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October 17, 2018  
File: rpt\_001\_let\_175567307  
Revision 0

Tennessee Valley Authority (TVA)  
1101 Market Street  
Chattanooga, Tennessee 37402

**RE: Placement Above the Uppermost Aquifer Demonstration  
Active Ash Pond 2  
EPA Final Coal Combustion Residuals (CCR) Rule  
TVA Johnsonville Fossil Plant  
New Johnsonville, Tennessee**

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## **1.0 PURPOSE**

As described in 40 CFR § 257.60(a), an owner or operator of an existing CCR surface impoundment is required to demonstrate that the unit is located no less than five feet above the upper limit of the uppermost aquifer. This letter documents Stantec's certification that Active Ash Pond 2 at the TVA Johnsonville Fossil Plant (JOF) complies with the location restrictions for aquifer separation in the EPA Final CCR Rule at 40 CFR § 257.60(a)

## **2.0 SUMMARY OF FINDINGS**

The attached demonstration documents that Active Ash Pond 2 meets the requirements set forth in 40 CFR § 257.60(a).

## **3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION**


I, Stephen H. Bickel, being a Professional Engineer in good standing in the State of Tennessee, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. that the information contained herein is accurate as of the date of my signature below;  
and
3. that the TVA Johnsonville Active Ash Pond 2 meets the requirements specified in 40 CFR 257.60(a).



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Re: **Placement Above the Uppermost Aquifer Demonstration  
Active Ash Pond 2  
EPA Final Coal Combustion Residuals (CCR) Rule  
TVA Johnsonville Fossil Plant  
New Johnsonville, Tennessee**

SIGNATURE 

DATE 10/16/2018

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ATTACHMENTS: Aquifer Location Demonstration Report



**Placement Above the  
Uppermost Aquifer  
Demonstration**

Active Ash Pond 2  
TVA Johnsonville Fossil Plant  
New Johnsonville, Tennessee



Prepared for:  
Tennessee Valley Authority

Prepared by:  
Stantec Consulting Services Inc.  
Lexington, Kentucky

October 16, 2018

# PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

October 16, 2018

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# PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Introduction  
October 16, 2018

## 1.0 INTRODUCTION

On April 17, 2015, the “Disposal of Coal Combustion Residuals (CCR) from Electric Utilities” (final rule) was published in the Federal Register. Stantec Consulting Services Inc. (Stantec) was tasked by the Tennessee Valley Authority (TVA) to determine whether the requirements for Placement Above the Uppermost Aquifer (UMA) Location Restriction for Active Ash Pond 2 at the Johnsonville Fossil Plant (JOF) are met as required by the final rule § 257.60.

### 1.1 OBJECTIVE

As required by §257.60 of the EPA Final CCR Rule, an owner or operator of new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units is required by October 17, 2018 to demonstrate whether Active Ash Pond 2 is located no less than five feet above the upper limit of the UMA. Relevant sections of the EPA Final CCR Rule are cited below to provide context and additional detail regarding the objective.

The final rule § 257.53 provides definitions of CCR and CCR surface impoundments.

*“Coal combustion residuals (CCR) means fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.” (§ 257.53)*

*“CCR surface impoundment means a natural topographic depression, manmade excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR.” (§ 257.53)*

The final rule § 257.60 (a) requires that the CCR unit is constructed:

*“...with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table).” (§ 257.60 (a))*

TVA must demonstrate that the requirements of paragraph (a) of section 257.60 are met, and the demonstration must be certified by a qualified professional engineer (P.E.) (§ 257.60 (b)). The demonstration and certification must be completed no later than October 17, 2018 (§ 257.60 (c)(1)).

## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Introduction  
October 16, 2018

### 1.2 UNIT DESCRIPTION

Johnsonville Fossil Plant is located on a 685-acre reservation in New Johnsonville, Humphreys County, Tennessee. The plant is on the east bank of Kentucky Lake reservoir, approximately 12 miles west from Waverly, Tennessee, and approximately 70 miles west from Nashville, Tennessee.

