Semiannual Report on the Progress of Remedy Selection

TVA Cumberland Fossil Plant, CCR Multiunit, Cumberland City, Stewart County, Tennessee

January 15, 2020

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

Stantec Consulting Services Inc.
Indianapolis, Indiana

1.0 Introduction

In accordance with 40 CFR § 257.97(a), the Tennessee Valley Authority (TVA) has prepared this semiannual report to document progress toward remedy selection and design at the Bottom Ash Pond, Gypsum Storage Area, and Dry Ash Stack Multiunit (also referred to herein as CCR Multiunit) at the Cumberland Fossil Plant (CUF) in Cumberland City, Stewart County, Tennessee.

1.1 Regulatory Background

On April 17, 2015, the United States Environmental Protection Agency (U.S. EPA) published a rule that sets forth national criteria for the management of coal combustion residuals (CCR) produced by electric utilities. The requirements can be found in Title 40, Code of Federal Regulations (CFR) Part 257, Subpart D. The rule includes requirements for monitoring groundwater and assessing corrective measures if constituents listed in Appendix IV of the rule are detected in groundwater samples collected from downgradient monitoring wells at statistically significant levels (SSLs) greater than established groundwater protection standards (GWPS).

In January 2019, TVA completed an evaluation of whether there were SSLs over established GWPS as defined in 40 CFR § 257.95(h) for one or more Appendix IV constituents in accordance with 40 CFR § 257.95(g). At the CUF CCR Multiunit, assessment monitoring in 2018 detected SSLs greater than the GWPS for cobalt and lithium at monitoring wells CUF-212 and 93-3, respectively. TVA recalculated the statistical analysis in mid-2019 after incorporating additional groundwater monitoring data from the first assessment monitoring event and retest event. In late-2019, TVA updated the statistical analysis after incorporating results from the second semiannual groundwater monitoring event. The same SSLs were observed at the same monitoring wells as previously identified; however, a new SSL for cobalt at monitoring well CUF-211[1] was also observed in late-2019. As of the date of this report, TVA has not completed a demonstration that a source other than the CCR Multiunit associated with wells CUF-211, CUF-212 and 93-3 caused the SSLs, as allowed under 40 CFR § 257.95(g)(3)(ii).

In accordance with 40 CFR § 257.96(a), TVA prepared the 2019 Assessment of Corrective Measures (ACM) Report for the CCR Multiunit at CUF, placed it in the facility operating record on July 15, 2019, and uploaded it to the public website on August 14, 2019. The ACM Report provided an assessment of the effectiveness of potential corrective measures in achieving the criteria provided in 40 CFR § 257.96(c).

Following preparation of the ACM Report, TVA began the remedy selection process. Semiannual reports are required pursuant to 40 CFR § 257.97(a) to document progress toward remedy selection and design. The CCR Rule contemplates that more investigation and consideration may be needed to evaluate and design the remedy before making the final selection. TVA will continue to review new data as it becomes available and implement changes to the groundwater monitoring and corrective action program as necessary to maintain compliance with 40 CFR § 257.90 through § 257.98.

[1] Cobalt concentrations at monitoring well CUF-211 are delineated horizontally by monitoring wells 93-2R to the southeast and CUF-209 to the northwest. The potential remedial technologies to address the SSLs observed at monitoring wells CUF-206, CUF-212, and 93-3 presented in the Assessment of Corrective Measures Report (Stantec, 2019) also apply to the new SSL for cobalt at monitoring well CUF-211.

At least 30 days prior to when the final remedy is selected, a public meeting will be held with interested and affected parties to discuss the results of the corrective measures assessment in accordance with 40 CFR § 257.96(e). The selected remedy must meet the requirements of 40 CFR § 257.97(b) and must consider the evaluation factors set forth in 40 CFR § 257.97(c). Once a final remedy is chosen, a final report describing the remedy and how it meets the standards set forth in 40 CFR § 257.97(b) will be prepared. The owner/operator must provide a schedule for implementing the selected remedy that considers the factors set forth in 40 CFR § 257.97(d).

