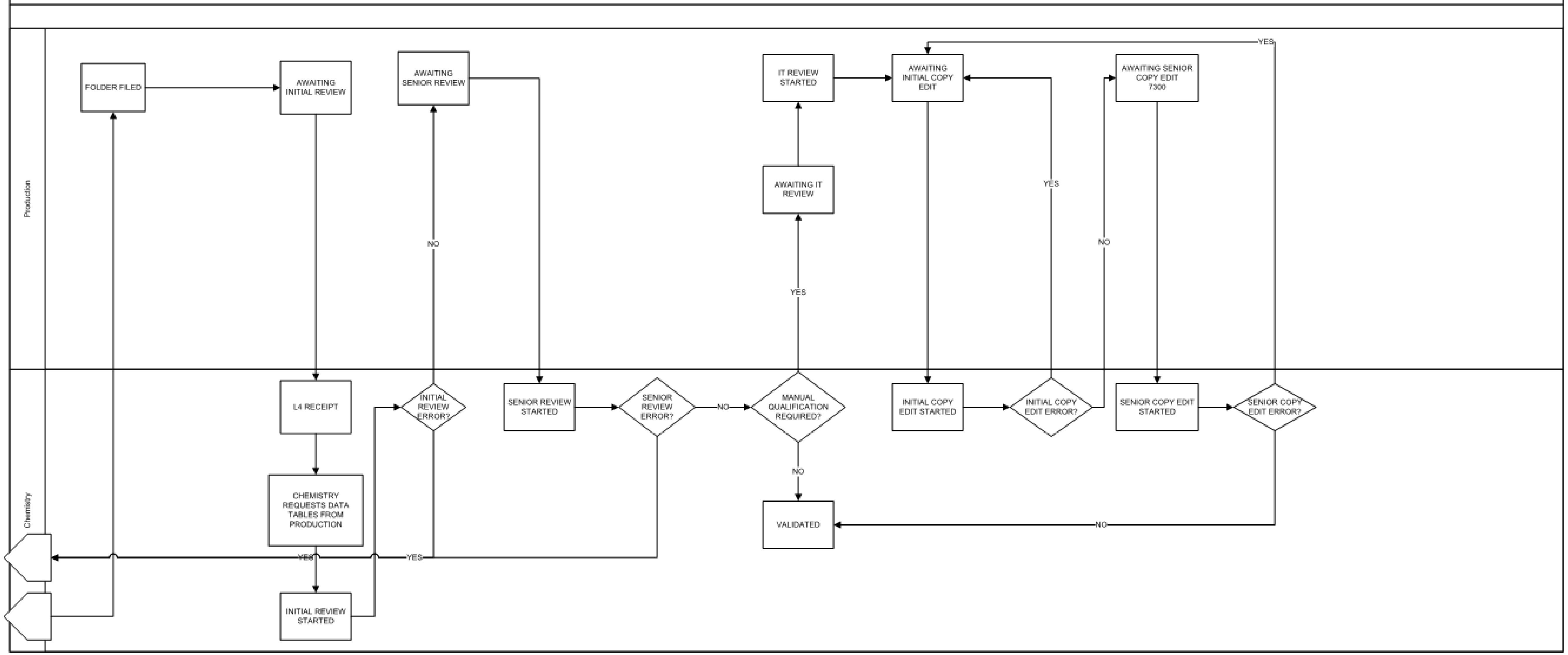
- ENV-TI 05.80.02 Sample Labeling and Custody
- ENV-TI 05.80.03 Field Record Keeping
- ENV-TI 05.80.04 Field Sampling Quality Control
- ENV-TI 05.80.06 Handling and Shipping of Samples

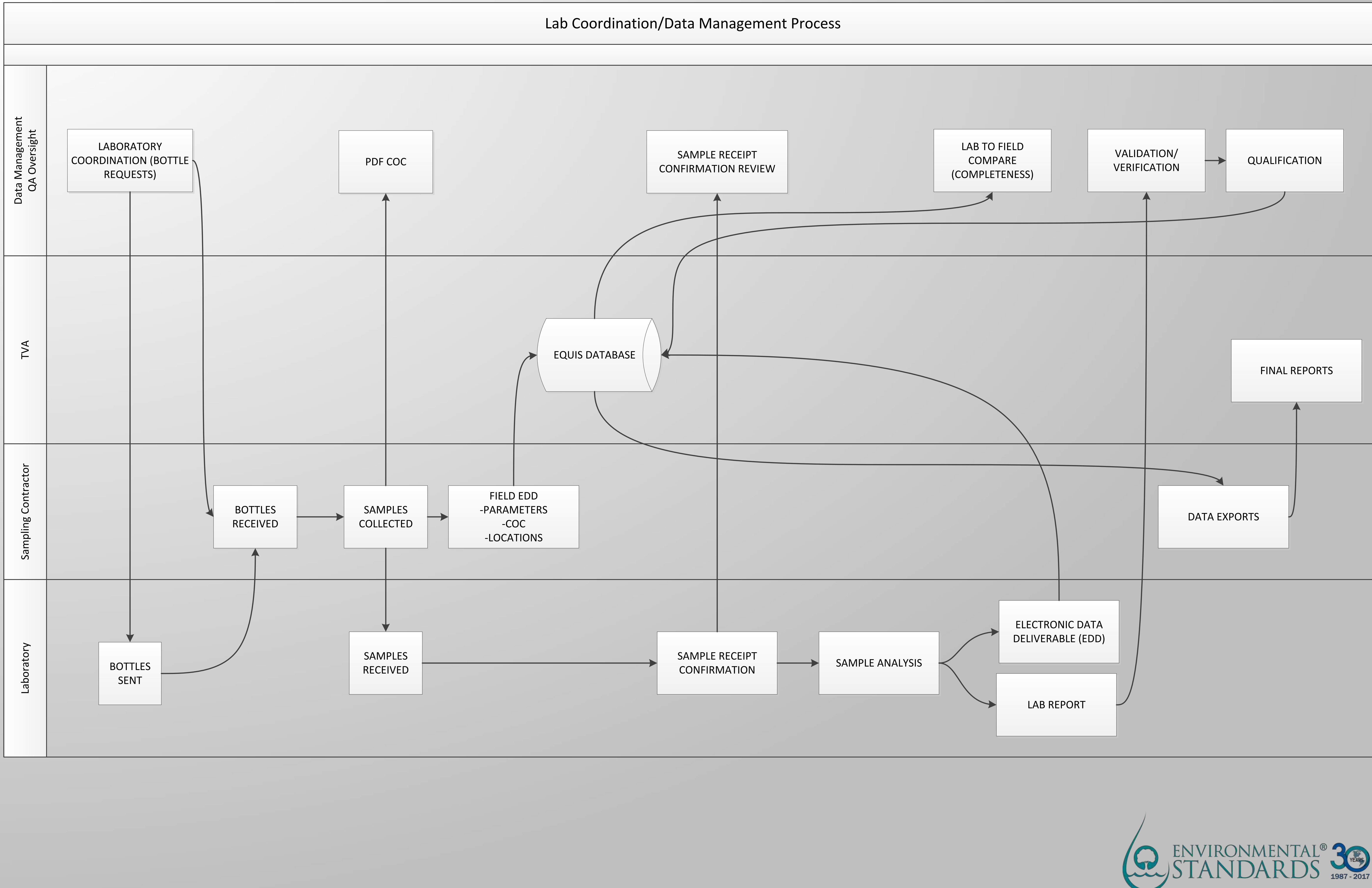
APPENDIX A

DATA MANAGEMENT WORKFLOW DIAGRAMS


TVA DATA MANAGEMENT PROCESS/VERIFICATION AND VALIDATION
Production
Chemistry
COC RECEIPT/ FOLDER CREATION
SRC RECEIPT
SRC REVIEWED
SRC ISSUES?
NO
L1 RECEIPT*
EDD RECEIPT
EDD LOAD
EDD LOAD ERROR?
COMPLETENESS REVIEW
COMPLETENESS ERROR?
DVM
DVM ERROR?
DATA TABLE AND REPORT GENERATION
AWAITING INITIAL REVIEW
IT REVIEW STARTED
AWAITING INITIAL COPY EDIT
AWAITING IT REVIEW
YES
YES 900
DATA RELATED?
PRODUCTION RESUBMIT
CHEMISTRY RESUBMIT
INITIAL REVIEW STARTED
INITIAL REVIEW ERROR?
INITIAL COPY EDIT STARTED
MANUAL QUALIFICATION REQUIRED?
VERIFIED

TVA DATA MANAGEMENT PROCESS/VERIFICATION AND VALIDATION (CONT)




Lab Coordination/Data Management Process
Data Management QA Oversight
TVA
Sampling Contractor
Laboratory
LABORATORY COORDINATION (BOTTLE REQUESTS)
PDF COC
SAMPLE RECEIPT CONFIRMATION REVIEW
LAB TO FIELD COMPARE (COMPLETENESS)
VALIDATION/ VERIFICATION
QUALIFICATION
EQUIS DATABASE
FINAL REPORTS
BOTTLES RECEIVED
SAMPLES COLLECTED
FIELD EDD -PARAMETERS -COC -LOCATIONS
DATA EXPORTS
BOTTLES SENT
SAMPLES RECEIVED
SAMPLE RECEIPT CONFIRMATION
SAMPLE ANALYSIS
ELECTRONIC DATA DELIVERABLE (EDD)
LAB REPORT
ENVIRONMENTAL® STANDARDS
30 YEARS 1987 - 2017

APPENDIX B

EQUIS EDD SPECIFICATIONS

EQuIS EQEDD Laboratory EDD Specifications

November 2017

INTRODUCTION

The purpose of this document is to describe the processing of the laboratory data and provides the required specifications of the electronic data deliverable (EDD).

FILE FORMAT

All data from the field must be stored in an ASCII file using a tab-delimited standard format. Maximum length of text fields is indicated in the parentheses. If the information is less than the maximum length, do not pad the record with spaces.

Each record must be terminated with a carriage return/line feed (*i.e.,* standard DOS text file). The file can be produced using any software with the capability to create ASCII files. Date is reported as MM/DD/YYYY (month/day/year) and time as HH:MM (hour: minute). Time uses a 24-hour clock, thus 3:30 p.m. will be reported as 15:30.

Each record in an import file must have one or more fields with values that make the row unique. These fields are indicated in the "PRIMARY KEY?" column. Required fields are indicated in the "REQUIRED?" column.

NULL FORMAT

Some fields in the EDD are optional or only required "when applicable." When a field is not listed as required, this means that a null or blank may be appropriate. However, the blank value must still be surrounded by tabs. In other words, the number of fields is always the same, whether or not the fields include data.

NAMING CONVENTION

The filename extensions are used to indicate the file type as follows:

Type of Rows	File Name
Lab Sample	LabSample._v1.txt
Test & Results	TestResultsQC_v1.txt
Test Batch	TestBatch_v1.txt

FILE DELIVERY

All EDD deliverables must be sent in a zip file containing the EDD files listed above. The zipped file must be named using the following naming convention:

- *SDG*.FACILITYCODE.EQEDD.zip

EDD SPECIFICATION

LabSample_v1

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	sys_sample_code	Text(40)	Y	PK		Unique sample identifier.
	sample_name	Text(50)				Additional sample identification information as necessary.
	sample_matrix_code	Text(10)	Y		RVF	Code which distinguishes between different of sample matrix types.
	sample_type_code	Text(20)	Y		RVF	Code which distinguishes between different types of samples.
	sample_source	Text(10)	Y		ENUM	This field identifies where the sample came from, either field or laboratory.
	parent_sample_code	Text(40)				The value of "sys_sample_code" that uniquely identifies the sample that was the source of this sample.
	sample_delivery_group	Text(20)				The sampling event with which the sample is associated.
	sample_date	DateTime	Y			Date and time sample was collected (in MM/DD/YYYY HH:MM format for EDD).
	sys_loc_code	Text(20)				Soil boring or well installation location.
	start_depth	Numeric				Beginning depth (top) of sample in feet below ground surface.

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	end_depth	Numeric				Ending depth (top) of sample in feet below ground surface.
	depth_unit	Text(15)			RVF	Unit of measurement for the sample begin and end depths.
	chain_of_custody	Text(40)				Chain-of-Custody identifier. A single sample may be assigned to only one Chain-of-Custody.
	sent_to_lab_date	DateTime				Date sample was sent to laboratory (in MM/DD/YYYY format for EDD).
	sample_receipt_date	DateTime				Date that sample was received at laboratory (in MM/DD/YYYY format for EDD).
	sampler	Text(50)				Name or initials of sampler.
	sampling_company_code	Text(40)	Y		RVF	Name or initials of sampling company (not controlled vocabulary).
	sampling_reason	Text(30)				
	sampling_method	Text(40)				Sampling method.
	task_code	Text(40)				Code used to identify the task under which the field sample was retrieved.
	collection_quarter	Text(5)				Format: YYQ# where YY is year and # is 1, 2, 3, or 4 representing the quarter.

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	composite_yn	Text(1)	Y		ENUM	Is sample a composite sample? 'Y' for yes or 'N' for no.
	composite_desc	Text(255)				Description of composite sample (if composite_yn is 'Yes').
	sample_class	Text(10)				Report as null.
	custom_field_1	Text(255)				Report as null.
	custom_field_2	Text(255)				Report as null.
	custom_field_3	Text(255)				Report as null.
	comment	Text(2000)				Comment.

TestResultsQC_v1

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	sys_sample_code	Text(40)	Y	PK		Unique sample identifier.
	lab_anl_method_name	Text(20)	Y	PK	RVF	Laboratory analytical method name or description.
	analysis_date	DateTime	Y	PK		Date and time of sample analysis in 'MM/DD/YYYY HH:MM' format.
	total_or_dissolved	Text(10)	Y	PK	RVF	Must be either 'D' for dissolved or filtered [metal] concentration, 'T' for total or undissolved, or "N" for everything else.
	column_number	Text(2)				Values include either '1C' for first-column analyses, '2C' for second-column analyses, or 'NA' for tests for which this distinction is not applicable.
	test_type	Text(10)	Y	PK	RVF	Type of test.
	lab_matrix_code	Text(10)			RVF	Code which distinguishes the type of sample matrix.
	analysis_location	Text(2)	Y		ENUM	Must be either 'FI' for field instrument or probe, 'FL' for mobile field laboratory analysis, or 'LB' for fixed based laboratory analysis.
	basis	Text(10)	Y		ENUM	Must be either 'Wet' for wet-weight basis reporting, 'Dry' for

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
						dry-weight basis reporting, or 'NA' for tests for which this distinction is not applicable.
	container_id	Text(30)				Report as null.
	dilution_factor	Numeric				Effective test dilution factor.
	prep_method	Text(20)			RVF	Laboratory sample preparation method name or description.
	prep_date	DateTime				Beginning date and time of sample preparation in 'MM/DD/YYYY HH:MM' format.
	leachate_method	Text(15)				Laboratory leachate generation method name or description.
	leachate_date	DateTime				Beginning date and time of leachate preparation in 'MM/DD/YYYY HH:MM' format.
	lab_name_code	Text(20)			RVF	Unique identifier of the laboratory.
	qc_level	Text(10)			ENUM	May be either 'screen' or 'quant'.
	lab_sample_id	Text(20)				Laboratory LIMS sample identifier.
	percent_moisture	Text(5)				Percent moisture of the sample portion used in this test.
	subsample_amount	Text(14)				Amount of sample used for test.
	subsample_amount_unit	Text(15)			RVF	Unit of measurement for

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
						subsample amount.
	analyst_name	Text(50)				
	instrument_id	Text(60)				Instrument identifier.
	comment	Text(2000)				Comments about the test.
	preservative	Text(20)			RVF	Sample preservative used.
	final_volume	Numeric				The final volume of the sample after sample preparation. Include all dilution factors.
	final_volume_unit	Text(15)			RVF	The unit of measure that corresponds to the final volume.
	cas_rn	Text(15)	Y	PK	RVF	Use values in analyte valid value table.
	chemical_name	Text(255)	Y			Use the name in the analyte valid value table.
	result_value	Numeric				Analytical result reported at an appropriate number of significant digits. May be blank for non-detects.
	result_error_delta	Text(20)				Error range applicable to the result value; typically used only for radiochemistry results.
	result_type_code	Text(10)	Y		RVF	Must be either 'TRG' for a target or regular result, 'TIC' for tentatively identified compounds, 'SUR' for surrogates, 'IS' for internal standards, or

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
						'SC' for spiked compounds.
	reportable_result	Text(10)	Y		ENUM	Must be either 'Yes' for results which are considered to be reportable, or 'No' for other results.
	detect_flag	Text(2)	Y		ENUM	May be either 'Y' for detected analytes, 'N' for non-detects or 'TR' for trace.
	lab_qualifiers	Text(20)				Qualifier flags assigned by the laboratory.
	validator_qualifiers	Text(20)				Qualifier flags assigned by the validation firm.
	interpreted_qualifiers	Text(20)			RVF	Qualifier flags assigned by the validation firm.
	organic_yn	Text(1)	Y		ENUM	Must be either 'Y' for organic constituents, or 'N' for inorganic constituents.
	method_detection_limit	Text(20)				Method detection limit.
	reporting_detection_limit	Numeric				Concentration level above which results can be quantified with confidence.
	quantitation_limit	Text(20)				Concentration level above which results can be quantified with confidence.
	result_unit	Text(15)			RVF	Unit of measurement for the result.
	detection_limit_unit	Text(15)			RVF	Unit of measurement for the detection limit(s).

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	tic_retention_time	Text(8)				Retention time in seconds for tentatively identified compounds.
	result_comment	Text(2000)				Result-specific comments.
	lab_sdg	Text(20)				Sample Delivery Group (SDG) identifier.
	qc_original_conc	Numeric				The concentration of the analyte in the original (un-spiked) sample.
	qc_spike_added	Numeric				The concentration of the analyte added to the original sample.
	qc_spike_measured	Numeric				The measured concentration of the analyte.
	qc_spike_recovery	Numeric				The percent recovery calculated as specified by the laboratory QC program.
	qc_dup_original_conc	Numeric				The concentration of the analyte in the original (un-spiked) sample.
	qc_dup_spike_added	Numeric				The concentration of the analyte added to the original sample.
	qc_dup_spike_measured	Numeric				The measured concentration of the analyte in the duplicate.
	qc_dup_spike_recovery	Numeric				The duplicate percent recovery calculated.
	qc_rpd	Text(8)				The relative percent difference calculated.

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	qc_spike_lcl	Text(8)				Lower control limit for spike recovery.
	qc_spike_ucl	Text(8)				Upper control limit for spike recovery.
	qc_rpd_cl	Text(8)				Relative percent difference control limit.
	qc_spike_status	Text(10)			ENUM	Used to indicate whether the spike recovery was within control limits.
	qc_dup_spike_status	Text(10)			ENUM	Used to indicate whether the duplicate spike recovery was within control limits.
	qc_rpd_status	Text(10)			ENUM	Used to indicate whether the relative percent difference was within control limits.

TestBatch_v1

POSITION	FIELD NAME	DATA TYPE	REQUIRED?	PRIMARY KEY?	REFERENCE VALUE?	DESCRIPTION
	sys_sample_code	Text(40)		PK		Unique sample identifier.
	lab_anl_method_name	Text(20)		PK	RVF	Laboratory analytical method name or description.
	analysis_date	DateTime		PK		Date and time of sample analysis in 'MM/DD/YYYY HH:MM' format.
	total_or_dissolved	Text(10)		PK	RVF	Must be either 'D' for dissolved or filtered [metal] concentration, 'T' for total or undissolved, or "N" for everything else.
	column_number	Text(2)				Values include either '1C' for first-column analyses, '2C' for second-column analyses, or 'NA' for tests for which this distinction is not applicable.
	test_type	Text(10)		PK	RVF	Type of test.
	test_batch_type	Text(10)	Y	PK	RVF	Laboratory batch type. Valid values include 'Prep', 'Analysis', and 'Leach'. This is a required field for all batches.
	test_batch_id	Text(20)	Y			Unique identifier for all laboratory batches.

ENVIRONMENTAL STANDARDS

“REQUIRED WHEN APPLICABLE” FIELDS

Some “Required When Applicable” fields are data driven and are, therefore, not listed below.

SAMPLE LEVEL

	BD	BS	EB	FB	FD	LB	LD	LR	MB	MS	N	RB	SD	TB
PARENT_SAMPLE_CODE	X				X		X	X		X			X	
SAMPLE_DATE			X	X	X					X	X	X	X	X
SAMPLE_TIME			X	X	X					X	X	X	X	X
SAMPLE_RECEIPT_DATE			X	X	X					X	X	X	X	X
SAMPLE_RECEIPT_TIME			X	X	X					X	X	X	X	X

RESULT LEVEL-TARGET & SPIKED RESULTS (TRG & SC)

	BD	BS	EB	FB	FD	LB	LD	LR	MB	MS	N	RB	SD	TB
QC_ORIGINAL_CONC		X			X			X		X				
QC_SPIKE_ADDED		X								X				
QC_SPIKE_MEASURED		X								X				
QC_SPIKE_RECOVERY		X								X				
QC_DUP_ORIGINAL_CONC													X	
QC_DUP_SPIKE_ADDED													X	
QC_DUP_SPIKE_MEASURED	X												X	
QC_DUP_SPIKE_RECOVERY	X												X	
QC_RPD	X							X					X	

RESULT LEVEL-SURROGATE RESULTS (SUR)

	BD	BS	EB	FB	FD	LB	LD	LR	MB	MS	N	RB	SD	TB
QC_SPIKE_ADDED		X	X	X		X		X	X	X	X	X		X
QC_SPIKE_MEASURED		X	X	X		X		X	X	X	X	X		X
QC_SPIKE_RECOVERY		X	X	X		X		X	X	X	X	X		X
QC_DUP_SPIKE_ADDED	X												X	
QC_DUP_SPIKE_MEASURED	X												X	
QC_DUP_SPIKE_RECOVERY	X												X	

APPENDIX C

EQUIS STANDARD REPORTS

EQuIS Standard Reports

Novemberr 2017

Introduction

The purpose of this document is to describe the standard reports provided with EQuIS version 6.6.

Action Level Reports

Action Level Exceedance

The Action Level Exceedance Report compares values from a saved Analytical Results Report against one or more action levels (*e.g.*, regulatory limits).

Action Level Exceedance (by EDD)

This version of the Action Level Exceedance Report is used for checking exceedances within an EDD (instead of within a saved report), and is commonly used as an Environmental Information Agent (EIA), or trigger, within EQuIS Enterprise

Analyte Exceedance (Over Time)

The Analyte Exceedance Report provides a simple way to find results for a chemical that exceeds a specified value.

Action Level Exceedance II by EDD

This version of the Action Level Exceedance II Report is used for checking exceedances within an EDD (instead of within a saved report), and is commonly used as an Environmental Information Agent (EIA), or trigger, within EQuIS Enterprise

Action Level Exceedance II by User Report

This report allows you to run an Action Level Exceedance Report by selecting a saved user report as well as the additional action level parameters.

Action Level Exceedance II - Percent Variance

The Action Level Exceedance II - Percent Variance Report is designed to flag analytical results within a given EDD that vary by more than the listed percentage from the historical average for each chemical and location

Action Level Exceedance II with Parameters

The Action Level Exceedance II with Parameters Report displays all of the parameters from the Analytical Results II Report, thus allowing you to create the Analytical Results Report and the Action Level Exceedance Report together (displayed once in the Action Level Exceedance format).

Action Level Exceedance Format I

The Action Level Exceedance Format I Report generates a report with or without action level exceedances. Its row headers are Constituent, action levels and units. Its column headers are

Location ID, Sample Date, Sample Time, Sampled Interval, Sample ID, Laboratory and Lab. Number. It can report up to a maximum of three action level codes. The units of action levels can be used as final units of the report. Checking results against summed action levels can be done in the report. It is a class report based on the Analytical Results II Report.

Action Level Exceedance Format III

The Action Level Exceedance Format III Report generates cross-tabbed analytic results with or without action level exceedances. The row headers are Analyte, Units, Limits, and action levels, if selected. Its column headers are Station ID, Sample ID, Matrix, and Sample Date. This allows you to add lab qualifiers after results and export RT_QUALIFIER.REMARK as a footnote. Two types of action level comparisons are possible.

ALE II Crosstab - Row-based

The report generates cross-tabbed analytic results with or without action level exceedances.

ALE II Crosstab - Column-based

The report generates cross-tabbed analytic results with or without action level exceedances

Analytical Results Reports

Analytical and Water Results

Analytical and Water Results runs the Analytical Results II* and Water Level (Extra Fields) reports, and combines the output rows so the water level data are reported as CAS_RN results. This enables direct comparison in crosstab reports.

Analytical Results by EDDs

The Analytical Results by EDDs Report is an advanced version of the Analytical Results II* Report. This report includes a new group of input parameters, "EDD." If the "Use EDD Date Range" input parameter is checked, the date range specified in the EDD input parameter group will override the date range specified in the Sample input parameter group. The EDD date range will query Analytical Results on the dates the results were loaded to EQuIS.

Analytical Results Crosstab (Chemicals by Location)

This report creates a Crosstab Report in Microsoft Excel that displays location, sample date and sample type as column headers, and chemicals as row headers.

Analytical Results (Extra Fields)

It provides "additional fields" for users to select extra fields, except for all the fields of the Analytical Results.

Analytical Results (QC)

This report is identical to the Analytical Results Report, except it also includes all of the DT_RESULT_QC fields in the output. The report is designed for users that need to report QC information.

Analytical Results with Sample Parameter (Table)

The Analytical Results with Sample Parameter (Table) Report combines the Analytical Results Report and the Sample Parameter Report

Analytical Results II

The core function for reporting analytical data in EQuIS Professional. You can execute this function standalone and also use it within several other reports.

Analytical Results II - No Sample Taken

The sample must still satisfy the defined parameters (date range, sample type, *etc*.). All of the other parameters are related to samples/test/results (date range, sample type, *etc*.). This report also includes sample data, even if that sample does not have any tests/results

Basic Results Profile

The Basic Results Profile is a result of cross tabbing the Basic Results Report so that the measured results of chemicals vs. their sampling dates and depths can easily be read. The results of each location are placed in their own Excel worksheet.

Basic Results II

In addition to reporting the content of DT_BASIC_RESULT, the Basic Results II Report also provides measured results with unit conversion, if users provide a unit over the user interface.

Gauging and Analytical Report

This report creates a Crosstab Report in Microsoft Excel. The columns include water level (i.e. gauging data) information, followed by the selected analytes.

Database Tables Tools

Client Metrics Report

The Client Metrics Report summarizes how many records are available in several main tables, and how many total records in DT_/AT_/RT_ tables of each facility listed in DT_FACILITY are in the EQuIS database, and the number of records in the tables without the FACILITY_ID field in DT_/AT_/RT_ tables

Database Diagnostics

Database Diagnostics Report provides information on the owner, type and CREATED_DATETIME of a selected object or the name, owner, and type of all objects in the database if you do not select a specific object.

EQuIS Data Audit

The report reports the questionable (location, sample, test, result and reference *etc.*) data information under the facilities and/or the locations that are involved in checking items.

EQuIS Enterprise Report Usage

The EQuIS Enterprise Report Usage Report generates a report on the information of users and the report names used during a range of date

Reference Values

A report that lists all the reference values with a status flag of “R” in all reference tables. This report exports all the reference tables to individual worksheets in Microsoft Excel. The worksheets are named for each reference table. You may select to export records with all or any specific individual status flags.

Table Row Counts

The Table Row Counts Report generates the total number of rows per table in the database (TOTAL_ROWS), the number of these rows in the current FACILITY_ID or facility group (IN_FACILITY), the number of reference values per reference table with STATUS_FLAG="A" and "R" (STATUS_FLAG_A and STATUS_FLAG_R, respectively).

EnviroInsite Reports

EnviroInsite Boring Log

This report creates a boring log in EnviroInsite according to the selected template file. The report queries the data in EQuIS, opens EnviroInsite and compiles the log

EnviroInsite Site Diagram

Site diagram report is an alternative report for the EnviroInsite Data Export. It is a simplified report that lets you automate steps in EnviroInsite to create tables, contours, etc.

EnviroInsite Spider Diagram

The EnviroInsite Spider Diagram Report allows you to create spider diagrams using EnviroInsite for data within EQuIS. Water Level and Analytical Results can be outputted as spider diagrams

Google Earth Reports

Google Earth 3D Action Levels

This report lets the user select a saved Analytical Results Report and an action level. The output of the report shows concentrations of each chemical represented as a vertical cylinder at each location. The height of the cylinder represents the amount of concentration (taller cylinders show greater amount of chemical).

Google Earth 3D Action Level Sample Parameters

This report lets you select a saved Sample Parameter Report, and an action level. The output of the report shows concentrations of each parameter represented as a vertical cylinder at each location. The height of the cylinder represents the parameter value (taller cylinders show greater value).

Google Earth 3D Analyte Aggregates

This report prompts you to select a saved Analytical Results Report. You then select whether you want to aggregate values by group or individual. You may also select the aggregate function you want to use (default is maximum). The report displays vertical cylinders representing the aggregate value at each location, along with a label showing the numeric value

Google Earth 3D Analytical Results (3D Cylinders)

This report prompts you to select a saved Analytical Results Report. The output of the report shows concentrations of each chemical represented as a vertical cylinder at each location. The height of the cylinder represents the amount of concentration (taller cylinders show greater amount of chemical). Each chemical is displayed in a different color. You can select which chemical to view by clicking in the circle next to the desired chemical name. This report includes data over the selected date range. You can drag the time slider, or press the Play button, to watch the values change over time

Google Earth 3D Basic Results (XYZ Plot)

This report is computationally intensive, and interpolates a unique grid for each parameter and date. For example, a site may have only 100 different records, but 25 different dates. In this case the report would interpolate 25 different grids, and potentially consume vast system resources. Please also note that there are limitations to the size and complexity of KML/KMZ files supported in Google Earth.

Google Earth Analytical Results (Aggregate) Pie Charts

The output of this report shows pie charts illustrating the sum of each of the chemicals. If you choose to aggregate by group, then the pie charts will show the sum of each group.

Google Earth Analytical Results (XYZ Plot)

This Google Earth Report uses a saved Analytical Results Pick Report as the primary input parameter. The Analytical Results output is exported into to a *.kmz, and separated by chemical with each sampling date. Multiple sampling dates can be displayed in animation using Google Earth's time animation bar.

Google Earth Location Parameter (XYZ Plot and Contour)

This report prompts you to select a date range and one (or more) location parameters. The output of this report shows values of each parameter represented as a three dimensional contour. The Places tree lists each parameter. Underneath each parameter there are folders for each of the days where values exist for that parameter. Values from each day are interpolated using a Nearest Neighbor algorithm. The interpolated values are then displayed using a color palette ranging from blue (low) to red (high). Each color in the palette is shown as a folder, so the user can check/uncheck that folder to show/hide values in that range.

Google Earth Locations

The purpose of this report is to show locations from an EQuIS facility in Google Earth. Each location is labeled with the DT_LOCATION.SYS_LOC_CODE. The Places tree in Google Earth groups each location by type (*i.e*. DT_LOCATION.LOC_TYPE). The report output can also include DT_LOCATION.LOC_DESC in the 'callout box' when a location is clicked

Google Earth Sample Parameters (3D Cylinders)

This report prompts you to select a saved Sample Parameter Report. The output of the report shows values of each parameter represented as a vertical cylinder at each sampling location. The height of the cylinder represents the parameter value (taller cylinders show greater values). Each parameter is displayed in a different color. You can select which parameter to view by clicking in the circle next to the desired parameter name.

This report includes data over the selected date range. You can drag the time slider or press the Play button to watch the values change over time.

Google Earth Water Levels (3D Cylinders)

This report prompts you to select a saved Water Level Report.

The output of the report shows the water level as a vertical cylinder at each location. The height of the cylinder represents the water level (taller cylinders show greater water elevation).

This report includes data over the selected date range. You can drag the time slider or press the Play button to watch the values change over time.

Google Earth Water Levels (XYZ Plot)

The output of this report shows the water level represented as a three dimensional contour. The Places tree contains folders for each of the days on which water level measurements exist. Values from each day are interpolated using a Nearest Neighbor algorithm. The interpolated values are then displayed using a color palette ranging from blue (low) to red (high). Each color in the palette is shown as a folder, so the user can check/uncheck that folder to show/hide values in that range.

In addition to the color palette, the elevation of each point (distance from the ground) represents the relative value to other points. For example, the lower valued points are close to the ground; whereas the higher valued points are farther above the ground. This relative distance from the ground makes it possible to view a 2D contour (by reducing the tilt in Google Earth to look straight down from above) or to view a 3D surface (by increasing the tilt in Google Earth to look from the side).

This report includes data over the selected date range. You can drag the time slider, or press the Play button, to watch the values change over time. The report provides the option to create Contours, Color grids, Dot Plots or Surface Plots.

Google Earth Weather - Wind Speed and Direction

This report creates an animated "wind sock" at each location. The sock (*i.e*. red line) points in the direction the wind is blowing and the length of the sock indicates the relative wind speed. This report includes data over the selected date range. You can drag the time slider, or press the Play button, to watch the values change over time.

Location Parameter Reports

Location Information

The Location Information Report is the class report based off of the database procedure Location Information Report. It provides metadata about sample locations (wells, boreholes, *etc.*), including the matrices by which locations have been sampled as well as the screened interval.

Location Parameter “Real Time” Ticker Charts

This report creates ticker charts based on location parameter data.
This report is deployed as a web page and requires EQuIS Enterprise.

Location Parameter Exceedance

The report compares PARAM_VALUE of DT_LOCATION_PARAMETER with a value provided over the user interface and generates an exceedance report. It calls the Location Parameters report

Location Parameters

Location Parameter Standard Report has been improved to fill non-numeric results as PARAM_TEXT in their respective outputs.

Location Parameters (Action Level Exceedance)

This report checks PARAM_VALUE of the Location Parameters report against the action levels of the Action Levels Report and then generates an Action Level Exceedance Report.

Location Parameters (Extra Fields)

The Location Parameters (Extra Fields) Report generates the location parameter information from DT_LOCATION_PARAMETER and other selectable fields from DT_FACILITY, DT_LOCATION_PARAMETER, DT_PRECIPITATION, VW_LOCATION and VW_WELL

Location Parameters (Most Recent)

The Location Parameters (Most Recent) Report compiles the PARAM_VALUES along with other parameters in DT_LOCATION_PARAMETER that are obtained most recently. It uses the Location Parameters Report

Location Parameters (Rollup)

The Location Parameters (Rollup) Report compiles the hourly, daily, weekly or monthly average values of PARAM_VALUES in DT_LOCATION_PARAMETER based on selected parameters. It uses the Location Parameters Report

Sample Parameter Reports

Analytical Results with Sample Parameter (Tables)

The Analytical Results with Sample Parameter (Table) Report combines the Analytical Results Report and the Sample Parameter Report.

Sample Parameters

This report queries data from the DT_SAMPLE_PARAMETER table. The Sample Parameter standard report has been improved to fill non-numeric results as PARAM_TEXT in their respective outputs

Sample Parameters (Action Level Exceedance)

The Sample Parameters (Action Level Exceedance) Report is similar to the Sample Parameters (Exceedance) Report with the exception that it uses a saved Sample Parameters Report, action levels from DT_ACTION_LEVEL and DT_ACTION_LEVEL_PARAMETER rather than a user-entered action level value over the user interface, and more output fields.

Sample Parameters (Exceedance)

The Sample Parameters (Exceedance) Report examines PARAM_VALUES of DT_SAMPLE_PARAMETER a user-entered action level value over the user interface and generates a report with exceedances.

Sample Parameters (Extra Fields)

This report adds the functionality of reporting more selective fields.

Sample Parameters (Most Recent)

Sample Parameters (Most Recent) II Report compiles the PARAM_VALUE along with other parameters in DT_SAMPLE_PARAMETER that are obtained most recently.
Sample Parameters (Most Recent) II

It compiles the PARAM_VALUE along with other parameters in DT_SAMPLE_PARAMETER that are obtained the most recently. It uses the Sample Parameters (Extra Fields) Report to get raw data.

Statistics Reports

Analytical Results – Statistics

The Analytical Results (Statistics) Report is a new report based from the standard Analytical Results (Aggregate) Report. It computes various statistical functions not found in the aggregate report, namely: minimum, maximum, mean, median, sum, standard deviation, variance, skewness, Mann-Kendall S, Sen slope, confidence (90%, 95%, 99%, and 95%) and 95% Student's-t UCL (UCL = mean + student_t *sd/n).

Analytical Results with Sample Calculations

The Analytical Results with Sample Calculations (Table) Report generates the results of the Analytical Results, and the results from the calculations of balance and summation of the results of the Analytical Results.

Analytical Statistics

This report allows you to compare results to historical data from the specified statistical date range. It includes the option to highlight exceedances and results that fall outside the range of the historical values as well as display the information in graphical form.

ChemStat Report

The ChemStat Report generates a table that presents a statistical analysis for the selected analytes. The report summarizes the entire dataset into a single table with the rows representing each analyte in the dataset, and the columns representing the summary statistics. It allows you to focus in on those analytes and use the spatial and temporal querying tools provided, to understand what is going on. It does not show the report by location or by sample, but allows you to easily identify what analytes exceed the LOD and Action Levels, and the statistics associated with these exceedances. It uses Analytical Results report to get source data

Facility Results II

Facility Results II provides a broad overview of the analytical result information for the selected locations, along with the sample depth and screened interval

Facility Samples (Summary by EDD Date)

For all facilities which the user is subscribed to, this report will return the date of the most recent sample entered, the number of samples within the date range, and the number of samples that have been loaded year-to-date

Flow Rate

The Flow Rate Report calculates the volumes and rates of instant flow and cumulative flow per selected time interval based on the data from DT_FLOW. It also compares flow rate (for Flow-Inst) or flow volume (for Flow-Daily etc.) to action levels, if action level data are provided.

Lithology Summary

The Lithology Summary Report generates a table that summarizes maximum depths, minimum depths, maximum thicknesses and minimum thicknesses of each GEO_UNIT_CODE1 of location groups

Location Analyte Review

This report creates a Crosstab Report in Microsoft Excel that displays summary information about which locations have been sampled for specific chemicals during the specified date range. The report also indicates whether the chemical was detected or not.

Relative Percent Difference

The Relative Percent Difference Report (RDP) determines the difference between analytical results reported in primary, duplicate, and triplicate samples

Relative Percent Difference II

Relative Percent Difference II Report (RDP) determines the difference between analytical results reported in primary, duplicate, and triplicate samples.

Relative Percent Difference III

The Relative Percent Difference III Report determines the difference between analytical results reported in primary, duplicate, and triplicate samples (SYS_SAMPLE_CODE) as defined by user selection.

Sample Summary by Analyte Group

The Sample Summary by Analyte Group Report generates analysis information of collected samples included in various groups of analytes. The analysis information is represented by a combination of x/X, e/E, s/S, t/T, a/A, z/Z, which marks a sample as detected/non-detected regular results as well as if the results use special leachate methods

Sanitas

The Sanitas Report generates necessary data used by the Sanitas statistics software

Statistics: Analytical Statistics (by Location)

The report generates the statistics information of Mean, UCL, Median, Standard Deviation, Coefficient of Variation, Skewness, Minimum, Maximum, Count (n), Mann-Kendall S, Trend analysis (at 80% confidence, 90% confidence, 95% confidence, 99% confidence) and Sen Slope based on a saved Analytical Results Report.

Statistics: Analyte by Sample (Lithology)

This report creates a Crosstab Report in Microsoft Excel that displays lithology samples down the side, and analytes across the top. Below the crosstab are summary statistics for each analyte. The report can also report action level violations if the Action Level input is selected.

Statistics: Samples, Statistics and Exceedances

This report creates a Crosstab Report in Microsoft Excel that displays samples down the side, and analytes across the top. Below the crosstab are summary statistics for each analyte. This report is similar to “Statistics: Analyte by Sample (Lithology)” with the exception that it does not have the information on the depths of lithology.

Statistics: Samples, Statistics and Exceedances of Each Location

The report lists sample values and calculates the statistics, such as the Number of Samples, the Number of Detects, Maximum, Mean, 95% UCL, and Minimum and Standard Deviation based on a saved Analytical Results Report. The report can also report action level exceedances, if the Action Level input is selected.

Water Level Reports

Water Level Report Basics

The Water Level Reports return the field measured water level elevations as stored directly in EQuIS or as calculated or estimated water level elevation based on user inputs if LNAPL thickness and density are stored in the database

Non-Detect Trend Report

The Non-Detect Trend Report produces an Excel spreadsheet that includes non-detects and detects as trend lines for multiple compounds

LNAPL Column Report

The LNAPL Column Report creates a visual display of daily LNAPL thickness and water levels in the selected wells. A series of wells are presented on a single MS Excel Column chart that displays the depth of air (white), LNAPL (brown), and water (blue). The vertical extent of each column represents the total depth of the well. The locations are organized in both alphanumeric and chronological order

Water Level Aggregate vs Location Plot (2d, 3d, or Bubble)

Water Level Aggregate vs. Location Plot (2d, 3d, or Bubble) generates surface 2d contours, surface 3d contours, and bubble charts of an aggregation (max, min, avg, or sum) of the water level vs locations.

Water Level Elevation Trend Plot

Water level Trend Plot Report generates charts of water level elevations. In addition, an analyte can be added to water level charts. It uses Water Levels report and Analytical Results report to retrieve source data

Water Level Information

The Water Level Info Report generates water level (DT_WATER_LEVEL.EXACT_ELEV) data of selected locations in the form of graphs, plus other location information such as well diameter, installation date, top of casing, depth, purpose and owner.

Water Levels

The Water Levels Report conveys information about water levels, LNAPLs, and DNAPLs stored in the DT_WATER_LEVEL table. This report uses specific logic for computing the corrected water level elevation based on input parameters selected by the user

Water Levels (Extra Fields)

The Water Levels (Extra Fields) Report generates water level information. It is an improved Class Report version of the Water Levels (EQuIS func) Report. The Water Levels Report conveys information about water levels, LNAPLs, and DNAPLs stored in the DT_WATER_LEVEL table. This report uses specific logic for computing the corrected water level elevation based on input parameters selected by the user.

Water Levels (Most Recent)

The Water Levels (Most Recent) Report uses the Water Levels report to show the most recent water level elevation for each location

Contact List Export

Export EQuIS st_user, dt_person, and rt_company information as a contact list suitable for import to eMail or Client Resource Management (CrM) system.

Downhole Point Parameters

This report converts the downwhole point parameter values into numeric values and allows you to plot the parameters in an x-y chart, and save a template

Execute Scheduled Report

The "Execute Scheduled Report" report allows you to run a scheduled EIA Report. You choose which scheduled EIA to run, then click the Go button. There is no output for the report, it simply tells workflow to start the scheduled report now instead of waiting for the scheduled time. The report will continue to run on the originally designated schedule.

Facility Detects by Chemical

This report uses Analytical Results as input and performs a crosstab that counts the number of detects for each chemical across the entire facility.

Facility Parameters

The Facility Parameters Report generates the facility parameter information from DT_FACILITY_PARAMETER and other selectable fields

License Use

The report allows users to investigate license uses in details or in a summary.

ProUCL_data

The EQuIS ProUCL Report export allows EQuIS users to export analytical data in a format that can be used in ProUCL (a third party statistical application developed by the US EPA)

Risk Assessment - SADA

Description: This is a report that will automatically interface with the University of Tennessee Knoxville's Spatial Analysis and Decision Assistance (SADA) Software

Sample Holding Time II

The Sample Holding Time II Report displays time spent from sampling to analyzing the samples plus other items, which can also be obtained in the Analytical Results II** Report

Service Provider Licensing - Usage Report

The Service Provider Licensing Usage Report reports on product usage and billing rate information for EarthSoft Resellers

Tag Cloud - Chemical Concentrations

This report creates a tag cloud, based on overall chemical concentrations for the current facility
Unsubscribed User Report

This report can be used to notify managers and admins of users not subscribed to facilities
VLA - PPU Usage and Billing Statement

Generate usage information for invoicing purposes. This report is only required for usage-based Viewer License Agreements.

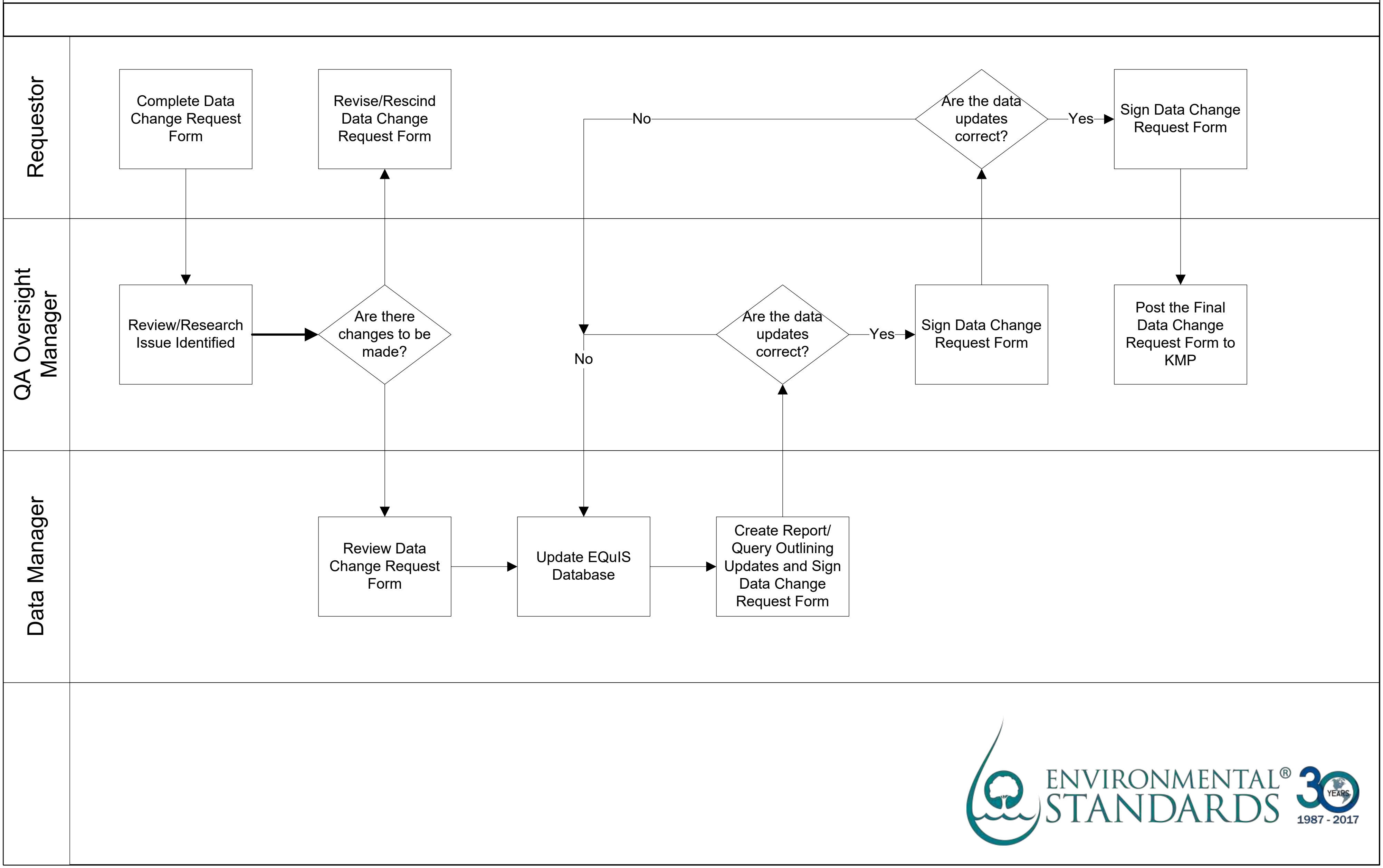
Well Construction

Well Construction Report is a class and Igrid Report that outputs well construction information from DT_WELL, DT_LOCATION, DT_COORDINATE, and DT_WELL_SEGMENT with default SEGMENT_TYPE='SCREEN'.

APPENDIX D

DATA CHANGE REQUEST WORKFLOW DIAGRAM

Data Change Request Process



APPENDIX E

TVA DATA CHANGE REQUEST FORM

Tennessee Valley Authority
Data Change Request Form

The Data Change Request Form will serve to document the data request and time-table for delivery.

Steps:

- Fill out Data Change Request Form and associated files to further explain the request.
- Attach the form and associated files in an e-mail to the Data Manager
- The subject of the e-mail should be- "**Data Change Request [Date].**"
- The Data Manager will be in contact to confirm information and delivery date.

Requestor Information		Data Manager use:
Date:		
Proposed Completion Date:		
Name:		
Company:	Phone:	
E-mail:		
Description of Request: (Below)	File Attached? Y N	
Summary: Proposed Solution:		Date Completed:

Data Manager/QA Oversight Manager

Signature ____________________________________ **Date:** _______________

Signature ____________________________________ **Date:** _______________

Data Change Requestor

Signature ____________________________________ **Date:** ______________

Stakeholders to Notify:

APPENDIX E
EXHIBITS

Exhibit No.
1

Title
Aerial Map
Allen Fossil Plant

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-06-09
Technical Review by TM on 2017-06-09

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

Legend

- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)
- TVA Property Boundary
- Levee

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)
3. The West Ash Disposal Area does not impound water; therefore, a water surface elevation is not applicable to the West Ash Disposal Area.
4. The water surface elevation for the East Ash Disposal Area is referenced to the National Geodetic Vertical Datum of 1929.
5. TVA property boundary is referenced from TVA Drawing 421 P 504 Allen Fossil Plant Reservation.

Stantec TVA

\\Us1269-f01\shared_projects\TVA-EIP\175567295\gis\mxds\ALF_MOA_Easement.mxd Revised: 2017-06-09 By: mbough

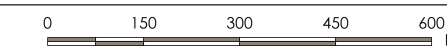
Exhibit No.
2

Title
Uppermost Foundation Soil Data
East Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by JD on 2017-11-14



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

Legend

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay	C	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silt		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

Current Impoundment (Approximate)
Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec TVA

Exhibit No.
3

Title

Uppermost Foundation Soil Data
West Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by JD on 2017-11-14

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

Legend

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay or Silt — *Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

Silty Sand to Sand — *Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec
TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Foundation_Soils_West.mxd Revised: 2017-11-14 By: mbough

Exhibit No.
4

Title
Proposed Borings
East Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

- Proposed Boring
- Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silt	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

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TVA

Exhibit No.
5

Title

Proposed Borings West Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location: Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

- Proposed Boring
- Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay or Silt	C	*Boring ID / Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand	C	*Boring ID / Lab Hydraulic Conductivity (cm/s) [if completed]*

- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec
TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Proposed_Borings_West.mxd Revised: 2018-05-22 By: tlink

Exhibit No.
6

Title
East Ash Disposal Area Monitoring Wells

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2019-02-25
Technical Review by LP on 2019-02-25

0 250 500 750 1,000 Feet
1:3,000 (At original document size of 22x34)

Legend

- Existing Groundwater Monitoring Well
- Existing Observation Monitoring Well
- 2017 Production Well
- Gauging Station
- Approximate Levee Centerline
- Approximate Extent of Levee
- TVA Property Boundary

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)
3. Existing Monitoring Wells is referenced from TVA Drawing 10W858-03 Allen Fossil Plant Reservation.

Stantec

TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Proposed_Monitoring_Well_East.mxd Revised: 2019-02-25 By: lblackman

Exhibit No.
7

Title
Proposed West Ash Disposal Area Monitoring Wells

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-11-09
Technical Review by LP on 2018-11-09

0 200 400 600 800 Feet
1:2,000 (At original document size of 22x34)

Legend

- Existing Groundwater Monitoring Well
- Proposed Groundwater Monitoring Well
- Gauging Station
- Approximate Levee Centerline
- Approximate Extent of Levee
- Approximate Extent of Culvert (26 Inch Wide)
- TVA Property Boundary
- West Ash Disposal Area

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)
3. Existing Monitoring Wells is referenced from TVA Drawing 10W858-03 Allen Fossil Plant Reservation.

Stantec TVA

L:\TVA-EIP\175567295\gis\mxds\ALF_Proposed_Monitoring_Well_West.mxd Revised: 2018-11-09 By: lblackman

Exhibit No.

8

Title

Historical Seeps (Approximate Location)

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location

Memphis, Tennessee

175567295
Prepared by TR on 2018-05-21
Technical Review by TM on 2018-05-21

0 300 600 900 1,200 Feet

1:3,600 (At original document size of 22x34)

Legend

Historical Seeps (Approximate Location)

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

Seep No.	Northing	Easting	Approx. Size	Field Notes and Status
1	294801.59255	732225.28610	5' to 15' in length	No flow; inactive; currently monitored
2	296219.09365	729287.61382	50' x 50'	Mitigated w/ graded filter
3	296498.59604	726116.33309	20' x 20'	No flow; inactive; mitigated - sod placement
4	296105.30024	729466.32180	25' x 20'	Currently monitored
5	294922.68974	728939.86058	5' x 450' in length	Flow directed to East Ash Pond, and subject to NPDES discharge permit
6	294903.00770	729104.89995	5' x 10'	Flow directed to East Ash Pond, and subject to NPDES discharge permit

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

U:\TVA-EIP\175567295\gis\mxds\ALF_Historic_Seeps.mxd Revised: 2018-05-21 By: trink

Exhibit No.
9

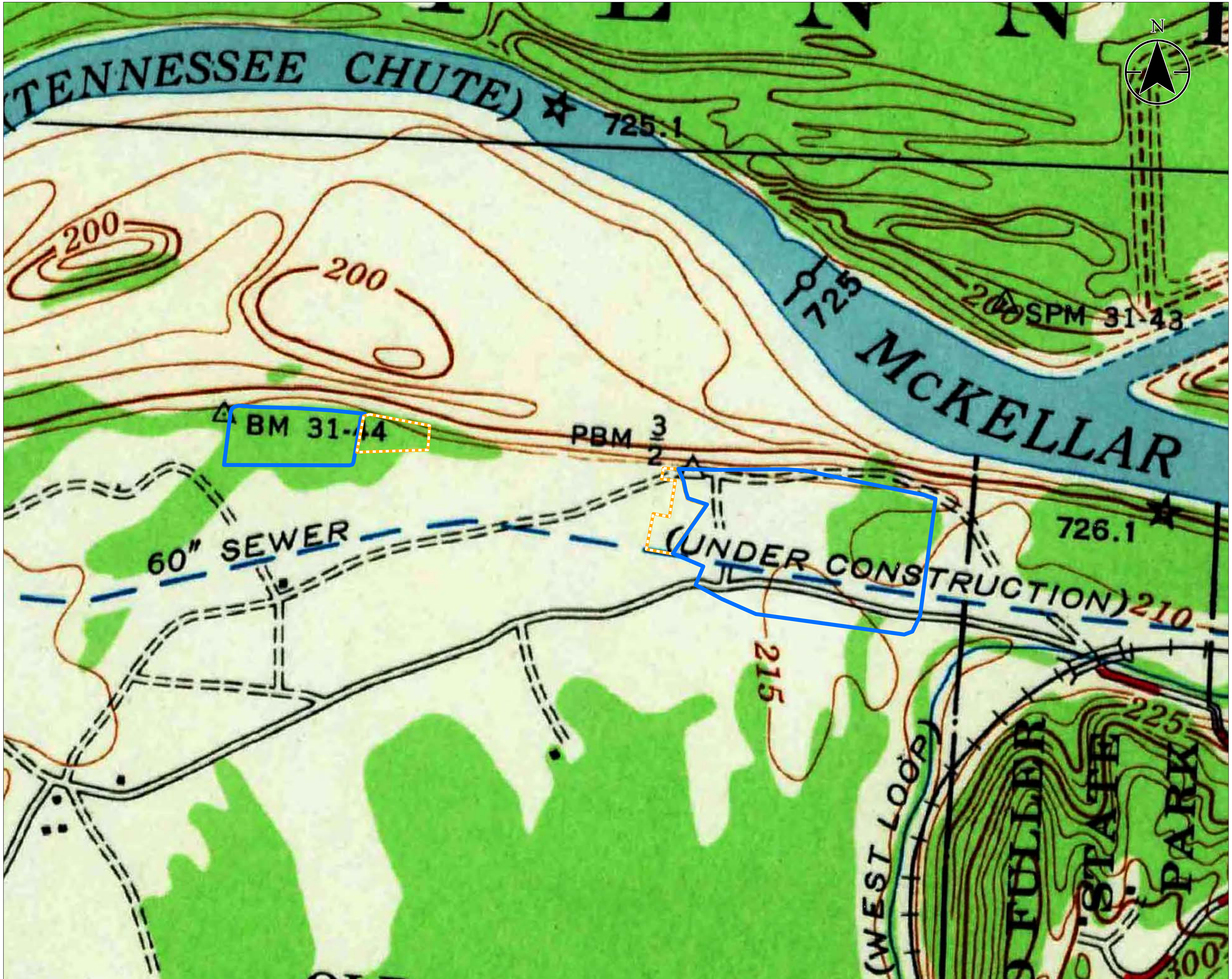
Title
Allen Fossil Plant
Topographic Map

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by TM on 2017-11-14

0 500 1,000 1,500 2,000 Feet
1:6,000 (At original document size of 22x34)



Legend

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Base map: USACE Memphis Topographic Quadrangle (1:62,500), 1955

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TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Topographic.mxd Revised: 2017-11-14 By: mbough

Exhibit No.
10

Title
Existing CCR Thickness Boring Data East Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by JD on 2017-11-13

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

Legend

- Boring with CCR Thickness Data
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_CCR_East.mxd Revised: 2017-11-13 By: mbough

Exhibit No.
11

Title
Existing CCR Thickness Boring Data West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by JD on 2017-11-13

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

Legend

- Boring with CCR Thickness Data
- 2015 Test Pit with CCR Thickness Data
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

U:\TVA-EIP\175567295\gis\mxds\ALF_CCR_West.mxd Revised: 2017-11-13 By: mbough

Exhibit No.
12

Title

Proposed Soil Sample Locations

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2019-02-22
Technical Review by TM on 2019-02-22

0 500 1,000 1,500 2,000 Feet
1:6,000 (At original document size of 22x34)

Legend

- Proposed Background Soil Sampling Location - Offsite
- Proposed Background Soil Sampling Location - TVA Property
- 2017 Remedial Investigation Background Soil Sampling Location
- Existing Background Groundwater Monitoring Well
- Existing Downgradient Monitoring Well
- Proposed Bachground Monitoring Well
- TVA Property Boundary
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2018 & 2015)
3. TVA property boundary is referenced from TVA Drawing 421 P 504 Allen Fossil Plant Reservation.

Stantec TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Proposed_Alt_BGS_w_SoilsOverlay_Exhibit12.mxd Revised: 2019-02-22 By: LBlackman

Exhibit No.
13

Title

Proposed Soil Sample Locations

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location

Memphis, Tennessee

175567295
Prepared by TR on 2019-02-22
Technical Review by TM on 2019-02-22

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

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

Legend

- Proposed Background Soil Sampling Location - Offsite
- Proposed Background Soil Sampling Location - TVA Property
- 2017 Remedial Investigation Background Soil Sampling Location
- Existing Background Groundwater Monitoring Well
- Existing Downgradient Monitoring Well
- Proposed Bachground Monitoring Well
- TVA Property Boundary
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Soil Unit	Soil Map Unit
Cr	Commerce silt loam
Cs	Convent silt loam
Cu	Crevasse fine sand
Fy	Filled land, sandy (udorthent, loamy)
Lb	Levees and borrow pits (udorthents, silty)
MeB	Memphis silt loam, 2 to 5 percent slopes
MeG	Memphis silt loam, 30 to 65 percent slopes
NOTCOM	No Digital Data Available
Rb	Robinsonville fine sandy loam
Rn	Robinsonville silt loam
Sh	Sharkey clay, 0 to 2 percent slopes, occasionally flooded
Tu	Tunica silty clay
W	Water

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2018 & 2015)
3. TVA property boundary is referenced from TVA Drawing 421 P 504 Allen Fossil Plant Reservation.

Stantec

TVA

Exhibit No.
14

Title

Completed and Proposed Stability Analysis East Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by TM on 2017-11-13

0 150 300 450 600 Feet

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

CCR Unit and Condition	Static Cases: Long-Term, Global	Static Cases: Long-Term, Veneer[2]	Seismic Cases: Pseudostatic[1], Global	Seismic Cases: Pseudostatic[1], Veneer[2]	Seismic Cases: Post-EQ[3], Global
East Ash Disposal Area (Closed Condition)	X, Y	Typ.[4]	X[5]	Typ.	X[5]

[1] Pseudostatic, correlated to a tolerable displacement.

[2] Veneer stability is the slope stability of the final cover.

[3] Post-earthquake (Post-EQ) analysis includes a preceding liquefaction triggering assessment.

[4] Typical design section was analyzed.

[5] After the closure design is finalized, it will be compared against analyses for the existing conditions. The existing conditions analyses may prove adequate to represent the closed conditions.

Blue cells are completed analyses. Yellow cells are proposed analyses.

Legend

- Cross Section
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec

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CCR Unit and Condition	Static Cases		Seismic Cases		
	Long-Term, Global	Long-Term, Veneer[2]	Pseudostatic[1], Global	Pseudostatic[1], Veneer[2]	Post-EQ[3], Global
West Ash Disposal Area (Closed Condition)	H, J	Typ.[4]	H	Typ.	H

[1] Pseudostatic, correlated to a tolerable displacement.

[2] Veneer stability is the slope stability of the final cover.

[3] Post-earthquake (Post-EQ) analysis includes a preceding liquefaction triggering assessment.

[4] Typical design section was analyzed.

Blue cells are completed analyses. Yellow cells are proposed analyses.

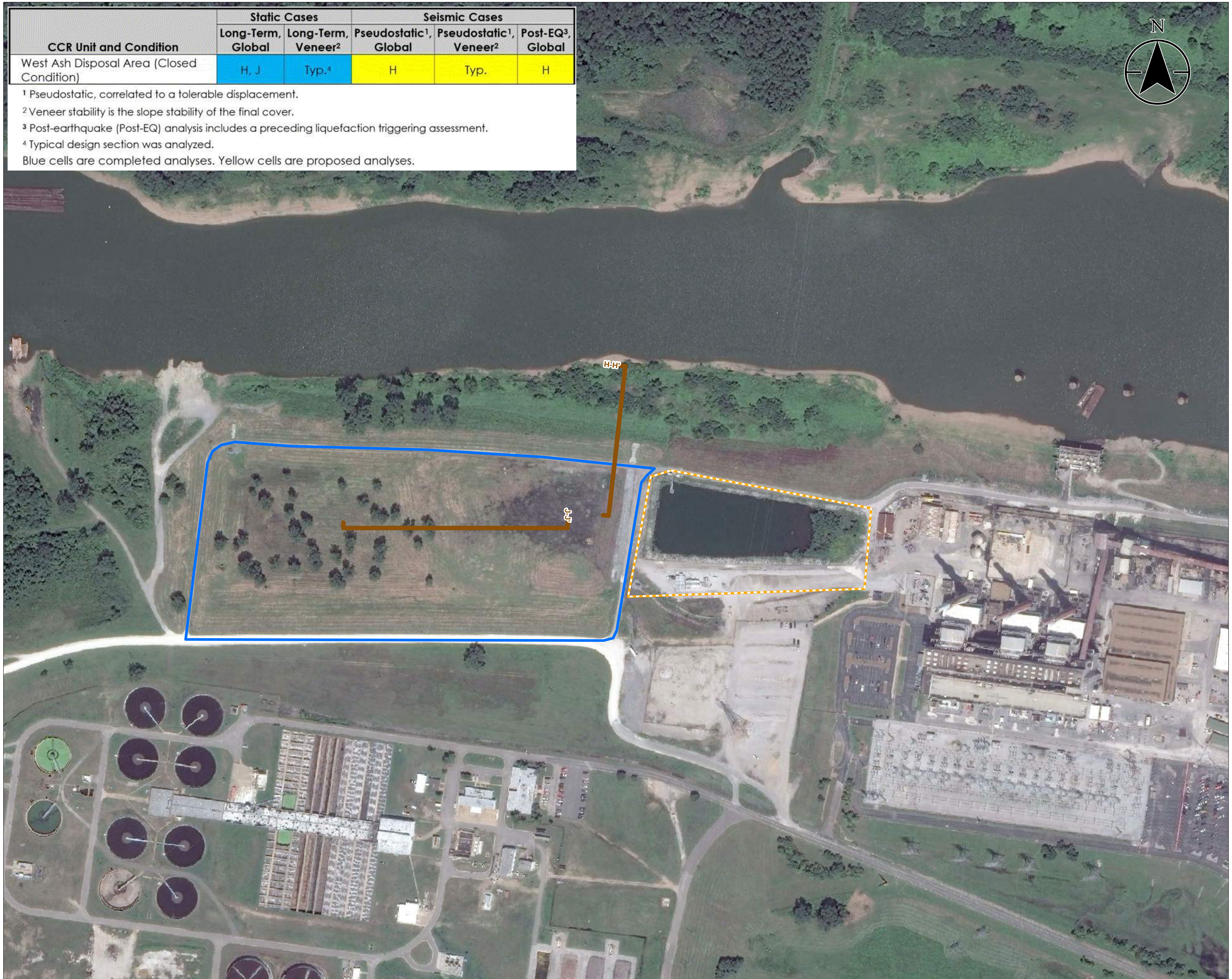

Exhibit No.
15

Title

Completed and Proposed Stability Analysis West Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by TM on 2017-11-13

0 150 300 450 600 Feet

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

Legend

- Cross Section
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by Terraserver (2016)

Stantec TVA

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APPENDIX F
MATERIAL QUANTITY SAP

Material Quantity Sampling and Analysis Plan Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

MATERIAL QUANTITY
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Material Quantity
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	3/1/19 Date
TVA Investigation Field Lead	3/1/19 Date
Health, Safety, and Environmental (HSE) Manager	3/1/19 Date
Investigation Project Manager	2/26/2019 Date
QA Oversight Manager	2/26/2019 Date
NA Laboratory Project Manager	Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, TVA has developed this Material Quantity Sampling and Analysis Plan (SAP) to answer TDEC's information requests regarding three-dimensional models, CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions with respect to the West and East Ash Disposal Areas, Chemical Treatment Pond, Coal Yard Runoff Pond and Reed Minerals Division, Harsco Corporation Area (Study Area Units) at the ALF Plant (Plant).

2.0 OBJECTIVES

The objectives of this Material Quantity SAP are to describe the methods TVA will use to answer TDEC's information requests regarding CCR unit geometry, CCR material quantity, groundwater elevations, saturation levels, and subsurface conditions with respect to the Study Area. Activities described in this SAP will be completed to:

- Estimate the volume of CCR below and above groundwater
- Estimate the volume of CCR below and above the piezometric level of saturation
- Develop three-dimensional models of the subsurface from ground surface to bedrock and CCR volume estimates for each CCR unit
- Produce drawings specified in TDEC's information requests from the three-dimensional model

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 APPROACH

4.1 EXPLORATORY BORINGS AND TEMPORARY WELLS

4.1.1 Proposed TDEC Order Borings and Temporary Wells

TVA proposes installing multi-purpose borings and temporary wells at the locations shown on Figures 1 and 2 (Attachment A) to supplement existing data related to CCR thickness (if encountered) and subsurface materials. A total of 36 borings are proposed. Details regarding proposed drilling, sampling, temporary well, and piezometric activities are provided in the Exploratory Drilling SAP. Table 1 summarizes the number of borings and temporary wells proposed in each CCR Unit.

Table 1. Exploratory Drilling Proposed in Each CCR Unit

CCR Unit	Total No. of Proposed Borings	No. of Borings with Temporary Wells
West Ash Disposal Area (including Chemical Treatment Pond)	17	2
East Ash Disposal Area	19	3
Total	**36**	**5**

4.1.2 Data Analysis

Data from the proposed multi-purpose borings will be compared to the existing boring data and pre-construction topographic information available for each unit. If this evaluation indicates different results between information sources for the lower CCR surface elevations, additional borings may be warranted. TVA will communicate with TDEC and discuss / determine if additional data collection is needed to meet the objectives listed in Section 2.0.

4.1.3 Water Level Monitoring

Monthly water level monitoring will be conducted for 6 months to estimate and monitor piezometric saturation levels in each CCR unit. Manual readings from temporary wells and open standpipe piezometers and readings from automated vibrating wire transducer piezometers will be used to estimate saturation levels in CCR. Details regarding water level monitoring field activities are provided in the CCR Material Characteristics SAP.

4.2 THREE-DIMENSIONAL MODELS

Three-dimensional models of the West Ash Disposal Area, Chemical Treatment Pond, East Ash Disposal Area, and the former Disposal Area consisting of the Coal Yard Runoff Pond, Reed Minerals Division, and Harsco Corporation Area (Harsco Area) will be developed to depict subsurface conditions from the ground surface to the upper foundation soils. The models will be developed using the data summarized below which includes data from the proposed exploratory borings, piezometers, and wells discussed in Section 4.1, as well as other relevant data collected during the Investigation. The site is underlain by extremely deep alluvial soils within the Mississippi River embayment area. Therefore, no top of bedrock models will be developed.

1. Ground and aerial survey data will be used with record drawings to model features such as a soil cap and riprap layers.

2. Contour data from the most recent aerial and hydrographic surveys will be used to provide an initial estimate of the upper CCR surface for the West and East Ash Disposal Areas and Harsco Area (where applicable).

3. Existing and historic aerial and hydrographic survey data, boring data, and historic construction drawings in Attachment B will be used to estimate the upper CCR surface below the Chemical Treatment Pond.

4. Pre-construction topographic information from USACE Memphis Quadrangle Mapping (1955) shown in Figure 3 and data from existing and proposed borings that penetrated the lower boundary of the CCR surface shown in Figures 1, 2, 4 and 5 will be used to model the lower CCR surface at each unit (where applicable).

5. Data from proposed and existing borings that encountered foundation soils shown in Figures 6 and 7 will be used to model foundation soils underlying each unit.

6. TVA surveyed slopes, embankments, and benches to develop stability sections of the West and East Ash Disposal Areas and Chemical Treatment Pond. TVA will use this topographic data with the most recent aerial survey data to model the geometry of the dikes and benches.

7. Estimated piezometric levels of saturation discussed in Section 4.1.3 will be incorporated into the models.

8. Groundwater levels estimated as part of the Hydrogeological Investigation described in the EIP will be incorporated into the models.

The three-dimensional model will be generated using software capable of rendering three-dimensional surfaces and calculating volumes such as Autodesk's AutoCAD Civil 3D or ArcGIS. Environmental Visualization Software (EVS) may also be used to visualize the three-dimensional model of the CCR units and Harsco Area.

4.3 DRAWINGS

After the three-dimensional models are finalized, they will be used to produce drawings of the West and East Ash Disposal Areas, Chemical Treatment Pond, Coal Yard Runoff Pond and Harsco Area showing the following:

- Subsurface material types, properties, elevations, and thickness from the ground surface to the upper foundation soils
- Estimated piezometric saturation levels, contours, and river stage
- Estimated groundwater elevations, contours, and river stage
- Plan views showing areas where CCR is saturated
- Normal operating pool elevations and minimum embankment crest elevations of the Chemical Treatment Pond and East Ash Disposal Area Stilling Pond
- Upper and lower CCR surfaces and CCR thickness for each facility
- Thickness and material types of foundation soils
- Cross sections of the facilities that identify materials and material properties discussed in the Exploratory Drilling SAP

4.4 VOLUMETRIC ESTIMATES

The following volumetric estimates will be calculated for each Study Area Unit using three-dimensional modeling software such as Autodesk's AutoCAD Civil 3D or ArcGIS:

- Total volume of CCR
- Volume of CCR below estimated piezometric saturation levels
- Volume of CCR below estimated groundwater elevations
- Volume of CCR above estimated piezometric saturation levels
- Volume of CCR above estimated groundwater elevations

The total volume of CCR for all Study Area Units at ALF will also be estimated. These volumetric estimates will be calculated using two methods to validate the model and results.

5.0 REPORTING AND DELIVERABLES

The EAR will document the field activities from the Investigation. This will include deviations from those procedures, results, and geological and hydrogeological interpretations. The results of the CCR material quantity assessment, including three-dimensional models of the facilities, drawings, and volumetric estimates, will also be incorporated into the EAR.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The Plant-specific Quality Assurance Project Plan (QAPP) describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to this Material Quantity SAP.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

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

6.2 QUALITY CONTROL CHECKS

The accuracy of the material quantity analysis procedures must be maintained throughout the investigation. Field and office personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable field forms and documentation of field and office activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 2. Preliminary Schedule for Material Quantity SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Material Quantity SAP Submittal		Completed
Develop Models	60 Days	Following EIP Approval
Supplement models with data from proposed TDEC Order multi-purpose borings and temporary wells	30 Days	Following Field Preparation
Use model to develop drawings and complete volumetric estimates	90 Days	Following Modeling Activities
Reporting and deliverables	60 Days	Following Analysis Activities

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Inaccuracies in historical data may cause uncertainty in the material quantity analysis. Uncertainty in the material quantity analysis will be evaluated and taken into consideration when determining if sufficient data has been gathered to complete the analysis.

9.0 REFERENCES

United States Army Corps of Engineers (USACE). 1955. "Memphis Quadrangle, Tennessee-Arkansas." Scale1:62,500.

ATTACHMENT A
FIGURES

Figure No.
1

Title
Proposed Borings
East Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

Proposed Boring

Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay	Boring ID	*Lab Hydraulic Conductivity (cm/s) [if completed]*
Silt	Boring ID	*Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand	Boring ID	*Lab Hydraulic Conductivity (cm/s) [if completed]*

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec

TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Proposed_Borings_East.mxd Revised: 2018-05-22 By: trink

Figure No.
2

Title
Proposed Borings
West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

- Proposed Boring
- Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

- Clay or Silt — *Boring ID / Lab Hydraulic Conductivity (cm/s) [if completed]*
- Silty Sand to Sand — *Boring ID / Lab Hydraulic Conductivity (cm/s) [if completed]*
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Proposed_Borings_West.mxd Revised: 2018-05-22 By: trink

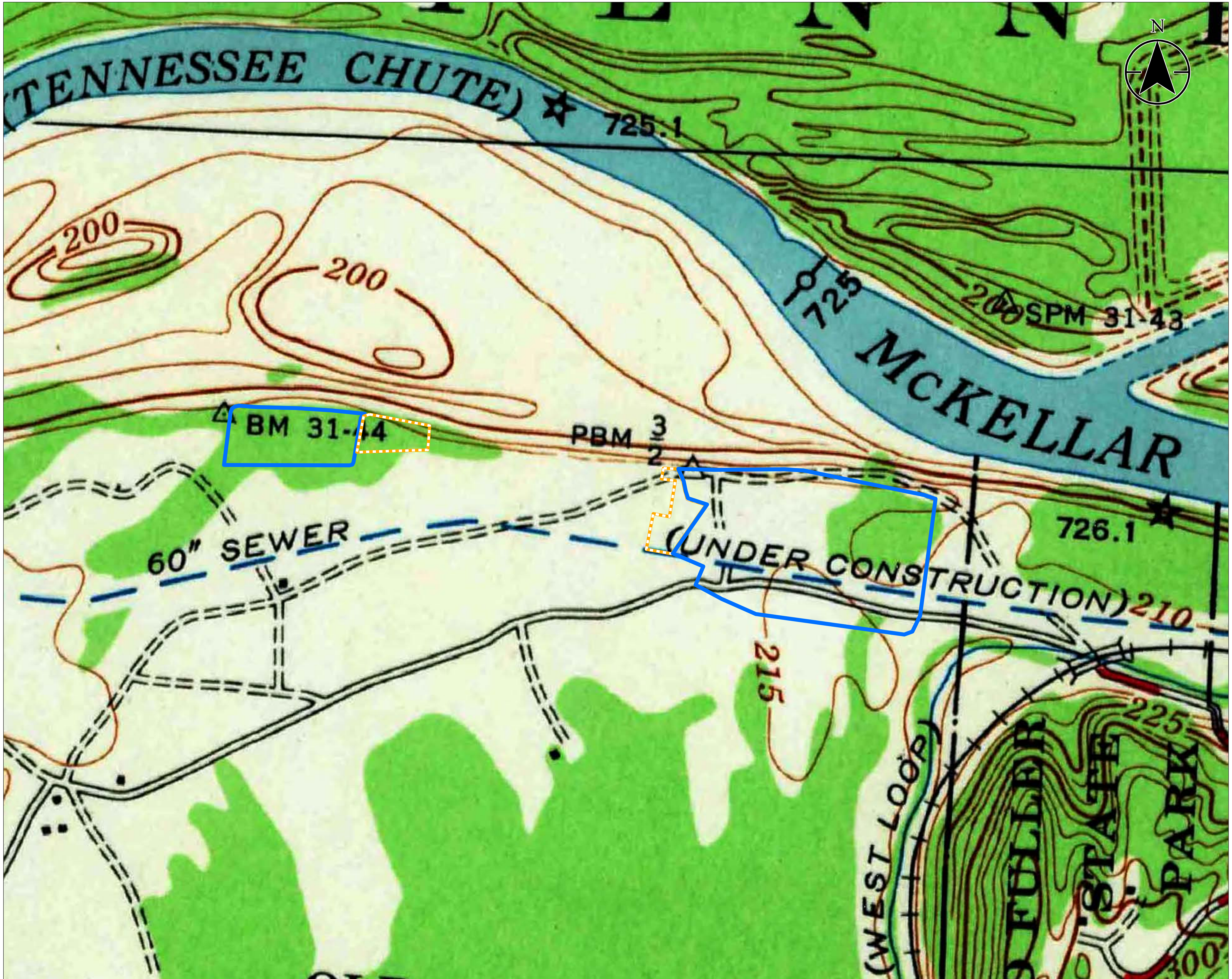

Figure No.
3

Title
Allen Fossil Plant
Topographic Map

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by TM on 2017-11-14

Legend

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Base map: USACE Memphis Topographic Quadrangle (1:62,500), 1955

Stantec

TVA

U:\TVA-EIP\175567295\gis\mxds\ALF_Topographic.mxd Revised: 2017-11-14 By: mbough

Figure No.
4

Title
Existing CCR Thickness Boring Data
West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by JD on 2017-11-13

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

Legend

- Boring with CCR Thickness Data
- 2015 Test Pit with CCR Thickness Data
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec TVA

Page 01 of 01

U:\TVA-EP\175567295\gis\mxds\ALF_CCR_West.mxd Revised: 2017-11-13 By: mbough

Figure No.
5

Title

Existing CCR Thickness Boring Data East Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by JD on 2017-11-13

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

Legend

- ● Boring with CCR Thickness Data
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec
TVA

Figure No.
6

Title
Uppermost Foundation Soil Data
East Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by JD on 2017-11-14

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

Legend

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silt		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

Current Impoundment (Approximate)
Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec TVA

Figure No.
7

Title
Uppermost Foundation Soil Data West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by JD on 2017-11-14

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

Legend

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay or Silt	C	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec TVA

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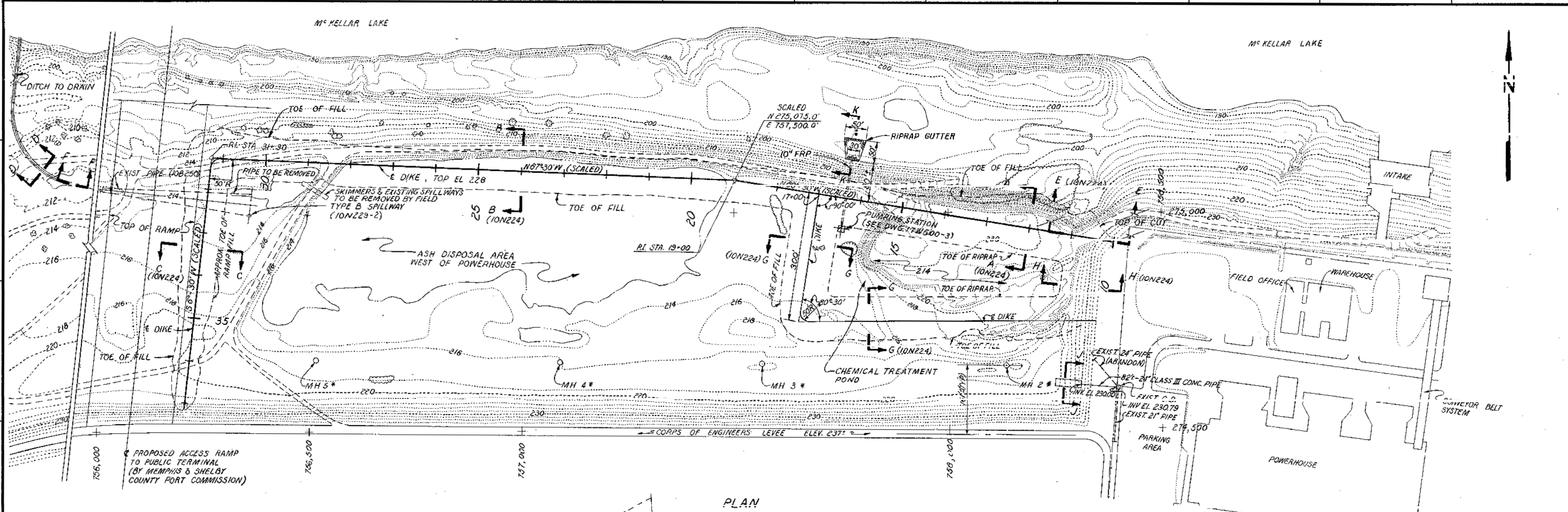
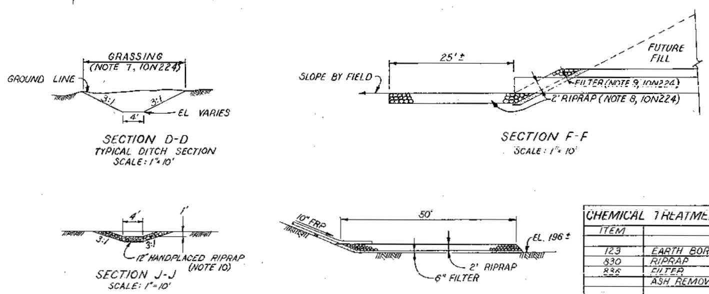
ATTACHMENT B
HISTORIC DRAWINGS



PLAN

* FOR LOCATION OF EXISTING MH SEE 31 PP 300 & 303.



SECTION D-D
TYPICAL DITCH SECTION
SCALE: 1" = 10'

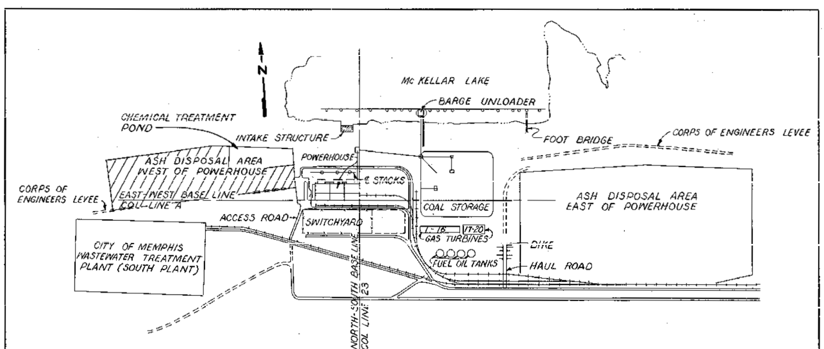
SECTION F-F
SCALE: 1" = 10'

SECTION J-J
SCALE: 1" = 10'

SECTION K-K
NOT TO SCALE

CHEMICAL TREATMENT POND SUMMARY OF QUANTITIES			
ITEM	DESCRIPTION	QUANTITY	UNIT
123	EARTH BORROW (CORE TYPE)	17,000	CY
830	RIPRAP	3,800	CY
836	FILTER	2,130	TONS
	ASH REMOVAL	45,800	CY
830	RIPRAP (GUTTER)	150	CY
836	FILTER (GUTTER)	65	TONS

NOTES:
FOR NOTES SEE 10N224.



LOCATION PLAN
SCALE: 1" = 600'

P.A. 3092
AND W.O. P33-544-82-31401-J6

COMPANION DRAWINGS, 10N224, 225, 226, 227, 228, 229-1, 229-2
SCALE 1" = 100'
EXCEPT AS NOTED

INSPECTED AND APPROVED FOR ISSUE
B.H. Montgomery

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR
2		9-15-78	RDP	JSB	RDP	AEH	KWB		RJB		
ADDED RIPRAP GUTTER FOR CHEM. POND DISCHARGE & SECT. K-K											
1		10-19-76	RDP	GRB	RDP	JLG	KWB		RBP		GLB

DSGN J. L. GLOVER
DRWN J.S. BERRY
CHKD D.A. VALENTINE
SUPV J. L. GLOVER
INSP
ENGINEER K. W. Burnett

MAIN PLANT - ASH DISPOSAL AREAS

ASH DISPOSAL AREA
WEST OF POWERHOUSE
SHEET 1

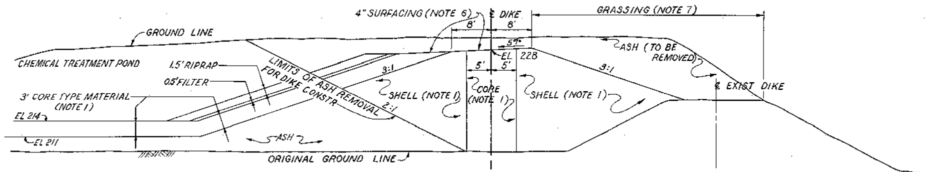
THOMAS H. ALLEN STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
Robert J. Bowman		

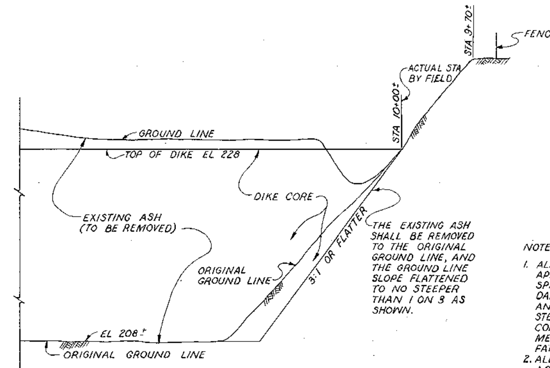
KNOXVILLE	9-5-75	38	C	10N223	R2

RECORD DRAWING AS CONSTRUCTED
11-6-78 R2

38 | C | 10N224



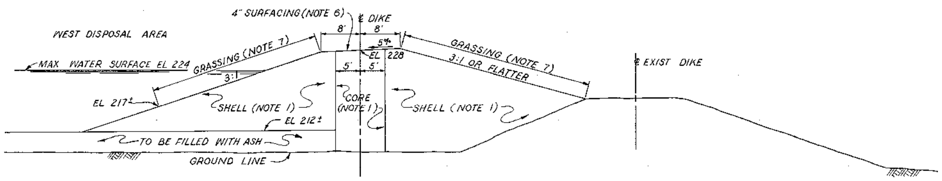
SECTION A-A
TYPICAL DIKE SECTION
STA 10+00± TO STA 17+00±



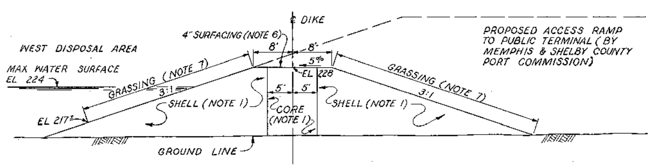
SECTION E-E
HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=5'

NOTES:

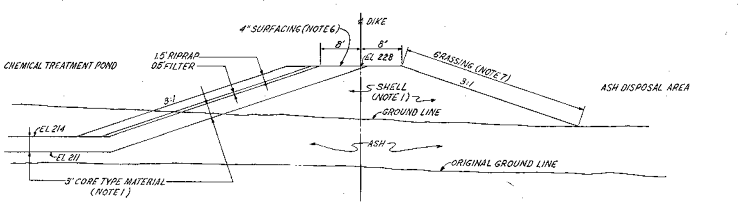
1. ALL DIKE CONSTRUCTION SHALL BE IN ACCORDANCE WITH APPLICABLE PORTIONS OF GENERAL CONSTRUCTION SPECIFICATION NO. G-9 FOR ROLLED EARTH FILL FOR DAMS AND POWER PLANTS. FOR ADDITIONAL INFORMATION AND FILL COMPACTION REQUIREMENTS SEE "ALLEN STEAM PLANT - ASH DISPOSAL AREAS DIKES RAISING-CONSTRUCTION INFORMATION", TRANSMITTED BY MEMORANDUM FROM G.L. BUCHANAN TO GENE FARMER, DATED JULY 24, 1975.
2. ALL WORK EXCEPT DIKE CONSTRUCTION SHALL BE IN ACCORDANCE WITH HIGHWAY SPECIFICATION T-1.
3. THE RESULTS OF THE SOIL INVESTIGATION FOR THE RAISING OF THE DIKES AT THE ASH DISPOSAL AREAS EAST AND WEST OF THE POWERHOUSE ARE REPORTED IN A MEMORANDUM FROM GENE FARMER TO G.L. BUCHANAN DATED MAY 2, 1975, ALLEN STEAM PLANT-ASH DISPOSAL AREAS DIKES - SOIL INVESTIGATION.
4. THE MINIMUM FACTOR OF SAFETY FOR ALL LOADING CONDITIONS ON THE WEST DISPOSAL AREA DIKES IS 1.26. THIS FACTOR OF SAFETY IS FOR THE QUICK DRAWDOWN CONDITION.
5. THE ASH AND FOUNDATION STRIPPING EXCAVATED FOR CONSTRUCTION OF THE WEST DISPOSAL AREA DIKES SHALL BE DISPOSED OF INSIDE THE DISPOSAL AREA BY THE FIELD.
6. CRUSHED STONE OR GRAVEL SURFACING, 4" THICK, SHALL BE APPLIED FOR THE FULL WIDTH OF TOP OF DIKE IN ACCORDANCE WITH SECTION 210 OF THE T-1 SPECS.
7. ALL CUT AND FILL SLOPES AND OTHER DISTURBED AREAS SHALL BE SEEDED WITH TYPE 6, MIXTURE B OR TYPE 7 MIXTURE A IN ACCORDANCE WITH SECTION 180 OF T-1 SPECS. DEPENDING ON THE TIME OF CONSTRUCTION, IT MAY BE NECESSARY TO PROVIDE A TEMPORARY COVER (TYPE 9) ON THE DIKE SLOPES. ALL GRASSED AREAS SHALL BE FERTILIZED AND MULCHED IN ACCORDANCE WITH SECTIONS 180 & 182 RESPECTIVELY.
8. RIPRAP SHALL BE PLACED AS SHOWN ON THE DRAWINGS. AT THE SPILLWAY OUTLETS AT LEAST 50%, BY WEIGHT, OF THE RIPRAP SHALL CONSIST OF STONES AT LEAST 200 POUNDS EACH. IN THE CHEMICAL TREATMENT POND AT LEAST 50%, BY WEIGHT, OF THE RIPRAP SHALL CONSIST OF STONES AT LEAST 100 POUNDS EACH. RIPRAP SHALL CONFORM TO SECTION 830 OF THE T-1 SPECS.
9. FILTER SHALL CONFORM TO SECTION 836.
10. HAND-PLACED RIPRAP SHALL CONFORM TO SECTION 831.



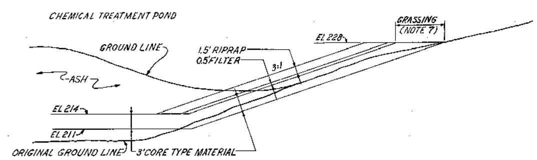
SECTION B-B
TYPICAL DIKE SECTION
STA 17+00± TO STA 30+00±



SECTION C-C
TYPICAL DIKE SECTION
STA 30+00± TO STA 37+00±



SECTION G-G



SECTION H-H

SUMMARY OF QUANTITIES WEST DISPOSAL AREA			
ITEM	DESCRIPTION	QUANTITY	UNIT
101	CLEARING AND GRUBBING	0.1	AC
	ASH REMOVAL	24,100	CY
123	EARTH BORROW - SHELL MATERIAL	90,600	CY
	EARTH BORROW - CORE MATERIAL	17,400	CY
180	GRASSING	20,300	SY
210	SURFACING	860	TON
830	RIPRAP	13	CY
836	FILTER	3	TON

P.A. 3092
AND W.O. P33-544-82-31401-J6

COMPANION DWGS., 10N223, 225, 226, 227, 228, 229-1, 229-2

SCALE: 1"=10'

INSPECTED AND APPROVED FOR ISSUE
B.F. Montgomery

1		10-19-76	RDP	RDP	RDP	JLG	KWB				
ADD SECTS FOR CHEMICAL TREATMENT POND & REVISED SECT A-A; P.A. 3076											
REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR

DSGN J.L. GLOVER
DRWN J.S. BERRY
CHKD D.A. VALENTINE
SUPV J.L. GLOVER
INSP
OHB
ENGINEER K.W. Burnett

MAIN PLANT - ASH DISPOSAL AREAS

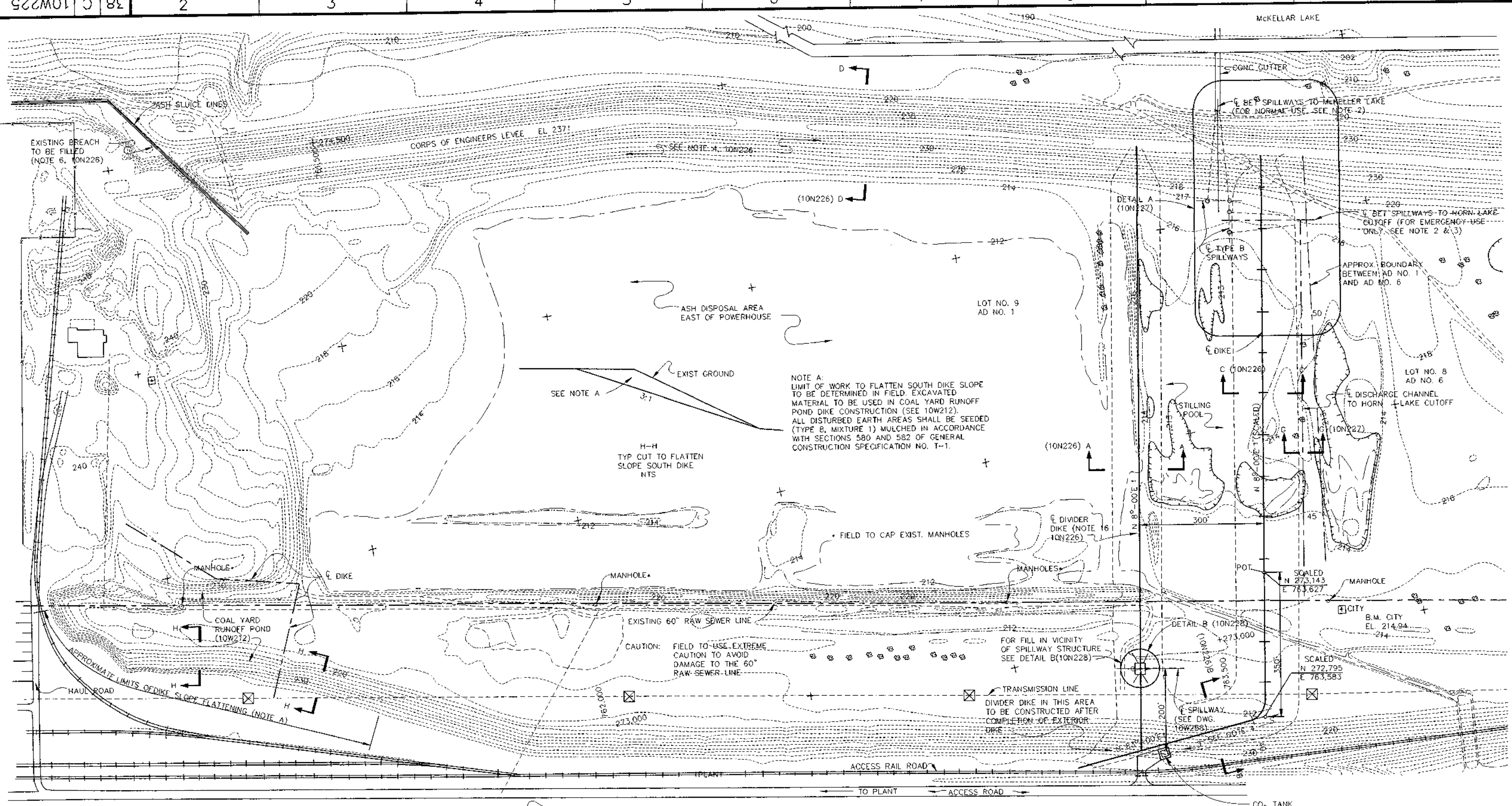
ASH DISPOSAL AREA
WEST OF POWERHOUSE
SHEET 2

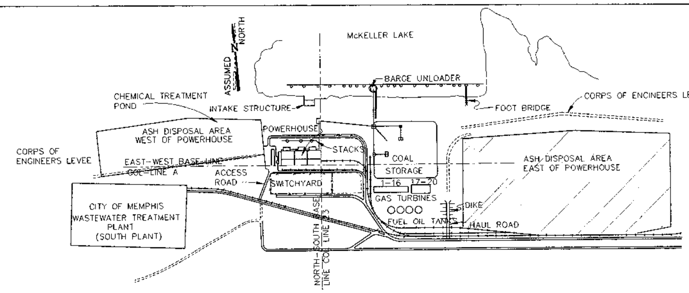
THOMAS H. ALLEN STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
Robert J. Bowman	F.D. Stansbury	G.L. Buchanan
KNOXVILLE	9-5-75	38 C 10N224 R1

RECORD DRAWING AS CONSTRUCTED
Gene Farmer 11-6-78 R1

MF
R1





LOCATION PLAN
SCALE: 1"=600'

NOTES:
1. FOR GENERAL NOTES SEE DWG 10N226.
2. THE STANDARD SPILLWAYS TO HORN LAKE CUTOFF ARE FOR EMERGENCY USE ONLY. NORMAL DISCHARGE FROM THE EAST DISPOSAL AREA SHALL BE THROUGH THE STANDARD SPILLWAYS TO McKELLAR LAKE. WHEN THE WATER LEVEL OF McKELLER LAKE REACHES A LEVEL THAT PROHIBITS THE DISCHARGE FROM THE EAST DISPOSAL AREA TO McKELLAR LAKE, THE GATES TO THESE SPILLWAYS ARE TO BE CLOSED AND THE STANDARD SPILLWAYS TO HORN LAKE CUTOFF ACTIVATED. THE SPILLWAYS TO McKELLAR LAKE ARE TO BE REACTIVATED AS SOON AS PRACTICAL.
3. SPILLWAYS TO HORN LAKE CUTOFF ARE TO BE TEMPORARILY PLUGGED, BY FIELF, UNTIL BREACH THROUGH CORPS OF ENGINEERS' LEVEE FOR CONSTRUCTION OF SPILLWAYS TO McKELLAR LAKE HAS BEEN BACKFILLED AND SPILLWAY GATES HAVE BEEN CONSTRUCTED.
4. WHEN CONNECTING THE DIKE TO THE RAILROAD FILL EXTREME CARE SHALL BE USED TO INSURE AN IMPERVIOUS AND STABLE CONNECTION.

P.A. 3092
AND W.O. P33-544-82-31401-J6

COMPANION DWGS. 10N223, 224, 226, 227, 228, 229-1, 229-2, 10W259-1, 259-2, 259-3

SCALE: 1"=100'
EXCEPT AS NOTED

		BKE	MGH	HLP	HLP	KWB	RGJ				
R 6	10-2-95	BKE	MGH	HLP	HLP	KWB	RGJ	WDH	ALF007		I
AS-BUILT											
R 5	10-27-94	BKE	MGH	HLP	HLP	KWB	RGJ	WDH	ALF007		
ADDED CO2 TANK & REFERENCE TO "W" SIZE.											
REV NO	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

SCALE: 1"=100' EXCEPT AS NOTED — EXCEPT AS NOTED

MAIN PLANT
ASH DISPOSAL AREAS

ASH DISPOSAL AREA EAST OF POWERHOUSE SHEET 1

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
B.K.ELDER	M.G.HRANEK	H.L.PETTY	H.L.PETTY	K.W.BURNETT	R.G.JOHNSON	W.D.HALL

THOMAS H. ALLEN STEAM PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

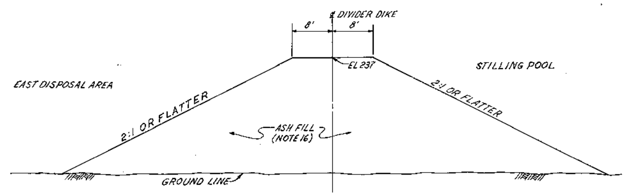
AUTOCAD R12 | DATE | 38 | C | 10W225 | R 6

ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN AND SUPERSEDES :(10N225 & R4)

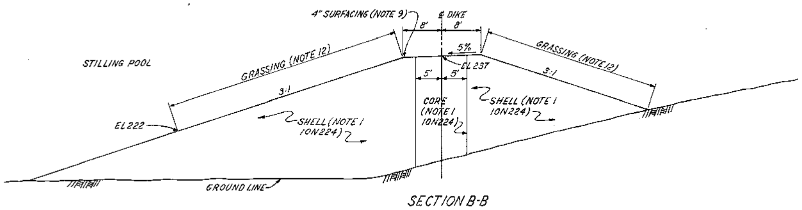
TASK COMPLETED BY: | REV NO

PLOT FACTOR:1/1200 - ACTUAL 1:1
W_TVA
FILENAME: AF225.DWG
C.A.D. DRAWING
DO NOT ALTER MANUALLY

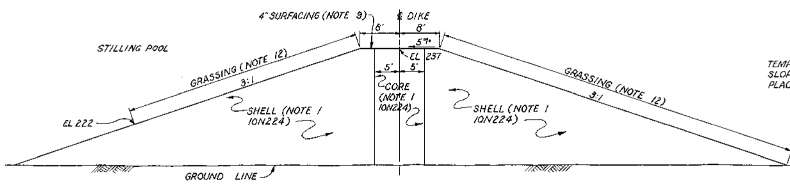
38 C 10W225



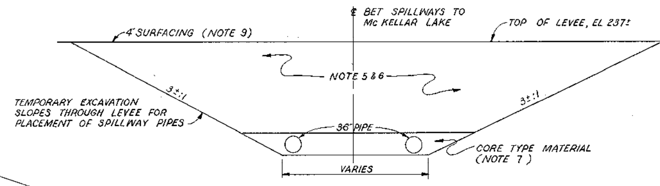
SECTION A-A
TYPICAL DIVIDER DIKE SECTION



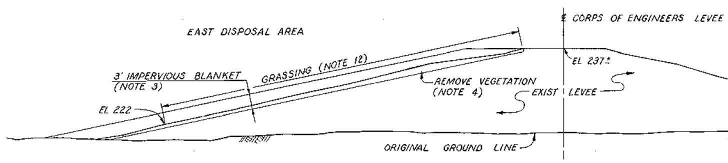
SECTION B-B



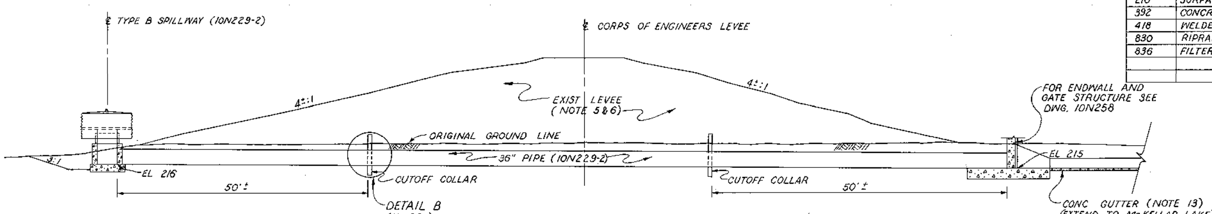
SECTION C-C
TYPICAL DIKE SECTION
STA 41+00± TO STA 53+00±



SECTION J-J
BREACH OF LEVEE SECTION



SECTION D-D
TYPICAL LEVEE SECTION



SECTION F-F
SPILLWAY TO McKELLAR LAKE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 10N224.
2. FIELD SHALL USE EXTREME CAUTION TO AVOID DAMAGE TO THE 60" RAW SEWER LINE LYING OUTSIDE AND SOUTH OF THE DISPOSAL AREA.
3. THE IMPERVIOUS BLANKET PLACED ON THE LANDSIDE SLOPE OF THE CORPS OF ENGINEERS' LEVEE SHALL BE OF CORE TYPE MATERIAL (MINIMUM 3 FEET THICK). PLACEMENT AND COMPACTION SHALL BE AS SPECIFIED FOR THE CORE MATERIAL (NOTE 1, 10N224). AT THE INTERSECTION OF THE LEVEE AND THE DIKE, THE IMPERVIOUS BLANKET ON THE SLOPE OF THE LEVEE SHALL EXTEND TO INTERSECT WITH THE CORE OF THE DIKE.
4. EXISTING VEGETATION SHALL BE STRIPPED FROM THE LANDSIDE SLOPE OF THE LEVEE BEFORE PLACEMENT OF THE IMPERVIOUS BLANKET AND STOCKPILED. AFTER PLACEMENT OF THE IMPERVIOUS BLANKET, THE STOCKPILED MATERIAL SHALL BE UNIFORMLY SPREAD OVER THE IMPERVIOUS BLANKET. THIS SLOPE SHALL THEN BE SEEDED PER NOTE 7, DRAWING 10N224.
5. THE BREACH IN THE LEVEE FOR CONSTRUCTION OF THE DISCHARGE SPILLWAYS TO McKELLAR LAKE SHALL NOT BE MADE UNTIL THE DIKES FOR THE EAST DISPOSAL AREA ARE CONSTRUCTED.
6. MATERIALS EXCAVATED FROM THE BREACH IN THE LEVEE SHALL BE STOCKPILED AND USED IN REFILLING THE BREACH AFTER INSTALLATION OF THE SPILLWAY PIPES. COMPACTION SHALL BE AS SPECIFIED FOR OTHER DIKE MATERIALS, (NOTE 1, 10N224), WITH CONTROLS AS ESTABLISHED BY THE CENTRAL SOILS LABORATORY. THE EXISTING LEVEE BREACH WHERE THE ASH SLUICE PIPES ARE LOCATED SHALL BE FILLED WITH SHELL TYPE MATERIAL, (NOTE 1, 10N224). THE LANDSIDE LEVEE SLOPE AT BOTH BREACHES SHALL BE PROVIDED WITH THE IMPERVIOUS BLANKET OF NOTE 3. SEVERAL ROUTINE FILL COMPACTION TESTS SHALL BE MADE ON THE COMPACTED FILL IN EACH BREACH, WELL DISTRIBUTED IN PLAN AND ELEVATION TO OBTAIN GOOD REPRESENTATION THROUGHOUT THE FILLS.
7. PIPE BACKFILL AND BEDDING MATERIAL SHALL CONSIST OF CORE TYPE MATERIAL (NOTE 1 10N224) AND SHALL BE PLACED IN ACCORDANCE WITH SECTION 7.7 OF THE G-9 SPECIFICATIONS.
8. THE ASH, HYDRAULIC FILL, AND FOUNDATION STRIPPING, EXCEPT FOR THAT REMOVED FROM THE CORPS OF ENGINEERS' LEVEE EXCAVATED FOR CONSTRUCTION OF THE EAST DISPOSAL AREA DIKES SHALL BE DISPOSED OF INSIDE THE DISPOSAL AREA.
9. CRUSHED STONE OR GRAVEL SURFACING, 4" THICK, SHALL BE APPLIED FOR THE FULL WIDTH OF THE TOP OF DIKE AND ALL DISTURBED SECTIONS OF THE CORPS OF ENGINEERS' LEVEE IN ACCORDANCE WITH SECTION 210 OF T-1 SPECIFICATIONS.
10. RIPRAP SHALL BE PLACED AT SPILLWAY OUTLETS AS SHOWN. AT LEAST 50%, BY WEIGHT, OF THE RIPRAP SHALL CONSIST OF STONES AT LEAST 200 POUNDS EACH. RIPRAP SHALL CONFORM TO SECTION 830 OF THE T-1 SPECIFICATIONS.
11. FILTER SHALL CONFORM TO SECTION 836.
12. ALL CUT AND FILL SLOPES AND OTHER DISTURBED AREAS SHALL BE SEEDED WITH TYPE 6, MIXTURE B OR TYPE 7, MIXTURE A IN ACCORDANCE WITH SECTION 180 OF T-1 SPECIFICATIONS. DEPENDING ON THE TIME OF CONSTRUCTION, IT MAY BE NECESSARY TO PROVIDE A TEMPORARY COVER (TYPE 9) ON THE DIKE AND LEVEE SLOPES. ALL GRASSED AREAS SHALL BE FERTILIZED AND MULCHED IN ACCORDANCE WITH SECTIONS 180 AND 182 RESPECTIVELY.
13. CONCRETE GUTTER SHALL CONFORM TO SECTION 390. INTERMEDIATE ANCHORS AND 3/4" EXPANSION JOINTS SHALL BE PLACED AT INTERVALS NOT TO EXCEED 50'.
14. WELDED WIRE FABRIC SHALL CONFORM TO ASTM SPECIFICATION A185 PLAIN FINISH, AND SHALL HAVE A MINIMUM LAP DISTANCE OF 8 INCHES.
15. THE MINIMUM FACTOR OF SAFETY FOR ALL LOADING CONDITIONS ON THE EAST DISPOSAL AREA IS 1.42. THIS FACTOR OF SAFETY IS FOR THE END OF CONSTRUCTION CONDITION.
16. THE DIVIDER DIKE SHALL BE CONSTRUCTED OF BOTTOM ASH PLACED IN NOT MORE THAN 9-INCH LAYERS, AND WELL COMPACTED WITH RUBBER-TIRED HAULING EQUIPMENT.

SUMMARY OF QUANTITIES EAST DISPOSAL AREA

ITEM	DESCRIPTION	QUANTITY	UNIT
101	CLEARING AND GRUBBING (DIKE)	3.4	AC.
120	CHAN EXCAV (TO HORN LAKE CUTOFF)	290	C.Y.
	ASH FILL (DIVIDER DIKE)	74,000	C.Y.
120	UNCLASSIFIED EXCAVATION (BREACH LEVEE)	4,745	C.Y.
123	EARTH BORROW - SHELL MATERIAL (DIKE)	102,000	C.Y.
	- CORE MATERIAL (DIKE)	13,500	C.Y.
	- SHELL MATERIAL (LEVEE)	5,945	C.Y.
	- CORE MATERIAL (LEVEE)	26,000	C.Y.
180	GRASSING (DIKE)	21,000	S.Y.
	GRASSING (LEVEE)	26,000	S.Y.
210	SURFACING (DIKE)	610	TONS
392	CONCRETE GUTTER (LEVEE)	300	L.F.
418	WELDED WIRE FABRIC	810	S.Y.
830	RIPRAP (DIKE)	990	C.Y.
836	FILTER (DIKE)	460	TONS

P.A. 3092
AND W.O. P33-544-82-31401-J6

COMPANION DWGS., 10N223, 224, 225, 227, 228, 229-1, 229-2
SCALE 1" = 10'

INSPECTED AND APPROVED FOR ISSUE
B.H. Montgomery

REV NO.	ECN NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENGR	INSP	SUBM	RECM	APPR			
2		3-16-77	ROP	JSB	ROP	JLG	KWB		RJB		GLB			WMB
REVISED RIPRAP & FILTER QUANTITIES P.A. 3076														
1		10-19-76	ROP	GRD	ROP	JLG	KWB		RJB		GLB			BSM
ADD DIVIDER DIKE - P.A. 3076; EXTEND ASH AREA DIKE TO RR FILL - P.A. 3092														

DSGN J.L. GLOVER
DRWN J.S. BERRY
CHKD R.W. SCHENK
SUPV J.L. GLOVER
INSP
OHR
ENGINEER K.W. Burnett

MAIN PLANT - ASH DISPOSAL AREAS

ASH DISPOSAL AREA EAST OF POWERHOUSE SHEET 2

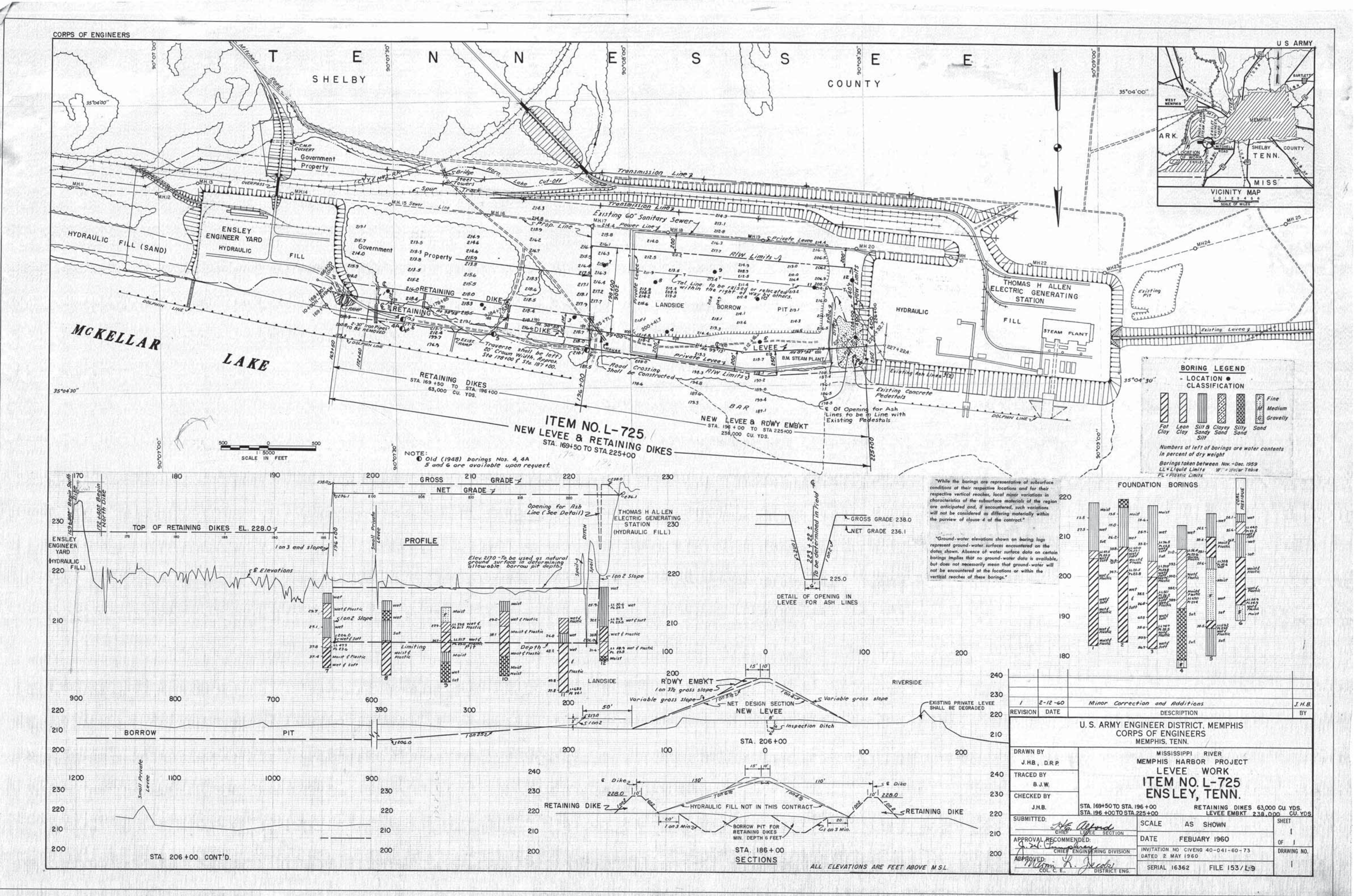
THOMAS H. ALLEN STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
Robert J. Bowman		

KNOXVILLE 9-5-75 | 38 | C | 10N226 | R2

RECORD DRAWING AS CONSTRUCTED
Dene Joiner 11-6-78 R2

38 | C | 10N226


CORPS OF ENGINEERS
U S ARMY
T E N N E S S E E
SHELBY
COUNTY
VICINITY MAP
McKELLAR
LAKE
HYDRAULIC FILL (SAND)
ENSLEY ENGINEER YARD
HYDRAULIC
FILL
Government Property
RETAINING DIKE
LANDSIDE
BORROW
PIT
LEVEE
THOMAS H ALLEN ELECTRIC GENERATING STATION
HYDRAULIC
FILL
STEAM PLANT
Existing Levee
Transmission Line
Existing 60" Sanitary Sewer
Private Levee
R/W Limits
RETAINING DIKES
STA. 169+50 TO STA. 196+00
63,000 CU. YDS.
ITEM NO. L-725
NEW LEVEE & RETAINING DIKES
STA. 169+50 TO STA. 225+00
NEW LEVEE & RDWY EMBK'T
STA. 196+00 TO STA. 225+00
238,000 CU. YDS.
BAR
Of Opening for Ash Lines to be in Line with Existing Pedestals
Existing Concrete Pedestals
Existing Ash Lines
SCALE IN FEET
NOTE:
Old (1948) borings Nos. 4, 4A 5 and 6 are available upon request.
BORING LEGEND
LOCATION
CLASSIFICATION
Fat Clay
Lean Clay
Silt & Sandy Silt
Clayey Sand
Silty Sand
Sand
Fine
Medium
Gravelly
Numbers at left of borings are water contents in percent of dry weight
Borings taken between Nov.-Dec. 1959
LL = Liquid Limits
PL = Plastic Limits
"While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local minor variations in characteristics of the subsurface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially within the purview of clause 4 of the contract."
"Ground-water elevations shown on boring logs represent ground-water surfaces encountered on the dates shown. Absence of water surface data on certain borings implies that no ground-water data is available, but does not necessarily mean that ground-water will not be encountered at the locations or within the vertical reaches of these borings."
FOUNDATION BORINGS
GROSS GRADE
NET GRADE
TOP OF RETAINING DIKES EL. 228.0
PROFILE
ENSLEY ENGINEER YARD (HYDRAULIC FILL)
THOMAS H ALLEN ELECTRIC GENERATING STATION (HYDRAULIC FILL)
Opening for Ash Line (See Detail)
GROSS GRADE 238.0
NET GRADE 236.1
DETAIL OF OPENING IN LEVEE FOR ASH LINES
R'DWY EMBK'T
NET DESIGN SECTION
NEW LEVEE
LANDSIDE
RIVERSIDE
EXISTING PRIVATE LEVEE SHALL BE DEGRADED
Inspection Ditch
BORROW
PIT
STA. 206+00
STA. 206+00 CONT'D.
RETAINING DIKE
HYDRAULIC FILL NOT IN THIS CONTRACT
BORROW PIT FOR RETAINING DIKES MIN. DEPTH 6 FEET
STA. 186+00
SECTIONS
ALL ELEVATIONS ARE FEET ABOVE M.S.L.
1 | 2-12-60 | Minor Correction and Additions | J.H.B.
REVISION | DATE | DESCRIPTION | BY
U.S. ARMY ENGINEER DISTRICT, MEMPHIS
CORPS OF ENGINEERS
MEMPHIS, TENN.
MISSISSIPPI RIVER
MEMPHIS HARBOR PROJECT
LEVEE WORK
ITEM NO. L-725
ENSLEY, TENN.
DRAWN BY J.H.B., D.R.P.
TRACED BY B.J.W.
CHECKED BY J.H.B.
STA. 169+50 TO STA. 196+00 RETAINING DIKES 63,000 CU. YDS.
STA. 196+00 TO STA. 225+00 LEVEE EMBKT 238,000 CU. YDS.
SUBMITTED:
CHIEF SECTION
APPROVAL RECOMMENDED:
CHIEF ENGINEERING DIVISION
APPROVED:
COL. C. E. DISTRICT ENG.
SCALE AS SHOWN
DATE FEBUARY 1960
INVITATION NO CIVENG 40-041-60-73
DATED 2 MAY 1960
SERIAL 16362
FILE 153/L-9
SHEET 1 OF 1
DRAWING NO. 1

APPENDIX G
EVALUATION OF EXISTING GEOTECHNICAL DATA

Evaluation of Existing Geotechnical Data Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

2.0 OBJECTIVES AND EVALUATION CRITERIA

Through the various information requests, as well as TDEC comments on the EIP, a need has been identified for an evaluation of existing geotechnical data. This document has been prepared to review the existing data and evaluate its adequacy with respect to responding to the various information requests.