Referring to **Figures 1 & 2**, Active Ash Pond 2 (the Unit) is centered approximately 2,000 feet west from the plant's powerhouse. It was created by placing fill and then building an approximate two-mile-long perimeter dike, on an area within the former Tennessee River floodplain (now inundated by Kentucky Lake), to enclose approximately 90 acres. The perimeter dike varies from 25 to 35 feet in height.

The Unit has been in operation since 1970. It formerly received sluiced fly ash and bottom ash and plant process water. It also received stormwater runoff pumped from the Coal Yard Drainage Basin. The last coal fired generating units were shut down in December 2017, therefore the Unit no longer receives fly ash or bottom ash.

It is noted that there were no construction record drawings, construction inspection reports, or quality control test results, contained in the archived materials related to the original construction of Active Ash Pond 2 (Stantec, 2016A).

TVA has determined that the Unit is a CCR Surface Impoundment and therefore subject to the final rule.

### 1.3 APPROACH AND METHODS

The following factors have been considered (specifically within the extent of the Active Ash Pond 2) to determine whether the Unit meets the requirements for placement above the UMA:

- Identification of the UMA beneath the Active Ash Pond 2;
- Identification of the upper limits of the UMA;
- Identification of the lower limits of the CCR;
- Comparison of distances between lower limits of the CCR and upper limits of the UMA.

The following methods were used to determine whether the Active Ash Pond 2 meets the requirements for placement above the UMA:

- Desktop review of historical documents;
- Assessment of compliance with the EPA Final CCR Rule.

## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Uppermost Aquifer (UMA)  
October 16, 2018

## 2.0 UPPERMOST AQUIFER (UMA)

### 2.1 DEFINITION

The EPA Final CCR Rule § 257.53 provides the following definitions of aquifer and uppermost aquifer (UMA):

*“Aquifer means a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs.”*

*“Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility’s property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season”*

### 2.2 IDENTIFICATION

#### **Groundwater Monitoring System Certification**

The groundwater monitoring system for Active Ash Pond 2 was developed by AECOM and is described in a letter dated October 16, 2017 (AECOM, 2017), which included a qualified professional engineer certification:

*“Based upon review of the available information, the groundwater monitoring system at Active Ash Pond 2 meets the performance standard specified in of 40 CFR § 257.91, based on the following criteria...The wells provide samples from the uppermost aquifer (257.91(a) and 257.53)” (AECOM, 2017).*

The groundwater monitoring system referenced in this letter includes six monitoring wells: 10-AP1, 10-AP3, B-9, JOF-101, JOF-103, and JOF-104. The letter indicates that the screened formation for these monitoring wells is Alluvial Deposits. A copy of this certification is available on the TVA Johnsonville Coal Combustion Residuals website.

#### **Alluvium UMA**

Review of boring logs indicates that the saturated alluvium at JOF may be differentiated between shallow low permeability alluvial clay and silt and confined alluvial sand and gravel deposits. Both alluvial units appear to be consistently present in the vicinity of Active Ash Pond 2. Differentiation between the two alluvial layers is consistent with the results of the geotechnical evaluations completed for Active Ash Pond 2 by Stantec in 2010 and 2012. This evaluation distinguished between two alluvial foundation layers below the dike based on the results of drilling, laboratory testing, historical documentation and drawings. The uppermost was referred to as “Alluvial Clay and Silt” and was typically encountered down to an approximate average elevation of 330 feet

## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Uppermost Aquifer (UMA)  
October 16, 2018

above mean sea level (msl). The layer is approximately 15 to 25 feet thick, and had USCS classifications of CL and ML, and textural descriptions of lean clay, lean clay with sand, lean clay with gravel, sandy lean clay, silt, and silt with gravel. The soil was described as wet and brown and gray in color. Additionally, pore dissipation and flexible wall permeameter tests of the alluvial clay and silt intervals consistently indicated low permeability values for the alluvial clay and silt (Stantec, 2016C).