1.2 Summary of State Required Investigation and Remedy Selection Process

TVA is currently conducting environmental investigations of the CCR disposal areas at CUF, including the CCR Multiunit, under the oversight of the Tennessee Department of Environment and Conservation (TDEC) through the TDEC Commissioner's Order, OGC 15-0177 (TDEC Order), issued on August 6, 2015. Once the environmental investigation (EI) is complete, TVA will submit environmental assessment reports (EARs) that provide an analysis of the extent of CCR contamination, including groundwater contamination, at CUF to TDEC for approval. Then, as part of the TDEC Order process, TVA will submit Corrective Action/Risk Assessment (CARA) Plans that specify actions that TVA plans to take at a site, including corrective measures for groundwater remediation, to TDEC for approval. TDEC must approve the CARA Plans, including the CCR unit closure methodologies, selected final remedy(s) and corrective measures for groundwater remediation.

1.3 Report Contents

This first semiannual progress report provides a summary of CUF site characteristics, the groundwater assessment monitoring program, the findings of the ACM process, and the current progress of selecting and designing a final remedy for the GWPS exceedances.

2.0 Site Background and Characteristics

CUF is located in Cumberland City, Stewart County, Tennessee. The facility lies on the south bank of Cumberland River and adjacent to Wells Creek. **Figure 1** shows an overview map of CUF including the CCR Multiunit. Construction of CUF began in 1968 and operations commenced in 1972. CUF currently continues to operate as a coal-fired power generation facility. The coal combustion process at CUF has resulted in the production of fly ash, bottom ash, and gypsum.

The Bottom Ash Pond, Dry Ash Stack, and the Gypsum Storage Area are referred to as the CCR Multiunit for purposes of this report as there is a common groundwater well network for these CCR units. The current area of the Bottom Ash Pond encompasses approximately 5.3 acres, the Dry Ash Stack encompasses approximately 115 acres, and the Gypsum Storage Area encompasses approximately 155 acres. These units are surrounded with perimeter dike systems. Bottom ash is sluiced to the Bottom Ash Pond, reclaimed, and then spread and compacted within the Dry Ash Stack. The Bottom Ash Pond also receives effluent from lined settling channels and a nearby plant that processes gypsum slurry. Effluent from the Bottom Ash Pond is then conveyed to the Stilling Pond.

Surplus gypsum material is stored at the Gypsum Storage Area for later use by the wallboard plant. Smaller particles from a gypsum dewatering process are pumped to TVA's fines dipping area in the corner of the bottom ash pond where they are dipped, allowed to decant and eventually hauled and placed on the gypsum stack in a specified area.

2.1 Conceptual Site Model Summary

CUF is located within the Wells Creek Basin, which is a meteor impact structure. The subsurface geology at CUF is characterized by two hydro-stratigraphic units which includes the alluvium and bedrock. The alluvium can be further differentiated into alluvial silts and clays and alluvial sands and gravels. The CUF site overlies eight bedrock formations that primarily consist of limestone, dolomite or shale. The alluvial sand and gravel is considered the upper-most aquifer and groundwater from this hydro-stratigraphic unit is monitored in accordance with 40 CFR § 257.91. A typical cross-section view of the subsurface geology is shown on **Figure 2**.

The hydrogeologic conceptual site model (CSM) is one of the primary tools that can be used to support decisions on corrective measures. This section of the report provides a summary of the hydrogeologic CSM. The geology and hydrogeology of the CUF site have been characterized during implementation of multiple investigations. These investigations provide an understanding of site geology and the presence of water-bearing zones in which groundwater and potential contaminants would be present and potentially migrating. Groundwater flow direction at the CCR Multiunit is generally to the southwest toward Wells Creek. **Figure 3** presents a groundwater flow direction map for CUF.

2.2 Potential Receptor Review

The two largest public water suppliers in Stewart County are the Dover Water Department and the North Stewart Utility District (CDC, 2019). The Dover Water Department withdrawals its drinking water from the Cumberland River. The Dover water treatment plant is located approximately 14.4 miles downstream of CUF. The North Stewart Utility District withdraws its water from the Brandon Spring, which is within the Cumberland River, is located approximately 20 miles downstream of CUF. The City of Erin Water Department provides potable water to Cumberland City and the survey area. The City of Erin water supply is sourced from the Cumberland River at its confluence with Yellow Creek approximately 3.7 miles northeast (upstream) of CUF Plant.

3.0 Groundwater Assessment Monitoring Program

Groundwater assessment monitoring for the CCR Unit is conducted at CUF in accordance with 40 CFR § 257.95.

3.1 Groundwater Monitoring Well Network

In compliance with 40 CFR § 257.91, two background wells (CUF-201 and CUF-202) were established and five monitoring wells (CUF-209, CUF-211, 93-2R, CUF-212 and 93-3) were installed downgradient and within the containment dikes of the CCR Multiunit. The locations of these monitoring wells are presented on **Figure 1**.