Characterization of geotechnical parameters may differ from one evaluation to the next and can be due to multiple factors, such as:

1. Different loading cases (long-term static, short-term static, seismic, etc.) necessitate different strengths,
2. Spatial variation in subsurface conditions and analyses that consider different locations,
3. New information (field data, laboratory data, etc.) that allows updates to the characterization,
4. Changes in subsurface conditions due to the passage of time and/or geometric/operational changes at the site,
5. Evolution of the standard of practice and differences in professional engineering judgement with respect to geotechnical characterization and/or stability analyses,

Such differences are common within geotechnical engineering practice, particularly over a long period of time, with multiple studies performed by various professionals, and as additional data becomes available through various field and laboratory testing efforts. The relevancy of the above factors, with respect to the existing and upcoming analyses will be included as part of the response in the Environmental Assessment Report (EAR).

Evaluating the adequacy of existing data depends on both the type of data and its use. Existing geotechnical data will be used to support the following subjects addressed within the information requests:

1. Three-dimensional model (including CCR saturation) and volumetric estimates,
2. Stability of bedrock below fill areas,
3. Stability of the waste fill and side-slope berms,
4. CCR and soil shear strengths,
5. Potential for solution channeling, karst features, etc. in the shallow rock formations beneath the CCR units.

6. Three-Dimensional Model (including CCR Saturation) and Volumetric Estimates.

For evaluating the three-dimensional model and volumetric estimates, existing data to be considered (if available) includes:

1. Ground survey, aerial, and hydrographic surveys which including existing ground surface, upper CCR surface, and dike geometry data,
2. Instrumentation data and/or seepage models that include piezometric levels of saturation in CCR,
3. Borings that included the lower CCR surface, thickness of the clay foundation (or other materials) overlying bedrock, and top of bedrock elevations.
4. Electrical Resistivity Imaging (ERI) data that includes interpreted top of bedrock data.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Suitability of methods used to perform topographic surveys, geotechnical borings, and geophysical surveys, as well as the associated documentation. Suitability is evaluated qualitatively, based on how well the methods obtain the necessary data and how the methods compare to the current standard of practice.
2. Spatial coverage of borings and geophysical surveys.
3. Potential for relevant changes in subsurface conditions since borings or surveys were performed.

2.1 STABILITY OF BEDROCK BELOW FILL AREAS

For evaluating the stability of bedrock below fill areas, existing data to be considered (if available) includes:

1. Geotechnical data from borings that included rock coring,
2. Geophysical surveys that included data below the top of bedrock,
3. Routine visual observations of CCR units, with respect to indicators of structural distress.
4. Geologic mapping and characterization of the site, including descriptions of the shallow rock formations.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Spatial coverage of borings, geophysical surveys, and visual observations,

2. Suitability of methods used to perform rock coring, geophysical surveys, and visual observations, and of the associated documentation. Suitability is evaluated qualitatively, based on how well the methods obtain the necessary data and how the methods compare to the current standard of practice.

3. Potential for relevant changes in subsurface conditions since borings, surveys, or observations were performed.

2.2 STABILITY OF WASTE FILL AND SIDE-SLOPE BERMS

For evaluating stability of the waste fill and side-slope berms, existing data to be considered includes:

1. Slope stability analyses of existing conditions,

2. Slope stability analyses of future (i.e., permitted, "build-out", or closed) conditions.

3. Structural stability assessments performed for CCR Rule compliance.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Representative coverage with stability analysis cross sections,

2. Representative cross section geometry and subsurface characterization,

3. Representative material parameters and phreatic conditions,

4. Representative loads (static loads, seismic loads, etc.),

5. Appropriate stability analysis methods,

6. Potential for relevant changes in conditions since analyses were performed.

2.3 CCR AND SOIL SHEAR STRENGTHS

For evaluating CCR and soil shear strengths, existing data to be considered includes:

1. Shear strengths based on in-situ testing,
2. Shear strengths based on laboratory testing,
3. Shear strengths based on published values for similar materials.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Locations of in-situ tests and/or samples for each material,
2. Suitability of methods used to perform in-situ testing, to collect samples, and to perform laboratory testing. Suitability is evaluated qualitatively, based on how well the methods obtain the necessary data and how the methods compare to the current standard of practice.
3. Potential for relevant changes in subsurface conditions since in-situ testing and/or sampling were performed.

2.4 POTENTIAL FOR SOLUTION CHANNELING AND KARST FEATURES

For evaluating the potential for solution channeling in the shallow rock formations beneath the CCR units, existing data to be considered (if available) includes:

1. Geotechnical data from borings that included rock coring,
2. Geophysical surveys that included data at/below the top of bedrock,
3. Geologic mapping/characterization of the site, including descriptions of the shallow rock formations.

For this subject, the basis for evaluating the adequacy of each type of data listed above are similar:

1. Spatial coverage of borings, geophysical surveys, and geologic mapping,
2. Suitability of methods used to perform rock coring, geophysical surveys, and geologic mapping, and of the associated documentation,
3. Potential for relevant changes in subsurface conditions since borings, surveys, or mapping was performed.

3.0 EXISTING GEOTECHNICAL REPORTS

The following sections review and evaluate existing geotechnical reports with respect to the data necessary to support EIP information request responses. Each evaluation begins with a summary table of the key items, followed by additional details of each report.

3.1 TVA (1975)

Table 1. Summary of Evaluation for TVA (1975)

Reference:	Tennessee Valley Authority (TVA). 1975. "Allen Steam Plant – Ash Disposal Areas Dikes – Soil Investigation." Memorandum from Gene Farmer to G. L. Buchanan. May.	
Purpose:	Field exploration and laboratory testing for proposed raises to East and West Ash Disposal Area Dikes	
CCR Unit(s):	East Ash Disposal Area, West Ash Disposal Area	
Spatial coverage:	Footprints of proposed raises to East and West perimeter dikes	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	14 borings (8 at East Ash Disposal Area Dike, 6 at West Ash Disposal Area Dike)
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	No	Written descriptions and laboratory test summaries provide comparative data for dike, CCR, and foundation soils. No boring logs provided.
Geometry at time of document representative of 2017 conditions:	No	Foundation soils likely similar, but raised dikes had not yet been constructed.
Piezometer installation:	No	
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Not documented if testing followed ASTM standards
Shear strength parameters:	Yes	Design strengths presented for foundation and dike soils
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	No	

3.1.1 Field Activities

In 1975, fourteen soil borings were advanced within the foundation areas of the proposed raises to the East and West Ash Disposal Area dikes (approximate locations are provided in Figures 1 and 2 of Attachment A). Eight borings (seven with standard penetration testing (SPT) and one for undisturbed (Shelby tube) samples) were drilled for the East Ash Disposal Area raised dike. Six borings (five with SPT and one for Shelby tubes) were drilled for the West Ash Disposal Area raised dike. The exploration was performed with a CME drill equipped with hollow-stem augers, a Minuteman mobile drill, and hand augers. The encountered soils and CCR were sampled by SPT. Undisturbed soil samples (Shelby tubes) were obtained from one boring (US-5) in the East Ash Disposal Area and one boring (US-4) in the West Ash Disposal Area, for laboratory testing. During the investigation, water levels within the borings were noted to vary approximately with the river level. The water levels within borings were initially noted between elevation 207 to 209.5 feet. However, due to flooding along the Mississippi River during the east dike exploration, the water levels within borings were noted at elevations between 212 and 216 feet.

It was not documented if the boring locations were surveyed upon the completion of drilling, but boring diagrams were provided that denoted the approximate location and station of each boring along the existing perimeter dikes.

3.1.2 Laboratory Testing

Laboratory classification and natural moisture content testing was performed on disturbed samples of the East and West Dike foundation soils. Triaxial tests were performed on representative undisturbed samples from both the East and West Dike foundation soils. Laboratory vane Shear tests were performed on undisturbed samples that were too soft for trimming. Additionally, shear strength and hydraulic conductivity tests were performed on remolded samples of borrow soils, to represent raised dike core and random fill materials.

3.1.3 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Soil index properties (gradation, Atterberg limits, natural moisture content)
    a. Testing appeared to follow conventional procedures, but testing standards are not explicitly documented. Results can be used for comparison/context to other data, but should not be used directly for analyses.

3.2 MACTEC (2004A)

Table 2. Summary of Evaluation for MACTEC (2004a)

Reference:	MACTEC. 2004a. "Final Summary of Laboratory Testing on Fly Ash, Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. May.	
Purpose:	To perform laboratory testing on fly ash materials from the site, and develop recommended engineering parameters from the test results.	
CCR Unit(s):	East Ash Disposal Area and West Ash Disposal Area	
Spatial coverage:	Bulk samples from within East and West Ash Disposal Areas	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	Yes	
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	Yes	Some testing follows ASTM standards. Other test methods are not documented
Shear strength parameters:	Yes	Static drained and undrained strengths of remolded CCR
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Laboratory testing is representative of compacted CCR
Other relevant analyses:	No	

3.2.1 Field Activities

MACTEC personnel collected bulk samples of fly ash from the East Ash Disposal Area and West Ash Disposal Area. Samples were also collected from a third location that is not part of the study area. Details regarding sample collection and specific location are not documented in the referenced report.

3.2.2 Laboratory Testing

The bulk samples from the subject areas were first tested according to ASTM standards to determine their index properties (sieve, hydrometer, Atterberg limits, USCS classification, specific gravity) and their moisture-density relationships (Standard and Modified Proctor). Remolded (i.e., compacted) samples were then tested for standard California Bearing Ratio (CBR) according to ASTM D1883 and resilient modulus according to AASHTO T307. The remolded samples were also tested for hydraulic conductivity, consolidation, unconsolidated-undrained (UU) triaxial shear strength, and consolidated-undrained (CU) triaxial shear strength. The hydraulic conductivity, consolidation, UU triaxial, and CU triaxial test methods were not documented in the referenced report, but appear to have been completed in general accordance with ASTM methods.

3.2.3 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Compacted CCR properties (including shear strengths)
    a. Testing generally followed relevant ASTM standards.

3.3 MACTEC (2004B)

Table 3. Summary of Evaluation for MACTEC (2004b)

Reference:	MACTEC. 2004b. "Report of Geotechnical Exploration, East and West Disposal Areas, Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. August.	
Purpose:	To determine general subsurface conditions and obtain data to evaluate the engineering characteristics of CCR and underlying soils.	
CCR Unit(s):	East Ash Disposal Area and West Ash Disposal Area	
Spatial coverage:	Various locations within East and West Ash Disposal Areas	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	9 Borings (3 at West Ash Disposal Area, 6 at East Ash Disposal Area)
Rock coring:	No	
Other subsurface data:	Yes	5 CPT borings (2 at West Ash Disposal Area, 3 at East Ash Disposal Area
Boring locations surveyed:	Yes	Borings surveyed by TVA after drilling
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, CCR thickness, and foundation soil stratigraphy.
Geometry at time of document representative of 2017 conditions:	Yes	
Piezometer installation:	No	
In-situ testing:	Yes	SPT, CPT (with pore pressure dissipation)
Laboratory testing:	Yes	Testing follows ASTM standards
Shear strength parameters:	Yes	Static drained and undrained strengths on CCR and alluvium foundation soil
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Laboratory testing is representative of existing CCR and foundation soils.
Other relevant analyses:	No	

3.3.1 Field Activities

A subsurface exploration program consisted of a total of nine borings, six at the East Ash Disposal Area and three at the West Ash Disposal Area. The locations for all the borings and CPT soundings were proposed by Parsons E&C and approved by TVA (approximate locations are shown on the boring layout in Figures 1 and 2).

The borings were drilled using a truck-mounted drill rig and hollow stem augers. Boring depths ranged from 40 to 100 feet. SPTs were performed in accordance with ASTM D1586, at three-foot intervals in the upper 20 feet, and at five-foot intervals below a depth of 20 feet. Shelby tube samples were obtained in accordance with ASTM D1587 at depths determined by MACTEC within three borings. Water levels within the borings were observed during drilling and approximately 24 hours after completion of the drilling.

Five CPT soundings were performed in accordance with ASTM D5778. Two CPT soundings were advanced in the West Ash Disposal Area and three were advanced in the East Ash Disposal Area. Pore pressure dissipation tests were performed in all the CPT soundings, and seismic cone penetrometer tests (i.e., CPT with shear wave velocity measurements) were performed in one sounding at the East Ash Disposal Area.

Upon completion of drilling, the borings were backfilled with cement grout. Additionally, all borings and CPT sounding locations were surveyed by others and the location and top of hole elevations for each boring were provided to MACTEC.

3.3.2 Laboratory Testing

The disturbed (SPT) and undisturbed (Shelby tube) soil samples obtained during conventional drilling were subjected to the following laboratory tests: 36 natural moisture content (D2216), 6 Atterberg limits (D4318), 19 gradation (D422), 7 specific gravity (D854), 9 USCS soil classifications (D2487), and 4 CU triaxial with pore pressure measurements (D4767).

3.3.3 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.
2. Soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.

3.4 STANTEC (2010A)

Table 4. Summary of Evaluation for Stantec (2010A)

Reference:	Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.	
Purpose:	Geotechnical exploration and static slope stability evaluation of the East Stilling Pond. This study was performed to evaluate slope stability and seepage for existing conditions.	
CCR Unit(s):	East Stilling Pond (part of the East Ash Disposal Area)	
Spatial coverage:	Crest and outboard toe of eastern perimeter dike and crest of southern perimeter dike	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	8 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by TVA after drilling.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry and foundation soil stratigraphy. Borings did not encounter CCR.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions similar to or more conservative than current. Interior sloughing of perimeter dike was remediated.
Piezometer installation:	Yes	Six borings, screened in dike fill or alluvium
In-situ testing:	Yes	SPT, slug testing of piezometers
Laboratory testing:	Yes	Testing follows ASTM standards
Shear strength parameters:	Yes	Static drained strengths (dike fill and alluvium)
Static slope stability:	Yes	Three cross-sections around perimeter
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of long term, static stability of perimeter.
Other relevant analyses:	Yes	Seepage analyses performed to support slope stability modeling and to evaluate critical exit gradients and associated piping factors of safety.

3.4.1 Field Activities

A geotechnical drilling program was developed that consisted of eight soil borings. The boring locations were chosen by Stantec and surveyed by TVA after drilling was completed (approximate locations are shown on the boring layout in Figure 1).

Six of the eight borings were drilled using hollow-stem augers powered by either a truck-mounted or an ATV-mounted drilling rig. The other two borings were performed using a hand auger. In the hollow-stem auger borings, continuous SPTs were performed in accordance with ASTM D1586. If applicable, an offset boring was performed after completion of a SPT boring to obtain Shelby tube samples in targeted soils at specific depths. Shelby tube samples were obtained in accordance with ASTM D1587. Additional disturbed bulk samples (auger cuttings) were obtained from the hand auger borings. These bulk samples consisted of "dike core" material.

Upon completion of drilling, the hand auger borings were backfilled. Boreholes with piezometers received a quartz sand filter pack around the piezometer, a bentonite seal above the sand, and then backfill with the cement-bentonite mixture. Piezometers were installed at six locations. Other borings without piezometers were backfilled with bentonite grout.

In-situ measurements of hydraulic conductivity of the soil were made at each piezometer location via slug testing. The testing followed ASTM D4044. These tests were conducted by introducing a measured quantity of water to a static column of water in a well. During the tests, water levels were measured over time using an electronic data logger. Field data was then processed using the Bouwer and Rice model for unconfined aquifer conditions.

3.4.2 Laboratory Testing

Laboratory tests were performed in accordance with ASTM standard testing procedures, as noted below.

Natural moisture content (D2216) tests were performed on all SPT, bulk, and Shelby tube samples. Soil Index classification testing (D2487) was performed on selected soil samples. These tests included particle size analyses (D422), Atterberg limits (D4318), and specific gravity (D854). In addition to soil index classification testing, unit weight (D7263), consolidated undrained triaxial compression (D4767), and falling head permeability (D5084) tests were performed on both in-situ and remolded samples. Disturbed samples were remolded in an effort to test dike fill materials that were not sampled with Shelby tubes.

3.4.3 Analysis

The drilling program had eight soil borings to support development of three cross-sections for slope stability analyses of the eastern and southern perimeter dikes of the East Stilling Pond. The cross-sections were selected because they are representative of the facility as a whole, are along the most critical slopes, and are at regular intervals along the dike alignment.

These analyses incorporated available historic information, results of the geotechnical field exploration, and the results of the laboratory testing.

The stability of the East Stilling Pond dike slopes was analyzed using limit equilibrium methods. Analyses were performed for static, long-term conditions with steady-state seepage. Steady-state pore pressures were obtained from the seepage analysis and the phreatic surface was determined from the water level monitoring program (i.e., borehole visual readings, piezometer readings, and noted elevations of surface water, such as in the nearby McKellar Lake). Material parameters were determined by soil index classification testing along with laboratory-derived material properties for modeling the soil horizons in the dikes and foundation soils. Strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, Tennessee. Shallow, surficial failures were neglected as they would not cause a failure of the entire embankment. The minimum failure depth for this analysis was set to 10 feet. Failures shallower than 10 feet were assumed to be repairable before any progressive failures occurred.

3.4.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
2. Perimeter dike and foundation geometry is substantially the same as current.
    a. Piezometers
    b. Installation methods meet current standard of practice,
    c. Locations and elevations were surveyed,
    d. Instruments are adequate to provide current water level readings.
3. Soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
4. Static slope stability analyses
    a. Material parameters are representative of current.

b. Surface and subsurface geometry is substantially the same at present.

c. Pool elevations and phreatic conditions are similar to present conditions.

d. Analysis methods meet current standard of practice.

3.5 STANTEC (2010B)

Table 5. Summary of Evaluation for Stantec (2010B)

Reference:	Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.	
Purpose:	Geotechnical exploration and static slope stability evaluation of the northern perimeter dike. This study was performed to evaluate slope stability and seepage due to an interior slough along the perimeter dike.	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	Crest and outboard toe of the northern perimeter dike	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	16 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by TVA after drilling.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry and foundation soil stratigraphy.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions similar to current.
Piezometer installation:	Yes	Eight borings, screened in dike fill or alluvium
In-situ testing:	Yes	SPT, slug testing of piezometers
Laboratory testing:	Yes	Testing follows ASTM standards
Shear strength parameters:	Yes	Static drained and undrained strengths (dike fill and alluvium)
Static slope stability:	Yes	Two sections along northern perimeter dike. Long term, drained and rapid drawdown stability analyzed.
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of long term, static stability of perimeter.
Other relevant analyses:	Yes	Seepage analyses performed to support slope stability modeling and to evaluate critical exit gradients and associated piping factors of safety.

3.5.1 Field Activities

A geotechnical drilling program was developed that consisted of 16 soil borings. The boring locations were chosen by Stantec and surveyed by TVA after drilling was completed (approximate locations are shown on the boring layout in Figure 1).

Eight of the sixteen borings were drilled using hollow-stem augers powered by either a truck-mounted or an ATV-mounted drilling rig. The other eight borings were performed using a hand auger. In the hollow-stem auger borings, continuous SPTs were performed in accordance with ASTM D1586. If applicable, an offset boring was performed after completion of a SPT boring to obtain Shelby tube samples in targeted soils at specific depths. Shelby tube samples were obtained in accordance with ASTM D1587. Additional disturbed bulk samples (auger cuttings) were obtained at one-foot intervals from the hand auger borings using a bucket sampler.

Upon completion of drilling, the auger borings without piezometers were backfilled with bentonite grout. Boreholes with piezometers received a quartz sand filter pack around the piezometer, a bentonite seal above the sand, and then backfill with the cement-bentonite mixture. Piezometers were installed at 8 locations.

In-situ measurements of hydraulic conductivity of the soil were made at each piezometer location via slug testing. The testing followed ASTM D4044. These tests were conducted by introducing a measured quantity of water to a static column of water in a well. During the tests, water levels were measured over time using an electronic data logger. Field data was then processed using the Bouwer and Rice model for unconfined aquifer conditions.

3.5.2 Laboratory Testing

Soil samples from the field exploration were returned to a Stantec (or certified vendor's) materials laboratory. The laboratory tests were performed in accordance with ASTM standard testing procedures.

Natural moisture content (D2216) tests were performed on all SPT and Shelby tube samples. Soil index classification testing (D2487) was performed on selected soil samples. These tests included particle size analyses (D421 and D422), Atterberg limits (D4318), and specific gravity (D854). In addition to soil index classification testing, consolidated undrained triaxial compression tests (D4767) were performed on Shelby tube samples. Falling head permeability tests (D5084) were performed on both in-situ and remolded samples. Disturbed samples were remolded in an effort to test dike fill materials that were not sampled with Shelby tubes. Unit weight (D7263) testing was performed on all triaxial compression and permeability tests.

3.5.3 Analysis

Two cross-sections were developed for slope stability analyses of the northern perimeter dike. One cross-section was selected because it is representative of the facility, while the other cross-section was at the center of the repaired slough area. These sections were based on available historic information, results of the geotechnical field exploration, and the results of the laboratory testing.

The stability of the ash pond dike slopes was analyzed using two-dimensional cross sections and limit equilibrium methods. Analyses were performed for static, long-term conditions with steady-state seepage (normal operating conditions, maximum ash pond storage elevation, and estimated maximum ash pond surcharge pool elevation) and for undrained conditions (saturated dike and rapid drawdown). Steady-state pore pressures were estimated using a seepage model based on in situ and laboratory testing, and water level monitoring (i.e., borehole visual readings, piezometer readings, and noted elevations of surface water, such as in the nearby McKellar Lake). Soil index classification testing and laboratory-derived material properties were used to model the dike fill and foundation soils. Strength parameters for the ash were based on historical test results for the TVA Fossil Plant at Kingston, Tennessee. Exterior slope "global" (i.e., deep seated) failures were evaluated for long term and rapid drawdown loading conditions. Exterior and interior slope "maintenance" (i.e., shallow) failures were also evaluated for long term loading conditions.

3.5.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
2. Perimeter dike and foundation geometry is substantially the same as current.
    a. Piezometers
    b. Installation methods meet current standard of practice,
    c. Locations and elevations were surveyed,
    d. Instruments are adequate to provide current water level readings.

3. Soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
4. Static slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same as present.
    c. Phreatic conditions are similar to current.
    d. Analysis methods meet current standard of practice.

3.6 STANTEC (2011)

Table 6. Summary of Evaluation for Stantec (2011)

Reference:	Stantec Consulting Services Inc. (Stantec). 2011. "Geotechnical Report for the Evaluation of Dike Stability, Remedial Measures for the Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. May.	
Purpose:	Slope stability analyses of the East Ash Disposal Area divider dike and eastern perimeter dike of East Stilling Pond, considering a lowered stilling pond pool elevation and riprap slope armoring.	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	Divider dike between Ash Pond and Stilling Pond and eastern perimeter dike of East Stilling Pond	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	5 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by TVA after drilling.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, CCR thickness, and foundation soil stratigraphy.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions likely similar or more conservative than current.
Piezometer installation:	No	
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Testing follows ASTM standards
Shear strength parameters:	Yes	Static drained strengths (CCR, dike fill, and alluvium)
Static slope stability:	Yes	Three cross-sections through both the divider dike and the east perimeter dike
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of long term, static stability of perimeter.
Other relevant analyses:	Yes	Updated seepage analyses performed to evaluate critical exit gradients and associated piping factors of safety after spillway modifications.

3.6.1 Field Activities

A geotechnical drilling program was developed that consisted of five borings: three soil borings plus two offset soil borings. Borings were located along the crest of the divider dike between the ash pond and stilling pond. The boring locations were chosen by Stantec and surveyed by TVA after drilling was completed (approximate locations are shown on the boring layout in Figure 1).

The borings were drilled using hollow-stem augers powered by either a truck-mounted or an ATV-mounted drilling rig. In the three primary soil borings, continuous SPTs were performed in accordance with ASTM D1586. If applicable, an offset boring was performed after completion of a SPT boring to obtain Shelby tube samples in targeted soils at specific depths. Shelby tube samples were obtained in accordance with ASTM D1587. Additional disturbed bulk samples (auger cuttings) were obtained in selected borings.

Upon completion of drilling, borings were backfilled with bentonite cement grout.

3.6.2 Laboratory Testing

Soil samples from the field exploration were returned to a Stantec (or certified vendor's) materials laboratory. The laboratory tests were performed in accordance with ASTM standard testing procedures.

Natural moisture content (D2216) tests were performed on all SPT and Shelby tube samples. Soil index classification testing (D2487) was performed on selected soil samples. These tests included particle size analyses (D421 and D422), Atterberg limits (D4318), and specific gravity (D854). In addition to soil index classification testing, consolidated undrained triaxial compression tests (D4767) were performed on cohesive Shelby tube samples. Constant head permeability tests (D2434), direct shear tests (D3080), and maximum and minimum density index tests (D4253 and D4254) were performed on remolded bottom ash samples. Unit weight (D7263) testing was performed on all triaxial compression, direct shear, and permeability tests.

3.6.3 Analysis

Three cross-sections were developed for slope stability analyses of the divider and east perimeter dikes. The cross-sections were selected because they are representative of the facility, are along the most critical slopes, and are at regular intervals along the dike alignment. These analyses incorporated available historic information, established correlations in published literature, results of the geotechnical field exploration, and the results of the laboratory testing.

The stability of the dike slopes was analyzed using two-dimensional cross sections and limit equilibrium methods. Analyses of the east perimeter dike were performed for static, long-term conditions with steady-state seepage, assuming the ash pond pool elevation of 230 feet and stilling pond pool elevation of 226 feet.

Analyses of the divider dike were performed for static, long-term conditions with steady-state seepage, considering two options for the stilling pond pool elevation (225 feet or 226 feet) and with or without a riprap blanket on the divider dike.

Steady-state pore pressures were estimated using a seepage model based on in situ and laboratory testing, and water level monitoring (i.e., borehole visual readings, piezometer readings, and noted elevations of surface water, such as in the nearby McKellar Lake). Soil index classification testing and laboratory-derived material properties were used to model the CCR, dike fill and foundation soils. For both the east perimeter dike and the divider dike, exterior/outboard slope “global” (i.e., deep seated) and “maintenance” (i.e., shallow) failures were evaluated for long term conditions.

3.6.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.
2. CCR and soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
3. Static slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same as present.
    c. Phreatic conditions are similar to current.
    d. Analysis methods meet current standard of practice

3.7 STANTEC (2012A)

Table 7. Summary of Evaluation for Stantec (2012A)

Reference:	Stantec Consulting Services Inc. (Stantec). 2012a. "Geotechnical Exploration Report, Northern Perimeter Dike Stability, Chemical Treatment Pond Closure, Allen Fossil Plant, Memphis Tennessee." Prepared for Tennessee Valley Authority. August.	
Purpose:	Evaluate stability of the Chemical Treatment Pond northern perimeter dike and to support future pond closure plans	
CCR Unit(s):	Chemical Treatment Pond adjacent to the West Ash Disposal Area	
Spatial coverage:	Chemical Treatment Pond Section F-F' and G-G', sections are both are through the Northern Perimeter Dike.	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	12 borings
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	Yes	Surveyed by TVA after drilling.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry and foundation soil stratigraphy.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry similar. Phreatic conditions likely similar.
Piezometer installation:	Yes	5 borings instrumented with strings of vibrating wire piezometers (14 sensors total) and 3 borings with pairs of slotted screens (6 piezometers total); screened in dike fill, CCR, and alluvium.
In-situ testing:	Yes	SPT
Laboratory testing:	Yes	Testing follows ASTM standards
Shear strength parameters:	Yes	Static drained and undrained strengths (dike fill and foundation soils)
Static slope stability:	Yes	2 sections (F-F', G-G')
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of long term, static stability, and rapid drawdown of perimeter.
Other relevant analyses:	Yes	Seepage analyses performed to estimate pore pressures for rapid drawdown conditions.

3.7.1 Field Activities

A subsurface exploration program consisted of twelve borings along the crest and exterior toe of the northern perimeter dike of the Chemical Treatment Pond, located just east of the West Ash Disposal Area. The approximate locations are shown on the boring layout in Figure 2.

The borings were drilled using either a truck-mounted or ATV-mounted drill rig. In the soil borings, continuous SPTs were performed in accordance with ASTM D1586. Shelby tube samples were obtained in accordance with ASTM D1587 at depths determined by Stantec within soil dike and alluvium materials. Upon completion of drilling, a multi-level vibrating wire piezometer (VWPZ) string was installed within five selected boreholes. Each VWPZ string (two or three transducers per string) was lowered into the open boring and then fully grouted into place with a cement/bentonite grout. Slotted screen piezometers were installed at three selected boreholes (two screened intervals per hole). The slotted screen piezometers were constructed from 1-inch diameter Schedule 40 PVC riser pipe and 5-foot long No. 10 slot well screens. The annular backfill consisted of a sand filter pack to some distance above the screen followed by a minimum two-foot bentonite seal. After allowing the bentonite to hydrate, the remaining annulus was backfilled with cement bentonite grout tremied into place.

3.7.2 Laboratory Testing

The disturbed (SPT) and undisturbed (Shelby tube) soil samples obtained during conventional drilling were subjected to the following laboratory tests: natural moisture content (D2216), Atterberg limits (D4318), USCS classification (D2487), gradation (D422), unit weight, and CU triaxial with pore pressure measurements (D4767).

3.7.3 Analysis

Stantec performed both slope stability and seepage analyses at two cross-sections of the Northern Perimeter Dike (North Dike) of the Chemical Treatment Pond. Cross-section F-F' was along the east side of the Chemical Treatment Pond. Cross-section G–G' was along the west side of the pond. Limit equilibrium slope stability analyses were performed for each cross-section for long-term static and rapid drawdown conditions. Pore pressures were estimated using piezometric lines for the long-term static loading condition, and using seepage models for rapid drawdown conditions. Exterior slope "global" (i.e., deep seated) failures were evaluated for long term and rapid drawdown loading conditions. Exterior slope "maintenance" (i.e., shallow) failures were also evaluated for long term loading conditions.

3.7.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.
2. Piezometers
    a. Installation methods meet current standard of practice,
    b. Locations and elevations were surveyed,
    c. Instruments are adequate to provide current water level readings.
3. Soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
4. Static slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same as present.
    c. Pool elevations and phreatic conditions are similar or more conservative than current.
    d. Analysis methods meet current standard of practice.

3.8 GEOCOMP (2013)

Table 8. Summary of Evaluation for Geocomp (2013)

Reference:	Geocomp Consulting, Inc. 2013. "Tennessee Valley Authority, EPA Seismic Assessment, Supplemental Site Exploration, Allen Fossil Plant." Prepared for Tennessee Valley Authority. March.	
Purpose:	Field exploration, laboratory testing, and analysis to evaluate the seismic performance of the East Ash Disposal Area	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	Cross-Section B-B' through the Northern Perimeter Dike	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	4 borings
Rock coring:	No	
Other subsurface data:	Yes	2 CPT soundings
Boring locations surveyed:	Yes	Surveyed by TVA after drilling.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry, CCR thickness, foundation stratigraphy
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions similar to current.
Piezometer installation:	Yes	2 borings instrumented with strings of vibrating wire piezometers; up to 5 sensors per boring (8 sensors total); sensing zones in alluvium and dike fill.
In-situ testing:	Yes	SPT, vane shear testing, CPT with shear wave velocity
Laboratory testing:	Yes	Testing follows ASTM standards
Shear strength parameters:	Yes	Static drained, static undrained, seismic, and post-earthquake strengths (CCR and soils)
Static slope stability:	Yes	1 section (B-B')
Seismic slope stability:	Yes	1 section (B-B')
Information adequate to support stability evaluation:	Yes	Analyses are representative of static, post-earthquake and pseudostatic stability of Northern Perimeter Dike.
Other relevant analyses:	Yes	Liquefaction triggering analyses; seismic displacement analysis (without liquefaction)

3.8.1 Field Activities

Based on previous work at the site, a supplemental evaluation of expected seismic performance of the East Ash Disposal Area was requested. A subsurface exploration program was designed that consisted of four borings (two with SPT and two with vane shear testing (VST)) for Section B-B' at the Northern Perimeter Dike of the East Ash Disposal Area. The approximate locations are shown in Figure 1.

The borings were drilled using either a truck-mounted or ATV-mounted drilling rig with mud rotary equipment using a 4-inch rotary bit. In the soil borings, SPTs were performed in accordance with ASTM D1586 at 2-foot intervals. Shelby tube samples were obtained in accordance with ASTM D1587 at depths determined by Geocomp personnel within cohesive soil layers. Upon completion of drilling, a multi-level vibrating wire piezometer (VWPZ) string was installed into selected boreholes. Each VWPZ string was lowered into the open boring and then fully grouted into place with a cement/bentonite grout that simulates the compressive strength of a very stiff to hard clay.

Following the completion of a conventional boring, an offset boring was advanced to targeted depths without sampling, where VSTs could be performed in general accordance with ASTM D2573. After peak torque was reached, the vane is rotated rapidly for five revolutions to remold the soil at the failure plane of the test. The slow rotation rate process is repeated to obtain a remolded shear strength. Nineteen VSTs were performed at Section B-B'.

Seismic CPT soundings were advanced approximately 5-10 feet away from the companion conventional boring. Tip resistance, sleeve friction, and dynamic pore pressure were recorded approximately every two inches as the cone was advanced into the ground. Shear wave velocity measurements were taken at approximately one meter intervals.

3.8.2 Laboratory Testing

The disturbed (SPT) and undisturbed (Shelby tube) soil samples obtained during conventional drilling were subjected to the following laboratory tests: natural moisture content (D2216), Atterberg limits (D4318), specific gravity (D854), USCS classification (D2487), gradation (D422), CU triaxial with pore pressure measurements (D4767), one-dimensional consolidation using controlled-strain loading (D4186), direct shear (D3080), direct simple shear (D6528), and one-dimensional incremental consolidation (D2435).

3.8.3 Analysis

Historical boring information along with the new data gathered from this geotechnical exploration were used to establish subsurface geometry and material parameters of the different soils and CCR at each cross section. The phreatic conditions were modeled based on the pore pressure data from the VWPZ.

Limit equilibrium slope stability analyses were performed for each cross-section for static undrained, pseudostatic, and post-earthquake conditions. The design earthquake had a return period of 2,500 years. Pseudostatic strengths were a reduced version of the static undrained strengths. Seismic displacements were estimated for a case that assumes no liquefaction. Liquefaction triggering was assessed and residual shear strengths were applied to the liquefied materials in the post-earthquake slope stability analyses.

3.8.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.
2. Piezometers
    a. Installation methods meet current standard of practice,
    b. Locations and elevations were surveyed,
    c. Instruments are adequate to provide current water level readings.
3. CCR and soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
4. Static and pseudostatic slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same at present.
    c. Pool elevations and phreatic conditions are similar or more conservative than current.
    d. Analysis methods meet current standard of practice.

3.9 STANTEC (2015)

Table 9. Summary of Evaluation for Stantec (2015)

Reference:	Stantec Consulting Services Inc. (Stantec). 2015. "Geotechnical Exploration Data Report, East Ash Disposal Area, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. December.	
Purpose:	Obtain additional subsurface information to support future closing plans	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	Harsco area, ash pond interior berms (primarily around the dredge cells) and one CPT sounding at northern extent of Stilling Pond divider dike	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	7 borings
Rock coring:	No	
Other subsurface data:	Yes	7 CPT soundings
Boring locations surveyed:	Yes	Surveyed by TVA personnel
Data adequate to support three-dimensional model:	Yes	Data supports dike geometry, CCR thickness, and foundation soil stratigraphy.
Geometry at time of document representative of 2017 conditions:	Yes	Harsco area, ash pond interior geometry and phreatic conditions similar.
Piezometer installation:	No	
In-situ testing:	Yes	SPT, CPT
Laboratory testing:	Yes	Testing followed respective ASTM standards
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	No	

3.9.1 Field Activities

A geotechnical drilling program was developed that consisted of seven soil borings and seven cone penetrometer test (CPT) soundings. Borings were located near the Harsco area and within the ash pond interior, on berms surrounding dredge cells. CPT soundings were often paired with a boring, except one CPT sounding at the north end of the Stilling Pond divider dike. The boring and sounding locations were chosen by Stantec and surveyed by TVA personnel (approximate locations are shown on the boring layout in Figure 1).

All seven of the borings were drilled using hollow-stem augers powered by a truck-mounted drilling rig. In the soil borings, continuous SPTs were performed in accordance with ASTM D1586. Within the same borings, Shelby tube samples were collected for targeted cohesive soils at specific depths. Shelby tube samples were obtained in accordance with ASTM D1587.

The CPT soundings were performed in general accordance with ASTM D5778. Tip resistance, sleeve friction, and dynamic pore pressure measurements were obtained approximately every two inches as the cone was advanced into the ground. Upon completion of drilling, all the borings and soundings (if applicable) were backfilled to the ground surface. Borings were backfilled with cement bentonite grout.

3.9.2 Laboratory Testing

Soil samples from the field exploration were returned to a Stantec (or certified vendor's) materials laboratory. Limited laboratory testing of the obtained split-spoon and Shelby tube samples were performed. The laboratory tests were performed in accordance with ASTM standard testing procedures.

Natural moisture content (D2216) tests were performed on all SPT samples. Soil index classification testing (D2487) was performed on selected soil samples. These tests included particle size analyses (D421 and D422), Atterberg limits (D4318), and specific gravity (D854). Falling head permeability (D5084) and unit weight (D7263) tests were performed on select Shelby tube samples.

3.9.3 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring and sounding locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.
2. Soil properties
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.

3.10 GEOCOMP (2016A)

Table 10. Summary of Evaluation for Geocomp (2016a)

Reference:	Geocomp. 2016a. "Tennessee Valley Authority EPA Seismic Assessment, Supplemental Site Exploration, Allen Fossil Plant, East Ash Disposal Area, Final Report." Volumes 1-4. Prepared for Tennessee Valley Authority. October.	
Purpose:	Geotechnical exploration and evaluation of seismic performance of the East Ash Disposal Area at ALF	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	One cross-section (B-B') through northern perimeter dike, one cross-section (E-E') through eastern perimeter dike	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	7 borings
Rock coring:	No	
Other subsurface data:	Yes	13 CPT soundings with shear wave velocity and pore pressure dissipation testing
Boring locations surveyed:	Yes	Surveyed by TVA after drilling.
Data adequate to support three-dimensional model:	Yes	Data support dike geometry and foundation soil stratigraphy.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions similar to current.
Piezometer installation:	Yes	4 borings instrumented with strings of vibrating wire piezometers; up to 5 sensors per boring (19 sensors total); sensing zones in alluvium and dike fill.
In-situ testing:	Yes	SPT, CPT with shear wave velocity, gamma density, and pore pressure dissipation
Laboratory testing:	Yes	All testing follows ASTM standards
Shear strength parameters:	Yes	Static drained, static undrained, seismic, and post-earthquake strengths (CCR and soils)
Static slope stability:	Yes	2 cross-sections (B-B' and E-E') along perimeter dike for East Ash Disposal Area
Seismic slope stability:	Yes	2 cross-sections (B-B' and E-E') along perimeter dike for East Ash Disposal Area
Information adequate to support stability evaluation:	Yes	Analyses are representative of static, post-earthquake and pseudostatic stability of existing dike perimeter.
Other relevant analyses:	Yes	Liquefaction triggering analyses; seismic displacement analysis (without liquefaction)

3.10.1 Field Activities

The geotechnical exploration program included the soil borings (with disturbed and undisturbed sampling) and SCPTu soundings (approximate locations are shown on the boring layout in Figure 1). A total of seven borings and 13 SCPTu soundings were performed along the perimeter dike of the East Ash Disposal Area.

The borings were performed using a truck-mounted drill rig with mud rotary drilling methods in accordance with ASTM D5783. Split spoon sampling was performed at approximately 2.5 feet to 5 feet intervals in accordance with ASTM D1586-11. SPT hammer energy verification was performed on one borehole in accordance with ASTM D4633-10. The SCPTu soundings were performed using both a CPT track rig and a CPT truck rig in general accordance with ASTM D5778-12.

Undisturbed samples were obtained with an Osterberg sampler in accordance with ASTM D6519-15. In material too stiff for an Osterberg sampler, Shelby tube sampling was used in accordance with ASTM D1587-15. Split spoon and undisturbed samples were transported in a wooden crate designed to limit disturbance.

SCPTu soundings were advanced at 13 locations. Tip resistance, sleeve friction, and dynamic pore pressure was recorded approximately every two inches as the cone was advanced into the ground. Cross-hole shear wave velocity (D4228) and gamma density measurements were taken at approximately 5 foot intervals to a depth of approximately 95 feet in cross-section E-E'.

Upon completion of drilling, four multi-level vibrating wire piezometer (VWPZ) strings with a total of 18 sensors were installed into selected boreholes at cross-sections B-B' and E-E'. Each VWPZ string was then lowered into the open boring and then fully grouted into place with a cement/bentonite grout.

3.10.2 Laboratory Testing

The disturbed (SPT) and undisturbed (Osterberg or Shelby tube) soil samples obtained during conventional drilling were subjected to the following laboratory tests: natural moisture content (D2216), Atterberg limits (D4318), specific gravity (D854), USCS classification (D2487), gradation (D422), unit weight (D7263), direct simple shear (D6528), cyclic direct simple shear (D6528), resonant column (D4015), and one-dimensional consolidation using controlled-strain loading (D4186). Prior to tube extrusion, tubes were x-rayed (D4452) to evaluate sample disturbance and to select intervals for testing.

3.10.3 Analysis

Historical boring information along with the new data gathered from this geotechnical exploration were used to establish subsurface geometry and material parameters of the different soils and CCR at each cross section. The phreatic conditions were modeled based on the pore pressure data from the VWPZ.

A site-specific seismic study was conducted on the design response spectra developed by USGS. The site-specific seismic amplification analyses (i.e., ground response analyses) used seven spectrally-matched ground motion time histories. Spectral matching was performed relative to the uniform hazard response spectrum. Site-specific two-dimensional amplification analyses were performed to model the seismic response of each analysis cross-section.

The results of the analyses were used to determine displacement-compatible accelerations used in the seismic slope stability analyses to calculate the seismic factor of safety. The results of these analyses were also used to determine cyclic shear stresses for laboratory testing to measure post-shaking residual strengths in evaluating the liquefaction factor of safety.

Liquefaction triggering was assessed using the stress-based methodology of Idriss and Boulanger. The cyclic resistance ratio (CRR) is based on in-situ penetration resistance (SPT and/or CPT) or cyclic laboratory testing. The results of the site-specific two-dimensional analysis were used to obtain the Cyclic Stress Ratio (CSR) imposed by the design earthquake on the soil. Liquefaction triggering was based on a comparison of the CRR to the CSR. If a layer was deemed potentially liquefiable, then its residual undrained shear strength was assigned in the post-earthquake slope stability analysis.

Limit equilibrium slope stability analyses were performed for each cross-section for static undrained, pseudostatic, and post-earthquake conditions. The design earthquake had a return period of 2,500 years. Pseudostatic strengths were a reduced version of the static undrained strengths. Liquefaction triggering was assessed and residual shear strengths were applied to the liquefied materials in the post-earthquake slope stability analyses.

3.10.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.

2. Piezometers
    a. Instruments are adequate to provide current water level readings.
3. CCR and soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
4. Static and pseudostatic slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same at present.
    c. Pool elevations and phreatic conditions are similar to current.
    d. Analysis methods meet current standard of practice.

3.11 GEOCOMP (2016B)

Table 11. Summary of Evaluation for Geocomp (2016b)

Reference:	Geocomp. 2016b. "Initial Seismic Safety Factor Assessment, EPA Final CCR Rule, TVA Allen Fossil Plant East Ash Disposal Area, Memphis, Tennessee." Prepared for Tennessee Valley Authority. October 14.	
Purpose:	Demonstrate adequate seismic performance (pseudostatic stability, post-earthquake stability considering liquefaction) of the East Ash Disposal Area	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	One cross-section (E-E') through eastern perimeter dike	
Item	**Yes/No**	**Remarks**
Soil borings:	No	This report leverages prior field and lab work (Geocomp 2016a)
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions similar
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static undrained strengths, seismic strengths for soils/CCR that do not liquefy, residual strengths for soils/CCR that do liquefy
Static slope stability:	No	
Seismic slope stability:	Yes	One Cross Section (E-E') through eastern perimeter dike
Information adequate to support stability evaluation:	Yes	Analyses are representative of pseudostatic stability and post-earthquake stability of existing East Ash Disposal Area, including perimeter dike
Other relevant analyses:	Yes	Liquefaction triggering analyses in support of post-earthquake slope stability evaluation

3.11.1 Analysis

As required by §257.73 of the EPA Final CCR Rule, an initial structural integrity evaluation for seismic loading was required by October 17, 2016 and must include initial assessments of the seismic factor of safety (i.e., pseudostatic slope stability) and liquefaction factor of safety (i.e., post-earthquake slope stability, considering liquefaction) for each existing CCR surface impoundment that meets the conditions of paragraph (b) as follows:

1. Has a height of five feet or more and a storage volume of 20 acre-feet or more, or
2. Has a height of 20 feet or more.

The seismic and liquefaction factor of safety assessments must document whether the calculated factors of safety for the critical cross-sections of each existing CCR surface impoundment achieve the minimum factors of safety specified in paragraphs (e)(1)(iii) and (e)(1)(iv) of §257.73 in the EPA Final CCR Rule.

As part of the EPA Final CCR Rule requirements, a site-specific seismic study was conducted on the design response spectra developed by USGS. The site-specific seismic amplification analyses (i.e., ground response analyses) used seven spectrally-matched ground motion time histories. Spectral matching was performed relative to the uniform hazard response spectrum. Site-specific two-dimensional amplification analyses were performed to model the seismic response of cross-section E-E'. This cross-section had been developed previously based on a subsurface exploration and laboratory testing by Stantec (2010a, 2011) and Geocomp (2016a).

The results of the analyses were used to determine displacement-compatible accelerations used in the seismic slope stability analyses to calculate the seismic factor of safety. The results of these analyses were also used to determine cyclic shear stresses for laboratory testing to measure post-shaking residual strengths in evaluating the liquefaction factor of safety.

The seismic factor of safety was evaluated under seismic loading using a phreatic surface developed from existing pond levels and piezometric data. The pseudostatic loading conditions were determined from applied displacement-compatible accelerations derived from the sliding block analyses from Geocomp (2016a).

Liquefaction triggering was assessed using the stress-based methodology of Idriss and Boulanger. The cyclic resistance ratio (CRR) is based on in-situ penetration resistance (SPT and/or CPT) or cyclic laboratory testing. The results of the site-specific two-dimensional analysis were used to obtain the Cyclic Stress Ratio (CSR) imposed by the design earthquake on the soil. Liquefaction triggering was based on a comparison of the CRR to the CSR. If a layer was deemed potentially liquefiable, then its residual undrained shear strength was assigned in the post-earthquake slope stability analysis.

The slope stability results were obtained with a two-dimensional limit equilibrium program. The minimum factors of safety correspond to slip surfaces that could potentially result in the release of water and CCR materials from within the impoundment. Based upon the analysis performed for the East Ash Disposal Area, the impoundment meets or exceeds the minimum factor of safety for both seismic factor of safety and liquefaction factor of safety.

3.11.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Pseudostatic and post-earthquake slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same at present.
    c. Pool elevations and phreatic conditions are similar to current.
    d. Analysis methods meet current standard of practice.

3.12 STANTEC (2016A)

Table 12. Summary of Evaluation for Stantec (2016a)

Reference:	Stantec Consulting Services Inc. (Stantec). 2016a. "Geotechnical Exploration Report, Northern Perimeter Dike Stability, West Ash Pond Closure, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.	
Purpose:	Geotechnical exploration and slope stability analysis to evaluate stability of the Northern Perimeter Dike of the West Ash Disposal Area	
CCR Unit(s):	West Ash Disposal Area	
Spatial coverage:	Two cross sections along the Northern Dike with additional borings and test pits on the unit interior.	
Item	**Yes/No**	**Remarks**
Soil borings:	Yes	19 borings (along two dike cross sections H-H' and I-I' and on the unit interior)
Rock coring:	No	
Other subsurface data:	Yes	7 cone penetration tests (CPT) borings, five test pits
Boring locations surveyed:	Yes	Surveyed by TVA after drilling
Data adequate to support three-dimensional model:	Yes	Data to support dike geometry, CCR thickness.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry, unit interior geometry, and phreatic conditions similar to current.
Piezometer installation:	Yes	3 borings instrumented with strings of vibrating wire piezometers; up to 3 sensors per boring (7 sensors total); sensing zones in alluvium and dike fill.
In-situ testing:	Yes	Continuous SPTs
Laboratory testing:	Yes	Testing follows relevant ASTM standards.
Shear strength parameters:	Yes	Static drained and static undrained strengths
Static slope stability:	Yes	2 cross-sections (H-H' and I-I') along north perimeter dike of West Ash Disposal Area
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of long-term and rapid drawdown static stability of existing dike perimeter. Both global (deep) and maintenance (shallow) failures were evaluated.
Other relevant analyses:	No	

3.12.1 Field Activities

The subsurface exploration program consisted of nineteen (19) soil borings, seven (7) cone penetration test soundings, and five (5) test pits along the crest and exterior toe of the Northern Perimeter Dike and well as within the unit interior. Note that the West Ash Disposal Area no longer impounds a permanent pool. The soil boring locations were surveyed onto the local plant coordinate system (approximate locations are shown on the boring layout in Figure 2).

The encountered soils and CCR were sampled by continuous SPT tests per ASTM D1586. Undisturbed soil samples (Shelby tubes) were also retrieved for laboratory testing. Seven CPT soundings with pore pressure measurements were completed by ConeTec near companion SPT borings. Five test pits were excavated within the West Ash Disposal Area to estimate the depth of fly ash within the pond. Strings of fully grouted, vibrating wire piezometers were installed at three boring locations. The piezometers were installed at depths ranging from 18 to 46 feet below grade. Borings were backfilled with cement bentonite grout.

Upon completion of drilling, four sets of piezometric readings were obtained over a one-month interval to provide an estimate of piezometric surface fluctuations at the site.

3.12.2 Laboratory Testing

The laboratory testing program included natural moisture content (D2216), Atterberg limits (D4318), grain size analysis (D422), unit weight, and hydraulic conductivity (D5084) tests. Natural moisture content tests were performed on all soil samples recovered from SPT testing. Atterberg limits and grain size analyses were performed on selected SPT and Shelby tube samples. Five falling head permeability tests were performed on selected extruded tube specimens. Laboratory test data was limited for various soil horizons at the West Ash Disposal Area. Test data on similar soils for historical explorations and correlated strength parameters using SPT data were also used to develop material parameters.

3.12.3 Analysis

Stantec reviewed historic documentation to gain an understanding of the development and construction of the Northern Perimeter Dike; performed a geotechnical exploration to obtain subsurface information, installed and monitored piezometers to develop an understanding of the piezometric surface; and performed slope stability and rapid drawdown analyses for the dike. This data was compiled with the new exploration to determine the material properties and subsurface geometry used to model two critical cross-sections within the West Ash Disposal Area.

Static slope stability was analyzed for both long-term, drained conditions (normal pool) and rapid drawdown conditions. Both global (deep seated) and maintenance (shallow) failures were analyzed.

3.12.4 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Material descriptions, thicknesses, and elevations from boring logs
    a. Boring locations and elevations were surveyed,
    b. Boring logs document material descriptions and thicknesses,
    c. Perimeter dike and foundation geometry is substantially the same as current.
2. Piezometers
    a. Installation methods meet current standard of practice,
    b. Locations and elevations were surveyed,
    c. Instruments are adequate to provide current water level readings.
3. Soil properties (including shear strengths)
    a. Sampling and testing followed relevant ASTM standards.
    b. Subsurface conditions are substantially the same as current.
4. Static slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same as present.
    c. Pool elevations and phreatic conditions are similar or more conservative than current.
    d. Analysis methods meet current standard of practice.

3.13 STANTEC (2016B)

Table 13. Summary of Evaluation for Stantec (2016b)

Reference:	Stantec Consulting Services Inc. (Stantec). 2016b. "Basis of Design Report (Rev. 1), West Ash Pond Final Closure, Allen Fossil Plant, Memphis, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. June.	
Purpose:	Engineering study to document the considerations and analyses used for the basis of design of the West Ash Disposal Area closure.	
CCR Unit(s):	West Ash Disposal Area	
Spatial coverage:	Perimeter and interior of West Ash Disposal Area	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	Yes	Data to support closure geometry and regraded CCR slopes.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry, unit interior geometry, and phreatic conditions for proposed closure geometry.
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static drained and static undrained strengths
Static slope stability:	Yes	2 cross-sections (H-H' and J-J') through north perimeter dike of West Ash Disposal Area; Typical section of final cap.
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of long-term static global and veneer stability of closed conditions, including final cap.
Other relevant analyses:	Yes	Settlement analysis

3.13.1 Analysis

Stantec used data from Stantec (2016a) and other historical explorations as the basis for the evaluation of the geotechnical aspects used in the closure design of the West Ash Disposal Area. The geotechnical calculations included global stability, final cap veneer stability, and settlement analyses. Data was compiled to determine the material properties and subsurface geometry used to model two critical cross-sections within the closed West Ash Disposal Area.

Global slope stability was analyzed for static long-term, drained conditions. Static veneer stability of the proposed final cap system was evaluated for drained and saturated conditions.

3.13.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Static global and veneer slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry was evaluated for closure conditions.
    c. Pool elevations and phreatic conditions are similar or more conservative than closed conditions.
    d. Analysis methods meet current standard of practice.

3.14 STANTEC (2016C)

Table 14. Summary of Evaluation for Stantec (2016c)

Reference:	Stantec Consulting Services Inc. (Stantec). 2016c. "Initial Static Safety Factor Assessment, East Ash Disposal Area, EPA Final CCR Rule, TVA Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. October 6.	
Purpose:	Demonstrate adequate static slope stability (long-term pool and short-term surcharge) for EPA Final CCR Rule initial safety factor assessment for the East Ash Disposal Area.	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	One cross section through the eastern perimeter dike and divider dike.	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions similar.
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static drained and static undrained strengths for soils/CCR
Static slope stability:	Yes	1 cross-section (E-E') along east perimeter dike
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of both long-term, drained and short-term, undrained static stability of existing East Ash Disposal Area, including perimeter dike and divider dike.
Other relevant analyses:	No	

3.14.1 Analysis

Static slope stability was analyzed for both long-term, drained conditions (normal pool) and short-term, undrained conditions (surcharge pool). The slope stability assessments were focused on the potential for slope failures of significant mass, which could directly influence potential release of water and CCR materials from the East Ash Disposal Area. The search for a critical slip surface in the slope stability assessments is thus restricted to consider only potential surfaces where the depth (measured at the base of at least one slice) is more than 10 feet vertically below the ground surface. Based upon these criteria, the East Ash Disposal Area meets or exceeds the minimum factor of safety required by the EPA Final CCR Rule for static slope stability.

3.14.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Static slope stability analyses
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry is substantially the same at present.
    c. Pool elevations and phreatic conditions are similar to (or more conservative than) current.
    d. Analysis methods meet current standard of practice.

3.15 STANTEC (2016D)

Table 15. Summary of Evaluation for Stantec (2016c)

Reference:	Stantec Consulting Services Inc. (Stantec). 2016d. "Initial Structural Stability Assessment, East Ash Disposal Area, EPA Final CCR Rule, TVA Allen Fossil Plant, Memphis, Tennessee." Prepared for Tennessee Valley Authority. October 12.	
Purpose:	Demonstrate adequate structural stability for EPA Final CCR Rule initial structural stability assessment for the East Ash Disposal Area.	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	Structures of East Ash Disposal Area	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	No	
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry and phreatic conditions similar.
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	No	
Static slope stability:	No	
Seismic slope stability:	No	
Information adequate to support stability evaluation:	No	
Other relevant analyses:	Yes	Qualitative assessment of perimeter dike foundations and abutments, slope protection, compaction, outflow condition and capacity. Slope stability analysis for sudden drawdown potential.

3.15.1 Analysis

On April 17, 2015, the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (EPA Final CCR Rule) was published in the Federal Register (USEPA, 2015). Stantec Consulting Services, Inc. (Stantec) was contracted by the Tennessee Valley Authority (TVA) to analyze the Structural Stability of the East Ash Disposal Area for Allen Fossil Plant (ALF) CCR surface impoundments (SI) and evaluate compliance with section §257.73(d) of the CCR Rule.

As required by §257.73(d) of the EPA Final CCR Rule, an initial structural integrity evaluation is required by October 17, 2016. The evaluation must include an initial structural stability assessment for each existing CCR surface impoundment that meets the conditions of paragraph (b) as follows:

1. Has a height of five feet or more and a storage volume of 20 acre-feet or more or
2. Has a height of 20 feet or more

The East Ash Disposal Area requires a multi-faceted approach to the analysis of embankments, spillways, and hydraulic structures for long-term durability (i.e., erosion resistance), construction standards (i.e., compaction records of the dikes) and short-term impacts (i.e., sudden drawdown). The EPA Final CCR Rule requires each facility to document whether the unit has been designed, constructed, operated and maintained per the following criteria at the East Ash Disposal Area:

1. Per §257.73(d)(1)(i), the initial structural stability assessment must document whether the unit has been designed, constructed, operated and maintained with stable foundations and abutments.
2. Per §257.73(d)(1)(ii), the initial structural stability assessment must document whether the unit has been designed, constructed, operated and maintained with adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown.
3. Per §257.73(d)(1)(iii), the initial structural stability assessment must document whether the unit has been designed, constructed, operated and maintained with dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit.
4. Per §257.73(d)(1)(v), the initial structural stability assessment must document whether the unit has been designed, constructed, operated and maintained with a single spillway or combination of spillways that meet the condition and capacity requirements as outlined in this section of the CCR Rule. The combined capacity of all spillways are to be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in this section.

5. Per §257.73(d)(1)(vii), the initial structural stability assessment must document whether the unit has been designed, constructed, operated, and maintained with downstream slopes that can be inundated by an adjacent water body (such as a river, stream, or lake) to determine if structural stability is maintained during low pool or sudden drawdown of the adjacent water body.

Based upon the criteria used for evaluation of the existing conditions at the site in conjunction with historical documentation of design, construction, and inspection of the East Ash Disposal Area, the criteria listed above have been met for this facility

3.15.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Structural integrity, with respect to the following factors:

    a. Stability of foundations and abutments,

    b. Slope protection against surface erosion, wave action, and adverse effects of sudden drawdown,

    c. Sufficient compaction of dikes,

    d. Spillway conditions and capacity,

    e. Performance of slopes subjected to sudden drawdown.

3.16 STANTEC (2017)

Table 16. Summary of Evaluation for Stantec (2017)

Reference:	Stantec Consulting Services Inc. (Stantec). 2017. "Basis of Design Report (Rev. 0), East Ash Pond Complex Closure, Allen Fossil Plant, Memphis, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. January.	
Purpose:	Engineering study to document the considerations and analyses used for the basis of design of the East Ash Disposal Area closure.	
CCR Unit(s):	East Ash Disposal Area	
Spatial coverage:	Perimeter and interior of East Ash Disposal Area	
Item	**Yes/No**	**Remarks**
Soil borings:	No	
Rock coring:	No	
Other subsurface data:	No	
Boring locations surveyed:	No	
Data adequate to support three-dimensional model:	Yes	Data to support closure geometry and regraded CCR slopes.
Geometry at time of document representative of 2017 conditions:	Yes	Perimeter dike geometry, unit interior geometry, and phreatic conditions for proposed closure geometry.
Piezometer installation:	No	
In-situ testing:	No	
Laboratory testing:	No	
Shear strength parameters:	Yes	Static drained and static undrained strengths
Static slope stability:	Yes	2 cross-sections (X-X' and Y-Y') through north perimeter dike of East Ash Disposal Area; Typical section of final cap.
Seismic slope stability:	No	
Information adequate to support stability evaluation:	Yes	Analyses are representative of long-term, short-term, and rapid-drawdown static global slope stability, and veneer stability of closed conditions, including final cap.
Other relevant analyses:	Yes	Settlement analysis

3.16.1 Analysis

Stantec used data from Stantec (2010b) and other historical explorations as the basis for the evaluation of the geotechnical aspects used in the closure design of the East Ash Disposal Area. The geotechnical calculations included global slope stability, final cap veneer stability, and settlement analyses. Data was compiled to determine the material properties and subsurface geometry used to model two critical cross-sections within the closed East Ash Disposal Area.

Global slope stability was analyzed for static long-term, drained and short-term, undrained conditions. Rapid drawdown conditions were also considered for global slope stability analyses. Static veneer stability of the proposed final cap system was evaluated for drained and saturated conditions.

3.16.2 Evaluation of Existing Data

Based on a review of the referenced document and its data, and comparing against the evaluation criteria in Section 2.0, the following data are considered suitable for use in responding to the EIP information requests:

1. Static global and veneer slope stability analyses:
    a. Material parameters are representative of current.
    b. Surface and subsurface geometry was evaluated for closure conditions.
    c. Pool elevations and phreatic conditions are similar or more conservative than closed conditions.

Analysis methods meet current standard of practice.

4.0 ASSUMPTIONS AND LIMITATIONS

In preparing this document, assumptions are as follows:

- The summaries presented herein cannot fully communicate the information contained in each document. Refer to the individual reference documents for additional context and detail.

5.0 REFERENCES

References are provided in the summary table for each document discussed herein.

ATTACHMENT A
FIGURES

Figure No.
1

Title
Existing Boring Data
East Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by JD on 2017-11-13

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

Legend

- Existing Boring
- Existing CPT
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec
TVA

V:\TVA-EIP\175567295\gis\mxds\ALF_Existing_Borings_East.mxd Revised: 2017-11-13 By: mbough

Figure No.
2

Title
Existing Boring Data
West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by JD on 2017-11-13

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

Legend

- ● Existing Boring
- ▲ Existing CPT
- ■ 2015 Test Pit
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec
TVA

Revised: 2017-11-13 By: mbough

APPENDIX H
EXPLORATORY DRILLING SAP

Exploratory Drilling
Sampling and Analysis Plan
Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

EXPLORATORY DRILLING
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Exploratory Drilling
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	3/1/19 Date
Yum R. Quia TVA Investigation Field Lead	3/1/19 Date
Health, Safety, and Environmental (HSE) Manager	3/1/19 Date
Bradley R Toth Investigation Project Manager	2/26/2019 Date
Rock J Vitale QA Oversight Manager	2/26/2019 Date
Ryan Jones Laboratory Project Manager	2/26/2019 Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

Stantec

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

Through the various information requests, as well as TDEC comments, a need for several exploratory borings at ALF (the Plant) has been identified. This Exploratory Drilling Sampling and Analysis Plan (SAP) has been prepared to outline the proposed borings and the methods to be employed during the Investigation.

2.0 OBJECTIVES

The objective of this Exploratory Drilling SAP is to outline the methods that will be used to execute the following activities:

- Where applicable, perform additional soil and rock borings, piezometer installation, and laboratory testing to refine subsurface characterization and material quantity estimates
- Where applicable, install temporary wells to allow for pore water sampling and measuring piezometric (i.e., water) levels within CCR units

Pore water sampling and water level readings are not within the scope of this SAP, but are addressed in other SAPs within the EIP.

Additional, future borings performed under other programs, such as EPA Final CCR Rule compliance and closure design, may be used to supplement the data necessary to respond to information requests in the EIP. However, performance of those borings is governed by other programs and is not covered herein.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 PLANT-SPECIFIC EXPLORATION PLAN

The proposed soil boring locations were selected to aid in closing data gaps and supplementing existing data, as necessary to address information requests of the TDEC Multi-Site Order for ALF. Rationale for individual boring locations are discussed below. Refer to Figures 1 and 2 in Attachment A for layouts of proposed boring locations.

In order to answer TDEC's information requests regarding CCR material quantity, water levels, CCR material characteristics, and subsurface materials, subsurface characterization will be supplemented by performing multi-purpose borings and installing temporary wells at the locations shown on Figures 1 and 2. These additional borings, some of which will be converted into temporary wells, will provide supplemental data relative to CCR thickness, water levels, material quantities, and foundation soil type and thickness. A total of 36 borings are proposed. Table 1 provides the number of borings and temporary wells proposed in each CCR unit. Table 2 lists the borings and more detail about the purpose of each. If the boring for a temporary well demonstrates that the CCR is unsaturated and above the expected phreatic surface, the temporary well will not be installed and the boring will be backfilled. Further, performance of some borings and/or installation of some temporary wells may be unnecessary following review of the data collected during the Remediation Investigation (RI) program.

Table 1. Exploratory Drilling Proposed in Each CCR Unit

CCR Unit	Total No. of Proposed Borings	No. of Borings with Temporary Wells
West Ash Disposal Area (including Chemical Treatment Pond)	17	2
East Ash Disposal Area	19	3
Total	**36**	**5**

Table 2. Detailed Boring Descriptions

Boring No.	CCR Unit	Deepest Material Encountered	Approx. Bottom Elevation (ft)	Temporary Well Screen Location	Boring Purpose[1]
TW01	East Ash Disposal Area	Foundation Soil	195	Sluiced Ash	PZ, PW, Geo
TW02	East Ash Disposal Area	Foundation Soil	195	Sluiced Ash	PZ, PW, Geo
TW03	East Ash Disposal Area	Foundation Soil	195	Sluiced Ash	PZ, PW, Geo
B01	East Ash Disposal Area	Foundation Soil	195	--	Geo
B02	East Ash Disposal Area	Foundation Soil	195	--	Geo
B03	East Ash Disposal Area	Foundation Soil	195	--	Geo
B04	East Ash Disposal Area	Foundation Soil	195	--	Geo
B05	East Ash Disposal Area	Foundation Soil	195	--	Geo
B06	East Ash Disposal Area	Foundation Soil	195	--	Geo
B07	East Ash Disposal Area	Foundation Soil	195	--	Geo
B08	East Ash Disposal Area	Foundation Soil	195	--	Geo
B09	East Ash Disposal Area	Foundation Soil	195	--	Geo
B10	East Ash Disposal Area	Foundation Soil	195	--	Geo
B11	East Ash Disposal Area	Foundation Soil	195	--	Geo
B12	East Ash Disposal Area	Foundation Soil	195	--	Geo
B13	East Ash Disposal Area	Foundation Soil	195	--	Geo
B14	East Ash Disposal Area	Foundation Soil	195	--	Geo
B15	East Ash Disposal Area	Foundation Soil	195	--	Geo
B16	East Ash Disposal Area	Foundation Soil	195	--	Geo
TW04	West Ash Disposal Area	Foundation Soil	185	Sluiced Ash	PZ, PW, Geo
TW05	West Ash Disposal Area	Foundation Soil	185	Sluiced Ash	PZ, PW, Geo
B17	West Ash Disposal Area	Foundation Soil	185	--	Geo
B18	West Ash Disposal Area	Foundation Soil	185	--	Geo
B19	West Ash Disposal Area	Foundation Soil	185	--	Geo
B20	West Ash Disposal Area	Foundation Soil	185	--	Geo
B21	West Ash Disposal Area	Foundation Soil	185	--	Geo
B22	West Ash Disposal Area	Foundation Soil	185	--	Geo
B23	West Ash Disposal Area	Foundation Soil	185	--	Geo
B24	West Ash Disposal Area	Foundation Soil	185	--	Geo
B25	West Ash Disposal Area	Foundation Soil	185	--	Geo
B26	West Ash Disposal Area	Foundation Soil	185	--	Geo
B27	West Ash Disposal Area	Foundation Soil	185	--	Geo
B28	West Ash Disposal Area	Foundation Soil	185	--	Geo
B29	West Ash Disposal Area	Foundation Soil	185	--	Geo
B30	West Ash Disposal Area	Foundation Soil	185	--	Geo
B31	West Ash Disposal Area	Foundation Soil	185	--	Geo

[1] PZ = Piezometric (Water) Levels in CCR; PW = Pore Water Sampling; Geo = Geotechnical Data

As shown in Figure 1, nineteen (19) of the proposed borings are located within the footprint of the East Ash Disposal Area. The borings will allow installation of temporary wells (TW01 through TW03) in the sluiced ash and will improve spatial coverage for CCR thickness, water levels, and foundation soils. Foundation soils of interest are those directly beneath the CCR materials and/or perimeter dikes. Borings B01 through B08 are located to improve spatial coverage of CCR thickness in the Harsco area and the Coal Yard Runoff Pond, as needed to address specific information requests in the EIP. Borings B11 through B14 are located along the southern perimeter of the unit to improve spatial coverage for water levels and foundation soils. Borings B15 and B16 are located in the eastern interior portion of the East Ash Disposal Area to improve spatial coverage for CCR thickness, water levels, and foundation soils. Temporary wells TW01 through TW03 are located in the unit interior to improve spatial coverage for CCR thickness, water levels, foundation soils, and to facilitate CCR material characterization of the East Ash Disposal Area. Borings B15, TW02, and TW03 are located in the eastern interior portion of the East Ash Disposal Area and will require significant access improvements and/or specialized drilling equipment in order to access the locations. Each of the borings will also allow undisturbed tube sampling (Shelby tubes or Osterberg tubes) of CCR and the foundation soils directly beneath the CCR materials and/or perimeter dikes.

Borings B01, B09, and B10 have been located immediately adjacent to historical borings that encountered the three predominant, uppermost foundation soil types: clay, silt, and silty sand to sand. Targeting these locations should improve the likelihood of recovering representative samples that can be tested in the laboratory for hydraulic conductivity (another specific information request in the EIP).

As shown in Figure 2, seventeen (17) of the proposed borings are located within the footprint of the West Ash Disposal Area or just south of the Chemical Treatment Pond. The borings will allow installation of temporary wells (TW04 and TW05) and will improve spatial coverage for CCR thickness, water levels, and foundation soils. Foundation soils of interest are those directly beneath the CCR materials and/or perimeter dikes. Borings B17 through B20, B28, and B29 are located to better delineate the presence of CCR materials in or beneath the perimeter dikes, as needed to address specific information requests in the EIP. Each of the borings will also allow undisturbed tube sampling (Shelby tubes or Osterberg tubes) of CCR and the foundation soils directly beneath the CCR materials and/or perimeter dikes.

Borings B17 and B21 through B24 have been located immediately adjacent to historical borings that encountered the three predominant, uppermost foundation soil types: clay, silt, and silty sand to sand. Targeting these locations should improve the likelihood of recovering representative samples that can be tested in the laboratory for hydraulic conductivity (another specific information request in the EIP).

Borings B25 through B27, B30, B31, and temporary wells TW04 and TW05 have been located on the interior of the unit, to provide additional spatial coverage, CCR thickness, water levels, delineation of various foundation soil types, and opportunity for recovering samples for laboratory hydraulic conductivity and shear strength testing.

The temporary wells in the East and West Ash Disposal Areas (TW01 through TW05), will be screened near the bottom of the sluiced ash after the portion of the borehole that penetrated the foundation soils is sealed and grouted to the bottom of the ash. These temporary wells will allow water level readings and pore water sampling in the sluiced ash, as well as ash samples for CCR material characterization testing. If it is later determined that sufficient data was obtained from the RI program, the temporary wells may not be required to respond to the pertinent information requests.

Borings will be advanced from the ground surface until reaching the intended bottom of hole elevation as listed in Table 2. Borings will be advanced using a conventional rotary drill rig with standard penetration test (SPT) and undisturbed Shelby tube or Osterberg tube samples. SPT samples will be collected for general soil and CCR characterization. Undisturbed tube samples will be collected for laboratory hydraulic conductivity and shear strength testing.

Approximate bottom of hole elevations are intended to be below the bottom of the foundation soil of interest. Actual termination depths will be determined in the field by the field geologist/engineer, based on the observed soil samples. Borings will be backfilled (by grouting or temporary well installation) upon completion.

Due to the significant depth of soils at the Plant, borings are not anticipated to encounter bedrock and no rock coring or downhole testing in rock is proposed.

Supplemental laboratory testing is also proposed using surplus undisturbed (Shelby tube) samples from a recent exploration by Geocomp (2016). Borings were performed on the perimeter of the East Ash Disposal Area. The actual testing program would be dependent upon review of tubes and extrusion of the samples to confirm the material type, available sample length, and sample condition.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to advance borings, collect soil and rock samples, install instruments, backfill borings, document field activities, and assist in providing scientifically defensible results.

Exploratory Drilling activities will adhere to applicable ASTM standards and TVA Environmental Technical Instruction (TI) documents. The field geologist/engineer will maintain a project field book and field forms (hard copy or electronic) to record field measurements and observations. Field activities will be documented in accordance with Section 5.2.3.

5.1 PREPARATION FOR FIELD ACTIVITIES

Truck or track-mounted drill rigs are proposed to advance borings for this exploration phase of the Investigation. The boring locations will be located and field utility cleared by TVA and/or Contractor personnel (using a field surveyor and the Excavation Permit process) prior to mobilizing the drill crews.

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer and a Tennessee licensed professional engineer or professional geologist.
- Complete required health and safety paperwork and confirm field team members have completed required training.
- Coordinate activities with the drill crew(s).
- Clear Access – Proposed boring locations will be marked using a wooden stake or survey flag with the position surveyed using the global positioning system (GPS). Suitability of each location will be evaluated for logistical issues including access, grubbing needs, overhead utility clearance, and proximity to Plant features. Access improvements, including clearing and grubbing or road building, will be completed prior to the investigation start date.
- If a boring will penetrate an engineered final cap component (e.g., low hydraulic conductivity soil layer, geosynthetic cap system, or vegetative soil layer), a temporary penetration will be prepared to allow drilling access. When applicable, field work plans will include detailed procedures for creating this temporary penetration.

- Perform Environmental Review - As required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC has a number of signatories from TVA. It is understood that the environmental review is to be completed before implementation of the field work. Additionally, plant staff will not issue an excavation permit ahead of the completed environmental review.

- Complete Utility Locate(s) / Excavation Permit(s) - Prior to initiating subsurface activities, subsurface utility clearance will be sought via the plant engineering department and/or the TN 811 service. At locations within the Plant, engineering will provide primary utility clearance assurance in addition to TN 811 being notified. At all other drilling locations, TVA or 3rd party underground locators will be engaged to clear boring locations. An excavation permit is required prior to initiating any digging or boring at the Plant. A key component to the completion of the excavation permit is consensus on the drilling locations with pertinent TVA staff.

- Identify Water Source – During implementation of the EIP, a source of potable water will be required to complete several investigation tasks, including certain drilling methods and decontamination procedures.

- Obtain required functional and calibrated field instruments, including health and safety equipment.

5.2 SAMPLING METHODS AND PROTOCOLS

TVA proposes to perform disturbed soil sampling (i.e., split-spoon sampling) and rock coring (only where specified) for the Investigation. Undisturbed soil sampling (Shelby tube) may be performed in selected borings if observed subsurface conditions and testing needs warrant. The sampling will allow TVA to develop a better understanding of the subsurface profile within the CCR and foundation materials and provide samples for subsequent laboratory testing to characterize materials. For geotechnical investigation borings and piezometer installations, a Tennessee licensed professional geologist (PG) or professional engineer (PE) will be present and will log the borings. The PG or PE will have suitable experience in geotechnical or geological engineering projects to support the work. This approach has been used at current investigations at other TVA Plants in Tennessee.

5.2.1 Drilling, Logging, and Surveying

5.2.1.1 Exploratory Borings

Borings will be advanced using truck- or track-mounted drilingl rigs. The borings associated with well installation are proposed to be advanced roto-sonic drilling techniques until boring termination depth or refusal, whichever is shallower.

If needed due to high water levels or underlying soils in the field, drilling will be performed using mud rotary techniques. Temporary casing will be set for mud circulation purposes and an upward discharge drag bit connected to drill rods will advance the boring through the soil materials.

The upward discharge bits are designed to direct the drilling fluid and cuttings upward and out of the boring. The drilling fluids are conveyed to the surface and into a recirculation tub where the suspended drill cuttings can settle out.

The recirculation tub employs a series of baffles to promote settling of the suspended particles allowing recirculation (recycling) of the drilling mud. The drilling fluid density and viscosity will be monitored at approximate 15-foot depth intervals using a mud balance and Marsh funnel, respectively.

5.2.1.2 Borehole Logging

The field geologist/engineer will prepare a written or electronic field log for each boring. In addition to describing each recovered soil or rock sample, the log will document boring location, drilling personnel, tooling/equipment used, drilling performance, depth to water, sample number, sample recovery, SPT blow counts, Rock Quality Designation (RQD), and other relevant observations. Soil color will be logged per the appropriate Munsell soil color chart.

Similarly, the field geologist/engineer will prepare a written or electronic installation log for each vibrating wire piezometer or temporary well. The log will document location, materials, depth, depth interval for each backfill material, and surface completion details (protective casing, concrete pad, bollards, etc.).

Field documentation will also be prepared for development and slug testing of each temporary well.

5.2.1.3 Surveying

Once completed, borings will be surveyed for horizontal and vertical control by survey grade GPS. The final survey of each location will be conducted following completion and abandonment of each individual sampling location. The survey data will be added to the final boring logs once available.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. 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 equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03*, Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 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 in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Boring log forms (hard copy or electronic) will be used to document lithologic conditions and field observations at each boring location.

5.2.3.3 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

5.2.4.1 Standard Penetration Test Sampling

The Standard Penetration Test (SPT) samples will provide information for developing the field boring logs/soil profiles, and soil specimens for laboratory natural moisture content and index testing. The SPT sampling will be conducted in accordance with ASTM D 1586 *Standard Method for Penetration Testing and Sampling for Soils*, and consists of dropping a 140-pound hammer from a height of 30 inches, to drive a standard size 2-inch diameter split-spoon sampler to a depth of 18-inches.

In certain cases, larger diameter sampling devices (e.g., 3-inch diameter split-spoon samplers) may be utilized to obtain disturbed samples. Applications of larger samplers may include obtaining larger quantity of material per depth interval or collecting material with larger particles (e.g., gravel too large for SPT sampling). Although similar to an SPT sample, the in-situ penetration resistance is not equivalent to a SPT blowcount (i.e., SPT N-value).

5.2.4.2 Shelby Tube (ST) Sampling

The guidelines for performing ST sampling for geotechnical investigations are found in ASTM D 1587 and United States Army Corps of Engineers (USACE) Engineer Manual EM 1110-1-1804 *Geotechnical Investigations,* Appendix F. The USACE manual is intended as a guide of commonly accepted soil sampling practices and procedures used by geotechnical personnel performing field sampling operations for earthen dams.

5.2.4.3 Rock Core Sampling

Rock coring is not anticipated.

5.2.5 Preservation and Handling

5.2.5.1 SPT Samples

SPT samples will be logged and placed in glass jars. Once each jar is filled, the rim and threads will be cleaned, the jar capped, and a label (Section 5.2.5.4) will be applied to the jar. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean before placing the sample container in a box for transport.

5.2.5.2 Shelby Tube Samples

Upon extraction of a ST sample from the boring, the tube will be carefully handled to prevent disturbance. After logging the sample recovery and describing the soil that is visible at the end of the tube, the ends will be labeled (top and bottom), sealed and capped. The top and bottom of each tube will be sealed with molten microcrystalline petroleum wax. Expandable O-ring packers may be used in lieu of wax seals. Plastic caps will be placed at each end of the tube and will be sealed with electrician tape. Each tube will be labeled (Section 5.2.5.4) and stored upright in a rack (Section 5.2.5.5).

5.2.5.3 Rock Core Samples

Rock coring is not anticipated.

5.2.5.4 Sample Labels and Identification System

Each SPT jar and ST will have a sample label affixed. Sample labels will contain the following information recorded in waterproof, non-erasable ink. Rock core boxes will have similar information written directly on the wooden core box in waterproof, non-erasable ink:

- Project number
- Sample location
- Boring ID number
- Depth of sampling interval
- Date of sample collection
- Sampler's initials

5.2.5.5 Packaging and Shipping

At appropriate intervals, assigned personnel will transport the samples to the testing laboratory or designated storage facility. SPT and other disturbed bulk samples (if any) will be treated as Group B samples as discussed in ASTM D4220.

The Shelby tubes will be stored vertically in padded racks constructed in accordance with ASTM D4220. Based on anticipated weather conditions during sampling operations, care will be taken in the storage of the samples to guard against the samples being exposed to extreme heat or cold. Prior to transport, the tubes will be transferred to a custom box built in accordance with ASTM D4220 guidelines for transporting Group D type soil samples.

Core boxes will be stacked for stable, secure transport to the laboratory, on-site, or off-site storage facility.

5.2.6 Sample Analyses

Select soil samples obtained during the geotechnical investigation will be subjected to geotechnical laboratory testing. Testing will be assigned to characterize the predominant CCR and soil materials recovered in each boring. The laboratory tests will be performed in accordance with applicable ASTM standard testing procedures.

The laboratory analyses are expected to include natural moisture content determinations (D2216), sieve and hydrometer analyses (D422), specific gravity (D854), and Atterberg Limits (D4318). The results of the testing will be used to assist in subsurface characterization and correlation with existing data. If other tests are found to be necessary, they will also be performed in accordance with applicable ASTM standard testing procedures. The Plant-specific laboratory testing program will be developed based on the recovery and spatial distribution of samples from the drilling and sampling program.

5.2.7 Equipment Decontamination Procedures

The decontamination procedures below apply to drilling and sampling in borings for temporary wells. For drilling and sampling in all other borings, decontamination (per procedures listed in TVA TI ENV-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*) will only occur before the first boring and after the last boring.

Documented decontamination will be performed for drilling equipment, tooling, and instruments in contact with subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Decontamination pads will be constructed for decontamination of large downhole tooling (augers, drill rods, etc.) using a high-pressure washer/steam cleaner.

Decontamination pads will be constructed at locations designated by TVA personnel using poly sheeting with sufficient berms to contain decontamination fluids and prevent potential runoff to uncontrolled areas. Following decontamination, fluids will be disposed of in accordance with Section 5.2.8. Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using potable water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

Decontamination of sampling equipment and instrument (e.g., split spoons, water level meters, pumps for well development, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.8 Waste Management

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

- Soil cuttings
- Drilling mud
- Well development water
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

5.3 DOWNHOLE TESTING

5.3.1 Downhole Geophysics

The borings advanced for the two deep monitoring wells (ALF-218A and ALF-219A) will be geophysically logged for naturally occurring gamma ray radiation. In Mississippi embayment sediments, the emission of naturally occurring gamma-emitting radiation (potassium-40, thorium-232, and uranium-238, as well as decay products of uranium and thorium) is much higher in clayey sediments such as the upper Claiborne confining unit than in sand intervals such as those that compose the Memphis aquifer. Natural gamma ray logging will provide continuous diagnostic data over the logged interval to help interpret the lithology. The geophysical logs will be used in conjunction with supporting lithologic information derived from the soil cores to determine how the screened intervals of the new wells correlate with the existing monitoring well network.

5.3.2 Pressure Testing

Pressure testing is not anticipated.

5.4 WELL INSTALLATION AND BACKFILLING

After a boring is advanced to its intended bottom depth, one of the following actions may be taken:

- Backfill the borehole without installing a well or a vibrating wire piezometer
- Install a vibrating wire piezometer and backfill the borehole around the instrument
- Install a temporary well and backfill the annular space around the well materials

In some cases, the lower portion of a borehole may be backfilled, followed by installing a vibrating wire piezometer or temporary well in the upper portion.

If a boring penetrates an engineered component (e.g., low hydraulic conductivity soil layer, geosynthetic cap system, or vegetative soil layer), these interval(s) will be backfilled such that equivalent or better performance is maintained. When applicable, field work plans will include procedures for repair of geosynthetics, protection around well riser pipes, and quality control monitoring and testing of such repairs.

5.4.1 Backfilling Boring without Instrumentation

Borings that do not include instrumentation (i.e., temporary well or vibrating wire piezometer) will generally be backfilled with a 30 percent solids bentonite grout or a bentonite-cement grout. A tremie pipe will be lowered to the bottom of borehole and grout will be injected as the drilling tools are removed, to displace water and cuttings to appropriately seal the boring. Stage grouting is not anticipated due to the modest depths. When backfilling using bentonite grout, follow the manufacturer's recommendations to achieve the desired percent solids. When backfilling using bentonite-cement grout, use the following mix:

- 30 gallons of water
- 94 lbs. of Portland Cement
- 25 lbs. of Bentonite
- This will produce a mix with a Water: Cement: Bentonite (W: C: B) ratio (by weight) of 2.5: 1.0: 0.3

If highly permeable zones are encountered (e.g., fractured rock), the grout mixture may be thickened. Bentonite pellets may be used to seal a permeable zone before resuming grouting above such a zone.

5.4.2 Temporary Wells

Within the context of the EIP, a temporary well may be used for measuring water levels, as well as obtaining pore water samples for analytical testing. Although constructed in the same way as a monitoring well, a temporary well serves a unique purpose for a limited duration and is thus differentiated in name.

Temporary wells will be installed by qualified drill crews using rotary or sonic drill units working under the direction of a licensed Tennessee driller. Additionally, field supervision will be provided by a Tennessee licensed PG or PE. The PG or PE will have suitable experience in geotechnical or geological engineering projects to support the work. This approach has been used at current investigations at other TVA Plants in Tennessee.

Temporary wells will be installed in accordance with TVA TI ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*. Exact depth/location of each screen will be determined based on as-drilled conditions. A temporary well installation record will be drafted for each well and will include notes and details of the installation procedures.

5.4.2.1 Materials and Installation

The temporary wells will be installed using current industry and regulatory protocols to reduce potential for introducing contaminants during the drilling and installation process. Decontamination processes will be in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*. 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 new well screen and riser that have been cleaned and sealed in plastic at the factory, and placing washed filter pack sand that is certified by NSF International. Other steps employed during the installations include the workers donning clean, nitrile gloves during the handling of downhole equipment and well materials, and using potable water for grouting purposes.

A temporary well will consist of a four-inch diameter Schedule 40 PVC well screen (0.010-inch slots) and riser. The screen and riser will consist of flush-joint, threaded PVC pipe. The screen length will be selected based on the results of the boring and the target stratum, but will not be longer than 10 feet. A pre-packed well screen may be used. A four-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 above (2.5 feet minimum) the ground surface and will be capped with a temporary plug or slip cap. The annular space will be backfilled with a sand filter pack (20/40 mesh) extending a minimum of two feet above and six inches below the screen. A minimum two-foot thick bentonite pellet seal will be placed on top of the sand filter pack.

After the bentonite pellet seal has sufficiently hydrated for a duration equal to or greater than the minimum recommended by the manufacturer, the remaining annular space will be backfilled with either a 30 percent solids bentonite grout or a bentonite-cement grout.

It should be noted that the grout will be placed by tremie method through one-inch (minimum) diameter PVC pipe. The grout will be placed using pumps gauged to allow the installation crew to monitor pressures during the grouting process. In open (uncased) boreholes, the sand filter zones and bentonite pellets will be placed by tremie method through one-inch (minimum) diameter PVC. In cased boreholes (i.e., through hollow-stem augers or temporary casing), the sand filter zones and bentonite pellets may be placed by tremie method or may be poured slowly into the annular space of the drill tooling to prevent bridging.

If vibrating wire piezometers became necessary, one or more transducers (at multiple depths, if needed) can be installed in a boring and grouted in-place. These grouted in-place piezometers (GIPPs) will be attached to a sacrificial one-inch (minimum) diameter PVC pipe. The boring will be backfilled using the 30 percent solids bentonite grout or the bentonite-cement grout described previously, placed by the tremie method.

If the well is not to be installed at the bottom of the borehole, the lower portion of the hole will be backfilled with 30 percent solids bentonite grout, bentonite-cement grout, or bentonite pellets. After the grout cures enough to support the weight of the overlying well materials and backfill, the well can be installed above the grouted zone.

Subsequent wellhead construction will consist of an above-grade, steel locking protective cover anchored to a concrete surface pad. The protective cover will extend above the concrete pad and the annular space will be filled with sand or pea gravel to about six-inches below the top of PVC casing. Steel protective bollards filled with concrete will be installed near each corner of the concrete pad. If the installation is only expected to be used for a relatively short duration and it is located in an area of little vehicular activity (i.e., low risk of damage), the surface protection may be modified to allow for easier removal when the instrument is no longer needed. The top of each well casing will be surveyed and correlated to the vertical datum used by the Plant.

An example installation log is shown in Figure 3. A drawing of the wellhead construction is shown in Figure 4.

5.4.2.2 Well Development

Each new well will be developed by a combination of bailing, surging, and pumping after a minimum of 24 hours following completion. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. First, a bailer will be lowered and raised within the screened intervals to create a slight surging action to dislodge particles within the wells and sand filter packs. A baseline reading of turbidity, pH, temperature, and specific conductance will be measured using a properly calibrated Oakton® turbidity and PCSTestr 35 water testing meters (or equivalents). If the well contains heavy sediment, further bailing will be performed before continuation of development with surge blocks and submersible pumps.

A surge block will be used within the screened interval to move water and particles through the screen and sand filter packs. This process may be repeated several times to decrease the water turbidity within the wells.

Lastly, a submersible pump will be employed to further develop the wells until an acceptable level of turbidity is achieved. Target turbidity value of less than or equal to ten (10) Nephelometric turbidity units (NTUs) will be utilized for temporary wells per TVA TI ENV-TI-05.80.42. If the target turbidity value cannot practically be achieved, well development will be conducted according to the requirements listed in TVA TI ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*.

5.4.2.3 Slug Testing

After development, TVA will perform a slug test in each temporary well to measure hydraulic conductivity. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. The slug tests will be performed in accordance with ASTM D 4044, *Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers*. A pressure transducer with a data recorder will be used to collect water level information from the wells.

As part of the slug testing, each well will be tested by taking an initial measurement of the static water level followed by the insertion of the pressure transducer into the well. After the transducer has been installed and the water level stabilizes, a solid slug (e.g., PVC pipe filled with sand) will be introduced into the well to cause a nearly instantaneous change in the water level. The water levels will then be recorded at regular intervals until reaching near static levels. After reaching static levels, the test will be terminated and a second slug test will be conducted by instantaneously removing the slug and monitoring water levels until static levels are reached again. The results will be recorded electronically and downloaded into a data collector. Raw data will be checked in the field for discrepancies prior to demobilizing from the Plant.

The field data, once collected and returned to the office, will be reduced using a software program to estimate the hydraulic conductivity of the in-situ soils.

5.4.3 Monitoring and Sampling

Monitoring and/or sampling of temporary wells is not addressed in this SAP. Refer to the CCR Material Characteristics SAP.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to Exploratory Drilling.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

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

6.2 QUALITY CONTROL CHECKS

The accuracy of the drilling, temporary well installation and slug testing processes must be maintained throughout the investigation. In addition, planned drilling and installation methods must be confirmed during field activities to provide confidence that porewater samples and water level measurements collected as part of other SAPs provide representative analytical results and data.

Field personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable field forms and documentation of field activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 3. Preliminary Schedule for Exploratory Drilling SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Exploratory Drilling SAP Submittal		Completed
Prepare for Field Activities	20 Days	Following EIP Approval
Conduct Field Activities	80 Days	Following Field Preparation
Laboratory Testing (hydraulic conductivity/shear strength)	40 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Assessment of suitability of areas and access to borings, including clearing and grubbing, will be completed prior to the exploration start date.
- Sampling methods and field locations may be adjusted based on actual field conditions. Changes made in the field will be reported in the Environmental Assessment Report (EAR) as appropriate.
- Well screen and riser pipe dimensions may be adjusted based on actual field conditions and sampling needs. Changes made in the field will be reported in the EAR as appropriate.
- Laboratory testing of surplus undisturbed samples assumes that samples are still suitable for testing. Suitability cannot be confirmed until samples are extruded from the tubes and visually evaluated.

9.0 REFERENCES

Geocomp. 2016. "Tennessee Valley Authority, EPA Seismic Assessment, Supplemental Site Exploration, Allen Fossil Plant, East Ash Disposal Area, Final Report." Volumes 1-4. Prepared for Tennessee Valley Authority. October.

Tennessee Valley Authority (TVA). 2017a. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017c. "Monitoring Well and Piezometer Installation and Development." Technical Instruction ENV-TI-05.80.25, Revision 0000. May 8.

Tennessee Valley Authority (TVA). 2017d. "Groundwater Sampling." Technical Instruction ENV-TI-05.80.42, Revision 0001. March 31.

United States Army Corps of Engineers (USACE). 2001. "Geotechnical Investigations." EM 1110-1-1804. January.

ATTACHMENT A
FIGURES

Figure No.
1

Title

Proposed Borings
East Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

- Proposed Boring
- Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silt	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand	*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

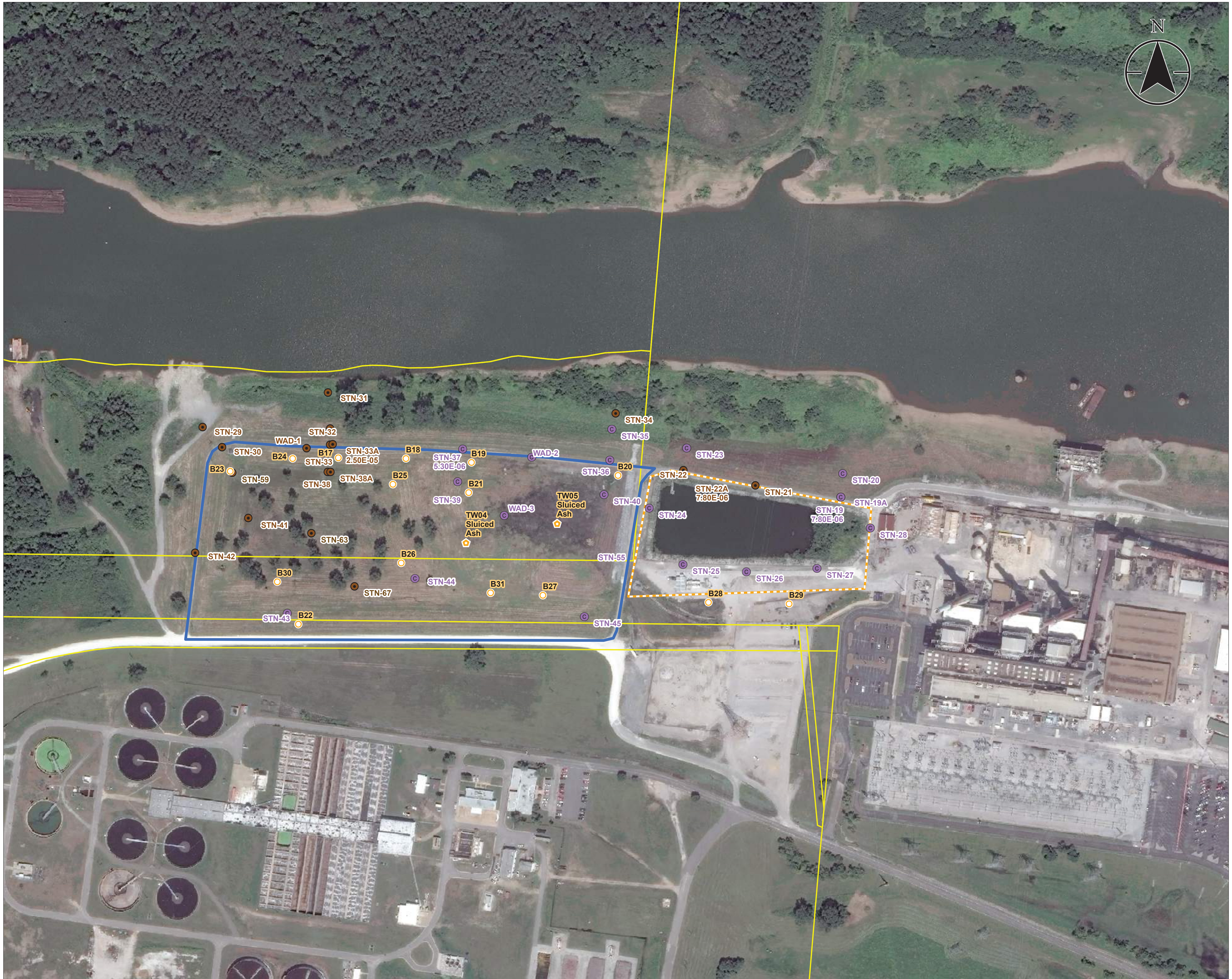

Figure No.
2

Title
Proposed Borings
West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

- Proposed Boring
- Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

- Clay or Silt — *Boring ID, Lab Hydraulic Conductivity (cm/s) [if completed]*
- Silty Sand to Sand — *Boring ID, Lab Hydraulic Conductivity (cm/s) [if completed]*
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec TVA

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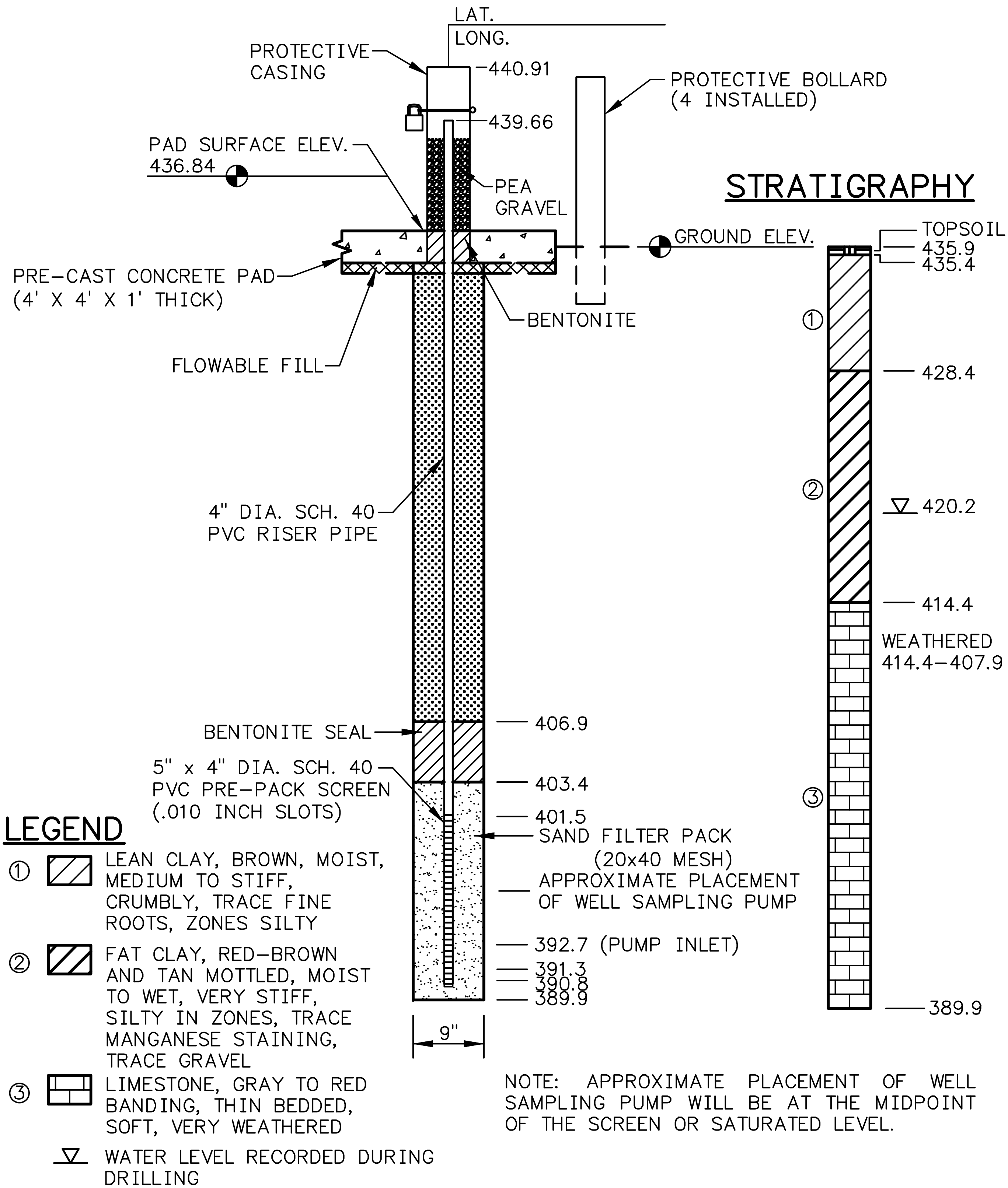

Figure 3. Temporary Well Installation Schematic

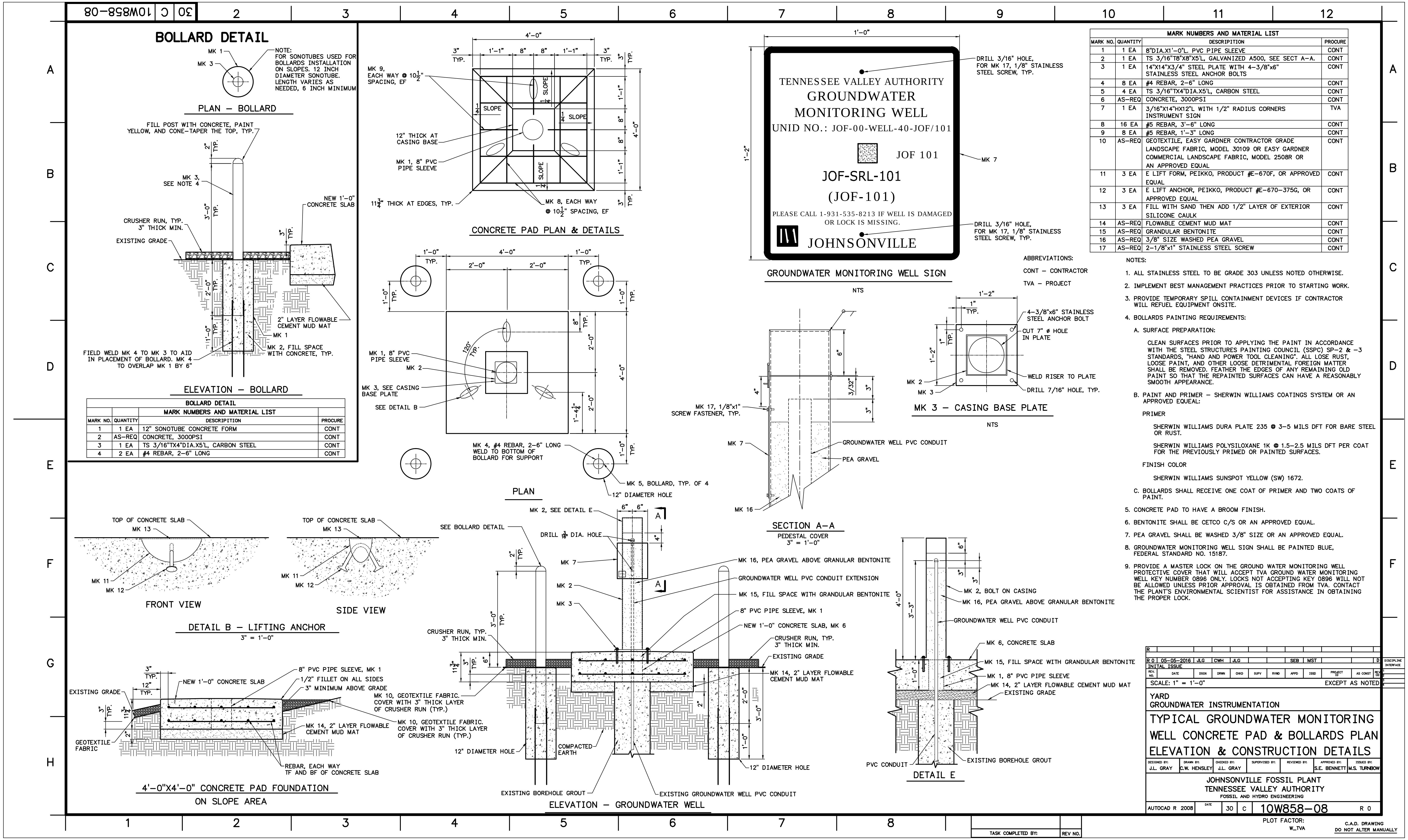

Figure 4. Typical Temporary Well Construction Details

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Exploratory Drilling

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Cone penetrometer testing assembly
Hollow stem augers
Split-spoon sampler and associated rods
Shelby tube sampler
[1]Drilling Rig and associated equipment
Water pump and water tank
Core barrel
Tremie pipe
Cement
Bentonite
Piezometer screen
Sand
Piezometer standpipe
Water level indicator meter
Well pump (purging well) and tubing
Hand tools (e.g. wrench, hammer, etc.)
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Drilling rig equipment will be selected based on site conditions, selected by the Drilling Contractor, and approved by TVA.

APPENDIX I
SECTION 408 PERMIT REQUEST FORM

408 Permit Request

Type of Modification: Date:

Location Information

Decimal Latitude: Decimal Longitude:

State: County: Nearest Town:

Owner Information

Federal Project Owner:

Owner's Approving Representative: Phone No.:

Requestor

Name:

Firm:

Phone No.:

Email:

Engineer of Record

Name:

Firm:

Phone No.:

Email:

Brief Description of Proposed Modification:

Reason for Modification:

Impact on System Integrity:

Impact on System Operation and Maintenance:

Proposed Construction Start: End:

Print Form

For Internal Use

From Rev 20120222

Levee System Number: Levee Segment Number: Approved Date:

Submit

APPENDIX J
ENGINEER CIRCULAR 1165-2-220

DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

EC 1165-2-220

CECW-ZB

Circular
No. 1165-2-220

10 September 2018

EXPIRES 30 SEPTEMBER 2020
Water Resource Policies and Authorities

POLICY AND PROCEDURAL GUIDANCE FOR PROCESSING REQUESTS TO ALTER US ARMY CORPS OF ENGINEERS CIVIL WORKS PROJECTS PURSUANT TO 33 USC 408

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DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

EC 1165-2-220

CECW-ZB

Circular
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EXPIRES 30 SEPTEMBER 2020
Water Resource Policies and Authorities
POLICY AND PROCEDURAL GUIDANCE FOR PROCESSING REQUESTS TO ALTER US ARMY CORPS OF ENGINEERS CIVIL WORKS PROJECTS PURSUANT TO 33 USC 408

1. Purpose. The purpose of this Engineer Circular (EC) is to provide policy and procedural guidance for processing requests by private, public, tribal, or other federal entities to make alterations to, or temporarily or permanently occupy or use, any US Army Corps of Engineers (USACE) federally authorized Civil Works project under 33 USC 408 (Section 408). Proposed alterations must not be injurious to the public interest or impair the usefulness of the USACE project.

a. This EC contains guidance applicable to all types of USACE projects that can be tailored to the appropriate level of detail for a specific Section 408 request. Supplemental guidance for specific infrastructure types (i.e., dams, hydropower, levee systems, and navigation) and other procedures can be found in the appendices.

b. This EC will serve as the most current comprehensive guidance for Section 408 reviews until it is supplemented, replaced, or expires. This EC applies to requests for alterations received by districts on or after the date of issuance. All requests submitted prior to the effective date of this EC can be processed consistent with the previous policy or this EC, at the requester's discretion.

c. This EC contains guidance related to interaction between USACE Section 408 decisions and other USACE processes, such as real estate decisions and permits under the USACE Regulatory Program.

2. Applicability. This EC is applicable to all headquarters USACE elements, divisions, districts, laboratories, and field operating activities related to USACE Civil Works projects.

3. Distribution Statement. Approved for public release; distribution is unlimited.

4. References. References for the main EC are in Appendix A. Other references are specified in specific appendices as appropriate.

5. Authority. See Appendix B.

6. Basic Definitions. For the purposes of this EC, the following terms are used:

a. "District" refers to a USACE district office and "division" refers to a USACE division office.

b. "USACE project" refers to a USACE federally authorized Civil Works project, including those operated and/or maintained by USACE and those operated and maintained by a non-federal sponsor.

c. "Alteration" refers to any action by any entity other than USACE that builds upon, alters, improves, moves, obstructs, or occupies an existing USACE project. Unless otherwise stated, for ease of reference, the use of the term "alteration" in this document also includes "occupation" and "use."

d. "Requester" refers to an entity other than USACE that is requesting permission to alter a USACE project. A request for Section 408 permission can originate from a non-federal sponsor (see definition in next paragraph) or an independent requester.

e. "Non-federal sponsor" refers to a non-federal interest, as defined in the Flood Control Act of 1970, as amended (42 USC 1962d-5b(b)), that has provided assurances or executed a binding agreement for the provision of items of local cooperation for a USACE project, including, as applicable, operation and maintenance.

f. "Regulatory Program" or "Regulatory" is the USACE program responsible for oversight and implementation of permits under Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (Section 10/404/103).

g. "Shoreline use permit" refers to the written permission issued by USACE under Part 327 of Title 36 of the Code of Federal Regulations to authorize certain structures, facilities, and uses in or adjacent to waters that are managed by USACE at Civil Works projects.

h. "Outgrant" refers to a real estate instrument which conveys or grants the right to use real property and is usually in the form of a lease, license, or easement. A consent is not an outgrant.

i. "Consent" refers to a written agreement between the holder of an easement and the owner of the underlying fee estate, that allows the owner of the underlying fee estate to use (or authorize another to use) their land in a manner that the easement holder has determined will not interfere with the easement holder's rights. A consent does not grant an interest in real estate and is not an outgrant.

j. "Real property" refers to any interest in land, including leaseholds, easements, and rights-of-way, together with the improvements, structures, and fixtures located thereon.

k. "Real property of the United States" refers to real property owned by the United States that is under the administrative jurisdiction of USACE.

7. Program Governance. USACE will maintain a three-level decentralized organization to implement this EC, comprising Headquarters USACE (HQUSACE), division, and district levels. The Commanders at each level – HQUSACE, division, and district – have ultimate responsibility for ensuring that Section 408 decisions comply with current policy and procedures. Each level is required to establish and maintain personnel and procedures to implement this EC.

a. Program Oversight. HQUSACE will designate a HQUSACE proponent to oversee the execution of this EC and monitor progress. Each fiscal year, HQUSACE will lead an audit. The audit will be coordinated through appropriate Division and District Commanders and will result in an audit report to be submitted to the Director of Civil Works. At a minimum, the audit report will include a review of a sampling of district and division Section 408 decisions, an assessment of the consistency of documentation of decisions and compliance with policy agency-wide, use of streamlining processes (e.g., categorical exclusions, categorical permissions, and procedural review plans), and lessons learned and corrective actions needed in order to improve the process agency-wide. The audit will also evaluate the timeliness of decisions.

b. Section 408 Coordinator. Each District and Division Commander will designate a Section 408 Coordinator with the appropriate professional expertise and experience to manage and coordinate (both internally and externally to USACE) Section 408 activities. Section 408 Coordinators must have management and communication abilities and have knowledge and experience with the Section 408 procedures. District Section 408 Coordinators will ensure proper coordination occurs among all the necessary elements internally and externally, including but not limited to regulatory, tribal liaisons, real estate, counsel, planning, engineering and construction, programs and project management, and operations. Division Section 408 Coordinators will ensure proper coordination among other districts if the USACE project or proposed alteration crosses more than one district's area of responsibility, reference paragraph 7.h.(3), and consistency in implementation within the divisions' areas of responsibility. In addition, Section 408 Coordinators are responsible for data management in the Section 408 database, reference paragraph 7.d, and appropriate webpages, reference paragraph 7.e, to ensure information and status of Section 408 requests are current. Section 408 Coordinators will ensure budgetary information and resource needs to accomplish USACE Section 408 activities are coordinated and submitted during the budgeting process.

c. Administrative Record. The district will be responsible for maintaining an administrative record for each Section 408 request in their area of responsibility. The administrative record should include all documents and materials directly or indirectly considered by the decision-maker. It should include documents, materials, and a record of the offices and staff that are pertinent to the merits of the decision, as well as those that are relevant to the decision-making process. Record documents will be uploaded to the Section 408 database, reference paragraph

7.d, as appropriate.

d. Section 408 Database. HQUSACE will establish and maintain a Section 408 database to serve as the database system of record for all Section 408 requests. The database system will be created in a manner to ensure information can be shared and synchronized with other USACE database systems as appropriate. The database will adhere to standards established for the Civil Works Business Intelligence (CWBI) and be managed under the CWBI Automated Information System, which is part of the Civil Works information technology portfolio. Database entry and quality control/quality assurance of entered data is the responsibility of districts and divisions. A subset of fields from this database will be made publicly available to provide information on the current status of Section 408 requests received.

e. Public Webpages. HQUSACE will establish and maintain a publicly available Section 408 webpage to provide basic information on Section 408, and viewable access to a subset of the Section 408 database fields related to status of requests. Each USACE district, and division if necessary, will ensure information on how a requester can submit a Section 408 request to the district is available on district-specific public webpages. District webpages will include contact information and a link to the HQUSACE Section 408 public webpage and database.

f. Funding for USACE Section 408 Responsibilities. USACE-led Section 408 activities that require funding include those on a programmatic level (e.g., data management, program management, coordination, generating categorical permissions, developing procedural review plans, and creating funding agreements) and those activities related to processing Section 408 requests (e.g., reviewing requests, development of environmental and cultural resource final documents, construction oversight, approving updates to Operation and Maintenance manuals related to the alteration, and alteration-specific review plans).

(1) See guidance on funding for Section 408 in the current Civil Works Program Development Guidance.

(2) Districts will ensure requesters are aware of the opportunity to use funding agreements to expedite activities related to processing Section 408 requests, see paragraph 7.g.

(3) Enforcement activities, reference paragraph 18, associated with completed and in-place Section 408 alterations or unapproved encroachments, will be funded from the appropriate source associated with the inspection and oversight procedures for that specific USACE project.

(4) Regulatory Program funds can only be used for a Section 10/404/103 action, which may include those actions with an associated Section 408 request. Regulatory staff can use Regulatory funds to participate in joint meetings and internally coordinate portions of shared documents when a Section 408 request also requires a Section 10/404/103 action.

g. Funding Agreements. The following are the three main authorities through which

USACE may accept and expend funds to expedite the review and evaluation of a Section 408 request. Districts should choose the funding agreement option that is most appropriate to provide the most efficiency. See Appendix I for detailed procedures.

(1) Section 1156(a)(2) of the Water Resources Development Act (WRDA) 2016 amended Section 14 of the Rivers and Harbors Act of 1899 (33 USC 408) to authorize the acceptance and expenditure of funds received from non-federal public or private entities to evaluate requests under Section 408. This authority is the most flexible and streamlined authority for accepting funding for Section 408 reviews.

(2) Funds may be accepted under the authority of Section 214 of WRDA 2000, as amended, (33 USC 2352) to expedite the review and evaluation of a Section 408 request for a public purpose. Funds may be accepted from non-federal public entities; public utility companies; natural gas companies; or railroad carriers. This authority requires a public notice before receipt of funds and has other limitations.

(3) Funds may be accepted under the authority of 23 USC 139(j) to expedite the review and evaluation of a Section 408 request associated with a federal-aid transportation project. Funds may be accepted from certain public entities that receive financial assistance from the U.S. Department of Transportation (USDOT). This authority requires USDOT approval of the agreement and has other restrictions and requirements. This authority may be more appropriate for projects for which the Federal Highway Administration (FHWA) and/or Federal Transit Administration (FTA) are the lead agency and the transportation project sponsor is seeking or receiving financial assistance from USDOT for permitting.

(4) To accept funds from another federal agency, a specific statutory authority must be identified that authorizes the transfer of funds for such a purpose.

h. Coordination.

(1) Effective communication and coordination, both internally and externally, is critical to achieve efficient decision-making on Section 408 requests. Districts will ensure that internal and external coordination is conducted as necessary to ensure timely and efficient reviews and decision-making. In addition, districts will seek opportunities to integrate or align internal procedures, leverage information between processes, and eliminate redundancy, while ensuring appropriate laws and policies are being met. Early and frequent coordination between USACE, the requester, and/or non-federal sponsor, if applicable, is strongly recommended. Coordination, notification and subsequent tribal government-to-government consultation should occur at the earliest stages and should be pre-decisional with interested federally recognized tribes, including tribes whose aboriginal territories extend into the lands where the proposed activity may occur. Coordination with tribes should happen prior to or concurrent with coordination with State Historic Preservation Officers. The most effective way to determine whether an area has tribal cultural, historic or spiritual significance is to work with representatives from each tribal nation

that either resides or has ancestral ties to the area proposed for the Section 408 request. Coordination will aid in early identification of potential issues and help to focus efforts, thereby minimizing costs to the requester and USACE.

(2) Districts will provide a copy of this EC to non-federal sponsors of USACE projects. This EC is not intended to replace existing coordination processes districts may have with non-federal sponsors for efficient reviews of alterations to the USACE project. Districts are encouraged to adapt existing coordination processes or develop new standard operating procedures to reflect requirements in this EC and to support effective and efficient reviews.

(3) One lead district, and its' associated division office, will be designated for any single non-USACE project that crosses district or state boundaries (e.g., pipelines, highway projects, electrical transmission projects) and requires either Section 10/404/103 review(s), Section 408 review(s), or a combination of both consistent with reference A.41. The lead district will be responsible for maintaining situational awareness on the status of all Section 10/404/103 and Section 408 reviews; serving as a primary point of contact for the requester; and coordinating schedules and requirements to meet review and decision milestones.