Below the alluvial clay and silt horizon, "Alluvial Sand and Gravel" was encountered. This horizon is approximately 40 to 50 feet thick and extends to bedrock. The alluvial sand and gravel had USCS classifications of SM, SP, SP-SM, SW, SW-SM, GP, GP-GM and textural descriptions of silty sand, silty sand with gravel, poorly graded sand with or without silt and gravel, well graded sand with or without silt and gravel, and poorly graded gravel with or without silt and sand. The sands and gravels were described as wet and brown in color.

The alluvial sand and gravel deposits are the UMA beneath Active Ash Pond 2 because of the low hydraulic conductivity of the confining alluvial clay and silt.

### 2.3 UPPER LIMIT

According to the EPA Final CCR Rule, the upper limit of the UMA is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season. For a confined aquifer the top of the UMA is the top of the aquifer (base of the confining layer). In the vicinity of Active Ash Pond 2, the continuous alluvial silt and clay layer above the alluvial sand and gravel (UMA) is a confining layer. This demonstration conservatively assumed that the UMA is confined and that the top of the UMA is defined based on the structure of the top of the alluvial sand and gravel (bottom of the alluvial clay and silt) and not at depth within the UMA.

### 2.4 TOP OF UMA SURFACE

Stantec reviewed boring logs for borings and wells completed in the vicinity of Active Ash Pond 2 and identified borings with indications of the elevation of the top of the alluvial sand and gravel (UMA). The elevation of the top of the UMA at each of these borings is shown on **Figure 3**. Review of these data indicates that the top of the UMA is relatively consistent beneath the Active Ash Pond 2, and it ranges from approximately 321.4 feet msl (at STN-CT) to 338.2 feet msl (at SS-15).

Interpolation of data between data points is an industry standard approach for estimating geologic surfaces utilizing geologic data from borings and wells. The stratigraphy data points identified in **Figure 3** were interpolated to produce a raster representing the elevation of the top of the UMA using a kriging method (ESRI, 2016). Kriging was selected as the interpolation method because it allows for extrapolation beyond the extent of the input data points to the edge of the Active Ash Pond 2. Extrapolation was required between borings STN-MT and STN-AT and the northern extent of the Unit (approximately 350 feet); and extrapolation was required between boring STN-GT and the southern extent of the Active Ash Pond 2 (approximately 80 feet).



## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Uppermost Aquifer (UMA)  
October 16, 2018

The extrapolated data was reviewed and found to be consistent with adjacent data points (elevations were within half of one foot of the value of the nearest data point).

**Figure 3** presents the interpolated surface representing the structure of the top of the UMA. The figure also includes labels for the data points used to produce the surface. Directly beneath the Active Ash Pond 2, the interpolated elevation of the UMA ranges from approximately 321.4 feet msl (at STN-CT) to 338.16 feet msl (at SS-15).

## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Affected Boundary (Base of CCR Unit)  
October 16, 2018

### 3.0 AFFECTED BOUNDARY (BASE OF CCR UNIT)

To determine if Active Ash Pond 2 meets the requirement for placement above the UMA, the affected boundary (base elevation of the CCR material) was identified. In 2012, Stantec completed a geotechnical exploration along the perimeter of and within Active Ash Pond 2. This work included borings, cone penetration test probes, and test pits. To provide TVA an estimate of the CCR volume contained in Active Ash Pond 2 for planning purposes, a surface representing the extent and elevation of the bottom of Active Ash Pond 2 (affected boundary) was developed from the resulting data. This surface is shown on **Figure 4**. Review of these data indicates that the bottom of the CCR beneath Active Ash Pond 2 ranges from approximately 342 feet msl to approximately 379 feet msl.

## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Separation  
October 16, 2018

### 4.0 SEPARATION

#### 4.1 ISOPACH

The surface representing the top of the UMA (**Section 2.4** and **Figure 3**) was subtracted from the surface representing the base of Active Ash Pond 2 (**Section 3.0** and **Figure 4**) to estimate the thickness of material between the base of the CCR and top of the UMA. This information was used to produce an isopach map with five-foot contour intervals of the separation of the base of Active Ash Pond 2 from the top of the UMA (**Figure 5**). A review of **Figure 5** shows that the separation between the CCR and the UMA was greater than five feet within the limits of Active Ash Pond 2.