3.2 Groundwater Characterization

Groundwater assessment monitoring was conducted during 2018 and 2019. Cobalt and lithium, Appendix IV constituents, were detected at SSLs above a GWPS. The following summarizes the 2018 and 2019 Appendix IV SSLs at the CUF CCR Unit.

- <u>Cobalt</u>
    - SSLs for cobalt were identified at monitoring well CUF-212 in 2018 and 2019, and at monitoring well CUF-211 in 2019;
    - The GWPS for cobalt is 6 µg/L;
- <u>Lithium</u>
    - SSLs for lithium were identified at monitoring well 93-3 in 2018 and 2019;
    - The GWPS for lithium is 40 µg/L.

Data from existing CCR network wells has been utilized to characterize the nature and extent of any release from the CCR Multiunit as required by 40 CFR 257.95(g)(1). The potential treatment zone to address the extent of cobalt and lithium above GWPS along the unit perimeter is illustrated on **Figure 4**. Under the CCR Rule, work is being performed and additional wells are being installed that will further inform the evaluation and selection of the remedy(s) under 40 CFR 257.97 (reference **Figures 5 and 6**).

4.0 Assessment of Corrective Measures

TVA prepared the 2019 ACM Report for the CCR Multiunit and placed it in the operating record on July 15, 2019. The report was posted to the TVA CCR Rule Compliance Data and Information website on August 14, 2019. The ACM Report provided an assessment of the effectiveness of potential corrective measures in achieving the criteria provided in 40 CFR § 257.96(c).

4.1 Planned Source Control Measures

The objectives of corrective measures under 40 CFR § 257.96(a) are to "prevent further releases [from the CCR units], to remediate any releases, and to restore affected areas to original conditions." Ultimately, in accordance with 40 CFR § 257.97(b)(3), the selected corrective measure must at a minimum "[c]ontrol the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents of appendix IV to this part into the environment."

The Preamble (80 Fed. Reg. 21302, 21406) to the CCR Rule discusses that source control measures may include modifying operational procedures. To achieve TVA's commitment to convert from wet to dry handling of CCR and to comply with regulatory requirements and timeframes under the CCR Rule, TVA will stop using and initiate closure of the Bottom Ash Pond. TVA has initiated placement of intermediate cover over portions of the landfill to limit the working area. The final closure method for the CCR Multiunit at CUF will be determined based on the outcome the TDEC Order EI and will be in accordance with 40 CFR § 257.102. Section 4.2 of the ACM Report describes the plan for closing CCR units at CUF. These measures will reduce the potential for migration of CCR constituents to groundwater and reduce releases to groundwater. Subsequent groundwater assessment monitoring will be conducted to track changes in groundwater conditions as a result of these closures and operational changes. These data will also be considered in the selection and design of a remedy in accordance with 40 CFR § 257.97. Groundwater assessment monitoring as required by 40 CFR § 257.96(b) will continue until a final remedy is selected.

4.2 Potential Remedial Technologies

Subject to all necessary environmental reviews, the CCR Multiunit will be closed in accordance with the requirements set forth in 40 CFR § 257.102.

In addition to source control measures, three primary strategies were evaluated to address groundwater exhibiting concentrations of cobalt and lithium above the GWPS including:

- Monitored Natural Attenuation (MNA);
- Hydraulic Containment and Treatment; and,
- Enhanced In-situ Treatment (EIST).

The ACM Report provides a more detailed description of these corrective measures. The effectiveness of each potential corrective measure was assessed in accordance with 40 CFR § 257.96(c).

5.0 Selection of Remedy: Current Progress

A remedy to address SSLs in groundwater will be selected in accordance with 40 CFR § 257.97 and the CARA Plan required by the TDEC Order. In support of the remedy selection process, additional investigation is needed and is described below.

5.1 Data Requirements for Design of Groundwater Corrective Action

In order to further refine the targeted area for corrective measures, develop remedial cost estimates and finalize the alternative for the CCR Multiunit, the currently available site-specific data may require additional refinement to address potential data gaps. The characterization of the horizontal extent of cobalt and lithium impacts downgradient of the Gypsum Storage Multiunit is being further refined by the investigation required under the CCR rule.

Current activities to further evaluate site conditions:

- Fifteen additional exploratory soil borings will be installed in proximity to downgradient monitoring wells 93-3, CUF-212, and CUF-211 to further delineate dissolved lithium and cobalt concentrations in groundwater. Exploratory boring locations are illustrated in **Figures 5 and 6**.