(4) In cases in which a Section 408 permission (except for Section 408 decisions that must be made by the Division Commander, per paragraph 8.c.) and a Regulatory standard individual permit are both required for the same proposed alteration/activity, the district will conduct these evaluations in a coordinated and concurrent manner resulting in a single decision document. Although each mission area (between Section 408 and Regulatory) is responsible for the review requirements specific to its respective authorities, the environmental compliance to cover both the Section 408 permission and Regulatory permit decisions will be coordinated by a single office. Consideration should be given to the scale and scope of the activities subject to each authority when designating the lead office for environmental compliance. The district Regulatory Chief and the Section 408 Coordinator will jointly decide which office will be the lead for environmental compliance. If agreement cannot be reached, then the District Commander will decide. The single decision document will contain documentation for the final decisions for both the Section 408 permission and the Regulatory permit. Note that implementing regulations and policies for the Regulatory permit require the evaluation of proposed activities and their compatibility with the purposes of a federal project. The Section 408 analysis informs the compatibility with the purposes of a federal project for Regulatory purposes. In addition, there will be a single transmittal letter to the requester that includes as attachments both the Section 408 decision letter and the Regulatory permit. The District Commander is the deciding official for the single decision document for these cases, although he or she may further delegate these combined decisions following the same requirements as in paragraph 8.d. As a result, in these cases, the Section 408 permission and Regulatory individual permit will be reviewed and finalized at the same decision level and by the same deciding official. See Appendix G for alternative procedures related to Section 10 and Section 408.

(5) In cases in which an alteration requiring a Section 408 permission and a Regulatory

permit decision other than a standard individual permit, the district will conduct these evaluations in a coordinated and concurrent manner to the maximum extent practicable. For these cases, there will be a single transmittal letter to the requester that includes as attachments both the Section 408 decision letter and the Regulatory permit. A single decision document, single office lead for environmental compliance, or the same deciding official is not required. However, the Section 408 decision must be finalized before or concurrent with, but not after, the Regulatory decision. Implementing regulations and policies for the Regulatory decisions require the evaluation of proposed activities and their compatibility with the purposes of a federal project. The Section 408 decision informs the compatibility with the purposes of a federal project for Regulatory purposes.

(6) In cases in which a proposed Section 408 alteration may affect the formulation, evaluation, or selection of alternatives for a current Investigation or other USACE study, (for example, when approval or denial of a proposed alteration would materially affect the completeness, effectiveness, efficiency, and/or acceptability of one or more alternatives being evaluated as part of a feasibility study), district staff reviewing the Section 408 request will coordinate with the district study team to identify, track, and ensure vertical awareness of the interdependencies between the Section 408 request and the USACE study. Study and implementation risks associated with the decision (approval or denial) on the Section 408 request will be managed and discussed with the vertical team through the study milestones.

(7) In cases in which a proposed Section 408 alteration changes how the USACE project will meet its authorized purpose, district staff reviewing the Section 408 request will coordinate vertically with the division to the appropriate Regional Integration Team (RIT) and Office of Counsel to confirm that Section 408 is being appropriately applied. An example is a proposed alteration to permanently breach a levee system for ecosystem restoration purposes and raise all structures behind the levee to achieve the same flood risk management benefits. This USACE project still meets the authorized flood risk management purpose but in a different manner.

(8) A proposed alteration may also be subject to other laws or requirements that involve additional coordination, prioritization, and/or transparency (e.g., Title 41 of the Fixing America's Surface Transportation Act (FAST-41), Federal-aid highway and transit projects subject to 23 USC 139, priority projects under an existing Executive Order, etc.). Districts should be aware of, and actively participate in, any additional coordination required for the Section 408 request, including supporting development of schedules and updating any non-USACE databases (e.g., FAST-41 Coordinated Project Plans and Dashboard), if required. Districts should coordinate vertically, through the division, to the appropriate Regional Integration Team (RIT), if upward reporting on status is required for these Section 408 requests. Reporting for Section 408 should be accomplished in a concurrent and coordinated manner with any other required USACE actions for that project (e.g., pending Regulatory permit decisions or real estate decisions, etc.).

(9) Requesters seeking sensitive information about an existing USACE project to develop a proposed alteration will submit requests for that information in writing to the district. Sensitive

information includes information that could pose a security risk or aid those intending to do harm to a USACE project. Examples include, but are not limited to, design analyses, as-builts or other drawings, specifications, location of deficiencies, operational information, and contingency plans. The district office that generated or is responsible for the information requested will review the request in coordination with the district operational security officer to determine whether it is sensitive. Districts should limit the distribution of sensitive information to only the information that is necessary for the proposed alteration. Districts will advise requesters that the information to be provided is sensitive and direct requesters to provide a list of individuals with whom the information will be shared. Districts will advise requesters that the sensitive information will not be shared with individuals not on the list. Reviewers should work with their District Office of Counsel to determine if a non-disclosure statement is needed. In some cases, districts may have to withhold sensitive information regardless of its necessity for the development of a proposed alteration. Requests to USACE for other agency data will be referred to the other agency for a release determination. Information provided by federally recognized tribes during consultation may be sensitive and not publicly available. Districts must ensure sensitive information provided by federally recognized tribes is not disclosed to the extent allowable by law and that the administrative record pertaining to this sensitive information is general in nature.

(10) Vertical coordination among district, division, and HQUSACE must occur when there is any question related to the appropriate course of action; the nature of the Section 408 request is without precedent; or the review of the Section 408 request requires deviation from policy.

8. Decision Authority. All final Section 408 decisions will comply with the following:

a. All Section 408 decision-makers must ensure accountability and consistency with federal law and policy. Section 408 decision-makers must also ensure the appropriate and requisite expertise has reviewed each Section 408 request.

b. A categorical permission may be created at the district, division, or HQUSACE level, but must be approved and signed by a District Commander, Division Commander, or the Director of Civil Works, depending upon the region in which it is applicable. Validation that a Section 408 request is consistent with the terms and conditions of a categorical permission and subsequent authorization of the activity under the categorical permission may be delegated. The delegation should be established through the process used to create the categorical permission. Reference Appendix C for additional information for categorical permissions.

c. Division Review and Decision. The following are the Section 408 requests that will require a final decision by the Division Commander and cannot be further delegated. Division Commander decisions will consider the analysis and recommendation by the District Commander. For Section 408 requests that require approval by the Division Commander and uses the multi-phased review option (reference paragraph 10.c.), Division Commanders have discretion to render a decision on any or all milestones, but must render the decision for the final milestone. Districts will keep divisions informed of the progress throughout the multi-phased review process, including any issues and concerns that would be pertinent to the Division Commander's decision for level of involvement and rendering the final decision. The Division Commander can delegate milestone decisions, except for the final milestone, to District Commanders or the District Commanders' designee.

(1) Proposed alterations that require a Safety Assurance Review (SAR), see paragraph 12.c.(4).

(2) Proposed alterations for the installation of hydropower facilities. Coordination and concurrence with the division Dam Safety Officer and the division Hydropower Coordinator is required prior to the final Section 408 decision.

(3) Proposed alterations for which the non-federal sponsor for a USACE project is seeking potential credit under Section 221 of the Flood Control Act of 1970, as amended. A decision on a Section 408 request is separate from any decision on potential credit for in-kind contributions. See paragraph 9.g.

(4) Proposed alterations that affect the formulation, evaluation, or selection of alternatives for a current study under the Investigations account or other USACE study. Coordination with the division Chief of Planning is required prior to the final Section 408 decision. See paragraph 7.h.(6).

(5) Proposed alterations that change how the USACE project will meet its authorized purpose. See paragraph 7.h.(7).

(6) Proposed navigation alterations for which federal assumption of operation and maintenance under Section 204(f) of Water Resources Development Act of 1986, as amended, is also being sought. See paragraph 9.f.(5).

d. District Review and Decision. All other decisions for Section 408 requests not included in paragraphs 8.c.(1) through 8.c.(6) may be rendered by the District Commander. A District Commander may further delegate authority for such decisions to his or her designees. The delegation must be in writing and signed by the District Commander, with the delegation identifying the name and title of the individual to whom authority is being delegated and what limitations, if any, are being imposed. District Commanders may not delegate Section 408 decisions below a supervisory Division Chief level. No further re-delegation by a designee is authorized. A copy of the delegation must be maintained in the office where the authority is held.

e. At any time, the Director of Civil Works, Division Commanders, and District Commanders have discretion to elevate decision-making authority for the final decision for a specific Section 408 request based on the unique or special circumstances involved. The following are examples of the types of considerations for elevating a Section 408 decision level:

(1) The nature of the Section 408 request is without precedent;

(2) The review of the Section 408 request may require variation from regional or national policy; or,

(3) A proposed alteration of a USACE project crosses more than one district's or division's area of responsibility.

f. The appropriate National Environmental Policy Act (NEPA) decision document (Record of Decision or Finding of No Significant Impact) will be signed by the USACE official making the decision for the corresponding Section 408 request, if it is not already integrated into the Summary of Findings document reference paragraph 15.b. Documentation of the applicability of a categorical exclusion may be signed by the Section 408 decision-maker or other appropriate district staff.

9. Determining When Procedures in this EC Apply. The following describes when the procedures in this EC apply, along with exceptions. The following does not affect the requirement for a Regulatory permit or any other applicable permits. Note, however, paragraphs 7.h.(4) and 7.h.(5) and Appendix G outline how Regulatory and Section 408 reviews must be either consolidated or effectively aligned depending on certain circumstances.

a. Geographical Limitations.

(1) This EC must be applied to alterations proposed within the real property identified and acquired for the USACE project, with exceptions further described in this section. An activity affecting a USACE project not yet constructed or under construction is considered to be an alteration, occupation, or use of a USACE project requiring permission under Section 408 if the activity will occur on real property that the Federal Government has acquired for the USACE project or that the non-federal sponsor has provided for the USACE project under the terms of a Project Partnership Agreement (PPA).

(2) This EC must be applied to alterations proposed to submerged lands occupied or used by a USACE project.

(3) This EC must be applied to alterations that cross over or under a federal navigation channel when the alteration is also subject to either Section 9 or 10 of the Rivers and Harbors Act of 1899.

(4) At the USACE district office's discretion, this EC may be applied to alterations to submerged lands proposed in the vicinity of a USACE project that occur in an area subject to the navigation servitude, when it is determined that the alterations have the potential to impair the

usefulness of the USACE project. Navigation servitude is defined as the dominant right of the Government under the Commerce Clause of the U.S. Constitution (U.S. Const. art. I, sec. 8, cl. 3) to use, control, and regulate the navigable waters of the United States and the submerged lands thereunder for various commerce-related purposes, including navigation and flood control. In tidal areas, the servitude extends to all lands below the mean high water mark. In non-tidal areas, the servitude extends to all lands within the beds and banks of a navigable stream that lie below the ordinary high water mark.

(5) This EC should not be applied to proposed alterations occurring outside of the areas specified in paragraphs 9.a.(1) to 9.a.(4). If there is a case in which a proposed alteration occurring outside of the areas specified could impair the usefulness of a USACE project, such cases should be coordinated vertically through the appropriate Regional Integration Team (RIT) to determine the course of action.

b. Emergency alterations or emergency activities performed by USACE on USACE projects under Public Law (PL) 84-99, reference A.29, do not require Section 408 permission. Alterations by others that are considered an emergency and/or urgent, which may include interim risk reduction measures, but not implemented under PL 84-99, may require Section 408 permission and this EC would apply. Districts will consider if the alteration meets other criteria defined under this paragraph 9. If this EC applies, districts can reprioritize and expedite reviews as appropriate given the urgency required for each specific situation. Reference Appendix D on expediting environmental compliance in emergency situations.

c. Non-federal Sponsor Maintenance and Repair Activities. Maintenance and repair activities conducted by non-federal sponsors on the USACE project for which they have operation and maintenance responsibilities do not require Section 408 permission, but may require coordination or concurrence from the USACE district, as further specified below.

(1) Operations and Maintenance (O&M) activities, including any floodfighting and/or other emergency activities, specified in a USACE-issued O&M manual do not require Section 408 permission.

(2) Activities to restore the USACE project to the physical dimensions and design of the constructed project, without any changes to the real property, existing design features, or physical dimensions or performance of the USACE project do not require Section 408 permission. USACE districts may at any time require the non-federal sponsor to coordinate with the district to verify the design or construction approach of such activities based on scope and scale. USACE districts should proactively coordinate with the non-federal sponsor to identify, if any, the types of activities that may need this verification.

(3) Geotechnical exploration drilling by the non-federal sponsor associated with activities described in paragraphs 9.c.(1) and (2) does not require Section 408 permission. However, drilling in embankment dams and levees must comply with requirements in reference A.31,

including a drilling plan. Districts will coordinate with non-federal sponsors to develop the drilling plan.

d. Improvements, excavations, construction, or changes to local flood protection works referenced in 33 Code of Federal Regulations (CFR) 208.10(a)(4) and (5) do not negate nor replace the requirement for approval from USACE under Section 408 as specified for such activities in this EC.

e. When a proposed alteration will be carried out entirely within the boundaries of real property of the United States or reservoirs managed by USACE, a separate evaluation under the procedures in this EC is not required, so long as the alteration is either consistent with an approved project master plan developed according to references A.34 and A.39, or subject to a Report and Determination of Availability under chapter 8 of reference A.28. In such cases, the project master planning process or the procedure for preparing the Report and Determination of Availability satisfies the requirements for Section 408 for the proposed alteration. No separate Section 408 permission is required to support issuance of the associated shoreline use permit or outgrant. Note, in these instances, Regulatory can render a permit decision before USACE issues the shoreline use permits or outgrants, as long as Regulatory has received the Determination of Availability or confirmation of consistency with the approved project master plan, whichever is applicable to the proposed alteration.

(1) When a federal agency other than USACE is responsible for issuing the permit or outgrant authorizing a proposed alteration that will be carried out within the boundaries of real property of the United States or reservoirs managed by the USACE (e.g., pipeline rights-of-way issued by the Bureau of Land Management under 30 USC 185, or hydropower licenses issued by the Federal Energy Regulatory Commission (FERC) under the Federal Power Act), a separate Section 408 permission is not required if USACE provides the other federal agency with a Report and Determination of Availability or confirmation of consistency with the approved project master plan prior to the other federal agency's issuance of the permit or outgrant. In cases where a Report or Determination of Availability is not required by chapter 8 of reference A.28, and the proposed alteration has not been evaluated during the project master planning process, a Section 408 permission is required prior and in addition to, the permit or outgrant issued by the other federal agency. In all cases, USACE will advise the other agency of any special conditions that must be incorporated into the permit or outgrant issued by the other federal agency.

(2) If a proposed alteration requires use of both real property of the United States and real property owned by other entities or non-federal sponsors, then the processes in this EC will apply. In these cases, USACE will incorporate the decisions associated with the USACE required shoreline use permit, outgrant, or consent as part of the comprehensive Section 408 evaluation and decision.

(3) In cases in which a USACE real estate decision and Section 408 decision are both

needed, the district will conduct these evaluations in a coordinated and concurrent manner to the maximum extent practicable. Although reviews for both Section 408 and the real estate decisions can be conducted concurrently, final decision-making requires that the Section 408 decision be rendered before or concurrent with, but not after, the USACE real estate decisions. Implementing regulations and policies for the real estate decisions require the evaluation of proposed activities and their compatibility with the purposes of a federal project. The Section 408 decision informs this element of the evaluation for shoreline use permits, outgrants, and consents. The required shoreline use permit, outgrant, or consent must still be issued before the alteration can be carried out on real property of the United States.

(4) Fees for administrative processing of outgrants issued by USACE will be determined by applicable regulations and policy promulgated under the authority of 10 USC 2695 and 30 USC 185(l). Evaluation of a USACE project alteration requiring the issuance of a permit or outgrant by another federal agency will be funded using Operation and Maintenance funds provided for the USACE project or appropriate funding associated for coordination for non-federal hydropower development, if applicable. If a Section 408 permission is required refer to paragraph 7.f. for funding related to Section 408 reviews.

f. Non-Federal Construction of a Water Resources Development Project.

(1) Section 204 of WRDA 1986, as amended, authorizes non-federal interests to undertake construction of certain water resources development projects, or separable elements, with potential credit or reimbursement of the federal share of that construction, subject to several requirements, including obtaining all necessary permits. If the proposed work under Section 204 would alter an existing USACE project, then the non-federal interest must obtain Section 408 permission under this EC, unless the proposed work has been authorized for construction by Congress, or the USACE real estate policies and process applies (reference paragraph 9.e). Further guidance on Section 204 of WRDA 1986 is included in reference A.38.

(2) If a Section 408 permission is needed to implement work under Section 204, conducted consistent with a feasibility study, the procedures and process in reference A.38 will be followed in lieu of the review and decision process in this EC, and the district report that is required for approval for construction will also serve as the documentation and basis for the Section 408 permission decision. The Section 204 report will specifically address any impacts to the usefulness of the existing USACE project and the public interest.

(3) Districts should ensure that, to the maximum extent practicable, information from the feasibility study, including technical analyses, NEPA documentation, National Historic Preservation Act (NHPA) documentation, and other environmental and cultural resources compliance is used for the Section 204 report. Districts must determine whether physical or environmental circumstances have changed since the feasibility study was completed and supplement those analyses if necessary.

(4) If the Section 204 report is approved by the Assistant Secretary of the Army for Civil Works (ASA(CW)), this approval will also constitute approval of the Section 408 permission. The District Commander will document that the Section 408 permission is granted and reference the Section 204 report approval.

(5) For alterations for which the non-federal interest is seeking federal assumption of maintenance under Section 204(f) of WRDA 1986, as amended, Section 408 permission will be required unless the modification to the USACE navigation project has already been specifically authorized by Congress. In order to avoid duplication of documentation for these two authorities, districts should ensure that requirements for both are coordinated and leveraged to the maximum extent practicable. Reference A.37 for the approval process and requirements for a Section 204(f) request. In general, the Section 204(f) report will not be submitted to the ASA(CW) for approval unless and until the Section 408 permission and any Section 10/404/103 permits have been approved.

g. In-kind Contribution Credit under Section 221 of the Flood Control Act of 1970, as amended (Section 221). There may be cases in which a non-federal sponsor wishes to undertake alterations to an existing USACE project for which there is an ongoing USACE feasibility study and the non-federal sponsor seeks credit eligibility for those alterations toward its cost share for the USACE project that is not yet authorized for construction. In such cases, any proposed alteration for which the non-federal sponsor is seeking credit cannot be initiated until the draft feasibility report is released for public review, an in-kind Memorandum of Understanding (MOU) for the work is executed, and Section 408 permission is issued.

(1) In those cases where a non-federal sponsor is undertaking work as an in-kind contribution on an authorized USACE project per an executed project partnership agreement that provides credit for such work, Section 408 permission is not required.

(2) Detailed guidance on crediting can be found in reference A.36.

h. Actions conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The portions of any removal or remedial action conducted entirely onsite (as that term is used in CERCLA) in a manner consistent with CERCLA and the National Contingency Plan (40 CFR Part 300) are not subject to the procedural requirements in this EC. USACE will work with the United States Environmental Protection Agency (EPA) or other federal agency undertaking or overseeing the CERCLA response during the investigation and during the process of developing the removal or remedial action to ensure that the remedy implemented does not impair the usefulness of the USACE project and is not injurious to the public interest.

10. Options for Seeking Section 408 Permission. Early coordination between USACE, the requester, and/or non-federal sponsor, if applicable, is recommended in order to determine the optimal option below. All information must be submitted in writing to USACE.

a. Categorical Permission. The district, division, and/or HQUSACE have the ability to create a “categorical permission” in order to expedite and streamline the review and decisions of Section 408 requests that are similar in nature and that have similar impacts to the USACE project and environment. An assessment of impacts to the usefulness of the USACE project, environmental compliance, and a public interest determination is conducted ahead of time for a common category of activities. For those individual Section 408 requests that are consistent with the terms and conditions of an established categorical permission, the Section 408 request can be granted with a simplified validation process. See Appendix C for details.

b. Single-Phased Review. Requesters may submit all information needed for a Section 408 request, reference paragraph 11, at one time for USACE to review and render a decision.

c. Multi-Phased Review. This option provides a formalized process for requesters to pursue Section 408 permission in milestones. In other words, there is a proposed alteration in which interim reviews are conducted as the level of detail of the information is progressively developed. However, the multi-phased review approach cannot be used to piecemeal the evaluation of effects of the proposed alteration. Assessing effects to the environment, public interest, and the USACE project must consider the proposed alteration as a whole. This approach will require the district, the requester, and non-federal sponsor, if applicable, to establish pre-determined milestones at which the requester will submit specified information to the district. The district will review the information at each milestone to identify any concerns. Based on the information provided at each milestone, the district will provide a written response providing feedback and a determination as to whether or not the requester can proceed to the next milestone. This approval to the next milestone means that USACE has not identified any critical items that would preclude the eventual approval of the Section 408 based on the information reviewed, but does not guarantee an approval of the final Section 408 request. Information submitted for a specific milestone is not required to meet all of the basic requirements for a complete Section 408 request; however, information for each milestone will be cumulative and result in a complete Section 408 request with the information submitted for the final milestone. The following are additional considerations for this multi-phased review approach:

(1) Submittal for the initial milestone must contain enough information at a conceptual or master plan level for USACE to understand the scope and scale of the complete Section 408 alteration. The initial submittal must also have the Statement of No Objection, if one is required, reference paragraph 11.a.

(2) For the multi-phased review approach, the district must develop an alteration-specific review plan for the complete alteration, reference paragraph 12.c., and is encouraged to initiate development of the review plan, as soon as possible, including determining if a SAR is required. Milestones will be managed, monitored, and adapted, if necessary, in the district review plan. If a SAR is required, there may be additional review milestones required for design and

construction activities.

d. If there is a situation that involves a long-term or large-scale plan, such as a watershed-based master plan, comprised of the construction of multiple alterations occurring over time, this case should be coordinated vertically through the appropriate RIT to the HQUSACE Section 408 proponent to determine the most efficient process to manage such a request.

11. Basic Requirements for a Complete Section 408 Request. All costs associated with information required for obtaining a Section 408 permission, constructing the alteration if approved, and complying with any conditions associated with the Section 408 permission is at 100 percent cost to the requester. This does not include costs for USACE to conduct the review of the request. Costs associated with USACE review is addressed paragraph 7.f. If submitting information for a categorical permission, reference the process in Appendix C. If the multi-phased review approach is used, then the information needed for a complete Section 408 request may be provided at different milestones for review. Because proposed alterations vary in size, level of complexity, and potential impacts, the procedures and required information to make such a determination are intended to be scalable. Requirements for data, analyses, and documentation may be subject to change as additional information about the Section 408 proposal is developed and reviewed. Determination for the required information for each Section 408 submittal is led by the district. Supplemental information specific to dams, levees, hydropower, and navigation can be found in the appendix appropriate to the type of infrastructure (Appendices E-G). Note, identification of whether or not the proposed alteration also requires Section 10/103/404 authorization should be done up front, and districts should encourage requesters to submit any required Section 10/103/404 request in a manner to facilitate concurrent and efficient reviews with the Section 408 permission request, to the maximum extent practicable. Basic requirements for a complete Section 408 request include the following:

a. Statement of No Objection. For USACE projects with a non-federal sponsor, a written "Statement of No Objection" from the non-federal sponsor is required if the requester is not the non-federal sponsor. Non-federal sponsors typically have operation and maintenance responsibilities; have a cost-share investment in the USACE project; and/or hold the real property for the USACE project. The purpose of the Statement of No Objection is to document that the non-federal sponsor is aware of the scope of the Section 408 request and does not object to the request being submitted to USACE to initiate the evaluation of the request. Districts must coordinate with non-federal sponsors throughout the review process and ensure feedback from non-federal sponsors is considered prior to USACE rendering a final decision on the Section 408 request. Requesters can ask the USACE district office to facilitate coordination with, and seek to obtain the Statement of No Objection from, the non-federal sponsor. If a Statement of No Objection cannot be obtained, the district will not proceed with the Section 408 review with the following exceptions:

(1) A Statement of No Objection is not required if the requester is the non-federal sponsor.

(2) A Statement of No Objection is not required when USACE has all operation and maintenance responsibilities for the portion of the USACE project proposed to be altered.

(3) If a USACE project has multiple non-federal sponsors and potential impacts of the proposed alteration are limited to the location of the alteration, Statements of No Objection are required only from the non-federal sponsors associated with the locations with potential impacts. However, if the proposed alteration may impact the usefulness of the USACE project as a whole, Statements of No Objection must be obtained from all non-federal sponsors.

(4) A Statement of No Objection from the non-federal sponsor is not required if the requester could obtain the real property necessary to undertake the alteration through eminent domain without the consent of the non-federal sponsor, and the alteration will not be integral to the functioning of the USACE project. An alteration would be considered integral to the USACE project if the alteration must be complete, functional, and in-place in order for the USACE project to function and meet its authorized purpose. In cases in which the alteration is not considered integral to the USACE project, if the requester makes reasonable efforts, but is unable to obtain a Statement of No Objection from the non-federal sponsor, the requester may submit a Section 408 request with a written statement documenting the efforts to obtain a Statement of No Objection, and cite the authority and process through which the requester will have the sufficient authority to condemn all real property required for the alteration in the event the Section 408 request is approved by USACE. For these cases, USACE will independently seek input from the non-federal sponsor on the potential impacts of the proposed alteration relative to the non-federal sponsor's responsibilities, and will take that input into consideration in making the Section 408 decision. Within 30 days of notification by USACE, the non-federal sponsor must provide its input or may propose a timeline for providing feedback commensurate with the complexity of the proposed alteration. If the non-federal sponsor provides no response within 30 days of USACE's notification, USACE may proceed with the review of the alteration request without such input. Throughout the USACE review phase, USACE will continue to provide the non-federal sponsor opportunities to provide input on the Section 408 request up until and just before USACE renders a final decision. For these subsequent opportunities for input, districts can use judgment as to the appropriate time in which to provide non-federal sponsors to respond. Approval of the Section 408 under these circumstances does not negate the process the requester must follow in order to obtain the real property needed to construct the alteration, nor provides the requester with eminent domain authority.

(5) A Statement of No Objection is not required if, after a good faith effort, neither the requester nor USACE can locate the non-federal sponsor or the non-federal sponsor's successor. If a requester is able to secure the necessary real property to execute the alteration but cannot identify the non-federal sponsor or successor, the requester should document the measures taken to locate the non-federal sponsor or successor and request that USACE determine if there is a viable non-federal sponsor or successor. USACE should document their efforts and decision for the administrative record and notify the requester.

b. USACE Project and Alteration Description. Basic requirements for a complete Section 408 submittal include the identification of the USACE project and a complete description of the proposed alteration(s), including necessary drawings, sketches, maps, and plans.

c. Technical Analysis and Design.

(1) The requester is responsible for ensuring a proposed alteration meets current USACE design and construction standards. However, a requester is not required to bring those portions or features of the existing USACE project that are not impacted by the alteration up to current USACE design standards. The district will work closely with the requester to determine the applicable USACE standards to be applied and the specific level of detail necessary to be provided in order for USACE to make a decision for a particular alteration request. The district determination of the appropriate level of detail will be risk-informed and documented in the USACE review plan.

(2) Districts will inform the requester if a hydrologic and hydraulic system analysis is required. The purpose of a hydrologic and hydraulics system analysis is to determine the potential hydrologic and hydraulic changes of proposed alterations. Districts will determine if such an analysis is needed and, if so, the appropriate scope of analysis based on the complexity of the proposed alteration. See Appendix H for more details regarding the requirements of a hydrologic and hydraulics system analysis.

(3) For alterations involving professional design services, the requester will be required to submit a certification that the design underwent a quality control process.

(4) If the district determines a SAR is required, a SAR review plan must be developed by the requester and the requester will be required to cover the costs of the SAR. A SAR is required for design and construction activities where potential hazards pose a significant threat to life safety. Districts will work with requesters to coordinate the development of the SAR review plan. See paragraph 12.c.(4).

d. Environmental and Cultural Resources Compliance. A decision on a Section 408 request is a federal action subject to NEPA and other federal environmental and cultural resources compliance requirements, such as Section 7 of the Endangered Species Act (ESA), Section 106 of the NHPA, essential fish habitat (EFH) consultation, tribal consultation, etc. When applicable, government-to-government tribal consultation is inherently a federal obligation and must be conducted in a meaningful, collaborative and effective communication process working toward mutual consensus, to the extent practicable and permitted by law, and begins at the earliest planning stages. Ensuring and conducting environmental and cultural resources compliance for a Section 408 request is the responsibility of USACE. However, the requester is responsible for providing all supporting information and documentation that the district identifies as necessary to assess compliance, such as species surveys, habitat assessments, and/or cultural resource surveys. Requesters may, but are not required to, draft the NEPA environmental assessment or fund a contractor to prepare an environmental impact statement for a Section 408 request consistent with 40 CFR 1506.5. However, the district must ensure that any NEPA documentation drafted by a requester or contractor is accurate and compliant with USACE and Council on Environmental Quality (CEQ) requirements prior to accepting it for use with the Section 408 request. A final Section 408 request cannot be rendered until the requester has provided all information necessary for the district to complete its assessment for environmental and cultural resources compliance. The district will work with the requester to determine the requirements for the information the requester is required to submit to constitute a complete request. The information required of the requester to facilitate the completion of environmental compliance will be scaled to be commensurate with the degree of potential environmental effects of the activity within the scope of the Section 408 analysis. Environmental and cultural resources compliance for Section 408 requests will typically not require the same level of detailed analysis as needed for feasibility reports or other planning studies. See Appendix D for further information.

(1) Alterations that are expected to not result in significant effects to the environment, both individually and cumulatively, should be evaluated for applicability with the approved categorical exclusions at 33 CFR 230.9. However, activities that qualify for a NEPA categorical exclusion must still satisfy compliance requirements under other statutes such as NHPA and ESA, and must fulfill consultation obligations with federally recognized tribes. Documentation of applicability of a categorical exclusion may be signed by the Section 408 decision-maker or other appropriate district staff.

(2) For categorical permissions, the district will inform the requester if additional documentation is necessary to complete environmental compliance.

(3) Districts are strongly encouraged to adopt and/or incorporate by reference any NEPA documentation that may already exist for the USACE project.

(4) For those alterations in which another federal agency is the NEPA lead agency (e.g. such as when FERC is the lead agency for private hydropower licensing, reference Appendix F), districts will participate in the NEPA review as a cooperating agency to the maximum extent practicable. Districts will typically adopt or incorporate by reference that federal agency's Environmental Impact Statement (EIS) or Environmental Assessment (EA) and consider it to be adequate for NEPA compliance for a Section 408 permission, unless the district finds substantial doubt as to the technical or procedural adequacy or omission of factors important to the Section 408 permission decision. Districts also have discretion to adopt/use another lead federal agency's environmental compliance documentation (ESA, NHPA, EFH, etc.) as allowable and appropriate for the Section 408 permission decision. Districts should ensure that the lead agency is informed of all needs to determine technical adequacy and environmental and cultural resources compliance for the purposes of Section 408 early in the process.

(5) Districts have discretion and are encouraged to develop new or use existing

programmatic NEPA documents (consistent with 40 CFR Part 1500.4(i)) and/or programmatic environmental consultations for Section 408 requests, when appropriate.

(6) Clean Water Act, Section 401 Water Quality Certification. If the requirement for a state water quality certification (33 USC 1341) applies to the alteration that is subject to a Section 408 review, as determined by USACE, then Section 408 authorization cannot be granted until the certification has been obtained or waived, as provided for by statute.

(7) Per USACE tribal consultation policy, federally recognized tribes have the right to request government-to-government consultation with the district. All requests by a tribe for government-to-government consultation with USACE will be honored.

e. Real Estate Requirements. A description of the real property required to support the proposed alteration must be provided. Non-federal sponsors issuing permits, outgrants, or consents for alterations undertaken by others will ensure that the terms of the instrument or agreement are consistent with the terms and conditions of the Section 408 permission, if applicable. If additional real property is required for an alteration that will be integral to the functioning of the USACE project, the district must follow the normal procedures to request approval of any non-standard estates under the guidance in chapter 12 of reference A.28. Maps clearly depicting both existing real property and the additional real property required must also be provided.

f. Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R). Requesters must identify any projected requirements for OMRR&R needed throughout the life of the proposed alteration and the responsible entity. For instances when there may be a desire for USACE to assume or incorporate operations and maintenance of the proposed alteration as part of its responsibilities for the USACE project being modified, a justification must be provided. See paragraph 9.f.(5) for federal assumption of maintenance associated with navigation features. If operation and maintenance of the USACE project is affected by the alteration, the requester, if not the non-federal sponsor, must provide written documentation that the non-federal sponsor agrees to assume responsibility for the changed OMRR&R of the USACE project at no cost to the federal government. This written documentation must be received prior to USACE issuing the Section 408 decision. If the Section 408 request is approved and an update to the USACE issued O&M manual is needed as the result of the alteration, the requester will be required to provide the district with sufficient information to update the portion of the O&M manual related to the approved alteration. As part of this update, as-builts may be required. See paragraph 17.

g. If applicable, a written statement regarding whether credit under Section 221 of the Flood Control Act of 1970, as amended, or other law or whether approval under Section 204 of WRDA 1986, as amended is being or will be sought must be provided.

12. <u>USACE Review Requirements</u>. In general, each Section 408 request will be reviewed by USACE consistent with the following:

a. Main Determinations.

(1) Impacts to the Usefulness of the USACE Project. The objective of this determination is to ensure that the proposed alteration will not limit the ability of the USACE project to function as authorized and will not compromise or change any authorized project conditions, purposes or outputs. All appropriate technical analyses including geotechnical, structural, hydraulic and hydrologic, real estate, construction, and operations and maintenance requirements, must be conducted, and the technical adequacy of the design must be reviewed. In addition, the district will determine whether or not the alteration is an integral component of the USACE project and therefore, will be treated as a federal component of the USACE project once constructed, including for purposes of the USACE Rehabilitation Program, reference A.29. An alteration would be considered integral to the USACE project if the alteration must be complete, functional, and in-place in order for the USACE project function and meet its authorized purpose. If at any time it is concluded that the usefulness of the authorized project will be negatively impacted, any further evaluation should be terminated and the requester notified. Section 408 permission will not be granted for a proposed alteration that would have an effect of deauthorizing a USACE project or eliminating an authorized project purpose.

(2) Injurious to the Public Interest. Proposed alterations will be reviewed to determine the probable impacts, including cumulative impacts, on the public interest. Evaluation of the probable impacts that the proposed alteration to the USACE project may have on the public interest requires a careful weighing of all those factors that are relevant in each particular case. The benefits that reasonably may be expected to accrue from the proposal must be compared against its reasonably foreseeable detriments. The decision whether to approve an alteration will be determined by the consideration of whether benefits are commensurate with risks. If the potential detriments are found to outweigh the potential benefits, then it may be determined that the proposed alteration is injurious to the public interest. Factors that may be relevant to the public interest depend upon the type of USACE project being altered and may include, but are not limited to, such things as conservation, economic development, historic properties, cultural resources, environmental impacts, water supply, water quality, flood hazards, floodplains, residual risk, induced damages, navigation, shore erosion or accretion, and recreation. This evaluation should consider information received from key stakeholders, interested parties, tribes, agencies, and the public. As a general rule, proposed alterations that will result in substantial adverse changes in water surface profiles will not be approved. The Regulatory Program also conducts a public interest review and cannot authorize activities that are “contrary to the public interest.” When an activity requires both a Regulatory review and Section 408 review, Regulatory and the office conducting the Section 408 review should closely coordinate and leverage any information to inform their respective analyses to ensure efficiency and consistency, to the extent appropriate.

(3) Legal and Policy Compliance. A determination will be made by the appropriate Office of Counsel as to whether the request meets all legal and policy requirements.

b. Public Notice. Districts must make diligent efforts to solicit public input as part of the decision-making process for a Section 408 request. Except for requests that meet an established categorical permission (where a public notice is issued as part of the establishment of the categorical permission), districts should issue a public notice for all Section 408 requests advising interested parties of the proposed alteration for which permission is sought and soliciting information necessary to inform USACE's evaluation and review. At a minimum, public notices should contain the requester, a description of the alteration being proposed, and the location of the alteration. As such, this public notice must be circulated to the public by methods deemed appropriate by the district (e.g., websites, email, social media, or media outlets) as early in the evaluation of a proposed alteration as possible to generate meaningful public and agency input to inform the evaluation and decision-making processes. Because input solicited through the public notice process can inform various aspects of the Section 408 review, such as the public interest determination, environmental compliance, Executive Order 11988, informing navigation stakeholders of alterations located in inland and intracoastal waterways, Section 214 funding agreements, and corresponding Regulatory standard individual permit applications, all effort should be made to ensure the public notice is developed and coordinated in a manner that helps maximize the value and use of the input received, and reduces the potential for issuing multiple public notices for different purposes. Likewise, for those Section 408 requests in which another federal agency is the lead federal agency, districts should coordinate with the lead agency to issue concurrent or joint public notices, when feasible and appropriate. The comment period associated with the public notice should generally be no more than 30 calendar days, but the comment period may deviate from this guideline in order to satisfy multiple purposes (i.e., 60-day comment period for a draft EIS) or to facilitate a joint public notice with another federal agency. Section 408 requests for which an environmental assessment (EA) is prepared or a categorical exclusion is used, draft NEPA compliance documents should not be circulated for public comment, except in rare circumstances. Instead, this public notice soliciting input will serve as the method of involving the public in the NEPA process that is required by 40 CFR 1501.4(e)(1). Environmental compliance may require other consultation and public engagement activities beyond a basic public notice. See Appendix D for more information on environmental compliance.

c. USACE Review Plan. The review of each Section 408 request will be conducted in conjunction with a review plan. Districts should ensure requesters understand the review requirements as early in the process as possible. A review plan will define the USACE resource requirements and procedures of how the review and decision for the Section 408 request will be conducted and rendered, respectively. The USACE review team will be subject matter experts based on expertise, experience, and skills, from multiple disciplines as necessary to ensure a comprehensive review. If the requester is not the non-federal sponsor, the review plan must also include opportunities for the non-federal sponsor to provide input on potential impacts to their responsibilities throughout the review process. Districts are encouraged to review information submitted by requesters as the review plan is being finalized, but no final Section 408 decision will be rendered without an approved review plan in place. Section 408 review plans do not have to be posted on the internet. If a SAR is required, districts and divisions may use discretion to post the SAR report on the district or division website. If the decision is made to post the SAR report, districts and/or divisions will ensure appropriate protection of sensitive or security related information when posting the SAR report.

(1) For categorical permissions, the review and validation process is established and documented as part of the creation of the categorical permission; therefore, no separate review plan is needed. Reference Appendix C for additional information for categorical permissions.

(2) Districts have the option to develop an overarching review plan, called a Procedural Review Plan, that establishes the review procedures to be used for Section 408 requests similar in nature and that have similar impacts and do not require a Safety Assurance Review (SAR), reference paragraph 12.c.(4). Procedural Review Plans are approved by the Division Commander; however, the Division Commander may delegate signature authority for the Procedural Review Plan to either the Division Regional Programs Director or the Division Regional Business Director. Districts must review and update approved Procedural Review Plans on an annual basis. The division must reapprove the Procedural Review Plans if there are any significant changes in scope or process.

(3) Districts must develop alteration-specific review plans for Section 408 requests that are not covered by a categorical permission or Procedural Review Plan. Section 408 requests using the multi-phased review approach, reference paragraph 10.c., or requiring a SAR, must have an alteration-specific review plan. If the multi-phased review approach is being used, documentation of established milestones will be managed in the district's review plan for the Section 408 request. Milestones can be adjusted as part of the process for updating the review plan. The decision-maker for the Section 408 request, reference paragraph 8, will be the approver of alteration-specific review plans. For example, if the decision-maker is the Division Commander, the Division Commander or the Division Commander's designee must approve the review plan. The Division Commander may delegate signature authority for the review plan to either the Division Programs Director or the Division Regional Business Director. If the Section 408 is to be approved by the District Commander, the District Commander must approve the review plan and so on. The division may choose to approve alteration-specific review plans that could be approved at the district level. Approved alteration-specific review plans must be updated as needed; however, if there are any significant changes in scope or process of the review, then the review plan must be reapproved at the appropriate approval level. The Review Management Organization (RMO) responsibilities can be at the level in which the Section 408 decision is made, with the exception of Section 408 requests that require a SAR, reference paragraph 12.c.(4). See reference A.40 for RMO responsibilities.

(4) The district Chief of Engineering will refer to reference A.40, or subsequent policy, to determine if a SAR is required for a proposed alteration. For alterations involving a levee or dam, this decision will be made in consultation with the district Dam Safety Officer or Levee Safety Officer when they are not the same person as the Chief of Engineering. If the district

determines a SAR is required, an alteration-specific review plan must be developed and the Risk Management Center (RMC) will be assigned as the RMO for the entire Section 408 review including the SAR. The final alteration-specific review plan and SAR review plan must be endorsed by the RMC and approved by the Division Commander or the Division Commander's designee. The Division Commander may delegate signature authority for the review plan to either the Division Regional Programs Director or the Division Regional Business Director. The district will work with the requester in the development of the review plan for the SAR. The district will include the requester's SAR review plan as an appendix to the USACE alteration-specific review plan.

13. Overall Process. The overall USACE review process for Section 408 requests involves four main steps: completeness determination (reference paragraph 14); review and decision (reference paragraph 15); final decision notification (reference paragraph 16); and construction oversight (reference paragraph 17). All information submitted by the requesters should be transmitted to the appropriate USACE district office having jurisdiction over the USACE project being altered.

a. The first submittal of information to the USACE district office should have a cover letter signed by the entity requesting the Section 408 permission.

b. Submittals may be accepted electronically (such as by email or file transfer) or by hard copy. When the initial submittal is received, the district will create a database entry for that request, including the assignment of a unique identifier (to be automatically generated by the Section 408 database). The unique identifier will be used for tracking purposes throughout the entire Section 408 request process and will be referenced in all correspondence with the requester.

c. USACE will provide timely responses to requesters regardless of the type of Section 408 request or the stage of the review. Districts and divisions should prioritize work in a manner to support timely responses and decisions (and within the timelines specified in paragraphs 14 and 15) to the maximum extent practicable.

d. Written notifications by districts to requesters can be provided by the district electronically or by hardcopy, depending on the preference of the requester. Districts will tailor content of the written notifications to each given situation. See Appendix J for example letters to requesters.

e. At any time in the process, a requester may choose to withdraw their Section 408 request in writing. In this case, the district will record the date of withdrawal in the Section 408 database.

f. For Section 408 requests involving funding agreements, the time required to develop and execute funding agreements, reference paragraph 7.g., themselves will not be subject to the notification timelines referenced in paragraphs 14 and 15. The districts will ensure timely responses and engagement in developing and executing funding agreements.

g. The written notifications to requesters may be issued and signed by the Section 408 Coordinator or other signatory designated by the District Commander, except for final decision notifications. Final decision notifications for validation of categorical permissions, single-phased decisions, or multi-phased review decisions will follow appropriate decision processes as specified in paragraph 8.

14. Step 1: Completeness Determination. This first part of the process involves the requester providing information to the district in one or more submittals in order to satisfy all the basic requirements of a complete Section 408 request as indicated in paragraph 11. When a requester submits information to a district office, districts are expected to provide a written completeness determination within 30 days of receipt. If the district determines a submittal is not complete, the district will provide the requester a written notification within 30 days of receipt, providing a description of what information is required in order for the submittal to be complete. The 30 day timeline for a completeness determination is then restarted upon any subsequent submittals of information. A submittal will be determined complete and therefore initiating the 90-day review and decision step (reference paragraph 15) when it meets one of the following scenarios:

a. For categorical permissions, information submitted by the requester will be considered complete when the information provided demonstrates the proposed alteration appears to meet the conditions of an established categorical permission. If the district can validate the use of the categorical permission based on the information in the submittal of information within 30 days of receipt, then the district can proceed and grant permission under the categorical permission and notify the requester in lieu of providing a completeness determination letter. If not, then the 90-day review and decision step will be initiated with the district providing a written notification that the submittal seeking authorization under a categorical permission is complete.

b. For requests using the multi-phased review approach, a completeness determination will be done on each milestone submittal. The requirements to determine what information is required for each milestone should be pre-determined and planned by agreement between the district and requester. When a district issues a written notification that a milestone is complete, that will initiate the 90-day review and decision step for that milestone.

c. For requests intended for a single-phased review, a submittal will be determined complete when all the basic requirements, reference paragraph 11, has been submitted. When a district issues a written notification that all basic requirements have been submitted, that will initiate the 90-day review and decision step for that Section 408 request.

d. If after evaluating the information provided by a requester the district determines that processes in this EC do not apply, the district will provide the requester a written notification within 30 days of receipt of the information with a description of why this EC would not apply and any other recommendations for the requester's next course of action, if needed.

15. Step 2: USACE Review and Decision. During this step, USACE will evaluate the information provided for the completeness determination following the review requirements in paragraph 12. This second step of the process results in USACE providing a final decision for either validating use of a categorical permission; a specific milestone; or a complete Section 408 request. Approval of the use of a categorical permission or a complete single-phase Section 408 request means that the requester can proceed to construction of the alteration, subject to specified conditions. Approval of a specific milestone results in the requester proceeding to the next milestone, unless the submittal is the final milestone. Approval of the final milestone constitutes approval of the entire Section 408 request; must be render by the appropriate Section 408 decision-maker (reference paragraph 8); and results in the requester being able to proceed to construction of the alteration, subject to specified conditions. Approved alterations for construction must result in a fully functional element once construction is complete.

a. Timeline for Review and Final Decision. A final decision will be provided by USACE to the requester within 90 days from the date the completeness determination was made by the district, unless one of the following stipulations apply. This 90-day timeframe is inclusive of the time needed for division review and decision, if required, and issuance of the final notification (reference paragraph 16).

(1) If a final decision cannot be made within 90 days, the district will provide a written notification to the requester with an estimated decision date. If the decision date extends beyond 120 days from a completeness determination, the district will send a memorandum through the Division Commander to the Director of Civil Works with a description of the Section 408 request and a justification for the decision extending beyond 120 days. HQUSACE will provide this information to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives.

(2) There may be cases during the USACE review and decision phase in which it is identified that more information is needed to render a final decision. If the additional information is needed to support or clarify the pending Section 408 request, the coordination for obtaining the additional information can be done informally between the district and requester. The 90-day timeframe for the final decision is not paused during this informal coordination. If this coordination causes the USACE review and decision timeframe to extend beyond 90 days, follow procedures in paragraph 15.a.(1). If the need for additional information is triggered by a change in the scope or scale of the alteration to the extent that it would require significant new information, such as new technical analyses, development of supplemental/re-initiation of environmental compliance, and/or additional real estate review, the USACE review should stop and the request should be withdrawn. This action will cease the 90-day review and decision timeline. The district then must provide written notification to the requester that a new request should be submitted to reflect the change in scope of the alteration. When the requester submits all of the required information, a new completeness determination will be made (subject to the

30-day timeline in paragraph 14) and the 90-day timeline will be restarted from the date of the new completeness determination.

b. Summary of Findings. The district will create a Summary of Findings (content and format scalable to the request) to serve as the decision document to summarize the administrative record, including the review findings and the basis for the final Section 408 decision. A Summary of Findings does not have to be developed for each individual milestone for the multi-phased review approach, but is required when the final milestone is reviewed and must summarize the entire Section 408 decision collectively. The Summary of Findings must include the following, as a minimum:

(1) USACE project description and authorization;

(2) Brief description of the request;

(3) Description and reference to the review plan process followed, including SAR determination;

(4) Summary of rationale and conclusions for recommending approval or denial, including determinations for the impact to the usefulness of the USACE project; whether or not the alteration is considered integral to the USACE project; and impacts to the public interest;

(5) Certification of legal sufficiency by Office of Counsel;

(6) Certification by the District Chief of Real Estate Division that all real property required for the proposed alteration has been identified; the identified real property is sufficient to support the alteration; and the proposed alteration will not adversely affect the USACE project's real property. If the proposed alteration will be integral to the functioning of the USACE project, the District Chief of Real Estate Division must also certify that standard estates are being used for the acquisition of any new real property that will become or may become a part of the USACE project, or that the requester is seeking approval to use non-standard estates (see paragraph 11.e.);

(7) Description of any related, ongoing USACE studies (if applicable), including how the proposed alteration may impact those studies;

(8) Summary of input from the non-federal sponsor, if the non-federal sponsor is not the requester demonstrating that the district provided opportunity for the non-federal sponsor to review and evaluate the proposed alteration along with the technical analysis and design, environmental effects, real estate requirements, and potential O&M effects and that the district sought to incorporate the non-federal sponsors feedback and concerns into the decision-making process;

(9) Summary of any changes to the O&M manual;

(10) If the district has determined that USACE would assume O&M responsibilities as part of its responsibilities for the USACE project, include the rationale and any anticipated increase in USACE O&M costs or if changes to O&M requirements would have to be implemented by the non-federal sponsor, documentation that the non-federal sponsor has agreed to those changes to their responsibilities;

(11) The NEPA Finding of No Significant Impact or Record of Decision, if the NEPA decision has not already been documented (such as applicability of a categorical exclusion, validation of a categorical permission, or an EIS led by another federal agency); and,

(12) Any additional final conclusions or information, including any associated controversial issues.

16. Step 3: Final Decision Notification. The district is responsible for providing a written decision signed by the USACE deciding official to the requester for all final Section 408 decisions, regardless of the decision level. This written decision must be issued within the 90-day review and decision timeline.

a. For those requests in which the non-federal sponsor is not the requester, USACE will coordinate the final decision with the non-federal sponsor.

b. If the final decision is to deny the request, the requester will be advised in writing as to the reason(s) for denial.

c. If the final decision is to approve the Section 408 request, the district will provide a written approval document. For cases involving a categorical permission, the written approval will be validation that the categorical permission is applicable.

d. In situations in which the district is evaluating a Regulatory standard individual permit application and Section 408 combined, reference paragraph 7.h.(4) and 7.h.(5), the district will ensure the final Section 408 decision letter and associated conditions be part of the single transmittal letter with the Regulatory permit.

e. Standard Terms and Conditions. At a minimum, the standard terms and conditions in Appendix K, except where noted as optional, must be included in all Section 408 approval notifications, including validation of use of a categorical permission. Districts and divisions may include any necessary special conditions as requirements for approval.

17. Step 4: Construction Oversight. District costs for construction oversight and closeout should be incorporated as part of review costs for the Section 408 request.

a. Construction oversight. The district should develop procedures for monitoring construction activities, including reviewing construction documentation at different phases if necessary, for the approved Section 408 request scaled to the complexity of the alteration to ensure the alteration is constructed in a manner consistent with the permission conditions. If a SAR was required, there may be SAR activities that carry through during construction. Any concerns regarding construction should be directed to the Section 408 requester (and the non-federal sponsor if applicable) for resolution.

b. As-builts. Plans and specifications with amendments during construction showing alterations as finally constructed will be furnished by the Section 408 requester after completion of the work if required by the district. As-builts must be provided to the district and the non-federal sponsor (if the requester is not the non-federal sponsor) within 180 days of construction completion.

c. O&M Manual Updates. The Section 408 requester is required to provide the district with sufficient information to update the portions of the USACE issued O&M manual to reflect changes as a result of the constructed alteration if necessary. If the requester was not the non-federal sponsor, the non-federal sponsor must be given must an opportunity to review all proposed changes to the O&M manual. O&M manual updates may range from simple removal and replacement of paragraphs or entirely new manuals depending on the scope and complexity of the alteration. The district is responsible for reviewing and approving any updates needed to the O&M manual as a result of the alteration. At a minimum, the update should include a description of the new features, reference to the Section 408 approvals, as-builts, and instructions regarding O&M of any new features not included in the existing manual. Reference A.32 and A.34 for information on O&M manuals.

d. Post Construction Closeout. District may need to conduct a post construction on-site inspection of the completed alteration to document final condition of the USACE project.

18. Enforcement.

a. Inspection and monitoring of approved and in-place alterations will be incorporated into the inspection and oversight procedures for that specific USACE project.

b. The policy of USACE is to pursue enforcement and correction of unauthorized alterations. If an unauthorized alteration is discovered, the district, after consulting with the Offices of Counsel and Real Estate, will take the appropriate steps to remedy the unauthorized alteration. Coordination with the district Regulatory office should also occur so it can be determined if any action should be taken with respect to Section 10/404/103. Regulatory funds cannot be used for enforcement and correction of unauthorized alterations. Specific enforcement steps the district takes will depend on the particular nature of the unauthorized alteration and whether the unauthorized alteration is located on project boundaries where a non-federal sponsor holds the land rights for operations and maintenance. Non-federal sponsors with operations and maintenance responsibilities for the USACE project remain responsible for ensuring no unauthorized alterations are occurring within the project boundaries.

FOR THE COMMANDER:

JAMES C. DALTON, P.E.
Director of Civil Works

APPENDIX A

References*

*Other appendices in this EC have additional references listed.

A.1. Rivers and Harbors Act of 1899, https://www.gpo.gov
A.2. Federal Power Act of 1920, https://www.gpo.gov
A.3. Section 106 of the National Historic Preservation Act of 1966, https://www.gpo.gov
A.4. Flood Control Act of 1970, as amended, https://www.gpo.gov
A.5. National Environmental Policy Act of 1970, https://www.gpo.gov
A.6. Section 103 of the Marine Protection, Research, and Sanctuaries Act, https://www.gpo.gov
A.7. Section 404 of the Clean Water Act of 1972, https://www.gpo.gov
A.8. Section 7 of the Endangered Species Act of 1973, https://www.gpo.gov
A.9. Section 204 of Water Resources Development Act of 1986, as amended, https://www.gpo.gov
A.10. Section 214 of Water Resources Development Act of 2000, as amended, https://www.gpo.gov
A.11. Section 2036 of Water Resources Development Act of 2007, https://www.gpo.gov
A.12. Section 1005(b) of Water Resources Reform and Development Act of 2014, https://www.gpo.gov
A.13. Title 41 of the Fixing America's Surface Transportation Act (FAST-41), https://www.gpo.gov
A.14. Section 1156(a)(2) of Water Resources Development Act of 2016, https://www.gpo.gov
A.15. 10 USC 2695 - Acceptance of funds to cover administrative expenses relating to certain real property transactions, https://www.gpo.gov
A.16. 23 USC 139 - Efficient environmental reviews for project decision making, https://www.gpo.gov
A.17. 30 USC 185 - Rights-of-way for pipelines through federal lands, https://www.gpo.gov
A.18. 33 USC 408 - Taking possession of, use of, or injury to harbor or river improvements, https://www.gpo.gov
A.19. 33 CFR 208.10 - Local Flood Protection Works; Maintenance and Operation of Structures and Facilities, https://www.gpo.gov
A.20. 33 CFR 230 - Procedures for Implementing NEPA, https://www.gpo.gov
A.21. 33 CFR 329 - Definition of Navigable Waters of the United States, https://www.gpo.gov
A.22. 36 CFR 327 - Rules and Regulations Governing Public Use of Water Resources Development Projects Administered by the Chief of Engineers, https://www.gpo.gov
A.23. 36 CFR 800 - Protection of Historic Properties, https://www.gpo.gov
A.24. 40 CFR 1500-1508 - CEQ Regulations for Implementing the Procedural Provisions of NEPA, https://www.gpo.gov
A.25. 50 CFR 402 - Interagency Cooperation - Endangered Species Act of 1973, as amended, https://www.gpo.gov

A.26. Executive Order 11988 - Floodplain management, https://www.archives.gov
A.27. AR 405-80, Management of Title and Granting Use of Real Property, http://www.aschq.army.mil
A.28. ER 405-1-12, Real Estate Handbook, https://www.publications.usace.army.mil
A.29. ER 500-1-1, Emergency Employment of Army and Other Resources - Civil Emergency Management Program, https://www.publications.usace.army.mil
A.30. ER 1105-2-100, Planning Guidance Notebook, https://www.publications.usace.army.mil
A.31. ER 1110-1-1807, Drilling in Earth Embankment Dams and Levees, https://www.publications.usace.army.mil
A.32. ER 1110-2-401, Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors, https://www.publications.usace.army.mil
A.33. ER 1130-2-500, Partners and Support (Work Management Policies), https://www.publications.usace.army.mil
A.34. ER 1130-2-550, Recreation Operations and Maintenance Policies, https://www.publications.usace.army.mil
A.35. ER 1165-2-26, Implementation of Executive Order 11988 on Floodplain Management, https://www.publications.usace.army.mil
A.36. ER 1165-2-208, In-Kind Contribution Credit Provisions of Section 221(a)(4) of the Flood Control Act of 1970, as amended, https://www.publications.usace.army.mil
A.37. ER 1165-2-211, Operation and Maintenance of Improvements Carried Out by Non-Federal Interests to Authorized Harbor or Inland Harbor Projects, https://www.publications.usace.army.mil
A.38. ER 1165-2-504, Construction of Water Resource Development Projects by Non-Federal Interests, https://www.publications.usace.army.mil
A.39. EP 1130-2-550, Recreation Operations and Maintenance Guidance and Procedures, https://www.publications.usace.army.mil
A.40. EC 1165-2-217, Review Policy for Civil Works, https://www.publications.usace.army.mil
A.41. Director’s Policy Memorandum, Civil Works Programs, No. DPM CW 2018-06, Designation of a Lead USACE District for Permitting of Non-USACE Projects Crossing Multiple Districts or States, dated 15 May 2018
A.42. Council on Environmental Quality, *Improving the Process for Preparing Efficient and Timely Environmental Reviews under the National Environmental Policy Act*, dated 6 March 2012, https://ceq.doe.gov
A.43. Council on Environmental Quality, *Establishing, Applying and Revising Categorical Exclusions under the National Environmental Policy Act*, dated 23 November 2010, https://ceq.doe.gov

APPENDIX B

33 USC 408

Below is the direct language of 33 USC 408.

§408. Taking possession of, use of, or injury to harbor or river improvements

(a) Prohibitions and permissions
It shall not be lawful for any person or persons to take possession of or make use of for any purpose, or build upon, alter, deface, destroy, move, injure, obstruct by fastening vessels thereto or otherwise, or in any manner whatever impair the usefulness of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States, or any piece of plant, floating or otherwise, used in the construction of such work under the control of the United States, in whole or in part, for the preservation and improvement of any of its navigable waters or to prevent floods, or as boundary marks, tide gauges, surveying stations, buoys, or other established marks, nor remove for ballast or other purposes any stone or other material composing such works: *Provided*, That the Secretary of the Army may, on the recommendation of the Chief of Engineers, grant permission for the temporary occupation or use of any of the aforementioned public works when in his judgment such occupation or use will not be injurious to the public interest: *Provided further*, That the Secretary may, on the recommendation of the Chief of Engineers, grant permission for the alteration or permanent occupation or use of any of the aforementioned public works when in the judgment of the Secretary such occupation or use will not be injurious to the public interest and will not impair the usefulness of such work.

(b) Concurrent review

(1) NEPA review

(A) In general
In any case in which an activity subject to this section requires a review under the National Environmental Policy Act of 1969 (42 USC 4321 et seq.), review and approval of the activity under this section shall, to the maximum extent practicable, occur concurrently with any review and decisions made under that Act.

(B) Corps of Engineers as a cooperating agency
If the Corps of Engineers is not the lead Federal agency for an environmental review described in subparagraph (A), the Corps of Engineers shall, to the maximum extent practicable and consistent with Federal laws-

(i) participate in the review as a cooperating agency (unless the Corps of Engineers does not intend to submit comments on the project); and

(ii) adopt and use any environmental document prepared under the National Environmental Policy Act of 1969 (42 USC 4321 et seq.) by the lead agency to the same extent that a Federal agency could adopt or use a document prepared by another Federal agency under-

(I) the National Environmental Policy Act of 1969 (42 USC 4321 et seq.); and

(II) parts 1500 through 1508 of title 40, Code of Federal Regulations (or successor regulations).

(2) Reviews by Secretary
In any case in which the Secretary must approve an action under this section and under another authority, including sections 401 and 403 of this title, section 1344 of this title, and section 1413 of this title, the Secretary shall-

(A) coordinate applicable reviews and, to the maximum extent practicable, carry out the reviews concurrently; and

(B) adopt and use any document prepared by the Corps of Engineers for the purpose of complying with the same law and that addresses the same types of impacts in the same geographic area if such document, as determined by the Secretary, is current and applicable.

(3) Contributed funds
The Secretary may accept and expend funds received from non-Federal public or private entities to evaluate under this section an alteration or permanent occupation or use of a work built by the United States.

(c) Timely review

(1) Complete application
On or before the date that is 30 days after the date on which the Secretary receives an application for permission to take action affecting public projects pursuant to subsection (a), the Secretary shall inform the applicant whether the application is complete and, if it is not, what items are needed for the application to be complete.

(2) Decision
On or before the date that is 90 days after the date on which the Secretary receives a complete application for permission under subsection (a), the Secretary shall-

(A) make a decision on the application; or

(B) provide a schedule to the applicant identifying when the Secretary will make a decision on the application.

(3) Notification to Congress

In any case in which a schedule provided under paragraph (2)(B) extends beyond 120 days from the date of receipt of a complete application, the Secretary shall provide to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives an explanation justifying the extended timeframe for review.

APPENDIX C

Categorical Permissions

C-1. Purpose. The purpose of this appendix is to provide supplemental information on categorical permissions including the process to establish categorical permissions and the use of a categorical permission with a Section 408 request. This appendix should be used in conjunction with the guidance in the main EC.

C-2. References. See Appendix A for a list of relevant references.

C-3. Policy. Categorical permissions are intended to be a flexible tool for districts, divisions, and HQUSACE to use in order to streamline the approval of "categories" of alterations that are similar in nature and that have similar effects to a USACE Civil Works project and impacts to the environment. The premise behind a categorical permission is that a USACE office identifies a specific and commonly occurring set of activities that require Section 408 permissions within a specified geographic area that, both individually and cumulatively, have been determined not to impact the usefulness of the USACE project(s); associated environmental impacts are less than significant; and the activities would not be injurious to the public interest.

a. A categorical permission is not the same as a NEPA categorical exclusion. The analysis of potential effects to the USACE project, public interest, and NEPA and other environmental and cultural resources compliance for the identified activities is done in advance to establish the categorical permission, and then individual Section 408 requests are reviewed for compliance with the established categorical permission. For those individual Section 408 requests that are consistent with the terms and conditions of a categorical permission, Section 408 permission can be granted with an abbreviated validation process to determine that the terms and conditions are met. The decision letter used to document the use of a categorical permission can include any additional clarifying environmental documentation necessary, likely avoiding the need for a separate NEPA document.

b. A categorical permission may be created at the district, division, or HQUSACE level, but must be approved by a District Commander, Division Commander, or the Director of Civil Works depending upon the region in which it is applicable. Validation that a Section 408 request is consistent with the terms and conditions of a categorical permission and subsequent authorization of the activity under the categorical permission may be delegated. The delegation should be established through the process used to create the categorical permission.

c. A categorical permission can be developed at any geographic scale so long as the effects can be meaningfully generalized across that scale. The use of terms and conditions to limit what activities can proceed under a categorical permission may be essential to successfully establishing a categorical permission. For example, it may be necessary to limit a categorical permission to actions that occur outside of areas designated under the Endangered Species Act

(ESA) as critical habitat or outside of areas subject to tribal treaty rights. Categorical permissions can be limited to not apply at all in those circumstances, or they can require the resolution of ESA consultation requirements or tribal coordination on a project-specific basis before validation of the categorical permission can be granted.

d. Potential categorical permissions should be coordinated with those non-federal sponsors with responsibility for the USACE projects that would be covered. Non-federal sponsors should be given opportunity to provide input on all aspects of the proposed categorical permission, with specific attention to concerns regarding impacts on their O&M responsibilities and public interest considerations. The categorical permission may include terms and conditions to address issues associated with the non-federal sponsor O&M responsibility. For example, a categorical permission could require requesters, if the requester is not the non-federal sponsor, to obtain a Statement of No Objection and/or require review by the non-federal sponsor prior to submitting the request to USACE.

C-4. Establishing Categorical Permissions.

a. Categorical permission development follows similar steps as the process to develop a programmatic NEPA document, but requires an evaluation of the potential effects to the USACE Civil Works project (such as structural and operational effects), public interest, and the potential environmental and cultural resources effects of the covered activities. The basic process will include:

(1) scoping;

(2) conducting an initial assessment of potential impacts to the USACE project to ensure the scope is appropriate for a categorical permission;

(3) development of the draft categorical permission with special conditions;

(4) soliciting non-federal sponsor input;

(5) making the draft categorical permission available for public comment and tribal government-to-government consultation. In addition, there will be opportunities for a public hearing afforded;

(6) developing a final categorical permission and decision document after taking into consideration all input and making necessary revisions; and

(7) making the final categorical permission publicly available on appropriate USACE websites.

b. All proposed and final categorical permissions should explicitly state that a categorical permission satisfies the Section 408 requirements only and that landowner permission and any other applicable federal, state, or local permits need to be secured before work can begin, including any applicable and required Regulatory Program authorization. Appropriate district staff should ensure the categorical permission decision is coordinated with the Section 10/404/103 permit decision if both are required.

c. When establishing a categorical permission, the district, division, or HQUSACE should develop:

(1) the detailed description and scope of the activities that are proposed to be covered by the categorical permission;

(2) the geographic area in which the categorical permission applies;

(3) the specific USACE project(s) or types of USACE projects to which the categorical permission applies;

(4) a list of circumstances that, if present, would disqualify an otherwise in-scope activity from using the categorical permission (such as the possibility for adverse effects to endangered species in the area);

(5) a summary of findings that supports the determination that all activities within the defined parameters of the categorical permission do not impair the usefulness of the applicable USACE project(s) and are not injurious to the public interest, as well as the NEPA decision document (categorical exclusion, finding of no significant impact (FONSI), or ROD, as appropriate) for the categorical permission;

(6) a description of what documentation is to be submitted to USACE by the entity requesting Section 408 permission in order to validate the applicability of the categorical permission for a specific activity;

(7) an appropriate period of validity for the categorical permission (i.e., expiration date), if appropriate; and

(8) the process for USACE staff to use to validate the applicability of the categorical permission and inform the requester of whether the activity is authorized under the categorical permission, including the identification of the decision level for the validation.

C-5. Implementing Categorical Permissions.

a. For individual Section 408 requests involving the validation of use of a categorical permission, a written decision will be provided to the requester. The written approval should attach or include any terms and conditions of the categorical permission with the approval letter.

b. The organizational level that developed the categorical permission should also develop a process to periodically conduct a review or audit of the categorical permission itself to ensure that its use continues to meet its intended purpose to not impair the usefulness of the applicable USACE project(s) and not be injurious to the public interest. Should the review or audit demonstrate that the categorical permission is not meeting its intended purpose, the District Commander, Division Commander, or Director of Civil Works, as appropriate, has the authority to suspend or revoke the categorical permission.

APPENDIX D

Environmental and Cultural Resources Compliance

D-1. Purpose. The purpose of this appendix is to provide supplemental policy guidance on conducting environmental and cultural resources compliance inclusive of NEPA compliance for Section 408 permission requests. This appendix should be used in conjunction with the guidance in the main EC.

D-2. References. The following are the primary references that are most relevant to environmental and cultural resources compliance for Section 408 permissions. There are multiple other federal statutes, Executive Orders, and regulations that potentially may be applicable to a specific Section 408 permission request. Districts should consult with environmental staff and/or counsel to determine which laws and regulations are applicable to a given request.

a. Rivers and Harbors Act of 1899

b. National Environmental Policy Act

c. Endangered Species Act of 1973

d. National Historic Preservation Act

e. Clean Water Act of 1972

f. 33 CFR Part 230 Procedures for Implementing NEPA

g. 40 CFR Part 1500-1508 Council on Environmental Quality (NEPA)

h. Establishing, Applying and Revising Categorical Exclusions under the National Environmental Policy Act, Council on Environmental Quality (2010)

i. Improving the Process for Preparing Efficient and Timely Environmental Reviews under the National Environmental Policy Act, Council on Environmental Quality (2012)

j. Council on Environmental Quality CEQ Information Memorandum to Agencies Containing Answers to 40 Most Asked Question on NEPA Regulations (46 FR 34263-68, July 28, 1983)

D-3. Policy.

a. A decision on a Section 408 request is a federal action subject to NEPA and other federal environmental and cultural resources compliance requirements such as Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act, essential fish habitat consultation, and tribal consultation, etc. Environmental and cultural resources compliance efforts should be conducted concurrently with the Section 408 review process to the maximum extent practicable. Environmental and cultural resources compliance, except those prepared for Regulatory permit decisions, must be completed prior to rendering a Section 408 permission decision.[1] Environmental and cultural resources compliance efforts should be commensurate with the degree of potential environmental and cultural effects of the activity within the scope of the Section 408 analysis.

b. Ensuring and conducting environmental and cultural resources compliance for a Section 408 request is the responsibility of USACE. However, the requester is responsible for providing all supporting information and documentation that the district identifies as necessary to assess compliance, such as species surveys, habitat assessments, and/or cultural resource surveys. Requesters may, but are not required to, draft the NEPA environmental assessment or fund a contractor to prepare an environmental impact statement for a Section 408 request consistent with 40 CFR 1506.5. The district must ensure that any NEPA documentation drafted by a requester or contractor is accurate and compliant with USACE and CEQ requirements prior to accepting it for use with the Section 408 request. A final Section 408 decision cannot be rendered until the requester has provided all information necessary for the district to complete its assessment for environmental and cultural resources compliance. The district will work with the requester to determine the requirements, which will be scaled to be commensurate with the degree of potential environmental effects of the activity within the scope of the Section 408 analysis.

c. USACE has jurisdiction under Section 408 only over the specific activities or portions of activities that have the potential to alter, occupy, or use a USACE project. Therefore, if a proposed alteration is part of a larger project that extends beyond the USACE project boundaries, the district should focus its analysis for environmental and cultural resources compliance on only those portions or features of the larger project that USACE has sufficient federal control and responsibility to review. The scope of analysis for environmental and cultural resources compliance for the Section 408 review should be limited to the area of the alteration and those adjacent areas that are directly or indirectly affected by the alteration. For example, a pipeline or highway can extend for many miles on either side of a USACE project boundary. In this example, the scope of analysis for Section 408 review should be limited to the effects of the pipeline or highway construction within the USACE project boundary and limited adjacent area to the extent that the location of the impacts are determined by the route within the USACE project boundary, but would not address those portions of the pipeline or highway construction that are sufficiently removed from the USACE project boundary. In contrast, a proposed

[1] Compliance and decision-making under Regulatory authorities (Section 10/404/103) is conducted by the Regulatory component within the applicable district. All final Regulatory permit decisions will be made concurrent with or after the corresponding Section 408 decision.

alteration that would increase the design level throughout a federally authorized levee system would likely significantly overlap the footprint of the USACE project such that the scope of analysis for environmental and cultural resources compliance would include all of the requester's activities. As a general rule, if there are features of a larger project occurring outside of the USACE project boundaries that are integral to the features of the larger project altering a USACE project that they cannot be meaningfully distinguished (e.g., a setback levee that is located outside of the original project boundary of the levee being replaced), the USACE Section 408 scope of analysis should be broad enough to address all those features/activities. Generally, elements of the larger project that are not integral to the features that would alter the USACE project should not be included in the USACE environmental and cultural resources compliance analysis. The scope of analysis should generally be similarly limited to include operations and maintenance of a proposed alteration only to the extent that the operation and maintenance of the alteration would affect the USACE project. However, in some cases the scope of analysis for operational effects may be broader than the scope of analysis for construction effects and may extend beyond the USACE project boundary. Note that the scope of analysis for a Section 408 request may be different than the scope of analysis for a Regulatory permit review (Sections 10/404/103) for the same proposal because the geographic extent of jurisdiction under each authority may be different.

d. Programmatic Compliance. Districts have discretion and are encouraged to develop new or use existing programmatic NEPA documents and/or programmatic environmental consultations for Section 408 permission requests, when appropriate. Programmatic NEPA documents and other environmental consultations (e.g., Programmatic or Regional Biological Opinions, Section 106 Programmatic Agreements, and Standard Local Operating Procedures for Endangered Species [SLOPES]) provide a way to efficiently conduct environmental compliance for categories of activities that have similar environmental effects.

e. Historic, Cultural, and Archaeological Resources. Districts should follow the regulations within 36 CFR 800 for complying with Section 106 of the NHPA when acting as the lead agency as outlined in 36 CFR 800.2(a)(2) for Section 106 compliance. The undertaking within the context of 36 CFR 800.16(y) is limited to the activity within the jurisdiction of USACE that requires permission under Section 408 (see paragraph D-3.c. above). The area of potential effects for a Section 408 request should therefore, be limited to the areas directly or indirectly affected by the limited scope of the undertaking. Section 106 compliance will be satisfied using Regulatory's compliance when the Regulatory element is the lead for environmental compliance on an action that requires both Section 408 and Regulatory authorization and activities and impacts within the scope of each review are the same. For Section 408 requests, the section on cultural resources within Appendix C of reference A.30 does not apply.

f. Tribal Consultation.

(1) USACE recognizes the sovereign status of federally recognized tribes and its obligations for pre-decisional government-to-government consultation. USACE also recognizes that

working with representatives from tribal nations, it can determine whether an area has tribal cultural, historic or spiritual significance. USACE further recognizes that tribes possess their own individual culture, histories, languages, customs and that tribal traditional knowledge is unique to each tribe and it will be used to inform the Section 408 review process. As a result, consultation may occur with individual tribes in bi-lateral engagement or with multiple tribes that have consented to consult in a multi-lateral engagement.

(2) Districts are required to ensure that meaningful government-to-government consultation occurs early in the review process of a Section 408 request. Consistent with the USACE tribal consultation policy, districts should involve the tribes in open, timely, meaningful, collaborative, and deliberative communication process that emphasizes trust and respect throughout review and decision-making process. During consultation districts should, to the extent practicable and permitted by law, work toward mutual consensus during consultation in an active and respectful dialogue concerning actions that may significantly affect tribal resources, tribal rights (including Treaty rights) or Indian lands. Tribal consultation is not bound nor limited to specific timelines. Districts must ensure early coordination with district tribal liaisons to identify any tribal issues (i.e., tribal holidays, timing of Tribal Council meetings, etc.) that could impact timelines prescribed in this EC. Per the USACE tribal consultation policy, federally recognized tribes have the right to request government-to-government consultation with the district. All requests by a tribe for government-to-government consultation with USACE will be honored.

g. Fish and Wildlife Coordination Act. If the proposed alteration would impound, divert, or otherwise control or modify any stream or other body of water (including channel deepening), consultation under the Fish and Wildlife Coordination Act is required. Districts must ensure that the US Fish and Wildlife Service (USFWS) and applicable state wildlife resources agency have an opportunity to provide input and recommendations regarding the impact of the action on wildlife resources. Districts should document the outreach to the wildlife resource agencies. Districts must integrate any reports or recommendations received in the documentation for the Section 408 decision along with an explanation of how that input was considered. However, districts should not be providing funds to USFWS to conduct this consultation for Section 408 requests.

h. Mitigation. Mitigation may include avoiding, minimizing, rectifying, reducing, and/or compensating for adverse impacts to resources and may include, but is not limited to, fish and wildlife mitigation, cultural resources mitigation, noise mitigation, and air quality mitigation.

(1) Districts have discretion to require mitigation for a Section 408 request for a mitigated FONSI for NEPA purposes, to ensure the proposed alteration is not injurious to the public interest, or as required under other applicable federal environmental law.

(2) Mitigation associated with Section 408 requests does not need to be incrementally cost justified and does not need to comply with requirements in Section 2036 of WRDA 2007, as amended.

(3) If the proposed alteration also requires Regulatory authorization, the review conducted by the Regulatory element within the district will determine if compensatory mitigation for losses to aquatic resources is appropriate under its applicable authorities. Therefore, the Section 408 request will not include an evaluation of mitigation for those resources subject to Regulatory's jurisdiction.

i. Emergency Situations. The district has discretion to use the emergency procedures provided for in environmental statutes to process Section 408 requests.

(1) NEPA. The regulations implementing NEPA provide for flexibility in the NEPA compliance process in circumstances of an emergency after coordination with CEQ.[2] NEPA documentation should be accomplished prior to initiation of emergency work if time constraints render this practicable. Such documentation may also be accomplished concurrent with or after the completion of emergency work, if appropriate.[3] Districts should be aware of categorical exclusions, including the categorical exclusion for emergencies at Section 1005(b) of Water Resources Reform and Development Act of 2014, to expedite NEPA compliance in these situations.

(2) Endangered Species. The regulations implementing ESA provide that where emergency circumstances mandate the need to consult in an expedited manner, consultation may be conducted informally through alternative procedures that the Service(s) determine to be consistent with the requirements of Section 7(a)-(d) of the Endangered Species Act.[4] Formal consultation, if required, should be initiated as soon as practicable after the emergency is under control.

(3) Historic and Cultural Resources. Specific procedures to comply with Section 106 of the NHPA during a disaster or emergency are located at 36 CFR 800.12, "Emergency Situations." Districts and divisions may develop, in consultation with the Advisory Council on Historic Preservation and others, standard procedures during a disaster and/or emergency; they may follow provisions of programmatic agreements that contain specific provisions for addressing historic properties in emergencies; or, in the absence of specific procedures, provide opportunities to comment as specified in 36 CFR 800.12(b)(2).

D-4. <u>NEPA</u>.

a. The NEPA compliance process should be completed in an efficient, effective and timely manner consistent with guidance issued by CEQ on March 6, 2012 entitled *Improving the Process for Preparing Efficient and Timely Environmental Reviews under the National Environmental Policy Act.* Controlling guidance for NEPA compliance is set forth in CEQ's

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[2] 40 CFR 1506.11
[3] 33 CFR 230.8
[4] 50 CFR 402.05

regulations at 40 CFR Parts 1500-1508 and the USACE Civil Works NEPA implementing regulations found at 33 CFR Part 230.

b. NEPA documentation for Section 408 requests will typically not require the same level of detailed analysis as needed for feasibility reports or other planning studies. In addition, portions of 33 CFR 230, such as Appendix A, that are applicable to feasibility, continuing authority, and/or special planning reports are not applicable to Section 408 permissions. However, districts are expected to comply with all basic requirements of NEPA.

c. Alternatives Analysis. For NEPA compliance for Section 408 requests, reasonable alternatives required by 40 CFR Part 1502.14 should focus on two scenarios: 1) no action (i.e., no proposed alteration in place) and 2) action (i.e., proposed alteration in place). Only reasonable alternatives need to be considered in detail. Reasonable alternatives must be those that are feasible, considering those that satisfy the underlying purpose and need (of the requester) that would be satisfied by the proposed federal action (granting of permission for the alteration). Thus, examination of alternative forms of a proposed alteration that the requester has not proposed should only be included to the extent necessary to allow a complete and objective evaluation of the public interest and informed decision regarding the alteration request.

(1) Because USACE is not the proponent for the alteration requested under Section 408, all environmental compliance documentation will refer to the requester's proposal as the "requester's preferred alternative."

(2) For NEPA compliance led by another entity such as another federal agency, that agency may include additional alternatives to comply with their specific requirements. District should be actively coordinating with the lead agency as a cooperating agency to ensure any information needed for NEPA compliance for the Section 408 request is included in the lead agency's NEPA document to maximize the ability to fully adopt that NEPA document.

(3) For NEPA compliance for Section 408 requests that also require Regulatory authorization, additional alternatives and additional detail may be included the NEPA document to comply with Section 404(b)(1) guidelines for the Clean Water Act (CWA). The various offices within the district should be coordinating to ensure appropriate alternatives and detail are included in any NEPA document to maximize the ability for one NEPA document to be prepared to satisfy NEPA compliance for both purposes.

(4) When Regulatory is conducting its alternatives analysis under the CWA Section 404(b)(1) guidelines, an alternative cannot be considered practicable if Section 408 permission cannot be granted. However, the need to seek a Section 408 permission does not make an alternative impracticable.

d. Public Involvement. Involving the public is a critical component to NEPA compliance. For Section 408 alteration requests that are expected to have a significant effect on the human or natural environment, the district must make diligent efforts to involve the public throughout the NEPA scoping and EIS process including the required comment periods. For those Section 408 requests for which an environmental assessment (EA) is prepared or a categorical exclusion is used, draft NEPA compliance documents should not be circulated for public comment, except for in rare circumstances. Instead, a public notice soliciting input will serve as the method of involving the public in the NEPA process required by 40 CFR 1501.4(e)(1). See paragraph 12.b. of the main EC for information on public notices. In circumstances where a proposed alteration is associated with a current study or other uncommon circumstances, a decision to circulate the draft Section 408 EA may be approved by the Division Commander or the Division Commander's designee. Any decision to circulate draft EA and/or draft FONSI for a Section 408 request that also requires a Section 10/404/103 permit decision must be coordinated with the Regulatory Program to ensure that no pre-decisional or deliberative information related to Regulatory decision making (e.g., Section 404(b)(1) guidelines analysis) is included in the document to be circulated.

e. Categorical Exclusions. Alterations that are expected to not result in significant effects on the environment, both individually and cumulatively should be evaluated to determine if an approved categorical exclusion at 33 CFR 230.9 applies. For example, the categorical exclusions at 33 CFR 230.9(b) and (i) may have applicability to some of the smaller scale alterations that may be in a Section 408 request. Real estate grants for rights-of-way as referenced in 33 CFR 230.9(i) should be broadly interpreted to include grants of rights-of-way by either USACE or the non-federal sponsor. Prior to using a categorical exclusion, the district must ensure that the proposed alteration is within the intended scope of the specific categorical exclusion and that no extraordinary circumstances exist that would merit the preparation of an EIS or EA. Applicability and use of approved USACE categorical exclusions for Section 408 permissions should be documented in a manner consistent with the CEQ guidance memorandum titled, *Establishing, Applying and Revising Categorical Exclusions under the National Environmental Policy Act*, dated 23 November 2010.

f. Adoption and Incorporation by Reference. Districts are strongly encouraged to adopt and/or incorporate by reference any NEPA documentation that may already exist or may already be in development for the federal project, or other relevant NEPA documentation. This may include recent NEPA documents from a feasibility study, operations study, dam safety modification study, and/or Regulatory actions. Districts must ensure that the information contained in these other NEPA documents is appropriate and applicable to the anticipated effects of the alteration, paying particular attention to re-evaluate information that is greater than 5 years old, prior to adoption or incorporation by reference for the Section 408 permission decision. Districts should provide supplemental NEPA documentation, to only cover those environmental impacts associated with the Section 408 alteration that were not considered in these previous NEPA documents. Districts may also adopt another agency's EA. When adopting all or portions of another agency's EIS or EA, the district is still responsible for developing a Record of Decision (ROD) or FONSI, as applicable, to document NEPA compliance for the Section 408 permission decision. The ROD or FONSI may be integrated with the Summary of Findings for purposes of efficiency.

g. Cooperating Agencies.

(1) As provided for in 40 CFR 1501.6, upon request of another federal agency that is the lead agency for NEPA, any other federal agency that has jurisdiction by law shall be a cooperating agency. This may include USACE when a Section 408 permission is required. For those alterations in which another Federal agency is the NEPA lead agency, districts will participate in the NEPA review as a cooperating agency to the maximum extent practicable.[5] When USACE is a cooperating agency, USACE will provide comments on another federal agency's draft EIS even if the response is no comment.[6] Districts will normally adopt that federal agency's EIS and consider it to be adequate for NEPA compliance for a Section 408 permission unless the district finds substantial doubt as to the technical or procedural adequacy or omission of factors important to the Section 408 permission decision,[7] particularly those that were raised by USACE during the development of the EA or EIS but rejected by the lead agency for inclusion. Districts may also adopt portions of an EIS under 40 CFR 1506.3, and supplement with any information necessary to comply with NEPA for the Section 408 permission decision. For hydropower alterations, USACE and FERC have entered into an MOU for meeting NEPA requirements (see Appendix F).

(2) Tribal governments may have special expertise with respect to alternatives and can participate as a cooperating agency. Meaningful coordination with tribal entities, and analysis of a proposed action's potential effect on tribal lands, resources, or areas of historic significance is an important part of federal agency decision-making. In addition to provisions in 40 CFR 1501.2 and 1501.7 which call for the involvement of tribes that may be affected by a federal proposal, CEQ issued a Memorandum to the Heads of Federal agencies (July 28, 1999) encouraging more active solicitation of tribal entities for participation as cooperating agencies in NEPA documents. Per the CEQ Memorandum, the benefits of granting cooperating agency status include "disclosure of relevant information early in the analytical process, receipt of technical expertise" which is consistent with the USACE tribal consultation policy.

h. Multi-phase Reviews and Tiering. Districts have discretion to use tiering to efficiently conduct NEPA compliance for a multi-phased review of a Section 408 request. In this case, a broad or programmatic EIS or EA, as appropriate, would be completed in the first milestone of a multi-phased review of a Section 408 request. The district may then supplement, or tier off of, the original NEPA document, as appropriate, for each subsequent milestone of the Section 408 request. When tiering, the initial broad or programmatic EIS or EA must present sufficient information regarding overall impacts of the proposed alteration so that decision-makers can make a reasoned judgment on the merits of the action at the present stage of planning or

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[5] 33 USC 408(b)(1)(B)
[6] 33 CFR 230.19(e)
[7] 33 CFR 230.21

development and exclude from consideration issues already decided or not ready for decision. The initial broad EIS or EA should also identify data gaps and discuss future plans to supplement the data and prepare and circulate phase-specific NEPA documents.[8]

[8] 33 CFR 230.13(c)

APPENDIX E

Dams and Levees

E-1. Purpose. The purpose of this appendix is to provide supplemental guidance to be used in conjunction with guidance in the main EC for proposed alterations by others to federally authorized dams and reservoirs, (including dams associated with navigation locks) and levee systems.

E-2. Applicability.

a. Dams and Reservoirs (including Navigation Dams). A dam is an artificial barrier, usually crossing a watercourse and including appurtenant structures, constructed for the purpose of storage, control, or diversion of water. This definition applies whether the dam has a permanent reservoir or is a detention dam for temporary storage of floodwaters. This appendix is applicable to federally authorized dams, and associated appurtenant structures, operated and maintained by USACE or those constructed by USACE, but which are operated and maintained by non-federal sponsors and may also be included under the jurisdiction of a State Dam Safety Agency defined by the National Dam Safety Program. This appendix may also be applicable to lands required to ensure reservoir integrity up to the project maximum flood (PMF), in addition to structures and canals where breach would release pool. See Appendix F for additional information concerning hydropower facilities. Below further describes applicability related to water supply at USACE dams and reservoirs.

(1) Water supply users entering into an agreement under Section 6 of the Flood Control Act (FCA) of 1944 (33 USC 708) or the Water Supply Act (WSA) of 1958, as amended (43 USC 390b) generally will not need a separate Section 408 permission.

(2) For currently authorized Municipal and Industrial (M&I) water supply storage, Section 408 considerations will be taken into account in the drafting of an M&I water storage agreement and associated outgrants or consents. Any requirements related to the user’s facilities (intake structures, etc.) will be included in the agreement and related outgrants or consents.

(3) For reallocated M&I water supply storage under the 1958 WSA authority, the water supply user must be advised that the reallocation study itself will not specifically address the Section 408 considerations but that Section 408 considerations will be taken into account in the drafting of a water storage agreement and associated outgrants or consents. Any requirements for water supply user’s facilities (intake structures, etc.) will be included in the agreement and associated outgrants or consents.

(4) For surplus water under the authority of Section 6 of the 1944 FCA, Section 408 considerations will be taken into account in the drafting of the surplus water agreement and

associated outgrants or consents and any requirements for water supply user's facilities (intake structures, etc.) will be included in the agreement and associated outgrants or consents.

(5) For M&I water supply intakes of any size to be placed in USACE-operated projects that do not fall within the scope of either Section 6 of the 1944 FCA or of the1958 WSA, e.g., intakes placed at projects not meeting the definition of "reservoir" projects for purposes of those two statutes, the guidance in paragraph 9.e. must be followed to determine if a separate Section 408 permission is required.

b. Levee Systems. A levee system (or sometimes referred to as "levee" in this document), is comprised of one or more components which collectively provide flood risk reduction to a defined area, referred to as a leveed area. A levee is inclusive of all components that are interconnected and necessary to exclude floods from the leveed area. Levees do not usually cross a watercourse. Common components and associated features for levee systems include sheetpile walls, berms, relief wells, cutoff walls, foundation, drainage structures, ponding areas, channels, closure structures, pump stations, transitions, and erosion protection. This appendix applies to federally authorized levee systems including those operated and/or maintained by USACE and those federally authorized levee systems operated and maintained by a non-federal sponsor.

E-3. References. The following is a list of references containing evaluation processes, design standards, and operations and maintenance procedures that may be relevant to consider for alterations to dams and levees.

a. Section 6 of the Flood Control Act (FCA) of 1944 (P.L. 78-534), Contracts for safe of surplus water at Army projects – Disposition of revenues

b. Water Supply Act (WSA) of 1958 (P.L. 85-500, as amended)

c. 44 CFR 65.10, Mapping of areas protected by levee systems

d. ER 1110-2-1150, Engineering and Design for Civil Works Projects

e. ER 1110-2-1156, Safety of Dams, Policy, and Procedures

f. ER 1110-2-1806, Earthquake Design and Evaluation of Civil Works Projects

g. ER 1110-2-1942, Inspection, Monitoring, and Maintenance of Relief Wells

h. EM 1110-1-1005, Control and Topographic Surveying

i. EM 1110-1-1804, Geotechnical Investigations

j. EM 1110-1-1904, Settlement Analysis

k. EM 1110-1-2908, Rock Foundations

l. EM 1110-2-1418, Channel Stability Assessment for Flood Control Projects

m. EM 1110-2-1601, Hydraulic Design of Flood Control Channels

n. EM 1110-2-1902, Slope Stability

o. EM 1110-2-1906, Laboratory Soils Testing

p. EM 1110-2-1913, Design and Construction of Levees

q. EM 1110-2-1914, Design, Construction, and Maintenance of Relief Wells

r. EM 1110-2-2002, Evaluation and Repair of Concrete Structures

s. EM 1110-2-2007, Structural Design of Concrete-Lined Flood Control Channels

t. EM 1110-2-2100, Stability Analysis of Concrete Structures

u. EM 1110-2-2104, Strength Design for Reinforced-Concrete Hydraulic Structures

v. EM 1110-2-2200, Gravity Dam Design

w. EM 1110-2-2502, Retaining and Flood Walls

x. EM 1110-2-2504, Sheet Pile Walls

y. EM 1110-2-2902, Conduits, Culverts, and Pipes

z. EC 1110-2-6066, Design of I-Wall

aa. ETL 1110-2-583, Engineering and Design: Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures

bb. ETL 1110-2-575, Evaluation of I-Walls

cc. U.S. Army Corps of Engineers, Policy for Development and Implementation of System-Wide Improvement Frameworks (SWIFs), CECW-HS memorandum, 29 November 2011 dd. U.S. Department of Interior Bureau of Reclamation and US Army Corps of Engineers, Best Practices in Dam and Levee Safety Risk Analysis, 1 July 2015 (or most recent version)

ee. See Appendix A for other applicable references.

E-4. Coordination.

a. For levee alterations, ensure involvement of the district Levee Safety Officer (LSO) and Levee Safety Program Manager (LSPM). For dam and reservoir alterations, ensure involvement of the district Dam Safety Officer (DSO) and Dam Safety Program Manager (DSPM). In addition, the district should inform the requester of any current USACE assessments, modifications, or other studies that are ongoing or are being considered that may have compatible objectives with the potential proposed alteration. These may include semi-quantitative or quantitative risk assessments, dam safety modification studies, interim risk reduction measures, or cost-shared studies.

b. Coordination with State Dam Safety Agencies. When the request is for the alteration of a dam operated by a non-federal sponsor, the alteration will be reviewed by the State Dam Safety Agency. In these cases, the requester must obtain written concurrence of the proposed alteration from the State Dam Safety Agency prior to USACE issuing the final Section 408 decision.

c. DSOG/LSOG Review. If the district determines a Safety Assurance Review (SAR) is required for a proposed alteration to a dam or levee, the RMC will determine if the Dam Senior Oversight Group (DSOG) or Levee Senior Oversight Group (LSOG) will review the proposed alteration. If it is determined that the DSOG or LSOG review is required, the RMC will inform the division and district and it will be documented in the review plan. If the DSOG review is required, the district should contact the HQUSACE DSPM to schedule a briefing with the DSOG as soon as possible. If the LSOG review is required, the district should contact the HQUSACE LSPM to schedule a briefing with the LSOG as soon as possible. Information to be presented should include available risk assessment (screening-level or higher-level risk assessments) information and a description of the proposed alteration. DSOG or LSOG will provide feedback, recommendations and concurrence or non-concurrence with proceeding with the Section 408 to the division and district safety officers. The DSOG or LSOG will consider the following when reviewing the Section 408 proposed alteration:

(1) whether the benefits of the alteration are generally commensurate with the risks

(2) whether the alteration potentially worsens or creates new failure modes or risk drivers for the USACE project; and

(3) whether the alteration is exceptionally complex or high risk.

E-5. Potential Considerations for Section 408 Submittals. The information below supplements the main EC. The list below is only a guide for information and/or analyses that may be needed to review alterations to dams and levees. It is not intended to list every analysis or design consideration that may be needed for all proposals.

a. Risk Assessment. Depending on the complexity and associated impacts of the proposed alternation on life safety as determined by the district DSO or LSO, the requester may be required to provide a risk assessment showing risk estimates associated potential failure modes with and without the proposed alteration in place. The district must also inform the requester if there is a change in the risk characterization of the dam or levee during the Section 408 review process and how or if the change in risk will require changes to the alteration being requested.

b. Discussion of Executive Order 11988 Considerations. The district may require the requester to submit sufficient data in order that the district may conduct its analysis required by reference A.35 to ensure that the proposed alteration is compliant with Executive Order (EO)11988. The request should be assessed as to whether there would be induced development in the floodplain, as defined in A.35, as a result of the proposed alteration and address the positive and negative impacts to the natural floodplain functions.

c. Civil. Each request should clearly identify the existing condition of the portion of the USACE project being altered and include plan, profile, and design details of the proposed alteration in relation to the existing USACE project. Below are examples of information that may be necessary to understand the existing and proposed conditions:

(1) Alteration location (Vicinity map and specific alteration location in station or river mile and/or decimal degrees)

(2) Applicable datum

(3) Real property, existing and to be acquired, needed for the proposed alteration

(4) Grading plans

(5) Layout plan, profiles, and cross-sections of proposed alteration

(6) Previous inspection reports to assist in identifying existing deficiencies and their proximity to the proposed alteration.

(7) Temporary measures required during construction (bypasses, cofferdams, etc.)

d. Geotechnical. The following is a list of analyses or information that may be necessary to consider for geotechnical considerations and assessing their impacts if proposed alterations alter the USACE project cross-section or penetrate the natural blanket or foundation.

(1) Erosion control (changes in erosive forces on a slope)

(2) Material usage/borrow/waste/transport/hauling

(3) Liquefaction susceptibility

(4) Placement of stockpiles, heavy equipment, or other surcharges

(5) Drilling plan, reference A.31

(5) Results of subsurface investigation – boring logs, test pit logs, laboratory test results, etc.

(6) Seepage analysis

(7) Settlement analysis

(8) Stability analysis

(9) Vegetation

e. Structural. The following is a list of analyses or information that may be necessary to evaluate the impacts of proposed alterations to concrete, floodwalls, or drainage structures:

(1) Bridges and related abutments

(2) Design analysis for retaining walls and excavation support system

(3) Design of shallow or deep foundations, including bearing capacity and settlement analysis if the construction is located within the line of protection or right-of-way and creates potential seepage problems

(4) Design recommendations for foundations on expansive soils

(5) Diaphragm walls

(6) Gates or other operable features

(7) Other structural components integral to the USACE project

(8) Pier penetrations of embankments

(9) Stability analysis including sliding, overturning, bearing, flotation, uplift and any seismic load effects for any alteration to the channel walls and/or flood walls

(10) Structural drainage control methods

(11) Water stops and contraction/expansion joints

f. Hydrology and Hydraulics. Refer to Appendix H for details on when and how a hydrology and hydraulic system analysis should be conducted. Refer to the list below for examples of factors that should be considered when evaluating hydrology and hydraulics impacts.

(1) Changes in inflow

(2) Changes in velocity

(3) Changes in water surface profiles and flow distribution

(4) Consideration of impacts to energy dissipation measures; hydropower generation; sedimentation; or navigation

(5) Scour analysis

(6) Sediment transport analysis

g. Water Control Management Plan. Alterations may have impacts on how water control structures are operated. In these cases, the alterations should consider any impacts or changes to water control plans that may be necessary. If a change to a water control manual is required, the NEPA document developed for the Section 408 alteration should incorporate appropriate analysis for updating the water control manual. Alterations that will work in conjunction with an existing Federal Water Control Manual (WCM) should be documented and incorporated into that WCM. Items to be considered are:

(1) Effects on existing Biological Opinions, Water Quality Certifications, Coastal Zone Management Concurrences, etc. should evaluate project impacts on any legal document, agreement, or requirement that informs water control management by the USACE

(2) Impacts/revisions to the operation of USACE facilities or other projects within the basin

h. Operations, Maintenance and Flood Fighting. Alterations may change how a dam, levee, floodwall, or channel project is to be operated or maintained. They may also require special flood fighting procedures. Reviews should consider the factors below to determine potential effects.

(1) Project and maintenance access

(2) Special inspection requirements

(3) Maintenance practices

(4) Flood fighting requirements and practices

(5) Flood contingency plan during construction, measures proposed to protect area under construction, monitoring of river level, river stage at which plan will be activated, materials and equipment to be used to activate plan, and personnel contact and telephone number to activate plan

E-6. USACE Review Considerations.

a. The district (and division, if applicable) LSO is required to review any Section 408 request that modifies a levee system. The district (and division, if applicable) DSO is required to review any Section 408 request that modifies a dam.

b. Risk. Districts will consider the effects of the proposed alteration on the risk associated with the USACE project as part of the review process.

c. National Flood Insurance Program (NFIP). The criteria related to NFIP mapping purposes (44 CFR 65.10, Mapping of areas protected by levee systems) are not USACE design standards and should not be a consideration in the technical analysis or design review. However, the impacts associated with mapping dams and levee systems for the NFIP, such as influences on floodplain management, should be discussed as part of compliance with EO 11988 and considered when discussing potential impacts to associated risks. For Section 408 requests that include an objective of achieving levee accreditation for the NFIP, if the Section 408 is approved, a statement in the written approval document will specify that approval does not constitute, nor should it be construed as, an evaluation to determine if NFIP criteria have been met.

d. Rehabilitation Program. Proposed alterations to federally authorized dams, levees, and floodwalls must also be evaluated to determine whether the alteration will become an integral component of the USACE project. If it is determined that the proposed alteration will become an integral component of the USACE project that is necessary for proper functioning of the USACE project for its authorized purpose, the completed alteration will be included as a USACE project feature eligible for rehabilitation assistance and treated as a federal project component under PL 84-99. The district is responsible for making a determination as to whether or not a proposed alteration will become an integral component of the USACE project. Factors to consider will vary depending on the type of infrastructure and the proposed alteration. This determination must be made for all proposed alterations to federally authorized dams and levees , regardless of their status in the Rehabilitation Program at the time of the Section 408 request, to ensure that the proposed alteration is appropriately considered in future decisions about project eligibility for rehabilitation assistance. Examples of such alterations include stability or seepage berms, and changes to the structure type or geometry. In addition, districts should identify if the alteration is part of an approved System Wide Improvement Framework (SWIF), see reference E-3.bb, and consider any information specified for the alteration in the SWIF. For more information on USACE emergency activities and the Rehabilitation Program, see reference A.29.

e. Alterations Within the Reservoir Area. These proposed alterations require the same level of technical review as alterations to dams. Generally, alterations within the reservoir areas will be requested by the water supply non-federal sponsor for intake facilities. These alterations should be reviewed for impacts to life safety, inundation, and intake levels. When reviewing the intake levels, consideration will be given to drought conditions and also to lake level drawdowns for dam safety water control purposes. When alterations are proposed along the reservoir, the alteration will be reviewed for constructability and for potential failure modes related to misoperation, overtopping, foundation failures, alteration-induced subsidence, and other possible incidents that could cause the uncontrolled loss of pool.

E-7. Post-Permission Oversight.

a. Inspections. Inspections conducted by USACE should document whether approved alterations are being operated and maintained consistent with the approved Section 408 and/or updated O&M manual.

b. National Levee Database (NLD). Districts should ensure that the NLD is updated to capture new or changed features of a levee system constructed as part of a Section 408 permission. The district will provide the requester with the requirements for any needed surveys, including updated centerline information and cross sections, in order to update the project information in the NLD to capture the alterations.

c. National Inventory of Dams (NID). Districts should ensure that the NID is updated to capture new or changed features of a dam, including appurtenant structures, constructed as part of a Section 408 permission. The district will provide the requester with the requirements to update the project information in the NID to capture the alterations.

APPENDIX F

Non-federal Hydropower Development at USACE Facilities

F-1. Purpose. The purpose of this appendix is to provide supplemental guidance to be used in conjunction with guidance in the main EC and Appendix E for requests for alterations of USACE projects by adding hydroelectric power generation and requiring a preliminary permit or license by the Federal Energy Regulatory Commission (FERC). In these cases, the main EC, this appendix, and the current Memorandum of Understanding (MOU) between the FERC and USACE, reference F-2.h (or most current version), will govern the Section 408 review process. The MOU contains the process to be used for the environmental and cultural resources compliance where FERC is the lead federal agency and USACE would be a cooperating agency. USACE is responsible for developing an understanding of the concept proposal and for responding to FERC inquiries regarding jurisdiction and conflict with USACE project purposes. USACE will also share, as appropriate, information regarding risks to the USACE project.

F-2. References.

a. Federal Power Act, as amended

b. ER 1110-2-401, Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors

c. ER 1110-2-1150, Engineering and Design for Civil Works Projects

d. ER 1110-2-1454, Corps Responsibilities for Non-Federal Hydroelectric Power Development under the Federal Power Act

e. ER 1110-2-1462, Water Quality and Water Control Considerations for Non-Federal Hydropower Development at Corps of Engineers Projects

f. ECB 2008-8, Sharing Technical Information in Support of Non-Federal Hydropower Development

g. US Army Corps of Engineers, Charging and Retaining Fees Charged to FERC Licensees, CECC-G memorandum, 6 June 2006

h. Memorandum of Understanding Between the United States Army Corps of Engineers and the Federal Energy Regulatory Commission on Non-Federal Hydropower Projects, 20 July 2016, with attachments.

i. See Appendix A of this EC for other applicable references.

F-3. USACE and FERC Coordination.

a. Under the default two-phase process established under reference F-2.h, USACE and FERC have agreed to work with each other and with other participating agencies or entities, as appropriate, to ensure that timely decisions are made and that the responsibilities of each agency are met. Specifically, subject to the availability of resources and consistent with applicable laws, regulations, Army policies and FERC policies, each agency agrees to: commit to early involvement; participate proactively; share data; communicate informally; attend public meetings; and coordinate on studies of hydropower potential.

b. Each district and division that operates non-powered dams or other facilities with the potential for generating hydroelectric power has a FERC Coordinator for coordination with FERC regarding the licensing process and all aspects of non-federal hydropower development on a USACE dam or facility. The FERC Coordinator will be responsible for working with the Section 408 Coordinator to ensure timely completion of the Section 408 review process consistent with reference F-2.h. The FERC Coordinator should also ensure coordination occurs with Regulatory, as appropriate.

c. When a USACE district receives a written request to alter a USACE project for the addition of hydroelectric generation, the district will confirm that the requester has applied or intends to apply for a FERC preliminary permit to investigate the potential for adding hydroelectric power facilities to the USACE project. Initial coordination should consist of a meeting to discuss the proposed project and inform the requester of any known issues that would impact their proposal, such as any dam safety or water supply issues.

d. For projects with an existing FERC permit or license, reference F-2.h should be utilized to the greatest extent possible.

e. USACE will seek to streamline processes to the maximum extent possible, such as through programmatic approaches or adoption of reviews conducted by others (Appendix D) or use of categorical permissions as described in Appendix C.

f. The public notice requirements for non-federal hydropower Section 408 requests must be closely coordinated with FERC's public notice requirements for the licensing process, and where feasible the FERC public notice process must be relied upon if sufficient to reduce redundancy.

g. Design documentation within the FERC license application Exhibit F generally satisfies the design and information requirements for environmental reviews for phase I when addressing non-federal hydropower proposals.

h. Where FERC license requirements are duplicative with Section 408 permission requirements in the EC, if feasible, the FERC requirements must be relied upon to inform the

USACE Section 408 permission and other related USACE decisions as encouraged by reference F-2.h to ensure streamlining and reduction of duplicative efforts.

i. Phase II of reference F-2.h allows for requesters to employ either the single-phased or multi-phased Section 408 process, as best suits the technical nature of the proposed project.

APPENDIX G

Navigation Channels, Harbors, Locks, Jetties, Bridges, and Features

G-1. Purpose. The purpose of this appendix is to provide supplemental information to be used in conjunction with guidance in the main EC for alterations proposed by others to USACE navigation projects, including channels, harbors, locks, jetties, bridges, and other associated features (upland dredged material containment facilities). The mission of the USACE navigation program is to provide safe, reliable, efficient, effective, and environmentally sustainable waterborne transportation systems for movement of commerce, national security needs, and recreation. This mission is accomplished by ensuring adequate project dimensions to provide safe passage of commercial navigation through the federally authorized navigation project, while minimizing environmental impacts. Accordingly, any proposed alterations to an authorized USACE navigation project must be evaluated to determine that such alteration will not impair the usefulness of the project and will not be injurious to the public interest. Refer to Appendix E for proposed alterations to navigation dams.

G-2. References. The following is a list of references that may be relevant to consider for alterations to navigation features.

a. Section 204 of Water Resources Development Act of 1986, Public Law (PL) 99-662

b. 33 USC 565, River and Harbor Improvement by Private or Municipal Enterprise

c. ER 1110-2-1403, Studies by Coastal, Hydraulic, and Hydrologic Facilities and Others

d. ER 1110-2-1404, Hydraulic Design of Deep Draft Navigation Projects

e. ER 1130-2-520, Navigation and Dredging Operations and Maintenance Policies

f. ER 1140-1-211, Non-Department of Defense Reimbursable Services

g. ER 1165-2-211, Water Resource Policies and Authorities – Operation and Maintenance of Improvements Carried Out By Non-Federal Interests to Authorized Harbor or Inland Harbor Projects

h. EM 1110-2-1611, Layout and Design of Shallow-Draft Waterways

i. EM 1110-2-1613, Hydraulic Design of Deep Draft Navigation Projects

j. EP 1130-2-520, Navigation and Dredging Operations and Maintenance Guidance and Procedures

k. COMDTPUB P16591.3D, Office of Bridge Programs, U.S. Coast Guard Bridge Permit Application Guide, July 2016

l. See Appendix A for other applicable references.

G-3. Project Specific Setbacks. Once it has been determined that Section 408 permission is required, districts are encouraged to use any project-specific setbacks as a guideline in evaluating whether a structure or activity is at a sufficient distance from the USACE project so not to impact the usefulness of the USACE navigation project. For those USACE navigation projects that do not have established setbacks, districts may elect to establish setbacks to delineate the minimum distances a structure or feature should be located from a navigation feature (adjacent, over, and/or below) to avoid impacting the usefulness of the project. Districts may consider project specific setbacks as a criterion when establishing a categorical permission. At a minimum, the following should be considered when developing setbacks:

a. Maximum dredging depth and width, to include advanced maintenance, allowable over-depth, and non-pay overdepth

b. Top edge of the navigation channel, including appropriate side slopes and overdepth

c. Sufficient clearances of equipment needed for dredging the navigation channel to its full depth and width, including side slopes

d. Minimum low sag clearance required for lines or structures crossing above the channel

e. Weather, tides, flow rates, velocities, and other factors related to the region

f. Dredged Material Placement Facility availability

G-4. Proposed Alterations in which the Scope of Analysis Completely Aligns Between Section 10 and Section 14 (33 USC 408) of the Rivers and Harbors Act of 1899. Activities proposed in, over, or under navigable waters within a USACE Navigation project typically require authorization under both Section 10 and Section 408. The scope of what USACE must evaluate to make a decision under each authority will be different for many activities due to the different nature of the jurisdiction of each authority. The scope of analysis for Section 10 is generally limited to jurisdictional waters (see 33 CFR Part 325 Appendix B Paragraph 7.b.), whereas the scope of analysis for Section 408 is defined in relation to the limits of the Civil Works project and can include operations and maintenance and/or emergency response considerations to the extent those activities have an effect on the USACE project. In cases in which there are different scopes of analysis for Section 10 and Section 408, USACE will issue separate authorizations under each authority after sharing and levering information and analysis to the maximum extent practicable. However, for many activities altering navigation projects, the scope of analysis for Section 10 and Section 408 will be identical. In those cases where the scope of analysis for

Section 10 and Section 408 is identical, a single authorization will be issued following the following procedures.

a. The district will use information provided by the applicant/requester for activities occurring within navigable waters and within the boundaries of a USACE Navigation project and make a determination as to whether or not the scope and information needs would be the same for both a Section 10 and Section 408 decision. The typical type of proposed activities within USACE Navigation projects in which it may be likely that the jurisdiction and scope would be the same for both Section 10 and Section 408 include proposals for electric transmission lines, boat docks, boat lifts, bulkheads, revetments, minor dredging, mooring buoys, mooring pilings, and other similar activities. In cases when the scope and jurisdiction of Section 10 and Section 408 do not completely align, separate authorizations under Section 10 and Section 408 are required. In addition, proposed activities that also would require authorization under Section 404 of the Clean Water Act outside the boundary of the activity that triggers Section 10 jurisdiction will require a separate Section 408 permission if one is needed. Districts should coordinate with the appropriate Regulatory office and Section 408 staff for clarification on jurisdiction.

b. For cases in which the scope and jurisdiction between Section 10 and Section 408 align, appropriate district staff for Regulatory will review the information submitted for the purposes of environmental compliance and the public interest review. Appropriate district staff for the USACE Navigation project will review the information for the purposes of determining impacts to the usefulness of the USACE Navigation project (e.g., compare the proposal to approved setback policies and/or overdepths). The district will ensure there is coordination between the Regulatory and Navigation staff in cases in which additional information may be needed from the requester to promote efficiency and reduce the burden on the requester.

c. The district staff evaluating impacts to the usefulness of the USACE Navigation project will document their findings in a Memorandum for Record (MFR) that will be provided to the district Regulatory staff for their use in the Section 10 permit evaluation and determination. The MFR will contain the rationale and basis for the impacts to the usefulness determination of the proposed activity on the USACE Navigation project, including any conditions that the applicant would be required to adhere to in order to ensure the continuance of no impacts to the usefulness of the USACE Navigation project. A determination that the alteration will not impair the usefulness of the project satisfies the requirement to ensure that the alteration is “compatible” with the purposes of the project set forth at 33 CFR 320.4(g)(5). Funding for district staff for the impact to the usefulness of the project determination and development of the MFR should come from project appropriated funds associated with the specific USACE Navigation project. Regulatory funds cannot be used for the development of the MFR. The USACE Navigation office is responsible for determining that the conditions in the MFR are enforceable and for enforcing such conditions in the Section 10 permit.

d. If the Section 10 authorization is approved, the Regulatory staff will ensure that any conditions specified in the MFR are included as conditions in the Section 10 permit document.

Note, the required standard terms and conditions in Appendix K will be the minimum conditions that will need to be included in the MFR and incorporated into the Section 10 permit. Also, Regulatory staff must include in the Section 10 permit document that is provided to the applicant the following statement: "It has been determined that the activities authorized do not impair the usefulness of the USACE Navigation project and is not injurious to the public interest."

G-5. Construction or Modification of Bridges over USACE Navigation Projects.

a. Federal law prohibits the construction of bridges over navigable waters of the United States unless first authorized by the U.S. Coast Guard (USCG) under one of its authorities within Title 33 of the U.S. Code, including Section 9 of the Rivers and Harbors Act of 1899. As part of its permit review process, the USCG will evaluate whether the construction or modification of a bridge will obstruct commercial and recreational navigation within the waterway. For bridges that cross a USACE navigation channel, the USCG bridge permit decision will be informed by USACE's determination under Section 408 whether the bridge will impact the usefulness of the navigation project.

b. In order to minimize duplication of effort among USACE and USCG's authorities, USACE districts should coordinate closely with the appropriate USCG personnel throughout the respective reviews, including issuance of concurrent or joint public notices (see paragraph 12.b) when feasible, and sharing information when a Navigation Impact Analysis is required for the USCG bridge permit review. USACE districts may use information provided to USCG as part of the bridge permit application package (see reference G-2.k.) to satisfy the basic requirements of a complete Section 408 request. When additional information is required from the requester to evaluate the Section 408 request, USACE districts should coordinate with the USCG to align, and not duplicate, those information needs.

c. For environmental compliance for bridges crossing USACE navigation channel, there is often another federal agency other than USACE or USCG that is the federal lead agency (such as the Federal Highway Administration). In those situations, USACE will assume a cooperating agency role as indicated in paragraph D-4.g. For situations in which either USCG or USACE is the lead agency, USACE and USCG will coordinate to conduct joint environmental compliance to the extent allowable, including the preparation of one NEPA document to inform both the USCG permit decision and the USACE Section 408 permission decision.

APPENDIX H

Hydrologic and Hydraulic System Analysis

H-1. Purpose. This appendix is intended to outline the requirements for a hydrologic and hydraulic (H&H) system analysis as referenced in paragraph 11.c.(2) of the main EC. The purpose of an H&H system analysis is to determine the potential hydrologic and hydraulic changes resulting from proposed Section 408 alterations. In general, these procedures focus on riverine situations, but analysis requirements can be tailored appropriately for interior systems, navigation systems, and coastal situations. Districts will determine whether an H&H system analysis is needed and, if so, the appropriate scope of analysis based on the complexity of the proposed alteration. The requester will be responsible for the analysis. This appendix describes how to perform an analysis and display the results when it has been determined that an H&H analysis is required.

H-2. References.

a. ER 1105-2-101, Risk Analysis for Flood Damage Reduction Studies.

b. EM 1110-2-1619, Risk-Based Analysis for Flood Damage Reduction Studies.

c. U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC), Hydrologic Modeling System HEC-HMS User's Manual, CPD-74A, Hydrologic Engineering Center, Davis, CA.

d. U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC), HEC-RAS River Analysis System User's Manual, CPD-68, Hydrologic Engineering Center, Davis, CA.

e. U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC), *HEC-ResSim Reservoir System Simulation, User's Manual*, CPD-82, Hydrologic Engineering Center, Davis, CA.

f. U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC), *HEC-FDA Flood Damage Reduction Analysis, User's Manual*, CPD-72, Hydrologic Engineering Center, Davis, CA.

g. U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC), *HEC-WAT Watershed Analysis Tool, User's Manual*, CPD-88, Hydrologic Engineering Center, Davis, CA.

H-3. Basic Requirements and Assumptions.

a. For the purposes of this appendix, the word "system" is an integrated combination of features, property, and environment that are influenced by the proposed alteration due to changes in the frequency, depth, duration, or extent of flooding. This includes hydrologic and hydraulic connections upstream, downstream, within a navigation system, or along the coast.

b. H&H system analyses will be applied to proposed alterations of federally authorized USACE projects that change the hydrologic and/or hydraulic conditions (e.g., changing the location or dimensions of levees or channels, changing reservoir operations, constructing bridges or roadways, etc.). Districts will determine the appropriate scope of the H&H analysis based on the complexity of the proposed alteration.

c. The H&H system analysis will consider flood events and hydraulic loading only. Infrastructure measures (dams, levee and floodwall systems, jetties, and channels) will be assumed to be stable and functional up to the top of containment, and no breaching will be assumed. Based on this assumption, system response curves are not required. Other factors such as changes in performance and consequences due to the H&H changes identified by this analysis will be determined based on other information and analyses beyond this H&H system analysis. All factors and information will be considered comprehensively to make the final Section 408 decision.

d. The hydraulic analysis will consider the full range of hydrologic loading conditions.

e. For loading conditions where flood waters exceed the system capacity, the analysis must include overtopping.

f. System impacts will be determined by comparing H&H results for the existing, authorized purpose, and with proposed alteration conditions. The district should try to identify and ensure that the analysis considers the effects of reasonably foreseeable and known future alterations and/or projects throughout the system in conjunction with the proposed alteration.

H-4. Evaluation Metrics. Results of the H&H system analysis must be presented in a way to assist the Section 408 decision-makers in understanding the impacts (i.e., consequences) of the H&H changes as a result of the proposed alteration. Results can be evaluated using either changes in median or expected values of various hydrologic and hydraulic parameters, or changes in assurance (i.e., uncertainty) about those values. To improve the understanding of the H&H changes of the proposed alteration, floodplain inundation maps showing flood depths and extent should be provided. The following are various H&H outputs that may be useful to display and determine H&H changes. Specific requirements will vary depending on the particular project and proposed modification.

a. Changes in water surface elevation.

b. Changes in Annual Exceedance Probability (AEP), where AEP is defined as the likelihood of a target water surface elevation being exceeded in any given year, based on the full range of possible flood events.

c. Changes in flow, velocity, frequency, and duration.

d. Changes in flood depth and flooding extent displayed on inundation maps.

H-5. Process.

a. The H&H system analysis will assess changes at the proposed alteration site and at all locations reasonably considered to be affected by the proposed alteration. The procedures described in this appendix are, in general, appropriate, with some adaptation to reflect the effects of hydraulic connectivity. Pre-approved software for analyses can be used, which include HEC-HMS (Ref. H-2.c), HEC-RAS (Ref. H-2.d), HEC-ResSim (Ref. H-2.e), HEC-FDA (Ref. H-2.f) and HEC-WAT (Ref. H-2.g). Use of any other software must be approved prior to application.

b. Methods for performing the H&H system analysis are flexible. One possible approach is described here, and follows the procedures outlined in EM 1110-2-1619 (Ref. H-2b).

(1) Step 1: Define the spatial extent of the system for which potential hydrologic and hydraulic changes must be assessed and select index locations within that extent for the H&H system analysis.

(a) The extent of the hydraulically interconnected system must be defined as the first step in an H&H system analysis. This extent must be broad enough to include channel reaches and floodplains downstream and upstream of the proposed alteration site that a reasonable analyst would expect to be influenced by changes in discharge or corresponding water surface elevation at the proposed alteration site. Within that extent, impact areas should be identified and index locations selected to allow assessment and reporting of changes. If initial findings show significant change at the outer extents represented by the selection of index locations, additional index points may be required out to the locations showing no change. Guidance for identifying impact areas and selecting index locations is included in the user's manual for the HEC-FDA (Ref. H-2.f) software and in EM 1110-2-1619 (Ref. H-2.b).