Boring logs, and reports completed by others have been furnished to Stantec by TVA which Stantec has used, as furnished, in preparing this demonstration report. Identification of separation distance relies of interpolation of data between data points.

## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

Conclusions  
October 16, 2018

### 5.0 CONCLUSIONS

Based on this assessment of the UMA and the CCR unit, the requirements of §257.60 of the final rule for placement above the UMA at the JOF Active Ash Pond 2 have been met.

## PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION

References

October 16, 2018

### 6.0 REFERENCES

AECOM. (2017). Groundwater Monitoring System Active Ash Pond 2 TVA Johnsonville Fossil Plant New Johnsonville, Tennessee.

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

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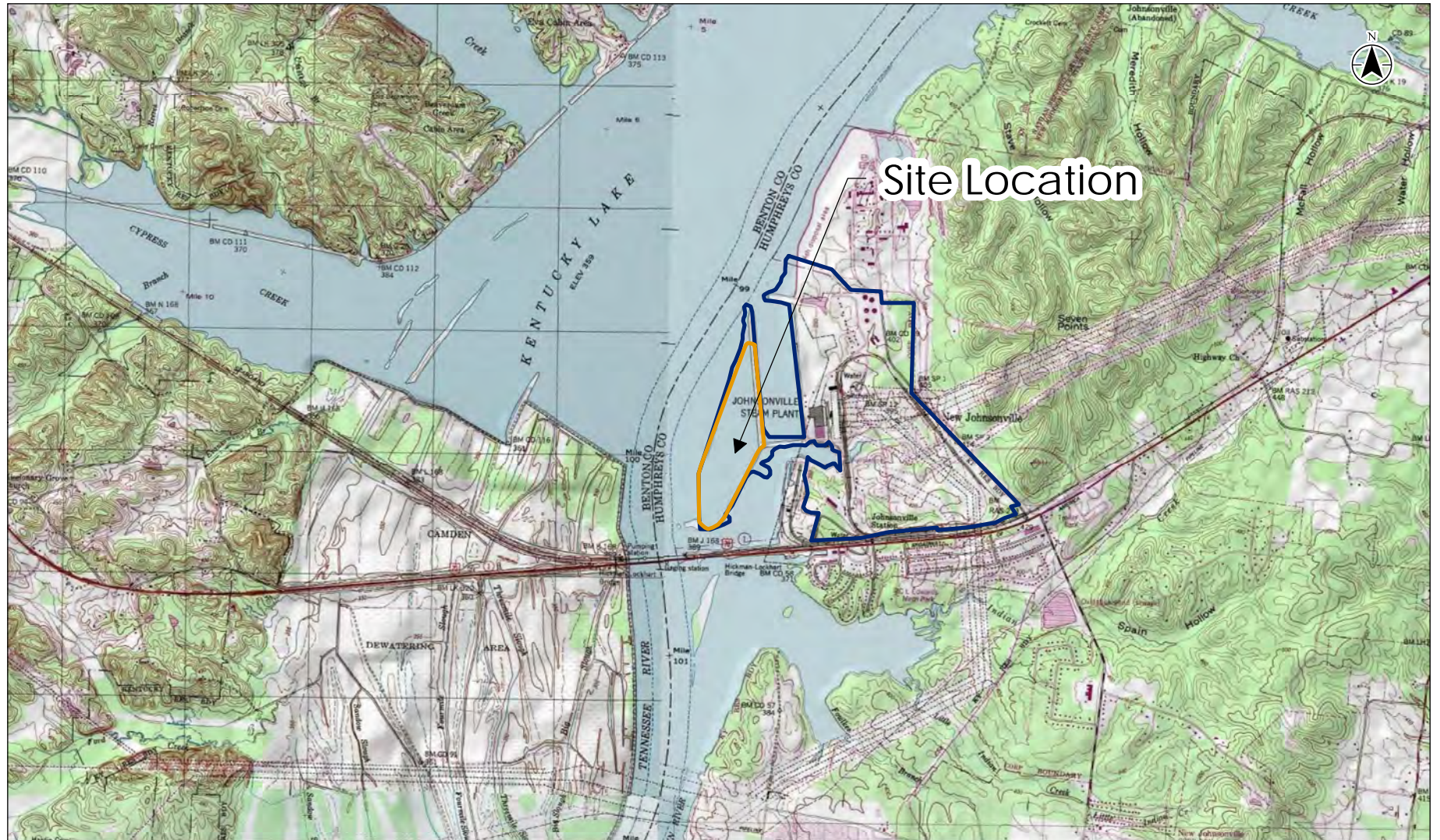
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**FIGURE 1**  
**SITE LOCATION MAP**