- The locations of three additional monitoring wells to be installed directly downgradient of monitoring wells 93-3, CUF-212, and CUF-211 as facility boundary wells will be based on the results of the exploratory soil borings.

- Slug testing will be performed at the newly installed well locations surrounding the CCR Multiunit to further characterize hydraulic conductivity.

- Three temporary monitoring wells have been installed at the Gypsum Storage Area and three temporary monitoring wells have been installed at the Dry Ash Stack. The temporary wells are being used to sample CCR material and pore water, and to analyze water level responses within the CCR units.

Potential future activities to further evaluate MNA:

- Supplemental Groundwater Flow Modeling Simulations – The existing groundwater flow model developed for the EI will be refined based on expanded groundwater elevation data gained from the ongoing EI and additional hydrogeologic characterization efforts.

- Supplemental Groundwater Fate and Transport Modeling Simulations – The refined groundwater flow model will first be calibrated to more recent existing conditions before groundwater fate and transport modeling can be performed. The fate and transport model will be used to further evaluate the estimated time for natural attenuation mechanisms to reduce the cobalt concentrations to below GWPS.

Potential future activities to further evaluate hydraulic containment and treatment:

- Supplemental Groundwater Flow Modeling Simulations – The existing groundwater flow model developed for the EI is currently being refined based on expanded groundwater elevation data gained from the ongoing EI and additional hydrogeologic characterization efforts. These flow model refinements will incorporate several groundwater extraction scenarios to optimize hydraulic containment of cobalt and lithium-impacted groundwater while balancing extracted groundwater treatment requirements.

- Groundwater Treatability Study - For ex-situ treatment of extracted groundwater, treatability studies would be needed to evaluate technologies for the treatment of cobalt and lithium.

- Supplemental Hydraulic Properties Evaluation – This evaluation could be necessary if the existing understanding of the hydraulic characteristics of the subsurface are not sufficient to evaluate hydraulic capture geometry and potential groundwater recovery rates. If needed, installation of new wells and performance of pumping tests to evaluate hydraulic capture geometry and potential groundwater recovery rates would feed back into the groundwater flow modeling simulations for groundwater extraction. This data would inform the feasibility, design, and implementation of any groundwater recovery systems.

Potential future activities to evaluate Enhanced In-situ Treatment:

- A geochemical investigation will be conducted to evaluate groundwater, pore water and aquifer solids associated with the CCR Multiunit.

- Groundwater Treatability Study – For in-situ treatment of groundwater, bench-scale treatability studies may be conducted on representative groundwater samples prior to selecting a groundwater corrective measure for implementation to address cobalt concentrations.

5.2 Semiannual Reporting, Public Meeting, Remedy Selection and Final Report

Progress toward the selection and design of the remedy will be documented in semiannual reports in accordance with 40 CFR § 257.97(a). At least 30-days prior to selecting a remedy, a public meeting to discuss the results of the corrective measures assessment will be conducted as required by 40 CFR § 257.96(e). A final report will be prepared after the remedy is selected. This final report will describe the remedy and how it meets the standards specified in 40 CFR § 257.97(b) and 257.97(c). Recordkeeping requirements specified in 40 CFR § 257.105(h), notification requirements specified in 40 CFR § 257.106(h), and internet requirements specified in 40 CFR § 257.107(h) will be complied with as required by 40 CFR § 257.96(f).

Attachments:

Figures

Figure 1 – Map with CCR Unit Background and Downgradient Wells

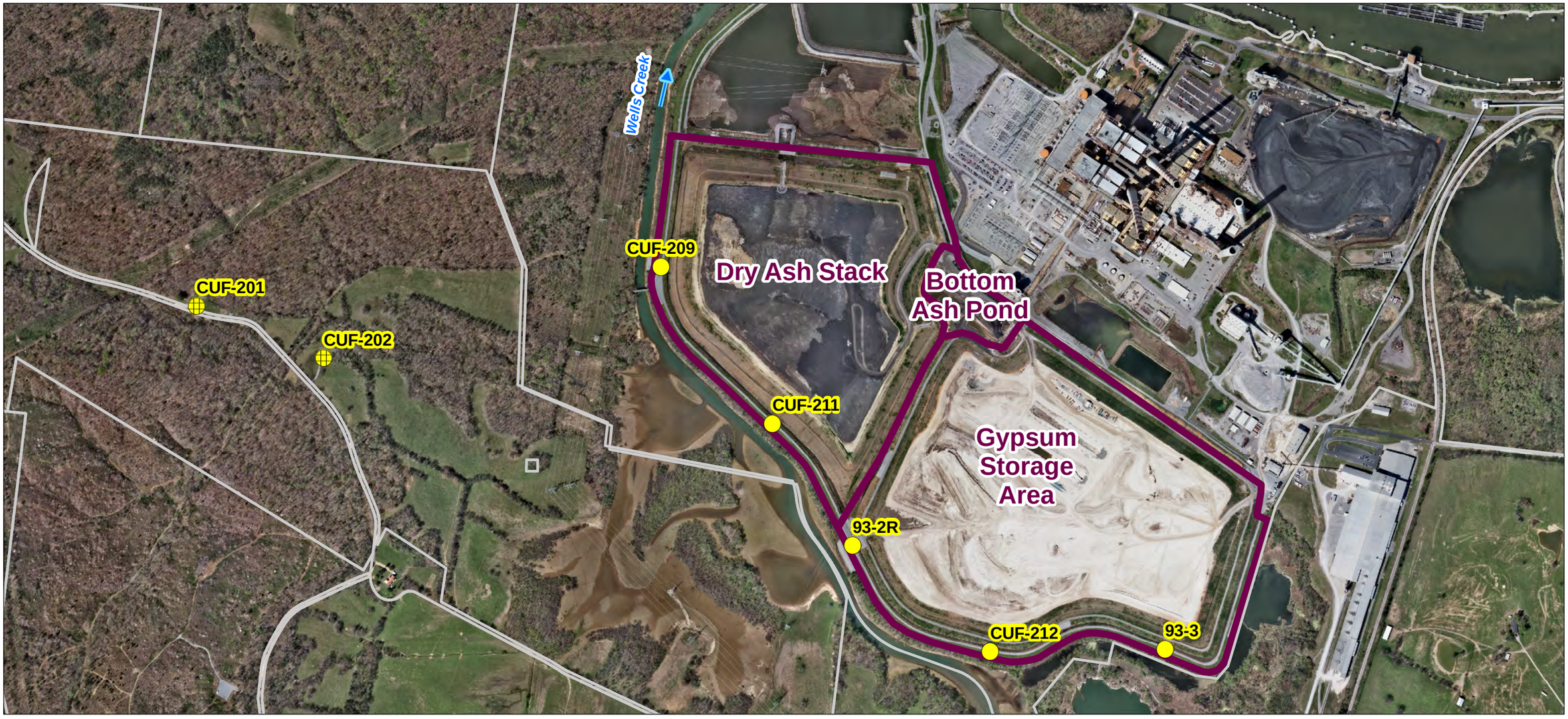
Figure 2 – Conceptual Cross-Section of Multiunit

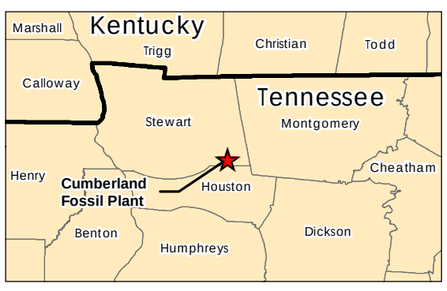
Figure 3 – Generalized Groundwater Flow Direction Map

Figure 4 – Monitoring Wells and Limits of Constituents of Interest (COI) Impacts

Figure 5 – Location of Existing Monitoring Wells 93-3 and CUF-212 and Proposed Soil Boring Locations

Figure 6 – Location of Existing Monitoring Well CUF-211 and Proposed Soil Boring Locations





Legend

- Background Well
- Downgradient Well
- TVA Property Boundary
- CCR Unit Area (Approximate)

0 800 1,600 Feet

(At original document size of 11x17)
1:9,600

N

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Background: TVA Imagery flown by Tuck Mapping (c. 2017)