(b) Review of hydraulic model results will aid in determining the appropriate extent. For example, examination of computed water surface profiles will identify locations upstream or downstream of a proposed alteration site at which changes in the geometry at the site will have an impact on water surface elevations. Care must be exercised and results scrutinized to judge if changes in computed elevations are logically related to the changes in the geometry, or if changes seen in the model results are artifacts of computational precision limits or model instabilities. In some cases, downstream flows at a confluence will increase for a proposed alteration, but the increase will be due to a change in timing between contributing hydrographs. Consideration should be given to whether the change in timing would be expected to be reflected in historical events, or whether the change in timing is an artifact of the synthetic hydrology developed.

(2) Step 2: Identify the existing, authorized purpose, and with proposed alteration conditions for all features (e.g. levee, floodwall, channel, jetties, and/or dams) of that system to serve as the basis for assessing H&H changes of proposed alterations.

(3) Step 3: Collect or develop the necessary functions and transforms to compute existing, authorized purpose, and with proposed alteration conditions all index locations within the system. In addition to the various functions required for the H&H system analysis, the uncertainty about each function must be described. This task is completed following the general guidance presented in this appendix and EM 1110-2-1619 (Ref. H-2.b). However, current policy does not cover how to describe the uncertainty about functions that represent accumulated impacts. For example, the uncertainty about the unregulated to regulated discharge transform at a location downstream of multiple reservoirs must reflect the accumulated uncertainty about joint operation of those reservoirs. If the district needs assistance in determining accumulated impacts, districts should consult experts at Engineer and Research Development Center Hydrologic Engineering Center (HEC), or engage the division and HQUSACE. All three conditions should be evaluated as part of the H&H system analysis.

(4) Step 4: Assess the H&H results, reference paragraph H-3.f, of the existing, authorized purpose, and with proposed alteration conditions at all index locations. H&H results are computed location by location within the extent of the system. Analysis needed in this step will depend upon the proposed alteration. For example, if the alteration includes the addition of flood storage or changes to the manner in which available storage is operated, a reservoir system simulation model such as HEC-ResSim (reference H-2.e) may be developed and run with a period of record or selected hypothetical events. Through this model, a new unregulated to regulated discharge transform can be developed. Similarly, if the proposed alteration includes changes to the project geometry, for example through levee setbacks, these changes must be simulated to derive new transforms for downstream locations. Those transforms may change as a result of the project geometry changes. Results may be reported as described in paragraph H-4.

(5) Step 5: Determine the changes in H&H conditions by comparing hydrologic and hydraulic results system-wide for the existing, authorized, and with proposed alteration cases. Once various results of hydrologic and hydraulic conditions are computed and reported, system-wide H&H changes of a proposed alteration can be assessed. For proposed alterations that reduce the likelihood of inundation, the AEP will be less and confidence in reduction in likelihood of inundation will be greater. However, outcomes may vary across all index locations within the system; therefore, all index locations must be assessed.

APPENDIX I

Funding Agreements

I-1. Purpose. The purpose of this appendix is to provide guidance on the establishment, management, and oversight of funding agreements under applicable statutory authorities that allow the US Army Corps of Engineers (USACE) to accept and expend funds to expedite requests to alter USACE Civil Works projects pursuant Section 408. This appendix describes the specific requirements applicable to acceptance of contributed funds and development of funding agreements under each authority.

I-2. References.

a. 25 USC 479a, Publications of List of Recognized Tribes

b. Section 1156(a)(2) of WRDA 2016, Contributed Funds (33 USC 408(b)(3))

c. 23 USC 139(j), Efficient Environmental Reviews for Project Decision-Making

d. Section 214 of WRDA 2000 (Public Law 106-541), as amended (33 USC 2352)

e. Section 404 of the Clean Water Act, Permits for Dredged or Fill Material (33 USC 1344)

f. Section 10 of the Rivers and Harbors Act of 1899, Obstruction of Navigable Waters, Generally; Wharves, Piers, and Excavations and Filling In (33 USC 403)

g. 10 USC 2695, Acceptance of Funds to Cover Administrative Expenses Relating to Certain Real Property Transactions

h. US Army Corps of Engineers, Implementation Guidance for Section 1125 of the Water Resources Development Act of 2016 - Use of Funding Agreements within the Regulatory Program, Memorandum, 19 January 2018.

I-3. Policies for All Authorities.

a. The provision of funds for a Section 408 review by USACE under any of these authorities is voluntary, and all requesters will receive a fair and timely review of their Section 408 request regardless of whether they have contributed funds to USACE for the evaluation or not.

b. The acceptance and expenditure of funds will not impact impartial decision making at any level with respect to the evaluation and any final decision, either substantively or procedurally. The USACE review of the Section 408 request must comply with all applicable laws, regulations, and procedures.

c. In general, funds should be accepted under one authority only. In the event that funds will be accepted under more than one authority, separate agreements should be executed and there should be no duplication of activities to be funded between the agreements.

d. Acceptable Uses of Funds. In general, except as noted in paragraph I-3.e., the funds can be used for all activities related to the USACE review of a Section 408 request, including pre-coordination and review activities. Prior to expending funds on any activity, the district must determine that the activity contributes to meeting the specific purpose of the appropriate authority as indicated in this appendix.

e. General Limitations for Funds Accepted for Reviews Under 33 USC 408.

(1) In order to preserve impartial decision making, the funds cannot be used by the final decision-maker for his or her review, recommendations, or decision concerning a Section 408 request.

(2) The funds cannot be used for compliance and enforcement activities. Enforcement activities must be charged to the applicable appropriations account based on the USACE Civil Works project.

(3) The funds cannot be used for Section 408 review activities related to non-federal hydropower development.

(4) The funds cannot be used to cover the administrative expenses incurred in processing a Covered Transaction (such as an easement, or a lease or a license of real property of the United States) under 10 USC 2695 or cost incurred for activities outlined in 30 USC 185(1). Costs associated with these administrative expenses will be recovered under 10 USC 2695 and 30 USC 185(1).

(5) The funds cannot be used to prepare documents or products for the Section 408 requester.

f. Acceptance of Contributed Funds and Accountability.

(1) The funds accepted and expended under a funding agreement, regardless of authority, must be accounted for and tracked to ensure that they are expended for their intended purpose. Receipt and expenditure of funds will be tracked by a separate account in the Corps of Engineers Financial Management System.

(2) Contributed funds will be recorded in 096X8862 as a cost-share control record (CSCR) and collect type code LCSA. The cost share advance account will cite AMSCO 190093 and CCS 408. The cost share control record must link to a zero dollar federal funding account citing

appropriation 096X3123 and CCS 408. Funding agreements for Regulatory permits are processed differently. There may be cases when there is one funding agreement that covers Section 408 and Regulatory actions. In these cases, the two different processes should still be followed for the funding amount pertaining to each program. In other words, the funding associated with Section 408 activities will use the process described above, and the funding associated with Regulatory permit actions will be processed using different procedures.

(3) Section 408 Coordinators must maintain copies of all funding agreements in the Section 408 database even after completion or closure.

(4) Section 408 Coordinators will be accountable for reporting to HQUSACE annually on the status of any active funding agreements within their area of responsibility when requested. Requirements for reporting are specific to the authority for the funding agreement and are outlined in the paragraphs below for each authority.

I-4. Section 1156(a)(2) of WRDA 2016.

a. Section 1156(a)(2) of WRDA 2016, among other things, further amends Section 14 of the Rivers and Harbors Act of 1899 (33 USC 408; referred to as Section 408) to authorize the Secretary of the Army to accept and expend funds received from non-federal public or private entities to evaluate requests under Section 408 for an alteration or permanent occupation or use of a work built by the United States.

b. Following the process in this appendix, District and Division Commanders may accept and expend funds from non-federal public or private entities to expedite the evaluation of Section 408 requests. Expediting the review process could include generally shorter review times as compared to prior to the agreement and the facilitation of a smoother review process through improved coordination and communication or through the development or use of programmatic agreements or standard operating procedures.

c. The template agreement for the acceptance of funds for the evaluation of Section 408 requests is posted on the USACE agreements website, under “Agreement Templates.” The template agreement may be modified as appropriate to address case-specific circumstances. In addition, it may be modified to cover multiple Section 408 requests by a single requester. Following district counsel or division counsel review and concurrence that the negotiated agreement is acceptable, the District Commander or Division Commander, respectively, may approve and sign the agreement.

d. Authority under Section 1156(a)(2) is limited to the acceptance of funds from non-federal public and private entities. Other federal agencies cannot provide USACE with funding under this authority. If the non-federal public or private entity is providing funds that it received from another federal agency, it must provide written confirmation from that federal agency that the funds are authorized to be used for the Section 408 evaluation.

e. Funds accepted under Section 1156(a)(2) cannot be used to cover the review of related Section 10/404/103 permit decisions.

f. Section 408 Coordinators will be accountable for reporting to HQUSACE when requested on the status of any active Section 1156(a)(2) agreements within their area of responsibility.

I-5. Section 214 of WRDA 2000.

a. Section 214, as amended (33 USC 2352) provides that the Secretary of the Army, after public notice, may accept and expend funds contributed by a non-federal public entity, natural gas company, public utility company, or railroad carrier to expedite the permit review process for that entity, company, or carrier for projects or activities that have a public purpose. The authority to accept and expend funds from non-federal public entities does not expire, unless modified by law. The authority to accept and expend funds from public-utility companies, natural gas companies, and railroad carriers expires on June 10, 2024, unless otherwise extended or revoked by law.

b. District and Division Commanders have delegated authority to accept and expend funds under Section 214. These delegations of authority remain in effect until 10 June 2024, unless revoked or superseded.

c. Acceptable Entities. Funding agreements under to Section 214 may be executed with the following entities. Further information on acceptable entities under Section 214 is available in reference I-2.h.

(1) Non-Federal Public Entities. The term “non-federal public entity” is limited to governmental agencies or governmental public authorities, including governments of federally recognized Indian tribes, i.e., any Indian or Alaska Native Tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Indian Tribe List Act of 1994 [25 USC 479(a)].

(2) Public-Utility Companies. Public-utility companies include the following two subcategories: (i) electric utility companies, which are companies that own or operate facilities used for the generation, transmission, or distribution of electric energy for sale; and (ii) gas utility companies, which are companies that own or operate facilities used for distribution at retail of natural or manufactured gas for heat, light, or power (other than the distribution only in enclosed portable containers or distribution to tenants or employees of the company operating such facilities for their own use and not for resale.

(3) Natural Gas Companies. Section 214 also allows for funding agreements to be entered into with a natural gas company. A natural gas company is a company engaged in the

transportation of natural gas in intrastate or interstate commerce or the sale of such gas in interstate commerce for resale.

(4) Railroad Carriers. The term "railroad carriers," is defined at Title 49 USC 20102 as a person providing railroad transportation, or, as approved by the Secretary of Transportation, a group of commonly controlled railroad carriers operating within the United States as a single, integrated rail system. "Railroad" means any form of non-highway ground transportation that runs on rails or electromagnetic guideways, including: a) commuter or other short-haul railroad passenger service in a metropolitan or suburban area; and b) high speed ground transportation systems that connect metropolitan areas, without regard to the technologies used for the system; but c) does not include rapid transit operations in an urban area that are not connected to the general railroad system of transportation. Districts may consult with the regional Federal Railroad Administration office if there is uncertainty as to whether a particular entity qualifies as a railroad carrier.

(5) There is no expiration of the authority to accept and expend funding from entities that meet the definition of non-federal public entity, unless modified by law. The authority to accept and expend funding from entities that meet the definition of public utility company, natural gas company, and railroad carrier expires on June 10, 2024, unless otherwise extended or revoked by law.

d. General Guidance. Activities conducted under a Section 214 agreement must expedite the Section 408 review process. Expediting the review process could include generally shorter review times as compared to prior to the agreement and the facilitation of a smoother review process through improved coordination and communication or through the development or use of programmatic agreements or standard operating procedures. The expedited review cannot result in an adverse effect on the timeframes for review of other Section 408 requests within the same district, when considered collectively.

e. Public Purpose. Funding can only be accepted and expended through Section 214 funding agreements to expedite a Section 408 review if the proposed alteration serves a public purpose. Districts must evaluate proposed agreements from non-federal public entities to ensure that the proposed activities needing Section 408 permission serve a public purpose, and districts have discretion in making that determination. It is recognized and allowable that funds provided under a Section 214 agreement with a non-federal public entity may potentially originate from a private entity or a combination of public and private entities, so long as it is verified that the proposed alteration would serve a public purpose.

f. Agreement Development and Decision.

(1) Initial Public Notice for Intent to Accept Funds.

i. Prior to accepting and expending funds, the division or district must issue a public notice, post the public notice in a clearly identified and easily accessible area (e.g., “Acceptance of Funds for Expediting Section 408 Requests”) on its webpage, and distribute the notice to concerned agencies, organizations, and the interested public. Further information on public purpose within the context of Section 214 is available in reference I-2.h. The district or division should consider if the purpose of this public notice can be combined with the purposes of other public notices that may be also be required, reference paragraph 12.b. of the main EC.

ii. The public notice will describe the entity providing such funds, the USACE authority to accept and expend such funds, the reason for such contributions, how acceptance of the funds is expected to expedite the Section 408 review process, what types of activities the funds will be expended on, what procedures will be in place to ensure that the funds will not impact the division or district’s impartial decision making, and information on the impacts, if any, to the review process for Section 408 requests within that division or district. Further, if funds are also intended to be accepted or have been accepted to expedite the evaluation of Section 10/404/103 permit applications for the same proposed alteration and/or by the same non-federal public entity, such intention should be clearly stated in the public notice or a joint public notice developed, if feasible. The public notice must also include information on the impacts of the proposed funding agreement on the division or district’s ability to review other Section 408 requests.

(2) Basis for Acceptance of Funds.

i. Following the review of the comments received in response to the public notice, the Division or District Commander will determine if the acceptance and expenditure of funds is appropriate in consideration of the requirements under the applicable statutory authority, if the division or district will be able to preserve impartial decision making, and if the acceptance and expenditure of funds will not adversely affect review timeframes for other Section 408 requests. A final draft of a funding agreement, see paragraph I-5.f.(3), must be completed to inform this decision.

ii. If the Division or District Commander determines, after considering public comments, that the acceptance and expenditure of the funds is appropriate, the funds may be accepted and expended. This decision will be documented in a Memorandum for Record (MFR). An informational public notice will be issued regarding the Division or District Commander's decision. The division or district will post the informational public notice on its webpage in the same, easily identifiable and accessible area used for the initial public notice and distribute the notice to concerned agencies, organizations, and the interested public.

(3) Acceptance of Funds.

i. Funds may only be accepted after the finalization of the decision MFR and issuance of the public notice of the execution of the funding agreement. Funding agreements will typically be executed in the format of a Memorandum of Agreement (MOA). At a minimum, the agreement must include a scope of work and an itemized budget estimate, address the provision of additional funds if needed, as well as the return of unused funds, and must identify the total annual cost for each federal fiscal year covered by the term of the MOA. The itemized budget estimate must include identification of personnel, hourly rates, indirect labor costs, estimated hours of work, and travel costs related to the MOA scope of work.

ii. Issuance of a new public notice is not required for renewal or modification of a funding agreement if the purpose of the agreement remains the same. For example, a new public notice would not be required if the MOA is amended to extend the term of the agreement, modify the proposed alteration identified in the MOA, or adjust the terms of the advance payment contemplated under the MOA. The decision and basis for the renewal or modification should be documented in the MFR described in paragraph I-5.f.(2).

g. No funds provided by a federal agency to a non-federal public entity may be accepted by USACE under Section 214 unless the non-federal public entity forwards to USACE a written confirmation from the federal agency that the use of the funds to expedite the review of the Section 408 request is acceptable.

h. Transparency. Legal requirements under Section 214 require making certain information publicly available on the internet including final decisions and copies of funding agreements. Section 408 Coordinators must ensure timely data entry on Section 408 decisions and maintain copies of all funding agreements in the Section 408 database, even after completion or closure, to facilitate these transparency requirements.

i. Annual Reporting. On an annual basis, HQUSACE will provide an annual report to the Assistant Secretary of the Army for Civil Works (ASA(CW)), including a summary of the use of funding agreements executed under Section 214 and 22 USC 139(j), see paragraph I-6. The ASA(CW) will submit the combined annual report to the specified Congressional committees. Within 30 calendar days of the conclusion of each fiscal year, district and division Section 408 Coordinators will provide to the HQUSACE Section 408 proponent the following:

(1) A list of all active Section 214 and Section 139(j) funding agreements during the subject fiscal year, including the date in which the agreement was initiated and whether Section 214 or Section 139(j)was used;

(2) An accounting of the total funds accepted and total funds expended per funding agreement; and,

(3) A list of all Section 408 decisions issued for the subject fiscal year under each funding agreement.

(4)

I-6. 23 USC 139(j).

a. Section 139(j) provides that the Secretary of Transportation may approve a request by certain public entities that receive financial assistance from the USDOT to provide funds to affected federal agencies participating in the environmental review process to support activities that directly and meaningfully contribute to expediting and improving permitting and review processes.

b. Acceptable Entities. Section 139(j) allows USACE to enter into agreements with public entities receiving financial assistance from the Department of Transportation under Title 23 or chapter 53 of Title 49, which are typically administered by the FHWA and the Federal Transit Administration (FTA), respectively. Section 139(j) agreements require approval by the Secretary of Transportation, as public entities are eligible to receive reimbursement with federal aid funds for these agreements. The Secretary of Transportation has delegated approval of funding agreements down to the division level of FHWA and FTA. The USDOT has not interpreted Section 139(j) as allowing other modal administrations (such as Federal Aviation Administration or Maritime Administration) to support agreements with public entities. If there is any uncertainty regarding whether an entity is eligible for a funding agreement under Section 139(j), the entity and/or the district should consult the USDOT operating administration from which the entity receives financial assistance.

c. General Guidance. Activities conducted under a Section 139(j) agreement must directly and meaningfully contribute to expediting and improving permitting and review processes, including planning, approval, and consultation processes, for the transportation project or program. In addition, Section 139(j) funds may only be used for activities beyond USACE's normal and ordinary capabilities under its general appropriations. Because transportation project planning and delivery encompasses a variety of activities and reviews, participation in the transportation planning (pre-NEPA) process and streamlining initiatives such as NEPA/Section 408 synchronization efforts are encouraged under Section 139(j), so long as those activities result in review times that are less than the customary time necessary for such a review. FHWA has provided guidance that the development of programmatic agreements and initiatives satisfies the requirement to reduce time limits as long as the results of those efforts are designed to provide a reduction in review time. Section 139(j) puts the onus on FHWA and FTA to interpret allowable activities under the statute. Districts will consider FHWA or FTA's approval of a funding agreement as certification that the agreement is compliant with Section 139(j). Section 139(j) agreements must also meet USACE's standards and requirements contained in this appendix.

(1) FHWA or FTA may require documentation of the "customary time" necessary for a review and/or establishment of performance metrics for the agreement to demonstrate it is contributing to expediting and improving transportation project planning and delivery. Districts have discretion on the number and type of performance metrics within an agreement, including which milestones to use to determine time in review (receipt of request, date determined complete, etc.). When considering the quantity and content of any performance metrics for an

agreement, the district must consider the potential effect of those metrics on performance management within the whole district. Districts must be cautious to not agree to any performance metrics that would be so onerous or stringent that achieving them comes at the cost of decreased performance for other Section 408 requests in the district.

(2) A Section 139(j) funding agreement between the district(s) or division(s) and the funding transportation agency must include the projects and priorities to be addressed by the agreement. If the funding transportation agency does not know a list of projects and/or priorities at the time of the agreement, then the funding agreement should describe the process to identify or change projects and/or priorities for the agreement.

d. Agreement Development and Decision. Districts will follow the same policy and procedures for establishing agreements under Section 139(j) as what is used for agreements under Section 214.

e. Annual Reporting. Districts will follow the same procedures for annual reporting for funding agreements under Section 139(j) as what is used for agreements under Section 214, reference paragraph I-5.i.

APPENDIX J

Example Letters

J-1. Purpose. This appendix contains example response letters and an example decision letter. These letters can be modified as necessary to fit each Section 408 request.

J-2. Completeness Determination Letter. This letter is sent to a requester no later than 30 days of receipt of a submittal of information supporting a Section 408 request to inform the requester whether the Section 408 request or a specific milestone for the Section 408 request (for multi-phased reviews) is complete or not. This letter can also be used and modified as necessary to inform the requester of completeness for validation under a categorical permission.

(District Letterhead)
(Date here)

(*Name and address of requester here*)
[Mr./Ms.] *(Full Name of Requester)*
(Title of Requester)
(Requester Address)
(City, State Abbreviation, and Zip Code)

Section 408 Request Number: ___*(Database ID)*___

Dear [Mr./Ms.] *(Last Name of Requester),*

The ___(*district name here*)_____ District ("District") of the U.S. Army Corps of Engineers (USACE) has received your request to __(*brief description of proposed alteration*)_ the ___(*name of USACE project to be altered*)__ operated and maintained by _(*name (s) of non-federal sponsor (s) and/or USACE*)___ under Section 14 of the Rivers and Harbors Act of 1899, 33 USC 408 (Section 408).

(*If incomplete include the following.)* The District has reviewed your submittal consistent with Engineer Circular (EC) 1165-2-220, to determine whether the Section 408 *(insert "milestone" for multi-phased reviews)* request is complete and is ready for USACE review and decision. We have determined that your Section 408 *(insert "milestone" for multi-phased reviews)* request is incomplete and request that you submit the following additional information:

(Describe required information needed in bullet point format using the below basic requirements

from paragraph 11 of this EC as a framework. Districts can delete those bullet point categories that have been satisfied or are not applicable. Districts can add supplemental information as enclosures if needed to help clarify what information is needed.)

- Statement of No Objection –
- USACE Project and Alteration Description –
- Technical Analysis and Design –
- Environmental and Cultural Resource Compliance –
- Real Estate Requirements –
- Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) –
- Crediting

Please submit the above information to *(Insert appropriate contact information such as organization code and address)* and include the Section 408 Request Number: *(Insert Database ID for this request)* with your information. For questions regarding your Section 408 request, please contact *(name and title of district Section 408 point of contact here)* at *(contact information here)*.

(*If complete, include the following.)* The District has reviewed your submittal consistent with Engineer Circular (EC) 1165-2-220 and has determine that you your Section 408 *(insert "milestone" for multi-phased reviews)* request is complete and will proceed to USACE review and decision. The District expects to render a decision on your Section 408 *(insert "milestone" for multi-phased reviews)* request within 90 days *(provide new timeline and explanation if 90 days cannot be met)* of the date on this letter. You will be notified if additional information is needed to complete the review and decision and/or if the review and decision to exceed the 90 day timeline. If you have questions regarding your Section 408 request, please contact (*name and title of district Section 408 point of contact here*) at (*contact information here*).

Sincerely,
(Name of signatory)

(*district name here*)
U.S. Army Corps of Engineers

Enclosures (*Attach supplemental documentation as needed).*

J-3. Potential Multi-phased Review Option. This letter is sent to a requester no later than 30 days of receipt of a submittal of information supporting a Section 408 request that would benefit from the multi-phased review option. This response letter is to inform the requester that they will be contacted for further discussion and planning.

(District Letterhead)
(*Date here*)

(*Name and address of requester here*)
[Mr./Ms.] *(Full Name of Requester)*
(Title of Requester)
(Requester Address)
(City, State Abbreviation, and Zip Code)

Section 408 Request Number: ___*(Database ID)*___

Dear [Mr./Ms.] *(Last Name of Requester)*,

The __(*district name here*)_____ District ("District") of the U.S. Army Corps of Engineers (USACE) has received your request to __(*brief description of proposed alteration*) the __(*name of federal project to be altered*)__ operated and maintained by _(*name (s) of non-federal sponsor (s) and/or USACE*)__ under Section 14 of the Rivers and Harbors Act of 1899, 33 USC 408 (Section 408).

Based on the scope, scale, or complexity of the proposed alteration, the District recommends a multi-phased review approach for processing your request. This option allows for information to be submitted with different levels of detail at pre-determined milestones progressing to a Section 408 decision. You will be contacted by *(insert anticipated timeframe)* to further discuss this option.

For any questions regarding this letter, please contact (*name and title of district Section 408 point of contact here*) at (*contact information here*).

Sincerely,
(Name of signatory)

______(*district name here*)______
U.S. Army Corps of Engineers

J-4. Multi-Phased Review Milestone Approval Letter. This letter is used to communicate a conditional approval of a milestone within a multi-phased review proves with the exception of the final decision milestone. Note that the language in boldface is needed for legal sufficiency of a conditional approval and should not be substantively modified or deleted. If the decision is to deny a milestone, then a Section 408 final decision letter expressing denial of permission may be used.

(District Letterhead)
(*Date here*)

(*Name and address of requester here*)
[Mr./Ms.] *(Full Name of Requester)*
(Title of Requester)
(Requester Address)
(City, State Abbreviation, and Zip Code)

Section 408 Request Number: ___*(Database ID)*___

Dear [Mr./Ms.] *(Last Name of Requester)*,

The __(*district name here*)______ District ("District") of the U.S. Army Corps of Engineers (USACE) has completed an evaluation of the milestone of your request to (*brief description of proposed alteration*)__to (*name of USACE project to be altered*)__operated and maintained by ___(*name (s) of non-federal sponsor (s) and/or USACE* under Section 14 of the Rivers and Harbors Act of 1899, 33 USC 408 (Section 408).

The District has reviewed your submittal consistent with Engineer Circular (EC) 1165-2-220. Based on the information provided to date, it appears that (*describe the work that is being conditionally approved*) is consistent with the requirements under Section 408. The District hereby grants conditional approval to advance to the next milestone of the Section 408 request. (*Insert any special conditions or additional requirements the requester needs to comply with to* *proceed to the next milestone.*)

Note that this milestone approval is based on the information you provided for this milestone submittal. If the information you provided in support of this milestone proves to have been false, incomplete, or inaccurate, or if significant new information surfaces which USACE did not consider in reaching this milestone decision, USACE reserves the right to reevaluate, and potentially revoke, this conditional approval. Further, this conditional approval does not comprise permission under Section 408 to alter the USACE project. USACE reserves the right to approve or deny future milestones of this Section 408 request based on further evaluation.

For any questions regarding this decision, please contact (*name and title of district Section 408 point of contact here*) at (*contact information here*).

Sincerely,
(Name of signatory)

(*district name here*)
U.S. Army Corps of Engineers

Enclosures (*Attach supplemental documentation as needed).*

J-5. Decision Delay Letter. This letter is used to communicate to the requester when USACE will be unable to render a decision on the Section 408 request within 90 days of the completeness determination. This letter can be used with single-phase reviews, multi-phase reviews, and categorical permissions, and should be sent as soon as the District anticipates that the 90-day timeline cannot be achieved and has determined an alternate target date for rendering a decision. If the district knows at the time of the completion determination that the 90-day timeline cannot be met, then notifications should be combined versus sending multiple letters. For those Section 408 requests that require division level review and decision, the letter can be modified accordingly.

(District Letterhead)
(*Date here*)

(*Name and address of requester here*)
[Mr./Ms.] *(Full Name of Requester)*
(Title of Requester)
(Requester Address)

(City, State Abbreviation, and Zip Code)

Section 408 Request Number: ___*(Database ID)*___

Dear [Mr./Ms.] *(Last Name of Requester)*,

The __(*district name here*)_____ District ("District") of the U.S. Army Corps of Engineers (USACE) is reviewing your request to __(*brief description of proposed alteration*) to (*name of federal project to be altered*) operated and maintained by (*name (s) of non-federal sponsor (s) and/or USACE*) under Section 14 of the Rivers and Harbors Act of 1899, 33 USC 408 (Section 408). This evaluation is being performed according to Engineer Circular (EC) 1165-2-220.

The District anticipates it will be unable to render a decision on your Section 408 request within 90 days of receipt of the completion determination dated *(insert date of the completion determination)*. Additional time is needed to ____(*summarize rationale for exceeding 90 day decision timeline*)_______. The District anticipates rendering a decision *(insert either "*within xx days of this letter*" or "*by date*").*

For any questions regarding your Section 408 request, please contact (*name and title of district Section 408 point of contact here*) at (*contact information here*).

Sincerely,
(Name of signatory)

______(*district name here*)______
U.S. Army Corps of Engineers

Enclosures (*Attach supplemental documentation as needed).*

J-6. Section 408 Final Decision Letter. This letter is used to communicate the decision to grant or deny permission under Section 408. It can be used with a single-phase review or for the final milestone of a multi-phased review.

(District Letterhead or Division Letter)
(*Date here*)

(*Name and address of requester here*)
[Mr./Ms.] *(Full Name of Requester)*
(Title of Requester)
(Requester Address)
(City, State Abbreviation, and Zip Code)

Section 408 Request Number: ___*(Database ID)*___

Dear [Mr./Ms.] *(Last Name of Requester),*

The __(*district or division name here*)_____ [District or Division] of the U.S. Army Corps of Engineers (USACE) has completed its review of your request to __(*brief description of proposed alteration*)_ to _(*name of federal project to be altered*)___operated and maintained by _(*name (s) of non-federal sponsor (s) and/or USACE*)__under Section 14 of the Rivers and Harbors Act of 1899, 33 U.S.C. 408 (Section 408). This evaluation was performed consistent with Engineer Circular (EC) 1165-2-220.

(*If granting permission, use the following)* Based on this evaluation, the [District or Division] is granting permission to (*describe the approved alteration work in detail*) as specified in your request and subject to compliance with the terms and conditions below and attached.

> (*Insert any additional special conditions necessary to ensure the alteration is not injurious to the public interest; does not impair the usefulness of the authorized project; and/or for environmental compliance purposes. Also attach a copy of the standard terms and conditions in Appendix K.)*

(If denying permission, use the following). Based on this evaluation, the District or Division is denying your request to (*describe the rejected alteration work in detail*). Your request cannot be approved at this time because *(Simply describe the main reason(s) why we are unable to grant permission. If appropriate, indicate the ability for the requester to revise his/her proposal and submit a new request for Section 408 permission.)*

For any questions regarding your Section 408 permission decision, please contact (*name and title of district Section 408 point of contact here*) at (*contact information here*).

Sincerely,
(Name of District or Division Commander or

other decision-maker with delegated authority)

______(*district name here*)_____
U.S. Army Corps of Engineers

Enclosures (*Attach supplemental documentation as needed).*

J-7. Categorical Permission Validation Letter. This letter is used to communicate validation (approval) of use of a categorical permission to the requester. Districts should attach a copy of the standard terms and conditions for the categorical permission to this letter.

(District Letterhead or Division Letter)
(Date here)

(*Name and address of requester here*)
[Mr./Ms.] *(Full Name of Requester)*
(Title of Requester)
(Requester Address)
(City, State Abbreviation, and Zip Code)

Section 408 Request Number: ___*(Database ID)*___

Dear [Mr./Ms.] *(Last Name of Requester)*,

The ___(*district or division name here*)_____ [District or Division] of the U.S. Army Corps of Engineers (USACE) has completed its evaluation of your request to ___(*brief description of proposed alteration*)___to (*name of federal project to be altered*)___operated and maintained by ___(*name (s) of non-federal sponsor (s) and/or USACE*)___under Section 14 of the Rivers and Harbors Act of 1899, 33 U.S.C. 408 (Section 408). This evaluation was performed consistent with Engineer Circular (EC) 1165-2-220.

Your request to (*describe the approved alteration work in detail*) has been validated for use with *(Insert name of District and/or title of the categorical permission)* Categorical Permission, subject to compliance with the terms and conditions below and attached.

(*Insert any additional special conditions necessary to ensure the alteration is not injurious to the public interest; does not impair the usefulness of the authorized project; and/or for* *environmental compliance purposes. Also attach a copy of the standard terms and conditions in Appendix K and the terms and conditions specific to the categorical permission.)*

For any questions regarding your Section 408 permission decision, please contact (*name and title of district Section 408 point of contact here*) at (*contact information here*).

Sincerely,
(Name of District Commander or other decision-maker with delegated authority)

______(*district name here*)______
U.S. Army Corps of Engineers

Enclosures (*Attach a copy of the standard terms and conditions in Appendix K and the terms and conditions of the categorical permission).*

APPENDIX K

Standard Terms and Conditions

This appendix includes the standard conditions that must be included in all Section 408 approval notifications, except where marked as optional. Use of optional conditions should be based on scope and scale of the approved activity:

LIMITS OF THE AUTHORIZATION

1. This permission only authorizes you, the requester, to undertake the activity described herein under the authority provided in Section 14 of the Rivers and Harbors Act of 1899, as amended (33 USC 408). This permission does not obviate the need to obtain other federal, state, or local authorizations required by law. This permission does not grant any property rights or exclusive privileges, and you must have appropriate real estate instruments in place prior to construction and/or installation.
2. The time limit for completing the work authorized ends on __________. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.
3. Without prior written approval of the USACE, you must neither transfer nor assign this permission nor sublet the premises or any part thereof, nor grant any interest, privilege or license whatsoever in connection with this permission. Failure to comply with this condition will constitute noncompliance for which the permission may be revoked immediately by USACE.
4. The requester understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration of the work herein authorized, or if, in the opinion of the Secretary of the Army or an authorized representative, said work will cause unreasonable conditions and/or obstruction of USACE project authorized design, the requester will be required upon due notice from the USACE, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim can be made against the United States on account of any such removal or alteration.

INDEMNIFICATION AND HOLD HARMLESS

5. The United States will in no case be liable for:
    a. any damage or injury to the structures or work authorized by this permission that may be caused or result from future operations undertaken by the United States, and no claim or right to compensation will accrue from any damage; or
    b. damage claims associated with any future modification, suspension, or revocation

of this permission.

6. The United States will not be responsible for damages or injuries which may arise from or be incident to the construction, maintenance, and use of the project requested by you, nor for damages to the property or injuries to your officers, agents, servants, or employees, or others who may be on your premises or project work areas or the federal project(s) rights-of-way. By accepting this permission, you hereby agree to fully defend, **indemnify,** and **hold harmless** the United States and USACE from any and all such claims, subject to any limitations in law.
7. Any damage to the water resources development project or other portions of any federal project(s) resulting from your activities must be repaired at your expense.

REEVALUATION OF PERMISSION

8. The determination that the activity authorized by this permission would not impair the usefulness of the federal project and would not be injurious to the public interest was made in reliance on the information you provided.
9. This office, at its sole discretion, may reevaluate its decision to issue this permission at any time circumstances warrant, which may result in a determination that it is appropriate or necessary to modify or revoke this permission. Circumstances that could require a reevaluation include, but are not limited to, the following:
   a. you fail to comply with the terms and conditions of this permission;
   b. the information provided in support of your application for permission proves to have been inaccurate or incomplete; or
   c. significant new information surfaces which this office did not consider in reaching the original decision that the activity would not impair the usefulness of the water resources development project and would not be injurious to the public interest.

CONDUCT OF WORK UNDER THIS PERMISSION

10. You are responsible for implementing any requirements for mitigation, reasonable and prudent alternatives, or other conditions or requirements imposed as a result of environmental compliance.
11. Work/usage allowed under this permission must proceed in a manner that avoids interference with the inspection, operation, and maintenance of the federal project.
12. In the event of any deficiency in the design or construction of the requested activity, you are solely responsible for taking remedial action to correct the deficiency.
13. The right is reserved to the USACE to enter upon the premises at any time and for any purpose necessary or convenient in connection with government purposes, to make inspections, to operate and/or to make any other use of the lands as may be necessary in connection with government purposes, and you will have no claim for damages on

account thereof against the United States or any officer, agent or employee thereof.

14. You must provide copies of pertinent design, construction, and/or usage submittals/documents. USACE may request that survey and photographic documentation of the alteration work and the impacted project area be provided before, during, and after construction and/or installation.
15. You may be required to perform an inspection of the federal project with the USACE, prior to your use of the structure, to document existing conditions.
16. USACE shall not be responsible for the technical sufficiency of the alteration design nor for the construction and/or installation work.
17. (optional, at the discretion of the district) Once permission is granted, you must notify the USACE District at least ________ (__) days before work/usage is started so that post-permission over sight can be performed by USACE.
18. (optional, at the discretion of the district) You must schedule a final inspection with the USACE within ________ (__) days after completion of the work/usage.
19. (optional, at the discretion of the district) You must submit a copy of "as-built" drawings within ________ (__) days of completion of work showing the new work as it relates to identifiable features of the federal project.

APPENDIX L

Terms and Abbreviations

AEP	Annual Exceedance Probability
ASA(CW)	Assistant Secretary of the Army for Civil Works
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWBI	Civil Works Business Intelligence
DSO	Dam Safety Officer
DSOG	Dam Safety Oversight Group
EA	Environmental Assessment
EC	Engineer Circular
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ERDC	Engineer and Research Development Center
ESA	Endangered Species Act
FAST-41	Title 41 of the Fixing America's Surface Transportation Act
FCA	Flood Control Act
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
FTA	Federal Transit Administration
H&H	Hydrology and Hydraulics
HEC	Hydrologic Engineering Center
HQUSACE	Headquarters USACE
LSO	Levee Safety Officer
LSOG	Levee Safety Oversight Group
LSPM	Levee Safety Program Manager
M&I	Municipal and Industrial
MFR	Memorandum for Record
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program

NHPA	National Historic Preservation Act
NID	National Inventory of Dams
NLD	National Levee Database
NOAA	National Oceanic and Atmospheric Administration
O&M	Operation and Maintenance
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
PL	Public Law
QCP	Quality Control Plan
RIT	Regional Integration Team
RMC	Risk Management Center
RMO	Review Management Organization
ROD	Record of Decision
SAR	Safety Assurance Review
SLOPES	Standard Local Operating Procedures for Endangered Species
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
WCM	Water Control Manual
WRDA	Water Resources and Development Act
WRRDA	Water Resources Reform and Development Act
WSA	Water Supply Act

APPENDIX K
MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT
AMONG
THE CITY OF MEMPHIS, SHELBY COUNTY, THE MEMPHIS AND SHELBY COUNTY PORT COMMISSION, THE MEMPHIS LIGHT, GAS AND WATER DIVISION, AND THE TENNESSEE VALLEY AUTHORITY

THIS **MEMORANDUM OF AGREEMENT** ("MOA") is entered into by the **City of Memphis** ("City"), **Shelby County** ("County"), the **Memphis and Shelby County Port Commission** ("Port"), the **Memphis Light, Gas and Water Division** ("MLGW") (hereinafter collectively, "Local Entities"), and the **Tennessee Valley Authority** ("TVA") in accordance with and pursuant to their respective authorities to establish a framework for the management and disposal of coal ash at TVA's Allen Fossil Plant.

WITNESSETH

WHEREAS, TVA purchased the Allen Fossil Plant ("Plant") in Memphis, Tennessee and associated real property and personalty from the City and MLGW under a "Deed and Bill of Sale" dated December 31, 1984, as amended; and

WHEREAS, the City and MLGW retained ownership (fee title) to the coal ash disposal impoundment to the west of the Plant and the City and the County hold fee title to the coal ash pond east of the Plant; and

WHEREAS, the City and/or MLGW granted TVA easements over the ash ponds to fill them with coal ash from the Plant up to identified elevations; and

WHEREAS, the easement over the west pond recites that the City and MLGW "shall have the ownership, with full right to sell, remove or dispose of, any and all ashes when placed within any part of said property;" and

WHEREAS, the easement over the east pond recites that the Port "shall have the ownership, with full right to sell, remove, or dispose of, any and all ashes when placed within any part of said property;" and

WHEREAS, TVA continues to use the east pond to dispose of coal ash generated at the plant and used the west pond to dispose of coal ash in the past; and

WHEREAS, the U.S. Environmental Protection Agency ("EPA") issued a rule comprehensively regulating the management and disposal of coal ash and other coal combustion residuals ("CCR") on April 17, 2015, at 74 Fed. Reg. 21302-21501 (the "CCR Rule"); and

WHEREAS, the CCR Rule requires owners and operators of CCR facilities to conduct a number of different analyses and complete a number of actions by specified time periods, including closing coal ash impoundments under certain conditions; and

WHEREAS, the requirements of the CCR Rule apply to TVA as operator of the coal ash ponds at the Plant, to the City, the County, and MLGW as owners of the west or east ponds, and, possibly, to the Port as owner of the coal ash in the east pond; and

WHEREAS, the Tennessee Department of Environment and Conservation ("TDEC") issued TVA an administrative order on August 6, 2015 (the "TDEC Order") that provides for TDEC review and approval of the activities that TVA undertakes to comply with the CCR Rule in Tennessee, including at the Plant; and

WHEREAS, the TDEC Order also requires TVA to investigate CCR-related conditions at six of its coal-fired power plants in Tennessee, including the Plant, to assess CCR-related risks and, if necessary, implement corrective action to mitigate unacceptable risks; and

NOW, THEREFORE, in consideration of the foregoing premises, the Parties agree as follows:

I. Compliance with CCR Rule and TDEC Order

The Local Entities agree that to meet their potential responsibilities under the CCR Rule and to better ensure that the TDEC Order can be complied with expeditiously and cost effectively, it is necessary that they cooperate with TVA in its implementation of the CCR Rule and the TDEC Order. Accordingly, the Local Entities agree to support TVA's implementation activities including, but not limited to, expeditiously providing TVA information and data upon TVA's request such as design and operating information about the wastewater pipelines that are owned and operated by the City and that underlie the east ash pond. The City already has provided information about its wastewater pipelines to TVA. Subject to other provisions of this MOA, TVA shall have sole authority to determine what actions are necessary to implement the CCR Rule and the TDEC Order.

II. Legal Responsibilities

TVA agrees to be solely responsible for complying with the CCR Rule and TDEC Order regarding CCR management areas at the Plant and other CCR management areas near the Plant, if any, that may become encompassed by the TDEC Order; provided, the Local Entities meet their responsibilities under this MOA. By executing this MOA, none of the Local Entities admit to any liability or responsibilities respecting the CCR Rule or TDEC Order. The Local Entities may pursue any cause of action they may have separately or collectively in law or equity if TVA does not comply with this MOA.

III. Coordination

TVA and each of the Local Entities shall designate a single-point of contact for implementation of this MOA within 30 days of its execution. TVA agrees to update the Local Entities quarterly about its implementation activities, including sending or linking the Local Entities to copies of information and reports that it is required to prepare and release publicly under the CCR Rule. In addition, TVA agrees to:

A. Provide the Local Entities copies of the Environmental Investigation Plan, the Environmental Assessment Report, and the Corrective Action/Risk Assessment Plan, if one is prepared, for the Plant under the TDEC Order prior to finalization of those plans and reports and their release to the public.
B. Provide the Local Entities copies of its proposed groundwater monitoring plan that identifies where monitoring wells are proposed to be located and any proposed future amendments to the plan.
C. Use its best efforts to timely alert the Local Entities to information that it plans to release publicly about CCR management activities at the Plant and that TVA

reasonably believes may generate unusual media interest so that the Local Entities can be better prepared to respond to such interest.

IV. TVA Easement Rights

The Local Entities and TVA agree that TVA's easement rights under the 1984 Deed and Bill of Sale, as amended, allow TVA to undertake the actions necessary to comply with the CCR Rule and the TDEC Order; provided, however, that any such actions impacting the real property of a Local Entity beyond TVA's ash pond easements be as least intrusive as possible. The Local Entities agree that their ownership interests do not require TVA to obtain their approval to conduct those actions that TVA determines necessary to comply with the CCR Rule and the TDEC Order. This includes, without limitation, operating and closing ash ponds as necessary to comply with the CCR Rule or TDEC Order, installing and operating groundwater monitoring systems, and completing corrective action, if required. However, this does not include taking actions that adversely affect continued operation of MLGW's distribution lines that cross the east ash pond or the City's wastewater pipes that underlie the east ash pond without first obtaining MLGW's and the City's review and approval, respectively. Any adjustments to the distribution lines or wastewater pipes determined to be necessary by TVA shall be at TVA's expense.

V. Effective Date, Modification and Termination

This MOA may be executed in counterparts and shall become effective when the last Party executes it. The MOA may be modified upon agreement in writing signed by each Party. Any Party may terminate this agreement upon 60 days written notice to the other Parties; provided, however, that Section IV of the MOA shall continue to be effective.

AGREED TO AND ENTERED INTO BY:

City of Memphis

Mayor

2/3/16
DATE

Division of Public Works:

Director

Approved as to Form:

City Attorney

~~Shelby County~~ Memphis

Mayor

2/2/16
DATE

Approved as to Form:

Assistant County Attorney

Memphis and Shelby County Port Commission

Chairman

DATE

Attest:

Approved as to Form:

Secretary-Treasurer

Port Commission Attorney

AGREED TO AND ENTERED INTO BY:

City of Memphis

Mayor	DATE
Division of Public Works:	Approved as to Form:
Director	City Attorney

Shelby County

Mayor	12-30-15 DATE

Approved as to Form:

Assistant County Attorney

Memphis and Shelby County Port Commission

Chairman	DATE
Attest:	Approved as to Form:
Secretary-Treasurer	Port Commission Attorney

AGREED TO AND ENTERED INTO BY:

City of Memphis

____________________	____________________
Mayor	DATE
Division of Public Works:	Approved as to Form:
____________________	____________________
Director	City Attorney

Shelby County

____________________	____________________
Mayor	DATE
Approved as to Form:	
____________________	
Assistant County Attorney	

Memphis and Shelby County Port Commission

____________________	1/20/16
Chairman	DATE
Attest:	Approved as to Form:
____________________	____________________
Secretary-Treasurer	Port Commission Attorney

Memphis, Light, Gas, and Water Division

By:______________________ 12/22/15
President and CEO DATE

Attest: Approved as to Form:

______________________ Charlotte Knight Griffin
Vice-President and Treasurer Attorney for MLGW

Tennessee Valley Authority

______________________ ______________________
Senior Vice President, Generation Construction, Projects & Services DATE

Memphis, Light, Gas, and Water Division

By:____________________
President and CEO

____
DATE

Attest:

Approved as to Form:

____
Vice-President and Treasurer

____
Attorney for MLGW

Tennessee Valley Authority

____
Senior Vice President, Generation Construction, Projects & Services

1/14/2016
DATE

APPENDIX L
REMEDIAL INVESTIGATION DOCUMENT LIST

1.0 DOCUMENT LIST

The following documents were prepared to support the Remedial Investigation and will be used to support the Environmental Assessment Report (EAR) and Corrective Actions / Risk Assessment (CARA). These documents have been provided to TDEC and are publicly available via a Freedom of Information Act (FOIA) request.

Stantec Consulting Services Inc. (Stantec). 2017. "TVA Allen Fossil Plant Remedial Investigation Work Plan." Prepared for Tennessee Valley Authority. September 15.

Stantec. 2018. "Draft TVA Allen Fossil Plant – East Ash Disposal Area – Remedial Investigation Report." Prepared for Tennessee Valley Authority. March 6.

Stantec. 2018. "Initial Remedial Design - Interim Response Action." Prepared for Tennessee Valley Authority. July 20.

Stantec. 2018. "Pre-Design Services Work Plan, Interim Response Action, East Ash Disposal Area, Allen Fossil Plant." Prepared for Tennessee Valley Authority. December 19.

Stantec. 2018. "Supplemental Remedial Investigation Work Plan, Allen Fossil Plant." Prepared for Tennessee Valley Authority. December 18.

Stantec. 2019. "Draft Updated Remedial Investigation Report, Allen Fossil Plant." Prepared for Tennessee Valley Authority. March 1.

APPENDIX M
HYDROGEOLOGICAL INVESTIGATION SAP

Hydrogeological Investigation Sampling and Analysis Plan Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

HYDROGEOLOGICAL INVESTIGATION
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Hydrogeological Investigation
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	3/1/19 Date
TVA Investigation Field Lead	3/1/19 Date
Health, Safety, and Environmental (HSE) Manager	3/1/19 Date
Investigation Project Manager	2/26/2019 Date
QA Oversight Manager	2/26/2019 Date
Ryan Jones Laboratory Project Manager	2/26/2019 Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

Stantec

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, TVA has developed this Hydrogeological Investigation Sampling and Analysis Plan (SAP) to install monitoring wells for measuring groundwater levels and to provide locations to collect groundwater samples. The plan provides procedures and methods necessary to conduct investigation activities at the ALF Plant (Plant).

2.0 OBJECTIVES

The objectives of this Hydrogeological Investigation SAP are to further characterize the groundwater flow direction at the Plant and install monitoring wells to provide locations to collect groundwater samples for analysis of CCR constituents. A Plant-specific Quality Assurance Project Plan (QAPP) will provide the procedures necessary to conduct investigation activities associated with the hydrogeological investigation.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements, safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 MONITORING WELL LOCATIONS

TVA has completed many studies at the Plant and has programs underway for CCR Rule, normal site operations, inspections and maintenance. In addition, TVA is currently conducting Remedial Investigation activities to characterize the hydrogeology and investigate CCR constituents in groundwater at the East Ash Disposal Area. However, TVA will incorporate pertinent data from these investigations that meet the Quality Assurance/Quality Control (QA/QC) requirements of the QAPP into the identification of proposed monitoring well locations. Monitoring wells installed as part of the Environmental Investigation (EI) will be used to collect groundwater samples and groundwater elevations to characterize groundwater flow direction and quality and vertical gradients within the Alluvial aquifer. Sampling frequency and procedures are provided in the Groundwater Investigation SAP.

As part of TVA's ongoing investigations, two new potential background monitoring wells (ALF-210 and ALF-210A) were installed upgradient of the West Ash Disposal Area in the unconsolidated deposits. Monitoring well ALF-210 was installed in the shallow portion of the Alluvial aquifer and ALF-210A was installed in the deep portion of the Alluvial aquifer immediately above the confining layer between the Alluvial aquifer and the underlying Memphis aquifer. Both wells were installed in a similar geological setting as the ALF well network. In addition, six other monitoring wells (ALF-207, ALF-207A, ALF-208, ALF-208A, ALF-209 and ALF-209A) were installed in potential downgradient locations north of the West Ash Disposal Area in the unconsolidated deposits in the shallow and deep portions of the Alluvial aquifer. Figure 1 (Attachment A) shows the locations of the new monitoring wells.

As part of the EI, TVA will install ten additional monitoring wells in the shallow, intermediate and deep portions of the Alluvial aquifer to evaluate groundwater flow direction and quality and vertical gradients within the Alluvial aquifer near the West Ash Disposal Area. Monitoring wells will be installed under the supervision of a Tennessee licensed Professional Geologist. One well (ALF-210B) will be installed to serve as a potential background monitoring well for the intermediate portion of the Alluvial aquifer. In addition, three wells (ALF-207B, ALF-208B and ALF-209B) will be installed downgradient of the West Ash Disposal Area in the intermediate portion of the Alluvial aquifer and co-located with existing wells ALF-207/ALF-207A, ALF-208/ALF-208A and ALF-209/ALF-209A installed within the shallow and deep portions of the Alluvial aquifer. Three wells (ALF-218, ALF-218A and ALF-218B) will be installed west and three wells (ALF-219, ALF-219A and ALF-219B) will be installed southeast of the West Ash Disposal Area in the shallow, intermediate and deep portions of the Alluvial aquifer. The proposed locations for monitoring wells west and southeast of the unit were constrained by the USACE levee and easement near the southern boundary of the West Ash Disposal Area. In addition, CCR material may be located near the eastern boundary of the West Ash Disposal Area and western boundary of the chemical pond.

The screened intervals for the deep wells are intended to be placed near the bottom of the alluvial aquifer, immediately above the upper Claiborne confining unit between the Alluvial aquifer and the underlying Memphis aquifer. The vertical placement near the bottom of the Alluvial aquifer was selected to provide a sampling point to characterize groundwater quality at the deepest part of the Alluvial aquifer and the potential for CCR constituents to migrate to the Memphis aquifer. The shallow and intermediate well locations will provide additional information to evaluate vertical gradients. Figure 1 (Attachment A) shows the proposed monitoring well locations.

TVA will evaluate the data collected and assess the suitability of the proposed background well locations during the initial investigative phase. The proposed background well locations will be provided to TDEC for review and comment. Based on the information gathered at the locations described above, additional monitoring wells may be needed to fully characterize groundwater flow direction and quality and vertical gradients within the Alluvial aquifer near the West Ash Disposal Area. If additional wells are needed, TVA, in communication with TDEC, will install these wells to obtain additional groundwater information. Results of the investigations will be included and described in the EAR.

The target depths and estimated screened intervals of the existing and proposed wells are presented in Table 1. The total depths and screen intervals for the proposed monitoring wells will be dependent on specific conditions at each proposed well location and may vary from the target depths.

Table 1. Existing and Proposed Well Construction Details

Well ID	Status	Estimated Total Depth (Feet below Ground Surface)	Estimated Screen Interval (Feet below Ground Surface)	Target Screen Lithology
ALF-207	Existing	60	29 - 60	Alluvial deposits
ALF-207B	Proposed	90	80 - 90	Alluvial deposits
ALF-207A	Existing	131	121 - 131	Alluvial deposits
ALF-208	Existing	56	29 - 56	Alluvial deposits
ALF-208B	Proposed	90	80 - 90	Alluvial deposits
ALF-208A	Existing	145	135 - 145	Alluvial deposits
ALF-209	Existing	36	15 - 36	Alluvial deposits
ALF-209B	Proposed	90	80 - 90	Alluvial deposits
ALF-209A	Existing	128	118 - 128	Alluvial deposits
ALF-210	Existing	48	27 - 48	Alluvial deposits
ALF-210B	Proposed	90	80 - 90	Alluvial deposits
ALF-210A	Existing	130	120 - 130	Alluvial deposits
ALF-218	Proposed	50	30 - 50	Alluvial deposits
ALF-218B	Proposed	90	80 - 90	Alluvial deposits
ALF-218A*	Proposed	140	130 - 140	Alluvial deposits
ALF-219	Proposed	50	30 - 50	Alluvial deposits
ALF-219B	Proposed	90	80 - 90	Alluvial deposits
ALF-219A*	Proposed	130	120 - 130	Alluvial deposits

Total depths and screen intervals for proposed monitoring wells are dependent on specific conditions at each proposed well location.
* Deep alluvial borings are intended to confirm the top of the upper Claiborne confining unit but will ultimately be set within 10 feet of the proposed target depths.

TVA plans to complete the initial phase of the investigation and jointly review the results with TDEC to identify data gaps. If data gaps exist, then TVA will fill those gaps with additional investigation in collaboration with TDEC. This may include installing additional groundwater monitoring wells to further characterize the hydrogeology.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, install groundwater monitoring wells, and assist in providing scientifically defensible results.

Monitoring well installation will adhere to applicable American Society for Testing and Materials (ASTM) and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer and a Tennessee-licensed Professional Geologist.
- Complete required health and safety paperwork and confirm field team members have completed required training.
- Coordinate activities with the drilling subcontractor.
- Clear Access – Proposed monitoring well locations will be marked using a wooden stake or survey flag with the position surveyed using the global positioning system (GPS). Suitability of each location will be evaluated for logistical issues including access, grubbing needs, overhead and underground utility clearance, and proximity to Plant features. Access improvements, including clearing and grubbing or road building, will be completed prior to the investigation start date.
- Perform Environmental Review – As required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC will require a number of signatories from TVA. It is understood that the environmental review is to be completed before implementation of the field work. Additionally, plant staff will not issue an excavation permit ahead of the completed environmental review.

- Complete Utility Locate(s) / Excavation Permit(s) - Prior to initiating subsurface activities, subsurface utility clearance will be sought via the plant engineering department and/or the TN 811 service. At locations within the Plant, engineering will provide primary utility clearance assurance in addition to TN 811 being notified. At all other drilling locations where, underground obstructions or utilities are expected nearby, TVA or 3rd party underground locators will be engaged to clear boring locations. For drilling locations outside the plant (e.g., along public roads and rights-of-way), utility avoidance assurance will be supplemented by the TN 811 service and the TVA or 3rd party underground locators. An excavation permit is required prior to initiating any digging or boring at the Plant. A key component to the completion of the excavation permit is consensus on the drilling locations with pertinent TVA staff.

- Identify Water Source – During implementation of the EIP, a source of potable water will be required to complete several investigation tasks, including certain drilling methods and decontamination procedures.

- Obtain required calibrated field instruments, including health and safety equipment.

- Discuss project objectives and potential hazards with project personnel.

5.2 DRILLING AND SAMPLING METHODS AND PROTOCOL

Drilling activities performed at the Plant during implementation of this SAP will include advancing subsurface boreholes using roto-sonic drilling techniques or other compatible technology based on field conditions and rig availability. If drilling methods that require the use of water are used for the installation of monitoring wells, then only potable water will be used.

The following sections present drilling and soil sampling procedures required to complete the tasks presented. Once completed, borings will be surveyed for horizontal and vertical control by survey grade GPS.

5.2.1 Drilling, Logging, and Survey

The monitoring well borings are proposed to be advanced utilizing roto-sonic drilling techniques until designed boring termination depth or refusal, whichever is shallower.

TVA proposes to perform continuous soil sampling during drilling to allow for visual logging of the materials encountered at each location. The soil boring logs will provide additional understanding of the subsurface profile including the saturated soils. Drilling and sampling activities will be performed under the direction of a Professional Geologist, licensed in the State of Tennessee, who has sufficient experience to execute the work.

The field geologist will prepare a written field log for each boring. In addition to describing each recovered soil sample, the log will document boring location, drilling personnel, tooling/equipment used, drilling performance, depth to water, sample number, sample recovery, Standard Penetration Test (SPT) blow counts, and other relevant observations. Soil color will be logged per the appropriate Munsell soil color chart.

Similarly, the field geologist will prepare a written installation log for each well. The log will document well location, well materials, well depth, depth interval for each backfill material, and surface completion details (protective casing, concrete pad, bollards, etc.).

In addition to the soil log, the field geologist will collect soil samples through the well screen intervals of background monitoring wells as described in Section 5.2.1.2 of the Background Soil SAP.

Once the boring is completed and the well is installed it will be surveyed for horizontal and vertical control by survey grade GPS to the vertical datum used by the Plant. The survey data will be added to the final boring logs once available and a crosswalk will be provided to indicate what the Plant datum's equivalency is to mean sea level (MSL).

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. 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 equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS or global positioning systems (GPS) documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 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 in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Boring log forms will be used to document lithologic conditions and field observations at each boring location. Monitoring well diagrams will be prepared for each well.

Field documentation will also be prepared for development of each monitoring well.

5.2.3.3 Chain-of-Custody Forms

Chain-of-custody (COC) forms are not applicable to this SAP. Refer to the Groundwater Investigation SAP for groundwater sampling and monitoring procedures.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

5.2.4.1 Standard Penetration Test Sampling

The SPT samples will provide information for developing continuous boring logs/soil profiles. The SPT sampling will be conducted in accordance with ASTM D 1586 *Standard Method for Penetration Testing and Sampling for Soils* and consists of dropping a 140-pound hammer from a height of 30 inches, to drive a standard size 2-inch diameter split-spoon sampler to a depth of 18-inches.

5.2.4.2 Monitoring and Sampling

Monitoring or sampling of wells is not addressed in this SAP. Refer to the Groundwater Investigation SAP for groundwater sampling and monitoring procedures.

5.2.5 Preservation and Handling

5.2.5.1 SPT Samples

SPT samples will be logged and placed in glass jars. Once each jar is filled, the rim and threads will be cleaned, the jar capped, and a label (Section 5.2.5.2) will be applied to the jar. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean before placing the sample container in a box for transport.

5.2.5.2 Sample Labels and Identification System

Each SPT jar will have a sample label affixed. Sample labels will contain the following information recorded in waterproof, non-erasable ink. Rock core boxes will have similar information written directly on the wooden core box in waterproof, non-erasable ink:

- Project number
- Sample location
- Boring ID number
- Depth of sampling interval
- Date of sample collection
- Sampler's initials

5.2.5.3 Packaging and Shipping

At appropriate intervals, assigned personnel will transport the samples to the testing laboratory or designated storage facility. SPT and other disturbed bulk samples (if any) will be treated as Group B samples as discussed in ASTM D4220.

5.2.6 Sample Analyses

Select soil samples obtained during the investigation will be subjected to geotechnical laboratory testing. Testing will be assigned to characterize the predominant soil materials recovered in each boring. The laboratory tests will be performed in accordance with applicable ASTM standard testing procedures.

The laboratory analyses are expected to include natural moisture content determinations (D2216), sieve and hydrometer analyses (D422), specific gravity (D854), and Atterberg Limits (D4318). The results of the testing will be used to assist in subsurface characterization and correlation with existing data. If other tests are found to be necessary, they will also be performed in accordance with applicable ASTM standard testing procedures. The Plant-specific laboratory testing program will be developed based on the recovery and spatial distribution of samples from the drilling and sampling program.

5.2.7 Equipment Decontamination Procedures

Documented decontamination will be performed for drilling equipment, tooling, and instruments in contact with subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Decontamination pads will be constructed for decontamination of large downhole tooling (augers, drill rods, etc.) using a high-pressure washer/steam cleaner.

Decontamination pads will be constructed at locations designated by TVA personnel using poly sheeting with sufficient berms to contain decontamination fluids and prevent potential runoff to uncontrolled areas. Following decontamination, fluids will be disposed of in accordance with Section 5.2.8. Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using potable water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

Decontamination of sampling equipment and instrument (e.g., split spoons, water level meters, pumps for well development, etc.) will be performed prior to use and between sampling locations. Decontamination activities will be documented in the logbook field notes. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.8 Waste Management

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

- Soil cuttings
- Well development water
- Purge water
- Personal Protective Equipment

- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*, the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

5.3 MONITORING WELL INSTALLATION

Monitoring wells will be installed at the boring locations by qualified drill crews under the direction of a licensed Tennessee driller. TVA and contractor personnel will assist by providing excavation (drill) permitting, utility clearances, and access to locations along with other coordination.

Monitoring wells will be installed in accordance with TVA TI ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*.

5.3.1 Materials and Installation

The monitoring wells will be installed using current industry and regulatory protocols to reduce potential for introducing contaminants during the drilling and installation process. Decontamination processes will be in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*. 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 new well screen and riser that have been cleaned and sealed in plastic at the factory, and placing washed filter pack sand that is certified by NSF International.

Other steps employed during the installations include the workers donning clean, nitrile gloves during the handling of downhole equipment and well materials and using potable water for grouting purposes.

Monitoring wells will consist of a four-inch diameter Schedule 40 PVC pre-packed well screen (0.010-inch slots) and riser. The screen and riser will consist of flush-joint, threaded PVC pipe. The screen length will be selected based on the results of the boring and the target stratum but will not be longer than 10 feet. A four-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 above (2.5 feet minimum) the ground surface and will be capped with a temporary plug or slip cap. The annular space will be backfilled with a sand filter pack (20/40 mesh) extending a minimum of two feet above and six inches below the screen. A minimum two-foot thick bentonite pellet seal will be placed on top of the sand filter pack.

After the bentonite pellet seal has sufficiently hydrated for a duration equal to or greater than the minimum recommended by the manufacturer, the remaining annular space will be backfilled with either a 30 percent solids bentonite grout or a bentonite-cement grout.

It should be noted that the grout will be placed by tremie method through one-inch (minimum) diameter PVC pipe. The grout will be placed using pumps gauged to allow the installation crew to monitor pressures during the grouting process. In open (uncased) boreholes, the sand filter zones and bentonite pellets will be placed by tremie method through one-inch (minimum) diameter PVC. In cased boreholes (i.e., through hollow-stem augers or temporary casing), the sand filter zones and bentonite pellets may be placed by tremie method or may be poured slowly into the annular space of the drill tooling to prevent bridging.

Subsequent wellhead construction will consist of an above-grade, steel locking protective cover anchored to a concrete surface pad. The protective cover will extend above the concrete pad and the annular space will be filled with sand or pea gravel to about six-inches below the top of casing. Steel protective bollards filled with concrete will be installed near each corner of the concrete pad. The top of each well casing will be surveyed and correlated to the vertical datum used by the Plant. A crosswalk will be provided that indicates what the Plant datum's equivalency is to MSL.

An example installation log is shown on Figure 2 (Attachment A). A drawing of the wellhead construction is shown on Figure 3 (Attachment A).

5.3.2 Well Development

Each new monitoring well will be developed by a combination of bailing, surging, and pumping after a minimum of 24 hours following completion. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. First, a bailer will be lowered and raised within the screened intervals to create a slight surging action to dislodge particles within the wells and sand filter packs. A baseline reading of turbidity, pH, temperature, and specific conductance will be measured using a properly calibrated Oakton® turbidity and PCSTestr 35 water testing meters (or equivalents). If the well contains heavy sediment, further bailing will be performed before continuation of development with surge blocks and submersible pumps. A surge block will be used within the screened interval to move water and particles through the screen and sand filter packs. This process may be repeated several times to decrease the water turbidity within the wells.

Lastly, a submersible pump will be employed to further develop the wells until an acceptable level of turbidity is achieved. Target turbidity value of less than or equal to ten (10) Nephelometric turbidity units (NTUs) will be utilized for the wells per TVA-ENV-TI-05.80.42. If the target turbidity value cannot practically be achieved, well development will be conducted according to the requirements listed in TVA-ENV-TI-05.80.25, *Monitoring Well and Piezometer Installation and Development*.

5.3.3 Slug Testing

After development, TVA will perform slug testing in each monitoring well to measure hydraulic conductivity. Equipment will be decontaminated per TVA TI ENV-TI-05.80.05. The slug tests will be performed in accordance with ASTM D 4044, *Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers*. A pressure transducer with a data recorder will be used to collect water level information from the wells.

As part of the slug testing, each well will be tested by taking an initial measurement of the static water level followed by the insertion of the pressure transducer into the well. After the transducer has been installed, a solid slug (e.g., PVC pipe filled with sand) will be introduced into the well to cause a nearly instantaneous change in the water level. The water levels will then be recorded at regular intervals until reaching near static levels. After reaching static levels, the test will be terminated, and a second slug test will be conducted by instantaneously removing the slug and monitoring water levels until static levels are reached again. The results will be recorded electronically and downloaded into a data collector. Raw data will be checked in the field for discrepancies prior to demobilizing from the Plant.

The field data, once collected and returned to the office, will be evaluated using a software program to estimate the hydraulic conductivity of the in-situ soils.

5.4 INSTALLATION OF DEDICATED SAMPLING PUMPS

New dedicated sampling pumps will be installed in the new groundwater monitoring wells after well development and slug testing are completed. The well depths and static groundwater levels will be measured during well development to place the pumps at the proper intake depths for future well sampling. The pump intake depth will be located at approximately the mid-point of the well screen or the mid-point of the saturated portion of the well screen. Well pump placement depths and additional pump installation calculations and details will be recorded on field forms in the field.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to the installation of groundwater monitoring wells.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the investigation.

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

6.2 QUALITY CONTROL CHECKS

The accuracy of the drilling, monitoring well installation and slug testing processes must be maintained throughout the investigation. In addition, planned drilling and installation methods must be confirmed during field activities to provide confidence that groundwater samples and water level measurements collected as part of other SAPs provide representative analytical results and data.

Field personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable field forms and documentation of field activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, site conditions, and weather conditions. For the overall EIP implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 2. Preliminary Schedule for Hydrogeological Investigation SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Hydrogeological SAP Submittal		Completed
Prepare for Field Activities	20 Days	Following EIP Approval
Conduct Field Activities	30 Days	Following Field Preparation

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Field locations may be adjusted based on actual field conditions
- Proposed monitoring well locations can be safely accessed.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017c. "Monitoring Well and Piezometer Installation and Development." Technical Instruction ENV-TI-05.80.25, Revision 0000. May 8.

ATTACHMENT A
FIGURES

Figure No.
1

Title
Proposed West Ash Disposal Area Monitoring Wells

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-11-09
Technical Review by LP on 2018-11-09

0 200 400 600 800 Feet
1:2,000 (At original document size of 22x34)

Legend

- Existing Groundwater Monitoring Well
- Proposed Groundwater Monitoring Well
- Gauging Station
- Approximate Levee Centerline
- Approximate Extent of Levee
- Approximate Extent of Culvert (26 Inch Wide)
- TVA Property Boundary
- West Ash Disposal Area

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)
3. Existing Monitoring Wells is referenced from TVA Drawing 10W858-03 Allen Fossil Plant Reservation.

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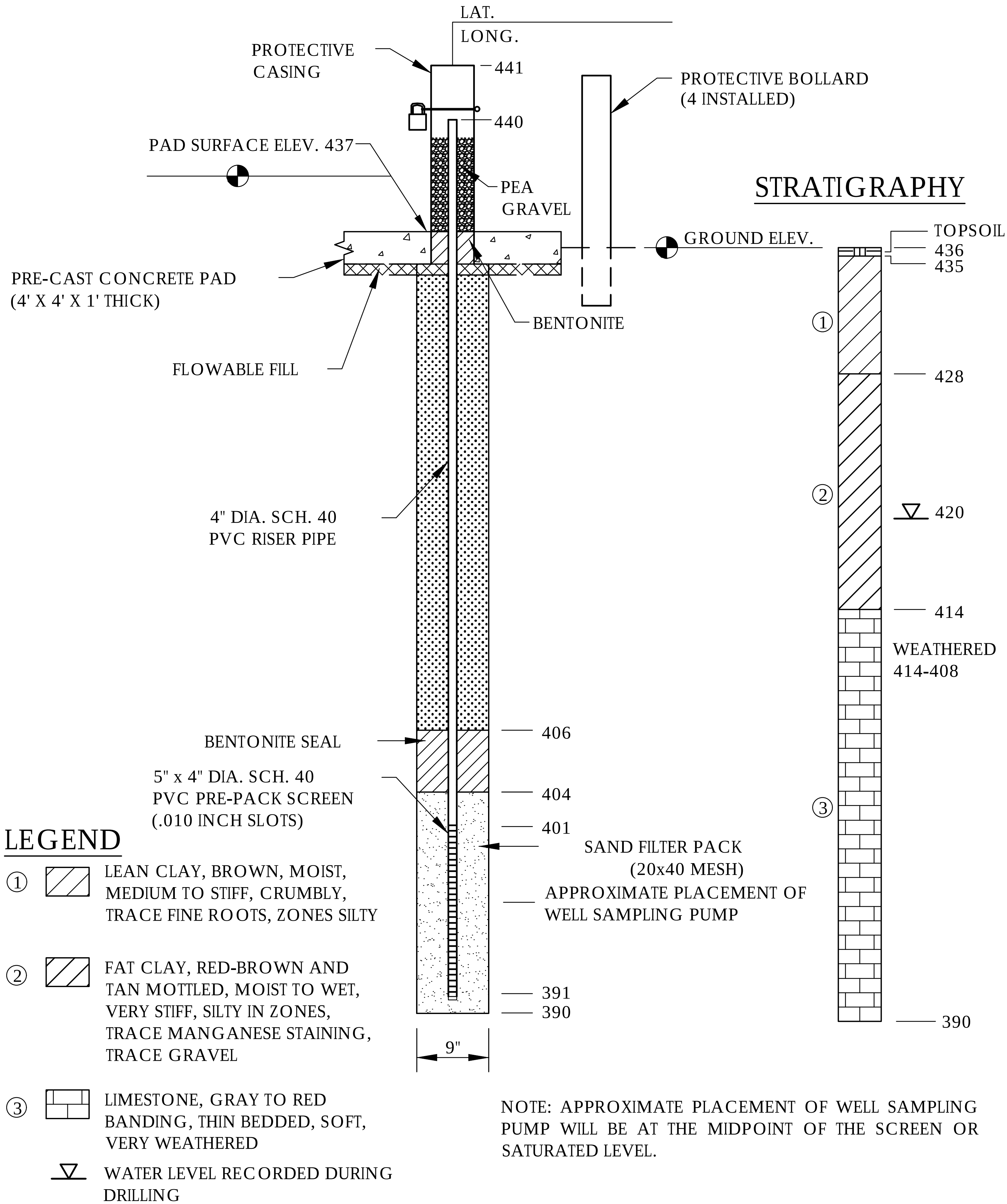
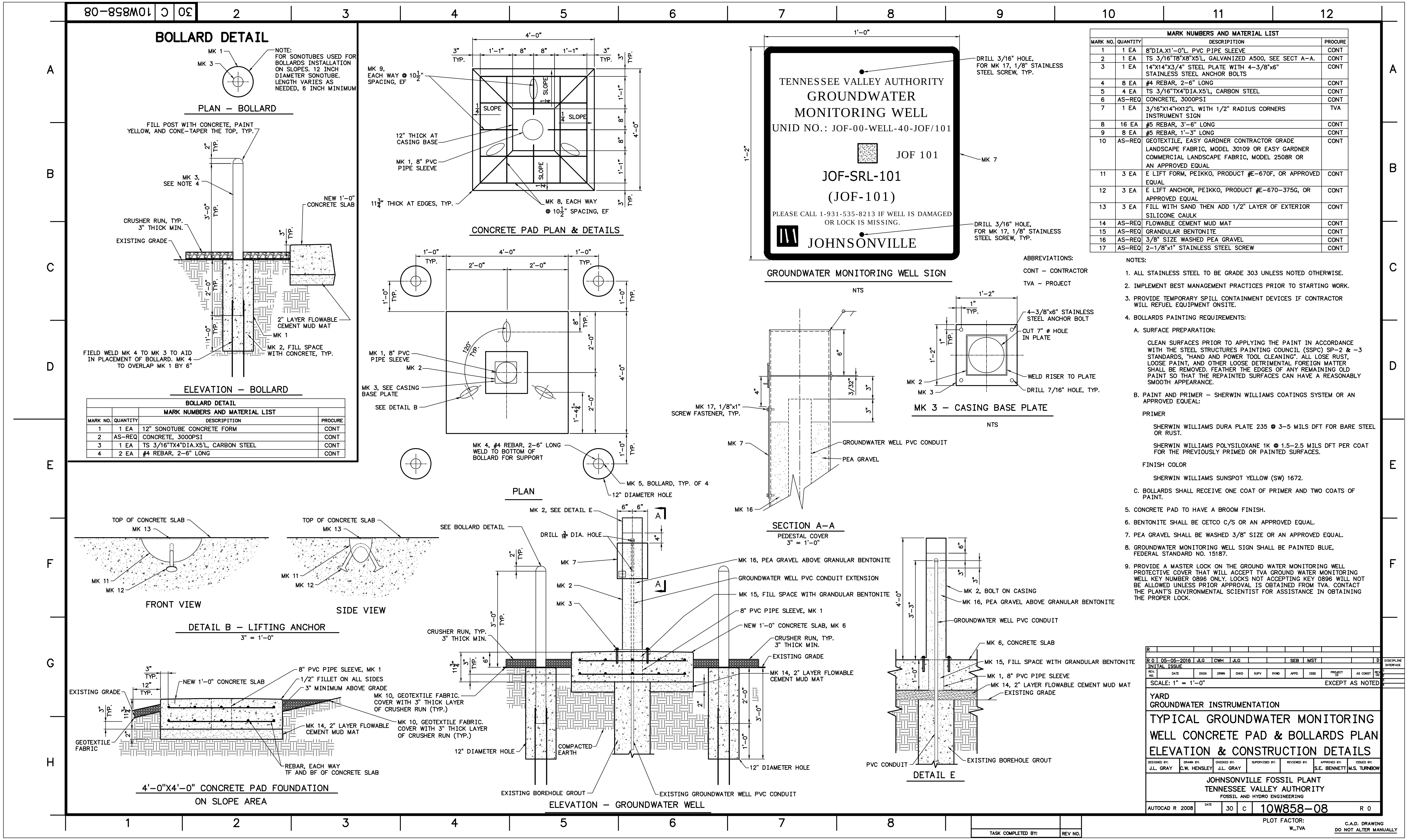
TVA



NOTE: THIS FIGURE IS AN EXAMPLE MONITORING WELL LOG PROVIDED FOR REFERENCE PURPOSES AND DOES NOT REPRESENT CURRENT SITE CONDITIONS.

Figure 2. Typical Groundwater Monitoring Well Installation Log



BOLLARD DETAIL			
MARK NUMBERS AND MATERIAL LIST			
MARK NO.	QUANTITY	DESCRIPITION	PROCURE
1	1 EA	12" SONOTUBE CONCRETE FORM	CONT
2	AS-REQ	CONCRETE, 3000PSI	CONT
3	1 EA	TS 3/16"TX4"DIA.X5'L, CARBON STEEL	CONT
4	2 EA	#4 REBAR, 2-6" LONG	CONT

MARK NUMBERS AND MATERIAL LIST			
MARK NO.	QUANTITY	DESCRIPITION	PROCURE
1	1 EA	8"DIA.X1'-0"L. PVC PIPE SLEEVE	CONT
2	1 EA	TS 3/16"T8"X8"X5'L, GALVANIZED A500, SEE SECT A-A.	CONT
3	1 EA	14"X14"X3/4" STEEL PLATE WITH 4-3/8"x6" STAINLESS STEEL ANCHOR BOLTS	CONT
4	8 EA	#4 REBAR, 2-6" LONG	CONT
5	4 EA	TS 3/16"TX4"DIA.X5'L, CARBON STEEL	CONT
6	AS-REQ	CONCRETE, 3000PSI	CONT
7	1 EA	3/16"X14"HX12"L WITH 1/2" RADIUS CORNERS INSTRUMENT SIGN	TVA
8	16 EA	#5 REBAR, 3'-6" LONG	CONT
9	8 EA	#5 REBAR, 1'-3" LONG	CONT
10	AS-REQ	GEOTEXTILE, EASY GARDNER CONTRACTOR GRADE LANDSCAPE FABRIC, MODEL 30109 OR EASY GARDNER COMMERCIAL LANDSCAPE FABRIC, MODEL 2508R OR AN APPROVED EQUAL	CONT
11	3 EA	E LIFT FORM, PEIKKO, PRODUCT #E-670F, OR APPROVED EQUAL	CONT
12	3 EA	E LIFT ANCHOR, PEIKKO, PRODUCT #E-670-375G, OR APPROVED EQUAL	CONT
13	3 EA	FILL WITH SAND THEN ADD 1/2" LAYER OF EXTERIOR SILICONE CAULK	CONT
14	AS-REQ	FLOWABLE CEMENT MUD MAT	CONT
15	AS-REQ	GRANDULAR BENTONITE	CONT
16	AS-REQ	3/8" SIZE WASHED PEA GRAVEL	CONT
17	AS-REQ	2-1/8"x1" STAINLESS STEEL SCREW	CONT

NOTES:

1. ALL STAINLESS STEEL TO BE GRADE 303 UNLESS NOTED OTHERWISE.
2. IMPLEMENT BEST MANAGEMENT PRACTICES PRIOR TO STARTING WORK.
3. PROVIDE TEMPORARY SPILL CONTAINMENT DEVICES IF CONTRACTOR WILL REFUEL EQUIPMENT ONSITE.
4. BOLLARDS PAINTING REQUIREMENTS:
   A. SURFACE PREPARATION:
      CLEAN SURFACES PRIOR TO APPLYING THE PAINT IN ACCORDANCE WITH THE STEEL STRUCTURES PAINTING COUNCIL (SSPC) SP-2 & -3 STANDARDS, "HAND AND POWER TOOL CLEANING". ALL LOSE RUST, LOOSE PAINT, AND OTHER LOOSE DETRIMENTAL FOREIGN MATTER SHALL BE REMOVED. FEATHER THE EDGES OF ANY REMAINING OLD PAINT SO THAT THE REPAINTED SURFACES CAN HAVE A REASONABLY SMOOTH APPEARANCE.
   B. PAINT AND PRIMER – SHERWIN WILLIAMS COATINGS SYSTEM OR AN APPROVED EQUEAL:
      PRIMER
      SHERWIN WILLIAMS DURA PLATE 235 @ 3-5 MILS DFT FOR BARE STEEL OR RUST.
      SHERWIN WILLIAMS POLYSILOXANE 1K @ 1.5-2.5 MILS DFT PER COAT FOR THE PREVIOUSLY PRIMED OR PAINTED SURFACES.
      FINISH COLOR
      SHERWIN WILLIAMS SUNSPOT YELLOW (SW) 1672.
   C. BOLLARDS SHALL RECEIVE ONE COAT OF PRIMER AND TWO COATS OF PAINT.
5. CONCRETE PAD TO HAVE A BROOM FINISH.
6. BENTONITE SHALL BE CETCO C/S OR AN APPROVED EQUAL.
7. PEA GRAVEL SHALL BE WASHED 3/8" SIZE OR AN APPROVED EQUAL.
8. GROUNDWATER MONITORING WELL SIGN SHALL BE PAINTED BLUE, FEDERAL STANDARD NO. 15187.
9. PROVIDE A MASTER LOCK ON THE GROUND WATER MONITORING WELL PROTECTIVE COVER THAT WILL ACCEPT TVA GROUND WATER MONITORING WELL KEY NUMBER 0896 ONLY. LOCKS NOT ACCEPTING KEY 0896 WILL NOT BE ALLOWED UNLESS PRIOR APPROVAL IS OBTAINED FROM TVA. CONTACT THE PLANT'S ENVIRONMENTAL SCIENTIST FOR ASSISTANCE IN OBTAINING THE PROPER LOCK.

R 0 | 05-05-2016 | JLG | CWH | JLG | SEB | MST
INITIAL ISSUE

SCALE: 1" = 1'-0" EXCEPT AS NOTED

YARD
GROUNDWATER INSTRUMENTATION

TYPICAL GROUNDWATER MONITORING WELL CONCRETE PAD & BOLLARDS PLAN ELEVATION & CONSTRUCTION DETAILS

DESIGNED BY: J.L. GRAY | DRAWN BY: C.W. HENSLEY | CHECKED BY: J.L. GRAY | APPROVED BY: S.E. BENNETT | ISSUED BY: M.S. TURNBOW

JOHNSONVILLE FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2008 | 30 | C | 10W858-08 | R 0

PLOT FACTOR: W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

Figure 3. Typical Groundwater Monitoring Well Construction Details

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Hydrogeological Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment[1]
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Pressure transducer and data recorder
Data collector
Dedicated well sampling pumps, fittings, and tubing
Stainless steel clamps
Pump controller and power supply
Generator (if needed)
Acoustic Televiewer
Heat Pulse Flow Meter
Multi-parameter sonde
Rubber packers
Solid Slug (e.g. PVC filled with sand)
Well pump (purging well) and tubing
Water level indicator meter
Oil/water interface meter
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Refer to the Exploratory Drilling SAP for other drilling-specific field equipment

APPENDIX N
GROUNDWATER INVESTIGATION SAP

Groundwater Investigation
Sampling and Analysis Plan
Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

GROUNDWATER INVESTIGATION
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Groundwater Investigation
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	3/1/19 Date
TVA Investigation Field Lead	3/1/19 Date
Health, Safety, and Environmental (HSE) Manager	3/1/19 Date
Bradley R Toth Investigation Project Manager	2/26/2019 Date
QA Oversight Manager	2/26/2019 Date
Laboratory Project Manager	2/28/19 Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

Stantec

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ATTACHMENT B FIELD EQUIPMENT LIST

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, TVA has developed this Groundwater Investigation Sampling and Analysis Plan (SAP) to investigate groundwater conditions at the ALF Plant (Plant). The Groundwater Investigation SAP provides the procedures necessary to conduct investigation activities associated with the sampling and analysis of groundwater.

2.0 OBJECTIVES

The objective of the Groundwater Investigation SAP is to provide the procedures necessary to characterize existing groundwater quality and evaluate groundwater flow conditions on the TVA Plant, in response to the TDEC Commissioner's Multi Site Order. The approach in characterizing the groundwater conditions is to collect groundwater samples for chemical analyses and measure groundwater and surface water elevations to evaluate the potential presence of CCR related constituents in groundwater and direction of groundwater flow to respond to TDEC's request.

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

TVA has completed many studies at the Plant and has programs underway for CCR Rule, normal site operations, inspections and maintenance. In addition, TVA is currently conducting Remedial Investigation activities to characterize the hydrogeology and investigate CCR constituents in groundwater at the East Ash Disposal Area. Groundwater samples collected from monitoring wells from other programs will be used as applicable to the TDEC Order. Duplicate samples will not be collected as part of the Environmental Investigation (EI) if samples have already been or will be collected as part of another program at the same time as proposed in the EI sampling schedule. However, groundwater levels will be measured in monitoring wells that are not sampled as part of this SAP to provide information to prepare groundwater contour maps for the Plant. The data collected for other programs will be utilized in the Environmental Assessment Report (EAR).

Sampling Scope

TVA will measure groundwater level elevations at the following monitoring well locations near the West Ash Disposal Area:

- Existing shallow well locations ALF-207 through ALF-210 and proposed shallow well locations ALF-218 and ALF-219
- Existing deep well monitoring well locations ALF-207A through ALF-210A and proposed deep well locations ALF-218A and ALF-219A
- Proposed intermediate monitoring well locations ALF-207B through ALF-210B, and ALF-218B and ALF-219B

Groundwater samples will be collected from monitoring wells ALF-207, ALF-207A, ALF-207B, ALF-208, ALF-208A, ALF-208B, ALF-209, ALF-209A, ALF-209B, ALF-210B, ALF-218, ALF-218A, ALF-218B, ALF-219, ALF-219A, ALF-219B and submitted for laboratory analysis of CCR Parameters as defined in Section 5.2.7 along with major cations/anions and total alkalinity (magnesium, potassium, sodium, carbonate and bicarbonate) (see Section 5.2.7 for the parameter list).

The Hydrogeological Investigation SAP provides the rationale, locations, and installation methods for proposed monitoring wells.

Surface water elevations will be measured at the gauging station in McKellar Lake. Figure 1 (Attachment A) shows the location of the McKellar Lake monitoring point.

Figure 1 shows the monitoring well locations (existing and proposed) that will be sampled or from which groundwater elevation measurements will be collected as part of this SAP.

This figure will be updated to show the actual locations for wells after execution of the Hydrogeological Investigation SAP.

In conjunction with the groundwater sampling events, TVA will collect effluent samples from Outfall 001. Outfall 001 is an NPDES-permitted discharge from the East Ash Disposal Area to McKellar Lake. These grab samples will be analyzed per the parameter list provided in Section 5.2.7. The results will be evaluated and provided with the EAR.

Sampling Frequency

TVA plans to conduct six sampling events at a frequency of one event every two months for one year as part of the EI to characterize seasonal groundwater flow direction, rates, and quality. According to United States Environmental Protection Agency (US EPA) Project Summary document "Sampling Frequency for Ground-Water Quality Monitoring" dated September 1989 (US EPA 1989), quarterly and bimonthly groundwater sampling frequencies are appropriate for major, non-reactive chemical constituents. However, more frequent sampling intervals are not recommended due to potential statistical autocorrelation issues.

Data from these six sampling events will be provided in the EAR.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, collect groundwater samples, take groundwater and surface water elevation measurements, and assist in providing scientifically defensible results.

Groundwater sampling will adhere to applicable EPA and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

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

- Designate a Safety Officer
- Complete required health and safety documentation and confirm field team members have completed required training
- Coordinate field activities with the Laboratory Coordinator, including ordering sample bottles and preservatives, obtaining coolers and distilled 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 parameters that define stability during well purging
- Discuss project objectives and potential hazards with project personnel
- Obtain a control box for dedicated pumps
- Complete sample paperwork to the extent possible, prior to deploying into the field, including chain-of-custody forms and sample labels
- Obtain ice prior to sample collection for sample preservation

5.2 SAMPLING METHODS AND PROTOCOL

5.2.1 Groundwater and Surface Water Level Measurements

Prior to sampling, each monitoring well and staff gauge will be inspected for damage or indications that the well integrity has been compromised. If field observations indicate the need for well or staff gauge maintenance or repairs, the Field Team Leader will notify TVA.

After the monitoring well and staff gauge integrity inspection is completed, the water level in each well and at each staff gauge will be measured in relation to a surveyed reference point (e.g., top of well casing) using an electronic water level indicator. Groundwater elevation data will be measured and recorded in accordance with TVA TI ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. 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 for the monitoring well network and staff gauges. At a minimum, measurements will be made within the same day. In addition, barometric pressure readings will be recorded daily. TVA plans to use a multi-parameter sensor equipped with a National Institute of Science & Technology (NIST) certified temperature sensor.

The water level indicator will be decontaminated between each well by following the decontamination procedures provided below in Section 5.2.8.

5.2.2 Well Purging

Following the measurement of groundwater levels, monitoring wells will be purged using pumps dedicated to each well. Purging will continue until field measurements of water quality parameters stabilize during three consecutive readings at 3 to 5-minute intervals per the criteria listed in TVA TI ENV-TI-05.80.42, *Groundwater Sampling*. The stabilization criteria follow:

- pH - ±0.1
- Specific conductivity - ±5% µS/cm
- Dissolved oxygen (DO) - ±10% for > 0.5 mg/L or <0.5 mg/L
- Turbidity - below 10 NTUs or ±10% for values above 10 NTUs

Field measurements, including pH, specific conductivity, turbidity, oxidation/reduction potential, and temperature, will be collected during purging using a flow-through cell. Once the field parameters have stabilized, samples 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 probe. A final turbidity measurement 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 log book and field data sheet. A final turbidity measurement will be made after each sample is collected.

Purging beginning and end times, pumping rates, water quality parameter readings, and groundwater levels will be recorded throughout the purging operation on field sampling forms. The total volume purged at each well may vary based on recharge rates and stabilization of water quality parameters.

Low-flow purging techniques will be used to collect a representative sample from the water bearing unit unless the wells do not yield sufficient water. If the well has been sampled historically using low-flow sampling methods, then the well will be purged at the rate known to induce minimal drawdown. If pump settings are unknown, purging will begin at a minimum 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. If drawdown exceeds 0.3 feet, but reaches stability, purging of the well will continue and the current flow rate, drawdown, and time will be recorded on the field data sheet by the sampler.

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% within the well bore to obtain the necessary sample volume, but no later than 24 hours after the well purge.

5.2.3 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. 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 equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the Quality Assurance Project Plan (QAPP).

5.2.4 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS or global positioning system (GPS) documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.4.1 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 in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.4.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. TVA groundwater sampling forms will be used to document groundwater level measurements, stabilization parameters and field observations at each monitoring well location.

5.2.4.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.4.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.5 Collection of Samples

5.2.5.1 Groundwater Sampling

A final reading of water quality parameters will be conducted and documented on field sampling forms at the time of sample collection, but these measurements will not be from the sample itself. Unfiltered 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 latex (or equivalent) gloves when handling sample containers and will not touch the interior of containers or container caps. New gloves will be used when handling each sample. 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 avoid overfilling and diluting preservatives. Each sample bottle will be capped before filling the next bottle.

It will be necessary to collect filtered (dissolved) inorganic constituent samples, in addition to unfiltered (total) inorganic constituent samples, if the final turbidity value prior to sampling exceeds 10 NTUs. Dissolved sample collection will be accomplished in accordance with TVA TI ENV-TI-05.80.42.

Issues that could affect the quality of samples will be recorded on the field data sheet or in the log book 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.

5.2.6 Preservation and Handling

Sample containers will be labeled in accordance with TVA TI ENV-TI-05.80.02, *Sample Labeling and Custody*. Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped, and a signed and dated custody seal will be applied. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-TI-05.80.06, *Handling and Shipping of Samples* 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. Loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable 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 sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. 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 call 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 the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.7 Sample Analyses

Groundwater samples will be submitted to the TVA-approved laboratory for analysis. Samples will be analyzed for the CCR related constituents listed in Title 40 of the Code of Federal Regulations Part 257 (40 CFR 257), Appendices III and IV. In addition, five inorganic constituents listed in Appendix I of TN Rule 0400-11-01-.04 (i.e., TDEC regulations), and not included in the 40 CFR 257 Appendices III and IV, will be analyzed to maintain continuity with TDEC environmental programs. The additional constituents listed in TDEC Appendix 1 include the following metals: copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents, and TDEC Appendix I inorganic constituents, will hereafter be referred to collectively as "CCR Parameters."

For geochemical evaluation, major cations/anions not included in the CCR Parameters are included in the analyses for this SAP. The additional geochemical parameters include bicarbonate, carbonate, magnesium, potassium, and sodium.

Tables 1 through 4 summarize the constituents requiring analysis. Analytical methods, preservation requirements, container size, and holding times for each chemical analysis are presented in Table 5. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 1. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids

Table 2. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 3. TN Rule 0400-11-01-.04, Appendix I Inorganic Constituents

TDEC Appendix I Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 4. Additional Geochemical Parameters

Major Cations/Anions
Bicarbonate
Carbonate
Magnesium
Potassium
Sodium

Table 5. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	SW-846 6020A	HNO3 to pH < 2 Cool to < 6°C	250-mL HDPE	180 days
Metals, total	SW-846 6020A	HNO3 to pH < 2 Cool to < 6°C	250-mL HDPE	180 days
Mercury, dissolved	SW-846 7470A	HNO3 to pH < 2 Cool to < 6°C	250-mL HDPE	28 days
Mercury, total	SW-846 7470A	HNO3 to pH < 2 Cool to < 6°C	250-mL HDPE	28 days
Radium 226	SW-846 903.0	HNO3 to pH < 2 Cool to < 6°C	1 L glass or Plastic	180 days
Radium 228	SW-846 904.0	HNO3 to pH < 2 Cool to < 6°C	2 L glass or plastic	180 days
Chloride	SW-846 9056A	Cool to < 6°C	250-mL HDPE	28 days
Fluoride	SW-846 9056A	Cool to < 6°C	250-mL HDPE	28 days
Sulfate	SW-846 9056A	Cool to < 6°C	125-mL HDPE	28 days
pH	SW-846 9040C (field measurement)	NA	NA	15 minutes
Alkalinity (Total, Carbonate, and Bicarbonate)	SM2320B	Cool to < 6°C	250-mL HDPE	14 days
Total Dissolved Solids	SM2540C	Cool to < 6°C	250-mL HDPE	7 days

The pH of groundwater samples will be measured in the field.

5.2.8 Equipment Decontamination Procedures

Documented decontamination will be performed for non-dedicated groundwater sampling equipment in contact with groundwater or surface water in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Pumps are dedicated to each well and do not need to be decontaminated.

Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox ® or other appropriate non-phosphatic detergent in 5-gallon buckets. Following decontamination, fluids will be disposed in accordance with Section 5.2.9.

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 logbook field notes. Additional information regarding equipment decontamination procedures is located in the QAPP.

5.2.9 Waste Management

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

- Purge water
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to groundwater sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

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

6.2 QUALITY CONTROL CHECKS

Five types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, field blanks, and filter blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below.

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 procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters 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 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 sample collection will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with the exception of parameters that are not amenable to MS/MSD.

For parameters such as Total Suspended 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) – 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), then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the monitoring well location where the equipment blank is prepared. If the tubing used to collect the filter blank is not certified clean tubing, then a tubing blank will be collected at a frequency of one blank per lot.

Field Blanks: One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

Filter Blanks – One filter blank will be collected during each day of the sampling activities when dissolved parameters are collected for analysis. The filter blank will be collected at a groundwater sampling location by passing laboratory-supplied deionized water through in-line filters used in the collection of dissolved metals (or other analytes), then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. In addition, one filter blank will be collected per lot of filters used. The filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, Sample Labeling and Custody and ENV-TI-05.80.03, Field Record Keeping. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 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 results of sample analyses to the appropriate parties. 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 is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP

Table 6. Preliminary Schedule for Groundwater Investigation SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Groundwater Investigation SAP Submittal		Completed
Prepare for Field Activities for the first bimonthly sampling event	10 Days	Following Completion of Monitoring Well Development
Conduct Field Activities	5 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

Note: Monitoring well installation and development schedules are provided in the Hydrogeological Investigation SAP.

Six bimonthly groundwater sampling events for one year are proposed for this EI. The first bimonthly sampling event will occur 10 days after completion of development of the proposed background monitoring wells. The next five sampling events will occur on a bimonthly basis.

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Access to well locations will be provided prior to the field preparation start date for each round of sampling.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017b. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. "Handling and Shipping of Samples." Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017f. "Groundwater Sampling." Technical Instruction ENV-TI-05.80.42, Revision 0001. March 31.

Tennessee Valley Authority (TVA). 2017g. "Groundwater Level and Well Depth Measurement." Technical Instruction ENV-TI-05.80.44, Revision 0000. March 31

Tennessee Valley Authority (TVA). 2017h. "Field Measurement Using a Multi-Parameter Sonde." Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

United States Environmental Protection Agency (US EPA). 1989. "Sampling Frequency for Ground-Water Quality Monitoring Project Summary Document." September.

ATTACHMENT A
FIGURE

Figure No.
1

Title

Proposed West Ash Disposal Area Monitoring Wells

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location

Memphis, Tennessee

175567295
Prepared by TR on 2018-11-09
Technical Review by LP on 2018-11-09

0 200 400 600 800 Feet

1:2,000 (At original document size of 22x34)

Legend

- Existing Groundwater Monitoring Well
- Proposed Groundwater Monitoring Well
- Gauging Station
- Approximate Levee Centerline
- Approximate Extent of Levee
- Approximate Extent of Culvert (26 Inch Wide)
- TVA Property Boundary
- West Ash Disposal Area

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)
3. Existing Monitoring Wells is referenced from TVA Drawing 10W858-03 Allen Fossil Plant Reservation.

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ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Groundwater Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Flow measurement supplies (e.g. graduated cylinder, stop watch)
Water level indicator meter
Oil/water interface meter
Photoionization detector (PID)
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
Multi-parameter sensor equipped with a National Institute of Science & Technology (NIST) certified temperature sensor
Turbidity meter
***These items are detailed in associated planning documents to avoid redundancy.**

APPENDIX O
SEEP SAP

Seep
Sampling and Analysis Plan
Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

SEEP
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Seep
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	3/1/19 Date
TVA Investigation Field Lead	3/1/19 Date
Health, Safety, and Environmental (HSE) Manager	3/1/19 Date
Bradley R. Tate Investigation Project Manager	2/26/2019 Date
QA Oversight Manager	2/26/2019 Date
Laboratory Project Manager	2/28/19 Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

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ATTACHMENT B FIELD EQUIPMENT LIST

1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

TVA has developed this Seep Sampling and Analysis Plan (SAP) to provide procedures and methods necessary to evaluate whether dissolved CCR material is present in McKellar Lake. This Seep SAP presents a phased approach and plan to sample water from seeps along surface impoundments and landfills at the ALF Plant (Plant).

2.0 OBJECTIVES

The objectives of this Seep SAP are to identify and characterize active seeps at the Plant for CCR constituents, and identify information that may explain and/or assess the potential movement of groundwater/pore water with dissolved CCR constituents into surface water streams on or adjacent to the Plant, through seepage.

This Seep SAP will provide the procedures necessary to identify and conduct the sampling and analysis of water from active seeps, along with soil samples from the same active seep area.

Proposed sampling locations are discussed in Section 4.0. Field activities will include the following tasks:

- Conduct a seep investigation to identify active seeps, if any, that could potentially discharge to adjacent surface water bodies
- Document the location of identified active seeps using a sub-meter global positioning system (GPS)
- Use the GPS data to identify seeps on the seep sampling location map
- Collect surface water samples from active seeps
- Collect soil samples from active seeps
- Package and deliver samples to the laboratory for analyses of CCR Parameters

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

Figure 1 (Attachment A) illustrates the locations of historical seeps at the Plant. Sampling locations will be based on the identification of active seeps at the impoundments, with locations verified in the field using Global Positioning System (GPS). Water and soil samples will be taken at each active seep location. A list of the identified active seep(s) will be included in Table 1, Proposed Seep Sampling Locations, and the completed table will be included in the EAR. If an active seep is suspected to be the result of releases from a subsurface utility (e.g., water supply line), an attempt will be made to collected a co-located sample directly from the suspected utility for comparison.

Table 1. Proposed Seep Sampling Locations

Example Sampling Location IDs	Descriptions
SeS01	(To be determined)
SeS02	(To be determined)
SeW01	(To be determined)
SeW02	(To be determined)

SeS – Seep Soil; SeW – Seep Water

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, collect samples, and assist in providing scientifically defensible results.

Seep water sample collection will adhere to TVA Environmental Technical Instruction (TI) documents. The seep water sampling will be conducted in accordance with TVA TI ENV-TI-05.80.40, *Surface Water Sampling*, which references other TIs that are applicable to various aspects of surface water sampling.

A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations Field activities will be planned in accordance with TVA TI ENV-TI-05.80.01 *Planning Sampling* Events and documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

Both soil and water samples (provided flow is available), will be collected at each active seep location. Soil samples will be collected provided the seep occurs from soils and not rock. Soil samples will be collected as a five-point composite from within the saturated soil area and will be conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*. If required for access to seeps, any removal of aggregate and riprap filters at repaired seep locations will be coordinated through TVA prior to sampling. Seep surface water samples will be collected provided flow is adequate to obtain sufficient sample volume. Due to anticipated high turbidity conditions of seep surface water samples, both field-filtered samples and unfiltered surface water samples will be taken. The purpose of field filtering is to obtain a sample that is representative of dissolved constituents in the seepage fluid; unfiltered seep surface water samples will be taken for comparative purposes.

Seep soil and seep water samples will be analyzed for the CCR Parameters listed in Section 5.3.5.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer.
- Complete required health and safety paperwork and confirm field team members have completed required training.
- Coordinate activities with the Laboratory Coordinator, including ordering sample bottles with contained preservatives (as required), obtaining coolers and analyte-free deionized water, if needed, and notifying the laboratory of sampling and sample arrival dates.

- Obtain required calibrated field instruments, including health and safety equipment.

- Perform environmental review prior to sampling – as required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC has a number of signatories from TVA.

- Complete sample paperwork to the extent possible, including chain-of-custody forms and sample labels in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping.*

- Obtain decontamination materials, including scrub brushes, soap, solvents, buckets, and DI water, as indicated in TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

- Obtain ice prior to sample collection for sample preservation

5.2 SEEP INVESTIGATION

As outlined in the EIP, a one-time seep investigation will be conducted to identify active seeps. Known locations of historical seeps, inspection reports, and any other related information will be utilized in the identification of active seeps. If active seeps in this area are discovered, their locations will be staked in the field and shown on a Seep Sampling Location(s) map.

In order to evaluate seeps not visible due to structural mitigation activities (e.g., rip rap), the following investigative protocol will be used:

1. Field testing shall be conducted at the point where water from a seep(s) most likely enters a stream. TVA shall use a boat to monitor the stream channel and surface water at the water's edge.

2. Field testing will be conducted for pH, temperature, dissolved oxygen, and conductivity using a multiparameter Sonde.

3. If field testing indicates a significant difference between stream channel samples and samples adjacent to the stream bank, then TVA shall determine if there is a flow from the seep.

4. If the seep is covered with rock or other material, the material shall be removed to determine if there is flow from the seep. [Note: additional work order will be required to remove rip rap.]

5. If there is flow from the seep, then the seep shall be sampled and analyzed for the CCR parameters.

Should active seeps be discovered during the investigation, a seep sampling location map will be finalized, and seep sampling will be implemented in accordance with Section 5.3.

5.3 SAMPLING METHODS AND PROTOCOL

Samples will be analyzed for CCR constituents listed in 40 CFR Part 257, Appendices III and IV. However, five inorganic constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations), and not included in the federal CCR Appendices III and IV, have been added to the list of CCR constituents for analyses to maintain continuity with other TDEC environmental programs. Those additional constituents include the following metals: copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents, and TDEC Appendix 1 inorganic constituents, will hereafter be referred to collectively as "CCR Parameters."

Seep soil and surface water samples will be collected once and then submitted to the laboratory for the chemical analysis of the CCR Parameters. Various means and methods for collecting seepage water will be used based on the location and flow of the seep. Sampling and collection methods will be conducted in accordance with applicable TVA TIs, including:

- ENV-TI-05.80.01, Planning Sampling Events
- ENV-TI-05.80.02, Sample Labeling and Custody
- ENV-TI-05.80.03, Field Record Keeping
- ENV-TI-05.80.04, Field Sampling Quality Control
- ENV-TI-05.80.05, Field Sampling Equipment Cleaning and Decontamination
- ENV-TI-05.80.06, Handling and Shipping of Samples
- ENV-TI-05.80.40, Surface Water Sampling
- ENV-TI-05.80.46, Field Measurement Using a Multiparameter Sonde
- ENV-TI-05.80.50, Soil and Sediment Sampling

5.3.1 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. 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 equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the Quality Assurance Project Plan (QAPP).

5.3.2 Field Documentation

Field documentation will be maintained in accordance with TVA TI *ENV-05.80.03, Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.3.2.1 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 in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.3.2.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks.

5.3.2.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form.

The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.3.2.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.3.3 Collection of Samples

5.3.3.1 Seep Soil Sample Collection

Seep soil samples will be collected from surface soils as a five-point composite from within the saturated soil area in accordance with TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*. Five surface soils will be collected from discolored areas in the seep areas using a dedicated or decontaminated trowel (or similar tool) or disposal sampling scoop, and placed in a re-sealable dedicated plastic bag or decontaminated glass or plastic bowl for compositing. The collected sample will be homogenized until the physical appearance is consistent over the entire sample. After homogenization, a sample will be collected from the mixed soil and placed in the appropriate laboratory-supplied sampling container. Seep soil samples will be submitted to the laboratory for the chemical analysis of the CCR Parameters. Any free water issues will be addressed by the laboratory.

5.3.3.2 Seep Water Sample Collection

Seep water samples will be collected from active seep locations at impoundments and landfills provided flow is adequate to obtain sufficient sample volume, as defined and required by the laboratory. A seep water sample will be collected by directly filling a properly decontaminated sampling device or clean, non-preserved laboratory container from the seep area, and transferring the seep surface water to an appropriate laboratory-supplied and preserved, sampling container for analysis of CCR Parameters listed in Section 5.3.5. Due to the expected high turbidity of seep surface water samples, a second sample of water from each location will be field filtered using a peristaltic pump and a new, certified clean 0.45-micron filter and placed in an appropriate laboratory-supplied and preserved, sampling container for analysis of dissolved constituents. The purpose of field filtering is to obtain a sample that is representative of the dissolved constituents in the seepage itself. In instances where a non-preserved laboratory supplied bottle is used as the transfer container, the transfer container will only be used at that seep location, properly disposed and will not be used for sampling at other seeps, unless properly decontaminated. A handheld calibrated pH meter will be used to collect pH data at each seep water sample location.

At locations where the surface water stream is not deep enough to directly fill the sampling device or transfer bottle, but a small area of "pooling" is occurring, a peristaltic pump with new, certified clean tubing or a pipette with a bulb may be viable collection options, if recharge is adequate. Collection options are dependent upon field conditions and every effort will be made to collect viable water samples from the seep locations. Filtered and unfiltered seep surface water samples will be submitted to the laboratory for the chemical analysis of CCR Parameters listed in Section 5.3.5.

5.3.4 Preservation and Handling

Sample containers will be labeled in accordance with TVA TI ENV-05.80.02, *Sample Labeling and Custody*. Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped, and a signed and dated custody seal will be applied. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-TI-05.80.06, *Handling and Shipping of Samples* 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. Loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable 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 sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. 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 call 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 the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.3.5 Sample Analyses

Samples will be submitted to the TVA-approved laboratory for analysis per the QAPP. Both soil and water samples will be analyzed for the CCR Parameters, while filtered and unfiltered water samples will also be evaluated for dissolved and total constituents, respectively. Tables 2, 3, and 4 summarize the listed constituents. Analytical methods, preservation, containers(s) and holding times are presented in Table 5. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 2. 40 CFR Part 257, Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

* Add TSS for aqueous unfiltered sampling

Table 3. 40 CFR Part 257, Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 4. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 5. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	SW-846 6020A	HNO_3 to pH < 2; & Cool to <6°C	250-mL HDPE	180 days
Metals, total	Liquid & Solid - SW-846 6020A	HNO_3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	180 days
Mercury, dissolved	SW-846 7470A	HNO_3 to pH < 2 & Cool to <6°C	250-mL HDPE	28 days
Mercury, total	Liquid - SW-846 7470A; Solid - SW-846 7471B	HNO_3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	28 days
Radium 226	Liquid - SW-846 903.0; Solid - SW-846 901.1	HNO_3 to pH < 2 & Cool to <6°C; Cool to <6°C	1 L glass or Plastic; 8-oz glass (soil)	180 days
Radium 228	Liquid - SW-846 904.0; Solid - SW-846 901.1	HNO_3 to pH < 2 & Cool to <6°C; Cool to <6°C	2 L glass or plastic; 8-oz glass (soil)	180 days
Chloride	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	28 days
Fluoride	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (soil)	28 days
Sulfate	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	125-mL HDPE; 4-oz glass (soil)	28 days

Table 5. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Total Dissolved Solids (TDS)	SM2540C	Cool to <6°C	250-mL HDPE	7 days
Total Suspended Solids (TSS)	SM2540C	Cool to <6°C	1 L HDPE	7 days
pH	Liquid - SW-846 9040C (field measurement); Solid - SW-846 9045D	NA	NA (liquids); 4-oz glass (soil)	NA*

*The pH of water samples will be measured in the field. Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

5.3.6 Equipment Decontamination Procedures

Documented decontamination will be performed for sampling equipment and instruments in contact with water or subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination.

Following decontamination, fluids will be placed into a drum for storage, transportation, and ultimately disposal in accordance with Section 5.3.7. Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

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

5.3.7 Waste Management

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

- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to pore water sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

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

6.2 QUALITY CONTROL CHECKS

Five types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, field blanks, and filter blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below. A complete description of the QA requirements is provided in the QAPP.

Field Duplicate Samples – One duplicate sample will be collected for every 20 samples or once per sampling event. Duplicates 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 procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters 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 to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 samples collected or once per sampling event. MS/MSD samples will be collected by filling bottles alternately by thirds in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control* into three sets of identical, laboratory-prepared sample bottles.

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 sample collection will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with exception of parameters that are not amenable to MS/MSD. For parameters such as Total Suspended 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) – One equipment (rinsate) blank will be collected for each sampling event. The equipment blank will be collected at a sampling location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment, then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the equipment blank is prepared. If the tubing used to collect the filter blank is not certified clean tubing, then a tubing blank will be collected at a frequency of blank per lot.

Field Blanks: One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

Filter Blanks – One filter blank will be collected during each day of the sampling activities when dissolved parameters are collected for analysis. The filter blank will be collected at a sampling location by passing laboratory-supplied deionized water through in-line filters used in the collection of dissolved metals, (or other analytes), then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. In addition, one filter blank will be collected per lot of filters used. The filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 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 results of sample analyses to the appropriate parties. 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 is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 6. Preliminary Schedule for Seep SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Seep SAP Submittal		Completed
Prepare for Field Activities	25 Days	Following NTP
Conduct Field Activities – Seep Investigation	20 Days	Following Field Preparation
Conduct Field Activities – Implement Seep SAP (if required)	20 Days	Following Seep Investigation
Laboratory Analysis (if required)	50 Days	Following Field Activities
Data Validation (if required)	30 Days	Following Lab Analysis

8.0 ASSUMPTION AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Approved sampling methods and protocols may have to be substituted in the EIP based on changing field conditions.

9.0 REFERENCES

Tennessee Valley Authority (TVA). (2017a). "Planning Sampling Events." Technical Instruction ENV-TI-05.80.01, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017b. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017f. "Handling and Shipping of Samples." Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017g. "Surface Water Sampling." Technical Instruction ENV-TI-05.80.40, Revision 0000. May 4.

Tennessee Valley Authority (TVA). 2017h. "Field Measurement Using a Multi-Parameter Sonde." Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017i. "Soil and Sediment Sampling." Technical Instruction ENV-TI-05.80.50, Revision 0000 September 29.

ATTACHMENT A
FIGURE

Figure No.
1

Title

Historical Seeps (Approximate Location)

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location

Memphis, Tennessee

175567295
Prepared by TR on 2018-05-21
Technical Review by TM on 2018-05-21

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

Legend

Historical Seeps (Approximate Location)
Current Impoundment (Approximate)
Former Disposal Area (Approximate)

Seep No.	Northing	Easting	Approx. Size	Field Notes and Status
1	294801.59255	732225.28610	5' to 15' in length	No flow; inactive; currently monitored
2	296219.09365	729287.61382	50' x 50'	Mitigated w/ graded filter
3	296498.59604	726116.33309	20' x 20'	No flow; inactive; mitigated - sod placement
4	296105.30024	729466.32180	25' x 20'	Currently monitored
5	294922.68974	728939.86058	5' x 450' in length	Flow directed to East Ash Pond, and subject to NPDES discharge permit
6	294903.00770	729104.89995	5' x 10'	Flow directed to East Ash Pond, and subject to NPDES discharge permit

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec TVA

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Seep Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Boat and paddles
Anchor
Two outboard gas tanks
Rope
Waders, muck boots, knee boots, etc.
pH and conductivity meters
Thermometer
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Drilling rig equipment will be selected based on site conditions, selected by the Drilling Contractor, and approved by TVA.

APPENDIX P
STABILITY SAP

Stability
Sampling and Analysis Plan
Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

STABILITY
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

REVISION LOG

Revision	Description	Date
1	Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

STABILITY
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Stability
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	Date
TVA Investigation Field Lead	Date
Health, Safety, and Environmental (HSE) Manager	Date
Bradley R Toth	2/26/2019
Investigation Project Manager	Date
QA Oversight Manager	Date
Ryan Jones	2/26/2019
Laboratory Project Manager	Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

Stantec

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

Through the various information requests, as well as TDEC comments, a need for several stability analyses at ALF (the Plant) has been identified. This Stability Sampling and Analysis Plan (SAP) has been prepared to outline the proposed analyses and the methods to be employed during the Investigation.

2.0 OBJECTIVES

The purpose of this Stability SAP is to outline the methods that will be used to execute the following activities:

- Develop slope stability models (including material parameters) and perform slope stability analyses for selected CCR units
- Document the analyses in the EAR

3.0 HEALTH AND SAFETY

Implementation of this SAP does not include field work. A Health and Safety Plan (HASP) is not required.

4.0 PLANT-SPECIFIC STABILITY ANALYSIS PLAN

The proposed stability analyses were selected to aid in addressing data gaps and supplementing existing data, as necessary to address information requests of the TDEC Multi-site Order for ALF. Rationale for individual analyses are discussed below. Refer to Figures 1 and 2 in Attachment A for a layout of proposed analysis cross section locations. The selected locations represent critical cross sections based on reviews of previous stability analysis results, subsurface stratigraphy, material properties, and structure geometry. For selection of analysis section(s) for post-earthquake stability, the location of potentially liquefiable materials is also considered. Proposed section locations may be adjusted based on the methodology in Section 5.1.

Table 1 provides the stability analyses (i.e., load cases) proposed for each CCR unit. In cases where new analyses are not proposed, existing analyses adequately address the load case(s) for the unit. For more information on these existing analyses, refer to summaries of existing geotechnical data in the Evaluation of Existing Geotechnical Data appendix.

Table 1. Stability Analyses Proposed for each CCR Unit

CCR Unit and Condition	Static Cases		Seismic Cases		
	Long-Term, Global	Long-Term, Veneer[2]	Pseudostatic[1], Global	Pseudostatic[1], Veneer[2]	Post-EQ[3], Global
West Ash Disposal Area (Closed Condition)			x	x	x
East Ash Disposal Area (Closed Condition)			x[4]	x	x[4]

[1] Pseudostatic, correlated to a tolerable displacement.
[2] Veneer stability is the slope stability of the final cover.
[3] Post-earthquake (Post-EQ) analysis includes a preceding liquefaction triggering assessment.
[4] After the closure design is finalized, it will be compared against analyses for the existing conditions. The existing conditions analyses may prove adequate to represent the closed conditions.

The rationale for the proposed analyses is as follows:

- The scope of work for the ongoing closure design for the West and East Ash Disposal Areas specifically excluded seismic load cases (Stantec 2016, 2017).

- Other load cases that are not proposed in Table 1 have existing analyses that are representative.

Loading conditions and results from the analyses will be documented within the EAR. For proposed stability analyses, recent water levels, including those measured per the EIP will be considered. When existing stability analyses are to be leveraged, recent water levels will be compared to the modeled levels to confirm that the analyses are still suitable.

5.0 TECHNICAL APPROACH

This section provides a framework for the procedures that will be used to perform the proposed slope stability analyses. Within this framework, industry standard engineering practices will be employed to execute the work. Individual engineering decisions cannot be prescribed, as they are dependent on the site conditions, available information, type of analysis, and other factors. Details of each analysis, including engineering judgments, will be documented in the EAR.

5.1 ANALYSIS FRAMEWORK

5.1.1 Load Cases

The load cases to be evaluated in the stability analyses are based on conventional practice and appropriate industry standards for landfills and surface impoundments, as applicable.

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

5.1.2 Phased Assessment and Acceptance Criteria

The stability analyses will be performed using a phased assessment process. Initial phases employ available site information, simplified analysis methods, and more conservative acceptance criteria. If acceptable performance is demonstrated, the analyses for the particular load case(s) are complete. If not, the next phase may include collection of additional site information and/or more advanced analysis methods. Less conservative acceptance criteria may be utilized, commensurate with the improved site characterization. The process may continue through multiple phases, as outlined below. The use of a phased approach is consistent with industry standard engineering practices.

The load cases and acceptance criteria presented herein (Table 2) apply specifically for the TDEC Order. The same CCR units may also be subject to other requirements (which may be more or less stringent) for compliance with other regulations such as state permitting, CCR Rule, etc.

Phase 1 Assessment

- Use available geotechnical data (Standard Penetration Testing (SPT), Cone Penetration Testing (CPT), lab testing, etc.)
    - Where geotechnical data are insufficient, collect supplemental CPT data
- Compute static, long-term factor of safety (global, FS_{static} and veneer, $FS_{static\text{-}veneer}$ slope stability)
- For seismic load cases, use site-specific design earthquake loading
    - If not already available, TVA will perform site-specific seismic hazards assessment (Section 5.4.2)
- Complete liquefaction triggering assessment based on SPT and CPT data
- Compute pseudostatic factor of safety (global, FS_{pseudo} and veneer, $FS_{pseudo\text{-}veneer}$ slope stability)
    - Using Newmark displacement analyses, compute displacements for range of yield accelerations
    - Select pseudostatic coefficient equal to yield acceleration that gives displacement of 3 feet in the Newmark analysis
    - Assign strengths considering results of liquefaction assessment
    - Compute pseudostatic FS_{pseudo} and $FS_{pseudo\text{-}veneer}$
- Compute static, post-earthquake factor of safety (global slope stability)
    - Assign pseudostatic coefficient equal to zero (static case)
    - Assign strengths considering results of liquefaction assessment
    - Compute post-earthquake $FS_{post\text{-}EQ}$
- Performance is acceptable if the following criteria are met
    - $FS_{static} \geq 1.5$
    - $FS_{static\text{-}veneer} \geq 1.5$
    - $FS_{pseudo} \geq 1.0$
    - $FS_{pseudo\text{-}veneer} \geq 1.0$

- $FS_{post\text{-}EQ} \geq 1.1$

- If any load cases do not meet criteria, go to Phase 2
- During the Phase 1 stability assessment, TVA will work with TDEC to define criteria for acceptable performance that would be utilized during a potential Phase 4 (the final phase) of the proposed phased stability assessment. The factors that contribute to defining acceptable performance will be site-specific and related to the consequences of the predicted deformations. As more site-specific information becomes available after Phase 1, TVA and TDEC may need to revisit the acceptable performance criteria in light of the additional information.