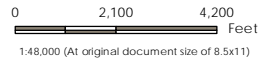




# Site Location



- Legend**
- Active Ash Pond 2
  - JOF Site Boundary



**Notes**

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Basemap Data Source: Sources: Esri, HERE, DeLorme, Intermap, Increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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**Project Location**  
 T11N, R12E, S05  
 T. of Dane, Dane Co., WI

Prepared by CNK on 2018-07-27  
 Technical Review by ABC on 2014-01-21  
 Independent Review by ABC on 2014-01-21

**Client/Project**  
 Client: Tennessee Valley Authority  
 Stantec No: 175568235

**Figure No.**  
 1

**Title**  
 SITE LOCATION MAP  
 JOHNSONEILLE FOSSIL PLANT






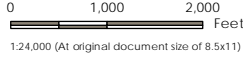
**FIGURE 2**  
**SITE LAYOUT MAP**





**Legend**

-  CCR Rule Monitoring System Well
-  Active Ash Pond 2
-  JOF Site Boundary



1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
 2. Basemap Data Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Project Location  
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 Client: Tennessee Valley Authority  
 Stantec No: 175568235

Figure No.  
 2  
 Title

**SITE LAYOUT MAP  
 JOHNSONVILLE FOSSIL PLANT**

O:\Active\TVA\JOF\_V01\_data\Map\_CCR\_Monitoring\2018\07\25\_Site\_Layout\_20180727.mxd Revised: 2018-10-08 By: pncdml  
 Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

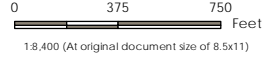
**FIGURE 3**  
**TOP OF UPPERMOST AQUIFER**





**Legend**

- Stratigraphy Data Point
- Top of Uppermost Aquifer (C. I. = 5 feet)
- Active Ash Pond 2



Notes  
 1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet  
 2. Basemap Data Source: Ortho-Photography was performed in 2017.

Project Location  
 T11N, R12E, S05  
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 Stantec No: 175568235

Figure No.  
 3



Title  
 TOP OF UPPERMOST AQUIFER  
 JOHNSONVILLE FOSSIL PLANT




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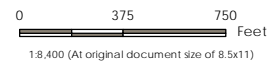
**FIGURE 4**  
**EFFECTED BOUNDARY**  
**(BASE OF CCR UNIT)**





**Legend**

-  Base of CCR Unit Data Point
-  Base of CCR (C. I. = 5 feet)
-  Active Ash Pond 2



- Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
  2. Basemap Data Source: Ortho-Photography was performed in 2017.

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Client/Project  
Client: Tennessee Valley Authority  
Stantec No: 175568235

Figure No.  
4




Title  
**EFFECTED BOUNDARY  
(BASE OF CCR UNIT)  
JOHNSVILLE FOSSIL PLANT**

**FIGURE 5**  
**ISOPACH MAP OF AQUIFER SEPARATION**

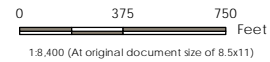




**Legend**

 Isopach Thickness of Separation (Bottom of CCR - Top UMA) (C. I. = 5 feet)

 Active Ash Pond 2



- Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
  2. Basemap Data Source: Ortho-Photography was performed in 2017.

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Figure No.  
 5

Title  
 ISOPACH MAP OF SEPARATION  
 JOHNSONVILLE FOSSIL PLANT