Project Location
Stewart County, Tennessee

Prepared by LMB on 2020-01-13
Technical Review by MD on 2020-01-13

Client/Project 182603538
Tennessee Valley Authority
Cumberland Fossil Plant

Figure No.
1

Title
Map with CCR Unit Background and Downgradient Monitoring Wells

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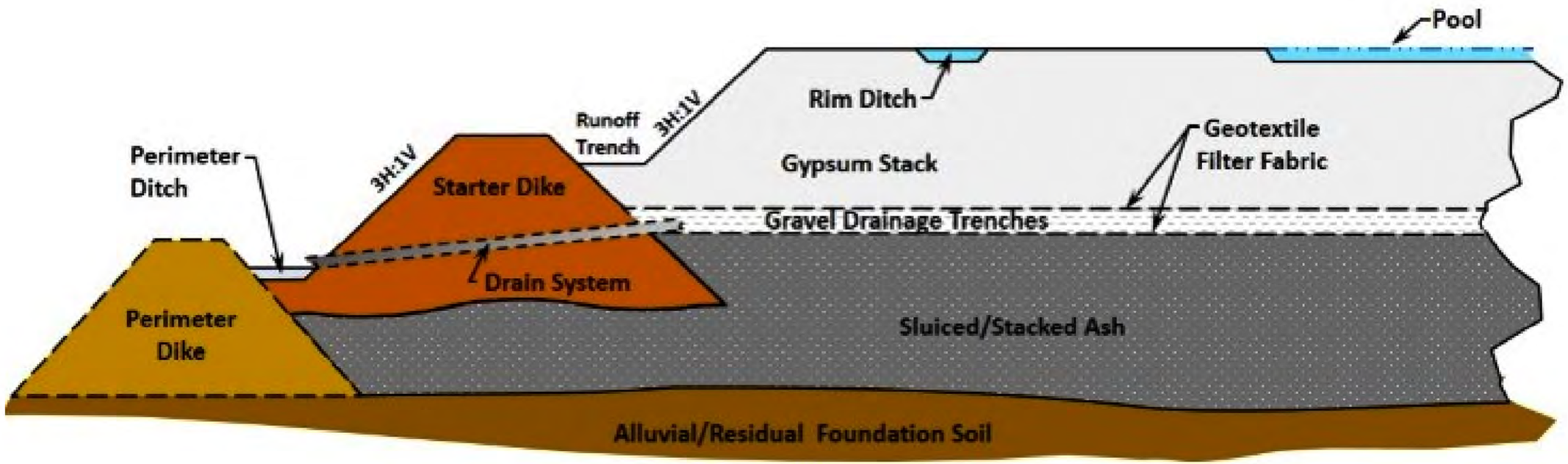

Legend

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Image Not To Scale

N

Project Location
Stewart County, Tennessee

Prepared by MB on 2020-01-13
Technical Review by MD on 2020-01-13

Client/Project
Tennessee Valley Authority
Cumberland Fossil Plant

182603538

Figure No.
2

Title
Conceptual Cross-Section of Multiunit

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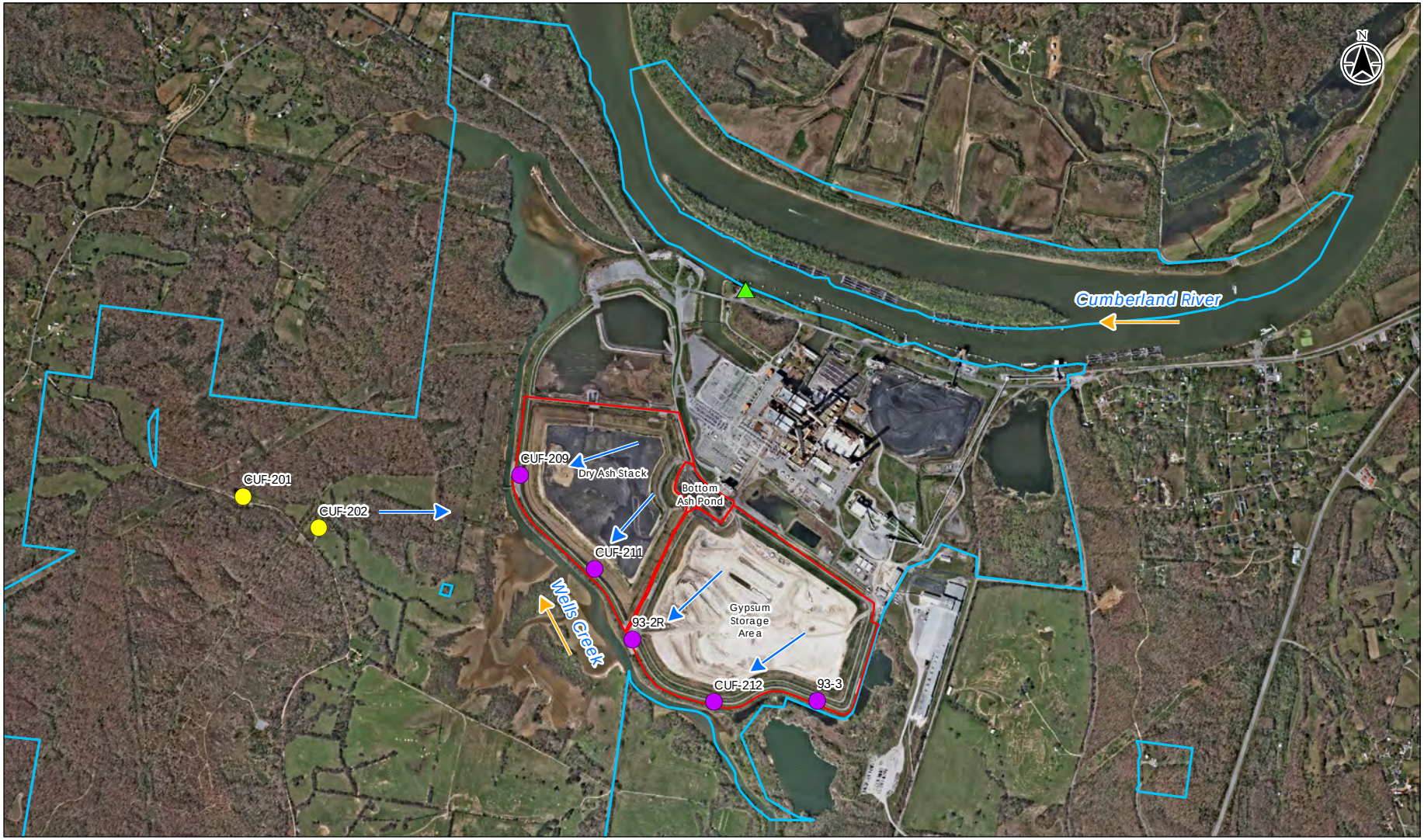