Phase 2 Assessment

- Perform additional site explorations in targeted areas
  - Critical areas to be identified by parametric analyses
  - SPT using mud rotary drilling (or other suitable drilling method)
  - Seismic CPT soundings (companion to SPT locations)
  - Lab testing tailored to analysis needs (including triaxial and/or direct shear strength testing, as applicable)
- Compute static factor of safety
  - Update Phase 1 analyses with new site data
- Complete liquefaction triggering assessment
  - Update Phase 1 analyses with new site data
- Compute pseudostatic factor of safety
  - Update Phase 1 analyses with new site data
- Compute post-earthquake factor of safety
  - Update Phase 1 analyses with new site data
- Performance is acceptable if the following criteria are met
  - $FS_{static} \geq 1.5$
  - $FS_{static\text{-}veneer} \geq 1.5$

- $FS_{pseudo} \geq 1.0$
- $FS_{pseudo\text{-}veneer} \geq 1.0$
- $FS_{post\text{-}EQ} \geq 1.0$ (lower criteria based on improved site characterization)

- If any load cases do not meet criteria, go to Phase 3

Phase 3 Assessment

- Perform a nonlinear deformation analysis (FLAC, OpenSees, or other appropriate code) to estimate displacements
- Performance is acceptable if representative displacement ≤ 3 feet
- If representative displacement > 3 feet, go to Phase 4

Phase 4 Assessment

- Consider the consequences (impacts to human health and/or environment) of the predicted deformations
- As more site-specific information becomes available after Phase 1, TVA and TDEC may need to revisit the acceptable performance criteria in light of the additional information.

Note that the tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

Table 2. Summary of Load Cases and Acceptance Criteria

Load Case	Pool Levels	Incipient Motion	Analysis	Soil Strengths	Pore Pressures	Acceptance Criteria
Static, Long-Term, Global and Veneer	Impoundment (where applicable): Normal Operating Pool Adjacent Reservoir: Winter Pool	Inboard (Impoundments Only) and Outboard	Drained	Drained Static	Seepage for Modeled Pool Levels and/or Piezometer Data	FS ≥ 1.5
Pseudostatic, Global and Veneer	Impoundment (where applicable): Normal Operating Pool Adjacent Reservoir: Winter Pool	Inboard (Impoundments Only) and Outboard	Undrained Seismic	Undrained Seismic	Seepage for Modeled Pool Levels and/or Piezometer Data	FS ≥ 1.0 (Correlated to tolerable displacement of 3 feet[1])
Post-Earthquake, Global	Impoundment (where applicable): Normal Operating Pool Adjacent Reservoir: Winter Pool	Inboard (Impoundments Only) and Outboard	Undrained Static	Undrained Seismic; Residual Strengths in Liquefied Materials	Seepage for Modeled Pool Levels and/or Piezometer Data	FS ≥ 1.1 (Phase 1); FS ≥ 1.0 (Phase 2); Representative displacement ≤ 3 feet[1] (Phase 3)

[1] Tolerable displacement subject to adjustment based on site-specific features and consequences of specific failure modes.

5.1.3 Basis for Load Cases and Acceptance Criteria

There are no established closure design criteria for certain categories of CCR units that are not regulated under the CCR Rule. The US Environmental Protection Agency (EPA) excluded from regulation inactive CCR landfills, § 257.50(d), as well as CCR surface impoundments that no longer impound water and that are "capped or otherwise maintained," 80 Fed. Reg. at 21343. EPA explained in its preamble that these exclusions are due to the lower risk associated with such units. Section VI.A.5 (page 21342) of the preamble states:

> "As noted, EPA's risk assessment shows that the highest risks are associated with CCR surface impoundments due to the hydraulic head imposed by impounded water. Dewatered CCR surface impoundments will no longer be subjected to hydraulic head so the risk of releases, including the risk that the unit will leach into the groundwater, would be no greater than those from CCR landfills."

To establish the closure design criteria presented herein, relevant standards from the landfill and embankment dam industries were considered. The following industries or agencies were considered when selecting the appropriate load cases and acceptance criteria:

- State of Tennessee solid waste landfill design guidance (TDEC, date unknown),
- EPA municipal solid waste landfill (i.e., RCRA Subtitle D) design guidance (Richardson et al. 1995),
- EPA CCR Rule requirements,
- US Army Corps of Engineers (USACE) embankment dam design guidance (Hynes-Griffin and Franklin 1984),
- TVA embankment dam design guidance (TVA 2016). (Note that the analysis load cases and acceptance criteria are based upon and generally consistent with other industry standards, such as the dam safety criteria of the U.S. Army Corps of Engineers and the Federal Energy Regulatory Commission.)

5.1.3.1 Static Loading

For static loading, the landfill and embankment dam practices are generally in agreement that long-term (i.e., normal operating condition) loading should be analyzed for global slope stability. For landfills with a final cover that may consist of relatively thin layer(s) of materials, the long-term veneer stability should also be analyzed. The reviewed guidance documents generally agree that a static, long-term factor of safety of 1.5 for both global and veneer slope stability is appropriate, and this criterion is applied herein.

Other common static load cases, such as end-of-construction loading, flood loading and sudden drawdown loading are not applicable to existing landfills or surface impoundments that no longer impound water.

5.1.3.2 Seismic Loading

For seismic loading, the landfill and embankment dam practices are less consistent on the load cases to consider and the associated acceptance criteria. However, there is general consensus that because earthquake loading is less probable than static loading, that lower factors of safety and some permanent displacement can be accepted.

In the case of landfills, the tolerable displacement is typically related to the potential damage to components (liners, leachate collection pipes, covers, etc.) and the ability to make repairs after the earthquake. In the case of embankment dams, the tolerable displacement is typically related to preventing uncontrolled loss of pool, potential damage to internal components (sand filters, drainage pipes, etc.), and ability to make repairs after the earthquake.

Seismic loading is commonly evaluated by considering two scenarios:

- Stability during shaking, either using pseudostatic slope stability analyses or simplified displacement analyses,
- Stability immediately after shaking, using static, post-earthquake stability analyses that consider liquefaction potential and associated reductions in shear strength.

5.1.3.2.1 Pseudostatic Stability

There is general consensus that seismic-induced displacements are key to judging acceptable performance during and after the earthquake. However, the most common difference between various design guidance is whether to perform pseudostatic analyses (which can infer tolerable displacement) or to perform simplified displacement analyses (which estimate displacements directly). Depending on how the pseudostatic seismic coefficient is derived (i.e., the degree of conservatism), the slope stability analysis may or may not be a good index of displacement.

TDEC guidance for solid waste landfills judges acceptable performance based on results of simplified displacement analyses (Newmark sliding block or similar analysis). TDEC does not have acceptance criteria based on a pseudostatic slope stability factor of safety. Two acceptance criteria were established to "…insure that the landfill liner, leachate collection system and landfill appurtenances will remain functional when subjected to earthquake induced forces." The acceptance criteria are as follows:

- "Leachate collection systems and waste cells shall be designed to function without collection pipes for solid waste fill embankments that are predicted to undergo more than six inches of deformation."

- "No landfill shall be acceptable if the predicted seismic induced deformations within the waste fill exceed one-half the thickness of the clay liner component of the liner system."

In many cases, inactive CCR landfills and/or CCR surface impoundments that no longer impound water do not include leachate collection systems or engineered bottom liners, and can tolerate greater seismic displacements. As such, the above acceptance criteria are considered overly conservative and not applicable.

In contrast, CCR Rule has acceptance criteria based on a pseudostatic slope stability factor of safety of 1.0. The means to derive an appropriate pseudostatic seismic coefficient are not defined in the CCR Rule. In order to perform CCR Rule demonstrations, TVA has developed a method whereby the coefficient is correlated to a site-specific tolerable displacement. As a result, a factor of safety of 1.0 equates to the tolerable displacement. A factor of safety less than 1.0 would imply displacements that exceed the tolerable value.

EPA guidance for solid waste landfills and USACE and TVA guidance for embankment dams employ phased approaches. A pseudostatic slope stability analysis is performed, and if acceptance criteria ($FS_{pseudo} \geq 1.0$ for EPA and USACE; 1.1 or 1.0 for TVA depending on how well the site is characterized) are met it is implied that displacements are tolerable. The analysis methods recommended by EPA and USACE are correlated to tolerable displacements of 12 inches and 1 meter, respectively. If acceptance criteria are not met, a simplified displacement analysis is then performed. The estimated displacements are compared against tolerable displacement that is based on site-specific features and/or consequences.

In most cases, inactive CCR landfills and/or CCR surface impoundments that no longer impound water do not include leachate collection systems or engineered bottom liners and can tolerate greater seismic displacements. Therefore, for pseudostatic slope stability (global), an acceptable factor of safety of 1.0 ($FS_{pseudo} \geq 1.0$) which is correlated to a tolerable displacement of 3 feet will be employed. Based on a series of seismic displacement analyses for a variety of earthquakes and site conditions, Hynes-Griffin and Franklin (1984) conclude that if FS_{pseudo} is greater than or equal to one, that the slope deformations should be tolerable for an embankment dam (they define tolerable as displacements less than 1 meter, or about 3 feet). The tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

With respect to veneer (i.e., final cover) slope stability during an earthquake, there is consensus that more permanent displacement is tolerable because of the low probability of the earthquake and the ability to repair the final cover. For solid waste landfills, EPA still suggests an acceptable factor of safety of 1.0, but states:

> "For cover systems, where permanent seismic deformations may be observed in post-earthquake inspections and damage to components can be repaired, larger permanent deformations may be considered acceptable. In fact, some regulatory agencies consider seismic deformations of the landfill cover system primarily a maintenance problem."

Indeed, the TDEC guidance for solid waste landfills requires a factor of safety of 1.0 but acknowledges design flexibility for final cover displacements that occur due to the earthquake:

> "Presently, it is the opinion of the Solid Waste Division that this type of failure mechanism will generally not result in a catastrophic type of failure. Therefore, some flexibility will be given for the design of the stability of landfill cover systems."

Therefore, for pseudostatic slope stability (veneer), an acceptable factor of safety of 1.0 ($FS_{pseudo\text{-}veneer} \geq 1.0$) which is correlated to a tolerable displacement of 1 meter (approximately 3 feet) will be employed. The tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

5.1.3.2.2 Post-Earthquake Stability

In addition to permanent displacements that occur during shaking, further movement can occur immediately after shaking if shear strengths are significantly reduced due to liquefaction triggering.

Assigning appropriate post-earthquake strengths first requires a liquefaction triggering assessment for each material in the slope stability model. The results of the liquefaction triggering assessment will inform the derivation of post-earthquake strengths. The post-earthquake slope stability analysis is a static load case; there is no earthquake load applied.

The TDEC guidance for solid waste landfills includes a liquefaction triggering assessment but does not stipulate a post-earthquake slope stability analysis. Instead, an effort is made to estimate liquefaction-induced damage at the ground surface.

The EPA guidance for solid waste landfills and the TVA guidance for embankment dams include a liquefaction triggering assessment followed by a post-earthquake slope stability analysis. In the EPA and TVA guidance, performance is considered acceptable if the factor of safety ($FS_{post\text{-}EQ}$) is 1.1 or greater. However, TVA guidance also allows an acceptable $FS_{post\text{-}EQ}$ of 1.0 "for embankments with well-defined subsurface and site condition information."

The CCR Rule requires a liquefaction triggering assessment followed by a post-earthquake slope stability analysis. The acceptance criterion is $FS_{post\text{-}EQ}$ of 1.2. Commentary within the Rule notes that a minimum factor of safety higher than 1.0 was selected because "liquefaction potential analysis and post-liquefaction residual strength analysis involves a larger degree of uncertainties…in assumptions and analysis…".

Therefore, for post-earthquake slope stability (global), an acceptable factor of safety of 1.1 ($FS_{post\text{-}EQ} \geq 1.1$) will be employed. This applies when an ordinary amount/type of site information is available, and generally corresponds to a Phase 1 assessment as defined herein. If the site characterization is "well-defined" an acceptable factor of safety of 1.0 ($FS_{post\text{-}EQ} \geq 1.0$) will be employed. This generally corresponds to a Phase 2 assessment as defined herein.

If a Phase 3 assessment is necessary, including a nonlinear deformation analysis, the acceptance criteria is a representative displacement of 3 feet. The tolerable displacement is subject to adjustment based on site-specific features and consequences of specific failure modes.

5.2 CROSS SECTION DEVELOPMENT

Each analysis cross section will be selected to represent the critical cross section for slope stability failure. Cross sections previously evaluated will be reviewed and evaluated for use in the proposed analyses. If the previously used cross sections are not considered representative for the new analyses, new cross sections will be developed using available site-specific data (including data collected per the Exploratory Drilling SAP). The basis for analysis cross sections will be documented in the EAR.

5.3 MATERIAL PROPERTIES

Measurements of material properties are obtained from site-specific field and/or laboratory testing where available (including data collected per the Exploratory Drilling SAP). If parameters are not available, they will be derived for each material based on the available data, specific characteristics of the material, geologic setting, application of the parameter in the analysis, and professional judgment. If needed, standard engineering references such as Navy (NAVFAC), U. S. Army Corps of Engineers (USACE), and U. S. Bureau of Reclamation (USBR) publications will be used to develop material parameters. Material properties to be developed include but are not limited to the following parameters for use in the analyses:

- Unit Weights,
- Drained Shear Strengths,
- Undrained Shear Strengths,
- Seismic Shear Strengths,

- Post-Earthquake (Liquefied Strengths), and
- Hydraulic Conductivity.

Prior to the post-earthquake analysis, the materials will be evaluated for liquefaction potential using an industry standard, simplified stress-based approach (e.g., Boulanger and Idriss 2014). The liquefaction assessment may include site-specific ground response analyses. If a material is anticipated to liquefy, residual strengths will be estimated using available laboratory data, field data and/or published correlations.

Appropriate material properties will be applied, consistent with each load case (Table 2). A discussion of utilized parameters and their derivations will be included in the EAR.

5.4 LOADING

5.4.1 Pool Levels and Pore Water Pressures

For static, long-term and seismic load cases, the pool within an impoundment (where applicable) is the normal operating pool. The pool in the adjacent body of water (e.g., river or reservoir) is the normal operating pool (Summer or Winter Pool, whichever is more conservative) for the reservoir.

The slope stability analyses require pore water pressures for computing effective consolidation stresses, as defined for the load conditions. Pore water pressures can be estimated with finite element analyses (i.e., seepage models) or by assigning a piezometric line to the cross section. Either approach will be based, in part, on available site-specific piezometer data. The methodology utilized in the analyses will be documented in the EAR.

Consideration of both estimated pore water pressures and adjacent reservoir pool levels (where applicable) will generally encompass the phreatic conditions that will be experienced by the unit.

5.4.2 Seismic Loading

The design earthquake is an event with a 2 percent probability of exceedance in 50 years (i.e., return period of 2,475 years). This return period is similar to that of an event with a 10 percent probability of exceedance in 250 years (return period of 2,373 years). TVA seismic hazard models or appropriate U. S Geological Survey (USGS) seismic hazard mapping may be used to derive the appropriate seismic loading. Derivation of the seismic loads will be documented in the EAR.

5.5 SOFTWARE EMPLOYED IN ANALYSES

Slope stability will be evaluated using conventional, limit equilibrium methods as implemented in the GeoStudio SLOPE/W software or equivalent. With SLOPE/W, the distribution of pore water pressures within the earth mass may be mapped directly from the results of a SEEP/W analysis or piezometric line(s) can be input.

If ground response analyses become warranted, software such as Strata, QUAD4, or other appropriate code may be utilized.

If nonlinear deformation analyses become warranted, software such as FLAC, OpenSees, or other appropriate code may be utilized.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The Quality Assurance Project Plan (QAPP) describes quality assurance (QA)/ quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to stability analyses.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

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

6.2 QUALITY CONTROL CHECKS

The accuracy of the stability analysis processes must be maintained throughout the Investigation.

Office personnel will be responsible for performing checks to confirm that the SAP has been followed. This consists of the completion of applicable forms and documentation of activities.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that data are appropriately maintained and accessible to data end users. The Investigation will be performed in accordance with the QAPP. Analyses will be subjected to data validation in accordance with the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 3. Preliminary Schedule for Stability SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Stability SAP Submittal		Completed
Conduct Stability Analyses	180 Days	Following EIP Approval
Documentation	60 Days	Following Analyses

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- None.

9.0 REFERENCES

Boulanger, R.W. and Idriss, I.M. (2014). "CPT and SPT based liquefaction triggering procedures." Report No. UCD/CGM-14/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, CA.

Hynes-Griffin, M. E., and Franklin, A. G. (1984). "Rationalizing the seismic coefficient method." Miscellaneous Paper GL-84-13, July. U.S. Army Engineer Waterways Experiment Station. Vicksburg, Mississippi, 37 pages.

Richardson, G. N., Kavazanjian, E., and Matasovi, N. (1995). "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities." Report No. EPA/600/R-95/051. Prepared for United States Environmental Protection Agency. April.

Stantec. (2016). "Basis of Design Report (Rev. 1), West Ash Pond Final Closure, Allen Fossil Plant, Memphis, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. June.

Stantec. (2017). "Basis of Design Report (Rev. 0), East Ash Pond Complex Closure, Allen Fossil Plant, Memphis, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. January.

Tennessee Division of Solid Waste Management (unknown date). "Earthquake Evaluation Guidance Document."

TVA (Tennessee Valley Authority). (2016). "Design and evaluation of new and existing river system dams." SRME-SPP-27.001, Rev. 0000, January 5 (effective date). Chattanooga, Tennessee.

United States Army Corps of Engineers (2003). "Slope stability." EM 1110-2-1902, October, Washington D.C.

United States Environmental Protection Agency (USEPA). (2015). "Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities." Federal Register, Vol. 80, No. 74, April 17.

ATTACHMENT A
FIGURES

CCR Unit and Condition	Static Cases: Long-Term, Global	Static Cases: Long-Term, Veneer[2]	Seismic Cases: Pseudostatic[1], Global	Seismic Cases: Pseudostatic[1], Veneer[2]	Seismic Cases: Post-EQ[3], Global
East Ash Disposal Area (Closed Condition)	X, Y	Typ.[4]	X[5]	Typ.	X[5]

[1] Pseudostatic, correlated to a tolerable displacement.

[2] Veneer stability is the slope stability of the final cover.

[3] Post-earthquake (Post-EQ) analysis includes a preceding liquefaction triggering assessment.

[4] Typical design section was analyzed.

[5] After the closure design is finalized, it will be compared against analyses for the existing conditions. The existing conditions analyses may prove adequate to represent the closed conditions.

Blue cells are completed analyses. Yellow cells are proposed analyses.

Figure No.
1

Title

Completed and Proposed Stability Analysis East Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location

Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by TM on 2017-11-13

0 150 300 450 600 Feet

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

Legend

Cross Section

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec

TVA

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CCR Unit and Condition	Static Cases: Long-Term, Global	Static Cases: Long-Term, Veneer[2]	Seismic Cases: Pseudostatic[1], Global	Seismic Cases: Pseudostatic[1], Veneer[2]	Seismic Cases: Post-EQ[3], Global
West Ash Disposal Area (Closed Condition)	H, J	Typ.[4]	H	Typ.	H

[1] Pseudostatic, correlated to a tolerable displacement.
[2] Veneer stability is the slope stability of the final cover.
[3] Post-earthquake (Post-EQ) analysis includes a preceding liquefaction triggering assessment.
[4] Typical design section was analyzed.
Blue cells are completed analyses. Yellow cells are proposed analyses.

Figure No.
2

Title
Completed and Proposed Stability Analysis West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-13
Technical Review by TM on 2017-11-13

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

Legend

- Cross Section
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by Terraserver (2016)

Stantec TVA

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APPENDIX Q
BORING AND INSTRUMENTATION LOCATION MAP AND CROSS SECTIONS

Figure No.
1

Title

Existing Instrumentation
East Ash Disposal Area

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by JD on 2017-11-14

0 150 300 450 600 Feet

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

Legend

- Existing Piezometer Open Standpipe (Screened Interval)
- Existing Piezometer Vibrating Wire (Tip Interval)
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec TVA

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Figure No.
2

Title
Existing Instrumentation
West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-11-14
Technical Review by JD on 2017-11-14

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

Legend

- Existing Piezometer Vibrating Wire (Tip Interval)
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

Stantec
TVA

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Figure No.
3

Title
Cross-Section Plan

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2017-06-09
Technical Review by TM on 2017-06-09

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

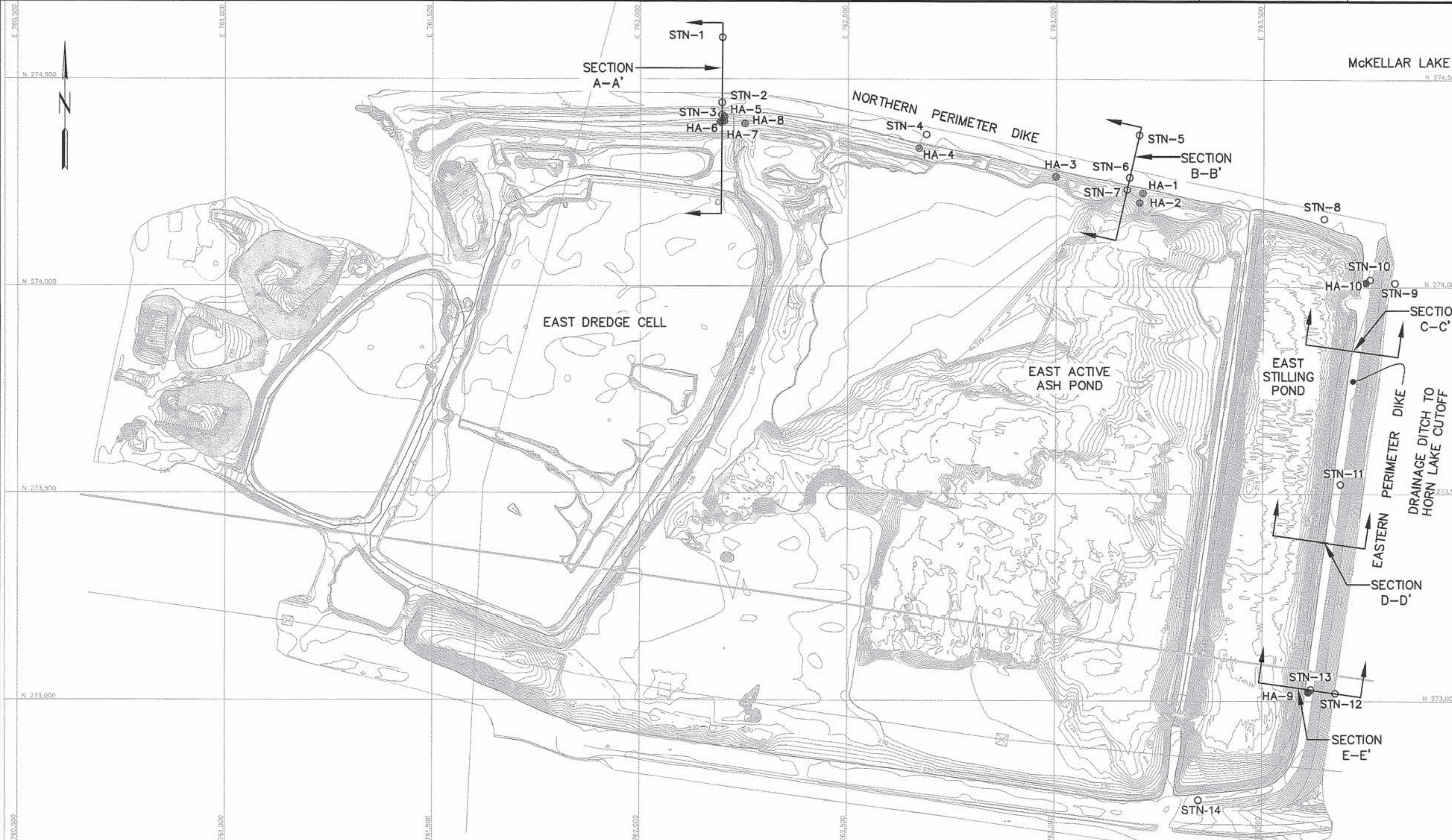
Legend

Cross Section

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)
3. TVA property boundary is referenced from TVA Drawing 421 P 504 Allen Fossil Plant Reservation.

Stantec
TVA



LEGEND

○ Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Location of Piezometers

● Hand Auger Boring

NOTES:

1. The topographic mapping presented on this drawing was provided to Stantec by TVA Surveying and Project Services. This plan view was prepared to support development of the geotechnical exploration program and should not be used for construction.
2. The geotechnical information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner or Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom. The information is made available in order that the Contractor may have ready access to the same information available to the Owner and the Engineer and is not part of this contract.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEV. (FT.)
STN-1	274600.73	762196.97	215.3
STN-2	274443.30	762195.73	238.8
STN-3	274413.31	762195.54	234.6
STN-4	274366.97	762687.88	237.5
STN-5	274366.34	763200.60	217.5
STN-6	274264.03	763177.15	238.3
STN-7	274234.70	763171.06	235.6
STN-8	274165.16	763646.95	237.5
STN-9	274009.16	763820.47	221.2
STN-10	274018.24	763758.37	236.9
STN-11	273523.29	763688.16	237.8
STN-12	273018.83	763676.83	216.7
STN-13	273020.21	763618.05	236.9
STN-14	272761.34	763347.91	236.5

HAND AUGER BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEV. (FT.)
HA-1	274226.34	763209.32	235.7
HA-2	274202.98	763201.48	230.5
HA-3	274265.91	762999.17	234.2
HA-4	274333.93	762669.73	233.6
HA-5	274409.74	762201.44	233.7
HA-6	274395.67	762191.04	232.5
HA-7	274398.58	762201.29	232.4
HA-8	274392.70	762251.17	232.1
HA-9	273021.67	763612.37	237.0
HA-10	274010.59	763748.55	237.2

RECORD DRAWING

For Supporting Design Calculations See FPGALFFESCDX00000020100001

R 0 02/04/10 PVK PS SF HRA HRA PVK TJ

RECORD DRAWING

SCALE: 1"=100' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
EASTERN PERIMETER DIKE
BORING LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

PATRICK V. KISER, REGISTERED ENGINEER, STATE OF TENNESSEE

2/4/2010

Stantec Consulting Services Inc.
100 Westwood Place Suite 420
Brentwood, Tennessee
37027-5044
Tel. 615.885.1144
Fax 615.885.1102
www.stantec.com

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502-01 | R 0

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

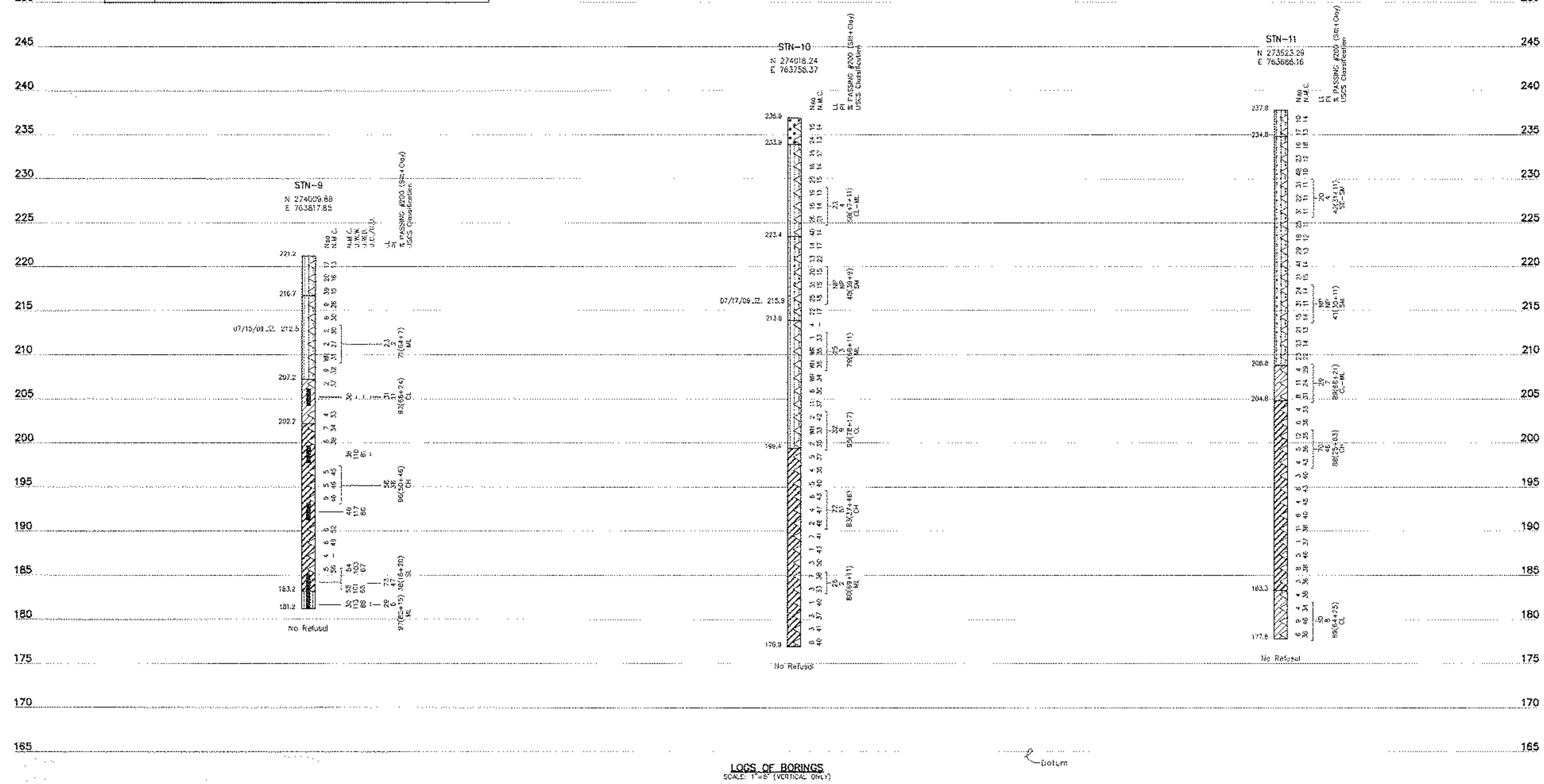
STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
TJ

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Source: Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS			
Location	STN-9	STN-9	STN-9
Depth	28.0'-28.5'	36.0'-36.5'	36.5'-37.0'
$\bar{\phi}$	28.20°		
$\bar{c}$	160.00 p.s.f.		



LOGS OF BORINGS
SCALE: 1"=8' (VERTICAL ONLY)

LEGEND

- Overburden
- Topsoil
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Silt to Sandy Silt, brown to gray, moist to saturated, occasional clay zones
- Sand to Silty Sand, brown to gray, moist to saturated

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
T.O.R.--	Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.--	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal using a carbide-tipped tooth auger bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.
NP	Non-Plastic

NOTES:

1. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.

2. The subsurface information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner, Engineer or Geotechnical Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom by the Contractor. The information is made available in order that the Contractor may have ready access to the same information available to the Owner, Engineer and Geotechnical Engineer and is not part of this contract.

SUMMARY OF OFFSET BORINGS				
BORING NO.	NORTHING	EASTING	SURFACE ELEV. (FT.)	BORING TYPE
PZ-10	274009.41	763758.03	237.39	PIEZOMETER
PZ-11	273517.12	763687.47	237.93	PIEZOMETER

Source: Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

RECORD DRAWING

For Supporting Design Calculations See FPGALFFESCDX00000020100001

R0 02/04/10 PVK TPS SF HRA HRA PVK TJ
RECORD DRAWING

SCALE: AS SHOWN EXCEPT AS NOTED

PATRICK V. KISER REGISTERED ENGINEER STATE OF TENNESSEE
2/4/2010

YARD

EASTERN PERIMETER DIKE
EAST STILLING POND
LOGS OF BORINGS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
P. KISER	P. SUPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

Stantec Consulting Services Inc
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Fax 615.885.1102
www.stantec.com

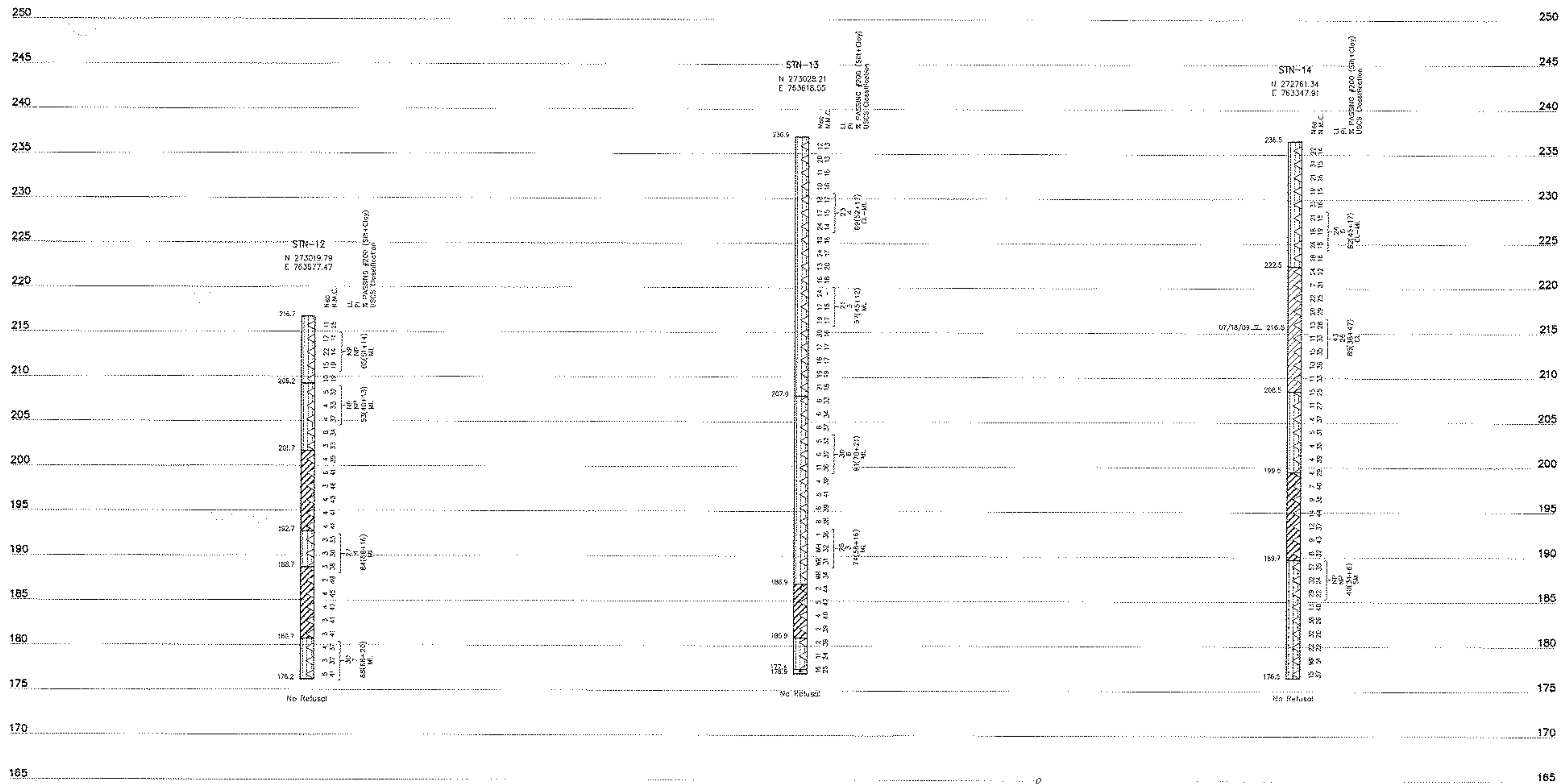
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502-02 | R 0

PLOT FACTOR:XX

C.A.D. DRAWING DO NOT ALTER MANUALLY

STANTEC | 0
TASK COMPLETED BY | REV NO



LOGS OF BORINGS
SCALE: 1"=5' (VERTICAL ONLY)

LEGEND

- Overburden
- Topsoil
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark grey, damp to wet
- Lean Clay, brown to grey, moist to saturated stiff, with sandy and silty zones
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, grey to brown
- Silt to Sandy Silt, brown to grey, moist to saturated, occasional clay zones
- Sand to Silty Sand, brown to grey, moist to saturated

WH — Weight of Hammer
WR — Weight of Rods
◁ — Standard Penetration Test Interval
■ — Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60} — Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{90} — Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C. — Natural Moisture Content (%)
U.W.W. — Unit Weight Wet (lbs./cu.ft.)
U.W.D. — Unit Weight Dry (lbs./cu.ft.)
U.C./U.U. — Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽ — Water Level and Date Recorded
T.O.R.– — Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.– — Begin Rock Core
R.Q.D. — Rock Quality Designation (%)
REC. — Recovery (%)
Refusal — Auger Refusal using a carbide-tipped tooth auger bit
No Refusal — No Refusal Encountered
* — Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.
NP — Non-Plastic

NOTES:

1. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.
2. The subsurface information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner, Engineer or Geotechnical Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom by the Contractor. The information is made available in order that the Contractor may have ready access to the same information available to the Owner, Engineer and Geotechnical Engineer and is not part of this contract.

SUMMARY OF OFFSET BORINGS

BORING NO.	NORTHING	EASTING	SURFACE ELEV. (FT.)	BORING TYPE
PZ-13	273020.94	763619.04	237.24	PIEZOMETER
PZ-14	272761.04	763351.79	236.64	PIEZOMETER

Source: Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

RECORD DRAWING

For Supporting Design Calculations See FPGALFFESCDX00000020100001

PATRICK V. KISER REGISTERED ENGINEER STATE OF TENNESSEE
2/4/2010

Stantec Consulting Services Inc.
100 Westwood Place Suite 400
Brentwood, Tennessee 37027-5044
Tel. 615.885.1144
Fax 615.885.1102
www.stantec.com

R 0 | 02/04/10 | PVK | TPS | SF | HRA | HRA | PVK | TJ
RECORD DRAWING

SCALE: AS SHOWN EXCEPT AS NOTED

YARD

EASTERN PERIMETER DIKE
EAST STILLING POND
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SUPACHARN	S. FELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

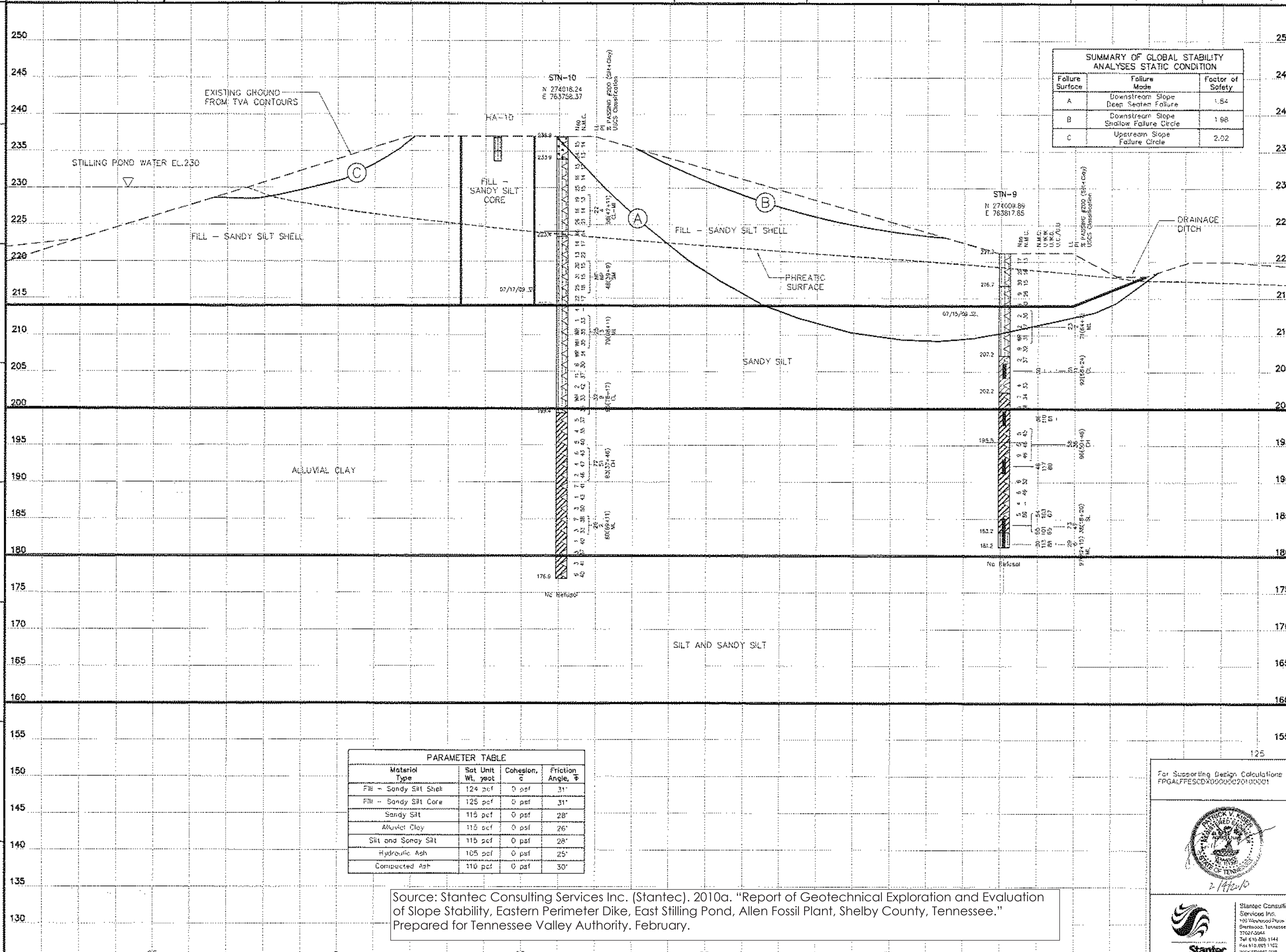
AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502-03 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: XX

C.A.D. DRAWING DO NOT ALTER MANUALLY

38 C 10W502-03



SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION		
Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.84
B	Downstream Slope Shallow Failure Circle	1.98
C	Upstream Slope Failure Circle	2.02

PARAMETER TABLE			
Material Type	Sat Unit Wt, γsat	Cohesion, $\bar{c}$	Friction Angle, $\bar{\Phi}$
Fill - Sandy Silt Shell	124 pcf	0 psf	31°
Fill - Sandy Silt Core	125 pcf	0 psf	31°
Sandy Silt	115 pcf	0 psf	28°
Alluvial Clay	115 pcf	0 psf	26°
Silt and Sandy Silt	115 pcf	0 psf	28°
Hydraulic Ash	105 pcf	0 psf	25°
Compacted Ash	110 pcf	0 psf	30°

Source: Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

LEGEND

- Overburden
- Topsoil
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Silty Clay, brown to greyish brown, moist to wet
- Gravel with Sand, gray to brown
- Silt to Sandy Silt, brown to gray, moist to saturated, occasional clay zones
- Sand to Silty Sand, brown to gray, moist to saturated

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
T.O.R.-	Top of Rock (Indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.-	Begin Rock Core
R.Q.D	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal using a carbide-tipped tooth auger bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.
NP	Non-Plastic

RECORD DRAWING

For Supporting Design Calculations See FPGALFFESCDX000000020100001

PATRICK V. KISER REGISTERED ENGINEER STATE OF TENNESSEE

2/19/2010

Stantec Consulting Services Inc.
100 Westwood Place Suite 420
Brentwood, Tennessee 37027-5044
Tel 615.885.1144
Fax 615.885.1102
www.stantec.com

Stantec

R 0	02/04/10	PVK	FS	SF	HRA	HRA	PVK	TJ

RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
EASTERN PERIMETER DIKE
CROSS-SECTION C-C'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	F. SUPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

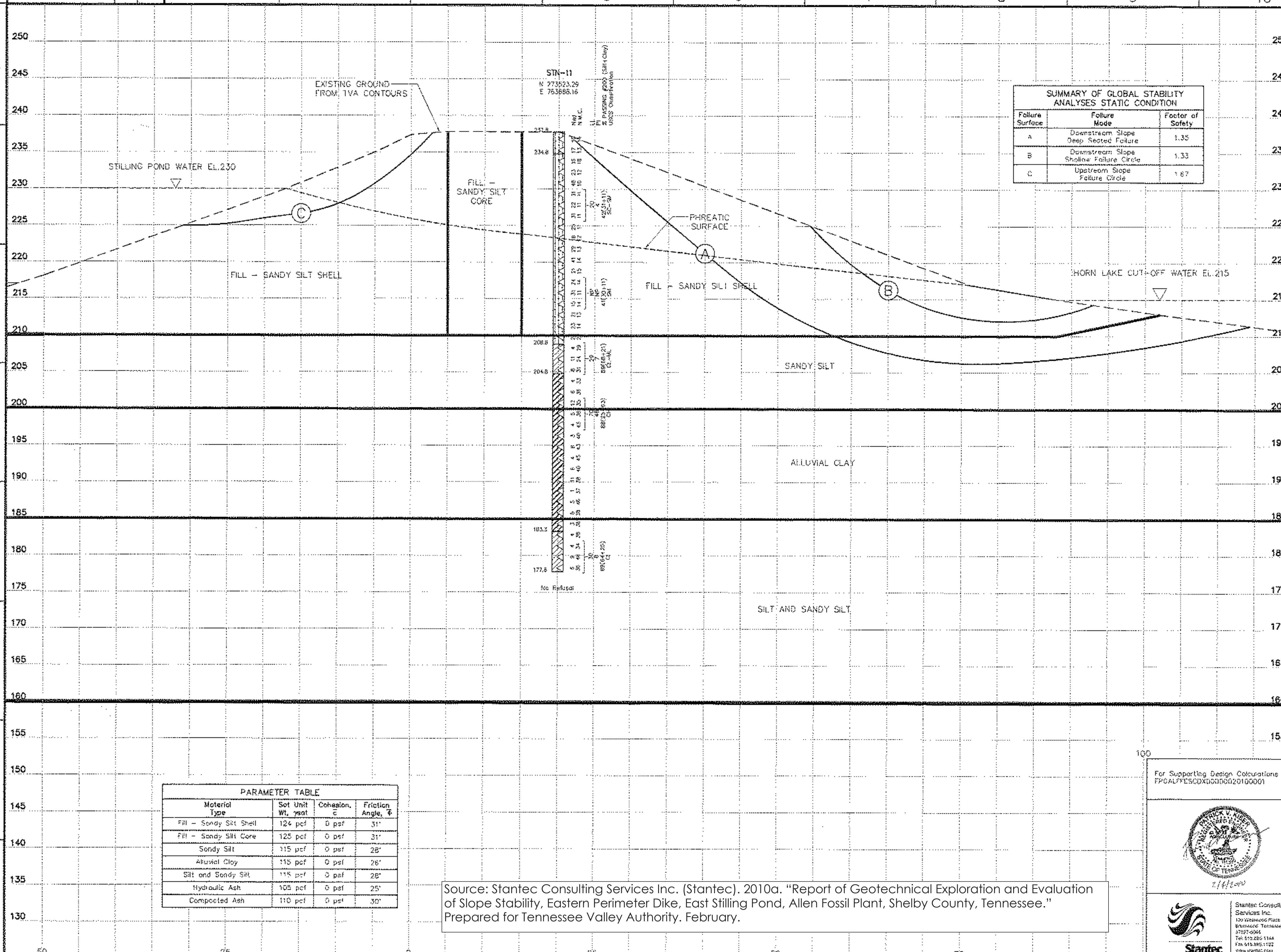
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 02/04/10 | 38 | C | 10W502-04 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX

C.A.D. DRAWING DO NOT ALTER MANUALLY



SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION		
Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.35
B	Downstream Slope Shallow Failure Circle	1.33
C	Upstream Slope Failure Circle	1.87

LEGEND

- Overburden
- Topsoil
- Fat Clay, brown to greyish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Silt to Sandy Silt, brown to gray, moist to saturated, occasional clay zones
- Sand to Silty Sand, brown to gray, moist to saturated

WH Weight of Hammer
WR Weight of Rods
Standard Penetration Test Interval
Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60} Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60} Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C. Natural Moisture Content (%)
U.W.W. Unit Weight Wet (lbs./cu.ft.)
U.W.D. Unit Weight Dry (lbs./cu.ft.)
U.C./U.U Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 Water Level and Date Recorded
T.O.R.- Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.- Begin Rock Core
R.Q.D. Rock Quality Designation (%)
REC. Recovery (%)
Refusal Auger Refusal using a carbide-tipped tooth auger bit
No Refusal No Refusal Encountered
* Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.
NP Non-Plastic

PARAMETER TABLE			
Material Type	Sat Unit Wt. γsat	Cohesion, c	Friction Angle, Φ
Fill - Sandy Silt Shell	124 pcf	0 psf	31°
Fill - Sandy Silt Core	125 pcf	0 psf	31°
Sandy Silt	115 pcf	0 psf	28°
Alluvial Clay	115 pcf	0 psf	26°
Silt and Sandy Silt	115 pcf	0 psf	28°
Hydraulic Ash	105 pcf	0 psf	25°
Compacted Ash	110 pcf	0 psf	30°

Source: Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

RECORD DRAWING

For Supporting Design Calculations See FPCAL7FESCDX000000020100001

SCALE: 1"=5' EXCEPT AS NOTED

YARD

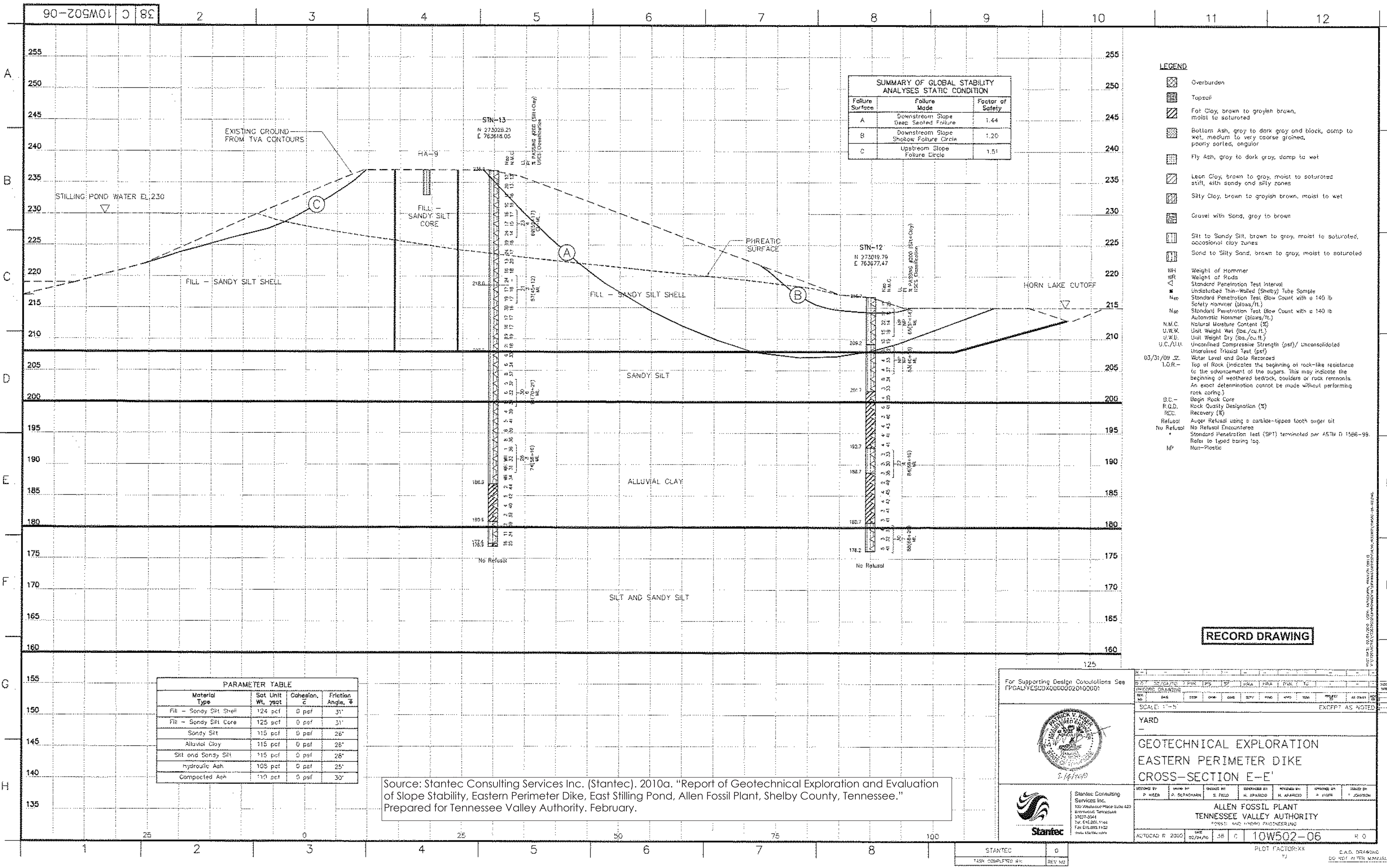
GEOTECHNICAL EXPLORATION
EASTERN PERIMETER DIKE
CROSS-SECTION D-D'

Stantec Consulting Services Inc.

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

38 C 10W502-05 R0

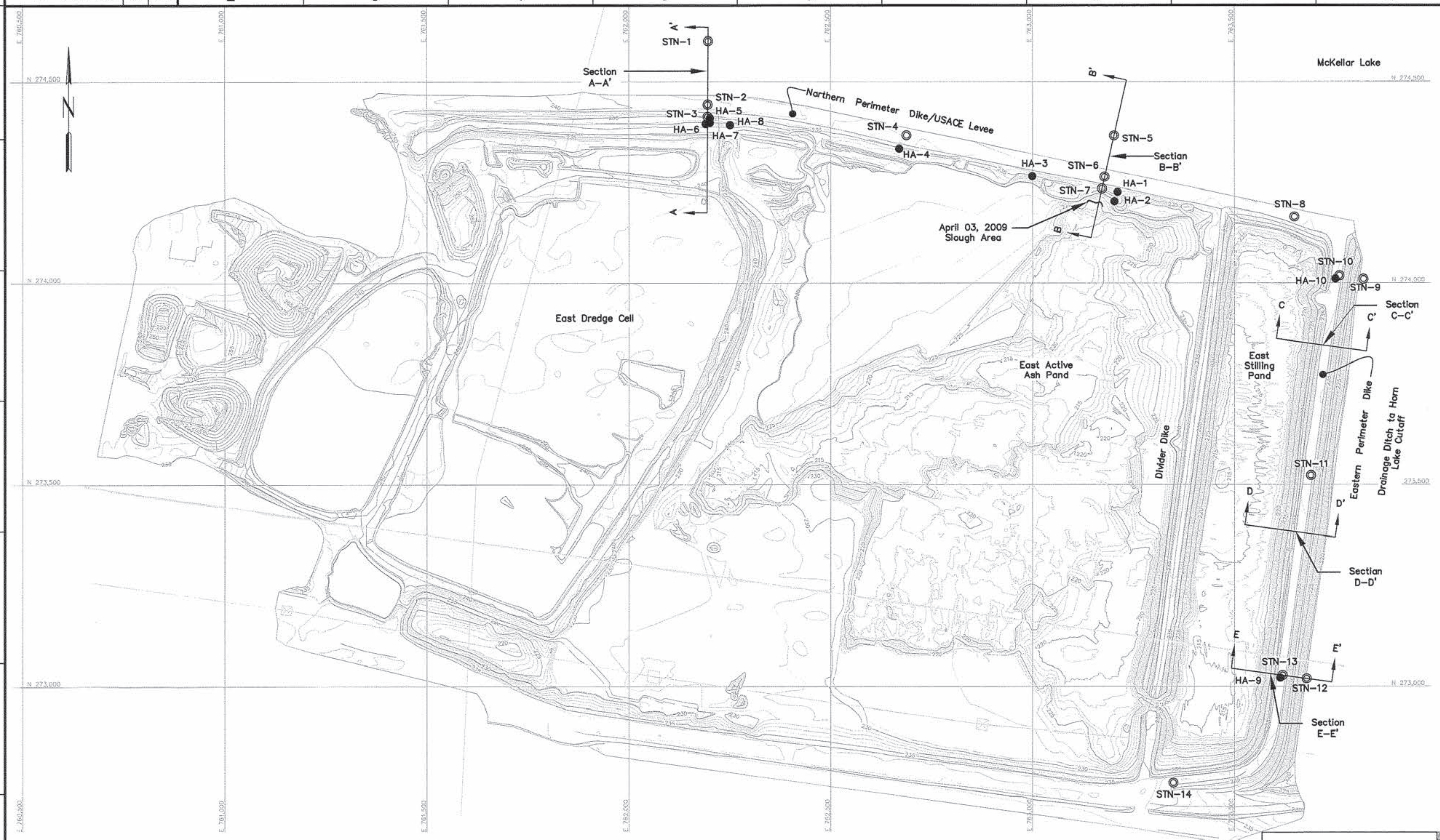
C.A.D. DRAWING DO NOT ALTER MANUALLY



SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION		
Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.44
B	Downstream Slope Shallow Failure Circle	1.20
C	Upstream Slope Failure Circle	1.51

PARAMETER TABLE			
Material Type	Sat Unit Wt, γsat	Cohesion, $\bar{c}$	Friction Angle, $\bar{\Phi}$
Fill - Sandy Silt Shell	124 pcf	0 psf	31°
Fill - Sandy Silt Core	125 pcf	0 psf	31°
Sandy Silt	115 pcf	0 psf	26°
Alluvial Clay	115 pcf	0 psf	26°
Silt and Sandy Silt	115 pcf	0 psf	28°
Hydraulic Ash	105 pcf	0 psf	25°
Compacted Ash	110 pcf	0 psf	30°

Source: Stantec Consulting Services Inc. (Stantec). 2010a. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Eastern Perimeter Dike, East Stilling Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.



LEGEND

- Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests (Piezometers Installed)
- Hand Auger Boring

NOTES:

1. The topographic mapping presented on this drawing was provided to Stantec by TVA Surveying and Project Services. This plan view was prepared to support development of the geotechnical exploration program and should not be used for construction.
2. The geotechnical information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner or Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom. The information is made available in order that the Contractor may have ready access to the same information available to the Owner and the Engineer and is not part of this contract.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEV. (FT.)
STN-1	274,600.73	762,196.97	215.3
STN-2	274,443.30	762,195.73	238.8
STN-3	274,413.31	762,195.54	234.6
STN-4	274,366.97	762,687.88	237.5
STN-5	274,366.34	763,200.60	217.5
STN-6	274,264.03	763,177.15	238.3
STN-7	274,234.70	763,171.06	235.6
STN-8	274,165.16	763,646.95	237.5
STN-9	274,009.16	763,820.47	221.2
STN-10	274,018.24	763,758.37	236.9
STN-11	273,523.29	763,688.16	237.8
STN-12	273,018.83	763,676.83	216.7
STN-13	273,020.21	763,618.05	236.9
STN-14	272,761.34	763,347.91	236.5

HAND AUGER BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEV. (FT.)
HA-1	274,226.34	763,209.32	235.7
HA-2	274,202.98	763,201.48	230.5
HA-3	274,265.91	762,999.17	234.2
HA-4	274,333.93	762,669.73	233.6
HA-5	274,409.74	762,201.44	233.7
HA-6	274,395.67	762,191.04	232.5
HA-7	274,398.58	762,201.29	232.4
HA-8	274,392.70	762,251.17	232.1
HA-9	273,021.67	763,612.37	237.0
HA-10	274,010.59	763,748.55	237.2

RECORD DRAWING

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

For Supporting Design Calculations See FPGALFFESCDX00000020100002

3/25/2010

Stantec Consulting Services Inc.
100 Westwood Place Suite 420
Brentwood, Tennessee 37027-5044
Tel. 615.885.1144
Fax 615.885.1102
www.stantec.com

R 0 03/25/10 PVK PS SF HRA HRA PVK TJ
RECORD DRAWING

SCALE: 1"=100' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
BORING LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 03/25/10 | 38 | C | 10W504-01 | R 0

PLOT FACTOR:XX
TJ

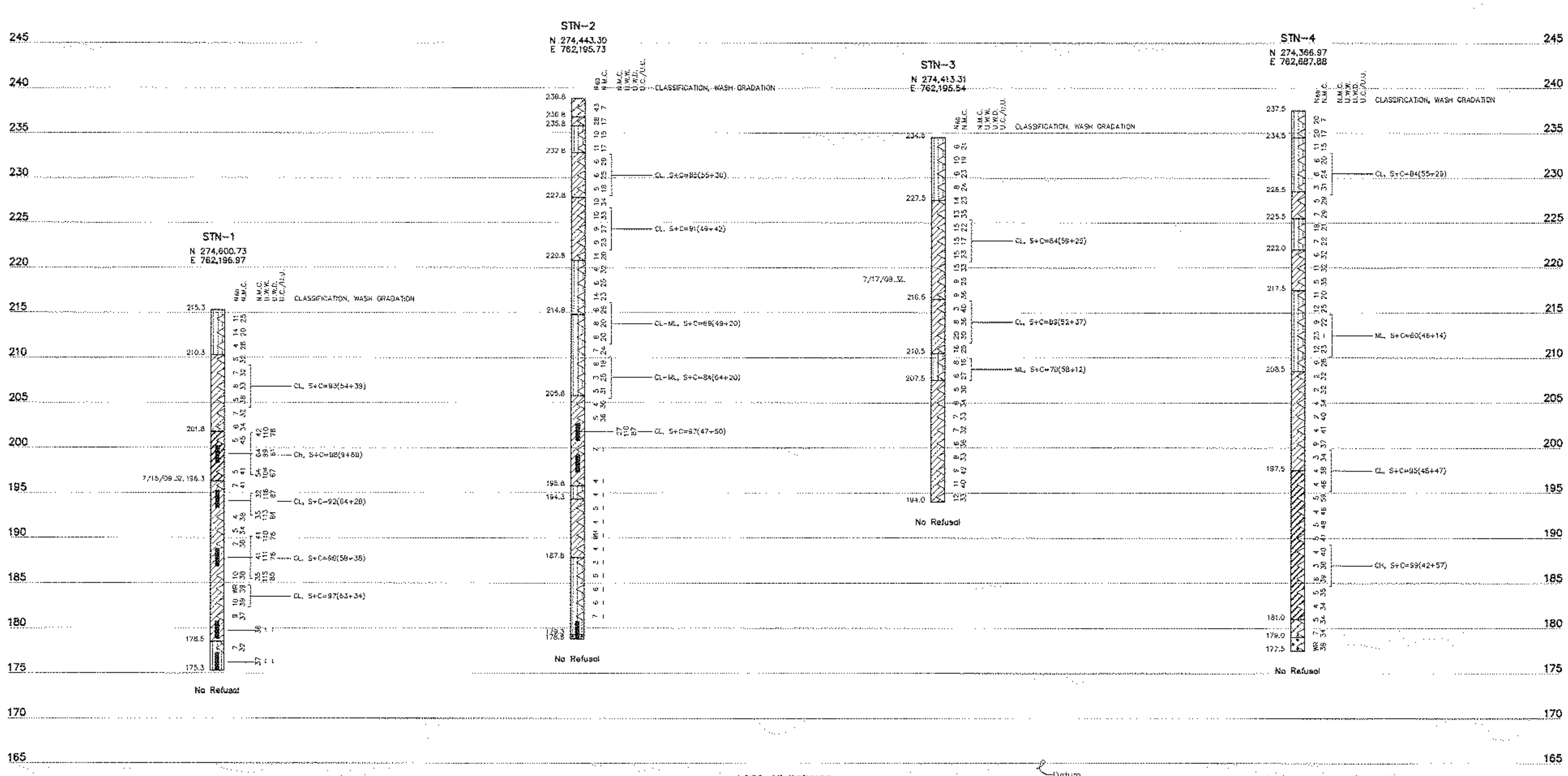
C.A.D. DRAWING DO NOT ALTER MANUALLY

STANTEC 0
TASK COMPLETED BY: REV NO.

Consolidated Undrained Triaxial Test Results			
Location	STN-1	STN-1	STN-1
Depth	15.0'-15.5'	15.7'-16.2'	16.3'-16.8'
$\bar{\phi}$	26.20°		
$\bar{c}$	220.00 p.s.f.		

Consolidated Undrained Triaxial Test Results			
Location	STN-1	STN-1	STN-2
Depth	20.0'-20.6'	20.7'-21.2'	36.0'-36.5'
$\bar{\phi}$	21.10°		
$\bar{c}$	720.00 p.s.f.		

Consolidated Undrained Triaxial Test Results			
Location	STN-1	STN-1	STN-1
Depth	26.5'-27.0'	27.0'-27.5'	27.5'-28.0'
$\bar{\phi}$	31.50°		
$\bar{c}$	60.00 p.s.f.		



LOGS OF BORINGS
SCALE: 1"=5' (VERTICAL ONLY)

LEGEND

- Topsoil
- Silt to Sandy Silt, brown to gray, moist
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N80	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
T.O.R.-	Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.-	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal using a carbide-tipped tooth auger bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log

RECORD DRAWING

NOTES:

1. The boring logs and related information shown on this drawing depict approximate subsurface conditions only of the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.
2. The subsurface information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner, Engineer or Geotechnical Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom by the Contractor. The information is made available in order that the Contractor may have ready access to the same information available to the Owner, Engineer and Geotechnical Engineer and is not part of this contract.

Consolidated Undrained Triaxial Test Results			
Location	STN-3A	STN-3A	STN-3A
Depth	4.0'-4.5'	4.6'-5.1'	6.6'-7.1'
$\bar{\phi}$	33.10°		
$\bar{c}$	220.00 p.s.f.		

Summary of Offset Borings					
BORING NO.	NORTHING	EASTING	SURFACE ELEV. (FT.)	BORING TYPE	UNDISTURBED SAMPLE INTERVALS
PZ-2	274441.09	762201.92	238.8	SAMPLE/ PIEZOMETER	10'-12' 18'-20'
PZ-3	274411.16	762192.94	234.5	SAMPLE/ PIEZOMETER	4'-6' 6'-8'
PZ-4	274367.46	762679.46	237.5	PIEZOMETER	N/A

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

For Supporting Design Calculations See FPGALFFESCDX00000020100002

PATRICK V. KISER REGISTERED ENGINEER STATE OF TENNESSEE
3/25/2010

Stantec Consulting Services Inc.
Tel 615.885.1144
Fax 615.885.1192
www.stantec.com

R 0 | 03/25/10 | PVK | PS | SF | HRA | HRA | PVK | TJ
ISSUED FOR REVIEW

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
–

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
LOGS OF BORINGS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
P. KISER	P. SILPACHAI	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

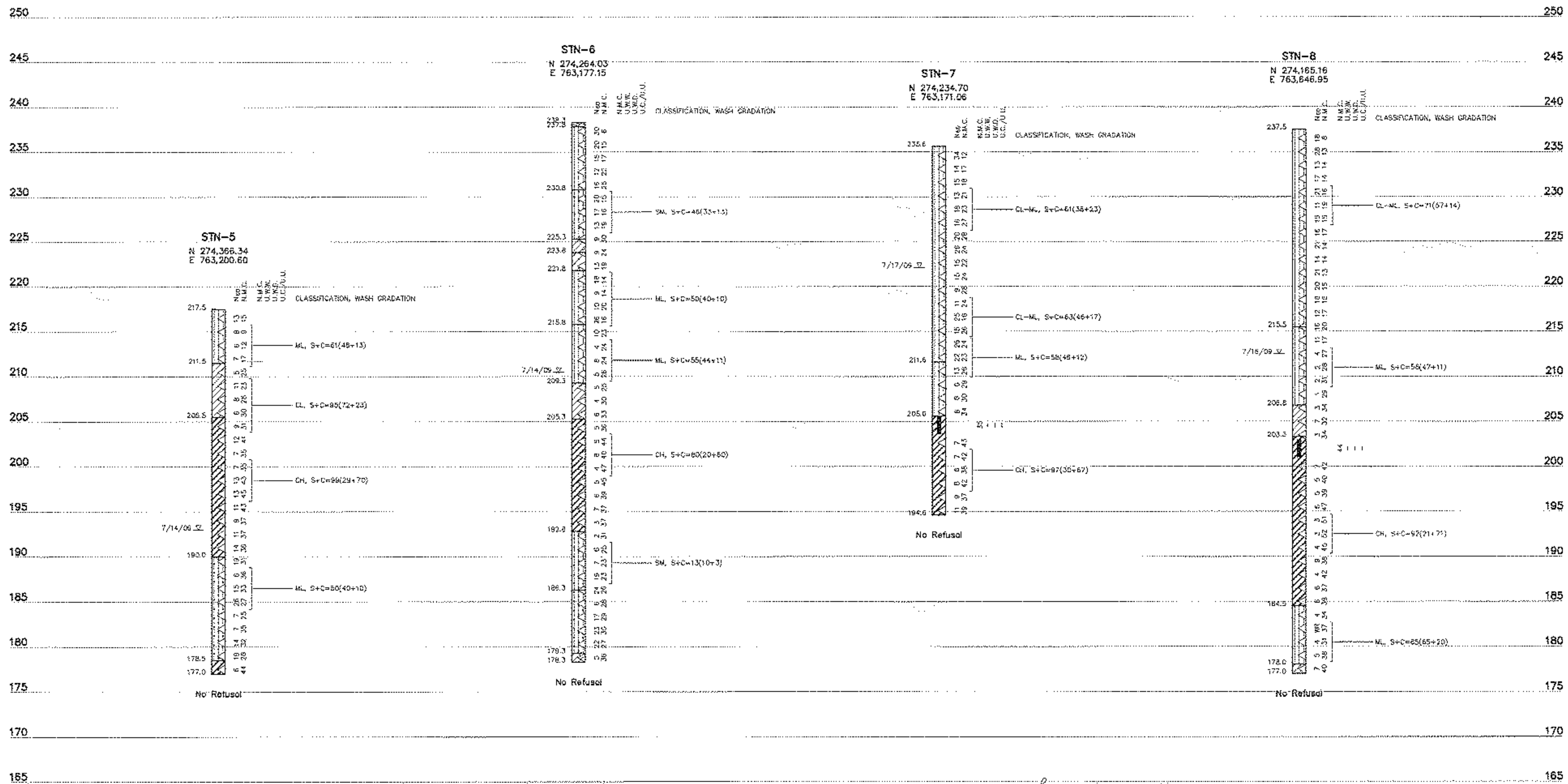
AUTOCAD R 2000 | DATE 03/25/10 | 38 | C | 10W504-02 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

38 | C | 10W504-02



LOGS OF BORINGS
SCALE: 1"=5' (VERTICAL ONLY)

LEGEND

- Topsoil
- Silt to Sandy Silt, brown to gray, moist
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH Weight of Hammer
WR Weight of Rods
◁ Standard Penetration Test interval
▪ Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60} Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80} Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C. Natural Moisture Content (%)
U.W.W. Unit Weight Wet (lbs./cu.ft.)
U.W.D. Unit Weight Dry (lbs./cu.ft.)
U.C./U.U. Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽ Water Level and Date Recorded
T.O.R.– Top of Rock (Indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.– Begin Rock Core
R.Q.D. Rock Quality Designation (%)
REC. Recovery (%)
Refusal Auger Refusal using a carbide-tipped tooth auger bit
No Refusal No Refusal Encountered
* Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.

RECORD DRAWING

NOTES:

1. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.
2. The subsurface information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner, Engineer or Geotechnical Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom by the Contractor. The information is made available in order that the Contractor may have ready access to the same information available to the Owner, Engineer and Geotechnical Engineer and is not part of this contract.

Summary of Offset Borings

BORING NO.	NORTHING	EASTING	SURFACE ELEV. (FT.)	BORING TYPE	UNDISTURBED SAMPLE INTERVALS
PZ-6	274263.61	763180.87	238.5	PIEZOMETER	N/A
PZ-7	274235.39	763163.82	235.5	PIEZOMETER	N/A
PZ-8	274166.09	763541.32	237.8	SAMPLE/ PIEZOMETER	5'-7'

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

For Supporting Design Calculations See FPGALFFESCDX00000020100002

PATRICK V. KISER REGISTERED ENGINEER STATE OF TENNESSEE

Stantec Consulting Services Inc.
100 Westwood Pl., Ste. 420
Brentwood, Tennessee 37027-5044
Tel. 615.885.1144
Fax 615.885.1102
www.stantec.com

R 0 | 03/25/10 | PVK | PS | SF | HRA | HRA | PVK | TJ
ISSUED FOR REVIEW

SCALE: AS SHOWN EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

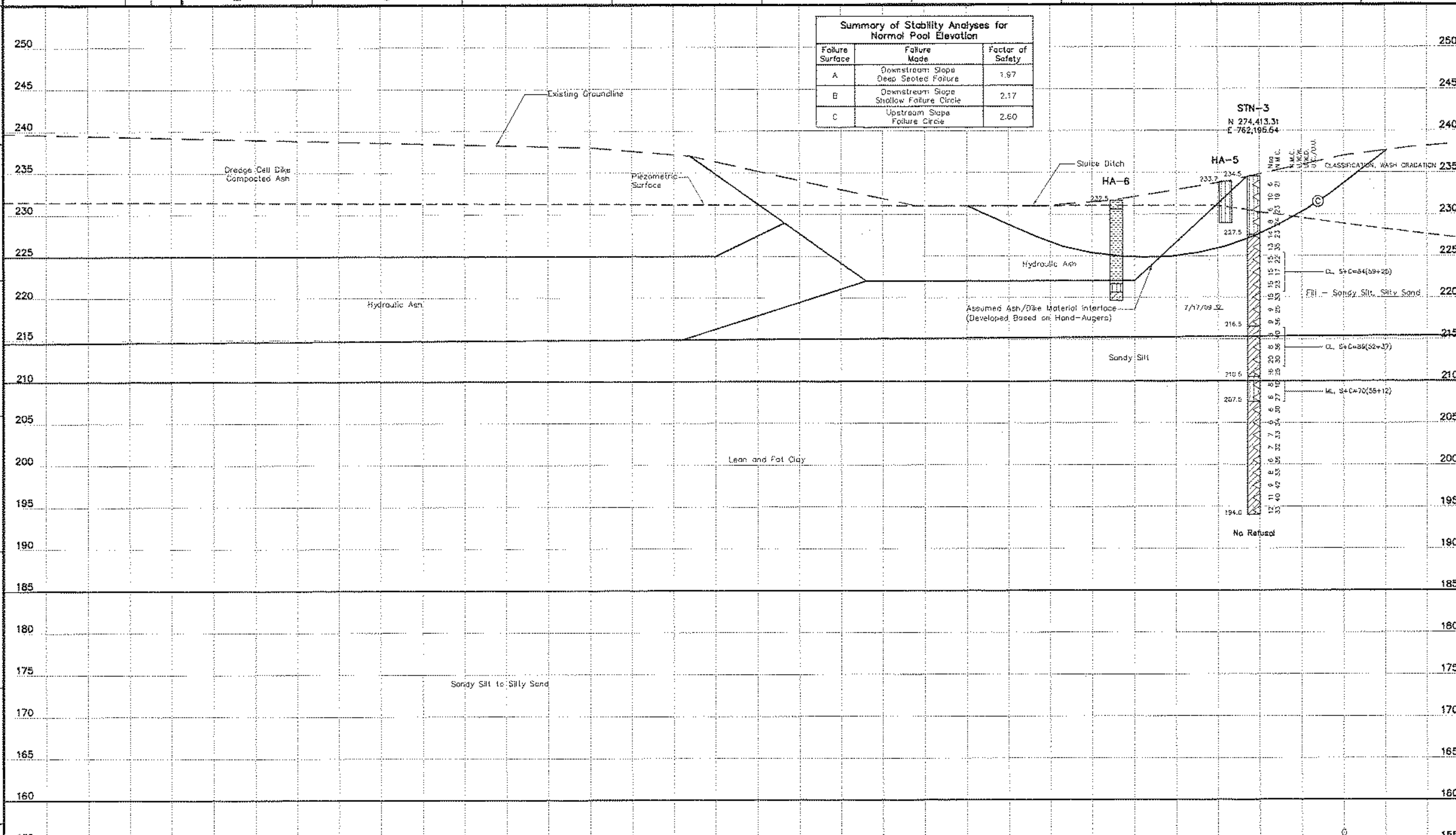
AUTOCAD R 2000 | DATE 03/25/10 | 38 | C | 10W504-03 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: XX
W..TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

Summary of Stability Analyses for Normal Pool Elevation		
Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.97
B	Downstream Slope Shallow Failure Circle	2.17
C	Upstream Slope Failure Circle	2.60



LEGEND

- Topsoil
- Silt to Sandy Silt, brown to gray, moist
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH Weight of Hammer
WR Weight of Rods
◁ Standard Penetration Test Interval
■ Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60} Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80} Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C. Natural Moisture Content (%)
U.W.W. Unit Weight Wet (lbs./cu.ft.)
U.W.D. Unit Weight Dry (lbs./cu.ft.)
U.C./U.U. Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 Water Level and Date Recorded
T.O.R.- Top of Rock (Indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.- Begin Rock Core
R.Q.D. Rock Quality Designation (%)
REC. Recovery (%)
Refusal Auger Refusal using a carbide-tipped tooth auger bit
No Refusal No Refusal Encountered
* Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.

RECORD DRAWING

Parameter Table			
Material Type	Sat Unit Wt, γsat	Cohesion, c̄	Friction Angle, φ̄
Fill - Sandy Silt, Silty Sand	125 pcf	0 psf	31°
Hydraulic Ash	105 pcf	0 psf	25°
Compacted Ash	110 pcf	0 psf	30°
Sandy Silt	125 pcf	0 psf	30°
Lean and Fat Clay	115 pcf	0 psf	26°
Sandy Silt to Silty Sand	115 pcf	0 psf	28°

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

For Supporting Design Calculations See FPGALFFESCDX00000020100002

RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
CROSS SECTION A–A'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHAN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

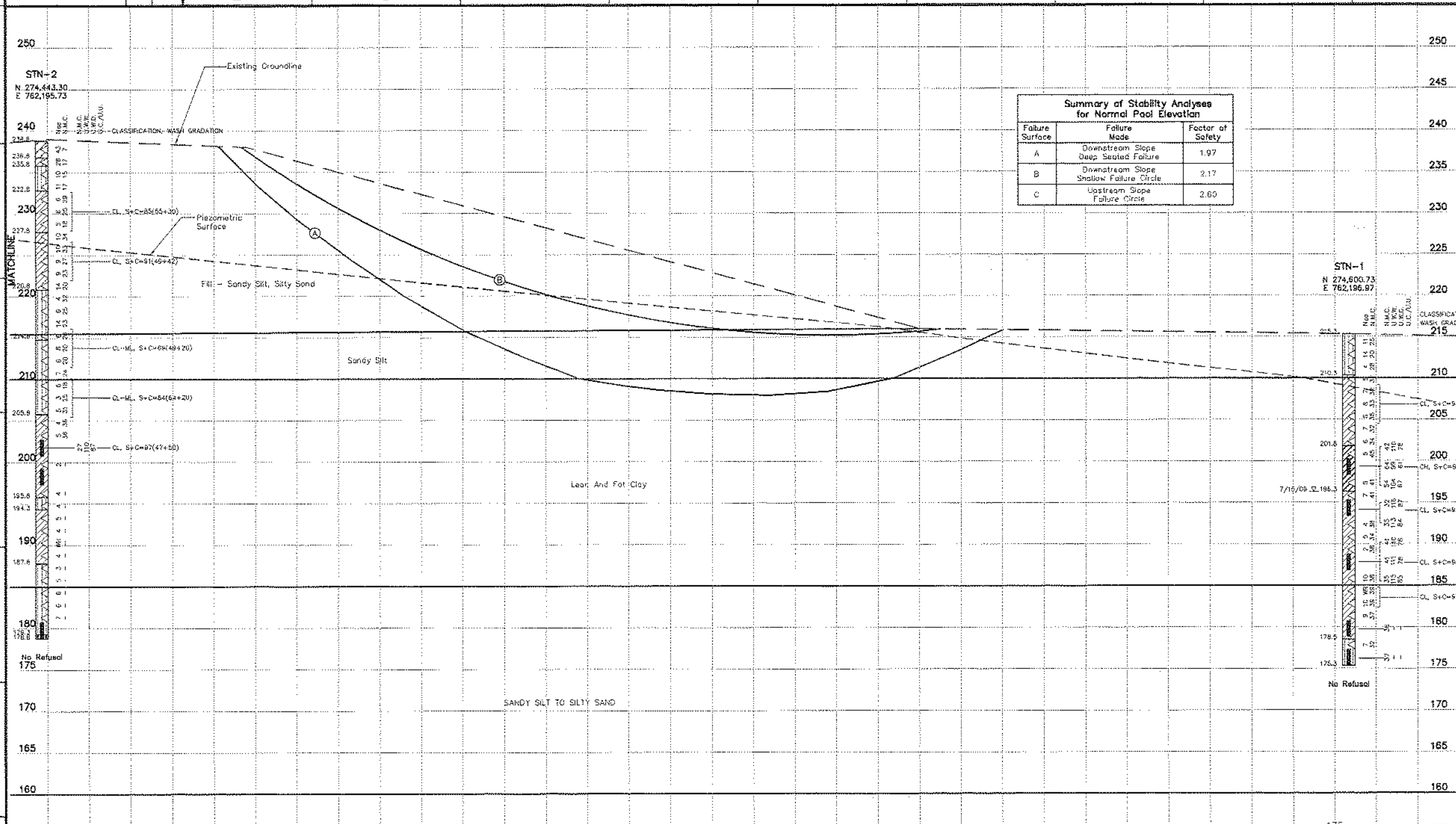
Stantec Consulting Services Inc.
Stantec

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/25/10 | 38 | C | 10W504-04

PLOT FACTOR:XX

C.A.D. DRAWING DO NOT ALTER MANUALLY



Summary of Stability Analyses for Normal Pool Elevation		
Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.97
B	Downstream Slope Shallow Failure Circle	2.17
C	Upstream Slope Failure Circle	2.60

LEGEND

- Topsoil
- Silt to Sandy Silt, brown to gray, moist
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{ac}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
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B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal using a carbide-tipped tooth auger bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.

Parameter Table			
Material Type	Sat Unit Wt, γsat	Cohesion, $\bar{c}$	Friction Angle, $\bar{\Phi}$
Fill – Sandy Silt, Silty Sand	125 pcf	0 psf	31°
Hydraulic Ash	105 pcf	0 psf	25°
Compacted Ash	110 pcf	0 psf	30°
Sandy Silt	125 pcf	0 psf	30°
Lean and Fat Clay	115 pcf	0 psf	26°
Sandy Silt to Silty Sand	115 pcf	0 psf	25°

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

For Supporting Design Calculations See FPGALFFESCDX00000020100002

Stantec Consulting Services Inc.
100 Westwood Pl., Ste 420
Brentwood, Tennessee 37027-5044
Tel 615.885.1144
Fax 615.885.1102
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SCALE: 1"=5' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
CROSS SECTION A–A'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. FIELD	H. APARICO	H. APARICO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 03/25/10 | 38 | C | 10W504–05 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

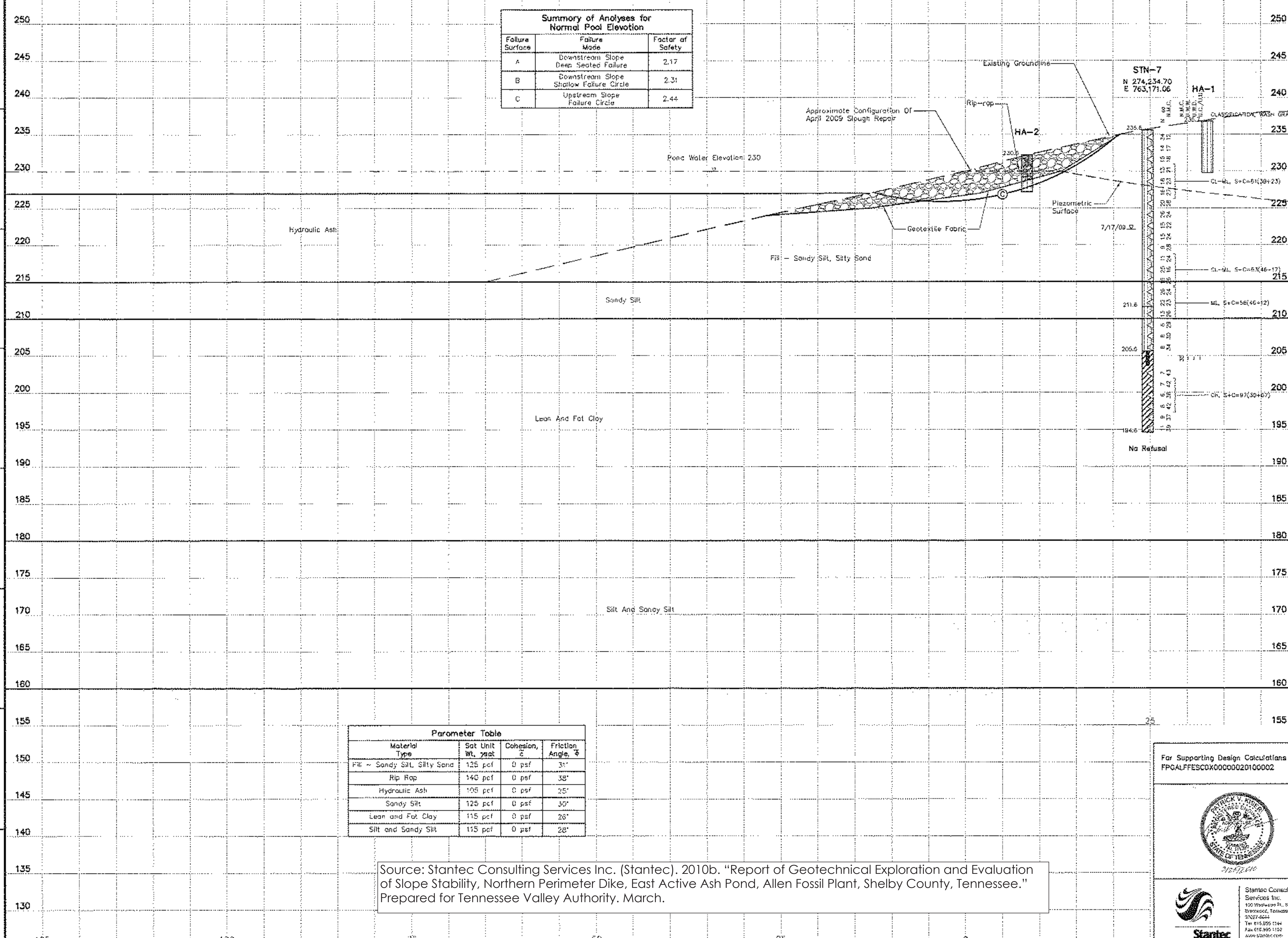
PLOT FACTOR:XX

C.A.D. DRAWING DO NOT ALTER MANUALLY

38 C 10W504-06

Summary of Analyses for Normal Pool Elevation

Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	2.17
B	Downstream Slope Shallow Failure Circle	2.31
C	Upstream Slope Failure Circle	2.44



LEGEND

- Topsoil
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- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
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- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
▪	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09	Water Level and Date Recorded
T.O.R.-	Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.-	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal using a carbide-tipped tooth auger bit
No Refusal	No Refusal Encountered
•	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.

RECORD DRAWING

Parameter Table

Material Type	Sat Unit Wt, γsat	Cohesion, c	Friction Angle, Φ
Fill ~ Sandy Silt, Silty Sand	125 pcf	0 psf	31°
Rip Rap	140 pcf	0 psf	38°
Hydraulic Ash	105 pcf	0 psf	25°
Sandy Silt	125 pcf	0 psf	30°
Lean and Fat Clay	115 pcf	0 psf	26°
Silt and Sandy Silt	115 pcf	0 psf	28°

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

For Supporting Design Calculations See FPGALFFESC0X00000020100002

PATRICK V. KISER REGISTERED ENGINEER STATE OF TENNESSEE

Stantec Consulting Services Inc.
100 Westwood Pl., Ste 420
Brentwood, Tennessee 37027-5044
Tel 615.885.1144
Fax 615.885.1152
www.stantec.com

R 0 03/25/10 PVK PS SF HRA HRA PVK TJ
RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
CROSS SECTION B–B'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILVACHARI	S. FIELD	H. AFARIGU	H. AFARIGU	P. KISER	T. JOHNSON

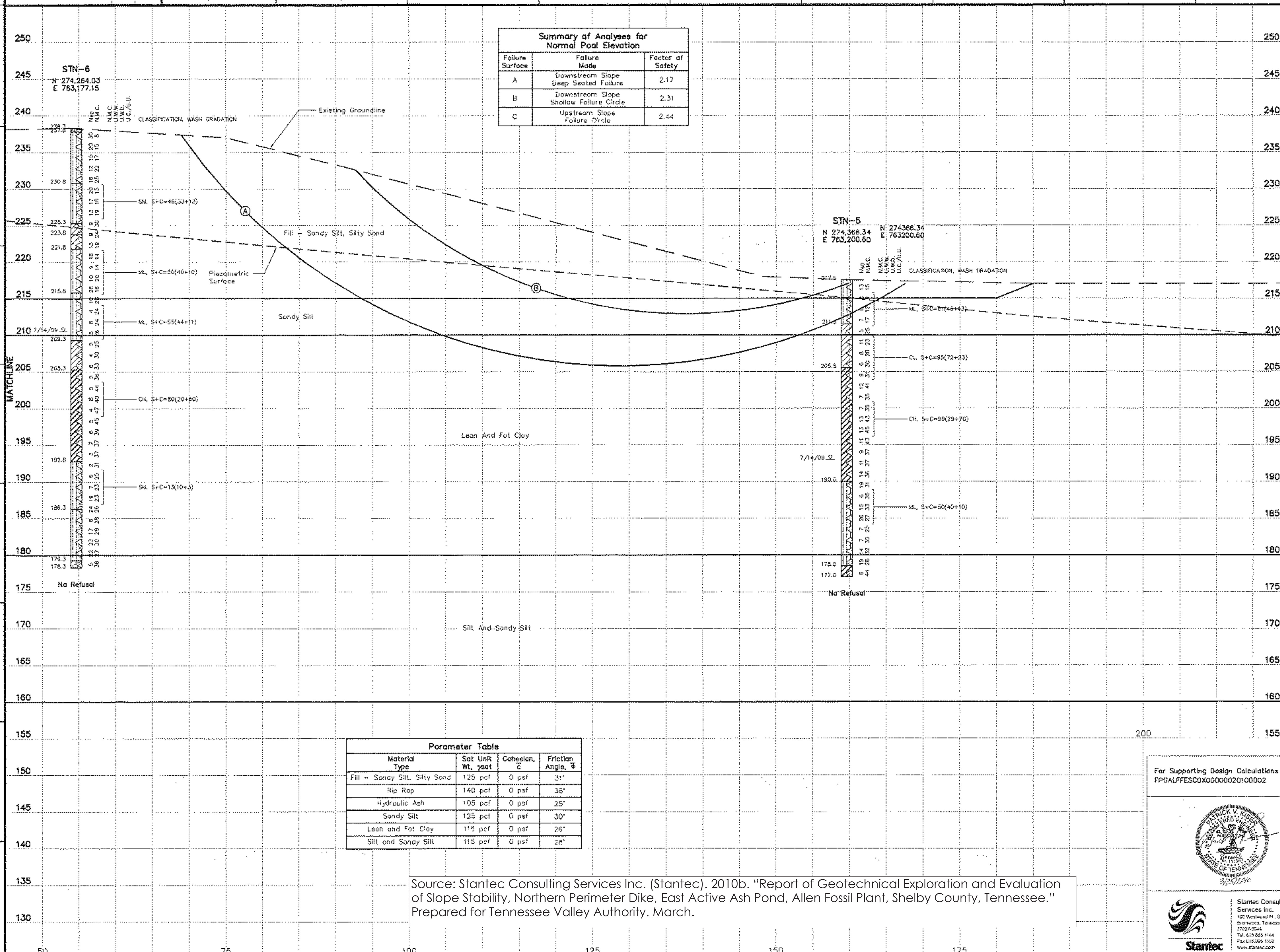
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 03/25/10 | 38 | C | 10W504–06 | R 0

PLOT FACTOR:XX
W.TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

STANTEC | 0
TASK COMPLETED BY: | REV NO



Summary of Analyses for Normal Pool Elevation		
Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	2.17
B	Downstream Slope Shallow Failure Circle	2.31
C	Upstream Slope Failure Circle	2.44

LEGEND

- Topsoil
- Silt to Sandy Silt, brown to gray, moist
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- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH Weight of Hammer
WR Weight of Rods
◁ Standard Penetration Test Interval
■ Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60} Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60} Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C. Natural Moisture Content (%)
U.W.W. Unit Weight Wet (lbs./cu.ft.)
U.W.D. Unit Weight Dry (lbs./cu.ft.)
U.C./U.U. Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 Water Level and Date Recorded
T.O.R.– Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
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REC. Recovery (%)
Refusal Auger Refusal using a carbide-tipped tooth auger bit
No Refusal No Refusal Encountered
* Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.

RECORD DRAWING

Parameter Table			
Material Type	Sat Unit Wt, γsat	Cohesion, c̃	Friction Angle, Φ̃
Fill – Sandy Silt, Silty Sand	125 pcf	0 psf	31°
Rip Rap	140 pcf	0 psf	38°
Hydraulic Ash	105 pcf	0 psf	25°
Sandy Silt	125 pcf	0 psf	30°
Lean and Fat Clay	115 pcf	0 psf	26°
Silt and Sandy Silt	115 pcf	0 psf	28°

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

For Supporting Design Calculations See FPGALFFESC0X0000020100002

R 0 03/25/10 PVK PS SF HRA HRA PVK TJ
RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
CROSS SECTION B–B'

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
P. KISER	P. SUPACKARN	S. FIELS	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

Stantec Consulting Services Inc.
Stantec

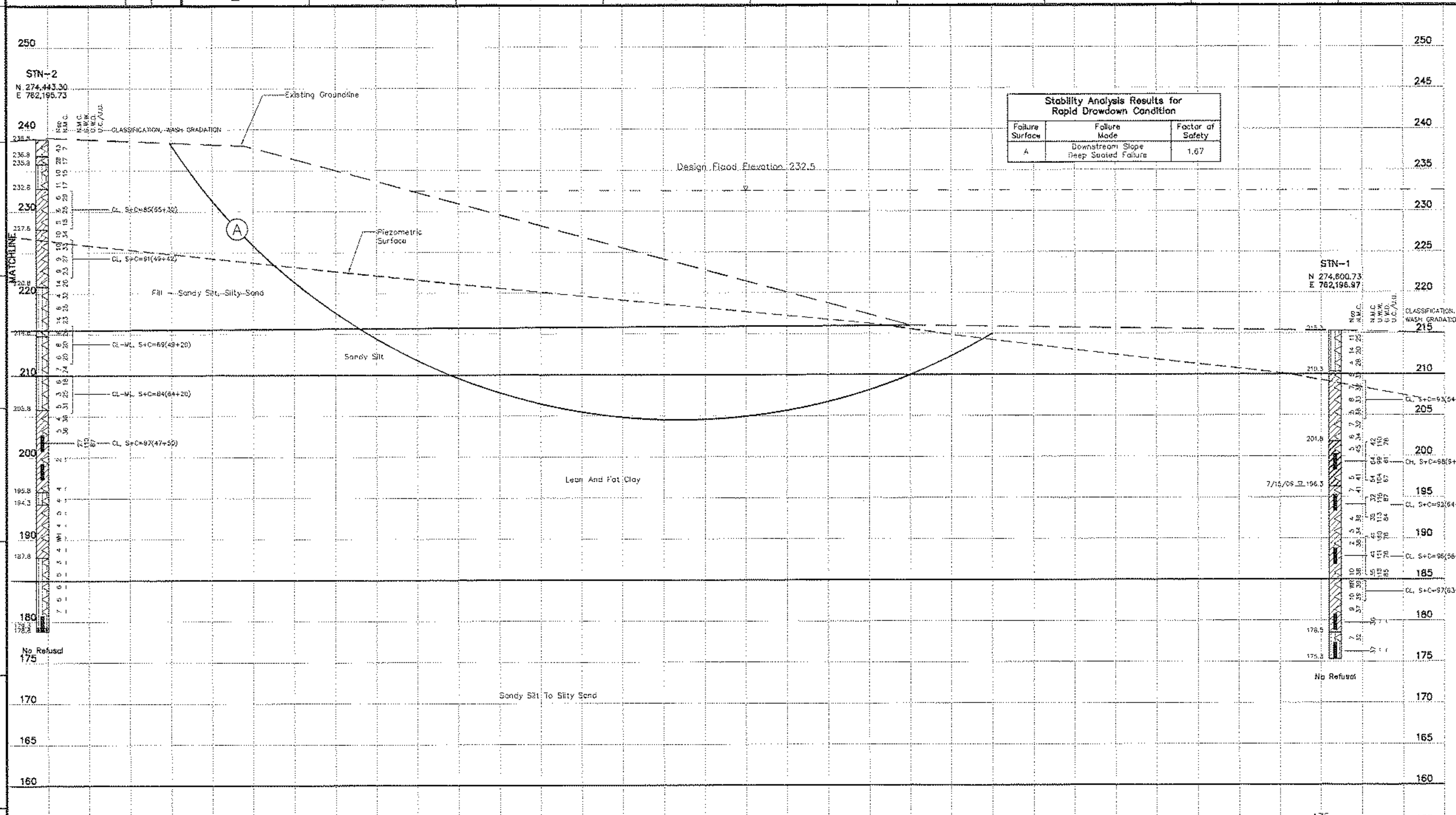
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 03/25/10 | 38 | C | 10W504-07 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX

C.A.D. DRAWING DO NOT ALTER MANUALLY



Stability Analysis Results for Rapid Drowdown Condition

Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.67

LEGEND

- Topsoil
- Silt to Sandy Silt, brown to gray, moist
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
●	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
T.C.R.	Top of Rock (Indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal using a carbide-tipped tooth auger bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.

Parameter Table

Material Type	Sat Unit Wt, γsat	Cohesion, c̄	Friction Angle, φ̄	Total Stress Parameters cKc=Kf	Total Stress Parameters ΨKc=Kf	Undrained Strength Parameters cKc=1	Undrained Strength Parameters ΨKc=1
Fill – Sandy Silt, Silty Sand	125 pcf	0 psf	31°	200 psf	22°	254.6 psf	27.16°
Hydraulic Ash	105 pcf	0 psf	25°	0 psf	10°	0 psf	10.78°
Compacted Ash	110 pcf	0 psf	30°	0 psf	30°	0 psf	30°
Sandy Silt	125 pcf	0 psf	30°	200 psf	22°	256.79 psf	27.4[illegible]°
Lean and Fat Clay	115 pcf	0 psf	26°	400 psf	12°	443.97 psf	13.27°
Sandy Silt to Silty Sand	115 pcf	0 psf	28°	200 psf	12°	218.07 psf	13.05°

Source: Stantec Consulting Services Inc. (Stantec). 2010b. "Report of Geotechnical Exploration and Evaluation of Slope Stability, Northern Perimeter Dike, East Active Ash Pond, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. March.

RECORD DRAWING

For Supporting Design Calculations See FPGALFFESCDX00000020100002

Stantec Consulting Services Inc.

SCALE: 1"=5' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE – EAST ASH POND
CROSS SECTION A–A'

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
P. KISER	H. SRIPACHARN	S. FIELD	H. APARICIO	H. APARICIO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 03/25/10 | 38 | C | 10W504–08 | R 0

PLOT FACTOR:XX

C.A.D. DRAWING DO NOT ALTER MANUALLY

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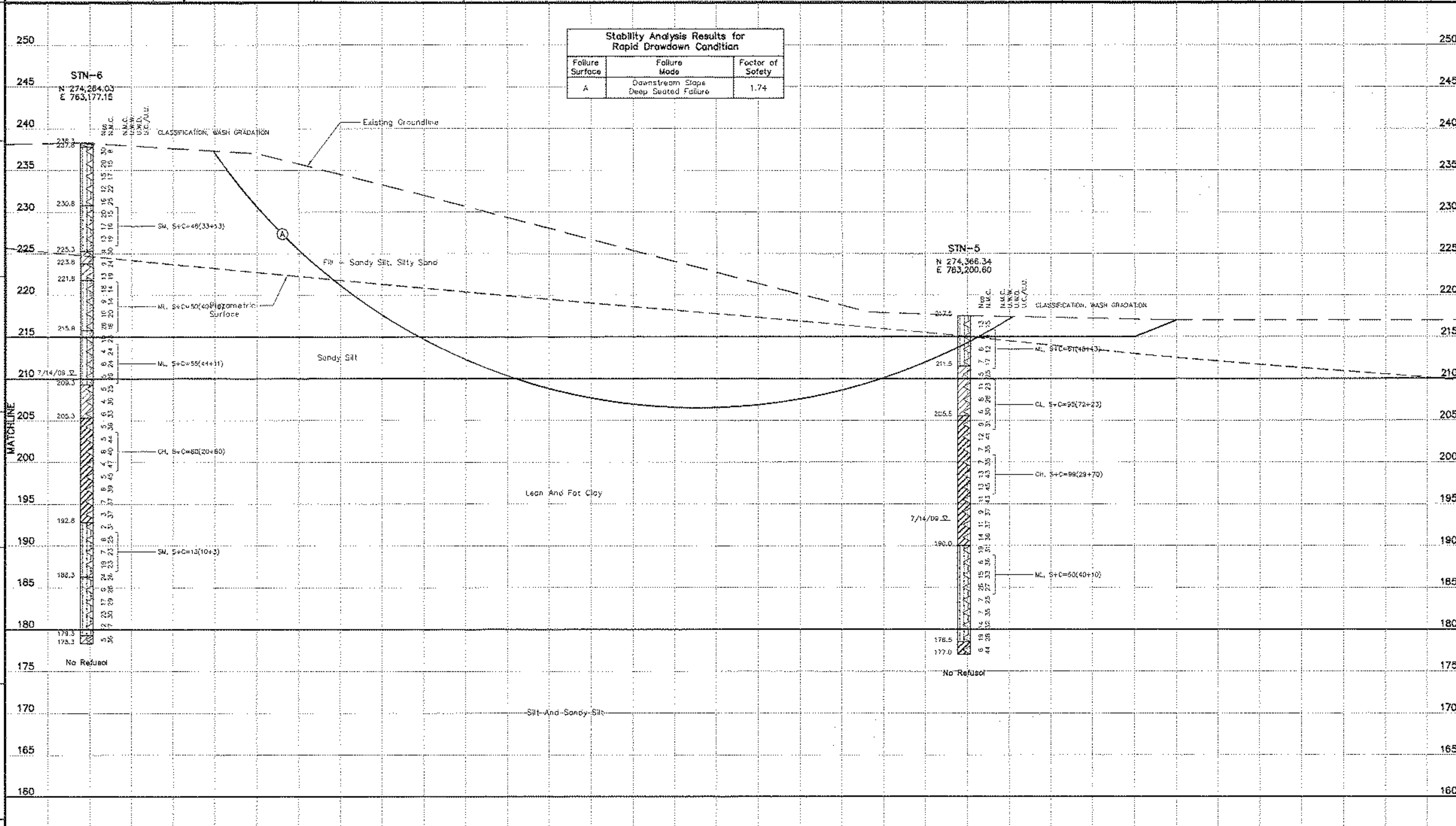
TASK COMPLETED BY: | REV NO.



Stability Analysis Results for Rapid Drawdown Condition

Failure Surface	Failure Mode	Factor of Safety
A	Downstream Slope Deep Seated Failure	1.74

LEGEND

- Topsoil
- Silt to Sandy Silt, brown to gray, moist
- Lean Clay, brown to gray, moist to saturated stiff, with sandy and silty zones
- Fat Clay, brown to grayish brown, moist to saturated
- Bottom Ash, gray to dark gray and black, damp to wet, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet
- Silty Clay, brown to grayish brown, moist to wet
- Gravel with Sand, gray to brown
- Sand to Silty Sand, brown to gray, moist to saturated fined grained

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09	Water Level and Date Recorded
T.O.R.-	Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock remnants. An exact determination cannot be made without performing rock coring.)
B.C.-	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal using a carbide-tipped tooth auger bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to typed boring log.

RECORD DRAWING

Parameter Table

Material Type	Sat Unit Wt, γsat	Cohesion, c̄	Friction Angle, Φ̄	Total Stress Parameters σKc=Kf	Total Stress Parameters ΨKc=Kf	Undrained Strength Parameters σKc=1	Undrained Strength Parameters ΨKc=1
Fill - Sandy Silt, Silty Sand	125 pcf	0 psf	31°	200 psf	22°	254.6 psf	27.18°
Rip Rap	140 pcf	0 psf	38°	0 psf	38°	0 psf	38°
Hydraulic Ash	105 pcf	0 psf	25°	0 psf	10°	0 psf	10.78°
Sandy Silt	125 pcf	0 psf	30°	200 psf	22°	256.79 psf	27.41°
Lean and Fat Clay	115 pcf	0 psf	26°	400 psf	12°	443.97 psf	13.27°
Sandy Silt to Silty Sand	115 pcf	0 psf	28°	200 psf	12°	218.07 psf	13.05°

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For Supporting Design Calculations See FPGALFFESCGX00000020100002

Stantec Consulting Services Inc.
100 Westwood Pl., Ste 420
Brentwood, Tennessee 37027-5044
Tel 615.885.1144
Fax 615.885.1192
www.stantec.com

SCALE: 1"=5' EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
USACE LEVEE - EAST ASH POND
CROSS SECTION B-B'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. KISER	P. SILPACHARN	S. HELD	N. ARARCIO	H. APARICIO	P. KISER	T. JOHNSON

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 03/25/10 | 38 | C | 10W504-09 | R 0

STANTEC | C
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W..TVA

C.A.D. DRAWING
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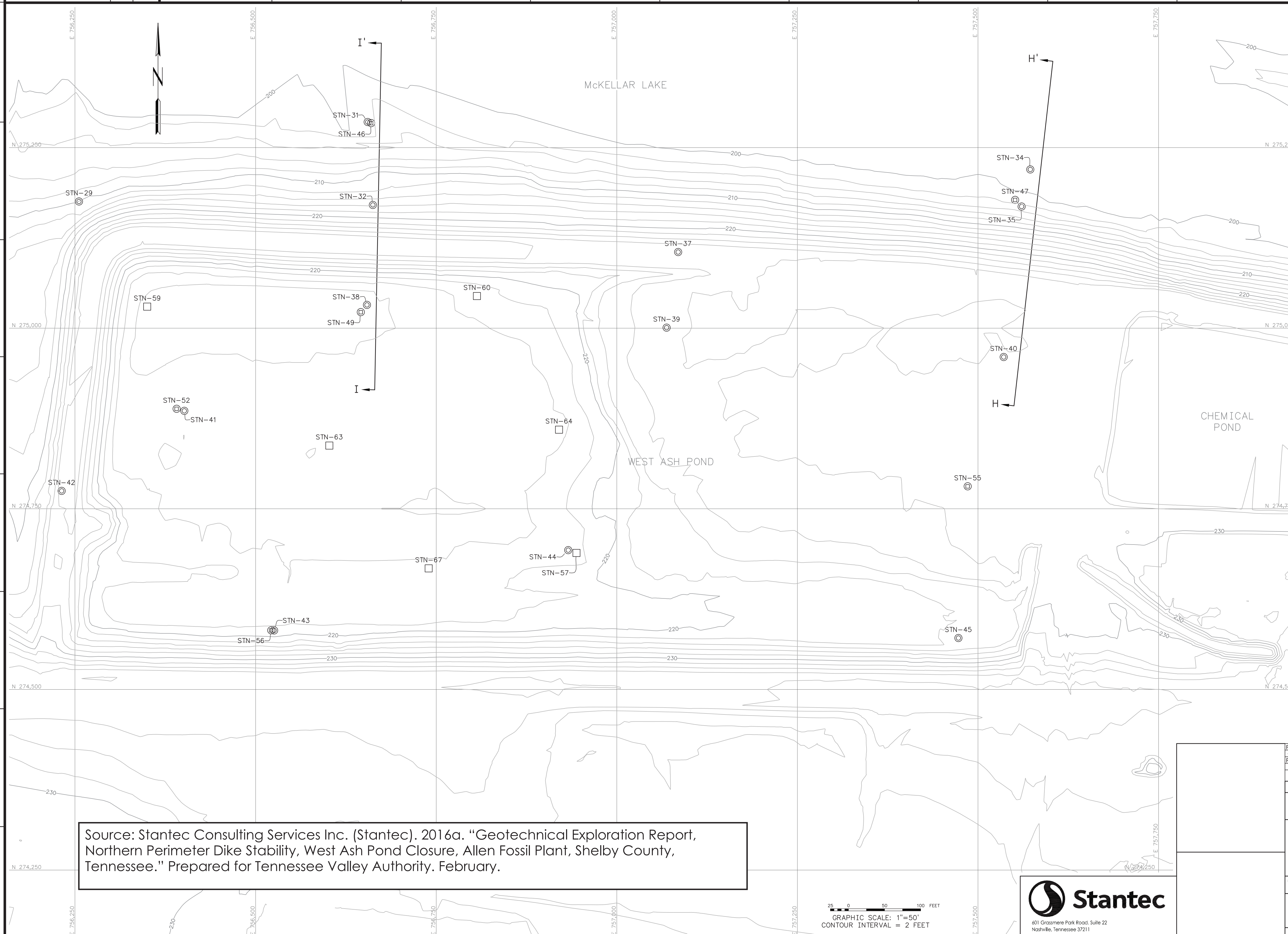

Source: Stantec Consulting Services Inc. (Stantec). 2016a. "Geotechnical Exploration Report, Northern Perimeter Dike Stability, West Ash Pond Closure, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

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.

NOTES:

1. THE TOPOGRAPHIC MAPPING PRESENTED ON THIS DRAWING WAS PROVIDED TO STANTEC BY TVA SURVEYING AND PROJECT SERVICES. THIS PLAN VIEW WAS PREPARED TO SUPPORT DEVELOPMENT OF THE GEOTECHNICAL EXPLORATION PROGRAM AND SHOULD NOT BE USED FOR CONSTRUCTION.
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BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEVATION (FEET)
STN-29	275,175.38	756,255.52	209.8
STN-31	275,285.22	756,655.03	197.3
STN-32	275,170.55	756,662.14	215.3
STN-34	275,219.61	757,572.32	197.3
STN-35	275,168.26	757,560.32	201.9
STN-37	275,105.39	757,084.79	227.9
STN-38	275,032.20	756,654.10	212.7
STN-39	275,000.71	757,068.83	227.7
STN-40	274,960.06	757,535.41	227.7
STN-41	274,885.49	756,401.22	214.9
STN-42	274,774.68	756,231.49	228.2
STN-43	274,581.55	756,525.54	218.5
STN-44	274,692.75	756,932.74	216.9
STN-45	274,571.04	757,472.72	222.1
STN-46	275,283.75	756,659.96	197.5
STN-47	275,177.52	757,551.23	200.7
STN-49	275,022.24	756,645.53	213.5
STN-52	274,888.39	756,390.55	215.1
STN-55	274,781.02	757,485.69	228.1
STN-56	274,581.78	756,521.61	218.0
STN-57	274,688.84	756,944.27	217.2
STN-59	275,029.76	756,349.96	213.1
STN-60	275,044.47	756,806.43	216.6
STN-63	274,837.56	756,602.00	215.2
STN-64	274,859.56	756,920.08	215.7
STN-67	274,667.54	756,739.62	216.8

LEGEND

- ◎ SOIL BORING WITH UNDISTURBED (SHELBY) TUBE SAMPLES AND/OR STANDARD PENETRATION TESTS
- ◎ CONE PENETRATION TESTS
- □ TEST PIT

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

RA — MST JCK
ISSUED FOR REVIEW

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
BORING LAYOUT

APPROVED BY: M.S. TURNBOW
ISSUED BY: J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

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STANTEC | A
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
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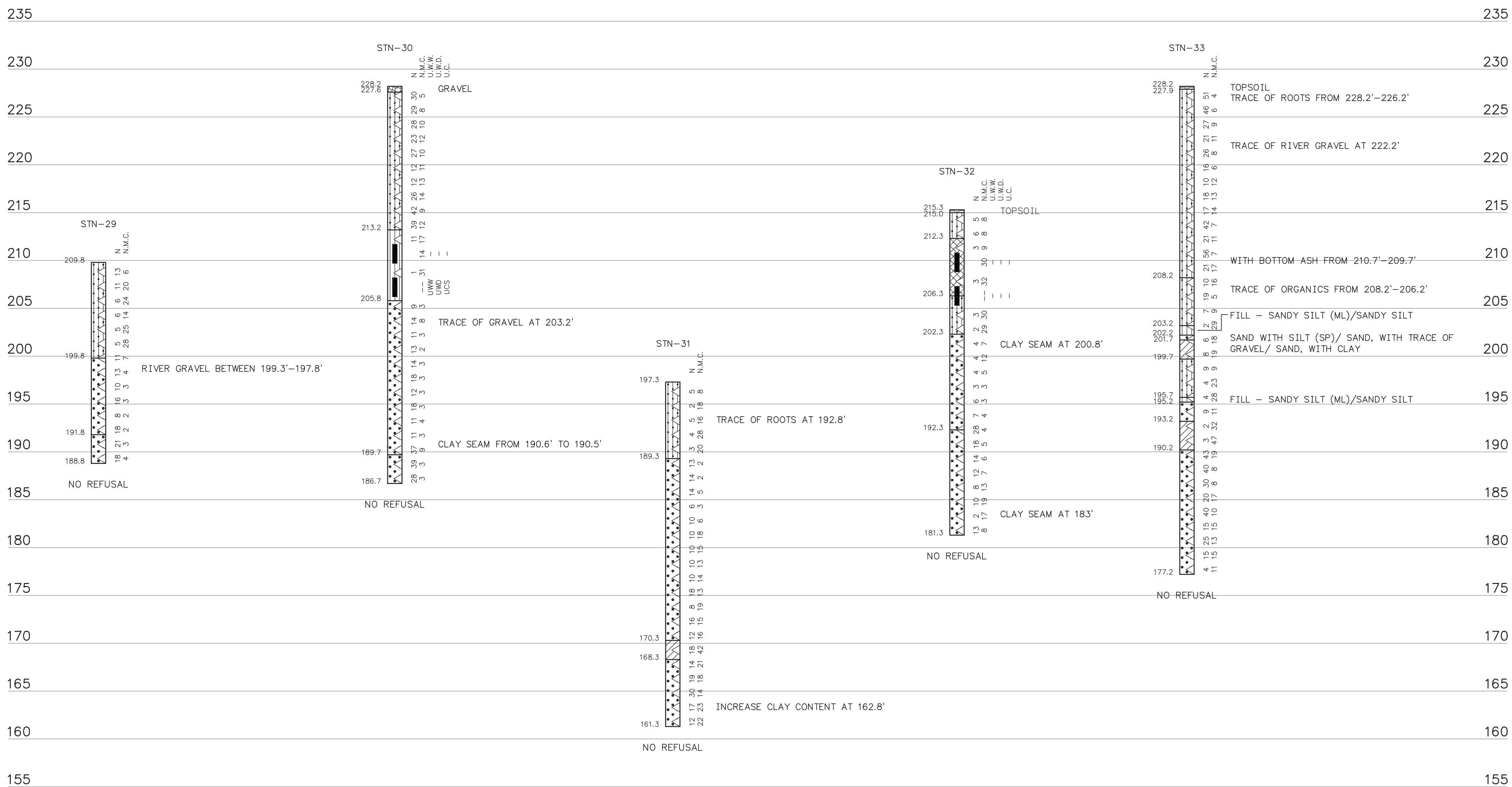

LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL - LEAN CLAY
- FILL - GRAVEL (GW), WITH SAND
- FILL - SAND SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- STANDARD PENETRATION TEST INTERVAL
- UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N — STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. — NATURAL MOISTURE CONTENT (%)
- U.W.W. — UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. — UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. — UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTE: THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

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

ISSUED FOR REVIEW — REV. A — DRWN BMS — APPD MST — ISSD JCK

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DESIGNED BY: - | DRAWN BY: B.M. SHELTON | CHECKED BY: - | SUPERVISED BY: - | REVIEWED BY: - | APPROVED BY: M.S. TURNBOW | ISSUED BY: J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | DATE - | 38 | C | 10WXXX-XX | R A

STANTEC | A
TASK COMPLETED BY: | REV NO.

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W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

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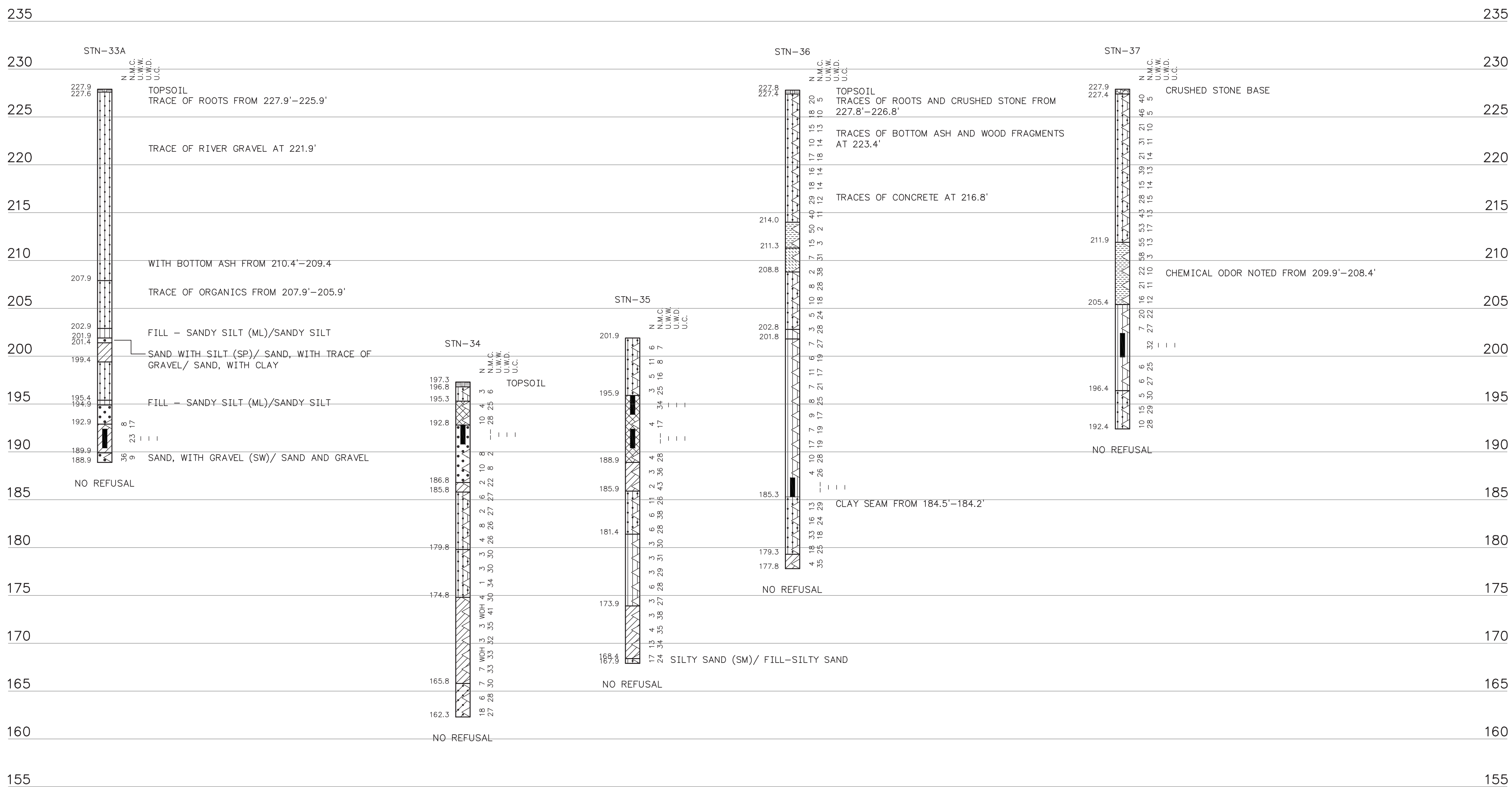

LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL–LEAN CLAY/ SANDY CLAY
- FILL – LEAN CLAY
- FILL – GRAVEL (GW), WITH SAND
- FILL – SAND SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL–SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY–PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- STANDARD PENETRATION TEST INTERVAL
- UNDISTURBED THIN–WALLED (SHELBY) TUBE SAMPLE
- N — STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. — NATURAL MOISTURE CONTENT (%)
- U.W.W. — UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. — UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. — UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTE:
THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.

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REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R –	–	–	–	–	–	–	–	–	–	–
R A	–	–	BMS	–	–	–	MST	JCK	–	–

ISSUED FOR REVIEW

SCALE: 1"=50' — EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	B.M. SHELTON	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | DATE – | 38 | C | 10WXXX–XX | R A

PLOT FACTOR:1
W_TVA

STANTEC | A
TASK COMPLETED BY: | REV NO.

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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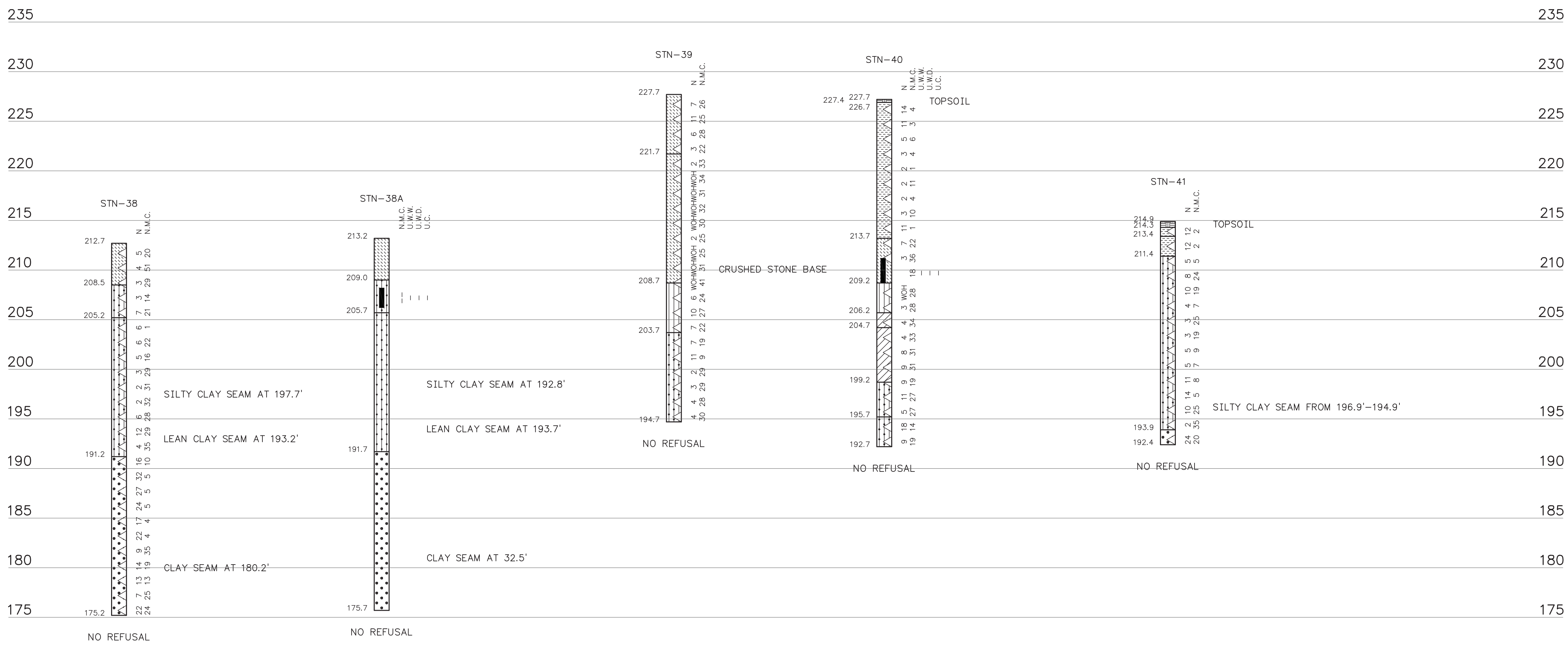

LEGEND

- TOPSOIL
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- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL–SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

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R A – – BMS – – – MST JCK
ISSUED FOR REVIEW

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DESIGNED BY: – | DRAWN BY: B.M. SHELTON | CHECKED BY: – | SUPERVISED BY: – | REVIEWED BY: – | APPROVED BY: M.S. TURNBOW | ISSUED BY: J.C. KAMMEYER

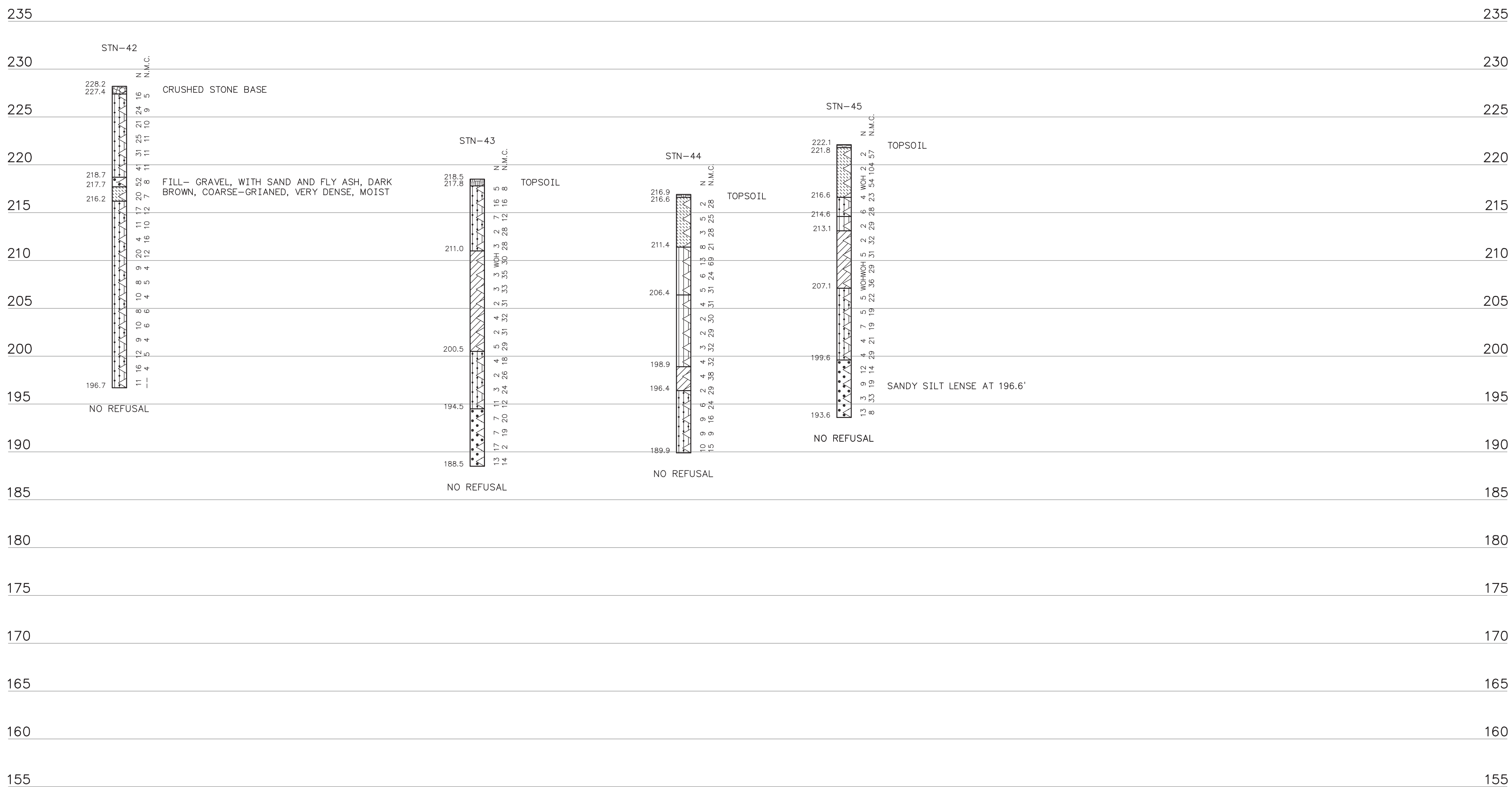
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | DATE – | 38 | C | 10WXXX–XX | R A

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC | A
TASK COMPLETED BY: | REV NO.



LEGEND

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- FILL – LEAN CLAY
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- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- ◁ STANDARD PENETRATION TEST INTERVAL
- ■ UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. NATURAL MOISTURE CONTENT (%)
- U.W.W. UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

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Source: Stantec Consulting Services Inc. (Stantec). 2016a. "Geotechnical Exploration Report, Northern Perimeter Dike Stability, West Ash Pond Closure, Allen Fossil Plant, Shelby County, Tennessee." Prepared for Tennessee Valley Authority. February.

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YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DRAWN BY: B.M. SHELTON
APPROVED BY: M.S. TURNBOW
ISSUED BY: J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | 38 | C | 10WXXX-XX | R A

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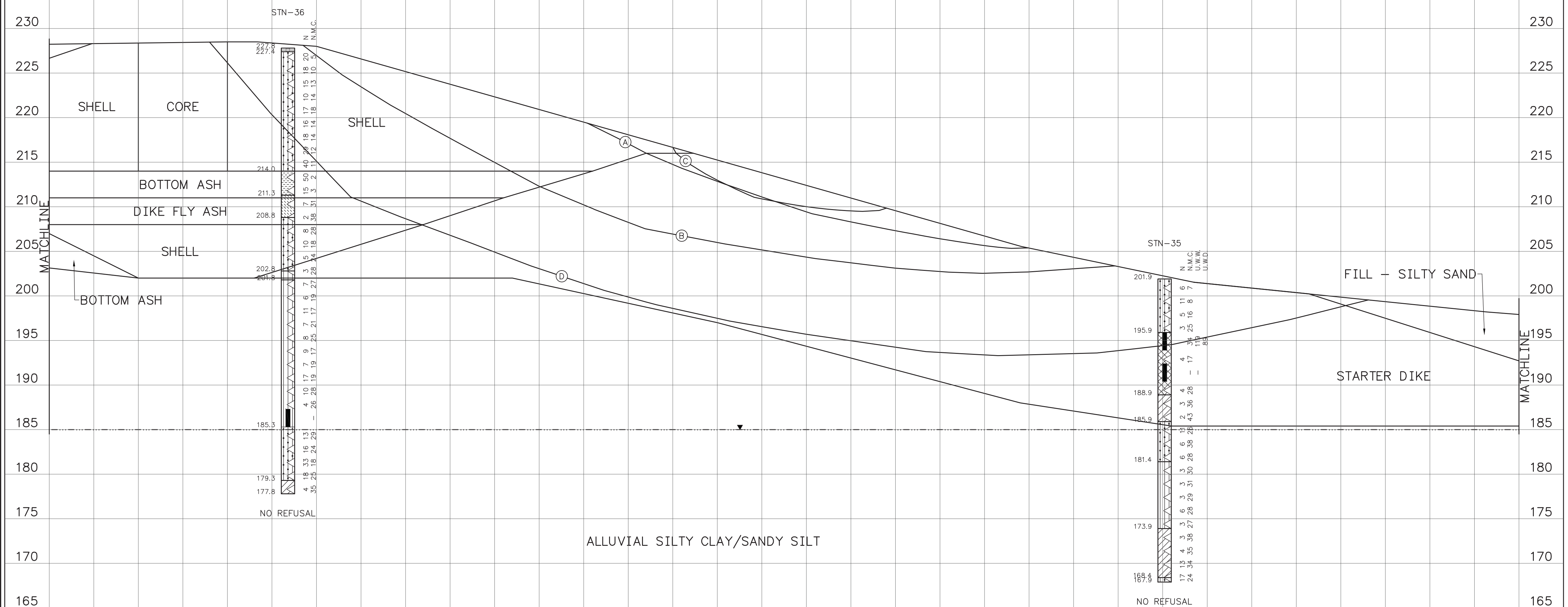
SUMMARY OF STABILITY ANALYSES

FAILURE SURFACE	FAILURE MODE	FACTOR OF SAFETY
A	SHALLOW FAILURE CIRCLE	2.1
B	DEEP FAILURE CIRCLE	2.2
C	SHALLOW FAILURE CIRCLE RAPID DRAW DOWN	2.2
D	DEEP FAILURE CIRCLE RAPID DRAW DOWN	2.0

PARAMETER TABLE

MATERIAL TYPE	DRAINED STRENGTH PARAMETERS			UNDRAINED STRENGTH PARAMETERS	
	SAT UNIT WT, γSAT	COHESION, c̄	FRICTION ANGLE, Φ̄	COHESION, c̄	FRICTION ANGLE, Φ̄
SHELL	127 PCF	0 PSF	33°	200 PSF	28°
CORE	127 PCF	0 PSF	33°	200 PSF	28°
STARTER DIKE	121 PCF	0 PSF	30°	200 PSF	28°
ALLUVIAL SILTY CLAY/SANDY SILT	119 PCF	0 PSF	31°	600 PSF	27°
DIKE FLY ASH	105 PCF	0 PSF	25°	0 PSF	10°
HYDRAULICALLY PLACED ASH	105 PCF	0 PSF	25°	0 PSF	10°
FILL – SILTY SAND	122 PCF	0 PSF	30°	200 PSF	28°
BOTTOM ASH	123 PCF	0 PSF	34°	0 PSF	34°



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LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL – LEAN CLAY
- FILL – GRAVEL (GW), WITH SAND
- FILL – SANDY SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- STANDARD PENETRATION TEST INTERVAL
- UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
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YARD

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
STABILITY CROSS SECTION H–H'

APPROVED BY: M.S. TURNBOW — ISSUED BY: J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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SUMMARY OF STABILITY ANALYSES

FAILURE SURFACE	FAILURE MODE	FACTOR OF SAFETY
A	SHALLOW FAILURE CIRCLE	2.3
B	DEEP FAILURE CIRCLE	2.6
C	SHALLOW FAILURE CIRCLE RAPID DRAW DOWN	2.6
D	DEEP FAILURE CIRCLE RAPID DRAW DOWN	2.5

PARAMETER TABLE

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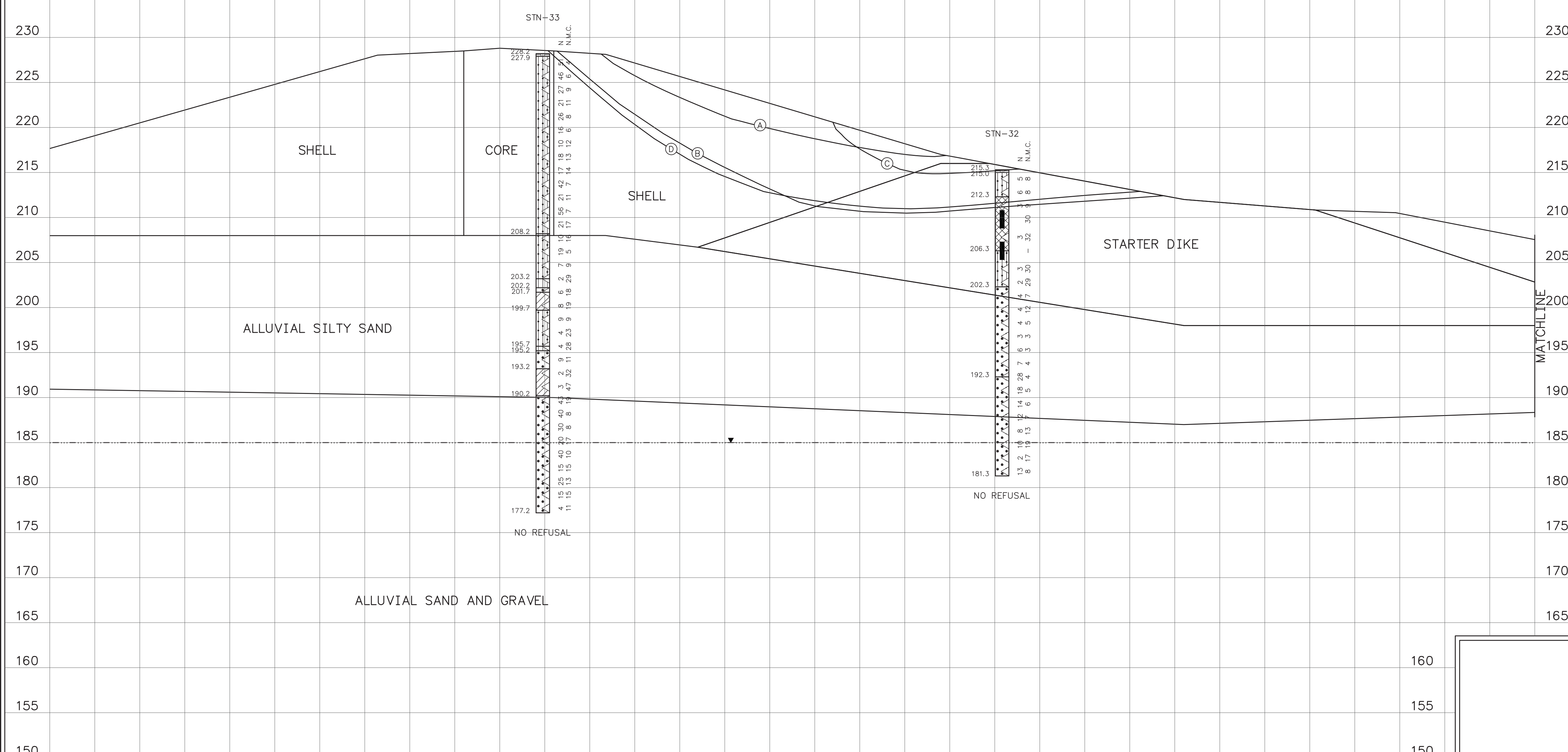

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YARD

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
STABILITY CROSS SECTION I-I'

APPROVED BY: M.S. TURNBOW — ISSUED BY: J.C. KAMMEYER

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APPENDIX R
BACKGROUND SOIL SAP

Background Soil
Sampling and Analysis Plan
Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

BACKGROUND SOIL
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: Background Soil
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager — Date 3/1/19

TVA Investigation Field Lead — Date 3/1/19

Health, Safety, and Environmental (HSE) Manager — Date 3/1/19

Bradley R Toth
Investigation Project Manager — Date 2/26/2019

QA Oversight Manager — Date 2/26/2019

Laboratory Project Manager — Date 2/28/19

Charles L. Head
TDEC Senior Advisor — Date

Robert Wilkinson
TDEC CCR Technical Manager — Date

Stantec

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

In response to TDEC's comments, this Background Soil Sampling and Analysis Plan (SAP) has been developed to provide procedures and methods necessary to characterize background soils in the vicinity of the ALF Plant (Plant).

2.0 OBJECTIVES

The objective of this Background Soil SAP is to characterize background soils on TVA property in the vicinity of the Plant. The approach in characterizing the background soils is to identify locations where naturally occurring, in place, native soils are present, yet unaffected by CCR material. Samples will be analyzed for CCR Parameters listed in 40 CFR Part 257, Appendices III and IV along with additional parameters required by the state groundwater monitoring program (copper, nickel, silver, vanadium, and zinc). These constituents will be hereafter referred to as "CCR Parameters." Additionally, the surficial soil at each location will be collected and analyzed for percent ash, to determine the presence or absence of windblown CCR.

This Background Soil SAP and the Plant-specific Quality Assurance Project Plan (QAPP) will provide the procedures necessary to conduct investigation activities associated with the sampling and analysis of background soils. Proposed field activities will include the following tasks:

- Verify and document proposed sampling locations using global positioning system (GPS) surveying
- Collect background soil samples from proposed locations
- Package and ship soil samples to laboratory for analysis of CCR Parameters

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

A map of twelve proposed background soil sampling locations is provided as Figure 1 (Attachment A). The locations were selected based on access, current hydrogeologic knowledge, and the sample location criteria set forth by TDEC. In addition, areas where known or suspected beneficial reuse of CCR has occurred were excluded from consideration as sampling locations. Additional considerations in selection of background soil boring locations included: relative elevation to the Plant, similar geologic units, and/or similar depositional environment (i.e., alluvial or non-alluvial), and when feasible, proximity to existing background groundwater monitoring wells. If background soil sample results collected during non-EIP activities (e.g., Remedial Investigation) are used to supplement the data set from this SAP, these non-EIP sample results will be reviewed as part of the historical documents to ensure that the samples were collected consistent with this SAP and associated Quality Assurance Plan. If necessary, additional field activities (e.g., collection of surficial samples for percent ash) will be performed to ensure the completeness and/or usability of non-EIP sample data.

Boring advancement through unconsolidated soils will be conducted at locations shown on Figure 1 within a one-mile radius of the Plant. Soil borings will be advanced using a direct-push technology (DPT) drill rig (typically equipped with five-foot long probe rods or dual tube samplers) or an equivalent technology. The rods will be decontaminated between sampling locations in accordance with Section 5.2.7. In addition to the soil data that will be collected from the proposed sampling locations, TVA will collect soil samples through the well screen interval at locations of proposed background groundwater monitoring wells.

Grab samples will be collected in five-foot intervals during boring advancement from the ground surface to a depth of at least 20 feet below the groundwater potentiometric surface, or through the well screen interval at locations of new background groundwater monitoring wells. Each boring will be logged by a Tennessee-licensed professional geologist.

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to prepare for field activities, advance soil borings, collect background soil samples, and assist in providing scientifically defensible results.

Background soil sample collection will adhere to applicable United States Environmental Protection Agency (EPA) and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be planned in accordance with TVA TI ENV-TI-05.80.01 *Planning Sampling* Events, conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling,* and documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

As part of field mobilization activities, the field sampling team will:

- Designate a Safety Officer and a Tennessee-licensed professional geologist.
- Complete required health and safety paperwork and confirm field team members have completed required training.
- Coordinate field activities with the Laboratory Coordinator to ensure that sample bottles and preservatives are ordered, coolers and analyte-free deionized water are obtained, and sampling and sample arrival dates are communicated to the laboratories.
- Coordinate activities with the drilling subcontractor.
- Clear Access – Proposed boring locations will be marked using a wooden stake or survey flag with the position surveyed using GPS. Suitability of each location will be evaluated for logistical issues including access, grubbing needs, overhead utility clearance, and proximity to Plant features. Access improvements, including clearing and grubbing or road building, will be completed prior to the investigation start date. If a proposed boring location is discovered to have accessibility restrictions related to agricultural, cultural, biological, or other such limiting factors, then a replacement boring will be proposed at a location that will meet the study's goals with approval from TDEC.
- Perform Environmental Review – As required by the National Environmental Policy Act (NEPA), an environmental review must be completed to document and mitigate any potential impact of the work described herein. The level of review required for this work is anticipated to be a categorical exclusion, which would be documented by TVA with a categorical exclusion checklist (CEC). A CEC has a number of signatories from TVA.

It is understood that the environmental review is to be completed before implementation of the field work. Additionally, plant staff will not issue an excavation permit ahead of the completed environmental review.

- Complete Utility Locate(s) / Excavation Permit(s) - Prior to initiating subsurface activities, subsurface utility clearance will be sought via the plant engineering department and/or the TN 811 service. At locations within the Plant, engineering will provide primary utility clearance assurance in addition to TN 811 being notified. At all other drilling locations TVA or 3rd party underground locators will be engaged to clear boring locations. For drilling locations outside the plant (e.g., along public roads and rights-of-way), utility avoidance assurance will be supplemented by the TN 811 service and the TVA or 3rd party underground locators. An excavation permit is required prior to initiating any digging or boring at the Plant. A key component to the completion of the excavation permit is consensus on the drilling locations with pertinent TVA staff.

- Identify Water Source – During implementation of the EIP, a source of potable water will be required to complete several investigation tasks, including certain drilling methods and decontamination procedures.

- Obtain required functional and calibrated field instruments, including health and safety equipment.

- Complete sample paperwork to the extent possible, including chain-of-custody forms and sample labels in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping.*

- Obtain ice daily prior to beginning work for sample preservation.

5.2 SAMPLING METHODS AND PROTOCOL

Drilling activities performed at the Plant during implementation of this SAP will include advancing subsurface boreholes using DPT or other compatible technology based on field conditions and rig availability. Sampling activities will be conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*.

The following sections present drilling and soil sampling procedures required to complete the tasks presented.

5.2.1 Drilling, Logging, and Surveying

5.2.1.1 Background Borings

Probe advancement will be initiated using the static weight of the rig until encountering refusal. Percussion will be used to advance the probe rods further following maximum penetration under the static load. A new two-inch inside diameter one- time use clear, polyvinyl chloride (PVC) sample liner will be placed inside the sample rod before each push to collect continuous soil samples. After the sample rod is pushed to the appropriate depth, it will be retracted, and the liner and sample removed and placed on clean plastic sheeting. A new PVC liner will then be placed in the sampler and another rod will be added to the run. DPT sample rods will be driven and retracted in a continuous run until the desired soil boring depth is achieved.

A liner cutter will be used to open the liner for sample retrieval. Soils that are not considered part of the representative sample (e.g., slough as determined by visual inspection of the sample) will be managed in accordance with Section 5.2.8. The core length will be measured to calculate sample recovery. Soils obtained in each PVC liner will be logged by a Tennessee-licensed professional geologist. Samples will be collected in accordance with Section 5.2.4.

Once sample collection is complete at each boring, the boreholes will generally be filled with a 30 percent solids bentonite grout or a bentonite-cement grout mixture using a tremie pipe to within approximately 6 inches of the surface. The top 6 inches will be restored to match the existing conditions.

5.2.1.2 Background Groundwater Monitoring Wells

During installation of proposed background monitoring wells, soil samples will be collected to provide additional background soil data. Soil samples collected during the installation of these monitoring wells will either be collected using the same method described above in Section 5.2.1.1 or by using split spoon samplers driven through the hollow stem augers used to advance the monitoring well boring. Soil samples from these monitoring well locations will be collected through the well screen interval.

5.2.1.3 Borehole Logging

During boring advancement, each borehole will be logged by a Tennessee-licensed professional geologist. At a minimum, the following information will be recorded in accordance with TVA TI ENV-TI-05.80.03, *Field Record Keeping* and *American Society of Testing and Materials (ASTM) Standard D2488* and entered on boring logs for each borehole and each distinct stratum described:

- Name of person completing boring log

- Boring identification and boring date
- Soil color and classification, using Munsell soil color charts and Modified Unified Soil Classification System (USCS) for unconsolidated materials
- Visual identification of CCR in soil cores, if present
- Moisture content (e.g. dry, moist, or wet)
- Soil consistency or density, size, shape, and angularity of particles (for fine to coarse grained soils)
- Soil pH as determined in the field using field pH test kits
- Depth interval represented by stratum observations
- Additional observations deemed relevant (e.g. presence of groundwater, fractures, GPS survey data, etc.)
- Field boring logs will be collected on field forms and then input to gINT for final production

5.2.1.4 Surveying

Once completed, borings will be surveyed for horizontal and vertical control by survey grade GPS. The final survey of each location will be conducted following completion and abandonment of each individual sampling location. The survey data will be added to the final boring logs once available.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration, and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by the Field Team Leader, and approved by TVA, prior to mobilization. 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 equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the QAPP.

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 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 in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Boring log forms will be used to document lithologic conditions and field observations at each boring location.

5.2.3.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

Sample collection for laboratory analysis at each location will be initiated at the ground surface. An initial grab sample representing the surficial soils (i.e., top 6 inches) will be collected by hand auger and submitted for laboratory analysis of percent ash by polarized light microscopy (PLM) in addition to CCR Parameters. The additional analysis of percent ash by PLM on the surficial sample is to determine if there have been any windblown CCRs deposited at the boring location. Sampling will continue the length of the boring by collecting grab samples from the mid-point of each five-foot boring interval. The mid-point for grab samples will be the mid-point based on recovery. If soils are expected to be hard to recover during core retrieval core catchers will be used to prevent loss of sample material. No composite samples are proposed. If a change in lithology, such as a change in residuum, colluvium, alluvium, etc. occurs within a core interval separate grab samples will be collected from the mid-point of both lithologies in the core. Each sample from the recovered core will be collected with a gloved hand, properly decontaminated sample scoop, or certified clean disposable sample scoop, field samplers will wear a new pair of disposable nitrile gloves while handling each sample. The samples will be placed in a new, re-sealable bag and will be homogenized using a gloved hand or decontaminated sample scoop, certified clean disposable sample scoop and/or by kneading the material through the outside of the bag until the physical appearance is consistent over the entire sample.

After homogenization, the sample will be collected from the bag and placed in the appropriate laboratory-supplied sample containers. Each sample will be submitted to the laboratory for CCR Parameters (refer to Section 5.2.6).

5.2.5 Preservation and Handling

Prior to placing each soil sample into the laboratory supplied containers, an aliquot of the homogenized soil sample will be tested using a field pH test kit with the results recorded in the daily field notes. Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped. Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-05.80.06, *Handling and Shipping of Samples* 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 (such as 4-ounce or 8-ounce soil jars) 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. Gel ice or loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable 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 sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. 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 call 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 the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.6 Sample Analyses

Samples will be submitted to the TVA-approved laboratory for analysis. These samples will be analyzed for concentrations of CCR Parameters in order to evaluate naturally occurring levels and establish a baseline in background soils. Tables 1-3 summarize the constituents requiring analysis. In addition to these analyses, one soil sample will be collected and analyzed for fraction organic carbon (FOC) from one background boring (adjacent to the background monitoring well). The FOC sample will be collected from a depth that corresponds to the base of the screened interval of the background well. Analytical methods, preservation requirements, container size, and holding times for each chemical analysis is presented in Table 4. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 1. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids – Not Applicable

Table 2. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 3. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 4. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Percent ash	PLM (RJ Lee SOP OPT23.02)	Not Applicable	4 oz. glass	Not Applicable
Metals	SW-846 6020A	Cool to <6° C	4 oz. glass	180 days
Mercury	SW-846 7471B	Cool to <6° C	4 oz. glass	28 days
Radium 226	SW-846 901.1	Cool to <6° C	8 oz. glass	180 days
Radium 228	SW-846 901.1	Cool to <6° C	8 oz. glass	180 days
Chloride	SW-846 9056A Modified	Cool to <6° C	4 oz. glass	28 days
Fluoride	SW-846 9056A Modified	Cool to <6° C	4 oz. glass	28 days
Sulfate	SW-846 9056A Modified	Cool to <6° C	4 oz. glass	28 days
pH	SW-846 9045D Modified	Cool to <6° C	4 oz. glass	Not Applicable*
Fraction Organic Carbon	ASTM-D2974	Cool to <6° C	4 oz. glass	28 Days

*Holding time for soil pH samples is 15 minutes following creation of soil paste. Soil samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH will have paste prepared in the laboratory so that analysis can be completed within the holding time.

5.2.7 Equipment Decontamination Procedures

Documented decontamination will be performed for drilling equipment, tooling, and instruments in contact with subsurface materials in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Decontamination pads will be constructed for decontamination of large downhole tooling (augers, drill rods, etc.) using a high-pressure washer/steam cleaner.

Decontamination pads will be constructed at locations designated by TVA personnel using poly sheeting with sufficient berms to contain decontamination fluids and prevent potential runoff to uncontrolled areas. Following decontamination, fluids will be pumped into a drum for storage, transportation, and ultimately disposal in accordance with Section 5.2.8. Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox® or other appropriate non-phosphatic detergent in 5-gallon buckets.

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

5.2.8 Waste Management

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

- Soil Cuttings
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05 *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to background soil sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

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

6.2 QUALITY CONTROL CHECKS

Four types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, and field blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control*. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below. A complete description of the QA requirements is provided in the QAPP.

Field Duplicate Samples – One field duplicate sample will be collected for every 20 soil samples or once per sampling event. Duplicates samples will be prepared as blind duplicates and will be collected by splitting the homogenized sample volume into two sets of identical, laboratory-prepared sample bottles. The primary and duplicate samples will be labeled according to procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters as the primary sample.

MS/MSD Samples – A sufficient volume of soil is already contained in the laboratory supplied soil sample jars for use as the MS/MSD. As such, MS/MSD samples will be collected by the laboratory from the sample containers submitted for standard analysis, allowing matrix spike samples to be run to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 soil samples collected. 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 sample collection will be noted in the log book.

The MS/MSD sample will be analyzed for the same analytes as the primary sample, with the exception of parameters that are not amenable to MS/MSD.

Equipment Blanks (Rinsate Blanks) – One equipment (rinsate) blank will be collected for every 20 samples. The equipment blank will be collected at a soil boring location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment (e.g., decontaminated DPT cutting shoe, sample scoops, or other non-disposable decontaminated equipment), then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes, with the exception of pH, as the sample collected from the soil boring location where the equipment blank is prepared.

Field Blanks: One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 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 results of sample analyses to the appropriate parties. 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 is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process are described in the QAPP.

PLM data will not be subjected to data validation due to the specialized training and equipment required to accurately visually quantitate ash. PLM data will be subjected to verification including a review of QC analyses and a reasonability assessment based on photomicrographs included in the data package.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 5. Preliminary Schedule for Background Soil SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
Background Soil SAP Submittal		Completed
Prepare for Field Activities	25 Days	Following EIP Approval
Conduct Field Activities	35 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Plant-specific safety requirements are anticipated to include TVA specified training and attendance at a safety briefing. Only the Investigation Team members and subcontractors performing work activities will be required to meet the above requirements.
- A dedicated Safety Officer will be present for this work.
- Assessment of suitability of areas and access to borings, including clearing and grubbing, will be provided by TVA and will be completed prior to the Investigation start date.

9.0 REFERENCES

Environmental Protection Agency (EPA). 1995. "Engineering Forum Issue; Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites." December 1995.

Environmental Protection Agency (EPA). 2004. "National Functional Guidelines for Inorganic Data Review." October.

Environmental Protection Agency (EPA) Region 4. 2001. "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual." November.

Tennessee Valley Authority (TVA). 2017a. "Planning Sampling Events." Technical Instruction ENV-TI-05.80.01, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017b. "Sample Labeling and Custody." Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017c. "Field Record Keeping." Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. "Field Sampling Quality Control." Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. "Field Sampling Equipment Cleaning and Decontamination." Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017f. "Handling and Shipping of Samples." Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017g. "Soil and Sediment Sampling." Technical Instruction ENV-TI-05.80.50, Revision 0000 September 29.

ATTACHMENT A
FIGURE

Figure No.
1

Title

Proposed Soil Sample Locations

Client/Project

Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2019-02-22
Technical Review by TM on 2019-02-22

0 500 1,000 1,500 2,000 Feet
1:6,000 (At original document size of 22x34)

Legend

- Proposed Background Soil Sampling Location - Offsite
- Proposed Background Soil Sampling Location - TVA Property
- 2017 Remedial Investigation Background Soil Sampling Location
- Existing Background Groundwater Monitoring Well
- Existing Downgradient Monitoring Well
- Proposed Bachground Monitoring Well
- TVA Property Boundary
- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)

Soil Unit	Soil Map Unit
Cr	Commerce silt loam
Cs	Convent silt loam
Cu	Crevasse fine sand
Fy	Filled land, sandy (udorthent, loamy)
Lb	Levees and borrow pits (udorthents, silty)
MeB	Memphis silt loam, 2 to 5 percent slopes
MeG	Memphis silt loam, 30 to 65 percent slopes
NOTCOM	No Digital Data Available
Rb	Robinsonville fine sandy loam
Rn	Robinsonville silt loam
Sh	Sharkey clay, 0 to 2 percent slopes, occasionally flooded
Tu	Tunica silty clay
W	Water

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2018 & 2015)
3. TVA property boundary is referenced from TVA Drawing 421 P 504 Allen Fossil Plant Reservation.

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TVA

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
Background Soil Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment[1]
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Photoionization detector (PID)
Water level indicator meter
Field pH Test Kits
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Refer to the Exploratory Drilling SAP for drilling-specific field equipment

APPENDIX S
CCR MATERIAL CHARACTERISTICS SAP

CCR Material Characteristics Sampling and Analysis Plan Allen Fossil Plant

Revision 3

TDEC Commissioner's Order:
Environmental Investigation Plan
Allen Fossil Plant
Memphis, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 4, 2019

CCR MATERIAL CHARACTERISTICS
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

REVISION LOG

Revision	Description	Date
0	Issued for TDEC Review	June 12, 2017
1	Addresses October 3, 2017 TDEC Review Comments and Issued for TDEC Review	December 8, 2017
1.5	Addresses January 5, 2018 TDEC Review Comments and Issued for TDEC Review	February 16, 2018
2	Addresses April 10, 2018 TDEC Review Comments and Issued for TDEC Review	July 20, 2018
3	Address public comments	March 4, 2019

CCR MATERIAL CHARACTERISTICS
SAMPLING AND ANALYSIS PLAN
ALLEN FOSSIL PLANT

TITLE AND REVIEW PAGE

Title of Plan: CCR Material Characteristics
Sampling and Analysis Plan
Allen Fossil Plant
Tennessee Valley Authority
Memphis, Tennessee

Prepared By: Stantec Consulting Services Inc.

Prepared For: Tennessee Valley Authority

Effective Date: March 4, 2019 Revision 3

All parties executing work as part of this Sampling and Analysis Plan sign below acknowledging they have reviewed, understand, and will abide by the requirements set forth herein.

TVA Investigation Project Manager	3/1/19 Date
TVA Investigation Field Lead	3/1/19 Date
Health, Safety, and Environmental (HSE) Manager	3/1/19 Date
Investigation Project Manager	2/26/2019 Date
QA Oversight Manager	2/26/2019 Date
Laboratory Project Manager	2/28/19 Date
Charles L. Head TDEC Senior Advisor	Date
Robert Wilkinson TDEC CCR Technical Manager	Date

Stantec

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1.0 BACKGROUND

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee. In accordance with the TDEC Order, TDEC and TVA held an Investigation Conference at the Allen Fossil Plant (ALF) on September 28-29, 2016, at which time TVA briefed TDEC on its Coal Combustion Residuals (CCR) management at ALF and discussed the documentation that TVA submitted to TDEC in advance of the Investigation Conference.

On February 6, 2017, TDEC submitted a follow-up letter to TVA which provided specific questions and tasks for TVA to address as part of the Environmental Investigation Plan (EIP). On June 12, 2017, TVA submitted ALF EIP Revision 0 to TDEC. TVA submitted subsequent revisions of the EIP based on review comments provided by TDEC as documented in the Revision Log.

TDEC's comments included a request for a sampling plan to determine the leachability of CCR constituents (listed in 40 CFR Part 257, Appendix III and IV of the CCR Rule) from material in surface impoundments, landfills, and non-registered CCR units at the ALF Plant (Plant). TDEC's comments also included a request for a Pore Water Sampling and Analysis Plan (SAP) for the Plant. The submittal of this CCR Material Characteristics SAP addresses both requests.

2.0 OBJECTIVES

The objective of this CCR Material Characteristics SAP is to characterize the leachability of CCR constituents from material in a CCR unit, in response to the TDEC Order. The approach is to collect and analyze pore water and CCR material from the locations identified in Section 4.0.

This CCR Material Characteristics SAP will provide procedures necessary to conduct the sampling and analysis of pore water and CCR material in the CCR units, and to characterize them for the CCR Parameters list. Proposed activities will include the following major tasks:

- Verify proposed sampling locations using the global positioning system (GPS)
- Develop temporary wells in the ash disposal area (drilling and installation procedures of the temporary wells are outlined in the Exploratory Drilling SAP)
- Collect pore water and CCR material samples from the temporary well locations
- Conduct laboratory testing and analyses

3.0 HEALTH AND SAFETY

This work will be conducted under an approved Plant-specific Health and Safety Plan (HASP). This HASP will be in accordance with TVA Safety policies and procedures. Each worker will be responsible for reviewing and following the HASP. Personnel conducting field activities will have completed required training, understand safety procedures, and be qualified to conduct the field work described in this SAP. The HASP will include a job safety analysis (JSA) for each task described in this SAP and provide control methods to protect personnel. Personal protective equipment (PPE) requirements and safety, security, health, and environmental procedures are defined in the HASP. In addition, authorized field personnel will attend TVA required safety training and Plant orientation.

The Field Team Leader will conduct safety briefings each day prior to beginning work and at mid-shift or after lunch breaks and document these meetings to include the names of those in attendance and items discussed. TVA-specific protocols will be followed, including the completion of 2-Minute Rule cards. The JSAs will be updated if conditions change.

4.0 SAMPLING LOCATIONS

The Study Area for this CCR Materials Characteristics SAP consists of the West Ash Disposal Area (WADA) and the East Ash Disposal Area (EADA). Each proposed sampling location in the Study Area will accommodate sampling for pore water and CCR material. Pore water will be collected as filtered and unfiltered samples, while CCR material will be collected as unsaturated and saturated samples (as conditions allow). Five sample locations were selected, based on TDEC's request to characterize the leachability of constituents from the material in each CCR Unit. All samples will be taken from temporary wells placed in the CCR units, which will also be used to determine the water level in those units.

In temporary wells TW01 through TW05, pore water samples will be taken at the base of the unit in the original sluiced ash.

During construction and installation of the temporary wells (i.e., sampling locations), a CCR material grab sample will be taken from each 5-foot core boring, from the top of the unit to its base. This will result in the collection of CCR material samples from both the phreatic zone (for saturated samples) and non-phreatic zone (for unsaturated samples). Samples shall not be taken from active ponds; they shall only be taken from former ponds once they have been dewatered and stabilized. After the temporary wells have been installed, pore water samples will be taken at the base of the units in the ash.

Maps showing all pore water/CCR material sampling locations are provided as Figures 1 and 2 in Attachment A. Installation and construction specifications for the temporary wells are provided in the ALF Exploratory Drilling SAP. The proposed temporary well locations are subject to change based on ongoing site operations and conditions. TDEC will be notified of any changes in well locations.

Table 1. Proposed Sample Locations

Sample Location ID	Description
TW01	EADA - western TW
TW02	EADA - northeastern TW
TW03	EADA - southeastern TW
TW04	WADA – western TW
TW05	WADA – eastern TW

TW = Temporary well

5.0 SAMPLE COLLECTION AND FIELD ACTIVITY PROCEDURES

This section provides details of procedures that will be used to collect samples, document field activities, and assist in providing scientifically defensible results.

Pore water and CCR material sampling will adhere to applicable EPA and TVA Environmental Technical Instruction (TI) documents. A project field book and field forms will be maintained by the Field Team Leader to record field measurements, analyses, and observations. Field activities will be planned in accordance with TVA TI ENV-TI-05.80.01 *Planning Sampling* Events, conducted according to TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling,* and documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

5.1 PREPARATION FOR FIELD ACTIVITIES

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

- Designate a Safety Officer
- Complete required health and safety paperwork and confirm field team members have completed required training
- Coordinate field activities with the Laboratory Coordinator to ensure that sample bottles and preservatives are ordered, coolers and analyte-free deionized (DI) water are obtained, and sampling and sample arrival dates are communicated to the laboratories
- Obtain required calibrated field instruments, including health and safety equipment, water level meters, and equipment needed for measuring parameters that define stability during well purging
- Discuss project objectives and potential hazards with project personnel
- Complete sample paperwork to the extent possible prior to deploying to the field, including chain-of-custody (COC) forms and sample labels
- Obtain ice prior to sample collection for sample preservation

5.2 SAMPLING METHODS AND PROTOCOL

Sampling and collection methods will be conducted in accordance with applicable TVA Technical Instructions (TIs), including:

- ENV-TI-05.80.02 *Sample Labeling and Custody*
- ENV-TI-05.80.03 *Field Record Keeping*

- ENV-TI-05.80.04 *Field Sampling Quality Control*
- ENV-TI-05.80.05 *Field Sampling Equipment Cleaning and Decontamination*
- ENV-TI-05.80.06 *Handling and Shipping of Samples*
- ENV-TI-05.80.42 *Groundwater Sampling*
- ENV-TI-05.80.44 *Groundwater Level and Well Depth Measurement*
- ENV-TI-05.80.46 *Field Measurement Using A Multiparameter Sonde*
- ENV-TI-05.80.50, *Soil and Sediment Sampling*

5.2.1 Pore Water and CCR Material Collection and Analysis

Pore water samples will be collected from the phreatic zone at the base of a unit, and above any applicable drainage layer, in order to obtain in-situ leaching information for the material. The analyses of actual pore water samples will provide real-time measurements of any constituents that may be leaching from the material.

Samples of CCR material will be collected from the borings advanced for the temporary wells, constructed specifically to obtain pore water samples, from both saturated and unsaturated zones in the CCR unit. These samples will be analyzed for the parameters described below both for totals and leachability, after being subjected to the most applicable leaching method based on emerging science in the industry, which could include the Synthetic Precipitation Leaching Procedure (SPLP).

The pore water and CCR material samples will be analyzed for the constituents listed in 40 CFR Part 257, Appendices III and IV, and the five inorganic constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations) which include copper, nickel, silver, vanadium, and zinc. The combined Appendices III and IV constituents, and TDEC Appendix 1 inorganic constituents, will hereafter be referred to collectively as the "CCR Parameters." Total organic carbon (TOC), iron, and manganese have been added to the CCR Parameters list as specific parameters of interest under this SAP. As an Appendix IV constituent, arsenic will be speciated into arsenate and arsenite for pore water samples. Sample analyses are described in greater detail in Section 5.2.6.

5.2.1.1 Water Level Measurements

Prior to sampling, each temporary well and staff gauge will be inspected for damage or indications that the well integrity has been compromised. If field observations indicate the need for well or staff gauge maintenance or repairs, the Field Team Leader will notify TVA.

After the temporary well and staff gauge integrity inspection is completed, the water level in each well and at each staff gauge will be measured in relation to a surveyed reference point (e.g., top of well casing) using an electronic water level indicator. Pore water elevation data will be measured and recorded in accordance with TVA TI ENV-TI-05.80.44, *Groundwater Level and Well Depth Measurement*. 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 for the monitoring well network and staff gauges. At a minimum, measurements will be made within the same day. In addition, barometric pressure readings will be recorded daily. TVA plans to use a multi-parameter sensor equipped with a National Institute of Science & Technology (NIST) certified temperature sensor.

The water level indicator will be decontaminated between each well by following the decontamination procedures provided below in Section 5.2.7.

5.2.1.2 Well Purging

Following the measurement of water levels, monitoring wells will be purged using a dedicated pump for pore water sampling. Purging will continue until field measurements of water quality parameters stabilize during three consecutive readings at 3 to 5 minute intervals per the criteria listed in TVA TI ENV-TI-05.80.42, *Groundwater Sampling*. The stabilization criteria follow:

- pH - ±0.1
- Specific conductivity - ±5% microsiemens per centimeter (µS/cm)
- Dissolved oxygen (DO) - ±10% for > 0.5 mg/L or <0.5 mg/L
- Turbidity - below 10 NTUs or ±10% for values above 10 NTUs

Field measurements, including pH, specific conductivity, turbidity, oxidation/reduction potential, and temperature, will be collected during purging using a flow-through cell. Once the field parameters have stabilized, samples 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 probe. A final turbidity measurement will be made after each sample is collected.

If after 2 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 log book and field data sheet. A final turbidity measurement will be made after each sample is collected.

Purging beginning and end times, pumping rates, water quality parameter readings, and groundwater levels will be recorded throughout the purging operation on field sampling forms. The total volume purged at each well may vary based on recharge rates and stabilization of water quality parameters.

Low-flow purging techniques will be used to collect a representative sample from the water bearing unit unless the wells do not yield sufficient water. If pump settings are unknown, purging will begin at a minimum 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. If drawdown exceeds 0.3 feet, but reaches stability, purging of the well will continue and the current flow rate, drawdown, and time will be recorded on the field data sheet by the sampler.

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% within the well bore, but no later than 24 hours after the well purge.

5.2.2 Field Equipment Description, Testing/Inspection, Calibration and Maintenance

A list of anticipated equipment for the field activities described herein is provided as Attachment B. A final list of equipment will be prepared by theField Team Leader, and approved by TVA, prior to mobilization. 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 equipment is not in the proper working condition, that piece of equipment will be repaired or taken out of service and replaced prior to use. Additional information regarding field equipment inspection and testing is included in the Quality Assurance Project Plan (QAPP).

5.2.3 Field Documentation

Field documentation will be maintained in accordance with TVA TI ENV-05.80.03, *Field Record Keeping* and the QAPP. Field documentation associated with investigation activities will primarily be recorded in Plant-specific field forms, logbooks and/or on digital media (e.g., geographic information system (GIS)/GPS documentation). Additional information regarding field documentation is provided below and included in the QAPP and TVAs TIs.

5.2.3.1 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 in bound, waterproof, sequentially paginated field logbooks and/or on digital media and field forms.

Deviations from applicable work plans will be documented in the field logbook during sampling and data collection operations. The TVA Technical Lead and the QA Oversight Manager or designee will approve deviations before they occur.

5.2.3.2 Field Forms

Plant-specific field forms will be used to record field measurements and observations for specific tasks. Field logbooks will be used to record daily activities, including sample collection and tracking information.

5.2.3.3 Chain-of-Custody Forms

For the environmental samples to be collected, chain-of-custody (COC) forms, shipping documents, and sample logs will be prepared and retained. Field Quality Control samples will be documented in both the field notes (logbooks and field forms) and on sample COC records. COC forms will be reviewed daily by the Field Team Leader and Field Oversight Coordinator for completeness and a quality control (QC) check of samples in each cooler compared to sample IDs on the corresponding COC form. The Investigation Project Manager will staff the project with a field sample manager during sample collection activities. Additional information regarding COC forms is included in Section 6.2.2 of this SAP, the QAPP, and TVA TIs.

5.2.3.4 Photographs

In addition to documentation of field activities as previously described, photographs of field activities will also be used to document the field investigation. A photo log will be developed, and each photo in the log will include the location, date taken, and a brief description of the photo content, including direction facing for orientation purposes.

5.2.4 Collection of Samples

5.2.4.1 Pore Water Sampling

Pore water sample collection will adhere to TVA TI ENV-TI-05.80.42, *Groundwater Sampling*. The sampling team leader will maintain a project field book and field forms to record field measurements, analyses, and observations. Field activities will be documented according to TVA TI ENV-TI-05.80.03, *Field Record Keeping*.

Filtered and unfiltered pore water samples will be collected once from each of the temporary well locations, in appropriate, laboratory provided, pre-preserved sample containers. Samples will be collected directly from the pump discharge line.

A final reading of water quality parameters will be conducted and documented on field sampling forms at the time of sample collection, based on the final reading collected at completion of purging and directly before the sample was collected. Unfiltered pore water samples will be collected in appropriate, laboratory provided, pre-preserved sample containers.

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 when handling each sample. 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 avoid overfilling and diluting preservatives. Each sample bottle will be capped before filling the next bottle.

It will be necessary to collect filtered (dissolved) inorganic constituent samples, in addition to unfiltered (total) inorganic constituent samples. Dissolved sample collection will be accomplished in accordance with TVA TI ENV-TI- 05.80.42.

Issues that could affect the quality of samples will be recorded on the field data sheet or in the log book 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.

5.2.4.2 CCR Material Sampling

Boring advancement through the CCR material to the base of the unit will be in concurrence with the Plant Exploratory Drilling SAP, with CCR material collected using 3-inch diameter split-spoon samplers. Sample collection will be conducted in accordance with TVA TI ENV-TI-05.80.50, *Soil and Sediment Sampling*. Continuous sampling will be conducted until the base of the CCR unit has been reached. Split-spoons will be decontaminated between sampling locations in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

Grab samples will be collected at the mid-point of the first unsaturated and saturated sample collected. No composite samples are proposed. Each sample will be collected with a gloved hand, properly decontaminated sample scoop, or certified clean disposable sample scoop. Field samplers will wear a new pair of disposable nitrile gloves (or equivalent) while handling each sample. The samples will be placed in a new, re-sealable bag and will be homogenized using a gloved hand or decontaminated sample scoop, certified clean disposable sample scoop and/or by kneading the material through the outside of the bag until the physical appearance is consistent over the entire sample. After homogenization, the sample will be collected from the bag and placed in the appropriate laboratory-supplied sample containers. Each sample will be submitted to the laboratory for analytical testing (refer to Section 5.2.6).

5.2.5 Preservation and Handling

Prior to placing each CCR material sample into the laboratory supplied containers, an aliquot of the homogenized sample will be tested using a field pH test kit with the results recorded in the daily field notes. Sample containers will be labeled in accordance with TVA TI ENV-05.80.02, *Sample Labeling and Custody*.

Once each sample container is filled, the rim and threads will be cleaned by wiping with a clean paper towel and capped, and a signed and dated custody seal will be applied.

Each sample container will be checked to ensure that it is sealed, labeled legibly, and externally clean. Sample containers will be packaged in a manner to prevent breakage during shipment.

Coolers will be prepared for shipment in accordance with TVA TI ENV-TI-05.80.06, *Handling and Shipping of Samples* 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. Loose ice will be placed around and among the sample containers to cool the samples to less than 6 degrees Celsius (°C) during shipment. The cooler will be filled with additional packing material to secure the containers.

The original COC form will be placed in a re-sealable 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 sign "received by laboratory" on each COC form. The laboratory will verify that the custody seals have not been previously broken and that the seal number corresponds with the number on the COC form. 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 call 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 the back copy of the COC form to the QA Oversight Manager and Investigation Project Manager.

5.2.6 Sample Analyses

Pore water and CCR material samples will be submitted to the TVA-approved laboratory for analysis. Pore water samples will consist of filtered and unfiltered samples, and analyzed for the CCR Parameters and additional parameters of interest.

CCR material samples (both saturated and unsaturated) will be analyzed for total CCR Parameters, as well as leachability, after being subjected to the most applicable leaching method based on emerging science in the industry, which could include the SPLP, prior to an analysis for the CCR Parameters and additional parameters of interest.

All samples will be analyzed for the CCR related constituents listed in Title 40 of the Code of Federal Regulations Part 257 (40 CFR 257), Appendices III and IV. As an Appendix IV constituent, arsenic will be speciated into arsenate and arsenite for pore water samples. In addition, five inorganic constituents listed in Appendix 1 of TN Rule 0400-11-01-.04 (i.e., TDEC regulations), and not included in the 40 CFR 257 Appendices III and IV, will be analyzed to maintain continuity with TDEC environmental programs. The additional constituents listed in TDEC Appendix 1 include the following metals: copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents, and TDEC Appendix 1 inorganic constituents, are referred to collectively as "CCR Parameters." Total organic carbon (TOC), manganese, and iron will be analyzed as additional parameters of interest.

Tables 2 through 5 summarize the constituents requiring analysis. Analytical methods, preservation requirements, container size, and holding times for each chemical analysis are presented in Table 6. Additional sampling and laboratory-specific information is covered in more detail in the QAPP.

Table 2. 40 CFR Part 257 Appendix III Constituents

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids

Table 3. 40 CFR Part 257 Appendix IV Constituents

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 Combined

Table 4. TN Rule 0400-11-01-.04, Appendix 1 Inorganic Constituents

TDEC Appendix 1 Constituents*
Copper
Nickel
Silver
Vanadium
Zinc

* Constituents not listed in CCR Appendices III and IV

Table 5. Additional Parameters of Interest

Parameters of Interest*
Total Organic Carbon (TOC)
Iron
Manganese

* Constituents not included in the CCR Parameters

Table 6. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Metals, dissolved	SW-846 6020A	HNO3 to pH < 2 & Cool to <6°C	250-mL HDPE	180 days
Metals, total	Liquid & Solid - SW-846 6020A	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	180 days
Mercury, dissolved	SW-846 7470A	HNO3 to pH < 2 & Cool to <6°C	250-mL HDPE	28 days
Mercury, total	Liquid - SW-846 7470A; Solid - SW-846 7471B	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	28 days
Radium 226	Liquid - SW-846 903.0; Solid - SW-846 901.1	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	1 L glass or Plastic; 8-oz glass (CCR)	180 days
Radium 228	Liquid - SW-846 904.0; Solid - SW-846 901.1	HNO3 to pH < 2 & Cool to <6°C; Cool to <6°C	2 L glass or plastic; 8-oz glass (CCR)	180 days
Arsenic species, aqueous - unfiltered	SW-846 6020A	Disodium EDTA, Acetic Acid Cool to <6°C	250-mL HDPE	21 days
Arsenic species, aqueous - filtered	SW-846 6020A	Disodium EDTA, Acetic Acid Cool to <6°C	250-mL HDPE	21 days
Chloride	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	28 days

Table 6. Analytical Methods, Preservatives, Containers, and Holding Times

Parameter	Analytical Methods	Preservative(s)	Container(s)	Holding Times
Fluoride	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	250-mL HDPE; 4-oz glass (CCR)	28 days
Sulfate	Liquid - SW-846 9056A; Solid - SW-846 9056A Modified	Cool to <6°C; Cool to <6°C	125-mL HDPE; 4-oz glass (CCR)	28 days
pH	Liquid - SW-846 9040C (field measurement); Solid - SW-846 9045D	NA	NA (liquids); 4-oz glass (CCR)	NA*
Total Dissolved Solids (TDS)	SM2540C	Cool to <6°C	250-mL HDPE	7 days
Total Organic Carbon (TOC)	Liquid - SM5310C; Solid - SW-846 9060A	H_2SO_4 to pH<2 & Cool to <6°C; Cool to <6°C	250-mL amber glass; 4-oz glass (CCR)	28 days

*The pH of pore water samples will be measured in the field. Holding time for CCR material pH samples is 15 minutes following creation of sample paste. CCR material samples will be tested in the field using field pH test kits, 10% of the sample locations will have confirmation samples submitted for laboratory analysis of pH and will have paste prepared in the laboratory so that analysis can be completed within the holding time.

5.2.7 Equipment Decontamination Procedures

Documented decontamination will be performed for non-dedicated sampling equipment in contact with groundwater or surface water, and drilling equipment, tooling, and instruments in contact with subsurface materials, in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination* to prevent cross-contamination. Pumps dedicated to a specific well do not need to be decontaminated.

Decontamination activities will be performed away from surface water bodies and areas of potential impacts. Decontamination of non-disposable sampling equipment or instruments can be performed using water and Liquinox ® or other appropriate non-phosphatic detergent in 5-gallon buckets. Following decontamination, fluids will be disposed of in accordance with Section 5.2.8.

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 logbook field notes. Additional information regarding equipment decontamination procedures is in the QAPP.

5.2.8 Waste Management

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

- CCR material Cuttings
- Purge Water
- Personal Protective Equipment
- Decontamination fluids
- General trash

IDW will be handled in accordance with TVA TI ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination,* the Plant-specific waste management plan, and local, state, and federal regulations. Transportation and disposal of IDW will be coordinated with TVA Plant personnel.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

The QAPP describes quality assurance (QA)/quality control (QC) requirements for the overall Investigation. The following sections provide details regarding QA/QC requirements specific to pore water and CCR material sampling and analysis.

6.1 OBJECTIVES

The Data Quality Objectives (DQOs) process is a tool employed during the project planning stage to ensure that data generated from an investigation are appropriate and of sufficient quality to address the investigation objectives. TVA and the Investigation Project Manager considered key components of the DQO process in developing investigation-specific SAPs to guide the data collection efforts for the Investigation.

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

6.2 QUALITY CONTROL CHECKS

Five types of field QA/QC samples will be collected during sampling activities: field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, equipment blanks, field blanks, and filter blanks. QA/QC samples will be collected in accordance with TVA TI ENV-TI-05.80.04, Field Sampling Quality Control. Criteria for the number and type of QA/QC samples to be collected for each analytical parameter are specified below. A complete description of the QA requirements is provided in the QAPP.

Field Duplicate Samples – One duplicate sample will be collected for every 20 samples or once per sampling event. Duplicates 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 procedure in Section 6.2.1. Sample identifier information will not be used to identify the duplicated samples. Actual sample identifiers for duplicate samples will be noted in the field logbook. The duplicate sample will be analyzed for the same parameters 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 to assess the effects of matrix on the accuracy and precision of the analyses. One MS/MSD sample will be analyzed for every 20 samples collected or once per sampling event. MS/MSD samples will be collected by filling bottles alternately by thirds in accordance with TVA TI ENV-TI-05.80.04, *Field Sampling Quality Control* into three sets of identical, laboratory-prepared sample bottles.

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 sample collection will be noted in the log book. The MS/MSD sample will be analyzed for the same analytes as the primary sample, with exception of parameters that are not amenable to MS/MSD. For parameters such as Total Suspended 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) – One equipment (rinsate) blank will be collected for every 20 samples or once per sampling event. The equipment blank will be collected at a sampling location by pouring laboratory-provided deionized water into or over the decontaminated sampling equipment, then into the appropriate sample containers. The time and location of collecting the equipment blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the equipment blank is prepared. If the tubing used to collect the filter blank is not certified clean tubing, then a tubing blank will be collected at a frequency of blank per lot.

Field Blanks - One field blank sample will be prepared per day using laboratory-supplied deionized water. The sample will be analyzed for the same analytes, with the exception of pH.

Filter Blanks – One filter blank will be collected during each day of the sampling activities when dissolved parameters are collected for analysis. The filter blank will be collected at a sampling location by passing laboratory-supplied deionized water through in-line filters used in the collection of dissolved metals, (or other analytes), then into the appropriate sample containers. The time and location of collecting the filter blank will be noted in the log book. The sample will be analyzed for the same analytes as the sample collected from the location where the filter blank is prepared. In addition, one filter blank will be collected per lot of filters used. The filter lot check is to be performed one per lot of filters used and scheduled in a manner to allow for laboratory to report data prior to investigative sample collection.

6.2.1 Sample Labels and Identification System

Sample IDs will be recorded on all sample container labels, custody records, and field sheets in accordance with TVA TIs ENV-TI-05.80.02, *Sample Labeling and Custody* and ENV-TI-05.80.03, *Field Record Keeping*. Each sample container will have a sample label affixed and secured with clear package tape as necessary to ensure the label is not removed. Information on sample labels will be recorded in waterproof, non-erasable ink. Specific information regarding sampling labeling and identification is included in the QAPP.

6.2.2 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 results of sample analyses to the appropriate parties. 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 is located in the QAPP.

6.3 DATA VALIDATION AND MANAGEMENT

As stated in the EIP, a QAPP has been developed such that environmental data are appropriately maintained and accessible to data end users. The field investigation will be performed in accordance with the QAPP. Laboratory analytical data will be subjected to data validation in accordance with the QAPP. The data validation levels and process will also be described in the QAPP.

7.0 SCHEDULE

Anticipated schedule activities and durations for the implementation of this SAP are summarized below. This schedule is preliminary and subject to change based on approval, field conditions, and weather conditions. For the overall EIP Implementation schedule, including anticipated dates, see the schedule provided in the EIP.

Table 7. Preliminary Schedule for CCR Material Characteristics SAP Activities

Project Schedule		
Task	**Duration**	**Notes**
CCR Material Characteristics SAP Submittal		Completed
Prepare for Field Activities	25 Days	Following EIP Approval
Conduct Field Activities	20 Days	Following Field Preparation
Laboratory Analysis	50 Days	Following Field Activities
Data Validation	30 Days	Following Lab Analysis

8.0 ASSUMPTIONS AND LIMITATIONS

In preparing this SAP, assumptions are as follows:

- Approved sampling methods and protocols may have to be substituted in the EIP based on changing field conditions.

9.0 REFERENCES

Tennessee Valley Authority (TVA). 2017a. “Planning Sampling Events.” Technical Instruction ENV-TI-05.80.01, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017b. “Sample Labeling and Custody.” Technical Instruction ENV-TI-05.80.02, Revision 0001 March 31.

Tennessee Valley Authority (TVA). 2017c. “Field Record Keeping.” Technical Instruction ENV-TI-05.80.03, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017d. “Field Sampling Quality Control.” Technical Instruction ENV-TI-05.80.04, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017e. “Field Sampling Equipment Cleaning and Decontamination.” Technical Instruction ENV-TI-05.80.05, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017f. “Handling and Shipping of Samples.” Technical Instruction ENV-TI-05.80.06, Revision 0000 March 31.

Tennessee Valley Authority (TVA). 2017g. “Groundwater Sampling.” Technical Instruction ENV-TI-05.80.42, Revision 0001. March 31.

Tennessee Valley Authority (TVA). 2017h. “Groundwater Level and Well Depth Measurement.” Technical Instruction ENV-TI-05.80.44, Revision 0000. March 31

Tennessee Valley Authority (TVA). 2017i. “Field Measurement Using a Multi-Parameter Sonde.” Technical Instruction ENV-TI-05.80.46, Revision 0000. March 31.

Tennessee Valley Authority (TVA). 2017j. “Soil and Sediment Sampling.” Technical Instruction ENV-TI-05.80.50, Revision 0000 September 29.

ATTACHMENT A
FIGURES

Figure No.
1

Title
Proposed Borings East Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

- Proposed Boring
- Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silt		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand		*Boring ID* *Lab Hydraulic Conductivity (cm/s) [if completed]*

- Current Impoundment (Approximate)
- Former Disposal Area (Approximate)
- TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)

Stantec TVA

U:\TVA-EP\175567295\gis\mxds\ALF_Proposed_Borings_East.mxd Revised: 2018-05-22 By: tmk

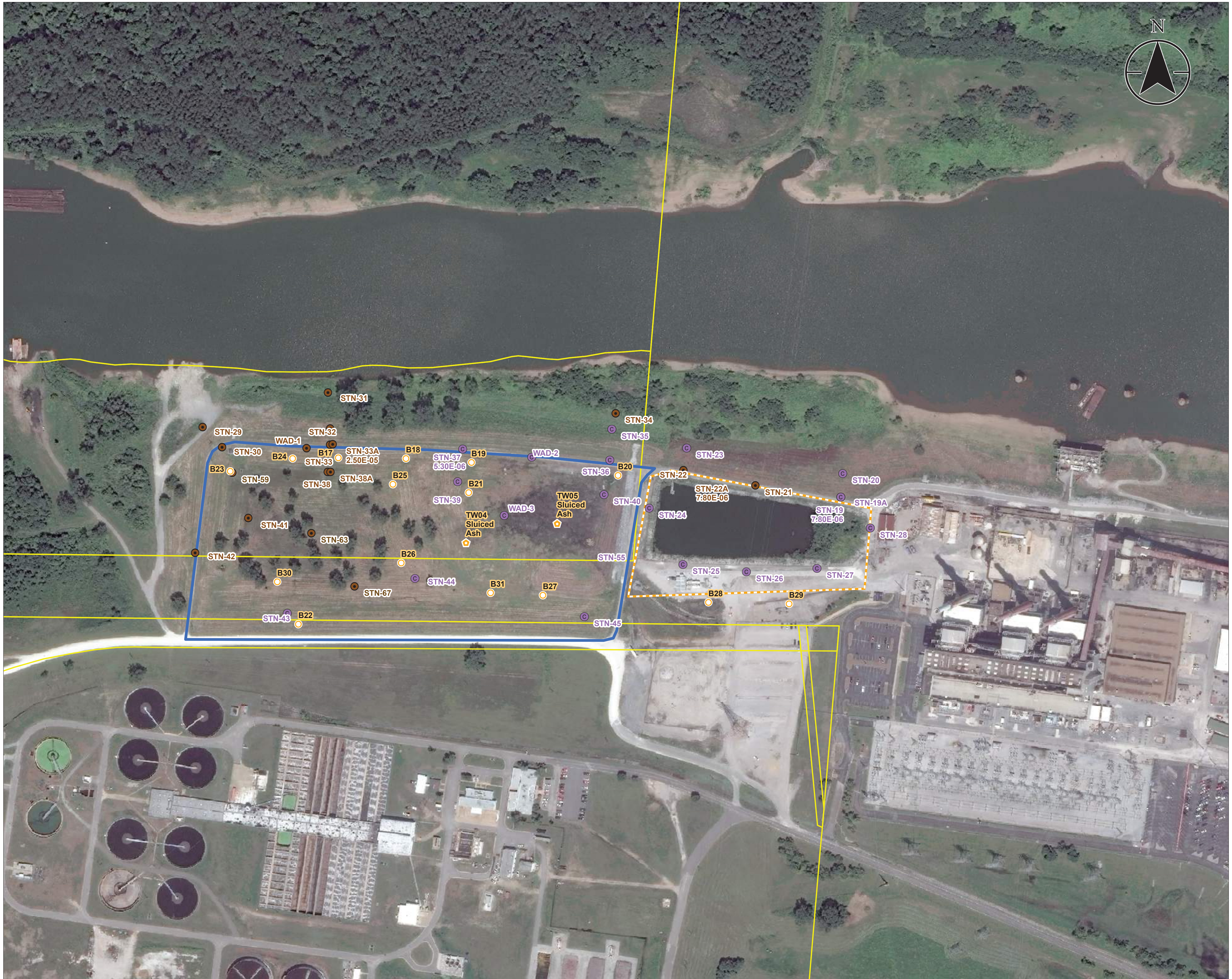

Figure No.
2

Title
Proposed Borings
West Ash Disposal Area

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-05-22
Technical Review by JD on 2018-05-22

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

Legend

Proposed Boring

Proposed Temporary Well (Screened Interval)

Foundation Soil [at the base of Perimeter Dikes and CCR]

Clay or Silt	*Boring ID*	*Lab Hydraulic Conductivity (cm/s) [if completed]*
Silty Sand to Sand	*Boring ID*	*Lab Hydraulic Conductivity (cm/s) [if completed]*

Current Impoundment (Approximate)

Former Disposal Area (Approximate)

TVA Property Boundary (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016)

ATTACHMENT B
FIELD EQUIPMENT LIST

Field Equipment List
CCR Material Characteristics Investigation

Item Description
***Health and Safety Equipment (e.g. PPE, PFD, first aid kit)**
***Field Supplies/Consumables (e.g. data forms, labels, nitrile gloves)**
***Decontamination Equipment (e.g. non-phosphate detergent)**
***Sampling/Shipping Equipment (e.g. cooler, ice, jars, forms)**
Field Equipment[1]
GPS (sub-meter accuracy preferred)
Digital camera
Batteries
Water level indicator meter
Peristaltic pump
Tubing
Multi-parameter Sonde
***These items are detailed in associated planning documents to avoid redundancy.**
[1]Refer to the Exploratory Drilling SAP for drilling-specific field equipment

APPENDIX T
GROUNDWATER MONITORING DATA

Figure No.
1

Title
Database Sampling Locations

Client/Project
Tennessee Valley Authority
Allen Fossil Plant

Project Location
Memphis, Tennessee

175567295
Prepared by TR on 2018-11-09
Technical Review by LP on 2018-11-09

0 200 400 600 800 Feet
1:3,600 (At original document size of 22x34)

Legend

- Existing Groundwater Monitoring Well
- Proposed Groundwater Monitoring Well
- Existing Observation Monitoring Well
- Closed Groundwater Monitoring Well
- 2017 Production Well
- Gauging Station
- Approximate Levee Centerline
- Approximate Extent of Levee
- Approximate Extent of Culvert (26 Inch Wide)
- TVA Property Boundary
- West & East Ash Disposal Areas

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Terraserver (2016) & TVA (2015)
3. Existing Monitoring Wells is referenced from TVA Drawing 10W858-03 Allen Fossil Plant Reservation.
4. Wells P-1 through P-6 were renamed ALF-P1 through ALF-P6, respectively.
5. Wells MLS-1 through MLS-5 were renamed ALF-MLS1 through ALF-MLS5, respectively.

Stantec TVA

Stantec

Table 1A
Groundwater Chemical Data

Well ID	Date	Metals																															Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	TDEC	-	6	10	2000	4	-	5	-	100	-	-	-	15	-	-	-	2	-	100	10*	-	50	-	100	-	-	2	-	-	-	-	-	4	-
	EPA	-	6	10	2000	4	-	5	-	100	-	1300	-	15	-	-	-	2	-	-	1**	-	50	-	-	-	-	2	-	-	-	-	-	4	-
ALF-201	11/15/16	<0.03	0.27	1.73	219	<1	3870	<1	90.6	<2	1.15	0.835	1380	<1	16.8	22.5	519	<0.2	247	2.58	--	2.94	0.452	--	--	47.6	280	<1	--	--	--	--	7.29	1.01	89.3
	01/30/17	<0.03	<2	3.37	386	<1	1900	<1	127	<2	1.2	<2	18800	<1	24.4	33.1	1310	<0.2	31.7	1.88	--	3.33	<5	--	--	27.2	424	<1	--	--	--	--	8.31	0.384	43.2
	02/28/17	<0.03	<2	3.92	200	<1	5130	<1	75	<2	0.944	<2	3330	<1	16.8	18.6	511	<0.2	396	2.52	--	3.06	<5	--	--	57.9	206	<1	--	--	--	--	14.2	1.48	94.6
	03/28/17	<0.03	<2	3.44	206	<1	3570	<1	79.6	<2	0.795	<2	3030	<1	15.7	20.4	460	<0.2	290	2.04	--	3.63	<5	--	--	49	258	<1	--	--	--	--	11	1.26	82.5
	04/18/17	<0.03	<2	3.65	319	<1	1460	<1	114	<2	1.4	<2	15400	<1	20.7	29.8	1020	<0.2	37.3	2.47	--	3.08	<5	--	--	27.8	360	<1	--	--	--	--	8.04	0.569	32.8
	05/10/17	<0.03	<2	3.14	463	<1	1650	<1	139	<2	0.635	<2	20600	<1	22.5	37	1160	<0.2	23	<1	--	3.13	<5	--	--	28.6	381	<1	--	--	--	--	9.34	0.282	51.2
	06/13/17	<0.03	<2	2.67	190	<1	2940	<1	91	<2	0.852	<2	2030	<1	15.6	23	573	<0.2	240	2	--	2.79	<5	--	--	45.1	246	<1	--	--	--	--	10.8	1.29	77.5
	07/13/17	<0.03	<2	2.59	225	<1	2820	<1	101	<2	0.648	<2	2700	<1	15.9	25.8	429	<0.2	239	2.29	--	2.82	<5	--	--	43.1	324	<1	--	--	--	--	10.6	1.42	75.2
	07/19/17	<0.03	<2	2.47	224	<1	3310	<1	108	<2	0.788	<2	1840	<1	15.9	27.2	421	<0.2	244	2.72	--	2.93	<5	--	--	43	326	<1	--	--	--	--	11.7	1.12	79.1
ALF-202	11/14/16	0.04	0.22	**177**	70.3	<1	5370	0.171	24.8	<2	0.22	3.09	1620	0.883	8.38	5.54	406	<0.2	473	1.41	--	1.92	<5	--	--	93	92.6	<1	--	--	--	--	13.8	**4.45**	133
	01/30/17	0.03	<2	**176**	75.1	<1	6130	<1	24.2	<2	<0.5	2.87	2250	<1	11.8	5.8	487	<0.2	313	1.03	--	1.88	<5	--	--	87.2	95.1	<1	--	--	--	--	17	3.46	168
	02/28/17	<0.03	<2	**199**	66.5	<1	6060	<1	22.1	<2	<0.5	3.35	1820	<1	9.29	5.4	449	<0.2	288	<1	--	1.81	<5	--	--	86	71.1	<1	--	--	--	--	16.9	3.49	164
	03/28/17	0.04	<2	**245**	73.5	<1	5510	<1	20.4	<2	<0.5	2.42	2220	<1	8.03	5.49	428	<0.2	291	<1	--	2.21	<5	--	--	76.7	77.7	<1	--	--	--	--	13.5	3.63	137
	04/18/17	0.04	<2	**197**	63.7	<1	4900	<1	20.9	<2	<0.5	2.54	1940	<1	7.53	4.89	422	<0.2	288	<1	--	1.6	<5	--	--	78.6	75	<1	--	--	--	--	16.4	3.5	153
	05/10/17	<0.03	<2	**234**	71.2	<1	7160	<1	23.4	<2	<0.5	<2	1660	<1	7.65	5.85	490	<0.2	309	<1	--	1.91	<5	--	--	97	78.2	<1	--	--	--	--	15.5	3.09	153
	06/13/17	<0.03	<2	**228**	74.5	<1	6010	<1	23.1	<2	<0.5	2.74	1650	<1	7.87	5.28	453	<0.2	329	<1	--	1.81	<5	--	--	85.1	76	<1	--	--	--	--	16.2	3.6	147
	07/13/17	<0.03	<2	**221**	71.6	<1	5100	<1	24.9	<2	<0.5	<2	2160	<1	7.98	6.09	519	<0.2	340	<1	--	1.83	<5	--	--	86.8	94.8	<1	--	--	--	--	16.2	3.68	152
	07/19/17	<0.03	<2	**298**	82.5	<1	5740	<1	28.3	<2	<0.5	<2	2400	<1	8.12	7.04	565	<0.2	349	<1	--	1.97	<5	--	--	92.6	102	<1	--	--	--	--	15.3	3.67	136
ALF-203	11/16/16	0.18	0.99	**3900**	36.2	0.149	3870	2.56	16.1	2.14	1.44	62.2	1430	**36.2**	4.05	2.28	234	<0.2	284	20.2	--	2.96	6.96	--	--	114	68.3	<1	--	--	--	--	12.6	**5.26**	141
	01/31/17	0.16	<2	**3230**	39.5	<1	5250	2.74	15.8	2.77	1.19	65.8	1750	**42**	6.69	2.22	201	<0.2	267	16.2	--	2.73	5.26	--	--	127	70.2	<1	--	--	--	--	13.6	**4.14**	184
	03/01/17	0.12	<2	**3220**	34.8	<1	5770	2.35	14	<2	1.18	73.2	1330	**36.3**	<5	1.96	165	<0.2	256	16.8	--	2.63	5.49	--	--	125	51.7	<1	--	--	--	--	13.8	**4.97**	188
	03/29/17	0.17	<2	**3620**	32.9	<1	5310	3.55	10.1	2.53	1.49	124	1710	**60.4**	<5	1.41	147	<0.2	270	21.1	--	2.74	10.8	--	--	113	51.5	<1	--	--	--	--	11.9	**5.01**	143
	04/19/17	0.23	<2	**2890**	35.5	<1	4080	3.72	13.1	2.64	1.3	112	1620	**61.3**	<5	1.71	155	<0.2	254	18.7	--	2.39	7.23	--	--	116	53.8	<1	--	--	--	--	14.8	**4.94**	158
	05/09/17	0.17	<2	**3560**	44.8	<1	6830	3.61	14.2	2.27	1.21	90	1370	**63.9**	<5	1.92	185	<0.2	296	15.5	--	2.72	6.44	--	--	145	52.5	<1	--	--	--	--	14.4	**4.53**	152
	06/14/17	0.19	<2	**3370**	36.8	<1	5570	3.02	13.2	2.7	1.12	84.1	1310	**56.8**	<5	1.64	175	<0.2	276	16.4	--	2.55	5.45	--	--	142	45.8	<1	--	--	--	--	15.2	**5.44**	157
	07/14/17	0.17	2.47	**3520**	33.3	<1	5230	2.98	12.2	3.28	1.27	86.4	1510	**55.9**	<5	1.55	146	<0.2	284	19.9	--	2.4	7.98	--	--	135	53.5	<1	--	--	--	--	16	**5.53**	164
	07/19/17	0.16	<2	**4140**	33.6	<1	5410	3.08	12.4	2.99	1.35	89.7	1530	**56.5**	<5	1.52	144	<0.2	307	20.9	--	2.5	7.87	--	--	148	52	<1	--	--	--	--	15.2	**5.26**	153
ALF-204	11/16/16	<0.03	0.16	**46**	358	<1	461	<1	64.6	<2	0.132	1.01	10800	<1	9.92	18.9	1630	<0.2	5.25	0.506	--	4.6	<5	--	--	23.6	359	<1	--	--	--	--	11.4	0.249	9.72
	01/31/17	<0.03	<2	**42.8**	318	<1	659	<1	78.5	<2	<0.5	<2	12000	<1	14	22.2	3300	<0.2	6.93	<1	--	4.57	<5	--	--	41.2	441	<1	--	--	--	--	18	0.224	2.25
	03/01/17	<0.03	<2	**36.8**	332	<1	598	<1	75.8	<2	<0.5	<2	6660	<1	12.7	21.7	3080	<0.2	<5	<1	--	4.59	<5	--	--	42	352	<1	--	--	--	--	19	2.5	<1
	03/29/17	<0.03	<2	**49.9**	296	<1	525	<1	61.4	<2	<0.5	<2	11300	<1	9.49	18.2	3010	<0.2	6.24	<1	--	4.96	<5	--	--	32.3	384	<1	--	--	--	--	15.4	0.283	1.33
	04/19/17	<0.03	<2	**49.1**	300	<1	467	<1	75.2	<2	<0.5	<2	14300	<1	8.94	20.8	2870	<0.2	8.61	<1	--	4.33	<5	--	--	33.1	390	<1	--	--	--	--	17.4	0.289	6.29
	05/09/17	<0.03	<2	**56.9**	332	<1	721	<1	78	<2	<0.5	<2	12700	<1	9.23	22.3	3060	<0.2	9.63	<1	--	4.71	<5	--	--	32.7	380	<1	--	--	--	--	16.6	0.233	16.8
	06/14/17	<0.03	<2	**45.5**	285	<1	534	<1	67.1	<2	<0.5	<2	9600	<1	8.52	18.7	2470	<0.2	9.08	<1	--	4.12	<5	--	--	26.4	323	<1	--	--	--	--	17.3	0.31	13.8
	07/14/17	<0.03	<2	**38.7**	257	<1	551	<1	68.2	<2	<0.5	<2	11100	<1	9.09	19.5	2480	<0.2	7.67	<1	--	4.09	<5	--	--	25.8	376	<1	--	--	--	--	17.5	0.262	13
	07/19/17	<0.03	<2	**47.3**	261	<1	660	<1	72.1	<2	<0.5	<2	11500	<1	8.14	20.8	2550	<0.2	8.2	<1	--	4.22	<5	--	--	27.3	377	<1	--	--	--	--	18.2	0.247	10
ALF-205	11/16/16	0.03	0.3	1.1	106	<1	6990	<1	61.8	<2	0.966	1.64	993	0.088	14.8	11.1	321	<0.2	252	5.95	--	2.3	0.816	--	--	68.6	226	<1	--	--	--	--	15.1	1.9	94.8
	01/31/17	0.16	<2	1.54	83.3	<1	6720	<1	53.3	<2	1.32	<2	601	<1	16.1	9.65	602	<0.2	279	5.76	--	2.31	<5	--	--	76.4	206	<1	--	--	--	--	23.1	2.54	123
	03/01/17	<0.03	<2	1.22	88.5	<1	7460	<1	54.3	<2	1.11	<2	449	<1	14.1	9.78	491	<0.2	299	5.05	--	2.43	<5	--	--	81.9	171	<1	--	--	--	--	23	2.5	125
	03/29/17	<0.03	<2	1.41	78.4	<1	6290	<1	43.9	<2	1.01	<2	350	<1	11.4	7.84	379	<0.2	325	5.03	--	2.62	<5	--	--	74.7	173	<1	--	--	--	--	20.3	2.68	91
	04/18/17	<0.03	<2	1.95	103	<1	5530	<1	61.4	<2	1.06	<2	1430	<1	12.7	10.9	541	<0.2	292	4.63	--	2.43	<5	--	--	77.4	223	<1	--	--	--	--	23.4	2.48	103
	05/09/17	0.15	<2	2.66	131	<1	8810	<1	74.2	<2	1.05	<2	2030	<1	14.5	13.7	708	<0.2	314	4.27	--	2.76	<5	--	--	88.4	249	<1	--	--	--	--	22.2	2.06	94.4
	06/14/17	0.08	<2	1.6	110	<1	7950	<1	62.3	<2	0.903	<2	1010	<1	13.4	11.2	424	<0.2	325	3.94	--	2.47	<5	--	--	76.6	210	<1	--	--	--	--	23.3	2.55	107

Table 1A
Groundwater Chemical Data

Well ID	Date	Metals																															Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	TDEC	-	6	10	2000	4	-	5	-	100	-	-	-	15	-	-	-	2	-	100	10*	-	50	-	100	-	-	2	-	-	-	-	-	4	-
	EPA	-	6	10	2000	4	-	5	-	100	-	1300	-	15	-	-	-	2	-	-	1**	-	50	-	-	-	-	2	-	-	-	-	-	4	-
ALF-205 (cont)	07/13/17	0.05	<2	1.83	100	<1	7470	<1	59.4	<2	1.13	<2	1530	<1	13.2	10.7	421	<0.2	311	4.76	--	2.42	<5	--	--	80.1	226	<1	--	--	--	--	23.1	2.57	108
	07/19/17	<0.03	<2	1.59	91.3	<1	7880	<1	58.1	<2	1.14	<2	882	<1	12.4	10.5	376	<0.2	337	5.15	--	2.45	<5	--	--	87.6	213	<1	--	--	--	--	23.9	2.53	94.7
ALF-206	11/16/16	<0.03	0.23	3.22	241	<1	121	<1	50	<2	0.05	0.954	11200	<1	7.52	13.3	1330	<0.2	2.77	<1	--	2.79	<5	--	--	16	248	<1	--	--	--	--	11.7	0.302	16.2
	01/30/17	<0.03	<2	4.48	245	<1	125	<1	50.2	<2	<0.5	<2	11200	<1	9.31	13.1	1250	<0.2	<5	<1	--	2.85	<5	--	--	15.1	252	<1	--	--	--	--	17.8	0.315	17.1
	02/28/17	<0.03	<2	5.36	232	<1	118	<1	46	<2	<0.5	<2	9770	<1	7.68	12.1	1120	<0.2	<5	<1	--	2.77	<5	--	--	14.6	189	<1	--	--	--	--	17.5	0.24	17.3
	03/29/17	<0.03	<2	5.8	237	<1	93.2	<1	42.5	<2	<0.5	<2	9890	<1	6.42	10.4	1030	<0.2	<5	<1	--	3.07	<5	--	--	13.7	214	<1	--	--	--	--	16.9	0.361	18
	04/18/17	<0.03	<2	4.89	243	<1	87.9	<1	44	<2	<0.5	<2	10300	<1	5.5	11	916	<0.2	<5	<1	--	2.63	<5	--	--	13.4	197	<1	--	--	--	--	18.3	0.355	21.8
	05/09/17	<0.03	<2	6.44	281	<1	131	<1	45.4	<2	<0.5	<2	9630	<1	5.85	12.3	978	<0.2	<5	<1	--	2.85	<5	--	--	15.4	197	<1	--	--	--	--	17.3	0.331	23
	06/13/17	<0.03	<2	5.31	238	<1	103	<1	39.8	<2	<0.5	<2	7250	<1	5.84	9.98	788	<0.2	<5	<1	--	2.6	<5	--	--	13.8	160	<1	--	--	--	--	16.4	0.401	24.3
	07/13/17	<0.03	2.5	5.55	229	<1	113	<1	40	<2	<0.5	<2	9050	<1	6.86	10.3	832	<0.2	<5	<1	--	2.56	<5	--	--	13.7	189	<1	--	--	--	--	16.4	0.372	23.4
	07/19/17	<0.03	<2	7.5	233	<1	178	<1	42.9	<2	<0.5	<2	9590	<1	5.5	11.1	866	<0.2	<5	<1	--	2.63	<5	--	--	14.7	195	<1	--	--	--	--	15.8	0.331	18.2
ALF-207	11/17/16	--	<2	1.59	296	<4	895	<5	195	<2	<50	<10	--	<1	17	--	--	<0.2	29	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	4.29	0.133	84.7
	05/10/17	--	<2	1.93	295	<1	374	<1	158	<2	<0.5	<2	--	<1	16.1	--	--	<0.2	8.34	<1	<0.1	--	<5	--	<1	--	--	<1	--	--	<1	<5	11.2	0.193	54.3
ALF-208	11/17/16	--	<2	7.91	286	<4	16900	<5	344	<2	<50	<10	--	<1	27	--	--	<0.2	1450	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	3.84	0.318	456
	05/11/17	--	<2	9.08	83.1	<1	7950	<1	114	<2	<0.5	<2	--	<1	16.5	--	--	<0.2	1700	<1	<0.1	--	<5	--	<1	--	--	<1	--	--	<1	<5	17.3	0.396	96.8
ALF-209	11/17/16	--	<2	2.62	<200	<4	138	<5	45.8	<2	<50	<10	--	<1	9.16	--	--	<0.2	19.9	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	11.4	0.358	34
ALF-210	11/15/16	<0.03	0.33	9.57	298	<1	80.3	<1	133	<2	2.46	1.17	14500	<1	23.1	31.3	797	<0.2	2.37	2.58	<0.1	2.83	0.687	--	--	3.61	463	<1	--	--	<1	<50	1.14	0.189	5.49
	01/30/17	<0.03	<2	3.46	323	<1	84	<1	137	<2	<0.5	<2	18300	<1	24.6	32.5	1170	<0.2	<5	<1	--	3.2	<5	--	--	3.94	499	<1	--	--	--	--	1.28	0.169	<1
	02/28/17	<0.03	<2	**10.6**	328	<1	<80	<1	137	<2	1.82	<2	20000	<1	23.3	32.8	1400	<0.2	<5	<1	--	3.26	<5	--	--	4.04	426	<1	--	--	--	--	1.11	0.183	5.14
	03/28/17	<0.03	<2	9.24	313	<1	<80	<1	123	<2	0.726	<2	18600	<1	21	34.3	1290	<0.2	<5	<1	--	3.55	<5	--	--	3.67	440	<1	--	--	--	--	1.18	0.216	1.62
	04/18/17	<0.03	<2	3.51	339	<1	<80	<1	132	<2	<0.5	<2	20900	<1	20.4	31.4	1450	<0.2	<5	<1	--	3.4	<5	--	--	4.18	482	<1	--	--	--	--	1.5	0.261	<1
	05/09/17	<0.03	<2	2.93	424	<1	83.1	<1	158	<2	<0.5	<2	18900	<1	23	38.2	1760	<0.2	<5	<1	--	4.17	<5	--	--	5.07	514	<1	--	--	--	--	1.4	0.227	3.08
	06/13/17	<0.03	<2	6.71	361	<1	<80	<1	131	<2	0.97	<2	13100	<1	20.6	31.6	1320	<0.2	<5	<1	--	3.46	<5	--	--	4.28	437	<1	--	--	--	--	1.34	0.287	7.54
	07/13/17	<0.03	<2	6.37	335	<1	83	<1	136	<2	1.05	<2	17800	<1	21.1	32.8	1440	<0.2	<5	<1	--	3.23	<5	--	--	4.92	504	<1	--	--	--	--	1.45	0.279	11.1
	07/18/17	<0.03	<2	7.03	324	<1	80.7	<1	135	<2	1.81	<2	15200	<1	20.7	33.4	1300	<0.2	<5	2.18	--	3.19	<5	--	--	5.13	487	<1	--	--	--	--	1.56	0.208	8.47
ALF-212	11/15/16	<0.03	0.17	**11.6**	273	<1	2770	<1	91.6	<2	0.283	0.72	11000	<1	14.6	23.6	1760	<0.2	38.5	<1	0.117	2.51	<5	--	<5	38.2	363	<1	--	--	<1	<50	10.3	1.63	16
	01/31/17	<0.03	<2	**12.2**	285	<1	3270	<1	102	<2	<0.5	<2	11200	<1	17.7	26.6	1740	<0.2	37.7	<1	--	2.56	<5	--	--	37.9	429	<1	--	--	--	--	20.2	1.42	18.9
	02/28/17	<0.03	<2	**15.4**	305	<1	3060	<1	101	<2	<0.5	<2	12100	<1	16.3	26.7	1900	<0.2	40.8	<1	--	2.71	<5	--	--	40.1	359	<1	--	--	--	--	20	1.42	17.9
	03/28/17	<0.03	<2	**14.5**	286	<1	2210	<1	91.9	<2	<0.5	<2	11300	<1	14.3	22	1750	<0.2	38.8	<1	--	2.84	<5	--	--	36	381	<1	--	--	--	--	17.5	1.19	13.8
	04/18/17	<0.03	<2	8.45	287	<1	2390	<1	96.3	<2	<0.5	<2	12700	<1	14.9	25.2	1600	<0.2	39.6	<1	--	2.24	<5	--	--	35.9	405	<1	--	--	--	--	20.7	1.02	18.1
	05/10/17	<0.03	<2	5.56	324	<1	3760	<1	109	<2	<0.5	<2	11900	<1	17.2	29.5	1490	<0.2	45.6	<1	--	2.5	<5	--	--	42.8	427	<1	--	--	--	--	20.3	0.656	22.2
	06/13/17	<0.03	<2	7.93	303	<1	3050	<1	99.2	<2	<0.5	<2	10300	<1	15.8	25.7	1420	<0.2	40.8	<1	--	2.43	<5	--	--	38.8	381	<1	--	--	--	--	21	0.842	19.4
	07/13/17	<0.03	<2	8.85	305	<1	2800	<1	105	<2	<0.5	<2	13700	<1	14.7	27.8	1820	<0.2	43.9	<1	--	2.48	<5	--	--	42.7	447	<1	--	--	--	--	21.3	0.982	24.6
	07/19/17	<0.03	<2	**12.3**	299	<1	3300	<1	105	<2	<0.5	<2	13100	<1	14.8	27.6	1770	<0.2	47.4	<1	--	2.49	<5	--	--	42.1	427	<1	--	--	--	--	21.8	0.961	20.2
ALF-213	11/16/16	<0.03	0.18	**31.6**	211	<1	189	<1	55.1	<2	0.265	0.663	16000	<1	10.3	17.1	1800	<0.2	5.18	<1	--	3.07	<5	--	--	26.6	323	<1	--	--	--	--	11.7	0.239	2.48
	01/31/17	<0.03	<2	**16.4**	174	<1	201	<1	46	<2	<0.5	<2	14800	<1	11.7	14.3	1560	<0.2	<5	<1	--	2.91	<5	--	--	19.5	266	<1	--	--	--	--	15.8	0.422	20.1
	02/28/17	<0.03	<2	**15.1**	172	<1	199	<1	43	<2	<0.5	<2	13300	<1	10.3	13.4	1400	<0.2	<5	<1	--	2.94	<5	--	--	20.8	199	<1	--	--	--	--	16.3	0.272	26
	03/28/17	<0.03	<2	**11.4**	165	<1	150	<1	35.6	<2	<0.5	<2	12000	<1	7.62	11.2	1110	<0.2	<5	<1	--	3.18	<5	--	--	16.4	187	<1	--	--	--	--	13.5	0.479	22.5
	04/18/17	<0.03	<2	7.99	201	<1	159	<1	37.8	<2	<0.5	<2	13000	<1	7.71	11.1	1050	<0.2	<5	<1	--	2.85	<5	--	--	15.8	176	<1	--	--	--	--	16.2	0.518	27.6
	05/10/17	<0.03	<2	7.53	259	<1	207	<1	37.9	<2	<0.5	<2	11300	<1	8.19	12.3	1020	<0.2	<5	<1	--	3.15	<5	--	--	17.9	163	<1	--	--	--	--	15.6	0.474	29.8
	06/13/17	<0.03	<2	7.03	255	<1	189	<1	35.5	<2	<0.5	<2	10500	<1	7.57	10.9	855	<0.2	<5	<1	--	2.86	<5	--	--	16.3	145	<1	--	--	--	--	16.1	0.555	31.4
	07/13/17	<0.03	<2	8.4	272	<1	291	<1	37.7	<2	<0.5	<2	13600	<1	8.23	11.5	946	<0.2	<5	<1	--	2.9	<5	--	--	16.6	179	<1	--	--	--	--	15.9	0.508	29.6

Well ID	Date	Metals																															Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	TDEC	-	6	10	2000	4	-	5	-	100	-	-	-	15	-	-	-	2	-	100	10*	-	50	-	100	-	-	2	-	-	-	-	-	4	-
	EPA	-	6	10	2000	4	-	5	-	100	-	1300	-	15	-	-	-	2	-	-	1**	-	50	-	-	-	-	2	-	-	-	-	-	4	-
ALF-213 (cont.)	07/19/17	<0.03	<2	**12.7**	279	<1	189	<1	42.8	<2	<0.5	<2	14800	<1	7.35	13.2	1080	<0.2	<5	<1	--	3.13	<5	--	--	19.2	197	<1	--	--	--	--	15.5	0.444	23.7
ALF-MLS1	03/02/88	--	--	--	--	--	--	--	--	--	--	--	17000	--	<10	--	470	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	35
	01/09/89	<0.05	--	--	670	--	1100	--	92	--	--	<10	18000	--	--	25	480	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	96
	03/20/89	<0.05	--	--	590	--	830	--	85	--	--	<10	15000	--	--	22	410	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	92
	05/30/89	<0.05	--	--	710	--	840	--	100	--	--	<10	17000	--	--	25	460	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	30
	02/26/90	<0.05	--	--	560	--	600	--	95	--	--	<10	16000	--	--	23	470	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--	--	24
	05/07/90	<0.05	--	--	630	--	650	--	99	--	--	10	17000	--	--	24	460	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	31
ALF-MLS2	03/20/89	0.15	--	--	450	--	<500	--	62	--	--	<10	5500	--	--	20	270	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	49
	02/26/90	<0.05	--	--	220	--	<500	--	46	--	--	<10	6000	--	--	12	200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--	--	74
ALF-MLS3	03/20/89	<0.05	--	--	60	--	<500	--	27	--	--	<10	520	--	--	8	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	31
	02/27/90	<0.05	--	--	270	--	<500	--	81	--	--	10	11000	--	--	24	400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	140
ALF-MLS4	03/02/88	--	--	--	--	--	--	--	--	--	--	--	1600	--	<10	--	120	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30
	01/10/89	<0.05	--	--	570	--	<500	--	100	--	--	20	27000	--	--	21	410	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	170
	03/21/89	<0.05	--	--	190	--	<500	--	36	--	--	<10	10000	--	--	8.2	200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	27
	05/30/89	<0.05	--	--	160	--	<500	--	36	--	--	50	7500	--	--	6.8	150	--	--	--	--	--	--	--	--	--	--	--	--	--	--	90	--	--	29
	02/27/90	<0.05	--	--	330	--	<500	--	56	--	--	<10	14000	--	--	13	320	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	110
	05/07/90	<0.05	--	--	190	--	<500	--	31	--	--	40	8200	--	--	7.7	160	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	6
ALF-MLS5	03/02/88	--	--	--	--	--	--	--	--	--	--	--	23000	--	<10	--	810	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
	01/10/89	<0.05	--	--	370	--	<500	--	56	--	--	<10	17000	--	--	20	620	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	64
	03/21/89	<0.05	--	--	630	--	<500	--	68	--	--	<10	23000	--	--	22	1100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	49
	05/31/89	<0.05	--	--	450	--	<500	--	52	--	--	<10	18000	--	--	16	820	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	--	--	18
	02/27/90	<0.05	--	--	240	--	700	--	78	--	--	<10	7600	--	--	27	370	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<10	--	--	210
	05/07/90	<0.05	--	--	250	--	<500	--	28	--	--	<10	10000	--	--	8.8	410	--	--	--	--	--	--	--	--	--	--	--	--	--	--	110	--	--	32
ALF-P1	03/02/88	<0.05	--	4	650	--	<500	0.3	130	<1	--	<10	12000	<1	<10	29	580	--	--	<1	--	--	<1	--	--	5.6	--	--	--	--	--	50	--	--	31
	06/08/88	<0.05	--	2	590	--	<500	0.2	130	<1	--	<10	15000	1	20	30	600	--	<20	<1	--	--	<1	--	--	3.9	460	--	--	<5	<10	<10	--	--	26
	01/09/89	<0.05	--	3	550	--	<500	<0.1	150	<1	--	<10	17000	--	1500	32	660	--	--	<1	--	3.7	<1	20000	--	5	520	--	--	21	--	<10	3	--	32
	03/20/89	<0.05	--	2	550	--	<500	<0.1	130	2	--	<10	15000	--	17	28	510	--	--	<1	--	3.5	<1	24000	--	4.3	500	--	--	<5	--	<10	2	--	27
	05/30/89	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/23/89	0.26	--	3	610	--	<500	0.2	120	<1	--	20	22000	--	28	37	770	--	--	<1	--	3.9	<1	21000	--	5.5	570	--	--	27	--	20	2	--	38
	11/27/89	<0.05	--	1	550	--	<500	0.2	160	<1	--	<10	19000	--	27	37	750	--	--	2	--	3.7	<1	10000	--	4.7	570	--	--	8	--	<10	2	--	44
	02/26/90	<0.05	--	2	490	--	<500	<0.1	150	<1	--	<10	18000	--	20	31	630	--	--	1	--	3.5	<1	21000	--	4.5	440	--	--	8	--	10	3	--	28
	05/07/90	0.26	--	4	480	--	<500	2	150	10	--	<10	20000	3	20	31	670	--	--	7	--	3.5	<1	21000	--	6.1	480	--	--	38	--	380	2	--	24
	08/06/90	0.06	--	2	510	--	<500	2	150	<1	--	50	17000	--	20	36	750	--	--	14	--	3.6	2	20000	--	4.7	530	--	--	13	--	50	2	--	54
	11/13/90	<0.05	--	<1	520	--	<500	0.3	150	<1	--	<10	19000	--	30	32	730	--	--	<1	--	3.8	<1	19000	--	4.9	530	--	--	<5	--	<10	2	--	57
	02/19/91	<0.05	--	1	530	--	<500	0.8	150	<1	--	10	21000	3	20	33	690	--	--	5	--	3.4	<1	20000	--	4.6	510	--	--	<5	--	10	3	--	24
	05/28/91	<0.05	--	<1	500	--	<500	<0.1	160	2	--	<10	20000	1	20	33	720	--	--	<1	--	3.4	2	24000	--	4.5	530	--	--	<5	--	70	3	--	46
	08/19/91	0.27	--	**81**	480	--	<500	1	150	4	--	<10	19000	<1	20	33	750	--	--	3	--	3.7	<1	22000	--	4.5	520	--	--	8	--	40	3	--	48
	11/12/91	<0.05	--	2	480	--	<500	<0.1	140	<1	--	10	20000	2	20	36	720	--	<20	4	0.01	3.9	<1	11000	--	5	630	--	--	--	<10	30	3	--	62
	02/11/92	<0.05	--	2	470	--	<500	0.2	150	<1	--	<10	18000	2	21	32	660	--	<20	3	<0.11	3.7	<1	23000	--	4.8	510	--	--	--	--	<10	3	--	44
	05/27/92	0.14	--	<1	460	--	<500	1	140	2	--	290	19000	<1	10	32	650	--	<20	<1	<0.01	3.8	<1	22000	--	4.9	500	--	--	--	--	<10	2	--	46
	08/25/92	<0.05	--	2	450	--	<500	<0.1	130	<1	--	130	17000	<1	20	29	640	--	<20	2	<0.21	3.7	<1	21000	--	4.9	430	--	--	--	--	<10	2	--	32
	11/16/92	0.12	<1	2	490	<1	<500	<0.1	150	2	--	170	19000	<1	20	32	720	--	<20	<1	0.03	3.8	--	--	--	4.9	500	--	--	--	--	120	3	--	44

Stantec

Table 1A
Groundwater Chemical Data

Well ID	Date	Metals																															Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	**TDEC**	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**-**	**-**	**15**	**-**	**-**	**-**	**2**	**-**	**100**	**10***	**-**	**50**	**-**	**100**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
	EPA	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**1300**	**-**	**15**	**-**	**-**	**-**	**2**	**-**	**-**	**1****	**-**	**50**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
ALF-P1 (cont)	02/17/93	0.1	<1	1	150	<1	<500	0.2	160	<1	--	<10	21000	1	30	35	720	<0.2	<20	2	<0.02	3.7	<1	7400	<10	4.8	90	<50	<50	--	<10	<10	4	0.2	50
	05/04/93	<0.05	<1	<1	470	<1	<500	<0.1	150	<1	--	<10	20000	<1	20	31	640	--	<20	<1	0.06	3.6	<1	--	--	4.8	510	--	--	--	--	<10	3	--	52
	11/01/93	<0.05	<1	<1	550	<1	<500	1	160	<1	--	<10	20000	<1	20	34	690	--	<20	<1	--	3.9	<1	--	--	5	590	--	--	--	--	<10	3	--	87
	05/23/94	<0.05	<1	1	570	<1	<500	0.1	180	<1	--	<10	21000	<1	20	38	780	--	<20	1	--	3.9	--	--	<10	4.8	590	--	--	--	--	<10	3	--	57
	11/28/94	<0.05	<1	2	540	<1	<500	<0.1	160	<1	--	<10	21000	<1	39	34	740	--	<20	<1	--	3.7	--	--	--	4.8	550	--	--	--	--	<10	2	--	50
	05/03/95	0.05	<1	2	430	<1	<500	<0.1	150	--	--	<10	20000	<1	--	34	740	--	--	--	--	3.5	--	--	--	5	550	--	--	--	--	<10	2	--	66
	11/02/95	<0.05	<1	1	540	<1	<500	0.1	150	--	--	<10	20000	<1	--	33	710	--	--	--	--	3.8	--	--	--	4.8	510	--	--	--	--	<10	5	--	62
	05/14/96	<0.05	<1	2	540	<1	<500	<0.1	170	--	--	<10	20000	<1	--	36	710	--	--	--	--	3.7	--	--	--	4.9	570	--	--	--	--	<10	2	--	79
	11/06/96	<0.05	<1	2	470	<1	<500	<0.1	84	--	--	<10	20000	<1	--	3.8	740	--	--	--	--	3.8	--	--	--	4.9	520	--	--	--	--	<10	2	--	40
	11/10/97	0.06	<1	<1	530	<1	<500	<0.1	140	--	--	<10	21000	<1	--	32	770	--	--	--	--	3.9	--	--	--	4.9	480	--	--	--	--	<10	3	--	46
	02/15/00	<0.05	<1	2.2	500	<1	<200	<0.1	130	--	--	<10	19000	<1	--	30	780	--	<20	--	--	3.8	--	32000	<10	4.6	490	--	<50	<5	<10	<10	10	--	19
	02/21/02	<0.05	<1	<1	560	<1	<200	<0.1	140	--	--	<10	22000	<1	--	32	720	--	--	--	<0.01	2.9	--	--	--	3.8	500	--	--	--	--	14	2.3	--	25
	03/17/04	<0.05	<0.6	1.4	600	<1	<200	0.05	140	<0.5	<0.5	<10	23000	<0.1	--	31	710	<0.1	<20	2.8	<0.01	1.7	<0.2	--	<10	1.8	500	<0.1	<50	<5	<10	<10	2.2	0.23	11
	02/07/06	<0.2	<3	1	590	<1	<200	<0.1	160	<1	<1	<10	21000	<1	--	37	780	<0.1	<20	<1	<0.01	4	<1	--	<10	5	590	<2	--	--	<10	<10	2.3	0.26	43
	02/28/08	<0.1	<1	1.7	560	<2	<200	<0.5	150	1.8	<1	<1	21000	<1	--	35	720	<0.2	<5	2.3	<0.1	4	<1	--	<0.5	4.8	620	<1	--	--	<10	16	1.8	0.3	20
	02/16/11	<0.1	<1	1.2	500	<1	<200	<0.5	140	<1	<1	<1	19000	<1	--	34	670	<0.2	<2	<1	0.17	3.4	<1	--	<0.5	4.2	480	<1	--	--	<2	22	1.4	0.18	8
	08/23/11	<0.1	<1	2.1	450	<1	<200	<0.5	130	<1	<1	<1	16000	<1	--	32	580	<0.2	<2	1.5	<0.1	3.4	<1	--	<0.5	3.9	460	<1	--	--	<2	<10	1.5	0.18	6
	01/31/12	<0.1	<1	1.3	480	<1	<200	<0.5	130	<1	<1	<1	17000	<1	--	32	590	<0.2	<2	2.8	<0.1	3.7	<1	--	<0.5	4.2	470	<1	--	--	<2	<10	1.4	0.26	5.1
	08/07/12	--	<1	1.3	520	<1	--	<0.5	--	<1	--	--	--	<1	--	--	--	<0.2	--	2	<0.1	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	0.25	--
	02/12/13	--	<1	1.6	510	<2	--	<0.5	--	3.1	--	--	--	<1	--	--	--	<0.2	--	2.9	--	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	0.2	--
	08/21/13	--	<1	1.6	519	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	03/25/14	--	<1	1.6	503	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	08/12/14	--	<1	1.3	488	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	<20
	05/23/16	--	<2	2	655	<4	71.4	2.4	141	<2	<10	<10	--	<2	<50	--	--	<0.2	<2	<10	<0.1	--	<10	--	<10	--	--	<10	--	--	<4	<50	1.39	0.209	8.5
	11/15/16	--	<2	<1	484	<4	64.8	<5	132	<2	<50	<10	--	<1	21	--	--	<0.2	<5	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	1.53	0.173	4.66
	05/10/17	--	<2	<1	427	<1	<80	<1	145	<2	<0.5	<2	--	<1	22.5	--	--	<0.2	<5	<1	<0.1	--	<5	--	<1	--	--	<1	--	--	<1	<5	1.43	0.22	9.4
ALF-P2	03/03/88	<0.05	--	**11**	270	--	1200	0.4	130	<1	--	<10	12000	<1	<10	29	660	--	--	<1	--	--	<1	--	--	59	--	--	--	--	--	10	--	--	160
	06/08/88	<0.05	--	10	290	--	1400	0.1	140	6	--	<10	15000	<1	19	36	750	--	<20	<1	--	--	<1	--	--	41	480	--	--	<5	<10	<10	--	--	360
	01/09/89	0.09	--	**13**	240	--	870	<0.1	110	<1	--	20	11000	--	1200	27	560	--	--	<1	--	5.1	<1	14000	--	44	400	--	--	16	--	<10	8	--	130
	03/20/89	<0.05	--	10	130	--	<500	<0.1	62	2	--	<10	6800	--	<10	16	330	--	--	<1	--	3.3	<1	12000	--	17	210	--	--	5	--	<10	5	--	39
	05/30/89	<0.05	--	9	120	--	520	0.1	66	3	--	20	6400	--	<10	15	310	--	--	1	--	3.5	<1	20000	--	23	230	--	--	<5	--	<10	10	--	8
	08/23/89	0.2	--	9	310	--	1000	0.2	120	<1	--	10	14000	--	23	39	840	--	--	<1	--	6	<1	16000	--	62	470	--	--	15	--	<10	13	--	220
	11/27/89	0.09	--	**14**	320	--	840	<0.1	160	1	--	<10	16000	--	19	38	870	--	--	1	--	5.9	<1	7500	--	54	470	--	--	11	--	80	14	--	240
	02/26/90	<0.05	--	8	150	--	570	0.1	67	<1	--	<10	6900	--	<10	16	370	--	--	<1	--	3.6	<1	11000	--	33	170	--	--	7	--	<10	16	--	87
	05/07/90	0.12	--	**12**	230	--	910	<0.1	110	<1	--	<10	11000	<1	20	25	590	--	--	5	--	4.6	<1	14000	--	50	390	--	--	30	--	60	12	--	200
	08/06/90	0.36	--	**11**	250	--	1100	4	110	2	--	60	11000	--	10	28	650	--	--	7	--	5.1	<1	14000	--	52	360	--	--	32	--	30	16	--	160
	11/13/90	0.37	--	**12**	340	--	1200	<0.1	170	<1	--	<10	17000	--	20	38	900	--	--	2	--	6.7	<1	15000	--	68	510	--	--	<5	--	<10	22	--	350
	02/19/91	<0.05	--	**11**	170	--	760	0.1	84	<1	--	10	8900	<1	20	21	510	--	--	2	--	4.6	<1	13000	--	66	250	--	--	<5	--	<10	13	--	21
	05/28/91	0.09	--	8	250	--	980	0.1	120	5	--	<10	13000	<1	10	29	720	--	--	<1	--	5.3	2	14000	--	68	350	--	--	<5	--	<10	20	--	200
	08/19/91	<0.05	--	**38**	290	--	1500	0.3	170	3	--	<10	16000	<1	20	40	900	--	--	2	--	6.7	2	16000	--	80	480	--	--	7	--	<10	21	--	350
	11/12/91	<0.05	--	**12**	240	--	1000	<0.1	140	<1	--	<10	15000	2	20	36	780	--	30	2	0.02	5.8	<1	8200	--	44	550	--	--	--	<10	10	14	--	260
	02/11/92	<0.05	--	**13**	250	--	<500	<0.1	150	<1	--	<10	14000	<1	17	35	790	--	<20	5	<0.11	5.9	<1	15000	--	51	460	--	--	--	--	<10	17	--	240
	05/26/92	0.06	--	10	230	--	1500	<0.1	160	6	--	150	15000	<1	13	36	790	--	<20	0.4	<0.01	6.9	<1	16000	--	93	450	--	--	--	--	<10	21	--	360