Staff Gauge
Background Well
Downgradient Well
Groundwater Flow Direction
CCR Unit Subject to CCR Rule
TVA Property Boundary

0 1,000 2,000 Feet

1:24,000 (At original document size of 8.5x11)

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Source: Tucker Mapping Solutions, INC (Flown April 8, 2017)

Groundwater flow directions are based on groundwater elevations from CCR and Non-CCR monitoring wells.

Project Location
Cumberland City
Stewart County,
Tennessee

182603538
Prepared by LMB on 2020-01-13
Technical Review by WSW on 2020-01-13
Independent Review by MD on 2020-01-13

Client/Project
Tennessee Valley Authority
Cumberland Fossil Plant
CCR Rule

Figure No.
3

Title
Generalized Groundwater Flow Direction Map

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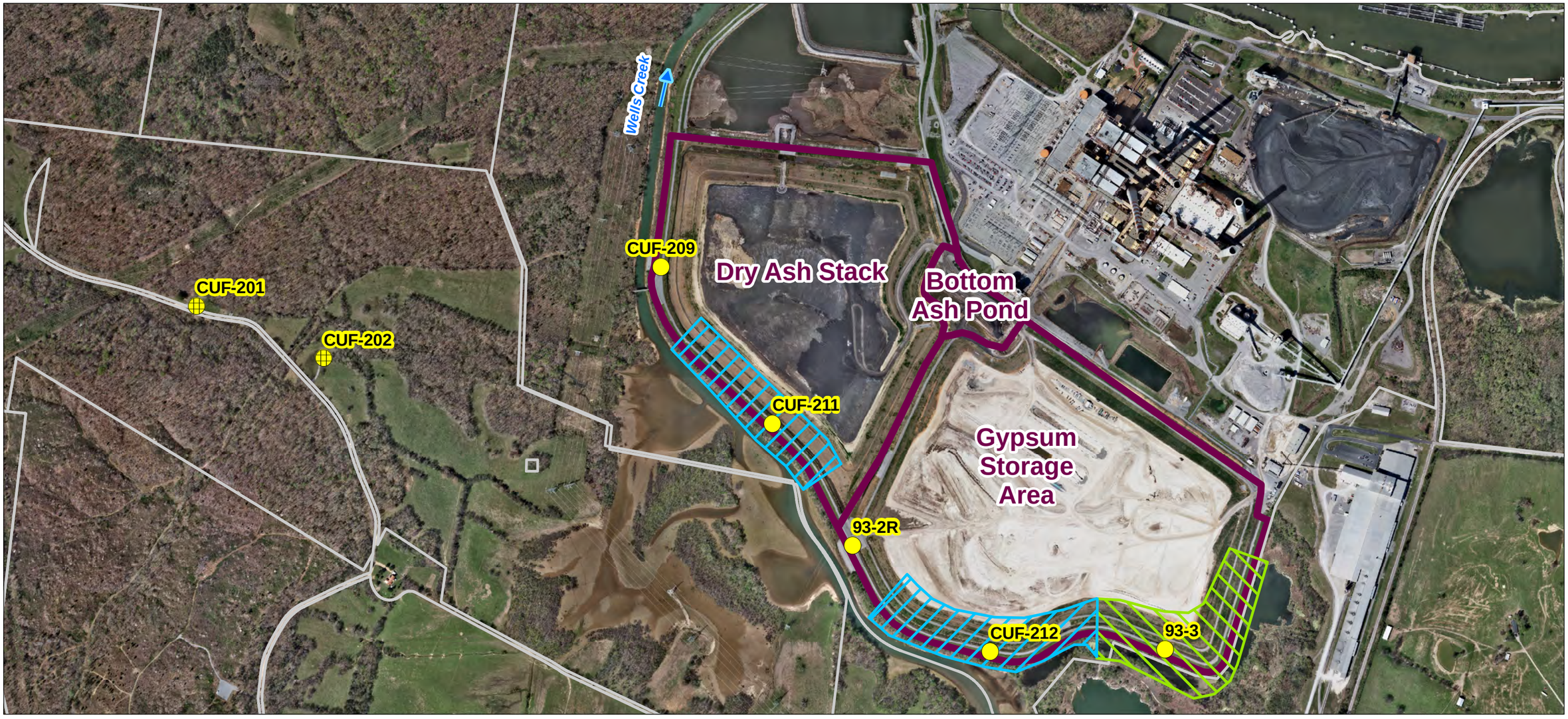