Well ID	Date	Metals																															Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	**TDEC**	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**-**	**-**	**15**	**-**	**-**	**-**	**2**	**-**	**100**	**10***	**-**	**50**	**-**	**100**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
	EPA	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**1300**	**-**	**15**	**-**	**-**	**-**	**2**	**-**	**-**	**1****	**-**	**50**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
ALF-P2 (cont)	08/25/92	<0.05	--	10	220	--	1000	<0.1	150	<1	--	<10	12000	2	20	34	840	--	<20	1	<0.21	6.4	<1	16000	--	46	420	--	--	--	--	<10	15	--	270
	11/16/92	<0.05	<1	**14**	270	<1	1200	<0.1	180	<1	--	140	18000	<1	<10	42	980	--	<20	<1	<0.01	6.2	--	--	--	48	500	--	--	--	--	40	15	--	360
	05/04/93	<0.05	<1	9	130	<1	<500	<0.1	83	2	--	<10	8600	<1	<10	1700	460	--	<20	<1	0.18	4	<1	--	--	22	220	--	--	--	--	<10	14	--	54
	11/01/93	<0.05	<1	7	130	<1	<500	1	73	<1	--	<10	7300	<1	<10	17	410	--	<20	<1	--	3.9	<1	--	--	25	240	--	--	--	--	<10	13	--	60
	05/23/94	<0.05	<1	**11**	190	<1	<500	<0.1	110	<1	--	<10	11000	<1	10	25	680	--	<20	<1	--	4.6	--	--	<10	50	320	--	--	--	--	<10	13	--	110
	11/28/94	0.07	<1	**12**	270	<1	1100	<0.1	150	<1	--	<10	14000	<1	36	34	830	--	20	<1	--	5.9	--	--	--	57	460	--	--	--	--	<10	17	--	200
	05/03/95	0.07	<1	**14**	200	<1	900	<0.1	130	--	--	<10	13000	<1	--	31	740	--	--	--	--	5.7	--	--	--	64	400	--	--	--	--	<10	18	--	210
	11/02/95	<0.05	<1	**12**	300	<1	1100	<0.1	160	--	--	<10	16000	<1	--	38	930	--	--	--	--	6.4	--	--	--	57	500	--	--	--	--	<10	17	--	290
	05/14/96	<0.05	<1	10	140	<1	<500	<0.1	83	--	--	<10	8600	<1	--	20	500	--	--	--	--	4	--	--	--	33	250	--	--	--	--	<10	16	--	33
	11/06/96	<0.05	<1	**12**	260	<1	600	<0.1	82	--	--	<10	16000	<1	--	3.8	870	--	--	--	--	5.7	--	--	--	59	500	--	--	--	--	<10	18	--	240
	11/10/97	0.14	<1	**12**	300	<1	570	<0.1	170	--	--	<10	18000	<1	--	38	1000	--	--	--	--	6.6	--	--	--	50	480	--	--	--	--	<10	17	--	210
	02/15/00	<0.05	<1	**13**	300	<1	950	<0.1	160	--	--	<10	17000	<1	--	40	1100	--	<20	--	--	7.2	--	26000	<10	30	550	--	<50	<5	<10	<10	13	--	120
	02/21/02	<0.05	<1	9.3	150	<1	350	<0.1	90	--	--	<10	11000	<1	--	22	640	--	--	--	<0.01	3.1	--	--	--	16	270	--	--	--	--	13	12	--	63
	03/17/04	<0.05	<0.6	8.1	160	<1	<200	0.05	77	<0.1	<0.1	<10	9900	0.5	--	18	560	<0.1	<20	1.7	<0.01	0.7	<0.2	--	<10	12	240	<0.1	<50	<5	<10	<10	17	0.2	59
	02/07/06	<0.2	<3	**14**	320	<1	500	<0.1	140	<1	<1	<10	19000	<1	--	32	930	<0.1	<20	<1	<0.01	5.9	<1	--	<10	38	460	<2	--	--	<10	<10	25	0.22	85
	02/28/08	<0.1	<1	10	190	<2	220	<0.5	75	1	<1	<1	12000	<1	--	18	620	<0.2	6.4	1.7	0.11	3.2	<1	--	<0.5	17	280	<1	--	--	<10	<10	20	0.18	52
	08/21/13	--	<1	9	135	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	03/25/14	--	<1	9.1	159	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	08/12/14	--	<1	9.6	204	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	05/24/16	--	<2	8.34	170	<4	307	<1	86	<2	<10	<10	--	<2	<50	--	--	<0.2	6.78	<10	<0.1	--	<10	--	<5	--	--	<10	--	--	<4	<50	12.2	0.168	45.6
	11/16/16	--	<2	**10.9**	378	<4	739	<5	161	<2	<50	<10	--	<1	17.6	--	--	<0.2	10.3	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	12	0.15	95.8
	05/10/17	--	2.04	8.38	165	<1	413	<1	75	<2	<0.5	<2	--	<1	11.5	--	--	<0.2	7.09	<1	<0.1	--	<5	--	<1	--	--	<1	--	--	<1	<5	16.1	0.211	44.8
ALF-P3	03/02/88	<0.05	--	5	200	--	<500	0.1	47	<1	--	<10	3700	<1	<10	13	180	--	--	<1	--	--	<1	--	--	9.4	--	--	--	--	--	<10	--	--	21
	06/08/88	0.06	--	3	310	--	<500	<0.1	71	3	--	<10	7300	<1	<10	23	310	--	<20	<1	--	--	<1	--	--	9	210	--	--	<5	<10	<10	--	--	58
	01/10/89	0.14	--	3	260	--	<500	<0.1	91	<1	--	10	9600	--	960	31	450	--	--	3	--	3.2	<1	8100	--	9.9	290	--	--	15	--	<10	12	--	96
	03/20/89	0.1	--	2	100	--	<500	<0.1	28	<1	--	<10	3500	--	<10	9.3	120	--	--	<1	--	1.7	<1	5800	--	6.2	80	--	--	10	--	<10	5	--	24
	05/30/89	<0.05	--	2	90	--	<500	<0.1	30	4	--	<10	3400	--	<10	10	100	--	--	<1	--	1.6	<1	5500	--	7	80	--	--	<5	--	<10	4	--	48
	08/23/89	0.67	--	4	130	--	<500	0.1	41	<1	--	10	5500	--	<10	13	170	--	--	<1	--	2	<1	8700	--	8.1	120	--	--	26	--	10	6	--	34
	11/27/89	0.38	--	3	140	--	<500	0.5	45	2	--	<10	6300	--	<10	16	200	--	--	2	--	2	<1	3300	--	7.3	90	--	--	16	--	10	5	--	30
	02/27/90	<0.05	--	3	180	--	<500	0.2	56	<1	--	<10	6400	--	<10	19	280	--	--	1	--	2.1	<1	5600	--	7	170	--	--	12	--	10	16	--	82
	05/07/90	0.07	--	4	180	--	<500	0.1	50	<1	--	10	9500	<1	<10	16	240	--	--	<1	--	1.8	<1	6000	--	8.5	140	--	--	31	--	330	10	--	63
	08/06/90	0.25	--	2	130	--	<500	2	40	1	--	50	3900	--	<10	14	160	--	--	2	--	1.8	<1	5300	--	6.5	120	--	--	13	--	20	10	--	30
	11/13/90	0.14	--	2	100	--	<500	0.3	36	<1	--	<10	2200	--	10	12	87	--	--	3	--	1.9	1	5300	--	5.2	90	--	--	<5	--	<10	6	--	32
	02/19/91	0.08	--	2	90	--	<500	0.2	31	<1	--	<10	3800	1	<10	11	130	--	--	1	--	1.5	<1	5600	--	5.5	70	--	--	<5	--	<10	7	--	120
	05/28/91	0.06	--	<1	110	--	<500	<0.1	34	<1	--	<10	3900	3	<10	12	160	--	--	<1	--	1.6	2	5100	--	5.4	70	--	--	<5	--	<10	8	--	27
	08/19/91	0.23	--	**22**	180	--	<500	0.2	64	1	--	<10	7200	<1	<10	21	300	--	--	2	--	2.3	<1	7700	--	7.9	160	--	--	33	--	<10	10	--	52
	11/12/91	0.08	--	2	300	--	<500	<0.1	100	<1	--	<10	12000	2	10	31	500	--	<20	1	0.02	3.1	<1	4800	--	11	120	--	--	--	<10	10	13	--	100
	02/11/92	1.7	--	4	270	--	<500	<0.1	76	1	--	<10	11000	3	<10	25	410	--	<20	4	<0.11	2.8	<1	11000	--	7.9	200	--	--	--	--	<10	13	--	64
	05/26/92	0.18	--	2	160	--	<500	0.2	59	2	--	80	7000	<1	<10	19	260	--	<20	<1	<0.01	2.4	4	7400	--	6.4	120	--	--	--	--	<10	16	--	52
	08/25/92	0.08	--	2	190	--	<500	<0.1	62	2	--	<10	6800	<1	<10	20	300	--	<20	2	<0.21	2.6	<1	7000	--	6.9	150	--	--	--	--	<10	15	--	52
	11/16/92	0.1	<1	2	270	<1	<500	<0.1	87	<1	--	120	9800	<1	<10	26	410	--	<20	<1	0.01	2.9	--	--	--	8.5	190	--	--	--	--	30	13	--	70
	05/04/93	0.1	<1	2	130	<1	<500	0.6	42	2	--	<10	5800	<1	<10	12	210	--	<20	2	0.07	2.1	<1	--	--	10	110	--	--	--	--	20	15	--	40

Table 1A
Groundwater Chemical Data

Well ID	Date	Metals																															Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	TDEC	-	6	10	2000	4	-	5	-	100	-	-	-	15	-	-	-	2	-	100	10*	-	50	-	100	-	-	2	-	-	-	-	-	4	-
	EPA	-	6	10	2000	4	-	5	-	100	-	1300	-	15	-	-	-	2	-	-	1**	-	50	-	-	-	-	2	-	-	-	-	-	4	-
ALF-P3 (cont)	11/01/93	<0.05	<1	1	190	<1	<500	1	53	<1	--	<10	6000	<1	<10	17	260	--	<20	<1	--	2.4	<1	--	--	13	100	--	--	--	--	<10	12	--	35
	05/23/94	0.14	<1	7	160	<1	<500	0.1	40	<1	--	<10	9100	1	<10	13	220	--	<20	<1	--	2.3	--	--	<10	6.4	70	--	--	--	--	<10	11	--	27
	11/28/94	0.05	<1	2	290	<1	<500	<0.1	84	<1	--	<10	9600	<1	25	28	430	--	<20	6	--	2.9	--	--	--	10	200	--	--	--	--	<10	13	--	55
	05/03/95	<0.05	<1	4	170	<1	<500	<0.1	56	--	--	<10	7100	1	--	21	300	--	--	--	--	3.1	--	--	--	9	120	--	--	--	--	<10	12	--	51
	11/02/95	<0.05	<1	2	230	<1	<500	<0.1	68	--	--	<10	7600	<1	--	23	350	--	--	--	--	2.8	--	--	--	9.2	190	--	--	--	--	<10	14	--	54
	05/14/96	<0.05	<1	3	140	<1	<500	<0.1	42	--	--	<10	4900	<1	--	15	220	--	--	--	--	2.3	--	--	--	9.2	100	--	--	--	--	<10	22	--	39
	11/06/96	<0.05	<1	2	160	<1	<500	<0.1	28	--	--	<10	5400	<1	--	2.1	240	--	--	--	--	2.2	--	--	--	7	120	--	--	--	--	<10	15	--	38
	11/10/97	0.09	<1	2	210	<1	<500	<0.1	60	--	--	<10	6600	4	--	20	330	--	--	--	--	3.2	--	--	--	12	120	--	--	--	--	<10	15	--	38
	02/15/00	0.07	<1	**15**	350	<1	<200	<0.1	63	--	--	<10	23000	<1	--	21	480	--	<20	--	--	3.4	--	15000	<10	10	160	--	<50	<5	<10	10	13	--	57
	02/21/02	<0.05	<1	4.9	220	<1	<200	<0.1	53	--	--	<10	7600	<1	--	19	370	--	--	--	<0.01	2.8	--	--	--	13	120	--	--	--	--	14	13	--	52
	03/17/04	<0.05	<0.6	3.9	240	<1	<200	<0.05	56	<0.1	<0.1	<10	7500	<0.1	--	17	400	<0.1	<20	1.6	<0.01	1	<0.2	--	<10	5.4	120	<0.1	<50	<5	<10	<10	16	0.15	45
	02/07/06	0.12	<3	**13**	500	<1	<200	0.1	100	<1	<1	<10	25000	1	--	30	1400	<0.1	<20	<1	<0.01	4.7	<1	--	<10	14	230	<2	--	--	<10	<10	14	0.19	66
	02/28/08	<0.1	<1	3.6	190	<2	<200	<0.5	48	<1	<1	<1	5100	<1	--	15	370	<0.2	<5	1.1	<0.1	3.1	<1	--	<0.5	14	110	<1	--	--	<10	<10	19	0.11	42
ALF-P4	03/02/88	<0.05	--	5	230	--	<500	0.2	60	<1	--	<10	4200	<1	<10	14	400	--	--	<1	--	--	<1	--	--	14	--	--	--	--	--	<10	--	--	32
	06/08/88	<0.05	--	5	370	--	<500	<0.1	99	2	--	<10	9500	1	<10	24	580	--	<20	<1	--	--	<1	--	--	22	350	--	--	<5	<10	<10	--	--	87
	01/10/89	0.56	--	5	360	--	<500	<0.1	110	<1	--	<10	13000	--	1100	27	600	--	--	<1	--	4.1	<1	10000	--	22	360	--	--	22	--	20	10	--	110
	03/21/89	0.15	--	1	70	--	<500	<0.1	26	<1	--	<10	2800	--	<10	6.9	120	--	--	<1	--	1.5	<1	5900	--	6.3	80	--	--	14	--	<10	4	--	23
	05/30/89	0.05	--	1	110	--	<500	<0.1	39	<1	--	<10	3700	--	<10	9.9	220	--	--	<1	--	1.7	<1	6700	--	7.7	150	--	--	16	--	20	4	--	27
	08/23/89	0.19	--	3	140	--	<500	0.1	45	<1	--	<10	4400	--	<10	11	280	--	--	<1	--	2.2	<1	7800	--	11	170	--	--	14	--	<10	6	--	37
	11/28/89	0.05	--	2	260	--	<500	<0.1	83	1	--	<10	7100	--	14	20	580	--	--	1	--	3.2	<1	4400	--	15	240	--	--	9	--	<10	11	--	77
	02/27/90	<0.05	--	2	110	--	<500	0.1	36	<1	--	<10	3700	--	<10	9.5	220	--	--	<1	--	1.8	<1	5700	--	9.8	110	--	--	<5	--	<10	9	--	42
	05/07/90	<0.05	--	2	90	--	<500	0.2	29	<1	--	<10	3700	<1	<10	7.8	230	--	--	<1	--	1.8	<1	6100	--	13	110	--	--	23	--	140	8	--	34
	08/06/90	0.19	--	2	130	--	<500	2	43	<1	--	40	3000	--	<10	12	280	--	--	4	--	2.3	<1	6400	--	12	220	--	--	13	--	20	11	--	29
	11/13/90	0.22	--	2	110	--	<500	0.1	33	<1	--	<10	3000	--	<10	8.8	120	--	--	<1	--	2	<1	6400	--	11	100	--	--	<5	--	<10	6	--	28
	02/19/91	0.51	--	4	90	--	<500	<0.1	28	<1	--	10	3400	3	<10	7.6	240	--	--	4	--	1.8	<1	8300	--	6	80	--	--	<5	--	<10	7	--	23
	05/28/91	0.1	--	2	90	--	<500	0.3	32	<1	--	<10	3700	<1	<10	7.9	260	--	--	<1	--	1.6	<1	6200	--	5.8	100	--	--	<5	--	50	8	--	26
	08/19/91	<0.05	--	**18**	150	--	<500	0.2	50	1	--	<10	5200	<1	<10	13	420	--	--	1	--	2.5	<1	8100	--	11	150	--	--	10	--	<10	9	--	44
	11/12/91	<0.05	--	3	280	--	<500	<0.1	160	<1	--	<10	18000	2	10	39	830	--	<20	<1	0.01	4	<1	4800	--	22	550	--	--	--	<10	10	26	--	430
	02/11/92	0.16	--	6	190	--	<500	<0.1	44	<1	--	<10	9900	2	<10	12	290	--	<20	1	<0.11	2.7	<1	9800	--	12	160	--	--	--	--	<10	16	--	56
	05/26/92	0.17	--	3	120	--	<500	0.1	44	3	--	60	5800	1	<10	11	250	--	<20	<1	<0.01	2.2	32	8300	--	9.5	140	--	--	--	--	<10	18	--	46
	08/25/92	0.05	--	2	130	--	<500	<0.1	41	1	--	<10	3300	<1	<10	9.9	98	--	<20	<1	<0.21	2.5	<1	7800	--	11	130	--	--	--	--	<10	12	--	17
	11/16/92	0.06	<1	2	80	<1	<500	<0.1	44	<1	--	90	2400	1	<10	9.6	90	--	<20	6	0.21	2.5	--	--	--	11	100	--	--	--	--	10	17	--	100
	05/04/93	<0.05	<1	2	90	<1	<500	<0.1	38	<1	--	<10	4000	1	<10	8.4	310	--	<20	2	0.05	1.8	<1	--	--	10	130	--	--	--	--	10	15	--	41
	11/01/93	0.06	<1	2	180	<1	<500	1	57	<1	--	<10	6000	1	<10	14	650	--	<20	<1	--	2.8	<1	--	--	12	160	--	--	--	--	<10	12	--	32
	05/23/94	<0.05	<1	4	120	<1	<500	0.1	34	<1	--	<10	4000	<1	<10	8.2	400	--	<20	<1	--	1.8	--	--	<10	5.9	70	--	--	--	--	<10	11	--	27
	11/28/94	<0.05	2	4	220	<1	<500	<0.1	66	<1	--	<10	6800	<1	29	16	790	--	<20	<1	--	3.2	--	--	--	12	180	--	--	--	--	<10	11	--	48
	05/03/95	<0.05	<1	5	130	<1	<500	<0.1	49	--	--	<10	5100	<1	--	13	610	--	--	--	--	3.2	--	--	--	11	160	--	--	--	--	<10	14	--	44
	11/02/95	<0.05	<1	4	190	<1	<500	<0.1	52	--	--	<10	5200	<1	--	13	720	--	--	--	--	2.9	--	--	--	12	140	--	--	--	--	<10	15	--	51
	05/14/96	<0.05	<1	2	120	<1	<500	<0.1	39	--	--	<10	4200	<1	--	9.7	560	--	--	--	--	1.9	--	--	--	9	110	--	--	--	--	<10	14	--	35
	11/06/96	<0.05	<1	4	150	<1	<500	<0.1	28	--	--	<10	4600	<1	--	1.6	820	--	--	--	--	3.1	--	--	--	12	200	--	--	--	--	<10	15	--	42
	11/10/97	<0.05	<1	4	140	<1	<500	<0.1	39	--	--	<10	3600	<1	--	8.8	650	--	--	--	--	3.1	--	--	--	12	90	--	--	--	--	<10	10	--	49
	02/15/00	0.08	<1	6	290	<1	230	<0.1	70	--	--	<10	6900	<1	--	17	1300	<0.2	<20	--	--	5.1	--	17000	<10	22	240	--	<50	<5	<10	<10	89	--	82

Table 1A
Groundwater Chemical Data

Well ID	Date	Metals																													Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	TDEC	-	6	10	2000	4	-	5	-	100	-	-	-	15	-	-	-	2	-	100	10*	-	50	-	100	-	-	2	-	-	-	-	-	4	-
	EPA	-	6	10	2000	4	-	5	-	100	-	1300	-	15	-	-	-	2	-	-	1**	-	50	-	-	-	-	2	-	-	-	-	-	4	-
ALF-P4 (cont)	02/21/02	<0.05	<1	3.9	170	<1	310	<0.1	44	--	--	<10	3500	<1	--	11	690	--	--	--	<0.01	3.7	--	--	--	42	140	--	--	--	--	<10	32	--	43
	03/17/04	<0.05	<0.6	2.7	210	<1	<200	<0.05	45	<0.1	<0.1	<10	3500	<0.1	--	9.7	750	<0.1	<20	1.1	<0.01	1.5	<0.2	--	<10	40	160	<0.1	<50	<5	<10	<10	61	0.32	43
	02/07/06	<0.2	<3	4	200	<1	300	<0.1	43	<1	<1	<10	3200	<1	--	9.4	690	<0.1	<20	<1	<0.01	4.2	<1	--	<10	40	150	<2	--	--	<10	<10	30	0.39	58
	02/28/08	<0.1	<1	1.8	160	<2	<200	<0.5	38	<1	<1	<1	3000	<1	--	9.2	610	<0.2	<5	<1	<0.1	2.2	<1	--	<0.5	22	140	<1	--	--	<10	<10	21	0.16	48
	02/16/11	<0.1	<1	3.2	190	<1	500	<0.5	46	<1	<1	<1	3800	<1	--	11	780	<0.2	2.1	<1	<0.1	2.8	<1	--	<0.5	31	150	<1	--	--	<2	<10	29	0.25	43
	08/23/11	<0.1	<1	4.9	54	<1	<200	<0.5	29	1.6	<1	<1	4600	<1	--	7.8	1700	<0.2	<2	3.2	<0.1	2.2	<1	--	<0.5	14	120	<1	--	--	<2	<10	10	0.19	27
	01/31/12	<0.1	<1	4.3	51	<1	<200	<0.5	24	<1	<1	<1	3000	<1	--	6.2	880	<0.2	2.4	<1	<0.1	2.2	<1	--	4.5	15	89	<1	--	--	<2	<10	8.6	0.34	28
	08/07/12	--	<1	5.5	130	<1	--	<0.5	--	<1	--	--	--	<1	--	--	--	<0.2	--	2.2	0.42	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	0.27	--
	02/12/13	--	<1	1.8	60	<2	--	<0.5	--	<1	--	--	--	<1	--	--	--	<0.2	--	2.1	--	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	0.11	--
	08/21/13	--	<1	2.7	77.6	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	03/25/14	--	<1	3.1	100	<1	--	<1	--	1	--	--	--	<1	--	--	--	<0.2	--	1.1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	08/12/14	--	<1	2.6	108	<1	--	<1	--	7.5	--	--	--	<1	--	--	--	<0.2	--	4.2	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	05/24/16	--	<2	2.48	111	<4	68.9	<1	34.4	<2	<10	<10	--	<2	<50	--	--	<0.2	2.26	<10	<0.1	--	<10	--	<5	--	--	<10	--	--	<4	<50	12	0.299	50.3
	11/16/16	--	<2	3.26	<200	<4	152	<5	47.3	<2	<50	<10	--	<1	5.45	--	--	<0.2	<5	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	8.95	0.274	34.6
	05/09/17	--	<2	2.23	151	<1	<80	<1	39.2	<2	<0.5	<2	--	<1	<5	--	--	<0.2	<5	<1	<0.1	--	<5	--	<1	--	--	<1	--	--	<1	<5	19.5	0.31	44.8
ALF-P5	03/03/88	0.06	--	2	500	--	<500	0.2	60	<1	--	<10	18000	2	<10	18	640	--	--	<1	--	--	<1	--	--	15	--	--	--	--	--	<10	--	--	1
	06/08/88	0.6	--	3	420	--	<500	0.2	57	2	--	<10	19000	6	<10	18	610	--	<20	<1	--	--	<1	--	--	13	250	--	--	<5	<10	10	--	--	22
	01/10/89	0.07	--	3	450	--	<500	<0.1	64	<1	--	<10	23000	--	720	23	890	--	--	<1	--	2.5	<1	11000	--	12	270	--	--	14	--	<10	15	--	72
	03/21/89	0.08	--	3	540	--	<500	<0.1	78	1	--	<10	24000	--	<10	24	860	--	--	<1	--	2.6	<1	14000	--	12	340	--	--	7	--	<10	14	--	85
	05/31/89	2.3	--	4	480	--	<500	0.3	67	4	--	20	24000	--	<10	19	760	--	--	8	--	2.5	<1	21000	--	13	290	--	--	69	--	40	11	--	63
	08/23/89	0.16	--	4	460	--	<500	<0.1	78	<1	--	80	21000	--	<10	22	760	--	--	2	--	2.7	<1	13000	--	15	310	--	--	13	--	<10	15	--	76
	11/28/89	<0.05	--	4	450	--	<500	<0.1	70	1	--	<10	21000	--	12	22	790	--	--	2	--	2.4	<1	6200	--	13	260	--	--	5	--	<10	14	--	66
	02/27/90	0.07	--	3	290	--	<500	0.1	38	<1	--	<10	12000	--	<10	12	470	--	--	1	--	1.9	<1	11000	--	9.8	130	--	--	<5	--	70	9	--	48
	05/07/90	0.08	--	6	470	--	<500	<0.1	68	<1	--	<10	24000	<1	<10	20	790	--	--	2	--	2.4	<1	12000	--	14	300	--	--	32	--	650	9	--	53
	08/06/90	<0.05	--	5	340	--	<500	0.9	52	<1	--	50	13000	--	<10	17	600	--	--	3	--	2.3	<1	11000	--	10	250	--	--	8	--	80	11	--	14
	11/13/90	0.51	--	9	520	--	<500	2	40	<1	--	10	23000	--	<10	12	520	--	--	7	--	2.2	<1	12000	--	9.8	180	--	--	<5	--	<10	4	--	31
	02/19/91	0.14	--	4	540	--	<500	**27**	84	8	--	10	23000	5	<10	26	850	--	--	33	--	2.4	1	11000	--	13	360	--	--	<5	--	<10	14	--	25
	05/28/91	0.07	--	3	370	--	<500	0.3	59	<1	--	<10	17000	2	<10	18	600	--	--	<1	--	2.2	<1	10000	--	11	260	--	--	<5	--	90	12	--	<1
	08/19/91	0.45	--	**13**	360	--	<500	0.4	64	1	--	<10	17000	2	<10	20	620	--	--	4	--	2.4	2	13000	--	12	290	--	--	45	--	20	12	--	10
	11/12/91	0.28	--	4	390	--	<500	<1	67	2	--	<10	19000	2	10	21	720	--	<20	2	0.13	2.5	<1	6800	--	13	330	--	--	--	<10	10	11	--	70
	02/11/92	0.21	--	4	360	--	<500	<0.1	54	<1	--	<10	17000	2	<10	17	610	--	<20	2	<0.11	2.3	<1	11000	--	12	220	--	--	--	--	<10	12	--	10
	05/26/92	0.39	--	2	420	--	<500	0.1	68	2	--	60	20000	2	<10	20	670	--	<20	<1	<0.01	2.7	2	12000	--	13	300	--	--	--	--	<10	13	--	36
	08/25/92	0.35	--	3	390	--	<500	<0.1	61	<1	--	<10	18000	3	<10	18	670	--	<20	<1	<0.21	2.6	2	12000	--	13	270	--	--	--	--	10	12	--	6
	11/16/92	<0.05	<1	2	220	<1	<500	**17**	59	<1	--	70	9400	1	<10	16	1000	--	<20	28	0.02	2.3	--	--	<10	12	250	<50	--	--	--	20	12	--	3
	05/04/93	<0.01	<1	2	420	<1	<500	<0.1	72	2	--	<10	1900	<1	<10	19	680	--	<20	2	0.03	2.6	<1	--	--	13	320	--	--	--	--	<10	13	--	4
	11/01/93	0.14	<1	2	310	<1	<500	2	50	<1	--	<10	13000	2	<10	15	480	--	<20	2	--	2.2	--	--	--	11	290	--	--	--	--	<10	13	--	8
	05/23/94	<0.05	<1	2	410	<1	<500	<1	69	<1	--	<10	17000	<1	<10	20	680	--	<20	<1	--	2.5	--	--	<10	12	290	--	--	--	--	<10	13	--	10
	11/28/94	0.13	<1	3	310	<1	<500	<0.1	56	<1	--	<10	15000	<1	29	17	590	--	<20	<1	--	2.1	--	--	--	11	230	--	--	--	--	<10	14	--	28
	05/03/95	0.19	<1	2	350	<1	<500	<0.1	66	--	--	<10	17000	3	--	20	670	--	--	--	--	2.7	--	--	--	13	290	--	--	--	--	<10	13	--	22
	11/02/95	<0.05	<1	2	470	<1	<500	<0.1	77	--	--	<10	20000	<1	--	23	780	--	--	--	--	2.6	--	--	--	13	350	--	--	--	--	<10	14	--	41
	11/02/95	<0.05	<1	2	490	<1	<500	<0.1	79	--	--	<10	20000	<1	--	24	800	--	--	--	--	2.6	--	--	--	13	360	--	--	--	--	<10	14	--	40
	05/14/96	<0.05	2	2	460	<1	<500	<0.1	72	--	--	<10	18000	3	--	21	700	--	--	--	--	2.5	--	--	--	11	320	--	--	--	--	<10	14	--	33

Table 1A
Groundwater Chemical Data

Well ID	Date	Metals																															Anions		
		Aluminum, total (ug/L)	Antimony, total (ug/L)	Arsenic, total (ug/L)	Barium, total (ug/L)	Beryllium, total (ug/L)	Boron, total (ug/L)	Cadmium, total (ug/L)	Calcium, total (mg/L)	Chromium, total (ug/L)	Cobalt, total (ug/L)	Copper, total (ug/L)	Iron, total (ug/L)	Lead, total (ug/L)	Lithium, total (ug/L)	Magnesium, total (mg/L)	Manganese, total (ug/L)	Mercury, total (ug/L)	Molybdenum, total (ug/L)	Nickel, total (ug/L)	Nitrite + Nitrate (mg/L)	Potassium, total (mg/L)	Selenium, total (ug/L)	Silicon, total (ug/L)	Silver, total (ug/L)	Sodium, total (mg/L)	Strontium, total (ug/L)	Thallium, total (ug/L)	Tin, total (ug/L)	Titanium, total (ug/L)	Vanadium, total (ug/L)	Zinc, total (ug/L)	Chloride, total (mg/L)	Fluoride, total (mg/L)	Sulfate, total (mg/L)
MCLs	**TDEC**	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**-**	**-**	**15**	**-**	**-**	**-**	**2**	**-**	**100**	**10***	**-**	**50**	**-**	**100**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
	EPA	**-**	**6**	**10**	**2000**	**4**	**-**	**5**	**-**	**100**	**-**	**1300**	**-**	**15**	**-**	**-**	**-**	**2**	**-**	**-**	**1****	**-**	**50**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**4**	**-**
ALF-P5 (cont)	11/06/96	<0.05	<1	3	330	<1	<500	0.1	58	--	--	<10	14000	4	--	17	540	--	--	--	--	2.3	--	--	--	11	330	--	--	--	--	<10	15	--	24
	11/10/97	0.07	<1	3	280	<1	<500	<0.1	52	--	--	<10	12000	<1	--	15	470	--	--	--	--	2.2	--	--	--	10	210	--	--	--	--	<10	16	--	40
	02/15/00	<0.05	<1	5.1	360	<1	390	<0.1	58	--	--	<10	14000	<1	--	17	620	<0.2	<20	--	--	2.6	--	21000	<10	12	260	--	<50	<5	<10	<10	11	--	55
	03/17/04	<0.05	<0.6	2.7	330	<1	220	<0.05	51	<0.1	<0.1	<10	12000	<0.1	--	14	540	<0.1	<20	1	0.01	0.5	<0.2	--	<10	7.8	210	<0.1	<50	<5	<10	<10	15	0.19	23
	02/07/06	<0.2	<3	4	450	<1	300	<0.1	65	<1	<1	<10	16000	<1	--	18	680	<0.1	<20	<1	<0.01	2.6	<1	--	<10	13	260	<2	--	--	<10	<10	15	0.19	43
	02/28/08	<0.1	<1	4.1	440	<2	270	<0.5	61	1.1	<1	<1	15000	<1	--	17	710	<0.2	5.2	1.4	<0.1	2.5	<1	--	<0.5	18	250	<1	--	--	<10	15	18	0.18	38
	02/16/11	<0.1	<1	3.6	260	<1	410	<0.5	40	1.6	<1	<1	9800	<1	--	11	480	<0.2	4.1	8.1	0.11	1.9	<1	--	<0.5	14	160	<1	--	--	<2	13	14	0.15	21
	08/23/11	<0.1	<1	3.1	250	<1	<200	<0.5	41	8.9	<1	<1	9500	<1	--	11	520	<0.2	3.1	9.9	<0.1	2.1	<1	--	<0.5	13	170	<1	--	--	<2	<10	22	0.16	33
	01/31/12	<0.1	<1	3.3	260	<1	<200	<0.5	37	<1	<1	<1	8700	<1	--	9.9	470	<0.2	<2	<1	<0.1	2	<1	--	<0.5	13	150	<1	--	--	<2	<10	20	0.2	35
	08/07/12	--	<1	4.5	320	<1	--	<0.5	--	1.3	--	--	--	<1	--	--	--	<0.2	--	2.1	<0.1	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	0.19	--
	02/12/13	--	<1	3.8	**2400**	<2	--	<0.5	--	<1	--	--	--	<1	--	--	--	<0.2	--	2.1	--	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.1	--
	08/21/13	--	<1	4	224	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	03/25/14	--	<1	4.1	230	<1	--	<1	--	1.7	--	--	--	<1	--	--	--	<0.2	--	2	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	08/12/14	--	<1	4.1	260	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	05/23/16	--	<2	3.21	348	<4	211	<1	62.7	<2	<10	<10	--	<2	<50	--	--	<0.2	2.64	<10	<0.1	--	<10	--	<5	--	--	<10	--	--	<4	<50	18.8	0.189	19.7
	11/30/16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	12/01/16	--	<2	4.01	274	<4	196	<5	42.2	<2	<50	<10	--	<1	5.55	--	--	<0.2	<5	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	17.7	0.222	30.1
	05/09/17	--	<2	2.44	253	<1	223	<1	41.5	<2	<0.5	<2	--	<1	5.69	--	--	<0.2	<5	<1	<0.1	--	<5	--	<1	--	--	<1	--	--	<1	7.2	15.6	0.194	26.1
ALF-P6	02/16/11	0.19	<1	**42**	490	<1	2100	<0.5	100	2.1	<1	1.1	20000	<1	--	36	870	<0.2	4	1.3	0.18	5.4	<1	--	<0.5	17	620	<1	--	--	<2	24	13	0.33	89
	04/07/11	--	--	**20**	--	--	660	--	--	--	--	--	--	--	--	--	790	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	56
	08/23/11	0.2	<1	**15**	220	<1	740	<0.5	67	<1	<1	<1	4900	<1	--	20	1000	<0.2	2.1	1.4	<0.1	3.7	<1	--	<0.5	12	320	<1	--	--	<2	16	14	0.14	52
	11/01/11	--	--	**30**	--	--	1100	--	--	--	--	--	--	--	--	--	890	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70
	01/31/12	<0.1	<1	**22**	220	<1	500	<0.5	51	<1	<1	<1	7800	<1	--	16	580	<0.2	3.8	1.7	<0.1	3.3	<1	--	<0.5	12	270	<1	--	--	<2	<10	14	0.2	44
	08/07/12	--	<1	**43**	380	<1	--	<0.5	--	3	--	--	--	<1	--	--	--	<0.2	--	4.4	<0.1	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	0.24	--
	02/12/13	--	<1	**25**	260	<2	--	<0.5	--	4.4	--	--	--	<1	--	--	--	<0.2	--	3	--	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.1	--
	08/21/13	--	<1	**32.8**	268	<1	--	<1	--	1.3	--	--	--	<1	--	--	--	<0.2	--	1.8	0.33	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	03/25/14	--	<1	**31.7**	286	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	08/12/14	--	<1	**42**	309	<1	--	<1	--	<1	--	--	--	<1	--	--	--	<0.2	--	<1	<0.25	--	<1	--	<0.5	--	--	<1	--	--	--	--	--	<0.4	--
	05/23/16	--	<2	**27.2**	238	<4	634	<1	67.9	<2	<10	<10	--	<2	<50	--	--	<0.2	4.89	<10	<0.1	--	<10	--	<5	--	--	<10	--	--	<4	<50	14.2	0.161	72.6
	11/16/16	--	<2	**43.3**	372	<4	1390	<5	89.6	<2	<50	<10	--	<1	6.54	--	--	<0.2	6.63	<40	<0.1	--	<10	--	<5	--	--	<20	--	--	<1	<50	7.74	0.121	52.9
	05/09/17	--	<2	**19.3**	236	<1	695	<1	58.5	<2	<0.5	<2	--	<1	6.34	--	--	<0.2	5	1.24	<0.1	--	<5	--	<1	--	--	<1	--	--	1.52	5.22	16.4	0.143	54

Bold numbers indicate that measured values exceed TDEC MCLs
cont - continued
EPA - Environmental Protection Agency; MCLs established in 40 CFR Part 257, Appendix I
Grey cells indicate that measured values exceed EPA MCLs
MCL - Maximum Contaminant Level
mg/L - milligrams per liter
N/A - not available
-- no data
TDEC - Tennessee Department of Environment and Conservation; MCLs established in Rules of TDEC Solid Waste Management Appendix III
ug/L - microgram per liter

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Table 1B
Groundwater Physical Data

Well ID	Date	General Chemistry: Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-201	11/15/16	<5	--	426	-17.2	0.46	6.94	770	21.8	1.4	484
	01/30/17	<5	--	560	-126.3	0.21	6.85	890	19.9	34	530
	02/28/17	<5	--	372	-48.2	0.37	7.04	740	20.4	4.8	477
	03/28/17	<5	--	412	56.6	0.34	6.9	750	22.4	5.3	491
	04/18/17	<5	--	614	-59.4	0.23	6.88	920	21.1	32.6	514
	05/10/17	<5	--	602	-74.8	0.33	6.8	960	22	51	572
	06/13/17	<5	--	404	46.4	0.58	6.95	790	24.2	5.2	497
	07/13/17	<5	--	466	64.8	0.72	6.93	780	24.8	5.3	508
	07/19/17	<5	--	451	76.4	0.43	6.91	790	23	2.7	533
ALF-202	11/14/16	<5	--	126	-205.3	0.23	7.9	580	19.2	<1	335
	01/30/17	<5	--	113	-151.7	0.26	7.46	560	18.1	1.8	391
	02/28/17	<5	--	113	-135.2	0.25	7.45	580	18.6	1.7	392
	03/28/17	<5	--	115	-128.3	0.23	7.29	540	19.3	2.8	392
	04/18/17	<5	--	152	-78	0.35	7.45	560	19.2	1.4	373
	05/10/17	<5	--	137	-74.1	0.41	7.34	570	19	1.7	386
	06/13/17	<5	--	117	-72.9	1.84	7.23	570	20.7	1.3	371
	07/13/17	<5	--	118	-165.7	0.2	7.55	560	20.9	0.6	383
	07/19/17	<5	--	125	-162.5	0.13	7.54	570	20	<1	391
ALF-203	11/16/16	40	--	96	-29.8	0.2	8.72	650	21.3	9.1	420
	01/31/17	48.5	--	97	-55.5	0.21	8.85	740	20.2	0.5	557
	03/01/17	52	--	108	-23.1	0.63	9.07	710	20	<0.5	533
	03/29/17	87.6	--	79.6	28.3	0.42	9.1	690	21.5	<0.5	506
	04/19/17	54.1	--	112	-69.2	0.37	9.1	660	21.5	<0.5	490
	05/09/17	69.4	--	137	351.4	0.3	9.06	690	23.7	<0.5	508
	06/14/17	72	--	114	58.2	1.49	9.07	710	24.7	<0.5	519
	07/14/17	82.3	--	94.1	-67.7	0.27	9.29	690	25.3	<0.5	524
	07/19/17	137	--	33.3	-72.6	0.32	9.36	710	26	<0.5	529
ALF-204	11/16/16	<5	--	450	-129.3	0.43	7	610	19	11.9	398
	01/31/17	<5	--	473	-133.8	0.35	7	740	16.9	27.2	458
	03/01/17	<5	--	436	-111.5	0.42	7.09	720	16.6	17.2	422
	03/29/17	<5	--	470	-89.4	0.71	7.1	720	17.5	27.4	400
	04/19/17	<5	--	466	-15.4	0.38	7.01	680	17.4	31.8	403
	05/09/17	<5	--	402	173	0.44	7.02	650	20.7	35.2	375
	06/14/17	<5	--	400	-13.2	1.77	7.07	650	21.4	30.2	380
	07/14/17	<5	--	374	-134.3	0.46	6.99	610	21.6	21.6	354
	07/19/17	<5	--	406	-133.6	0.43	7.12	610	23.9	28.8	341

Stantec

Table 1B
Groundwater Physical Data

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-205	11/16/16	<5	--	294	6.1	2.74	7.17	680	19	1	401
	01/31/17	<5	--	220	-37.9	0.55	7.21	660	16.4	15.6	461
	03/01/17	<5	--	246	-26.5	0.78	7.22	670	16.8	1.1	455
	03/29/17	<5	--	265	-19.1	0.97	7.32	670	16.9	3.1	436
	04/18/17	<5	--	318	8	1.08	7.11	710	18.6	4.4	454
	05/09/17	<5	--	343	268.7	0.64	7.05	740	20.5	14.5	492
	06/14/17	<5	--	299	80.4	0.76	7.08	730	18.5	7.2	469
	07/13/17	<5	--	304	-90.7	0.47	7.24	690	27.7	21	462
	07/19/17	<5	--	280	-63.7	0.9	7.27	690	28.6	3.1	455
ALF-206	11/16/16	<5	--	246	-144.1	0.26	7.15	450	16.3	25.4	242
	01/30/17	<5	--	230	-142.2	0.17	7.07	413	16.2	24.2	220
	02/28/17	<5	--	234	-131.9	0.31	7.09	437	16.5	22	242
	03/29/17	<5	--	207	-55.4	0.19	7.03	432	15.7	23.4	236
	04/18/17	<5	--	223	-71.8	0.35	7.06	408	16.9	20.6	215
	05/09/17	<5	--	188	170.7	0.47	7.12	388	16.8	23.2	229
	06/13/17	<5	--	171	-101.8	1.52	7.21	381	17.4	21.2	218
	07/13/17	<5	--	178	-150.5	0.7	7.27	371	18	17.8	216
	07/19/17	<5	--	192	-147.6	0.1	7.27	372	18	23.4	168
ALF-207	11/17/16	--	--	--	268	0	6.6	1157.3	20.05	9	729
	05/10/17	618	--	--	85	0	6.6	928.5	20.35	32	618
ALF-208	11/17/16	--	--	--	177	0.79	6.7	1823.1	18.84	43.5	1480
	05/11/17	333	--	--	107	0	6.7	638.1	18.16	11.3	--
ALF-209	11/17/16	--	--	--	195	3.57	7.2	365.4	17.23	7.8	242
ALF-210	11/15/16	<5	--	590	-97.5	0.45	6.67	860	18.7	27.2	488
	01/30/17	<5	--	634	-107.9	0.37	6.78	850	15.9	35.6	488
	02/28/17	<5	--	592	-92.6	0.59	6.73	900	18.2	42.6	506
	03/28/17	<5	--	625	-98.9	0.61	6.73	870	20.2	46	503
	04/18/17	<5	--	659	-3	0.69	6.76	920	18.6	43.6	491
	05/09/17	<5	--	653	197.3	0.54	6.83	940	22.9	47.8	537
	06/13/17	<5	--	597	-38.1	0.84	6.73	900	22.9	38.2	524
	07/13/17	<5	--	572	-84	0.52	6.72	840	25.5	34.2	495
	07/18/17	<5	--	561	-92.4	0.49	6.72	850	27.4	27.2	496
ALF-212	11/15/16	<5	--	494	-134.3	0.55	6.96	790	20.2	25.7	443
	01/31/17	<5	--	558	-119.8	0.3	6.94	840	17.5	28.6	522
	02/28/17	<5	--	499	-121.8	0.33	6.97	850	19.3	27.4	491
	03/28/17	<5	--	494	-115.8	0.41	6.89	820	19.7	30.2	495
	04/18/17	<5	--	537	-53.7	1.03	6.93	860	20.6	29.4	480
	05/10/17	<5	--	506	-47.1	3.31	6.86	860	19.7	31.6	502

Table 1B
Groundwater Physical Data

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-212 (cont)	06/13/17	<5	--	529	-7.4	2.43	6.99	840	20.3	30.8	488
	07/13/17	<5	--	498	-129.3	0.13	6.97	810	20.3	28.8	487
	07/19/17	<5	--	494	-125.3	0.13	6.98	780	20.1	26.8	468
ALF-213	11/16/16	<5	--	316	-147.3	0.27	6.98	550	17.2	32.9	300
	01/31/17	<5	--	228	-132.8	0.19	6.98	450	16.4	30	267
	02/28/17	<5	--	216	-133.6	0.26	7.06	460	17.4	28.4	264
	03/28/17	<5	--	193	-130.8	0.43	6.98	400	17.6	29.2	221
	04/18/17	<5	--	204	-79.1	0.38	6.99	392	17.5	25.8	206
	05/10/17	<5	--	171	-6.1	0.39	6.92	393	17.6	26.8	221
	06/13/17	<5	--	177	-46.7	1.44	7.05	402	18.7	29.4	231
	07/13/17	<5	--	178	-159.2	0.14	7.2	398	18.5	28.4	234
	07/19/17	<5	--	194	-150.9	0.16	7.18	406	19.5	28.2	228
ALF-MLS1	03/02/88	--	--	--	--	--	5.7	488	19.6	--	380
	01/09/89	--	--	--	--	--	6.6	423	14	--	420
	03/20/89	--	--	--	--	--	5.5	590	20.4	--	420
	05/30/89	--	--	--	--	--	6.4	610	20.7	--	410
	02/26/90	--	--	--	--	--	6.8	800	19.3	--	440
	05/07/90	--	--	--	--	--	6.8	656	21.8	--	410
ALF-MLS2	03/20/89	--	--	--	--	--	6.6	460	22.1	--	310
	02/26/90	--	--	--	--	--	7.4	428	18	--	260
ALF-MLS3	03/20/89	--	--	--	--	--	6.5	239	21.5	--	180
	02/27/90	--	--	--	--	--	7.3	590	13.3	--	330
ALF-MLS4	03/02/88	--	--	--	--	--	7.5	459	19.7	--	400
	01/10/89	--	--	--	--	--	6.7	487	15.7	--	470
	03/21/89	--	--	--	--	--	5.5	180	8.2	--	160
	05/30/89	--	--	--	--	--	6.9	230	26.3	--	150
	02/27/90	--	--	--	--	--	7.3	442	19.6	--	260
	05/07/90	--	--	--	--	--	7	322	23.5	--	180
ALF-MLS5	03/02/88	--	--	--	--	--	6.8	380	15.3	--	210
	01/10/89	--	--	--	--	--	6.7	396	15.4	--	310
	03/21/89	--	--	--	--	--	6.8	180	9.7	--	320
	05/31/89	--	--	--	--	--	6.5	445	24.4	--	260
	02/27/90	--	--	--	--	--	7.2	699	18.9	--	470
	05/07/90	--	--	--	--	--	7.1	289	23.1	--	220
ALF-P1	03/02/88	--	468	--	-108	--	7	820	18.2	--	480
	06/08/88	--	434	--	-113	--	6.8	800	20.3	--	500
	01/09/89	--	495	--	-77	1.3	6.9	909	16.8	--	540
	03/20/89	--	490	--	-95	1.3	6.7	868	17.9	--	520

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-P1 (cont)	05/30/89	--	492	--	-44	0.4	6.3	861	19.8	--	--
	08/23/89	--	448	--	-20	0.7	6.5	888	20.5	--	600
	11/27/89	--	500	--	49	0.4	6.7	910	18.8	--	580
	02/26/90	--	445	--	-55	0.3	6.8	--	17.8	--	530
	05/07/90	--	463	--	-10	2.8	6.8	790	21.7	--	530
	08/06/90	--	483	--	240	1.6	6.8	914	19.9	--	550
	11/13/90	--	481	--	50	1.2	6.7	949	20	46	550
	02/19/91	--	392	--	188	--	6.9	698	17.6	36	500
	05/28/91	--	475	--	140	0.2	6.8	914	19.1	38	550
	08/19/91	--	410	--	20	2	6.9	899	19.5	38	540
	11/12/91	--	480	--	124	0.9	6.8	950	17	38	570
	02/11/92	--	620	--	37	0.8	6.7	933	17.8	37	520
	05/27/92	--	495	--	78	0.6	6.78	942	18.3	40	430
	08/25/92	--	420	--	116	1	6.8	905	21.5	43	530
	11/16/92	--	481	--	86	0.2	6.8	945	18.3	40	560
	02/17/93	--	494	--	322	6.9	6.95	918	16.6	47	540
	05/04/93	--	520	--	92	0.2	6.74	907	18.4	36	570
	11/01/93	--	--	--	--	--	--	--	--	49	620
	05/23/94	--	518	--	237	0.2	6.8	940	18.4	40	420
	11/28/94	--	495	--	102	0.2	6.82	803	17.8	50	450
	05/03/95	--	504	--	154	0.1	6.8	946	18	30	470
	11/02/95	--	510	--	79	0.2	6.84	930	18.4	32	600
	05/14/96	--	508	--	81	0.2	6.84	1021	18.6	29	620
	11/06/96	--	536	--	81	0.2	6.8	995	17.8	44	530
	11/10/97	--	474	--	71	0.4	6.92	934	16.7	43	600
	02/15/00	--	456	--	85	0.29	6.84	877	17.33	48	520
	02/21/02	--	452	--	101	0.33	6.8	847	17.1	29	490
	03/17/04	--	472	--	86	0.2	6.9	815	18.1	37	480
	02/07/06	--	448	--	59	0.2	6.7	1004	17.9	34	600
	02/28/08	--	496	--	75	0.2	7.1	991	17.9	32	560
	02/16/11	--	470	--	81	0.1	6.7	895	18.4	35	530
	08/23/11	--	424	--	44	0.1	6.8	862	19.8	35	510
	01/31/12	--	464	--	85	0.2	6.8	894	19	27	510
	08/07/12	--	480	--	74	0.2	6.8	932	20.3	26	--
	02/12/13	--	502	--	73	0.1	6.7	935	17.8	41	--
	08/21/13	--	524	--	63	0.1	6.8	971	19.3	34	--
	03/25/14	--	508	--	78	0.1	6.7	963	17.8	36.4	--
	08/12/14	--	528	--	75	0.1	6.7	973	21.7	25.6	--

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-P1 (cont)	05/23/16	--	490	--	86	0	6.4	857	20.4	46.6	526
	11/15/16	--	--	--	75	38.92	6.7	859.6	19.16	39.2	416
	05/10/17	667	--	--	81	0	6.5	844.7	18.97	41.4	553
ALF-P2	03/03/88	--	481	--	-140	--	7.2	1017	18.9	--	660
	06/08/88	--	306	--	-133	--	7	1200	21.4	--	880
	01/09/89	--	339	--	-93	1.2	7	885	17.6	--	560
	03/20/89	--	290	--	-101	1.1	7	528	18.7	--	320
	05/30/89	--	203	--	-53	0.4	6.8	474	20.5	--	310
	08/23/89	--	406	--	119	3.1	6.7	1061	21.3	--	800
	11/27/89	--	380	--	13	0.5	6.8	1054	19.6	--	780
	02/26/90	--	197	--	-78	0.2	7	563	18.1	--	340
	05/07/90	--	300	--	11	1.2	6.9	822	21.9	--	570
	08/06/90	--	329	--	170	1	6.9	758	22.3	--	560
	11/13/90	--	379	--	-18	0.9	6.9	1296	19.6	62	880
	02/19/91	--	271	--	74	0.6	6.8	779	17.9	16	480
	05/28/91	--	327	--	139	0.5	6.9	1033	21.5	28	680
	08/19/91	--	385	--	-21	2	7.1	1292	20.4	32	890
	11/12/91	--	370	--	10	0.6	7	1112	18.1	24	760
	02/11/92	--	463	--	-46	0.7	6.9	1166	18.5	31	980
	05/26/92	--	408	--	79	0.7	6.99	1576	19.6	27	770
	08/25/92	--	371	--	74	1.4	7	1152	22.9	32	760
	11/16/92	--	372	--	72	0.2	6.9	1293	19.2	28	830
	05/04/93	--	350	--	83	0.2	6.91	597	19.2	18	360
	11/01/93	--	250	--	78	0.4	6.96	597	18.3	39	370
	05/23/94	--	343	--	199	0.3	6.95	850	18.6	21	340
	11/28/94	--	391	--	101	0.2	6.98	959	18.1	41	580
	05/03/95	--	370	--	111	0.1	6.98	1070	18	30	800
	11/02/95	--	440	--	78	0.3	7	1230	18.4	27	870
	05/14/96	--	282	--	91	0.1	7.11	637	16.8	19	420
	11/06/96	--	390	--	76	0.2	6.99	1237	17.5	34	870
	11/10/97	--	430	--	60	0.3	7.13	1245	15.9	28	880
	02/15/00	--	504	--	169	0.66	7.03	1175	15.05	34	730
	02/21/02	--	498	--	176	0.49	6.96	629	14.47	15	380
	03/17/04	--	432	--	119	0.5	7.1	592	14.7	10	340
	02/07/06	--	472	--	88	0.5	6.8	1030	12.1	31	620
	02/28/08	--	204	--	110	1.1	7.3	602	13.6	20	340
	08/21/13	--	204	--	66	0.1	7	500	17.3	19.2	--
	03/25/14	--	200	--	85	0.1	6.9	570	14.9	13.8	--

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-P2 (cont)	08/12/14	--	292	--	70	0.1	6.8	721	18.3	16.2	--
	05/24/16	--	263	--	88	0	6.6	563	19.4	26.4	356
	11/16/16	--	--	--	5	0	6.9	1120.1	18.32	35.9	672
	05/10/17	363	--	--	69	0.95	6.9	533.6	17.79	20.2	361
ALF-P3	03/02/88	--	166	--	-121	--	7.3	350	17.7	--	200
	06/08/88	--	240	--	-126	--	7.1	562	18.7	--	330
	01/10/89	--	264	--	-65	1.5	7.1	697	15.9	--	400
	03/20/89	--	125	--	-102	1	7.3	264	13.4	--	160
	05/30/89	--	116	--	-88	0.4	7.3	246	15	--	120
	08/23/89	--	132	--	-91	0.3	7.1	291	15.4	--	190
	11/27/89	--	135	--	190	0.4	7.1	315	15.6	--	190
	02/27/90	--	155	--	-53	0.3	6.9	433	13.5	--	260
	05/07/90	--	134	--	48	1.3	7.1	381	17.1	--	260
	08/06/90	--	124	--	177	1	7.1	300	17	--	180
	11/13/90	--	126	--	222	2.4	7.2	300	19.6	24	190
	02/19/91	--	120	--	-74	0.2	7.1	256	13.5	14	150
	05/28/91	--	115	--	124	0.4	7.4	283	17.1	10	160
	08/19/91	--	190	--	-18	2.1	7.2	465	17	18	270
	11/12/91	--	300	--	-20	0.6	7	724	15.5	14	440
	02/11/92	--	325	--	-45	0.7	7.17	605	15.2	78	340
	05/26/92	--	246	--	70	0.5	7.2	516	16.3	17	170
	08/25/92	--	214	--	58	0.8	7.2	514	20.2	12	310
	11/16/92	--	264	--	96	0.4	7.1	656	16.1	<1	400
	05/04/93	--	138	--	244	0.5	7.3	418	13.1	14	200
	11/01/93	--	190	--	74	0.3	7.15	461	11.3	30	260
	05/23/94	--	135	--	247	0.4	7.1	308	16.1	19	130
	11/28/94	--	272	--	140	0.4	7.26	560	13.6	27	270
	05/03/95	--	186	--	155	0.1	7.17	479	14.7	14	310
	11/02/95	--	214	--	64	0.4	7.22	547	14.9	13	330
	05/14/96	--	122	--	91	0.1	7.32	340	14.4	11	210
	11/06/96	--	156	--	81	0.2	7.27	441	13.8	11	230
	11/10/97	--	198	--	55	0.4	7.36	489	13.2	10	290
	02/15/00	--	192	--	190	0.69	7.22	518	14.13	43	320
	02/21/02	--	188	--	300	0.62	6.98	434	13.37	17	260
	03/17/04	--	196	--	127	0.6	7.2	434	15.4	9	250
	02/07/06	--	192	--	80	0.6	7	769	14.7	47	450
	02/28/08	--	200	--	106	0.5	7.4	425	13	12	250

Table 1B
Groundwater Physical Data

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-P4	03/02/88	--	211	--	-94	--	7.1	462	20.6	--	260
	06/08/88	--	275	--	-100	--	6.8	707	23.1	--	440
	01/10/89	--	287	--	-69	1.1	6.9	748	20.4	--	420
	03/21/89	--	83	--	56	1.2	7.3	212	10.4	--	140
	05/30/89	--	126	--	-23	0.5	7.1	284	14.5	--	140
	08/23/89	--	125	--	-64	0.4	7	315	15.5	--	200
	11/28/89	--	194	--	51	0.4	7	569	17	--	350
	02/27/90	--	45	--	70	0.4	7.1	299	15.1	--	200
	05/07/90	--	94	--	73	1.4	7	241	20.6	--	170
	08/06/90	--	126	--	266	2.4	7	255	21	--	180
	11/13/90	--	101	--	220	0.9	6.9	348	19.2	11	160
	02/19/91	--	84	--	59	0.2	6.8	220	17	35	130
	05/28/91	--	87	--	223	1	7.1	244	18.9	8	140
	08/19/91	--	155	--	82	1.4	7.1	366	20.1	7	220
	11/12/91	--	260	--	-11	0.5	6.8	1096	19.6	15	770
	02/11/92	--	137	--	-19	0.7	6.9	381	19	15	180
	05/26/92	--	158	--	88	0.5	7	399	18.2	17	150
	08/25/92	--	140	--	206	2	7	377	22.9	85	300
	11/16/92	--	114	--	485	3.4	6.9	367	21.1	8	210
	05/04/93	--	115	--	172	0.3	7.15	324	11.4	4	170
	11/01/93	--	152	--	140	0.5	6.98	423	13.8	16	280
	05/23/94	--	100	--	93	0.3	7.04	241	16.2	4	100
	11/28/94	--	200	--	182	0.7	7.06	445	16.9	17	160
	05/03/95	--	161	--	274	0.5	6.93	419	19.9	8	260
	11/02/95	--	152	--	94	0.2	7	424	20.4	4	270
	05/14/96	--	108	--	116	0.1	7.16	296	13.4	4	190
	11/06/96	--	160	--	108	0.2	6.99	437	17.6	8	250
	11/10/97	--	110	--	93	0.3	7.06	341	20.2	2	220
	02/15/00	--	104	--	107	0.29	6.97	669	22.37	9	440
	02/21/02	--	104	--	176	0.55	7.02	451	20.44	7	270
	03/17/04	--	108	--	109	0.3	7.2	501	19.2	4	300
	02/07/06	--	102	--	69	0.2	7	467	22.9	5	300
	02/28/08	--	112	--	104	0.3	7.4	381	11.7	2.8	220
	02/16/11	--	140	--	100	0.1	7	465	19	8.4	280
	08/23/11	--	94	--	21	0.2	7.1	305	20.5	12	180
	01/31/12	--	88	--	46	0.1	7.1	264	18.8	11	160
	08/07/12	--	162	--	73	0.3	7.1	521	23.1	16	--
	02/12/13	--	76	--	88	0.1	7.1	277	14.5	2.9	--

Table 1B
Groundwater Physical Data

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-P4 (cont)	08/21/13	--	98	--	74	0.1	7.2	290	15.8	5.8	--
	03/25/14	--	96	--	90	0.1	7.1	327	16.6	6	--
	08/12/14	--	100	--	97	0.3	7	360	20.5	8.2	--
	05/24/16	--	101	--	77	0	7.7	246.1	17.05	6.6	170
	11/16/16	--	--	--	38	0	7.1	399	20.3	7.3	233
	05/09/17	153	--	--	63	0	8	345.7	17.75	3.8	231
ALF-P5	03/03/88	--	301	--	-245	--	7.3	518	15.2	--	270
	06/08/88	--	216	--	-153	--	7.2	482	16.9	--	270
	01/10/89	--	223	--	-131	1.1	7.1	570	14.8	--	340
	03/21/89	--	112	--	-128	0.9	7.1	651	14.4	--	380
	05/31/89	--	225	--	-125	0.4	7	527	17.2	--	300
	08/23/89	--	200	--	-126	0.3	6.9	536	16.8	--	350
	11/28/89	--	200	--	-41	0.4	7	568	14.8	--	320
	02/27/90	--	--	--	-95	0.4	7	348	17.7	--	210
	05/07/90	--	285	--	64	1	6.7	507	19.2	--	340
	08/06/90	--	199	--	130	0.9	6.9	422	20	--	250
	11/13/90	--	138	--	118	2	7	382	19.8	130	210
	02/19/91	--	318	--	-147	0.4	6.9	575	20.2	55	320
	05/28/91	--	250	--	66	0.3	7.1	495	17.3	41	260
	08/19/91	--	270	--	-77	1.2	7	532	17.5	56	280
	11/12/91	--	220	--	-113	0.5	7	554	15.8	41	310
	02/11/92	--	314	--	-121	0.6	7.1	498	--	56	260
	05/26/92	--	312	--	51	0.7	7.1	657	16.1	79	280
	08/25/92	--	250	--	69	0.9	7.2	541	20.4	70	240
	11/16/92	--	250	--	216	2.5	6.9	519	21.4	8	290
	05/04/93	--	334	--	61	0.3	7.02	572	16.8	36	280
	11/01/93	--	264	--	65	0.6	7.12	418	15.4	150	250
	05/23/94	--	277	--	30	0.3	7.08	523	15.9	26	180
	11/28/94	--	201	--	107	0.6	7.19	--	14.9	46	190
	05/03/95	--	256	--	121	0.5	7.09	557	15.3	62	330
	11/02/95	--	324	--	37	0.2	7.14	629	17.3	36	360
	11/02/95	--	--	--	--	--	--	--	--	38	360
	05/14/96	--	268	--	41	0.2	7.18	590	16.7	29	330
	11/06/96	--	250	--	40	0.2	7.13	528	17.2	29	260
	11/10/97	--	144	--	37	0.4	7.34	440	16.1	16	270
	02/15/00	--	196	--	53	0.3	7.1	512	16.72	24	300
	03/17/04	--	204	--	60	0.2	7.2	403	16.3	12	220
	02/07/06	--	200	--	29	0.2	7	547	16.1	17	320

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Table 1B
Groundwater Physical Data

Well ID	Date	General Chemistry									
		Alkalinity, Carbonate (mg/L)	Alkalinity, total (mg/L CaCO3)	Alkalinity, Bicarbonate (mg/L)	ORP (mV)	Oxygen, dissolved (mg/L)	pH	Specific Cond. (micromhos/cm)	Temperature (°C)	TDS (mg/L)	TSS (mg/L)
ALF-P5 (cont)	02/28/08	--	208	--	53	0.3	7.4	568	16.9	18	300
	02/16/11	--	144	--	65	0.2	7.2	359	15.7	22	190
	08/23/11	--	108	--	49	0.2	6.9	386	18.5	18	240
	01/31/12	--	106	--	88	0.2	7.1	366	16.1	18	200
	08/07/12	--	136	--	36	0.1	7.2	427	18	22	--
	02/12/13	--	152	--	34	0.1	7	453	16	22	--
	08/21/13	--	104	--	24	0.1	7.1	329	17.5	17.8	--
	03/25/14	--	104	--	52	0.1	7.2	333	15.9	17.6	--
	08/12/14	--	132	--	27	0.1	7	377	16.6	17.6	--
	05/23/16	--	195	--	53	0	637	453	21.4	25.8	257
	11/30/16	--	--	--	85	2.4	7.1	336.7	15.71	--	--
	12/01/16	--	--	--	--	--	--	--	--	23.2	205
	05/09/17	212	--	--	111	3.08	7	386.5	21.4	18	234
ALF-P6	02/16/11	--	396	--	58	0.2	6.9	866	15.9	140	510
	04/07/11	--	188	--	40	0.2	6.9	540	18.1	--	320
	08/23/11	--	204	--	106	0.2	7	555	20.7	16	350
	11/01/11	--	200	--	162	0.2	7	677	15.3	--	400
	01/31/12	--	172	--	113	0.2	7	478	16.8	18	270
	08/07/12	--	236	--	64	0.3	7	679	18.9	42	--
	02/12/13	--	188	--	70	0.1	6.9	525	15.5	28	--
	08/21/13	--	216	--	51	0.1	7	552	15.5	38.2	--
	03/25/14	--	108	--	74	0.1	7	597	13	31.8	--
	08/12/14	--	264	--	59	0.1	6.9	661	16.7	30.8	--
	05/23/16	--	216	--	78	0	6.6	461.5	15.8	76.4	312
	11/16/16	--	--	--	272	0.56	6.9	656.7	15.4	37.3	406
	05/09/17	304	--	--	82	0	6.8	506.5	17.19	49.8	334

°C - Degrees Celcius
cont - continued
mg/L - milligrams per liter
mv - millivolt
-- no data
ORP - Oxygen Reduction Potential
uhom/cm - micro ohms per centimeter

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-201	11/15/16	186.96	50.70	35.25
	01/30/17	194.01	47.00	28.20
	02/28/17	190.47	50.70	31.74
	03/28/17	192.21	50.70	30.00
	04/18/17	196.18	50.70	26.03
	05/10/17	200.20	50.70	22.01
	06/13/17	198.49	50.70	23.72
	07/13/17	195.45	50.70	26.76
	07/19/17	193.85	50.70	28.36
ALF-202	11/14/16	203.76	44.80	16.42
	01/30/17	206.39	41.00	13.79
	02/28/17	205.39	44.80	14.79
	03/28/17	205.80	44.80	14.38
	04/18/17	205.79	44.80	14.39
	05/10/17	206.67	44.80	13.51
	06/13/17	206.70	44.80	13.48
	07/13/17	205.72	44.80	14.46
	07/19/17	205.37	44.80	14.81
ALF-203	11/16/16	189.48	54.10	32.91
	01/31/17	201.04	50.60	21.35
	03/01/17	192.56	54.10	29.83
	03/29/17	195.27	54.10	27.12
	04/19/17	202.26	54.10	20.13
	05/09/17	210.27	54.10	12.12
	06/14/17	201.62	54.10	20.77
	07/14/17	198.55	54.10	23.84
	07/19/17	195.49	54.10	26.90
ALF-204	11/16/16	182.60	59.20	35.98
	01/31/17	200.51	55.40	18.07
	03/01/17	187.17	59.20	31.41
	03/29/17	192.19	59.20	26.39
	04/19/17	203.40	59.20	15.18
	05/09/17	209.63	59.20	8.95
	06/14/17	199.13	59.20	19.45
	07/14/17	196.23	59.20	22.35
	07/19/17	191.56	59.20	27.02
ALF-205	11/16/16	183.18	55.60	38.44
	01/31/17	199.61	52.00	22.01
	03/01/17	187.51	55.60	34.11
	03/29/17	191.79	55.60	29.83
	04/18/17	199.62	55.60	22.00
	05/09/17	208.17	55.60	13.45
	06/14/17	198.74	55.60	22.88

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-205 (cont)	07/13/17	195.58	55.60	26.04
	07/19/17	191.12	55.60	30.50
ALF-206	11/16/16	182.76	64.40	43.26
	01/30/17	199.86	60.60	26.16
	02/28/17	187.24	64.40	38.78
	03/29/17	192.06	64.40	33.96
	04/18/17	199.80	64.40	26.22
	05/09/17	208.64	64.40	17.38
	06/13/17	198.87	64.40	27.15
	07/13/17	196.03	64.40	29.99
	07/19/17	191.63	64.40	34.39
ALF-207	11/17/16	185.20	71.85	46.39
	05/10/17	209.20	60.70	22.41
ALF-208	11/17/16	180.97	81.56	50.00
	05/11/17	211.51	55.90	19.46
ALF-209	11/17/16	184.19	81.56	24.34
ALF-210	11/15/16	186.38	48.80	33.40
	01/30/17	195.37	44.50	24.41
	02/28/17	190.44	48.80	29.34
	03/28/17	192.52	48.80	27.26
	04/18/17	197.45	48.80	22.33
	05/09/17	202.99	48.80	16.79
	06/13/17	199.75	48.80	20.03
	07/13/17	196.17	48.80	23.61
	07/18/17	194.02	48.80	25.76
ALF-212	11/15/16	203.42	67.90	36.28
	01/31/17	205.98	65.00	33.72
	02/28/17	205.16	67.90	34.54
	03/28/17	205.51	67.90	34.19
	04/18/17	205.19	67.90	34.51
	05/10/17	205.95	67.90	33.75
	06/13/17	205.71	67.90	33.99
	07/13/17	204.95	67.90	34.75
	07/19/17	204.59	67.90	35.11
ALF-213	11/16/16	184.30	81.30	56.10
	01/31/17	196.78	77.50	43.62
	02/28/17	188.12	81.30	52.28
	03/28/17	191.57	81.30	48.83
	04/18/17	197.55	81.30	42.85
	05/10/17	204.18	81.30	36.22
	06/13/17	197.91	81.30	42.49
	07/13/17	195.17	81.30	45.23
	07/19/17	191.99	81.30	48.41

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-P1	03/02/88	193.00	60.30	25.20
	06/08/88	184.60	60.30	33.60
	01/09/89	187.81	60.30	30.39
	03/20/89	200.40	60.30	17.80
	05/30/89	194.75	60.30	23.45
	08/23/89	186.20	60.30	32.00
	11/27/89	190.38	60.30	27.82
	02/26/90	202.80	60.30	15.40
	05/07/90	194.80	60.30	23.40
	08/06/90	188.68	60.30	29.52
	11/13/90	189.17	60.30	29.03
	02/19/91	200.60	60.30	17.60
	05/28/91	200.20	60.30	18.00
	08/19/91	187.40	60.30	30.80
	11/12/91	184.00	60.30	34.20
	02/11/92	187.80	60.40	31.40
	05/27/92	190.98	60.40	28.20
	08/25/92	190.68	60.40	28.51
	11/16/92	188.35	60.40	30.84
	02/17/93	191.17	61.68	--
	05/03/93	205.09	--	--
	05/04/93	205.94	60.37	--
	11/01/93	194.36	60.37	--
	05/23/94	202.43	60.37	--
	11/28/94	187.80	60.37	--
	05/03/95	195.21	60.37	--
	11/02/95	187.20	60.37	--
	05/14/96	203.87	60.37	15.32
	11/06/96	189.83	60.37	--
	11/10/97	186.65	60.37	--
	02/15/00	179.17	60.37	40.03
	02/21/02	190.65	60.37	28.54
	03/17/04	199.08	60.37	20.11
	06/30/05	188.98	60.37	30.22
	02/07/06	190.26	60.37	28.94
	02/28/08	195.87	60.37	23.33
	02/16/11	187.96	60.37	31.23
	08/23/11	193.80	60.37	25.39
	01/31/12	198.98	60.37	20.21
	08/07/12	181.69	60.37	37.50
	02/12/13	194.82	60.37	24.38
	08/21/13	54.46	60.37	26.87
	03/25/14	193.37	60.37	25.82

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-P2	08/12/14	189.14	60.37	30.05
	05/23/16	199.84	60.37	19.36
	11/15/16	186.25	60.37	31.96
	05/10/17	203.31	59.30	14.90
	03/03/88	193.05	71.78	39.40
	06/08/88	181.25	71.78	51.20
	01/09/89	192.40	71.78	40.05
	03/20/89	203.25	71.78	29.20
	05/30/89	194.75	71.78	37.70
	08/23/89	182.25	71.78	50.20
	11/27/89	191.95	71.78	40.50
	02/26/90	208.55	71.78	23.90
	05/07/90	194.10	71.78	38.35
	08/06/90	191.35	71.78	41.10
	11/13/90	185.55	71.78	46.90
	02/19/91	202.45	71.78	30.00
	05/28/91	198.44	71.78	34.00
	08/19/91	183.84	71.78	48.60
	11/12/91	182.20	71.78	50.25
	02/11/92	188.19	71.92	46.30
	05/26/92	186.91	71.92	47.57
	08/25/92	189.73	71.92	44.75
	11/16/92	191.14	71.92	43.34
	05/04/93	209.81	71.85	--
	11/01/93	194.26	71.85	--
	05/23/94	202.49	71.85	--
	11/28/94	188.02	71.85	--
	05/03/95	198.82	71.85	--
	11/02/95	186.81	71.85	--
	05/14/96	211.42	71.85	23.06
	11/06/96	191.17	71.85	--
	11/10/97	187.63	71.85	--
	02/15/00	178.64	71.85	55.84
	02/21/02	191.63	71.85	42.85
	03/17/04	205.31	71.85	29.17
	06/30/05	188.19	71.85	46.29
	02/07/06	194.65	71.85	39.83
	02/28/08	202.26	71.85	32.22
	08/21/13	65.62	71.85	41.86
	03/25/14	194.62	71.85	39.86
	08/12/14	186.91	71.85	47.57
	05/24/16	200.07	71.85	34.42
	11/16/16	184.55	71.85	48.06

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-P2 (cont)	05/10/17	210.87	72.40	21.75
ALF-P3	03/02/88	193.41	91.40	39.70
	06/08/88	180.21	91.40	52.90
	01/10/89	192.28	91.40	40.83
	03/20/89	202.61	91.40	30.50
	05/30/89	194.51	91.40	38.60
	08/23/89	181.31	91.40	51.80
	11/27/89	191.81	91.40	41.30
	02/27/90	209.31	91.40	23.80
	05/07/90	193.31	91.40	39.80
	08/06/90	192.01	91.40	41.10
	11/13/90	185.01	91.40	48.10
	02/19/91	202.21	91.40	30.90
	05/28/91	197.91	91.40	35.20
	08/19/91	183.31	91.40	49.80
	11/12/91	182.38	91.40	50.73
	02/11/92	186.52	91.40	47.50
	05/26/92	188.39	91.40	45.64
	08/25/92	188.19	91.40	45.84
	11/16/92	190.19	91.40	43.84
	05/03/93	207.48	--	--
	05/04/93	208.40	91.40	--
	11/01/93	191.60	91.40	--
	05/23/94	200.82	91.40	--
	11/28/94	187.14	91.40	--
	05/03/95	197.51	91.40	--
	11/02/95	186.35	91.40	--
	05/14/96	210.24	91.40	23.79
	11/06/96	189.93	91.40	--
	11/10/97	186.15	91.40	--
	02/15/00	176.41	91.40	57.61
	02/21/02	190.22	91.40	43.80
	03/17/04	204.40	91.40	29.63
	06/30/05	186.32	91.40	47.70
	02/07/06	193.24	91.40	40.78
	02/28/08	203.97	91.40	33.33
ALF-P4	03/02/88	193.07	81.69	28.30
	06/08/88	180.37	81.69	41.00
	01/10/89	192.27	81.69	29.10
	03/21/89	202.37	81.69	19.00
	05/30/89	194.27	81.69	27.10
	08/23/89	180.27	81.69	41.10
	11/28/89	191.37	81.69	30.00

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-P4 (cont)	02/27/90	207.57	87.70	13.80
	05/07/90	193.77	87.20	27.60
	08/06/90	189.97	87.20	31.40
	11/13/90	184.57	87.20	36.80
	02/19/91	201.97	87.20	19.40
	05/28/91	197.82	87.20	23.55
	08/19/91	183.07	81.20	38.30
	11/12/91	182.52	81.20	38.85
	02/11/92	185.37	81.69	36.00
	05/26/92	187.20	81.69	34.16
	08/25/92	186.65	81.69	34.71
	11/16/92	190.19	81.69	31.17
	05/03/93	207.02	--	--
	05/04/93	207.02	81.69	--
	11/01/93	192.52	81.69	--
	05/23/94	200.56	81.69	--
	11/28/94	187.50	81.69	--
	05/03/95	197.51	81.69	--
	11/02/95	185.04	81.69	--
	05/14/96	209.25	81.56	12.11
	11/06/96	189.57	81.56	--
	11/10/97	186.58	81.56	--
	02/15/00	176.71	81.56	44.65
	02/21/02	189.30	81.56	32.05
	03/17/04	203.64	81.56	17.72
	06/30/05	186.29	81.56	35.07
	02/07/06	192.29	81.56	29.07
	02/28/08	199.38	81.56	21.98
	02/16/11	186.58	81.56	34.78
	08/23/11	190.58	81.56	30.77
	01/31/12	201.41	81.56	19.95
	08/07/12	177.66	81.56	43.70
	02/12/13	199.51	81.56	21.85
	08/21/13	49.21	81.56	31.27
	03/25/14	192.19	81.56	29.17
	08/12/14	184.38	81.56	36.98
	05/24/16	197.80	81.56	23.56
	11/16/16	184.48	81.56	36.71
	05/09/17	209.91	81.80	11.29
ALF-P5	03/03/88	191.59	70.31	29.60
	06/08/88	178.78	70.31	42.41
	01/10/89	191.47	70.21	29.72
	03/21/89	200.34	70.21	20.85

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-P5 (cont)	05/31/89	193.69	70.21	27.50
	08/23/89	180.69	70.31	40.50
	11/28/89	190.69	70.21	30.50
	02/27/90	206.39	70.21	14.80
	05/07/90	193.39	70.21	27.80
	08/06/90	189.59	70.21	31.60
	11/13/90	184.29	70.21	36.90
	02/19/91	201.09	70.21	20.10
	05/28/91	197.44	70.21	23.75
	08/19/91	182.39	70.21	38.80
	11/12/91	182.89	70.21	38.30
	02/11/92	184.55	70.41	36.65
	05/26/92	186.42	70.41	34.78
	08/25/92	185.79	70.41	35.40
	11/16/92	190.58	70.41	30.61
	05/03/93	205.64	--	--
	05/04/93	205.68	70.41	--
	11/01/93	192.16	70.41	--
	05/23/94	219.59	70.41	--
	11/28/94	187.53	70.41	--
	05/03/95	196.52	70.41	--
	11/02/95	184.65	70.41	--
	05/14/96	207.05	70.41	14.14
	11/06/96	188.91	70.41	--
	11/10/97	186.12	70.41	--
	02/15/00	175.98	70.41	45.21
	02/21/02	--	70.41	--
	03/17/04	--	71.52	20.41
	06/30/05	184.06	70.41	37.14
	02/07/06	--	71.52	31.04
	02/28/08	--	71.52	24.38
	02/16/11	185.14	71.19	36.06
	08/23/11	189.50	71.19	31.69
	01/31/12	199.31	71.19	21.88
	08/07/12	175.56	71.19	45.64
	02/12/13	197.44	71.19	23.75
	08/21/13	39.37	71.19	32.25
	03/25/14	190.75	71.19	30.45
	08/12/14	182.87	70.41	38.32
	05/23/16	197.60	70.41	23.59
	11/30/16	183.53	70.41	38.32
	05/09/17	208.03	69.30	13.16

Well ID	Date	GW Elevation (ft abv s/l)	Well Depth (ft)	Water Level Depth (ft)
ALF-P6	02/16/11	187.14	51.87	31.66
	04/07/11	203.74	51.87	15.06
	08/23/11	191.44	51.87	27.36
	11/01/11	186.19	51.87	32.61
	01/31/12	202.36	51.87	16.44
	08/07/12	177.46	51.87	41.34
	02/12/13	200.82	51.87	17.98
	08/21/13	44.29	51.87	27.69
	03/25/14	192.95	51.87	25.85
	08/12/14	184.51	51.87	34.28
	05/23/16	199.67	51.87	19.13
	11/16/16	182.91	51.87	34.68
	05/09/17	210.39	51.50	7.58

cont - continued
ft = feet
ft abv s/l = feet above sea level
-- no data

APPENDIX U
PUBLIC COMMENTS

Table 1
TVA Allen Fossil Plant EIP
Summary of Public Comments & TVA Responses
March 4, 2019

Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
1	NA	NA	NA	NA	NA	Notify the public better. Lot of information.	November 1, 2018	Postcard Comment - Van Rutherford, Memphis, TN	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.
2	NA	NA	NA	NA	NA	Let the public know about these meetings by radio, television, flyers.	November 1, 2018	Postcard Comment - Ernestine Green, Memphis, TN	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.
3	NA	NA	NA	NA	NA	My concern is that this is a city wide informational event with concerns that will affect all of us and I do not see good representation from the city. There is a lot of information from TVA and representatives on hand to answer our questions but the public is not well represented.	November 1, 2018	Postcard Comment - Marcella Shepherd, Memphis, TN	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.
4	NA	NA	NA	NA	NA	My concern is not only that this presentation could possibly be re-vamped whereby there will be a panel and we could ask questions in a different setting. There was a lot of information visually on hand. Knowledgeable TVA reps also on hand.	November 1, 2018	Postcard Comment - Marcella Shepherd, Memphis, TN	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.
5	NA	NA	NA	NA	NA	…the Public Notice that was mailed to residents of the immediate area didn't receive the mailer until a week after the meeting was held.	November 20, 2018	Comment - Marylin Ingram	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.
6	NA	NA	NA	NA	NA	The first thing I would like to know is why I am just receiving the notice, on today's date 11-6-2018. So I had no chance to go to the informational meeting. What is this about, in terms of how it is affecting me and my family's health. This is very disturbing, as my husband and I have only been living here for about 3 years, what does that mean for us? Try to send or email the date of the next informational meeting.	November 6, 2018	Comment – Celeste Jackson	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.

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7	NA	NA	NA	NA	NA	My opinion of the meeting I attended was not carefully planned. There were more of TVA than it were of the community. My question was how was the information of the meeting being held relayed to the surrounding community due to the fact that someone called me by telephone and informed me the night before the meeting. I advised one of TVA members that I had not received a telephone call nor did I get a mailer. The information should have gotten to the media since the majority of the citizens in the area are elderly and most of their was of communication is through television. I also advised that another meeting should be scheduled and it should be in a group presentation form and Q and A format. This would allow the citizens to ask questions and also give input on the plan and it would clear the understanding and misunderstanding of rumors that are being passed along.	-	Comment – Pamela Green	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.
8	NA	NA	NA	NA	NA	My name is Vera Holmes and I am with Mallory Heights Community Development Corporation. I met you last night November 1) as you were leaving the TVA's Allen Fossil Plant Environmental Investigation Plan community meeting. As I approached you and your team at 7:20 p.m., I was very concerned for my safety, the location, and time of this meeting. This community meeting was already completed and dismissed. The location was very hard to find and the lighting was unappropriated for a very serious community event. I hope Tennessee Valley Authority will help educate, engage and enlighten every household in our community about the current contamination of arsenic, lead and fluoride leaking coal ash ponds that threaten the Memphis Sand Aquifer.	November 2, 2018	Comment – Vera Holmes	Based on feedback received following the public meeting in November 2018, TVA held a second public meeting in January 2019.
9	NA	NA	NA	NA	NA	Data already gathered through the RI and USGS/CAESER should be disclosed and appropriately analyzed in the EIP. (page 3)	November 28, 2018	SELC Letter	The data gathered during the RI and USGS/CAESER report have been properly disclosed and are available to the public via the Tennessee Open Records Act request to TDEC. Further analysis of these data will be incorporated into the Environmental Assessment Report (EAR) and Corrective Action / Risk Assessment (CARA) as appropriate.

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10	NA	NA	NA	NA	NA	The RI and USGS/CAESER data indicate a current and ongoing risk of contamination of the Memphis Sand Aquifer, which should form the basis for further investigation in the RI and EIP. (page 5)	November 28, 2018	SELC Letter	Further investigation to evaluate risk of contamination is proposed in the Environmental Investigation Plan (EIP) and is ongoing under the Supplemental Remedial Investigation (RI), which began in October 2018. The results of the Supplemental RI will be provided to TDEC in March 2019. The specific investigative activities include deep soil borings to characterize the upper Claiborne confining unit; installation of additional deep groundwater monitoring wells to monitor the Alluvial aquifer; and groundwater sampling and analysis. All of these activities will enable continued assessment of potential risks to the Memphis aquifer.
11	NA	NA	NA	NA	NA	Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP. (page 7)	November 28, 2018	SELC Letter	The results of the USGS/CAESER report were incorporated into the RI Report. The results of the Environmental Investigation (EI) will incorporate the conclusions into the EAR and CARA, as appropriate.
12	NA	NA	NA	NA	NA	Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer. (page 7)	November 28, 2018	SELC Letter	TVA has implemented the recommendations of the USGS-CAESER report into data collection and analysis activities. The Supplemental Remedial Investigation, which began in October 2018 and is in-progress, and the EI which is planned to begin in April 2019, both include investigative activities designed to more accurately characterize the upper Claiborne confining unit and evaluate groundwater flow and quality. The investigative activities include deep soil borings to characterize the upper Claiborne confining unit; installation of additional deep groundwater monitoring wells to monitor the Alluvial aquifer; and groundwater sampling and analysis. These activities will enable continued assessment of potential risks to the Memphis aquifer. In addition, TVA is developing a three-dimensional groundwater model to evaluate groundwater flow and transport of dissolved CCR constituents in the Alluvial aquifer with time.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
13	NA	NA	NA	NA	NA	Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial distribution of CCR contamination (including all Appendix III and IV constituents required to be monitored under the federal Coal Combustion Residuals Rule), the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates. (page 7)	November 28, 2018	SELC Letter	After evaluation of the preliminary EI data, and after the East Ash Disposal Area is dewatered, TVA will discuss with TDEC whether wells within the footprints of the disposal areas are needed and can be safely installed.
14	NA	NA	NA	NA	NA	Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface. (page 7)	November 28, 2018	SELC Letter	Groundwater elevation maps using data from site monitoring wells and McKellar Lake will continue to be prepared to illustrate groundwater flow at the site. To evaluate more complex hydrogeological interactions, , TVA is developing a three-dimensional groundwater model to evaluate groundwater flow and the transport of dissolved CCR constituents in the Alluvial aquifer with time.
15	NA	NA	NA	NA	NA	Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated. (page 7)	November 28, 2018	SELC Letter	To support the three-dimensional groundwater model, TVA will develop and use site-specific partitioning coefficients for CCR constituents.
16	NA	NA	NA	NA	NA	Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents). (page 8)	November 28, 2018	SELC Letter	TVA is developing a three-dimensional groundwater model to evaluate groundwater flow and the transport of dissolved CCR constituents in the Alluvial aquifer with time.

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17	NA	NA	NA	NA	NA	Redesign the Interim Remedial Action as further discussed in the Cosler Report. (page 8)	November 28, 2018	SELC Letter	The Interim Response Action described in the draft report titled *Initial Remedial Design (Stantec, July 20, 2018)*, was conceptual and based on data available at the time. To provide further information to support the final design of the Interim Response Action, a Pre-Design Study is in progress. TVA has already installed two extraction wells and 18 performance monitoring wells in the two areas of elevated arsenic concentrations north and south of the East Ash Pond. TVA conducted aquifer tests in December 2018 to evaluate the radius of influence of CCR constituent capture zones, IRA pumping rates, and the quality of the extracted groundwater. The information obtained from this study will be used along with predictive groundwater modeling to revise the design of the Interim Response Action to meet the remedial objectives.
18	NA	NA	NA	NA	NA	The EIP must include investigation of coal ash pollution in McKellar Lake and other surface water bodies. (page 8)	November 28, 2018	SELC Letter	Due to the heavily industrialized and already impaired water quality of McKellar Lake, TVA is not planning to collect surface water or sediment samples from McKellar Lake.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
19	NA	NA	NA	NA	NA	The timeline to begin remediation is unacceptable. (page 9)	November 28, 2018	SELC Letter	TVA is already implementing Interim Response Actions to begin the remediation process. Since early 2017, when elevated concentrations of arsenic were detected in groundwater north and south of the East Ash Pond, TVA has completed the following remedial activities in the East Ash Disposal Area in just 18 months: 1. Voluntary Groundwater Investigation (May-August 2017) 2. Draft Remedial Investigation Work Plan (August 2017) 3. Final Remedial Investigation Work Plan (September 2017) 4. Remedial Investigation Field Work (September-November 2017) 5. Remedial Investigation Report (March 2018) 6. USGS Pumping Test (October 2017) 7. USGS Report (December 2018) 8. Initial Remedial Design (July 2018) 9. Dewatering Plan for East Ash Disposal Area (September 2018) 10. NEPA Environmental Impact Statement (in progress) 11. Supplemental Remedial Investigation Field Work (October – December 2018) 12. Pre-Design Study (December 2018 - current) TVA's planned activities in the near future include the implementation of the EIP, design/installation of the Interim Response Actions (i.e., groundwater extraction and treatment system), dewatering the East Ash Disposal Area, and completion of the EIS.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
20	NA	NA	NA	NA	NA	The EIP lacks analysis of existing information. (page 10)	November 28, 2018	SELC Letter	TVA is following the process established in the TDEC Order. After reviewing existing information and data, in preparation of the EIP, TVA and TDEC have identified additional investigations needed to understand the conditions and impacts at each site, and the EIP establishes the plan for these investigations. New and existing data will be subject to additional quality review processes documented in the Quality Assessment Project Plan to confirm the validity of the data. As required by the TDEC Order, TVA will evaluate and provide an analysis of both new and existing, validated data in the Environmental Assessment Report (EAR). The comments do not provide specific suggestions to improve the current version of the EIP, which sets forth technical investigations necessary to properly evaluate coal ash impacts.
21	NA	NA	NA	NA	NA	The EIP artificially segregates data and information obtained in other regulatory processes. (page 10)	November 28, 2018	SELC Letter	TVA is following the process established in the TDEC Order. Data collected for and during other regulatory programs, such as for purposes of the Federal CCR Rule, will be subject to additional quality review processes documented in the Quality Assessment Project Plan and will be evaluated along with data generated by the EI under the TDEC Order. TVA will provide an analysis of both new and existing, validated data in the EAR as required by the TDEC Order. The comments do not provide specific suggestions to improve the current version of the EIP, which sets forth technical investigations necessary to properly evaluate coal ash impacts.

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22	NA	NA	NA	NA	NA	The Commissioner's Order process lacks transparency and accessibility of information. (page 12)	November 28, 2018	SELC Letter	Both TDEC and TVA have shared pertinent information as the development of the EIP has progressed. This has included sharing formal communications between TDEC and TVA via each organization's website. The final draft EIP and its appendices, including the Sampling and Analysis Plans, have been posted to TVA's website for public access. Pursuant to the TDEC Order, there will be additional opportunities for public input and participation, including a public comment period for the Corrective Action/Risk Assessment (CARA) Plan. The comments do not provide specific suggestions to improve the current version of the EIP, which sets forth technical investigations necessary to properly evaluate coal ash impacts.
23	NA	NA	NA	NA	NA	Please contact all city officials and we get a tour bus or something and take community members to the different sites and explain each situation in details. And please connect with area churches to make sure all parties and community stakeholders are involved. If help is needed for this feel free to contact me and I will assist.	January 17, 2019	Postcard Comment - Anthony Hardaway	TVA and TDEC will continue to address community questions and concerns about the Allen Fossil Plant environmental activities with ongoing public information sessions, community outreach efforts, information materials and will also provide additional opportunities to meet with TVA technical representatives, as requested.
24	NA	NA	NA	NA	NA	What we want a. A clean up of coal ash ponds and surrounding areas.	January 23, 2019	Comments - Mallory Heights CDC	a. TVA is working to meets its obligations to address environmental conditions at the site. Through various programs overseen by TDEC (including the TDEC Order, RI, and Environmental Impact Statement, EIS), TVA is evaluating potential closure activities for the former CCR disposal units and will seek public comment throughout the process. An appropriate response will be selected that considers public input and is protective of human health and the environment.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
						b. A grey water solution for cooling the new power plant.			b. Please note that operations of the Allen Combined Cycle plant (ACC, also known as the new gas plant) are outside the scope of this EIP. TVA has considered several options to provide cooling water for ACC, including the use of gray water. TVA is currently purchasing water from MLGW to be used as cooling water.
						c. A pledge by TVA to improve the health and well-being of surrounding neighborhoods.			c. TVA's overarching Environmental Policy is to produce clean, reliable and affordable power, support sustainable economic growth in the Tennessee Valley and promote proactive environmental sustainability in a balanced and ecologically sound manner. TVA will apply this principle during the closure of the ALF.
25	NA	NA	NA	NA	NA	Coal Ash a. How does TVA intend to solve the problem of contaminants from the coal ash piles? (such as arsenic, lead, boron, sulfate, fluoride, and others)	January 23, 2019	Comments - Mallory Heights CDC	a. Following the completion of the environmental investigation outlined in the EIP, TVA will prepare a Corrective Action / Risk Assessment (CARA) Plan. The CARA Plan will specify the actions TVA will take at the site and the basis of those actions. Corrective measures may include (1) soil, surface water, and groundwater remediation, (2) risk assessment and institutional controls, (3) a combination of these various approaches, or (4) no further corrective action. The corrective measures will be reviewed and approved by TDEC. The proposed corrective measures will also be made available for public comment.
						b. What will TVA do with the coal ash?			b. Based on the result of the EIS, CCR will either be capped per regulatory requirements and left within the footprint of the current unit (Closure In Place) or removed from the site for beneficial reuse and/or disposal at a permitted landfill (Closure By Removal).

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
						c. How will TVA clean the contaminated water in the coal ash ponds?			c. Free water within the East Ash Disposal Area will be removed, treated, tested, and discharged to the Mississippi River via a permitted outfall. This dewatering process will be performed in accordance with the requirements of the National Pollution Discharge Elimination System (NPDES).
						d. How will TVA deal with the contaminated soil underneath the ash piles?			d. During the closure process, TVA will test the soil to assure that it meets pre-established concentrations of CCR constituents that will not cause a future environmental risk if left in place.
						e. How will the neighborhood be affected or protected from the movement of coal ash, soil, or contaminants from the site?			e. Protection of surrounding areas and neighborhoods during possible movement of CCR materials will be evaluated by TVA during the EIS process. If CCR is removed from the site, it will be performed in accordance with applicable safety and traffic regulations.
						f. As a contributor to other ground and water pollution, how will TVA assist in fixing problems surrounding this site?			f. TVA is committed to meeting our environmental obligations associated with the historical operations of ALF.
26	NA	NA	NA	NA	NA	Cooling Water a. Will TVA consider using grey water (a source other than the deep Aquifer) to cool their new gas power plant? (such as wastewater, surface water, river water or shallow aquifer water)	January 23, 2019	Comments - Mallory Heights CDC	a. Although, operations of the Allen Combined Cycle (ACC, the new gas plant) plant are outside the scope of this EIP, TVA has considered several options to provide cooling water for ACC. TVA is currently purchasing water from MLGW to be used as cooling water for ACC.
						b. Will TVA conduct research and share findings of the Memphis Sand Aquifer system?			b. As part of the RI, TVA collected groundwater samples from the Memphis aquifer. The results of these samples, which were shared with the public, indicate that the Memphis aquifer has not been affected by site operations. Consequently, investigation of the Memphis aquifer is not part of the EIP.

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March 4, 2019

Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
						c. Will TVA research and share findings of the entire water eco-system at this site?			c. The information obtained during the environmental investigation will be provided to TDEC and the public. An Environmental Assessment Report (EAR) will be published following the completion of the environmental investigation.
27	NA	NA	NA	NA	NA	Health and Well-being a. Will TVA make sure that the surrounding neighborhoods are clean, safe, and free of pollution generated by 50 years of power production?	January 23, 2019	Comments - Mallory Heights CDC	a. TVA is committed to meeting our obligations associated with the historical operations of ALF. TVA is not aware of any CCR-related environmental conditions in the neighborhoods resulting from historical operations at ALF.
						b. Will TVA make an investment in surrounding neighborhoods (38109) to test for and repair any adverse effects of their coal power production?			b. Although TVA is not aware of any potential adverse effect to the surrounding area due to historical operations, we are committed to meeting our obligations associated with the historical operations of ALF. At this time, TVA is not planning to collect environmental samples in the neighborhoods near ALF.
						c. Will TVA inform local residents of major activities and completed projects?			c. TVA will routinely update local residents and officials when significant project activities are planned and completed.
						d. Will TVA consider training or hiring residents from the area for safe jobs?			d. TVA posts all open positions on its website – www.TVA.gov/Careers, which is open to all the residents. TVA will reach out to this individual to better understand their request to help direct them to the appropriate programs already in place.
						e. Will TVA provide any education to local residents on subjects such as safety?			e. TVA posts all open positions on its website – www.TVA.gov/Careers, which is open to all the residents. TVA will reach out to this individual to better understand their request to help direct them to the appropriate programs already in place.

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Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
28	NA	NA	NA	NA	NA	a. When did TDEC discover the spill (improper disposal of CCR)?	January 25, 2019	Comments - Edgar Hunt Sr.	a. The TDEC Order was not issued in response to a spill or improper CCR storage at the Allen Fossil Plant. On August 6, 2015, TDEC issued Commissioner's Order No. OGC15-0177 (TDEC Order), to the Tennessee Valley Authority (TVA), setting forth a process to investigate, assess, and address coal ash disposal sites at TVA's facilities in Tennessee.
						b. When did the arsenic leak or seek[sic] into the ground water?			b. The Allen plant began operating in the 1950s, and groundwater monitoring was not required until 2015. Elevated concentrations of arsenic in groundwater near the East Ash Disposal Area were first observed in November 2016 during routine groundwater monitoring.
						c. When did the arsenic leak or seek[sic] into the soil?			c. Elevated concentrations of arsenic in soil have not been observed at the site. The results from soil sampling during the RI indicate that arsenic concentrations in soil near the site are consistent with statewide background concentrations.
						d. When did the arsenic leak or seek[sic] into surface water?			d. Elevated concentrations of arsenic in surface water have not been observed at the site.
						e. Name the chemicals that are in the arsenic that affect the human body?			e. Arsenic is a metal that is naturally present in soil and groundwater as part of various compounds. Please refer to TVA's arsenic fact sheet, which is available on TVA's website (tva.com/ccr).
						f. What is the environmental effect that the chemicals have?			f. Arsenic occurs naturally in soil and groundwater. Leaching and dissolution of arsenic from both anthropogenic and naturally occurring media can result in the presence of dissolved arsenic in groundwater or surface water under certain conditions. The soil and groundwater results from the environmental investigation will be further evaluated in the Environmental Assessment Report (EAR), which will be published at the completion of the environmental investigation.

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						g. What are the health effects of the residents living in the community?			g. The purpose of the EIP is to evaluate possible CCR-related impacts to human health and the environment. The results of this evaluation will be provided in the EAR.
						h. How long will it take to clean the spill up?			h. The timeline for remedial actions will be developed during the CARA Plan and will depend on the selected corrective actions. Please note that TVA is already implementing Interim Response Actions for the areas with known groundwater impacts around the East Ash Pond. Additionally, TVA is currently assessing potential closure alternatives for the disposal areas that will result in long-term mitigation of potential environmental concerns. TVA's preferred alternative is closure-by-removal after dewatering, which will begin in 2019.
						i. When did the contamination take place?			i. The Allen plant began operating in the 1950s, and groundwater monitoring was not required until 2015. Elevated concentrations of arsenic in groundwater near the East Ash Disposal Area were first observed in November 2016 during routine groundwater monitoring.
						j. How many spills where discovered?			j. CCR-related "spills" have not occurred at the Allen Fossil Plant. The work performed under the TDEC Order is not in response to a "spill" at the Allen Fossil Plant.
						k. Did the contamination spill into the upper drinking water?			k. The Allen Fossil Plant is underlain by an Alluvial aquifer, which is not used for drinking water. Groundwater is present within this aquifer in a sandy zone between approximately 20 and 150 feet below ground surface. To date, the information gathered indicates that CCR-impacted groundwater is only present within the shallow portion of Alluvial aquifer (i.e., upper 40 feet).

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						l. Did the contamination spill into the lower drinking water?			l. As part of the RI, TVA collected groundwater samples from the deep Memphis aquifer, which is used as a drinking water source. The results of these samples, which were shared with the public, indicate that the Memphis aquifer has not been affected by site operations.
						m. We no longer want a facility on the Allen fossil plant to process CCR material.			m. TVA ceased operations in April 2018 and no longer generates CCR at the Allen Fossil Plant. A separate company is present onsite that recycles remaining CCR materials for reuse. This recycling is done in accordance with applicable regulations and local zoning.
						n. Can you give a timeline on groundwater (second aquifer) contaminants in interval of 10 years, starting in 1975?			n. Historical groundwater quality data will be provided with the Environmental Assessment Report (EAR) that will be published following the completion of the environmental investigation.
29	NA	NA	NA	NA	NA	I have concerns and questions about the health and environmental issues of TVA ALLEN FOSSIL PLANT investigation of the disposal of CCR and arsenic groundwater remedial investigation and contamination. I am requesting a meeting, as soon as possible with the WEST JUNCTION /WALKER HOMES COALITION.	January 25, 2019	Comments – Danny Mitchell	TVA and TDEC will continue to address community questions and concerns about the Allen Fossil Plant environmental activities with ongoing public information sessions, community outreach efforts, information materials and will also provide additional opportunities to meet with TVA technical representatives, as requested.

Table 1
TVA Allen Fossil Plant EIP
Summary of Public Comments & TVA Responses
March 4, 2019

Comment Number	Section Number	Section Title	Page	Paragraph	Line	Public Comment	Date	Source	TVA Response (March 4, 2019)
30	NA	NA	NA	NA	NA	I am requesting a meeting to be held for the coalition for concerns of health and environmental issues of residents that live in this area. We want the Report of TVA (Allen Fossil Plant) Investigation Plan, Environmental Assessment Report, Sampling and Analyses Plan and Report, Remedial Investigation Report, Coal Combustion Residual Report, (TDEC Report) and (EPA Report) for all investigation of order No. OGC15-0177 by TDEC for TVA. Also, the Arsenic Investigation report for soil, underground water, surface water and upper and lower ground aquifer.	January 28, 2019	Comments – Desma Turner	TVA and TDEC will continue to address community questions and concerns about the Allen Fossil Plant environmental activities with ongoing public information sessions, community outreach efforts, information materials and will also provide additional opportunities to meet with TVA technical representatives, as requested. The following documents are available on TVA's website for public review: • Environmental Investigation Plan (EIP), which contains the associated Sampling and Analyses Plans (SAPs) - https://www.tva.gov/Environment/Environmental-Stewardship/TDEC-Order • EIP Public Meeting Presentation - https://www.tva.gov/Environment/Environmental-Stewardship/TDEC-Order • Coal Combustion Residual Reporting - https://www.tva.gov/Environment/Environmental-Stewardship/Coal-Combustion-Residuals • Remedial Investigation (RI) Fact Sheet - https://www.tva.gov/Newsroom/Press-Releases/Fact-Sheet:-Environmental-Investigation-at-Allen-Fossil-Plant • Supplemental Remedial Investigation (RI) Report - The results of the Supplemental RI will be made available to TDEC and the public in March 2019. As outlined in the EIP, the Environmental Assessment Report (EAR) will be made available following the completion of the environmental investigation.

Comments on the plan can be submitted... Card # 1

In writing at:
TN Commissioner's Order Comment
Tennessee Valley Authority
1101 Market St. BR 4A, Chattanooga, TN 37402

Via email at: TDECorder@tva.gov
Online at:
https://www.tva.com/AllenEIP

Comments must be received by the end of the comment period, November 28, 2018.

Comments: My concern is that this is a city wide informational event with concerns that will affect all of us and I do not see good representation from the city. There is a lot of information from TVA and representatives on hand to answer our questions but the public is not well represented.

Name: Marietta Shepherd Email: sheparm26@att.net

Address: 1643 Fields Rd 38109

TVA

Comments on the plan can be submitted... Card # 2

In writing at:
TN Commissioner's Order Comment
Tennessee Valley Authority
1101 Market St. BR 4A, Chattanooga, TN 37402

Via email at: TDECorder@tva.gov
Online at:
https://www.tva.com/AllenEIP

Comments must be received by the end of the comment period, November 28, 2018.

Comments: My concern is not only that this presentation could possibly be re-vamped whereby there will be a panel and we could ask questions in a different setting. There was a lot of ~~of~~ information visually on hand. Knowledgeable TVA Reps also on hand.

Name: Marcella Shepherd Email: sheparm2@att.net

Address: 1643 Fields Rd 38109

TVA

Comments on the plan can be submitted...

In writing at:
TN Commissioner's Order Comment
Tennessee Valley Authority
1101 Market St. BR 4A, Chattanooga, TN 37402

Via email at: TDECorder@tva.gov

Online at:
https://www.tva.com/AllenEIP

Comments must be received by the end of the comment period, November 28, 2018.

Comments: Let the public Know about these meetings by Radio, television, Flyers.

Name: Ernestine Green Email:

Address: 3431 Cook 38109

TVA

Comments on the plan can be submitted...

In writing at:
TN Commissioner's Order Comment
Tennessee Valley Authority
1101 Market St. BR 4A, Chattanooga, TN 37402

Via email at: TDECorder@tva.gov

Online at:
https://www.tva.com/AllenEIP

Comments must be received by the end of the comment period, November 28, 2018.

Comments: Notify the public better Lot of information.

Name: Van Rutherford Email:

Address: 1861 W. Holmes Rd 38109

TVA

From: Searchtrack
To: CCR Comments
Subject: Allen Fossil Plant Meeting
Date: Tuesday, November 20, 2018 6:49:54 PM

TVA External Message. Please use caution when opening.

November 20, 2018

Tennessee Valley Authority
Allen Fossil Plant
Shelby Bluff Center
1500 W. Mitchell Rd.
Memphis, TN. 38109

Dear TVA,

First I'd like to state that the Public Notice that was mailed to residents of the immediate area didn't receive the mailer until a week after the meeting was held. I would have been at the meeting to ask questions about the Proposed Environmental Investigation Plan (EIP). I would like to request that a 2nd meeting be scheduled for the area residents, due to the fact that so many residents of the area didn't get the Public Notice until after the meeting. I can promise that my entire neighbor will be present.

TVA's Allen Fossil Plant effects are neighborhoods greatly with various problems that are affecting the health of residents in the area. I'm wandering if the Notices were sent out after the meeting deliberately.

Is there a video of the meeting with residents of the area present to ask questions about the EIP? If you have this video please forward a copy of it to me via email.

Please contact me in reference to the new meeting with the residents of this area that will be effected the most by whatever TVA does.

Thank you for your time and consideration of this very important matter.

Time is of the essence.

Sincerely,
Marylin Ingram

Sent from Mail for Windows 10

Name: Celestine jackson

Comments: The first thing I would like to know is why I am just receiving the notice, on today's date 11-6-2018. So I had no chance to go to the informational meeting. What is this about, in terms of how it is affecting me and my family's health. This is very disturbing, as my husband and I have only been living here for about 3 years, what does that mean for us? Try to send or email the date of the next informational meeting. Thank you. C. Jackson.

close window

TVA

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902-1401

November 14, 2018

Celestine Jackson
4900 East Shore Drive
Memphis, TN 38109

Dear Ms. Jackson,

Thank you for submitting a comment regarding TVA's Environmental Investigation Plan for the Allen Fossil Plant. I am very sorry you did not receive the postcard in advance of the meeting. The cards arrived at the Post Office for delivery on Friday, October 26. We were not aware of any delay, but have no way of determining why yours was delivered so late.

TVA operated the Allen Fossil Plant near your home until its closure last year. The plant was one of TVA's power generation facilities that provides electricity to the ten million people of the Tennessee Valley. (TVA generates the electricity that MLGW then distributes to its customers, such as yourself.)

To answer your question, there are multiple numbers of environmental studies and activities that are taking place as a part of the Allen plant closure and past operations. The meeting covered two of those: (1) the Tennessee State Environment and Conservation Order to review the current management and storage of coal combustion residuals (CCR) at the former Allen Fossil Plant and (2) the remedial investigation and proposed actions for the arsenic levels found onsite in the East Pond impoundment area at the site.

The information at the public meeting outlined the ongoing studies and investigations that will take place to determine the extent of contamination of groundwater, surface water and soil in the area to ensure that the coal ash is safely stored in order to avoid environmental impacts. This activity will include sampling groundwater wells, taking soil samples, site surveys, monitoring and checking background levels to provide data on the site and the CCR storage. Even though arsenic has been found, all of the studies show that your drinking water has not been impacted.

The information is available online at www.tva.com/Environment/Environmental-Stewardship/TDEC-Order, as well as ways in which you can provide additional comments or input. We will make sure that you are notified of any additional meetings in the future, as well as provide you with any updates or mailings concerning the environmental activities at the site. If you would like to provide an email address, you will be added to our project update distribution list.

TVA is committed to ensuring the safety and protection of the Memphis area residents and of the environment. Please know that your drinking water is safe and there are no adverse human health impacts as a result of the plant operations. If you'd like further information on your drinking water quality, please see your MLGW water quality report located at: http://www.mlgw.com/about/waterqualityreport.

Again, I'd like to apologize for the delay in your notification. I will be glad to help answer any questions you may have. Please feel to reach out to me at gerymer@tva.gov or 865-632-2911.

Sincerely,

Gail Rymer

Gail Rymer, APR, Fellow PRSA
Director, TVA Environmental Communications

Name: Pamela Green

Comments: My opinion of the meeting I attended was not carefully planned. There were more of TVA than it were of the community.
My question was how was the information of the meeting being held relayed to the surrounding community due to the fact that someone called me by telephone and informed me the night before the meeting. I advised one of TVA members that I had not received a telephone call nor did I get a mailer.
The information should have gotten to the media since the majority of the citizens in the area are elderly and most of their was of communication is through television. I also advised that another meeting should be scheduled and it should be in a group presentation form and Q and A format. This would allow the citizens to ask questions and also give input on the plan and it would clear the understanding and misunderstanding of rumors that are being passed along.

close window

From:	Vera M Holmes
To:	Rymer, Gail Elaine
Cc:	repcoop86@gmail.com; rep.barbara.cooper@capitol.tn.gov; info@malloryheightscdc.org; CCR Comments
Subject:	TVA"s Allen Fossil Plant meeting_location_time_community safety
Date:	Friday, November 02, 2018 6:00:19 PM

TVA External Message. Please use caution when opening.

Ms. Gail Rymer,

My name is Vera Holmes and I am with Mallory Heights Community Development Corporation. I met you last night November 1) as you were leaving the TVA's Allen Fossil Plant Environmental Investigation Plan community meeting.

As I approached you and your team at 7:20 p.m., I was very concerned for my safety, the location, and time of this meeting. This community meeting was already completed and dismissed. The location was very hard to find and the lighting was unappropriated for a very serious community event.

I hope Tennessee Valley Authority will help educate, engage and enlighten every household in our community about the current contamination of arsenic, lead and fluoride leaking coal ash ponds that threaten the Memphis Sand Aquifer.

Thank you in this matter.

Vera Holmes

From:	Amanda Garcia
To:	CCR Comments
Cc:	Robert.S.Wilkinson@tn.gov; "Ward Archer" (ward.archer@gmail.com); Scott Banbury (smbanbury@gmail.com); Anne Passino
Subject:	Comments of Protect Our Aquifer and Sierra Club re: Allen EIP rev 2
Date:	Wednesday, November 28, 2018 3:18:40 PM
Attachments:	2018-11-28 POA and SC Comments on Allen EIP rev2.PDF

TVA External Message. Please use caution when opening.

Please find attached the comments of Protect Our Aquifer and Sierra Club regarding the Allen Fossil Plant Environmental Investigation Plan revision 2.

The analysis of Douglas J. Cosler, Chemical Hydrogeologist, is included in the attached comments as Attachment 1.

Additional attachments are available here:
https://southernenvironment.sharefile.com/d-s45c309aecc543f1a

Amanda Garcia
Senior Attorney
Southern Environmental Law Center
1033 Demonbreun St., Ste. 205
Nashville, TN 37203
615-921-9470
agarcia@selctn.org

SOUTHERN ENVIRONMENTAL LAW CENTER

Telephone 615-921-9470 | 1033 DEMONBREUN STREET, SUITE 205
NASHVILLE, TN 37203 | Facsimile 615-921-8011

November 28, 2018

Submitted via TDECorder@tva.gov

Re: Tennessee Department of Environment and Conservation Commissioner's Order: Environmental Investigation Plan, Revision 2, Allen Fossil Plant

On behalf of Protect Our Aquifer and the Tennessee Chapter Sierra Club, the Southern Environmental Law Center respectfully submits the following comments on the draft Environmental Investigation Plan, Revision 2, for the Allen Fossil Plant (EIP). In support of our comments, we also submit the attached analysis of Douglas J. Cosler, Ph.D., Chemical Hydrogeologist, Adaptive Groundwater Management, LLC (Cosler Report).[1]

Our comments are focused on TVA's failure to properly interpret and incorporate the data it obtained through the Remedial Investigation (RI) and related United States Geological Survey and University of Memphis Center for Applied Earth Science and Engineering Research (USGS/CAESER) pumping test. The RI was required by the Tennessee Department of Environment and Conservation (TDEC) after TVA disclosed arsenic levels at 300 times the groundwater protection standard under its East Ash Pond at the Allen Plant. The RI and USGS/CAESER data indicate that there is a current risk of ongoing coal ash contamination in the Memphis Sand Aquifer and McKellar Lake due to TVA's storage of coal ash in the leaking, unlined East Ash Pond and consequent coal ash contamination of the alluvial aquifer. Neither the RI itself nor the EIP acknowledge

[1] Att. 1, Douglas J. Cosler, Risk of Contamination of the Memphis Sand Aquifer, Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action (November 26, 2018) [Cosler Report]; Att. 2, Resume of Douglas J. Cosler, Ph.D.

this current and ongoing risk, and therefore do not outline appropriate next steps in the ongoing investigation of coal ash contamination at the Allen Plant site.

TVA's failure to properly interpret the RI and USGS/CAESER data and characterize the current and ongoing risk of coal ash contaminant transport into the Memphis Sand Aquifer and McKellar Lake casts serious doubt on whether the EIP will achieve the stated objective of the Commissioner's Order to "fully identify the extent of soil, surface water, and ground water contamination by CCR."[2] This failure is deeply concerning because TVA's coal ash contamination threatens pollution of the Memphis Sand Aquifer, the primary drinking water source for the City of Memphis and Shelby County. TVA's coal ash pollution also further burdens McKellar Lake, a water body that struggles with legacy and current pollution from many sources. Rather than addressing TVA's contribution to this pollution, the EIP proposes to simply decline to look for it.

The ultimate goal of the process set forth in the Commissioner's Order is to remediate "unacceptable risks, resulting from the management and disposal of coal combustion residuals…."[3] Ostensibly, the RI shares this goal at the Allen Plant. However, based on the analysis presented in the RI and EIP, we have little confidence that the process will achieve its goal of remediating the risk of coal ash pollution in the Memphis Sand Aquifer and McKellar Lake. Instead, the RI and the EIP appear to be designed *not* to acknowledge the implications of the existing data or to accurately characterize the scope and extent of the contamination that is already occurring on the site.

To restore the public's trust and to meaningfully address the coal ash contamination at the Allen Plant, TVA must acknowledge the implications of the data gathered through the RI and USGS/CAESER report and redesign the RI and EIP accordingly.

[2] Att. 3, Tennessee Department of Environment and Conservation, In the Matter of Tennessee Valley Authority, Order No. OGC15-0177, Sec. VII.A.d (Aug. 6, 2015) [Commissioner's Order].
[3] *Id.* Preamble.

<u>Data Already Gathered Through the RI and USGS/CAESER Should Be Disclosed and Appropriately Analyzed in the EIP.</u>

In the summer of 2017, TDEC publicly disclosed that groundwater under TVA's East Ash Pond at the Allen Plant was exceeding the groundwater protection standard for arsenic by more than 300 times, as well as standards for lead and fluoride. Alarmed by the high levels of a cancer-causing toxin, TDEC required TVA to perform the RI, with a particular focus on the potential for the contaminated groundwater to be pulled into the Memphis Sand Aquifer, the primary drinking water source for the City of Memphis and Shelby County. As part of the RI, TVA engaged USGS and CAESER to conduct a pumping test to evaluate the hydraulic connectivity between the shallow, contaminated aquifer and the Memphis Sand Aquifer. After months of delay, TVA submitted the RI to TDEC in March 2018.[4] The USGS/CAESER portion of the RI, which was subsequently independently published by USGS and CAESER, concludes that the shallow, contaminated groundwater is connected to the Memphis Sand Aquifer.[5]

Meanwhile, despite the ongoing RI, early versions of the EIP submitted by TVA to TDEC contained no meaningful discussion of the RI or the condition of contamination that led to TDEC requiring it.[6] The current version of the EIP, revision 2, which was submitted to TDEC after USGS and CAESER made their findings, references the RI, but does not incorporate any data from the RI or the USGS/CAESER findings into the baseline characterization of the Allen site or the EIP investigation design. Nor does the EIP acknowledge the central finding of USGS/CAESER, which is that the contaminated shallow aquifer is hydraulically connected to the Memphis Sand Aquifer.

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[4] Att. 4, Stantec, Draft TVA Allen Fossil Plant-East Ash Disposal Area-Remedial Investigation Report (March 6, 2018) [RI Report].
[5] *Id.*, App. E; *see also* Att. 5, Carmichael, J.K., Kingsbury, J.A, Larsen, Daniel, and Schoefernacker, Scott, 2018 Preliminary evaluation of the hydrogeology and groundwater quality of the Mississippi River Valley alluvial aquifer and Memphis aquifer at the Tennessee Valley Authority Allen Power Plants, Memphis, Shelby County, Tennessee: U.S. Geological Survey Open-File Report 2018-1097, 66 p., https://doi.org/10.3133/ofr20181097 [USGS/CAESER Report].
[6] See EIP at p. 1, Section 1.0 (describing revisions of EIP).

Indeed, although the EIP includes the RI Work Plan as an appendix, it does not include the RI itself, or the USGS/CAESER report. Instead, TVA states: "Based on the similarities between the RI activities and the TDEC Order EI objectives, TVA plans to provide the results of the investigations in the TDEC Order EAR."[7] According to TVA's proposed schedule, it will not submit a draft EAR to TDEC until late August 2020.[8]

Rather than disclosing the crucially important implications of the RI and USGS/CAESER data, the EIP alternately ignores or obfuscates it. For example, section 1.2 of the EIP, which purports to set forth "a summary of events related to the TDEC Order," completely omits the disclosure of high levels of arsenic and other coal ash pollution at the Allen Plant, TDEC's requirement that TVA conduct the RI, and other significant milestones in the RI, including its submission to TDEC and TDEC's requirement that TVA implement a supplemental RI and interim remedial action. Similarly, section 1.3 of the EIP, which purports to set forth "a summary of the proposed EIP process" for Allen, includes no discussion of any additional activities to be performed under the RI or how the data and results of the RI will be integrated into the EIP process. Section 3.3.1 of the EIP, to which several other sections of the EIP refers, contains a bare description of activities conducted under the RI and states that the results of these activities "will provide information to address many of TDEC's requests for the TDEC Order EIP."

As discussed in detail below and in the attached Cosler Report, data already gathered through the RI and USGS/CAESER research reveal conditions at the Allen site that indicate a current and ongoing risk of coal ash contamination of the Memphis Sand Aquifer and McKellar Lake. To achieve the objectives of the RI and the Commissioner's Order, the RI and EIP design must be revised to disclose and meaningfully integrate these data.

[7] *See* EIP at p. 18, Section 3.3.1.
[8] *Id.* App. A (Proposed EIP Schedule).

The RI and USGS/CAESER Data Indicate a Current and Ongoing Risk of Contamination of the Memphis Sand Aquifer, Which Should Form the Basis for Further Investigation in the RI and EIP.

Despite the key finding of USGS/CAESER that the contaminated alluvial aquifer and the Memphis Sand Aquifer are hydraulically connected,[9] the RI erroneously concludes that there is no risk of coal ash contamination migrating to the Memphis Sand Aquifer.[10] The RI also fails to accurately characterize the extent of the existing coal ash contaminant plume by selectively including only data for arsenic, fluoride and lead, and by failing to take into account additional indicators of downward groundwater flow at the site.[11]

Our independent review of the data from the RI and USGS/CAESER support the following key findings:

- There is a hydraulic connection between the Mississippi River Valley Alluvial (MRVA) Aquifer and the Memphis Sand Aquifer;
- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;
- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;

[9] USGS/CAESER Report, 44 ("The aquifer-test results indicate that the MRVA and Memphis aquifers are hydraulically connected in the TVA plants area.").
[10] RI, ES-i ("The north and south areas of affected groundwater are not impacting the Memphis aquifer or the public drinking water supply.")
[11] *Id.*, ES-i ("Sampling confirmed the highest concentrations of arsenic, fluoride and lead were limited to the north and south areas, primarily within the upper 40 feet of the shallow Alluvial aquifer. The aquifer is over 100 feet thick. Groundwater flow in the aquifer is essentially horizontal and is not moving downward.")

- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;

- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;

- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;

- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring; and

- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand.

The technical bases for these findings are set forth in the Cosler Report, which is incorporated into these comments by reference.

Based on these findings, we recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;

- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;

- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial distribution of CCR contamination (including all Appendix III and IV constituents required to be monitored under the federal Coal Combustion Residuals Rule),[12] the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;

- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;

- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;

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[12] 40 C.F.R. § Pt. 257, App. III (Boron, Calcium, Chloride, Fluoride, pH, Sulfate, Total Dissolved Solids (TDS)); *id.* App. IV (Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Fluoride, Lead, Lithium, Mercury, Molybdenum, Selenium, Thallium, Radium 226 and 228 combined).

- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and

- Redesign the interim remedial action as further discussed in the Cosler Report.

Without these significant changes, the RI and EIP risk allowing TVA's leaking, unlined coal ash pits at Allen to pollute public drinking water resources and nearby surface water now and far into the future. This result is contrary to the intent of the Commissioner's Order as well as state and federal laws that protect our clean water from coal ash pollution.

<u>The EIP Must Include Investigation of Coal Ash Pollution in McKellar Lake and Other Surface Water Bodies.</u>

Data presented in the EIP, RI and USGS/CAESER report strongly indicate that coal ash pollution is moving from the East Ash Pond and groundwater beneath the East Ash Pond into McKellar Lake. As described in the Cosler Report, the RI underestimates the transport rate of coal ash pollution into McKellar Lake because it does not properly characterize the groundwater flow. In addition, the EIP describes historic and current seeps through the berms of the East Ash Pond and West Ash Pond.[13] Despite these data, in the EIP TVA states that it is not planning to undertake investigation of surface water or sediment impacts in McKellar Lake or other surface water bodies including Nonconnah Creek.[14] TVA's primary justification for omitting investigation of the impacts its coal ash pollution is having on McKellar Lake is that the lake is polluted by many sources.[15] The fact that McKellar Lake may be polluted by other sources does not give TVA a free

[13] EIP, p. 24, Sec. 3.42 (West Ash Pond); pp. 29-31, Sec. 3.5.5 (East Ash Pond).
[14] EIP, pp. 62-67.
[15] *Id.* at 63-64.

pass to add to its pollutant load additional arsenic, lead, boron and other coal ash contaminants.