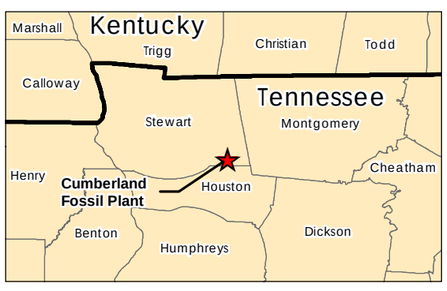

Legend

- Background Well
- Downgradient Well
- TVA Property Boundary
- CCR Unit Area (Approximate)
- Potential Cobalt Treatment Zone (CUF-211, CUF-212)
- Potential Lithium Treatment Zone (93-3)

0 800 1,600 Feet

(At original document size of 11x17)
1:9,600

N

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Background: TVA Imagery flown by Tuck Mapping (c. 2017)

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Stewart County, Tennessee

Prepared by MB on 2020-01-13
Technical Review by MD on 2020-01-13

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Cumberland Fossil Plant

182603538

Figure No.
4

Title
Monitoring Wells and Limits of Constituents of Interest (COI) Impacts

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Legend

- Downgradient Well
- Proposed Soil Boring
- 93-3 Investigation Area
- CUF-212 Investigation Area
- TVA Property Boundary
- CCR Unit Area (Approximate)

0 200 400 Feet

(At original document size of 11x17)
1:2,400

N

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Data Sources:
3. Background:

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Stewart County, Tennessee

Prepared by MB on 2020-01-13
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Tennessee Valley Authority
Cumberland Fossil Plant

Figure No.
5

Title
Location of Existing Monitoring Wells 93-3 and CUF-212 and Proposed Soil Boring Locations

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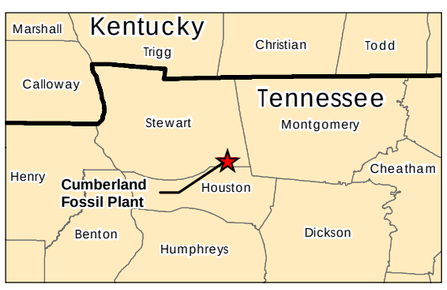

Legend

- Downgradient Well
- Proposed Soil Boring
- CUF-211 Investigation Area
- TVA Property Boundary
- CCR Unit Area (Approximate)

0 400 800 Feet

(At original document size of 11x17)
1:4,800

N

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Data Sources:
3. Background:

Project Location
Stewart County, Tennessee

Prepared by MB on 2020-01-13
Technical Review by MD on 2020-01-13

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Tennessee Valley Authority
Cumberland Fossil Plant

182603538

Figure No.
6

Title
Location of Existing Monitoring Well CUF-211 and Proposed Soil Boring Locations

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