The Commissioner's Order requires investigation and remediation of surface water impacts.[16] TVA must investigate the full extent of its contamination of McKellar Lake, Nonconnah Creek, and other nearby surface water bodies.

The Timeline to Begin Remediation Is Unacceptable.

The Commissioner signed the Order on August 7, 2015. By the time TVA and TDEC respond to comments and finalize the EIP, it will have taken more than three years to delineate the scope and terms of the environmental investigation at the Allen Plant. The timeline proposed by TVA and TDEC includes an additional two years until TDEC approves any Environmental Assessment Report prepared by TVA, and even longer before TDEC requires TVA to actually implement a corrective action plan at the site. In other words, it will have taken at least five years since the issuance of the Order to even *begin* a discussion about appropriate corrective action to address pollution we already know has occurred and is occurring at the site.

The record shows that TVA has repeatedly submitted manifestly inadequate EIP drafts, despite the relatively clear mandate of the Order to comprehensively investigate and address coal ash contamination at the Allen Fossil Plant. The record of TDEC's comments and TVA's successive draft EIP revisions speaks for itself.[17]

TDEC should not countenance continued foot-dragging by TVA, at either the Allen Fossil Plant or the other six sites covered by the Order, including Cumberland Fossil Plant, Bull Run Fossil Plant, Kingston Fossil Plant, Johnsonville Fossil Plant, John Sevier Fossil Plant, and Watts Bar. The citizens of

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[16] Commissioner's Order, Sec. VII.A.d ("Each EIP shall include a schedule of the work to be performed to fully identify the extent of soil, *surface water*, and groundwater contamination by CCR.")(emphasis added); *id.* Sec. VII.A.f ("As appropriate for the site, the final approved CARA plan shall include:…(ii) the method(s) TVA will employ to remediate CCR contaminated soil, *surface water*, and ground water at the site.") .")(emphasis added)).
[17] *See* EIP, App. B (regulatory correspondence).

Tennessee have waited nearly a decade since the catastrophic Kingston coal ash for TVA to fulfill its promise to clean up its coal ash and protect our clean water. Another decade of waiting is unacceptable.

The EIP Lacks Analysis of Existing Information.

As discussed above and in the Cosler Report, TVA already has significant existing data in its possession regarding issues such as hydrogeology, groundwater contamination, and other subjects it is required to study under the Order. Setting aside the vitally important omission of data from the RI and USGS/CAESER, the EIP in general simply identifies and lists existing data sources and states that TVA plans to analyze this existing data over the next year. It should not have taken TVA three years to simply identify existing sources of information. Instead, TVA should have analyzed and discussed what it already knows based on existing data and identified discrete areas for additional investigation. TVA's apparent refusal to date to analyze data already in its possession has resulted in unnecessary delay and will continue to do so with respect to the EIP for the Allen site.

In this EIP and EIPs for the other six sites, TDEC should require TVA to analyze and synthesize data it already possesses *in the EIP itself*, rather than deferring such analysis until later in the process. To the extent that TDEC is concerned about the quality of TVA's existing data, TDEC can identify such concerns as a basis for requiring further investigation. This process should happen at the outset of the EIP, not after the EIP has already been adopted and is being implemented by TVA.

The EIP Artificially Segregates Data and Information Obtained in Other Regulatory Processes.

One of the stated purposes of the Order is to ensure that TVA implements the federal Coal Ash Rule in a manner that ensures coordination and compliance with Tennessee laws governing the management and disposal of coal ash, including the Tennessee Solid Waste Disposal Act, and the Tennessee Water Quality Control Act. But the EIP makes little to no effort to analyze and synthesize data and analysis TVA is required to produce under the federal Coal Combustion Residuals Rule (Coal Ash Rule). The Order includes provisions for

TVA to notify TDEC when TVA posts Coal Ash Rule information pursuant to the Rule. Why isn't this information being incorporated into the EIP? Again, if TDEC has concerns about the quality of TVA's Coal Ash Rule data and its adequacy to comply with TVA's obligations under state law, those concerns should be explicitly identified in the EIP and dealt with through additional investigation. The potentially relevant data sets and analysis from TVA's implementation of the Coal Ash Rule should not simply be ignored or segregated as irrelevant to the project of evaluating the scope of the impacts of TVA's coal ash management practices.

The EIP also does not explain how data and corrective action processes required by the Remedial Investigation will interact with the EIP and corrective action requirements in the Order. Nor does the EIP explain how information TVA discloses and analyzes under NEPA will be considered or integrated into these requirements.[18]

[18] TVA issued a record of decision for closure of the West Ash Pond in July 2016. *See* https://www.tva.gov/file_source/TVA/Site%20Content/Environment/Environmental%20Stewardship/Environmental%20Reviews/Closure%20of%20Coal%20Combustion%20Residual%20Impoundments/2016-0729%20Ash%20Impoundment%20Closure%20Final%20ROD.pdf; *see also* TVA, Final Ash Impoundment Closure Programmatic EIS, Part II Site-Specific Review, Allen Fossil Plant (June 2016), https://www.tva.gov/file_source/TVA/Site%20Content/Environment/Environmental%20Stewardship/Environmental%20Reviews/Closure%20of%20Coal%20Combustion%20Residual%20Impoundments/Final%20EIS%20Part%20II-Allen%20Fossil%20Plant.pdf. TVA has indicated in recent SEC filings that it also intends to prepare NEPA documents related to the closure of the East Ash Pond. *See* Att. 6, Tennessee Valley Authority, U.S. Securities and Exchange Commission, Form 10-Q, 24 (August 2, 2018) ("TVA is expected to begin a NEPA review process at Allen Fossil Plant in October 2018 to analyze closure alternatives to support a final TVA decision on the appropriate closure methodology.")

The Commissioner's Order Process Lacks Transparency and Accessibility of Information.

A stated purpose of the Order is to develop a *transparent* process for investigating and remediating coal ash contamination at the seven sites that are subject to the Order. But most of the correspondence, data, and other information that has been or will be generated is not easily available to the general public.[19] Both TVA and TDEC have well-established websites for hosting large amounts of information. TVA has a CCR Rule compliance website. TDEC Division of Solid Waste has a data viewer. Either of these platforms could be used to post correspondence and comments exchanged between these two public entities regarding implementation of the Order, as well as data that is generated as part of the investigation. Such a publicly-accessible site could also host important technical documents that serve as protocols for TVA's implementation of the Order. This is important because, in response to a recent open records request, the Southern Environmental Law Center learned that not even TDEC appears to have all of the relevant protocols TVA will employ in its investigation.[20] TDEC provided only ten of the seventeen technical protocols we requested, and did not have TVA's protocols for, among other things, sediment sampling and obtaining biological samples, such as mayflies and fish.

The EIP also states that TVA will submit periodic EIP progress reports. These reports are described as providing updates on timelines and milestones. To keep the public and TDEC adequately informed of current environmental conditions at the site, the reports should include interim analytical results and data. Such periodic technical updates are imperative to ensure public health and environmental quality. For example, TVA withheld from TDEC and the public for several months disclosure of arsenic contamination at 300 times the groundwater protection standard at the Allen Fossil Plant, even though the contamination put the

[19] Despite the stated intent of the Commissioner's Order to provide a transparent process, to date, Protect Our Aquifer and Sierra Club have obtained access to most information related to the RI and EIP through public records requests independent of the Commissioner's Order process itself.
[20] Att. 7, Letter from Christina Reichert, SELC, to Joe Sanders, TDEC, re: Tennessee Open Records Act Request for Documents Cited in TVA Cumberland Environmental Investigation Plan, Revision 3 (May 8, 2018); Att. 8, Email from Melanie Vanderloop, TDEC, to Christina Reichert, SELC, re: Public Records Request (May 10, 2018).

City of Memphis's drinking water source at risk. We strongly urge TDEC to prevent this type of behavior from recurring by requiring greater transparency in the EIP process.

Sincerely,

Amanda Garcia
Senior Attorney
Southern Environmental Law Center

/s with permission
Ward Archer
President
Protect Our Aquifer

/s with permission
Scott Banbury
Conservation Program Coordinator
Tennessee Chapter Sierra Club

Attachment 1, Cosler Report, attached to this letter.

Additional attachments available via ShareFile at the following link:
https://southernenvironment.sharefile.com/d-s45c309aecc543f1a

ATTACHMENT 1

Risk of Contamination of the Memphis Sand Aquifer Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action

Memphis, Tennessee

Douglas J. Cosler, Ph.D.

Chemical Hydrogeologist
Adaptive Groundwater Solutions LLC
Charlotte, North Carolina

November 26, 2018

Executive Summary

The Environmental Investigation Plan, revision 2, for the Allen Fossil Plant (EIP) repeatedly refers to data collected and analyses performed pursuant to the Remedial Investigation (RI). See, for example, Sections 3.3 (Groundwater Monitoring), 3.8 (Migration of Constituents via Groundwater and Identification of Uppermost Aquifer), 4.3.3, 4.3.4, 4.3.5, 4.3.6, and 4.3.7 (Groundwater Monitoring and Mapping Requests). The RI data and analyses are not, however, included in the EIP. Instead, in the EIP, TVA states: “Based on the similarities between the RI activities and the TDEC Order EI objectives, TVA plans to provide the results of the investigations in the TDEC Order EAR.” [EIP at page 18 in Section 3.3.1]. This report addresses fundamental flaws in the RI that also affect data collection and analyses referenced in the EIP.

The RI was conducted pursuant to the request of the Tennessee Department of Environment and Conservation (TDEC) after Tennessee Valley Authority (TVA) reported elevated concentrations of arsenic and other Coal Combustion Residual (CCR) constituents in the Mississippi River Valley Alluvial (MRVA) aquifer at the Allen Fossil (ALF) Plant, adjacent to the new Allen Combined Cycle (ACC) Plant in southwest Memphis, Shelby County, Tennessee (Figure 1). In particular, TDEC requested that TVA evaluate the effects of pumping the five new Memphis aquifer production wells installed at the ACC Plant to evaluate potential hydraulic interconnection of the MRVA and Memphis Sand aquifers and possible leakage of groundwater from the overlying MRVA aquifer into the Memphis Sand. As a result, TVA requested that the U.S. Geological Survey (USGS) and the University of Memphis’ Center for Applied Earth Science and Engineering Research (CAESER) jointly investigate the hydrogeology and groundwater conditions in the area. TVA also retained Stantec to conduct a Remedial Investigation (RI) and prepare a RI Report (Stantec, 2018a) for the TVA ALF Plant that discusses the nature and extent of potential contamination in the MRVA aquifer.

As TVA acknowledges in the EIP, the RI and the data upon which it is based are vitally important to accomplishing the objectives outlined in the Commissioner’s Order. These objectives include to (1) fully identify the extent of soil, surface water, and groundwater contamination by CCR constituents (Section VII.A.d); (2) adequately characterize the extent of CCR contamination in soil, surface water, and groundwater at [Allen] (Section VII.A.e); (3) remediate CCR-contaminated soil, surface water, and groundwater at [Allen] (Section VII.A.f.ii); and (4) protect public and private water supplies from CCR contamination (Section VII.A.f.v). In my opinion, to achieve the stated objectives of the EIP—to fully identify the extent of soil, surface water and groundwater contamination by CCR constituents at Allen—it is vitally important to disclose and understand the data provided through the RI process and its implications.

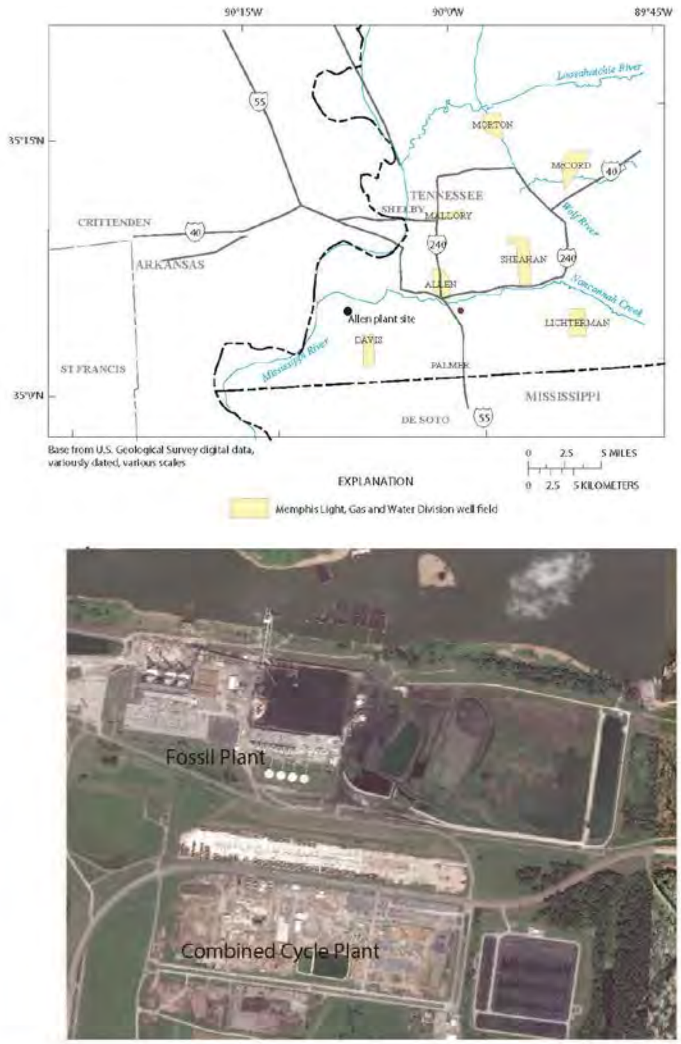

Figure 1

Locations of the ALF and ACC Plants in Southwest Memphis, Tennessee (Stantec, 2018a)

In the report that follows, I describe my independent review of the data collected and analyses performed pursuant to the RI and the related USGS-CAESER pumping test in the Memphis Sand. In particular, I evaluate the implications of the data for the risk of contamination of the Memphis Sand Aquifer by CCR constituents present in the MRVA aquifer at the Allen Plant. I also evaluate the risk of contamination of McKellar Lake via groundwater transport of CCR constituents. Data sources that I evaluated include the RI report, USGS-CAESER pumping test report (USGS, 2018), and various referenced USGS regional groundwater investigations and groundwater modeling studies.

My independent evaluation of the RI and USGS-CAESER data leads me to make the following findings:

- There is a hydraulic connection between the MRVA Aquifer and the Memphis Sand Aquifer;
- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;

- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;
- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;
- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;
- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;
- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring;
- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand;

Based on these findings, I recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;
- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;
- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial distribution of CCR contamination (including all Appendix III and IV constituents), the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;
- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;
- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;
- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and
- Redesign the interim remedial action as further discussed in this report.

Investigations of Leakage from MRVA Aquifer into Memphis Sand

The USGS has conducted multiple hydrologic investigations which evaluate the potential for vertical groundwater flow and chemical transport between the MRVA and the Memphis Sand Aquifer (i.e., inter-aquifer exchange of groundwater) in the vicinity of the Allen plants (USGS, 1986; USGS, 1990; USGS, 1992; USGS, 1995; USGS, 2016; USGS, 2018). [Note: Vertical geologic cross-sections showing the alluvial and Memphis Sand aquifers, separated by a confining unit (absent in some areas), are presented below]. This issue is the subject of EIP Sections 3.3.5, 3.3.6, 4.3.3, 4.3.6, 4.3.7, and 4.4.2.

The 1986 USGS investigation analyzed the following types of data in the Memphis area: geologic information; groundwater-level data; carbon and hydrogen isotope concentration data; and groundwater temperature data. One of the key findings of the 1986 USGS study was that the hydraulic head (i.e., groundwater "driving force") in the uppermost water-table aquifers (including the MRVA) is greater than or equal to the hydraulic head in the Memphis Sand Aquifer in the Memphis urban area (Figure 2), including

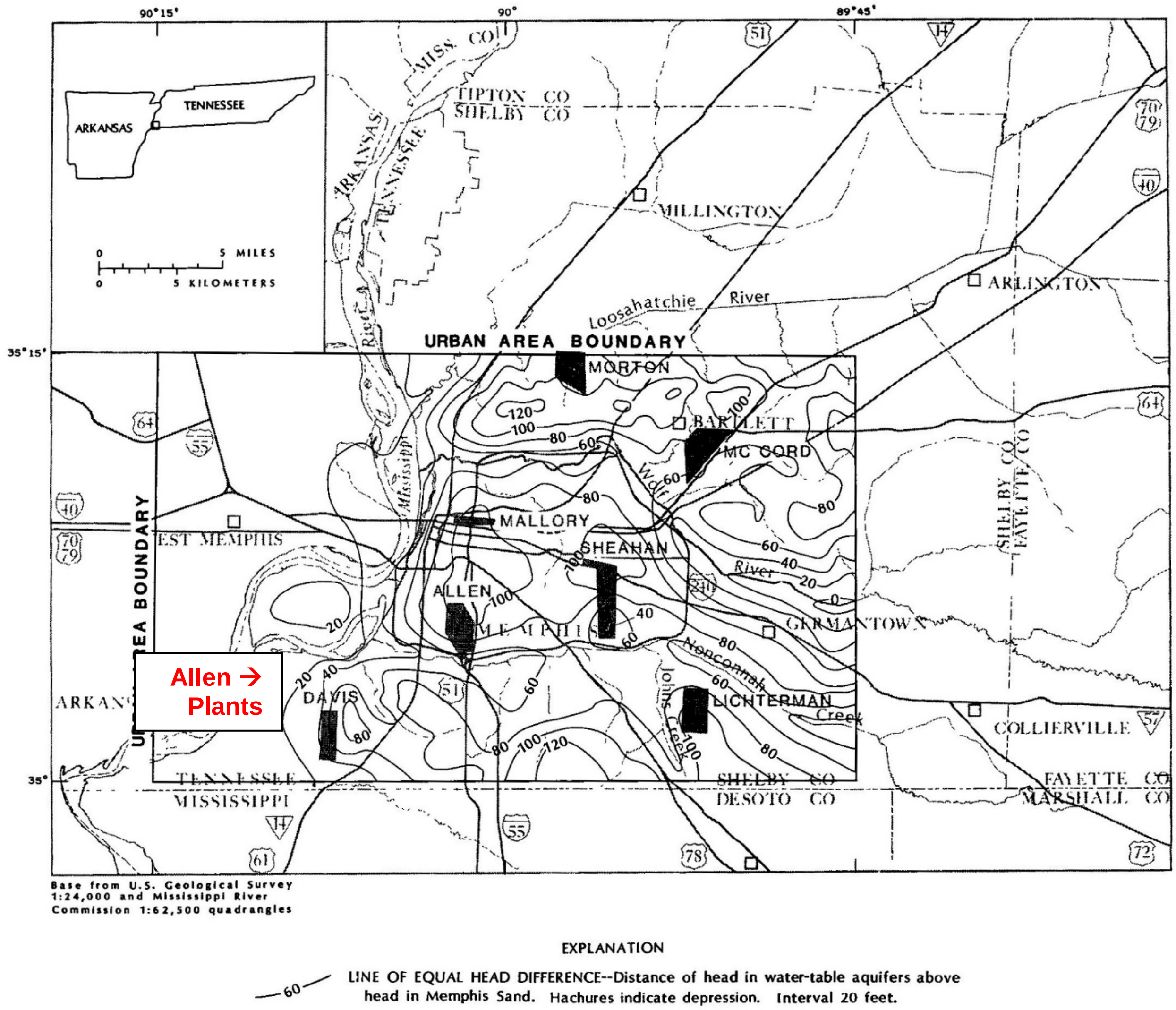

Figure 2

Hydraulic Head Differences between the Water-Table Aquifers and the Memphis Sand in the Memphis Urban Area, Fall 1984 (from USGS, 1986; locations of Memphis Light, Gas, and Water well fields are shown as black-filled polygons)

the Allen site. Specifically, the water-table aquifer hydraulic heads range from about 20 feet (e.g., near the Allen site) to 130 feet greater than the heads in the Memphis Sand. Therefore, throughout this area the vertical hydraulic gradient is downward toward the Memphis Sand, as is the associated vertical direction of groundwater flow. The hydraulic-head differences are greater in areas where water-supply wells extract significant amounts of groundwater from the Memphis Sand and generally smallest near the Mississippi River and major streams, where the water-table elevation (e.g., MRVA aquifer near the Allen plants) is lower. The USGS (1986) has also identified localized reductions in hydraulic head in the upper alluvial aquifers due to Memphis-Sand groundwater extraction in areas where breaches in the confining layer (separating the alluvial and Memphis Sand aquifers) have been identified (further discussed below). Geothermal gradients computed from groundwater temperature data confirm that vertical leakage occurs from the water-table aquifers through the Jackson-upper Claiborne confining unit to the Memphis Sand. This groundwater leakage rate is greatest in areas where the hydraulic head in the Memphis Sand is depressed due to groundwater extraction. The vertical distribution of carbon-14 concentrations in groundwater generally confirm this vertical-leakage pattern.

The 1990 and 1995 USGS investigations identified “windows”, or discontinuities, in the upper Claiborne confining unit separating the MRVA and Memphis aquifers (Figure 3). One inferred window is located

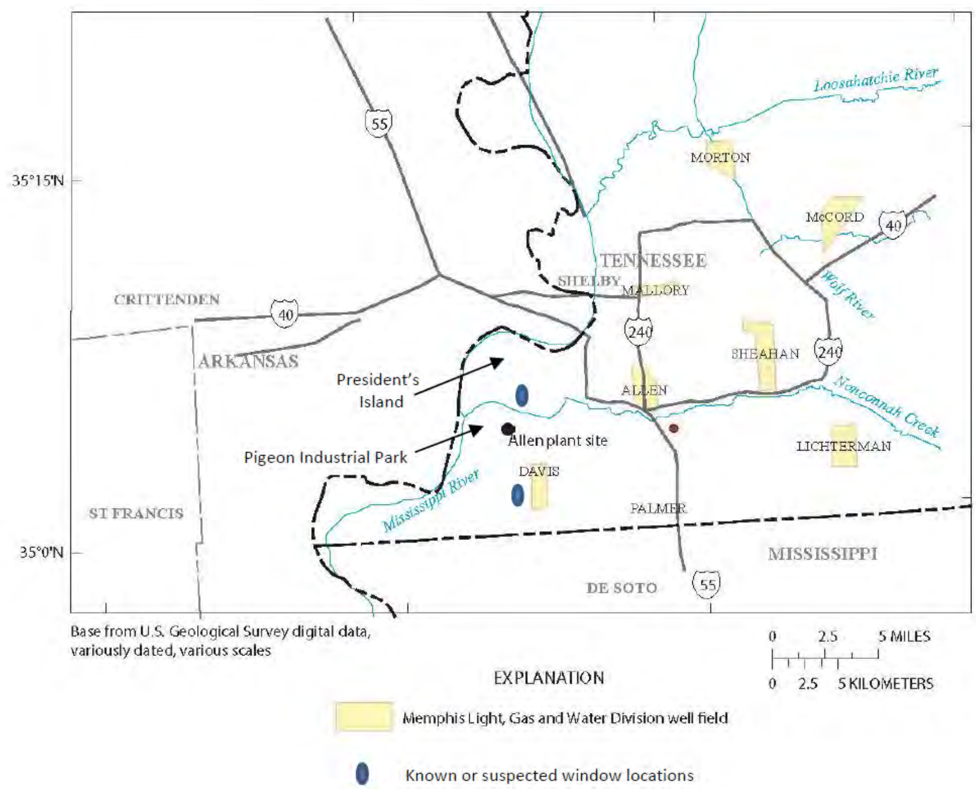

Figure 3
Known or Suspected Windows in Upper Claiborne Confining Unit
(from Appendix E of RI Report)

beneath President’s Island one mile northeast of the Allen plants. A second window was identified about three miles south of the Allen plants and west of the Davis Well Field, where downward groundwater leakage from the MRVA to the Memphis aquifer was documented (USGS, 1995; Koban et al., 2011). As summarized in Appendix E of the Remedial Investigation report (Stantec, 2018a), downward leakage from the shallow water-table aquifers into the Memphis Sand Aquifer has been identified at several other locations in the Memphis area based on shallow-aquifer water-table lowering, water-quality changes in the Memphis aquifer, and/or hydrologic tracer studies (USGS, 1986; USGS, 1992; Larsen et al., 2003; Gentry et al., 2005; Gentry et al., 2006; Ivey et al., 2008; Larsen et al., 2013; Larsen et al., 2016).

The 2016 USGS report summarizes the results of a regional groundwater modeling study in which the USGS Mississippi Embayment Regional Aquifer Study (MERAS) groundwater-flow model (Clark and Hunt, 2009) was used to simulate the potential effects (i.e., hydraulic-head decreases caused by pressure reductions related to pumping) of future groundwater withdrawals from the Memphis Sand Aquifer at the proposed Allen combined-cycle plant (potential groundwater-quality changes were not analyzed). The groundwater extraction scenario for the simulation was a 30-year average withdrawal of 2,500 gallons per minute (gpm), followed by a 30-day maximum expected withdrawal rate of 5,000 gpm. The simulated hydraulic head reduction (Figure 4) in the Memphis Sand after the average 30-year period was as large

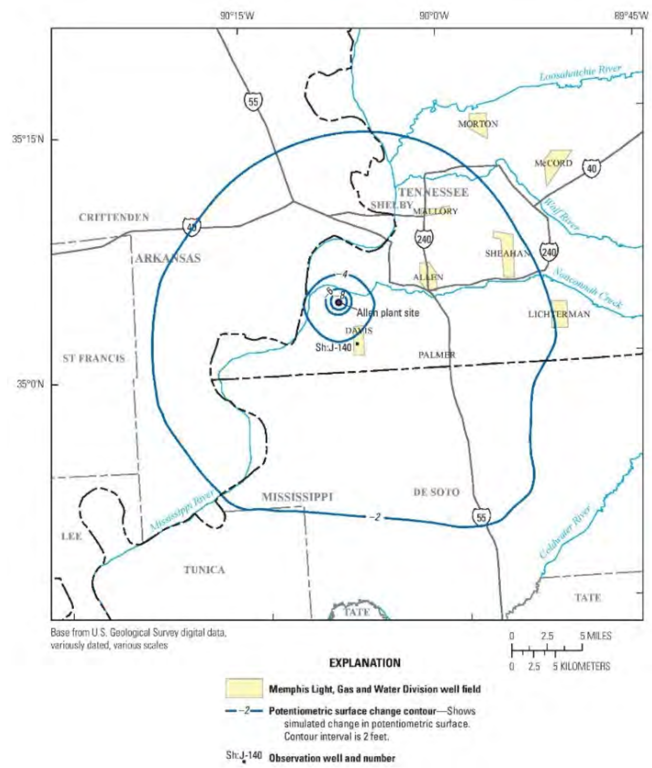

Figure 4
Simulated Hydraulic Head Change in Memphis Sand Aquifer
at End of TVA Withdrawal Scenario for ACC Plant (from USGS, 2016)

as 7 feet; the Memphis-Sand head reductions after the 30-day maximum-withdrawal period were up to 11 feet. Hydraulic head reductions in the shallow MRVA aquifer did not exceed one foot. Note that the MERAS model did not incorporate recent hydrogeologic information from the RI or the 2018 USGS-CAESER study (USGS, 2018).

USGS-CAESER Hydrogeologic Investigation and Groundwater-Pumping Test

Introduction

The objectives of the USGS-CAESER investigation were to evaluate (i) the potential for hydraulic connection between the MRVA and Memphis Sand aquifers and (ii) the potential for water-quality impacts in the Memphis Sand Aquifer due to groundwater leakage from the MRVA aquifer. In addition to the MRVA-aquifer monitoring wells installed by Stantec for the RI, four deep stratigraphic borings were also drilled into the upper Memphis aquifer to determine the thickness of the confining unit. USGS-CAESER correlated geophysical logs from TVA production wells, and other historical wells in the study area, with site boring logs to develop a conceptual hydrogeologic model of the study area. Field investigations also included groundwater sampling and a 24-hour pumping test during which as much as 5,000 gpm was extracted from the Memphis aquifer. The results of the USGS/CAESER investigation are presented in Appendix E of the RI report (Stantec, 2018a) and by USGS (2018). The following is my discussion of specific investigation results that are particularly relevant to the evaluation of the risk of groundwater contamination in the Memphis Sand Aquifer by CCR constituents present in the MRVA aquifer in the vicinity of the Allen plants.

Results

The most important finding of the USGS/CAESER investigation is that the MRVA and Memphis Sand Aquifers are hydraulically interconnected in the Allen plant area due to the presence of a window or breach in the confining (upper Claiborne) unit separating the two aquifers. Significantly, during the Memphis-aquifer pumping test hydraulic head reductions (drawdown) were observed in several overlying MRVA monitoring wells at both Allen plants. Figure 5 is a contour map of estimated maximum drawdown in MRVA wells related to the pumping test. Drawdown in the MRVA aquifer ranged from 0.1 feet near McKellar Lake to 0.5 feet in the southeastern part of the ALF Plant and along the eastern part of the ACC Plant. It is important to note, per my discussion below, that no drawdowns at any MRVA monitoring wells should have been measured if the confining unit was continuous across the site. Therefore, as USGS/CAESER conclude, these Alluvial aquifer drawdowns indicate that an area of downward leakage from the MRVA to the Memphis Sand aquifer is present in this general vicinity.

Figure 5

Estimated Drawdown in MRVA Aquifer Monitoring Wells During Memphis Aquifer Pumping Test (values in black, contours in blue; from USGS, 2018)

The hydraulically-identified window, or breach, in the confining unit is consistent with the findings of the refined site geologic conceptual model developed by USGS/CAESER. Figure 6 shows the locations of geologic cross-sections developed as part of the conceptual model for the ALF and ACC Plants area. Cross-sections A-B, C-B, and D-E are presented in Figures 7, 8, and 9 respectively. As shown, the Claiborne confining unit thins in an east-southeasterly direction across the site (e.g., questionable thickness at boring location ALF-212). As shown in Figure 6 the investigation also identified two geologic faults (a discontinuity in geologic units across which a significant vertical displacement has occurred), one which extends southwest to northeast across the site and may contribute to the hydraulic connection between the MRVA and Memphis aquifers.

<u>Discussion</u>

To further illustrate why the Claiborne confining unit would hydraulically isolate the MRVA and Memphis Sand aquifers if it was continuous across the site I used an analytical (exact mathematical) solution for one-dimensional groundwater flow (Crank, 1975) through a homogeneous porous medium to compute the transient, vertical hydraulic head reduction (drawdown) in a clay layer (hydraulic conductivity of 1E-7 cm/sec) in response to a 10-foot drawdown (head reduction) in the underlying aquifer (Memphis Sand).

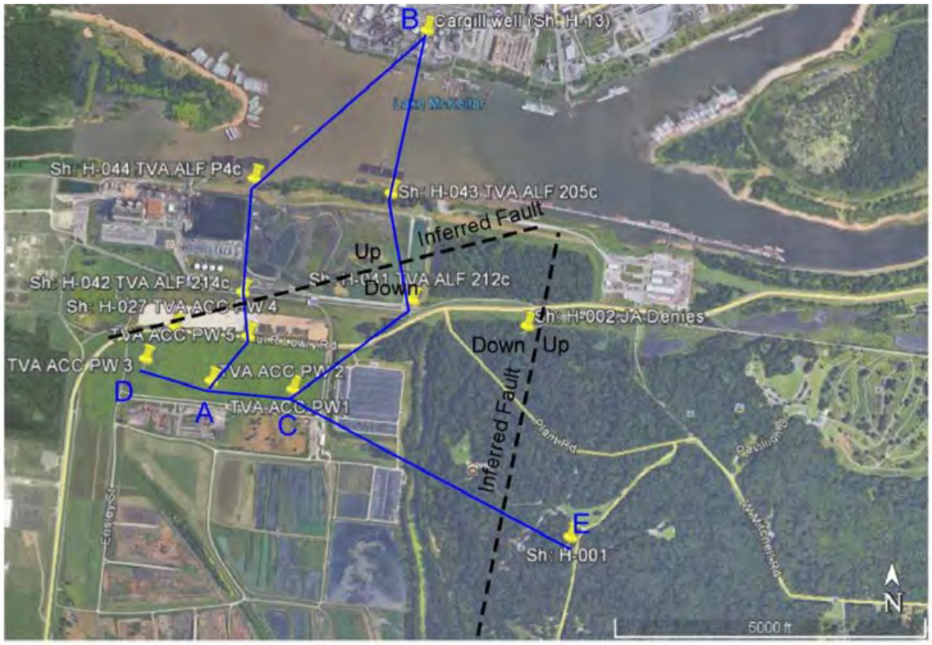

Figure 6
Geologic Cross-Section Locations and Inferred Faults in ALF and ACC Plants Area
(from USGS, 2018)

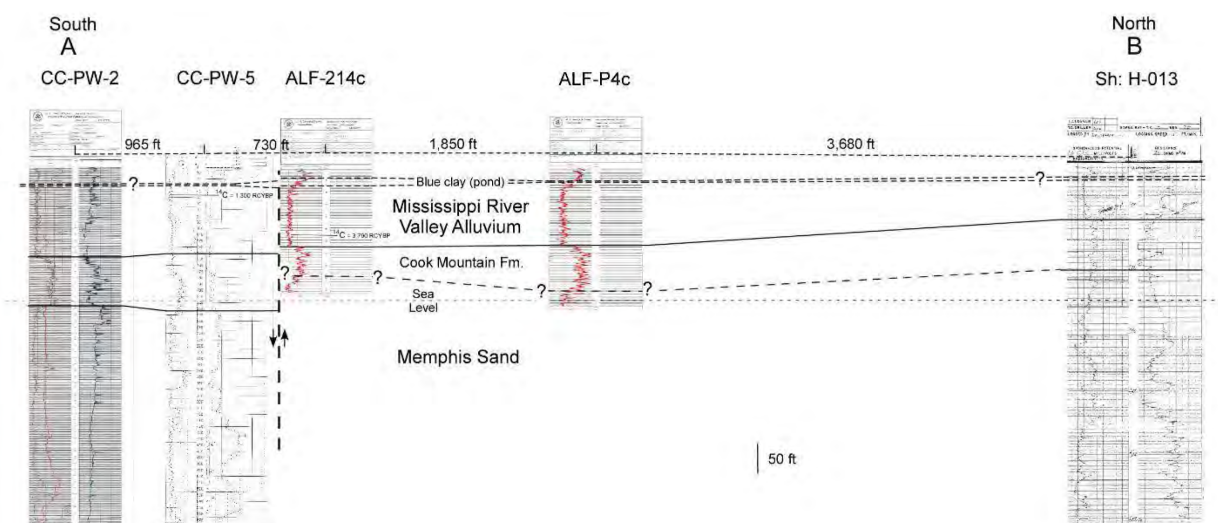

Figure 7
Geologic Cross-Section A-B in ALF and ACC Plants Area
(from USGS, 2018)

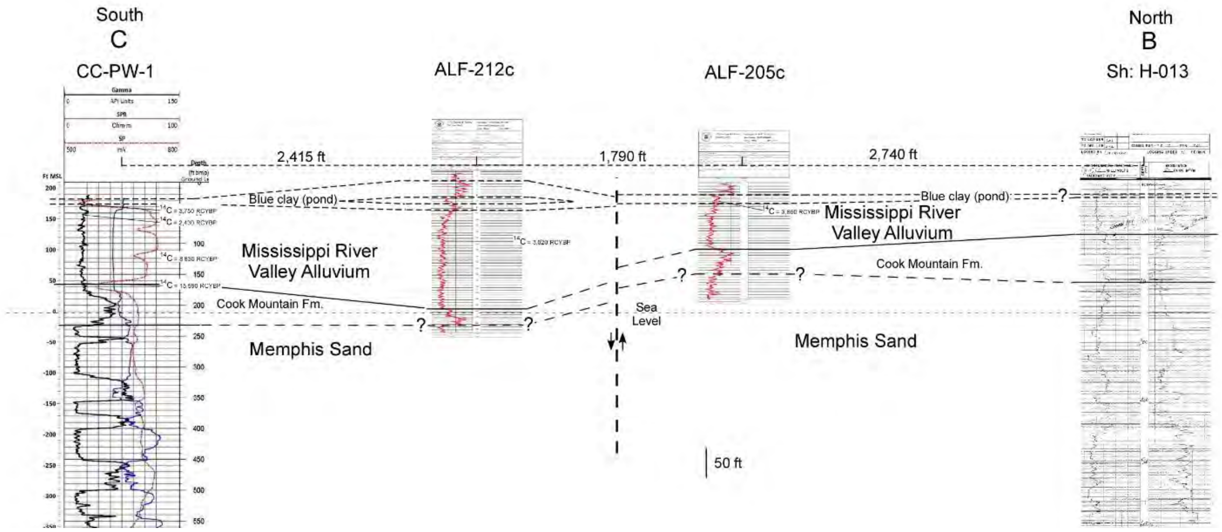

Figure 8
Geologic Cross-Section C-B in ALF and ACC Plants Area
(from USGS, 2018)

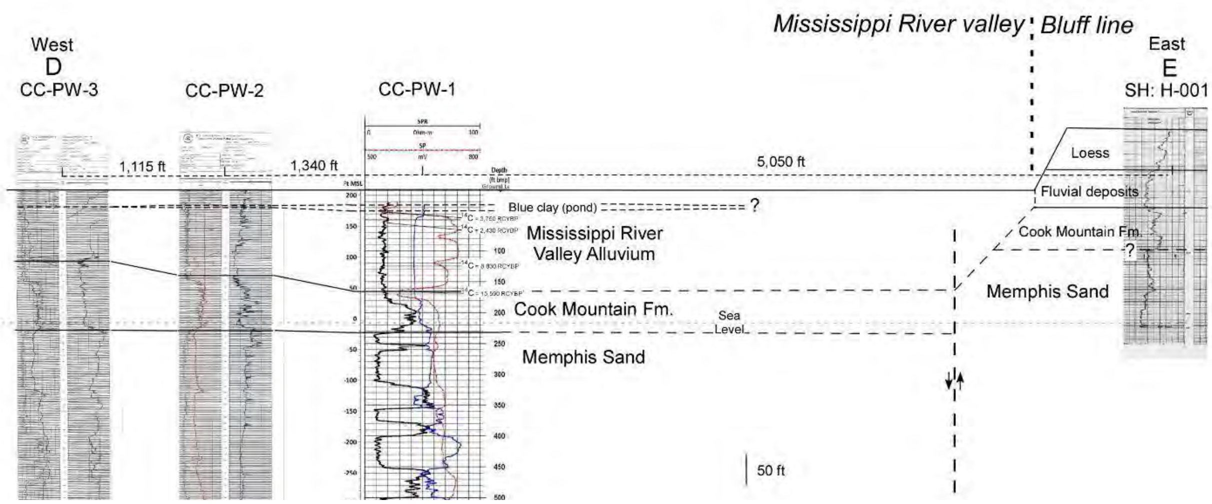

Figure 9
Geologic Cross-Section D-E in ALF and ACC Plants Area
(from USGS, 2018)

The simulated confining-unit drawdown as a function of distance above the base of the clay layer (Figure 10) shows that the drawdown after 24 hours (USGS pumping test duration) would be less than about 0.01 inch at a distance of two inches into the clay due to a constant 10-foot drawdown at the base of the clay layer. This simple example illustrates why the drawdown in the MRVA aquifer in response to groundwater withdrawal from the Memphis aquifer should have been zero.

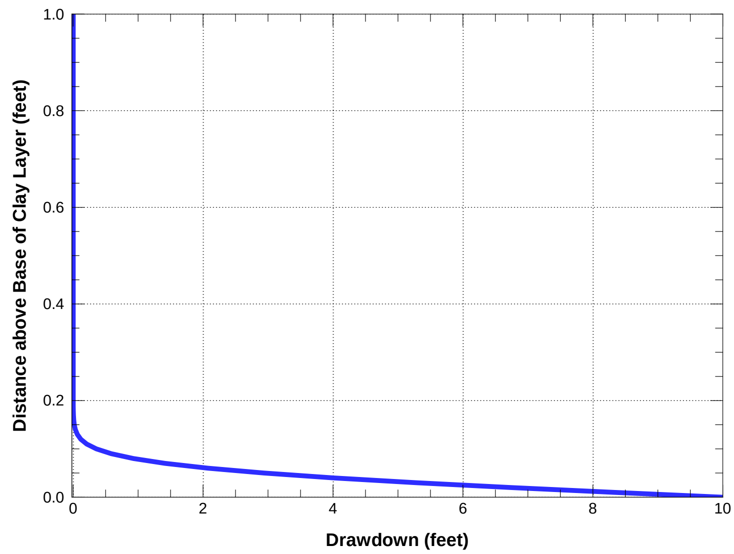

Figure 10
Drawdown in Clay Confining Layer after 24 Hours

I also further analyzed the magnitudes of the measured MRVA pumping-test drawdowns based on their locations relative to the Mississippi River, McKellar Lake, and ponded water in the East Ash Disposal Area. It is well-know that drawdown is reduced in the vicinity of a constant-head or leaky-type boundary (e.g., river, lakes, and/or impoundments) due to recharge from the waterbody in response to hydraulic head reductions in the aquifer (Bear, 1979; Freeze and Cherry, 1979). For example, as shown in Figure 5 a large portion of the area with measurable pumping-test drawdown in the MRVA aquifer is either located close to McKellar Lake or underlies impoundments in the East Ash Disposal Area. Therefore, depending on the distance of an MRVA monitoring well from one of these waterbodies, it is expected that the true hydraulic interconnection (as measured by MRVA drawdown) between the MRVA and Memphis aquifers is greater than that suggested by Figure 5.

To illustrate this point I computed drawdown versus distance and time in a hypothetical confined aquifer with similar hydraulic conductivity and thickness (i.e., transmissivity) as the Memphis aquifer due to a groundwater extraction rate of 5,000 gpm (similar to the USGS-CAESER pumping test). I used the Theis solution for drawdown due to groundwater from a fully-penetrating pumping well located in an infinite homogeneous confined aquifer (Bear, 1979). Figure 11 is a plot of the simulated drawdowns versus time and distance from the pumping well for two scenarios: with and without a constant-head boundary at a distance of 2,600 feet from the extraction well. Figure 11 also contains a graph of the ratio of drawdown without the waterbody to the drawdown with the hydraulic effects of the waterbody (constant-head in this case, which reduces the drawdown). This hypothetical scenario is designed to approximately mimic the 24-hour pumping test and the hydraulic effects of McKellar Lake (with the assumption that the lake acts as a constant-head boundary for illustration purposes). The drawdown ratio graphs show that at about the midpoint between the pumping well and waterbody (~1,300 feet) the hydraulic impacts of pumping (as measured by drawdown) would be almost twice as large if the assumed waterbody was not present. Moreover, the hydraulic effects of the waterbody significantly increase as the distance between the waterbody and the monitoring point decreases. For example, at a distance of 300 feet from the waterbody (2,300 feet from the extraction well) the measured drawdown would be expected to be on the order of five times greater without the hydraulic impact of the waterbody. Therefore, it is very possible that (i) the areal extent of MRVA drawdown during the Memphis-aquifer pumping test is larger than that indicated in Figure 5 (i.e., the window in the confining unit may be much larger than Figure 5 suggests) and (ii) the drawdown values shown in Figure 5 may have been much larger if the waterbodies and impoundments were not present (i.e., the hydraulic interconnection between the MRVA and Memphis Sand aquifers may be stronger than the Figure 5 results indicate).

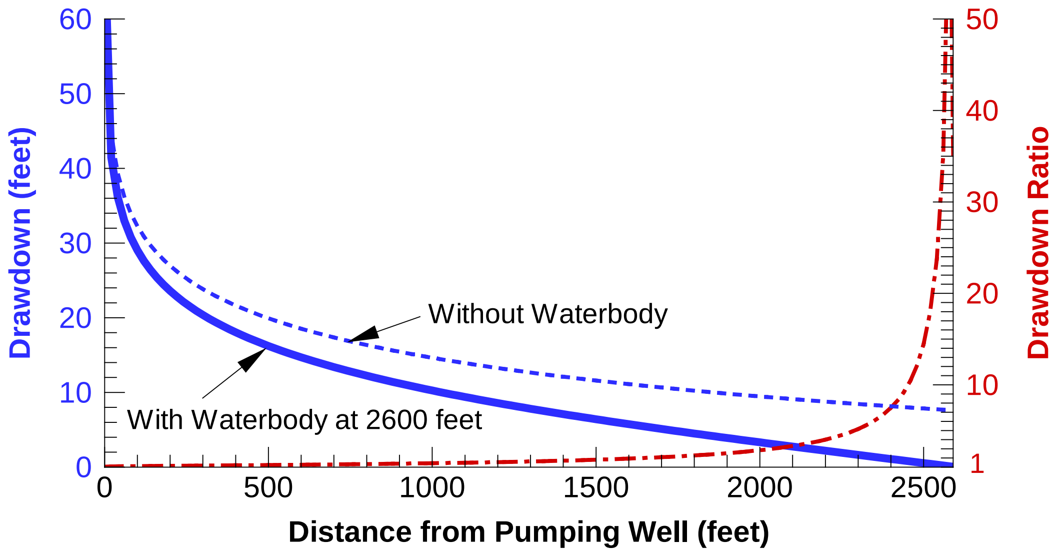

Figure 11
Drawdown vs. Distance from Pumping Well with and without Constant-Head Boundary Condition at 2,600 Feet

Boron and Sulfate Transport in the MRVA and Memphis Sand Aquifers

<u>Introduction</u>

Boron and sulfate are commonly used as environmental tracers to monitor the fate and transport of CCR constituents in groundwater (Ruhl et al., 2014). The reasons for this are primarily because these two constituents are present at high concentrations in CCR source areas, and they are very mobile in groundwater relative to other CCR constituents. In contrast, most metals (e.g., arsenic and lead) migrate much slower (e.g., 10-100 times, or more) than the groundwater pore velocity due to a very strong tendency of the metals to bind, or adsorb, to immobile soil grains (Hemond and Fechner, 1994). The fact that boron and sulfate concentrations in CCR source areas are typically large leads to more reliable detection of the leading edge of a CCR plume despite dilution mechanisms (e.g., mixing and dispersion) that reduce groundwater concentrations as a function of transport distance and time. Environmental tracers such as boron and sulfate are also excellent tools for accurately determining the long-term (e.g., decades), average three-dimensional groundwater flow directions in an aquifer and the relative importance of horizontal and vertical flow because their aqueous-phase concentration distributions are the direct result of the mean groundwater velocity field. This tracer attribute is particularly useful at the ALF and ACC Plants site where (i) short-term hydraulic-head variations in the MRVA aquifer, induced by stage fluctuations in McKellar Lake and the Mississippi River, have made it difficult to determine the true mean groundwater flow directions based on the limited hydraulic data set and (ii) the potential for leakage and chemical transport from the MRVA aquifer to the Memphis Sand are relevant questions that are currently being evaluated. This issue is the subject of EIP Sections 3.3.5, 3.3.6, 4.3.3, 4.3.6, 4.3.7, and 4.4.2.

<u>Boron and Sulfate Transport within the MRVA Aquifer in the ALF and ACC Plants Area</u>

In Figures 12 and 13 I have plotted the measured boron and sulfate concentrations based on filtered groundwater samples from several MRVA monitoring wells (MW) and Direct-Push Technology (DPT) borings along east-west cross-sections on the northern and southern parts of the ALF-ACC Plants area, respectively. These figures also show arsenic concentration data and interpreted contours developed for the RI report. Notably, high boron and/or sulfate concentrations extend from shallow source areas down to the bottom (or near-bottom) of the MRVA aquifer (e.g., MWs ALF-203A, ALF-204A, ALF-205A, P-4, ALF-202A, ALF-201A). In the northern cross-section (Figure 12) boron and sulfate concentrations in deep groundwater are as large as 340 – 6,330 μg/L and about 23,000 – 85,000 μg/L, respectively. In the southern cross-section (Figure 13) boron and sulfate concentrations in deep groundwater are as large as 2,280 μg/L and about 35,000 – 70,000 μg/L, respectively. High sulfate concentrations were also detected at depth in the MRVA aquifer in ACC monitoring wells ACC-005-A (32,000 – 64,700 μg/L) and ACC-003-A (12,000 – 23,100 μg/L) (see RI Tables 6-13,a,b,c). These concentrations are significant relative to background levels. As reproduced in Table 1, the 2017 Annual Groundwater Monitoring Report (TVA, 2018a) for the ALF Plant indicates average (November 2016 to August 2017) boron and sulfate background concentrations of approximately 78 and 5,700 micrograms per liter (μg/L). The sulfate and boron concentrations at depth also represent a large percentage of the source concentrations. As illustrated in Figures 12 and 13, and ash porewater DPT data (RI report Fig. 3-1), source-area boron and sulfate concentrations in groundwater are generally in the ranges of 6,000 - 12,000 μg/L and 100,000 - 200,000 μg/L, respectively. Assuming one percent of the source-area concentrations as representative of the leading edge of the CCR plume (e.g., refer to analytical solutions of the one-dimensional advection-dispersion equation presented by Bear, 1979), equivalent “transport-based” threshold values would correspond to boron and sulfate concentrations ranging from 60 - 120 µg/L and 1,000 - 2,000 µg/L, respectively. These "plume leading-edge" indicator concentrations are similar in magnitude to the respective measured background levels.

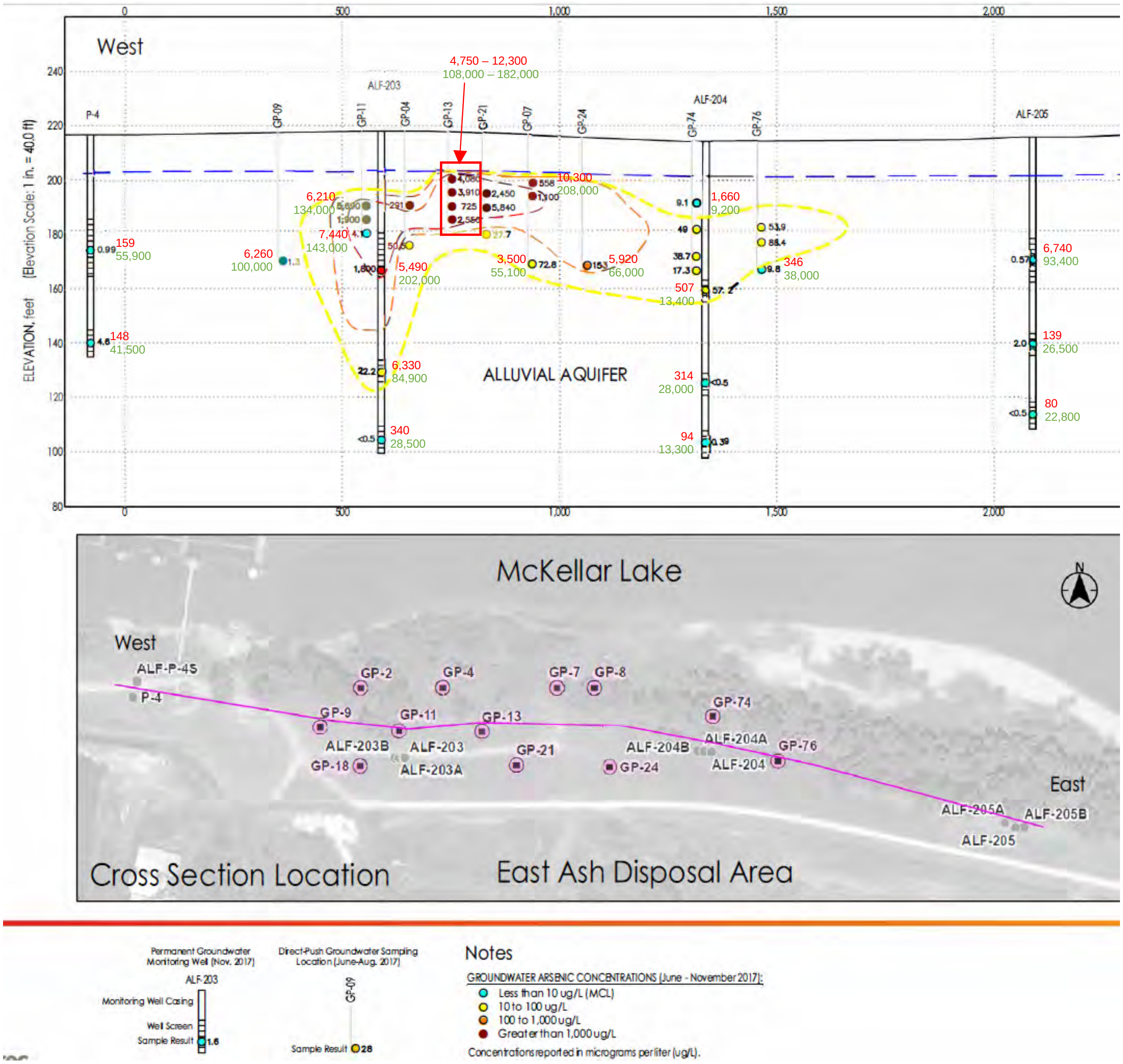

Figure 12
Arsenic (black), Boron (red), and Sulfate (green) Concentrations in Groundwater (Filtered)
East-West Cross-Section in Northern ALF and ACC Plants Area
(based on Fig. 6-20a in RI Report; Stantec, 2018a)

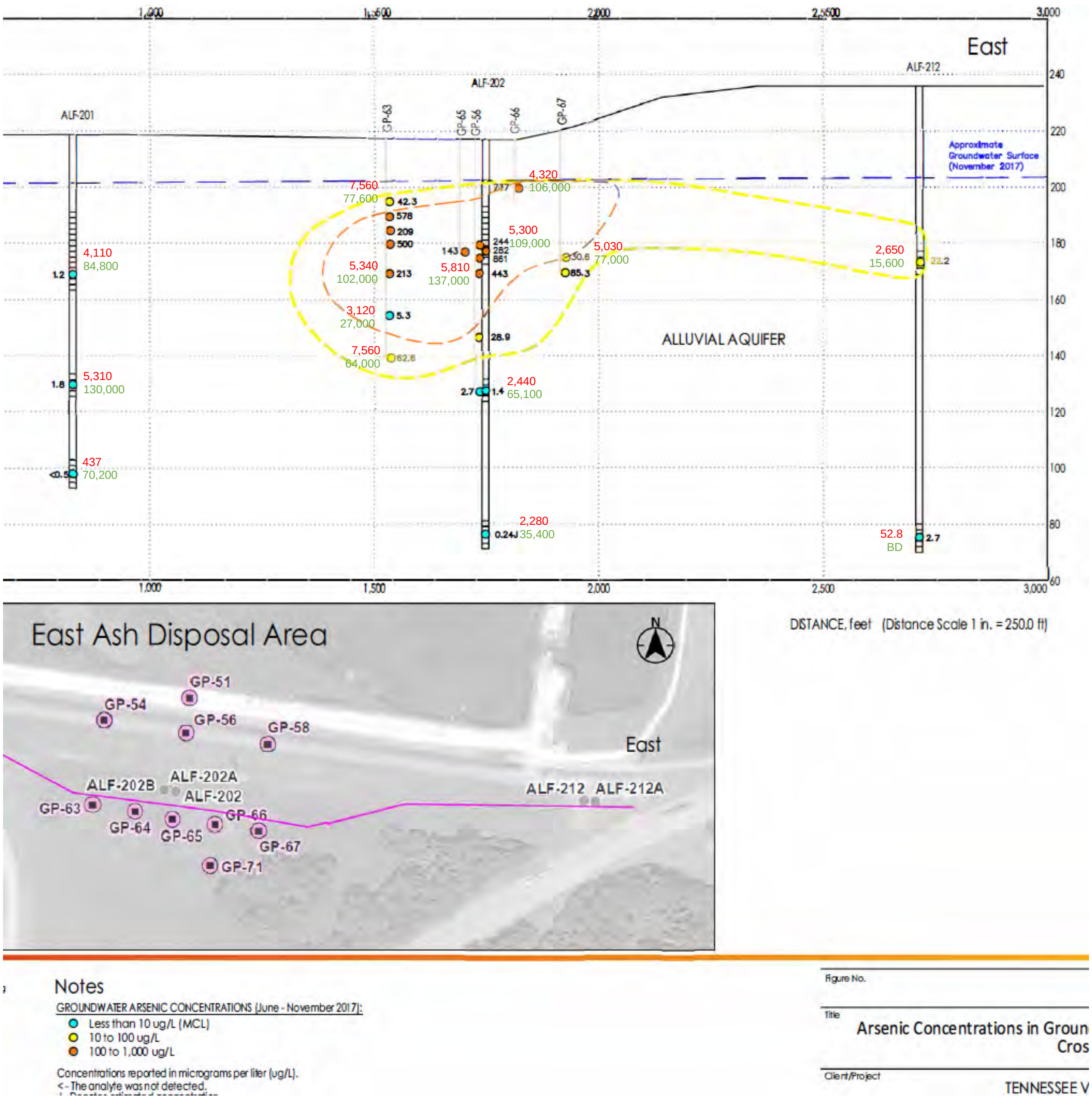

Figure 13
Arsenic (black), Boron (red), and Sulfate (green) Concentrations in Groundwater (Filtered)
East-West Cross-Section in Southern ALF and ACC Plants Area
(based on Fig. 6-20b in RI Report; Stantec, 2018a)

Therefore, using both background and source-area concentrations (i.e., transport-based threshold values) as a comparison, the site groundwater analytical data demonstrate that a long-term, downward component of groundwater transport has resulted in the migration of aqueous-phase boron and sulfate plumes to near the base of the MRVA alluvial aquifer. For example, boron levels in groundwater from the deepest alluvial-aquifer (MRVA) monitoring wells are typically a factor of 5 to 30 times greater than the background concentration. Similarly, sulfate levels in groundwater near the base of the MRVA aquifer are typically a factor of 5 to 12 times greater than the background concentration. Relative to shallow-depth MRVA groundwater concentrations, this deep boron/sulfate contamination is generally about 10-35 percent and 25-50 percent of the boron/sulfate source-area concentrations, respectively, which is a very strong indicator that these deep boron/sulfate detections are related to CCR source areas. Moreover, if the predominant flow directions in the MRVA aquifer were horizontal or upward (e.g., near McKellar Lake) as concluded in the RI report, these high boron/sulfate concentrations would not be present at depth in the aquifer because vertical mixing due to transverse dispersion (assuming predominantly horizontal flow) is known to be very small (Gelhar et al., 1992; Zheng et al., 2010; Sudicky and Illman, 2011; Siegel, 2014) and would not cause such deep contamination. Specifically, the boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow (i.e., solute advection) has been occurring in the ALF-ACC Plants area.

Table 1
Background Groundwater Sampling Results
ALF Plant (from TVA, 2018a)

Monitoring Well		ALF-210																			
Sample Date		15-Nov-16		30-Jan-17		28-Feb-17		28-Mar-17		18-Apr-17		09-May-17		13-Jun-17		13-Jul-17		18-Jul-17		23-Aug-17	
Sample Type		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
Location/Well ID		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210	
Sample ID		ALF-GW-014-11152016		ALF-GW-014-01302017		ALF-GW-014-02282017		ALF-GW-014-03282017		ALF-GW-014-04182017		ALF-GW-014-05092017		ALF-GW-014-06132017		ALF-GW-014-07132017		ALF-GW-014-07182017		ALF-GW-014-08232017	
Well Designation		Background		Background		Background		Background		Background		Background		Background		Background		Background		Background	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Total Metals																					
Antimony	mg/L	< 0.000330	U*	< 0.000998	U*	< 0.000565	U*	< 0.00142	U*	< 0.000478	U*	< 0.000443	U	< 0.000443	U	< 0.00103	U*	< 0.000669	U*	< 0.000918	U*
Arsenic	mg/L	0.00957	J	0.00346		0.0106		0.00924		0.00351		0.00293		0.00671		0.00637		0.00703		0.00474	
Barium	mg/L	0.298		0.323		0.328		0.313		0.339		0.424		0.361		0.335		0.324		0.311	
Beryllium	mg/L	< 0.000102	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U
Boron	mg/L	0.0803		0.0840		0.0794	J	0.0675	J	0.0694	J	0.0831		0.0691	J	< 0.0830	U*	0.0807		0.0805	
Cadmium	mg/L	< 0.000152	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U
Calcium	mg/L	133		137		137		123		132		158		131		136		135		132	
Chromium	mg/L	< 0.000339	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	UJ	< 0.000378	U	< 0.000378	U	< 0.000378	U
Cobalt	mg/L	0.00246		0.000212	J	0.00182		0.000726		0.000164	J	< 0.0000960	U*	0.000970		0.00105		0.00181		0.00124	
Lead	mg/L	< 0.0000675	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U
Lithium	mg/L	0.0231		0.0246		0.0233		0.0210		0.0204		0.0230		0.0206		0.0211		0.0207		0.0203	
Mercury	mg/L	< 0.0000521	U	< 0.0000521	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U
Molybdenum	mg/L	0.00237	J	0.00154	J	0.00258	J	0.00141	J	0.00137	J	< 0.00108	U*	0.00122	J	0.00122	J	0.00161	J	< 0.00176	U*
Selenium	mg/L	0.000687	J	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U
Thallium	mg/L	< 0.0000360	U	0.000135	J	< 0.000110	U*	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U
Radium 226 + radium 228	pCi/L	< 0.568	U	< 0.887	U	< 0.724	U	< 0.992	U*	0.844	J	< 0.830	U*	0.685	J	< 0.518	U	1.13	J	< 0.551	U
Anions																					
Chloride	mg/L	1.14		1.28		1.11	J	1.18		1.50		1.40		1.34		1.45		1.56		1.21	
Fluoride	mg/L	0.189		0.169		0.183		0.216		0.261		0.227		0.287		0.279		0.208		0.212	
Sulfate	mg/L	5.49		0.876	J	5.14		1.62		0.970	J	3.08		7.54		11.1		8.47		12.5	
General Chemistry																					
Total Dissolved Solids	mg/L	488		488		506		503		491		537		524		495		496		481	
Field pH																					
pH (field)	SU	6.67		6.78		6.73		6.73		6.76		6.83		6.73		6.72		6.72		6.78	

Notes:
NA - Not Available
Q - Data Qualifier
U* - Result should be considered "not-detected" because it was detected in a rinsate blank or laboratory blank at a similar level
J - Quantitation is approximate due to limitations identified during data validation
UJ - Analyte not detected, but the reporting limit may or may not be higher due to a bias identified during data validation
U - Analyte not detected
mg/L - milligrams per liter
pCi/L - picoCurie per liter
SU - Standard Unit

The shallow and deep hydraulic gradients in the MRVA aquifer also indicate downward groundwater flow. For example, in Figure 14 I have added the vertical hydraulic head differences (positive indicates downward flow) between shallow and deep MRVA monitoring wells measured before the start of the pumping test (9-20-2017) to the pumping-test drawdown contour map (Figure 5). These data show that the vertical flow direction is downward within the MRVA aquifer across most of the ALF-ACC Plants area except for one well cluster by McKellar Lake. Further, prior to the pumping test USGS/CAESER noted that hydraulic heads in the MRVA aquifer were about 3 to 5 feet greater than heads in the Memphis Sand at Production Wells 5, 3, and 1 (“Data Analysis” section of RI Appendix E). A consistent downward flow component in the MRVA aquifer within this area is also demonstrated by the USGS regional modeling results (Figure 2) due to the very-high Memphis-Aquifer transmissivity and groundwater withdrawal, both of create a downward “driving force” for groundwater flow. In the ALF-ACC Plants area the identified window in the confining unit significantly increases downward flow and associated chemical transport rates due to the absence of the low-permeability layer.

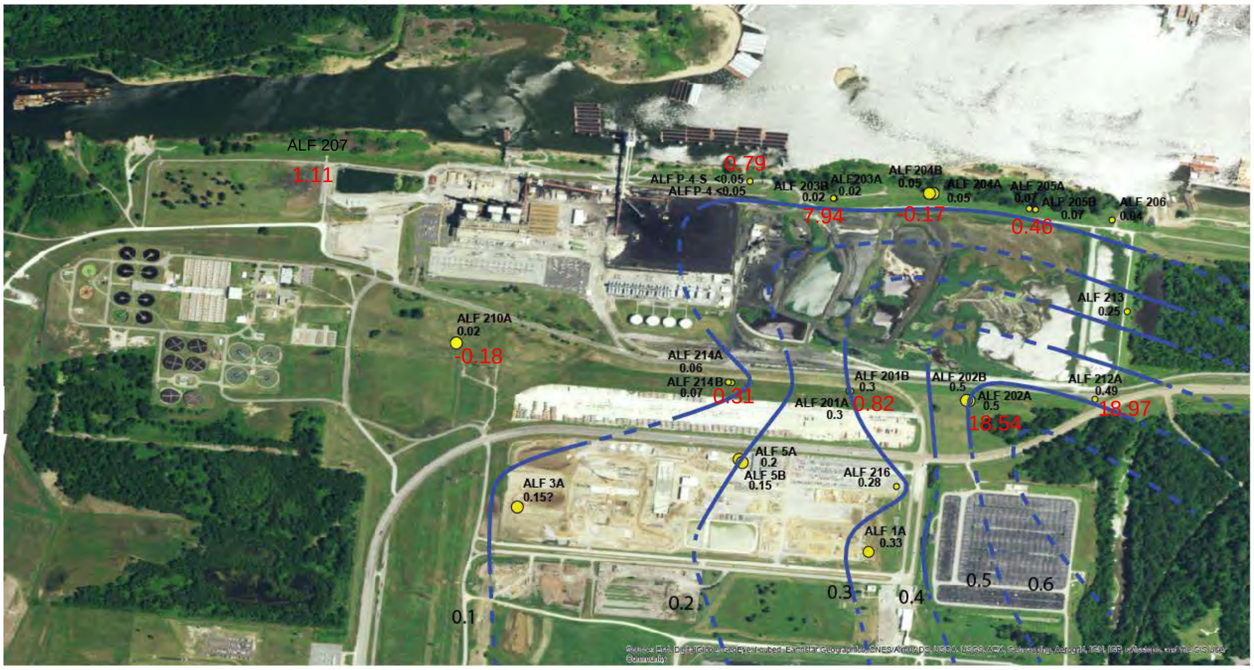

Figure 14
Estimated Drawdown in MRVA Aquifer Monitoring Wells During Memphis Aquifer Pumping Test (values in black, contours in blue). Red Numbers are 9-20-2017 (before Pumping Test) Hydraulic Head Differences between Shallow and Deep MRVA Monitoring Wells (pos. values indicate downward groundwater flow; neg. values indicate upward flow) (from USGS, 2018)

Groundwater Quality in the Memphis Sand Aquifer

The USGS/CAESER investigation also concluded that that mixing of MRVA groundwater with Memphis Sand water is occurring in in the vicinity of Production Wells (PW) 5 and PW 3 based on water quality differences. Water-quality parameters that indicate this contrast before and during the pumping test include specific conductance (Tables 3 and 5 in RI Appendix E), tritium (Tables 4 and 5 in RI Appendix E), sulfate (Table 3 in RI Appendix E and RI Tables 6-15a,b,c), total dissolved solids (RI Tables 6-15a,b,c), and other major inorganic constituents. The tritium analyses demonstrate that a component of young groundwater (post 1950) is present in the Memphis Sand aquifer beneath the ALF-ACC Plants area. Concentrations of these parameters are much higher in samples from PW 5 compared to the other

PWs, which is likely due to the shallower-depth well screen for PW 5 (i.e., less mixing of deeper, lower-concentration groundwater in the Memphis Sand aquifer).

Of particular interest are the high PW-5 sulfate concentrations (about 26,000 – 30,000 μg/L), which are almost a factor of ten greater than concentrations in samples of the other PWs and are similar in magnitude to MRVA sulfate levels in deep groundwater (discussed above). Sulfate concentrations in PW-5 water samples remained greater than 24,000 μg/L throughout the pumping test (Table 5 in RI Appendix E). These sulfate detections in PW 5 water samples are about an order of magnitude (~10x) greater than reported Memphis-Sand background sulfate levels of approximately 2,000-8,000 μg/L (Table A-1 of Stantec, 2017) and median of 3,100 μg/L (Table A-2 of Stantec, 2017). The fact that sulfate concentrations in PW-5 groundwater samples are similar in magnitude to deep-MRVA groundwater suggests possible ongoing transport of CCR constituents from the MRVA to Memphis Sand aquifers. The relatively elevated tritium and inorganic constituent concentrations in PW-5 water samples are consistent with this potential MRVA- to Memphis-aquifer chemical migration in the ALF-ACC Plants area.

Potential Hydraulic Impacts of Off-Site Groundwater Extraction at Davis Well Field

Due to environmental concerns the TVA is now planning on purchasing ACC-plant cooling water from the Memphis Light, Gas and Water (MLGW) Division's Davis Pumping Station located about three miles from the Allen plants (e.g., Charlier, 2018; Figure 1). To evaluate potential hydraulic head decreases in the Memphis Sand aquifer beneath the Allen plants due to pumping at the Davis Well Field I developed a three-dimensional, analytical (exact mathematical solution) groundwater flow model (Hantush, 1964) of the Memphis Sand aquifer. The steady-state (i.e., non-transient, average hydraulic conditions) Hantush model assumes a uniform hydraulic-conductivity distribution and groundwater leakage (proportional to drawdown) from the MRVA aquifer. I calibrated the Memphis Sand hydraulic conductivity and leakage rate to approximately match the steady-state Memphis-Sand hydraulic head decrease (drawdown) predicted by the USGS MERAS groundwater flow model for a uniform 2,500 gpm pumping rate (Figure 15).

Figure 16 shows the simulated Hantush-solution, steady-state Memphis-Sand drawdown for Davis Well Field groundwater pumping rates of 2,500 and 5,000 gpm. The rate of 2,500 gpm is the reported average cooling water requirements for the ACC plant, and 5,000 gpm corresponds to a short-term maximum required flow rate (Figure 4). The calibrated model hydraulic conductivity (K) is 230 ft/day and the aquifer

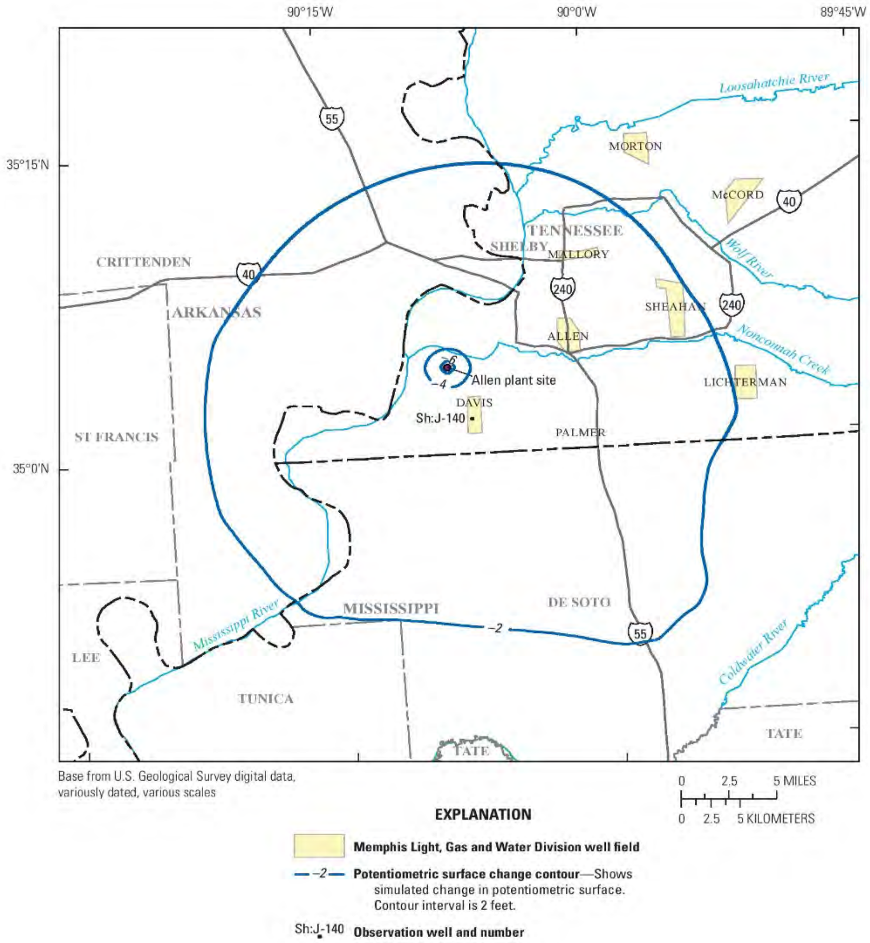

Figure 15
Simulated Hydraulic Head Change in Memphis Sand Aquifer
at End of 30-Year Average Withdrawal (2,500 gpm) Scenario for ACC Plant (from USGS, 2016)

thickness (*b*) is 350 feet. A 100-foot extraction well screen was assumed and drawdown was computed at the top of the aquifer. This calibrated transmissivity (*K* x *b*) is similar in magnitude to reported measured values in the Memphis area (Parks and Carmichael, 1990). The estimated long-term drawdown in the Memphis Sand aquifer beneath the Allen plants is about 3 to 7 feet for uniform pumping rates of 2,500 and 5,000 gpm, respectively. Note that these drawdown values could be smaller beneath the Allen plants due to local recharge from the Mississippi River and McKellar Lake. However, the near-circular nature of the drawdown distribution in Figure15 suggests that the difference would not be significant. For example, if the Mississippi River acted as a constant-head boundary (i.e., direct hydraulic connection between the river and the Memphis Sand) the drawdown near the Allen plants in Figure 15 would be near zero.

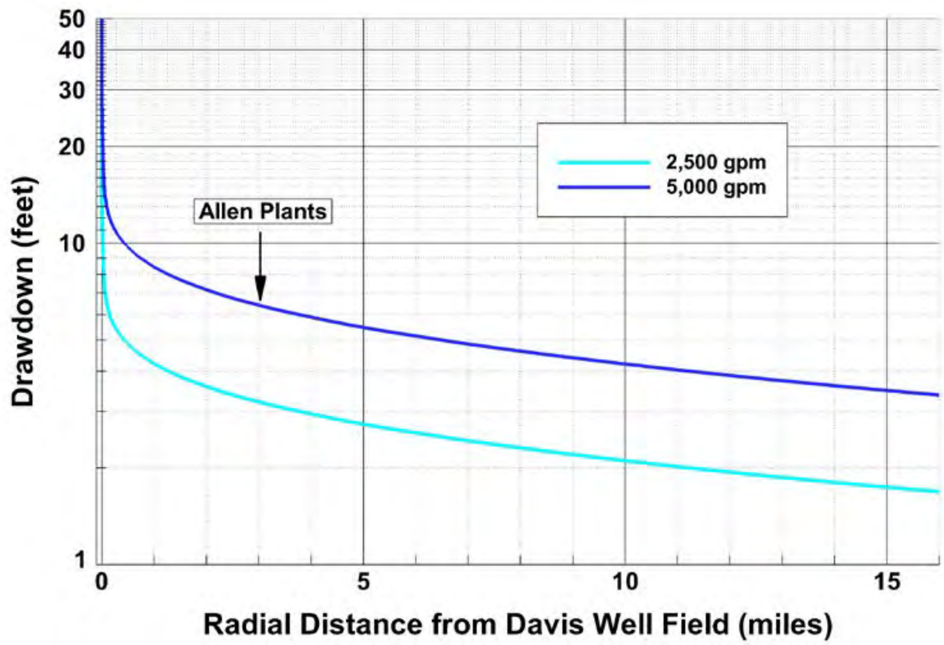

Figure 16
Simulated (Hantush Model) Steady-State Drawdown in Memphis Sand Aquifer due to Groundwater Extraction at the Davis Well Field

As discussed in the previous section, prior to the recent Allen-site pumping test USGS/CAESER noted that hydraulic heads in the MRVA aquifer were about 3 to 5 feet greater than heads in the Memphis Sand at Production Wells 5, 3, and 1 ("Data Analysis" section of RI Appendix E). Therefore, extraction of an additional 2,500-5,000 gpm of groundwater from the Davis Well Field could double the downward flux of groundwater from the MRVA aquifer to the Memphis Sand in the vicinity of the Allen plants due to the possible doubling of the vertical hydraulic gradient between the two aquifers. Moreover, the flux of any dissolved coal-ash constituents that may be present in deep MRVA groundwater into the Memphis Sand could also be increased by up to a factor of two. Additional data collection and groundwater flow and solute transport modeling are needed to refine these estimates and better assess the potential groundwater quality impacts.

Chemical and Hydraulic Characterization of Groundwater beneath East Ash Basin

As shown below in Figure 17, no monitoring well clusters (shallow, intermediate, or deep) have been installed in the Alluvial Aquifer to enable the collection of groundwater hydraulic-head data or water-quality data directly beneath the central portion of the East Ash Basin CCR source area. This issue relates to the following sections of the EIP: 3.3.5, 4.3.3, 4.3.6, 4.3.7, and 4.5.2. These groundwater data are important for the following reasons:

- As illustrated in RI Figure 17 below, and other hydraulic-head maps presented in the RI report (Stantec, 2018a), the total horizontal hydraulic-head difference between the northern and southern limits of the East Ash Basin is generally on the order of a few feet, with the horizontal groundwater flow direction varying from northerly (toward McKellar Lake) to southerly on different dates. In addition, the RI interprets the vertical groundwater flow direction in the Alluvial Aquifer to vary from upward to downward on different dates, with a vertical groundwater velocity that is small (due to small vertical hydraulic head differences at monitoring well clusters that are typically less than a foot to a few tenths of a foot).

- Per EIP Section 3.2.4 (TDEC Memorandum of Agreement Request No. 4) the normal pool (water surface) elevation in the East Ash Disposal Area Stilling Pond is 225.39 feet. As shown above in Figure 12 this Stilling Pond water surface elevation is similar to the ground surface elevation in this area and is more than 30 feet higher than the interpolated East Ash Basin water table elevation (~ 185-190 feet in Figure 17). The water surface elevations of other ponded areas in the East Ash Disposal Area are likely to be similar in magnitude. In addition, if measured, the hydraulic head in the uppermost portion of the Alluvial Aquifer would be similar in magnitude to the Disposal Area ponded-water surface elevations because the East Basin acts as a constant-head boundary relative to groundwater flow (i.e., large source of groundwater inflow to the Alluvial Aquifer).

- Therefore, the true vertical groundwater velocity beneath most of the East Ash Basin CCR source area is definitively downward, and the corresponding downward groundwater velocity (proportional to shallow minus deep hydraulic heads) is more than a factor of 30 (30-foot vertical head difference compared to one foot, as reported in the RI) greater than the values reported in the RI. Similarly, the downward transport rates of all CCR constituents from the East Ash Basin source area are more than 30 times greater than values suggested in the RI. In other words, the potential for CCR contamination at depth in the Alluvial Aquifer is much greater than what was concluded in the RI. The RI ignored these key site-specific groundwater-flow and chemical-transport mechanisms and only installed monitoring-well clusters outside of the East Ash Basin footprint.

- Horizontal groundwater velocities and CCR transport rates are also much greater than values reported in the RI when the correct hydraulic head values beneath the East Ash Basin are used. In the immediate vicinity of the East Ash Basin the horizontal hydraulic gradients (and

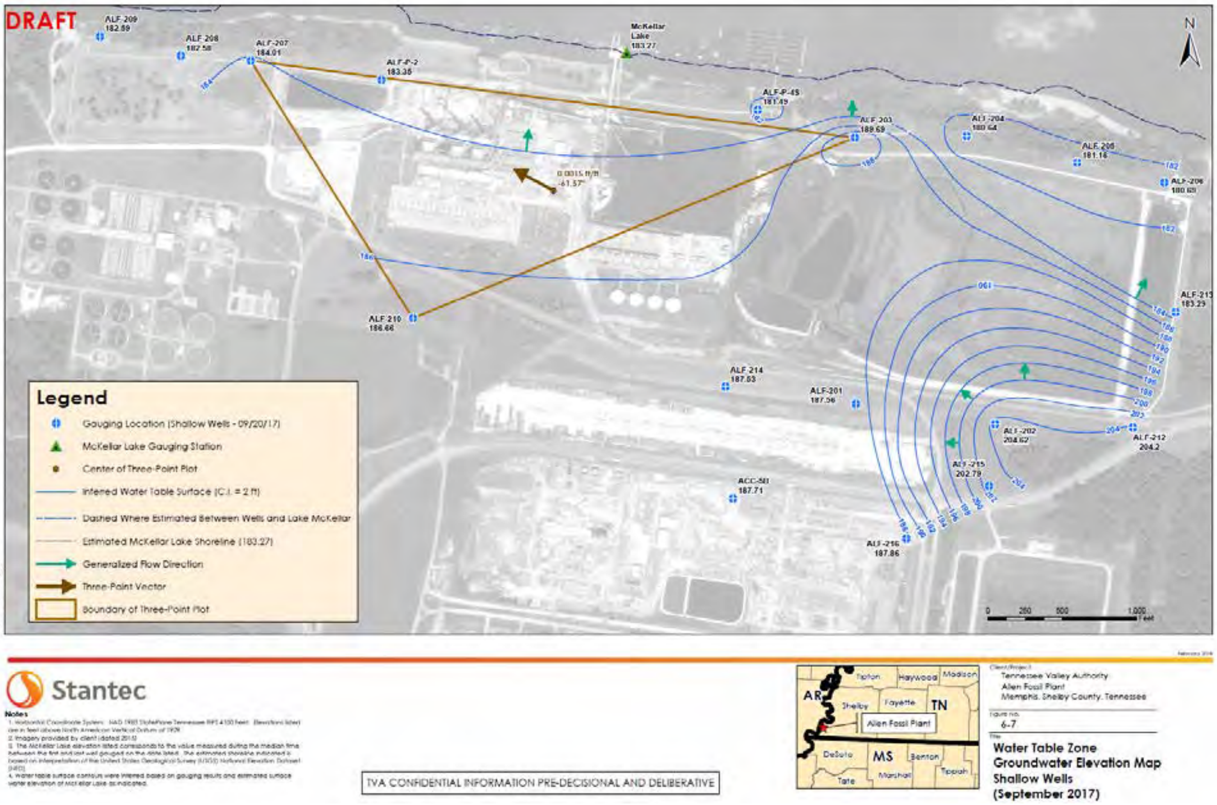

Figure 17

Locations of Shallow-Depth Monitoring Wells in Alluvial Aquifer (from Stantec, 2018a)

groundwater velocities) are expected to be as much as a factor of ten greater than reported in the RI (e.g., 30 feet actual horizontal head change compared to the few feet shown on RI hydraulic-head maps). Moreover, the correct groundwater flow direction beneath large portions of the East Ash Basin is expected to be northerly from the CCR source areas toward McKellar Lake and downward toward the Memphis Sand. The groundwater flow direction at depth in the Alluvial aquifer may also be influenced by flow into the Memphis Sand through the identified breach in the confining layer. This interpretation is significantly different that the RI conclusions of horizontal flow directions that vary from northerly to southerly.

- Moreover, the RI failed to measure the true average horizontal and vertical hydraulic heads in the alluvial aquifer which determine long-term horizontal/vertical chemical transport fluxes. Instead, the RI hydraulic-head maps are only random “snapshots” of the hydraulic heads and groundwater flow directions based on manual water-level measurements which, due to McKellar-Lake stage fluctuations, significantly change from one measurement date to another. Therefore, the RI significantly underestimates the horizontal mass transport rate of CCR constituents from groundwater into McKellar Lake and the downward flux of contaminants toward the Memphis Sand because the large influx of water from the East Ash Basin is not incorporated into the RI groundwater flow characterization and correct mean hydraulic gradients were not used to evaluate chemical transport directions and rates. This situation is similar to a coastal aquifer and flow regime wherein tidally-induced water-level fluctuations must be filtered out of the data sets using analysis methods such as those presented by Serfes (1991). The U.S. Geological survey addressed this issue in their analysis of pumping-test data (water-level drawdown data in RI Appendix E) by using the software program SeriesSEE (Version 1.20), which is a Microsoft Excel Add-In (Halford et al., 2012), to remove the hydraulic influences of McKellar Lake and other environmental fluctuations such as barometric pressure changes and drawdown due to local water-supply wells. These types of water-level filtering techniques (i.e., averaging) need to be applied to water-level data collected by transducers over a sufficient averaging period in order to develop correct mean hydraulic head maps and groundwater-velocity distributions for the alluvial aquifer.

Characterization of CCR Constituent Sorption to Soil

Background

The fraction of chemical mass sorbed to soil can be represented by the soil-water partition coefficient, K_d (Lyman et al., 1982). K_d is an especially important parameter for most CCR constituents because the bulk of the chemical mass in the soil is associated with the solid phase (i.e., sorbed to soil grains rather than dissolved in pore water). In effect, the solid fraction of the soil matrix acts as a large "storage reservoir" for chemical mass when K_d is large [e.g., metals (e.g., CCR), many chlorinated solvents, and highly-chlorinated polycyclic aromatic hydrocarbon (PAH) compounds associated with coal tars and wood-treating fluids]. K_d is also a very important chemical transport parameter which is used to compute the chemical retardation factor, R_d, assuming linear equilibrium partitioning of mass between the soil (solid) and pore-water phases (Hemond and Fechner, 1994):

$$R_d = 1 + \rho_b K_d / n_e$$

where ρ_b is the soil matrix bulk dry density and n_e is the effective soil porosity. For example, the chemical migration rate (V) is directly proportional to hydraulic conductivity (K) and inversely proportional to R_d :

$$V = \frac{K\, i}{n_e\, R_d}$$

where i is the hydraulic gradient (change in hydraulic head divided by distance).

The total contaminant mass in an aquifer is also directly proportional to R_d, as well as aquifer cleanup times once the source is removed (e.g., Zheng et al., 1991). For most CCR constituents R_d is on the order of 10 to 1,000 (e.g., EPRI, 1984). For example, a chemical with R_d equal to 100 has 99 percent of its total mass sorbed to soil. Similarly, even constituents with R_d ~ 10 have about 90 percent of their mass sorbed onto the soil matrix with the remaining ten percent dissolved in groundwater.

Discussion

The RI has not measured or characterized the most critical chemical-specific fate and transport parameter, the soil-water partition coefficient (K_d), for any CCR constituent (refer to EIP Sections 3.3.3 and 4.1.2). As discussed above, K_d is a chemical parameter that quantifies the amount of chemical mass that is sorbed, or partitioned, onto the immobile soil grains in the aquifer compared to the dissolved-phase (porewater) mass. K_d also determines both chemical migration rate (along with hydraulic conductivity and hydraulic gradient) and the total mass of any CCR constituent in the Alluvial Aquifer. Clearly, site-specific characterization of the soil-water partition coefficient for the various CCR constituents should have been a key component of the Remedial Investigation.

Initial Remedial Design – Interim Response Action

The Initial Remedial Design (IRD) of the groundwater extraction well locations and pumping rates for the East Ash Basin (Stantec, 2018b) is incorrect because it is based on a groundwater model that was improperly calibrated and does not match existing hydraulic conditions in the alluvial aquifer. Hydrogeologic issues related to the IRD are the subject of most sections of the EIP. In addition, the vertical extent of CCR constituent contamination beneath the East Basin source area has not been determined, as discussed above. Therefore, the target depth for hydraulic containment of CCR plumes (i.e., capture zone), which largely determines extraction-well locations and pumping rates, has not been accurately characterized. The primary flaw in the model is that it inexplicably does not include a boundary condition to represent the major groundwater mounding effect of the East Ash Basin (refer to Figure 18 and above discussion), even though the model was constructed (i.e., calibrated) using hydraulic heads that were measured while the impoundment was active (full of effluent). One of the most impactful results of this erroneous approach to groundwater model development is that artificial, high-rate groundwater recharge zones (e.g., several hundred inches per year, whereas natural recharge rates are on the order of 10-20 inches per year) were defined in the model without any physical basis (refer to Figure 19). The false recharge zones are due to the fact that the water-level data sets used to calibrate the model were measured when the East Basin was full of effluent, but the model does not include the East Basin. Therefore, basically the model developers were forced to introduce an artificial source of groundwater recharge to account for the "real" influx of water from the East Ash Basin. A major problem with this, of course, is that these spurious recharge zones largely determined the extraction-well locations and pumping rates presented in the IRD. Accordingly, the IRD extraction-well designs need to be corrected.

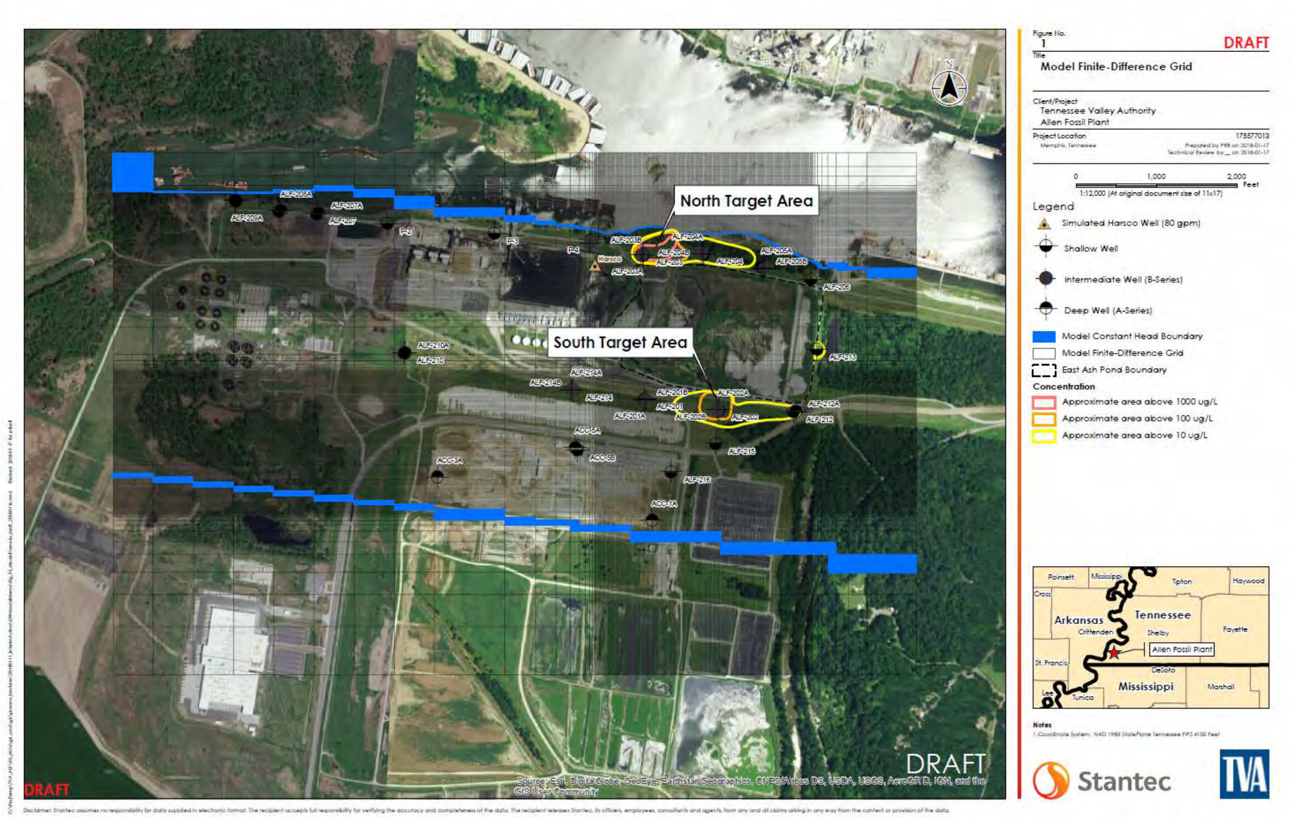

Figure 18
Groundwater Model Computational Grid for Initial Remedial Design (from Stantec, 2018b)

The IRD report (Section 2.6) also proposes monitoring of CCR concentration trends (i.e., concentration versus time) in monitoring and extraction wells as a key part of the Performance Monitoring plan:

Treatment performance will be measured through analysis of groundwater COC concentration trends, estimation of contaminant mass distribution prior to and during remedy operation, and by analyzing the COC concentration and general chemistry of the effluent.

However, as discussed above, accurate evaluation of temporal concentration trends requires that site-specific characterization of the soil-water partition coefficients (K_d) for CCR constituents has been completed. Since K_d values have not been measured it is not possible to achieve the stated IRD objectives of "*analysis of groundwater COC concentration trends*" and "*estimation of contaminant mass distribution prior to and during remedy operation*" because concentration trends (a function of chemical migration rate, V, presented above) and contaminant mass (directly proportional to R_d values) are determined by both groundwater (aqueous-phase) concentrations and soil (sorbed fraction, which is proportional to K_d) concentrations. For example, if Performance-Monitoring decisions related to hydraulic containment of CCR plumes ignore chemical sorption and retardation then it is very possible that short-term Performance Monitoring Well (PMW) concentration reductions (e.g., due to effluent concentration reductions caused by rainwater infiltration events) would be misconstrued as meaningful levels of aquifer remediation. The present CCR distribution in the Alluvial Aquifer has occurred over a period of decades, and a very-long time period will be required for aquifer cleanup. These types of time scales are consistent with characteristic CCR R_d values on the order of 100 to 1,000.

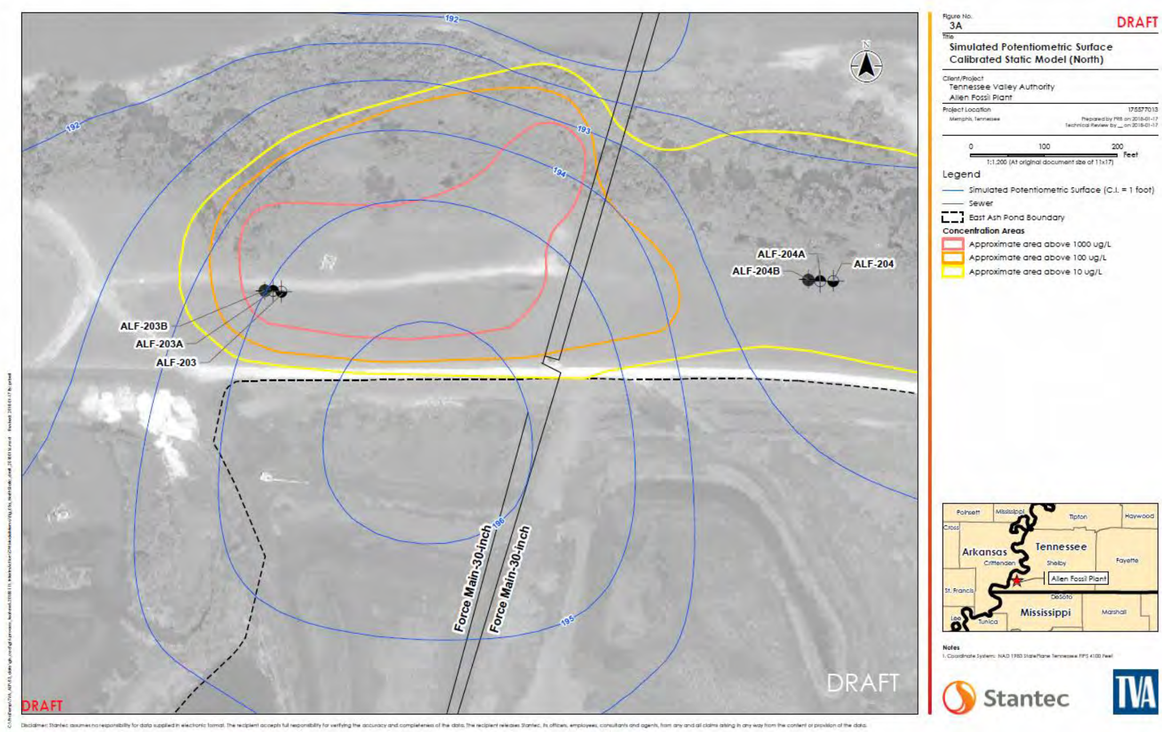

Figure 19

Simulated Shallow-Depth Hydraulic Heads Used for Initial Remedial Design (from Stantec, 2018b)

Characterization of Groundwater beneath West Ash Disposal Area

Figure 20 (TVA, 2018b; EIP Appendix M) shows the proposed monitoring well clusters (shallow, intermediate, deep) in the vicinity of the West Ash Disposal Area. This topic relates to EIP Sections 3.3.1, 3.4.1, and 4.3.6. Three of the proposed locations are downgradient well clusters (northern area), one is side-gradient (ALF-218), and two other clusters are upgradient (ALF-217 and ALF-210). Note that no monitoring wells are proposed in the middle of the coal-ash source area, which is also a major limitation with the East Ash Basin monitoring network. This data gap is very important because the West Ash Disposal Area used to be an active wastewater treatment facility during its operational phase, which means that the deepest vertical extent of CCR contamination is likely the interior portions of the disposal area due to the large downward hydraulic gradients that existed while the West Disposal Area was active (refer to similar discussions above regarding the East Ash Basin).

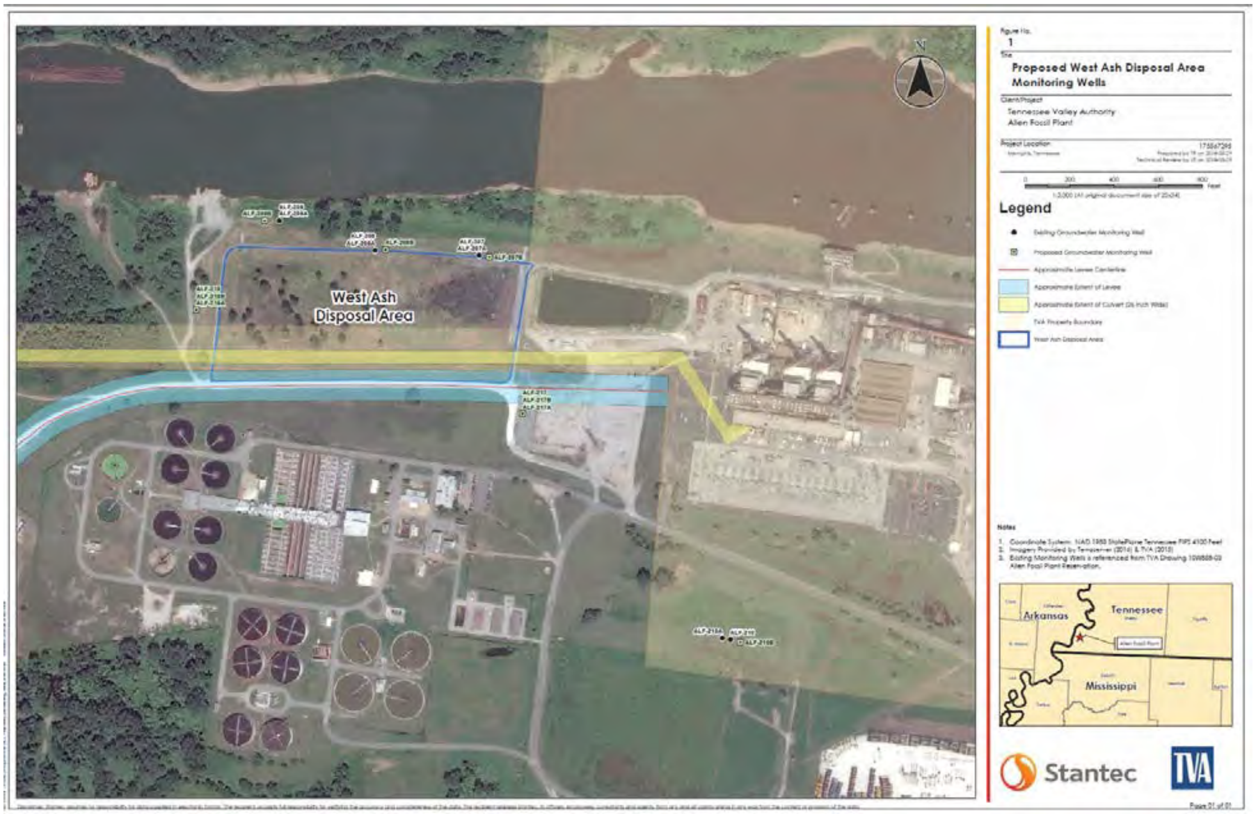

Figure 20
Proposed West Ash Disposal Area Monitoring Wells (from TVA, 2018b)

Summary and Conclusions

Hydrogeologic and groundwater-quality data from the recent 24-hours USGS/CAESER pumping test in the Memphis Sand Aquifer clearly identify a window, or breach, in the upper Claiborne confining unit that separates the MRVA and Memphis Sand aquifers in the ALF-ACC Plants area. In addition, pre-pumping-test vertical hydraulic gradient data (shallow-deep MRVA monitoring wells, and MRVA-Memphis aquifer gradients) indicated that the vertical groundwater flow direction in the MRVA aquifer was downward across most of the ALF-ACC Plants area. Regional groundwater-flow simulations using the USGS MERAS model also confirm strong downward hydraulic gradients from the MRVA to Memphis aquifer in the Memphis area and beyond on an average basis. Consistent with the measured downward flow component in the MRVA aquifer, very high boron and sulfate CCR-constituent concentrations (up to 30 times background levels) were detected near the bottom of the MRVA aquifer during the Remedial Investigation in both the northern and southern parts of the ALF-ACC Plants area. Further, water-quality data for the Memphis Sand aquifer (e.g., PW 5) are consistent with possible ongoing transport of CCR constituents from the MRVA to Memphis Sand aquifers in the ALF-ACC Plants area. Based on the high concentrations of boron and sulfate in the deepest parts of the MRVA aquifer the potential exists for increased fluxes of CCR constituents through the confining unit window(s) in the future.

Therefore, it is very important to further characterize and quantify the risk of contamination by CCR constituents of the Memphis Sand Aquifer in the Allen Plants area. The conclusions of the USGS/CAESER investigation also strongly recommend these types of analyses. Specifically, the location(s) and extent(s) of leakage/window features in the confining unit need to be better defined and the fluxes of groundwater and CCR constituents from the MRVA to Memphis Sand aquifers need to be accurately quantified under current conditions and into the future under both static and pumping conditions. Depending on the results of these computations, three-dimensional groundwater flow and chemical transport (advection-dispersion) modeling of the Memphis Sand Aquifer should be conducted to evaluate potential impacts on downgradient environmental receptors.

In summary, my conclusions are:

- There is a hydraulic connection between the MRVA Aquifer and the Memphis Sand Aquifer;
- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;
- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;
- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;
- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;
- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;
- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring;
- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand;

Based on these findings, I recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;
- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;
- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial

distribution of CCR contamination (including all Appendix III and IV constituents), the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;

- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;
- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;
- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and
- Redesign the interim remedial action as further discussed in this report.

References

Bear, J. 1979. *Hydraulics of Groundwater*. New York: McGraw-Hill.

Charlier, T. 2018. TVA Absorbing Higher Costs to Cool New Memphis Power Plant. Published in Memphis Commercial Appeal, July 6, 2018.

Clark, B.R., and R.M. Hart. 2009. The Mississippi Embayment Regional Aquifer Study (MERAS): Documentation of a Groundwater-Flow Model Constructed to Assess Water Availability in the Mississippi Embayment. U.S. Geological Survey, Water-Resources Investigations Report 2009-5172.

Crank, J. 1975. *The Mathematics of Diffusion*. Oxford University Press.

EPRI. 1984. Chemical Attenuation Rates, Coefficients, and Constants in Leachate Migration. Volume 1: A Critical Review. Electric Power Research Institute Report EA-3356, Volume 1. Prepared by Battelle, Pacific Northwest Laboratories, Richland, Washington. February 1984.

Freeze, R.A., and J.A. Cherry. 1979. *Groundwater*. Prentice-Hall, Inc.

Gelhar, L.W., C. Welty, and K.R. Rehfeldt. 1992. A Critical Review of Data on Field-Scale Dispersion in Aquifers. *Water Resources Research*. Vol. 28, No. 7. pp. 1955-1974.

Gentry, R.W., T.-L. Ku, S. Luo, V. Todd, D. Larsen, and J. McCarthy. 2005. Resolving Aquifer Behavior Near a Focused Recharge Feature Based Upon Synoptic Wellfield Hydrogeochemical Tracer Results. *Journal of Hydrology*, doi:10.1016/j.jhydrol.2005.09.011.

Gentry, R.W., L. McKay, N. Thonnard, J.L. Anderson, D. Larsen, J.K. Carmichael, and K. Solomon. 2006. Novel Techniques for Investigating Recharge to the Memphis Aquifer. American Water Works Association Report No. 91137, American Water Works Association, Denver.

Halford, K., Garcia, C.A., Fenelon, J., and Mirus, B., 201. Advanced methods for modeling water-levels and estimating drawdowns with SeriesSEE, an Excel Add-In, (ver. 1.1, July, 2016): U.S. Geological Survey Techniques and Methods 4–F4, 28 p. https://dx.doi.org/10.3133/tm4F4.

Hantush, M.S. 1964. Hydraulics of Wells. *Advances in Hydroscience*. Vol. 1. Academic Press. Ed. V.T. Chow. 282-437.

Hemond, H.F., and E.J. Fechner. 1994. *Chemical Fate and Transport in the Environment*. Academic Press.

Ivey, S.S., R. Gentry, D. Larsen, and J. Anderson. 2008. Case Study of the Inverse Application of Age Distribution Modeling Using 3H/3He: MLGW Sheahan Wellfield, Memphis, TN. *Journal of Hydraulic Engineering*. Vol. 13, pp. 1011-1020.

Koban, J., D. Larsen, and S. Ivey. 2011. Resolving the Source and Mixing Proportions of Modern Leakage to the Memphis Aquifer in a Municipal Well Field Using Geochemical and 3H/3He Data, Memphis, Tennessee. Environmental Earth Sciences, DOI 10.1007/s12665-011-1239-x.

Larsen, D., R.W. Gentry, and D.K. Solomon. 2003. The Geochemistry and Mising of Leakage in a Semi-Confined Aquifer at a Municipal Well Field. *Applied Geochemistry*. Vol. 18, pp. 1043-1063.

Larsen, D., J. Morat, B. Waldron, S. Ivey, and J. Anderson. 2013. Stream Loss "Contributions to a Municipal Water Supply Aquifer, Memphis, Tennessee. *Environmental and Engineering Geoscience*. Vol. 19, pp. 265-287.

Larsen, D., B. Waldron, B. Schoefernacker, S. Gallo, J. Koban, and E. Bradshaw. 2016. Application of Environmental Tracers in the Memphis Aquifer and Implication for Sustainability of Groundwater Resources in the Memphis Metropolitan Area, Tennessee. *Journal of Contemporary Water Research and Education*. Vol. 159, pp. 78-104.

Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt. 1982. *Handbook of Chemical Property Estimation Methods*. McGraw-Hill Book Company.

Parks, W.S., and J.K. Carmichael. 1990. Geology and Ground-Water Resources of the Memphis Sand in Western Tennessee. U.S. Geological Survey, Water-Resources Investigations Report 88-4182.

Ruhl, L.S., G.S Dwyer, H.-K. Heileen, J.C. Hower, and A. Vengosh. Boron and Strontium Isotopic Characterization of Coal Combustion Residuals: Validation of New Environmental Tracers. *Environmental Science & Technology*. Vol. 48, pp. 14790-14798.

Serfes, M.E. 1991. Determining the Mean Hydraulic Gradient of Ground Water Affected by Tidal Fluctuations. *Groundwater*, Vol. 29, No. 4, 549-555.

Siegel, D.I. 2014. On the Effectiveness of Remediating Groundwater Contamination: Waiting for the *Black Swan*. *Groundwater*, Vol. 52, No. 4. 488-490.

Stantec, 2017. Technical Memorandum, Groundwater Quality in the Vicinity of the Allen Fossil Plant, Memphis, Tennessee. Prepared for: Tennessee Valley Authority, Chattanooga, Tennessee by Stantec Consulting Services, December 21, 2017. Appendix J of 2018 RI Report.

Stantec, 2018a. DRAFT TVA Allen Fossil Plant – East Ash Disposal Area – Remedial Investigation Report, Tennessee Valley Authority, Allen Fossil Plant, Memphis, Tennessee. Prepared for: Tennessee Valley Authority, Chattanooga, Tennessee by Stantec Consulting Services, March 6, 2018.

Stantec, 2018b. Initial Remedial Design – Interim Response Action, Allen Fossil Plant, Memphis, Shelby County, Tennessee. Prepared for: Tennessee Valley Authority, Chattanooga, Tennessee by Stantec Consulting Services, July 20, 2018.

Sudicky, E.A., and W.A. Illman. 2011. Lessons Learned from a Suite of CFB Borden Experiments. *Groundwater*, Vol. 49, No. 5. 630-648.

TVA, 2018a. 2017 Annual Groundwater Monitoring and Corrective Action Report, Tennessee Valley Authority, Allen Fossil Plant East Ash Disposal Area CCR Unit. Prepared by Stantec Consulting Services, Inc., Indianapolis, IN, January 31, 2018.

TVA, 2018b. Environmental Investigation Plan, Allen Fossil Plant, Revision 2, July 20, 2018.

USGS, 1986. Potential for Leakage Among Principal Aquifers in the Memphis Area, Tennessee. U.S. Geological Survey, Water-Resources Investigations Report 85-4295. Authors: D.D. Graham and W.S. Parks.

USGS, 1990. Hydrogeology and Preliminary Assessment of the Potential for Contamination of the Memphis Aquifer in the Memphis Area, Tennessee. U.S. Geological Survey, Water-Resources Investigations Report 90-4092. Author: W.S. Parks.

USGS, 1992. Hydrogeology, Ground-Water Quality and Potential for Water-Supply Contamination near the Shelby County Landfill in Memphis, Tennessee. U.S. Geological Survey, Water-Resources Investigations Report 91-4173. Authors: W.S. Parks and J.E. Mirecki.

USGS, 1995. Hydrogeology, Ground-Water Quality, and Source of Ground Water Causing Water-Quality Changes in the Davis Well Field at Memphis, Tennessee. U.S. Geological Survey, Water-Resources Investigations Report 94-4212. Authors: W.S. Parks, J.E. Mirecki, and J.A. Kingsbury.

USGS, 2016. Evaluation of Effects of Groundwater Withdrawals at the Proposed Allen Combined-Cycle Combustion Turbine Plant, Shelby County, Tennessee. U.S. Geological Survey, Water-Resources Investigations Report 2016-5072. Author: C.J. Haugh.

USGS, 2018. Preliminary Evaluation of the Hydrogeology and Groundwater Quality of the Mississippi River Valley Alluvial Aquifer and Memphis Aquifer at the Tennessee Valley Authority Allen Power Plants, Memphis, Shelby County, Tennessee. U.S. Geological Survey, Open-File Report 2018-1097. Authors: J.K. Carmichael, J.A. Kingsbury, D. Larsen, and S. Schoefernacker.

Zheng, C., G.D. Bennett, and C.B. Andrews. 1991. Analysis of Ground-Water Remedial Alternatives at a Superfund Site. *Groundwater*, Vol. 29, No. 6. pp. 838-848.

Zheng, C., M. Bianchi, S.M. Gorelick. 2010. Lessons Learned from 25 Years of Research at the MADE Site. *Groundwater*, Vol. 49, No. 5. 649-662.

Comments on the **Environmental Impact Statement** can be submitted…

In writing at:
Attn: Ashley Farless
NEPA Compliance Specialist
1101 Market Street, BR4A-C
Chattanooga, TN 37402

Via email at: **arfarless@tva.gov**

Online at:
https://www.tva.gov/nepa

All comments received by January 31, 2019 will become part of the EIS record.

Comments: Please contact ALL city officials and we get a tour bus or something and take community members to the different sites and explain each situation in details. And please connect with area (flip over)

Name:

Email:

Address:

TVA

Comments on the **Environmental Investigation Plan** can be submitted…

In writing at:
TN Commissioner's Order Comment
Tennessee Valley Authority
1101 Market St. BR 4A, Chattanooga, TN 37402

Via email at: **TDECorder@tva.gov**

Online at:
https://www.tva.com/AllenEIP

Comments must be received by the end of the comment period, January 31, 2019.

Comments:
churches to make sure all parties and community stakeholders are involved. If help is needed for this feel free to contact me and I will assist.

Name: Anthony Hardaway Email:

Address: 3435 Outlet Rd. 38109

TVA

From: Mallory Heights CDC <info@malloryheightscdc.org>
Sent: Wednesday, January 23, 2019 8:49 PM
To: McCormick, Gary D
Cc: mary morrow; Vera M Holmes
Subject: Allen Ash Impoundment Closure at Allen Fossil Plant

TVA External Message. Please use caution when opening.

Allen Ash Impoundment Closure (TVA)
Key Issues
17 January 2019

What we want
A clean up of coal ash ponds and surrounding areas
A grey water solution for cooling the new power plant
A **pledge** by TVA to improve the health and well-being of surrounding neighborhoods

What we want to know
Coal Ash
How does TVA intend to solve the problem of contaminants from the coal ash piles? (such as arsenic, lead, boron, sulfate, fluoride, and others)
What will TVA do with the coal ash?
How will TVA clean the contaminated water in the coal ash ponds?
How will TVA deal with the contaminated soil underneath the ash piles?
How will the neighborhood be affected or protected from the movement of coal ash, soil, or contaminants from the site?

As a contributor to other ground and water pollution, how will TVA assist in fixing problems surrounding this site?

Cooling Water
Will TVA consider using grey water (a source other than the deep Aquifer) to cool their new gas power plant? (such as wastewater, surface water, river water or shallow aquifer water)
Will TVA conduct research and share findings of the Memphis Sand Aquifer system?
Will TVA research and share findings of the entire water eco-system at this site?

Health and Well-being
Will TVA make sure that the surrounding neighborhoods are clean, safe, and free of pollution generated by 50 years of power production?
Will TVA make an investment in surrounding neighborhoods (38109) to test for and repair any adverse effects of their coal power production?
Will TVA inform local residents of major activities and completed projects?
Will TVA consider training or hiring residents from the area for safe jobs?
Will TVA provide any education to local residents on subjects such as safety?

Thank you in advance in this matter! Please contact Vera M. Holmes regarding all updates and responses.

Vera M. Holmes, Community Development Advocate
Mallory Heights Community Development Corporation
(B) 904-553-1718 – veramholmes@gmail.com
(O) 901-774-6235 – info@malloryheightscdc.org

Attn: Ashley Farless

NEPA Compliance Specialist

1101 Market Street, BR4A-C

Chattanooga, TN 37402

E-mail: arfarless@tva.gov

I Edgar Hunt Jr a member of the West Junction/ Walker Holmes Coalition concerning the TVA Allen fossil plant investigation Order No. OGC15-0177 by TDEC. I would like these questions to be addressed:

- **When did TDEC discover the spill (improper disposal of CCR)?**
- **When did the arsenic leak or seek into the ground water?** *
- **When did the arsenic leak or seek into the soil?**
- **When did the arsenic leak or seek into surface water?**
- **Name the chemicals that are in the arsenic that affect the human body?**
- **What is the environmental effect that the chemicals have?**
- **What are the health effects of the residents living in the community?**
- **How long will it take to clean the spill up?**
- **When did the contamination take place?**
- **How many spills where discovered?**

* Did the containmination spill into the upper drinking water?
* Did the containmination spill into lower drinking water?

We no longer want a facility on the Allen fossil plant to process the CCR material.

Name Edgar Hunt Sr. **Date** 1/25/2019

Address 792 Hazelwood Rd **Cty/St/Zip** Memphis, TN. 38109

Cell 901-314-0957 **E-mail** ________________

* Can you give a timeline on groundwater (second aquifer) contaminants in interval of 10 yrs. starting in 1975?

Edgar Hunt Jr.
792 Hazelwood Rd.
Memphis, TN. 38109

MEMPHIS TN 380

26 JAN 2019 PM 2 L

Thinking

ATTN: Ashley Farless
NEPA Compliance Specialist
1101 Market Street, BR4A-C
Chattanooga, TN
37402

37402$2881 C003

ASHLEY FARLESS

NEPA Compliance Specialist

1101 Market Street,BR4-C

Chattanooga,TN.37402

EMAIL: arfless@tva.gov

I Danny Mitchell a member of WEST JUNCTION/WALKER HOMES COALITION. I have concerns and questions about the health and environmental issues of TVA ALLEN FOSSIL PLANT investigation of the disposal of CCR and arsenic groundwater remedial investigation and contamination. I am requesting a meeting, as soon as possible with the WEST JUNCTION /WALKER HOMES COALITION.

Thank you

name Danny Mitchell date 1/25/2019

address 793 Hazelwood Rd cty/st/zip 38109

cell 901-834-7630 email dleemitchell@icloud.com

Danny Lee Mitchell
793 Hazelwood Rd
Memphis, TN. 38109

BR4A

Ashley Farless
NEPA Compliance Specialist
1101 Market Street, BR4-C
Chattanooga, TN. 37402

37402$2881~C003

Jan. 26, 2019

AHN: Ashley Farless
TN Commissioner's Order Comment
Tennessee Valley Authority
1101 Market St. BR 4A
Chattanooga, TN 37402

I am Desma Turner a member of West Junction / Walker Holmes Coalition. I am requesting a meeting to be held for the coalition for concerns of health and environmental issues of the residents that live in this area. We want the Report of TVA (Allen Fossil Plant) investigation Plan, Environmental Assessment report, Sampling and Analyses Plan and report, Remedial investigation report, Coal Combustion Residuals report, (TDEC report) and (EPA report) for all investigations of order NO. OGC15-0177 by TDEC for TVA. Also, the Arsenic investigation report for soil, underground water, surface water and upper and lower ground aquafier.

Thank you,

Desma Turner

@ desmaturner20@live.com

Degma Turner
792 Hazelwood Rd.
Memphis, TN. 38109

MEMPHIS TN 380
28 JAN 2019 PM 3 L

Thinking

ATTN: Ashley Farless
NEPA Compliance Specialis
1101 Market Street, BR4A-C
Chattanooga, TN.
37402

37402232713 C003.

ATTN: ASHLEY FARLESS

NEPA Compliance Specialist

1101 Market Street,BR4A-C

Chattanooga, TN 37402

E-mail: arfarless@tva.gov

I Desma Turner is requesting a meeting for

WEST JUNCTION/WALKER HOMES COALITION RESIDENTS

OF WEST JUNCTION COMMUNITY, as soon as possible. We have concerns for the health and environmental safety of our communities. We want a meeting for TVA Allen fossil plant Order No. OGC15-0177 for the CCR by TDEC.

THANK YOU

YOU CAN CONTACT ME AT:

Name Desma Turner Date 11/24/2019

Address 792 Hazelwood Cty/St/Zip 38109

Cell 901-785-7376 E-mail desmaturner20@live.com

Desmon Turner
792 Hazelwood Rd
Memphis, Tnk
38109

MEMPHIS TN 380
26 JAN 2019 PM 2 L

TN. Commissioner's Order Comm
Tennessee Valley Authority
1101 Market Street. BR4-A
Chattanooga, TN.
37402

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