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2020 Annual CCR Rule Groundwater Monitoring Report - North Rail Loop Landfill

Gallatin Fossil Plant
Gallatin, Tennessee

Prepared for:

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January 2021

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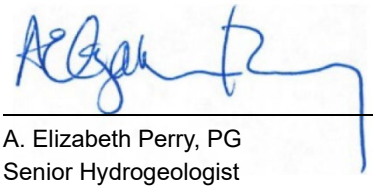
Quality Information

Prepared by	Reviewed by	Reviewed by
		
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Overview of Groundwater Monitoring Program Status

In August 2020, the United States Environmental Protection Agency (USEPA) issued updated regulations for management of coal combustion residuals (CCR). Among other requirements, 40 CFR 257.90 of the updated CCR Rule requires "A section at the beginning of the annual report that provides an overview of the current status of groundwater monitoring and corrective action programs for the CCR unit." The specific regulatory requirements of that summary are provided here:

- 257.90(e)(6)(i): At the beginning of the 2020 annual reporting period the North Rail Loop (NRL) Landfill CCR unit was operating under the detection monitoring program in 257.94.
- 257.90(e)(6)(ii): At the end of the 2020 annual reporting period the NRL Landfill CCR unit was also operating under the detection monitoring program in 257.94.
- 257.90(e)(6)(iii): During the 2020 annual reporting period, statistically significant increases (SSIs) over background were found for one or more constituents listed in Appendix III pursuant to 257.94(e). However, the concentrations leading to the SSIs are consistent with concentrations that have been successfully shown to originate from an Alternate Source in accordance with 257.94(e)(2). Thus, the NRL Landfill remains in detection monitoring. For additional details on the SSIs identified in 2020, please refer to the table in the Statistical Evaluation Section of this report.
- 257.90(e)(6)(iv): Not applicable to the NRL Landfill.
- 257.90(e)(6)(v): Not applicable to the NRL Landfill.
- 257.90(e)(6)(vi): Not applicable to the NRL Landfill.

Introduction

This report documents groundwater compliance monitoring activities performed at the Tennessee Valley Authority (TVA) Gallatin Fossil Plant (GAF), North Rail Loop (NRL) Landfill as required under the United States Environmental Protection Agency (USEPA) coal combustion residuals (CCR) Rule (40 Code of Federal Regulations [CFR] 257.90(e)). The groundwater monitoring system at the NRL Landfill is shown on **Figure 1**. This report covers the compliance activities performed at the NRL Landfill in 2020 and presents the monitoring activities planned for 2021.

Throughout the 2020 annual reporting period, the NRL Landfill has been in the Detection monitoring phase pursuant to 257.94. As explained in further detail below, statistically significant increases above background were found during the 2020 Detection monitoring events. However, the concentrations leading to the SSIs are consistent with concentrations that have been successfully shown to originate from an Alternate Source. Thus, the NRL Landfill remains in detection monitoring.

To comply with the CCR Rule, the following actions were taken in 2020:

- The 2019 Annual Groundwater Monitoring Report (AECOM, 2020) was completed in January 2020 and posted on TVA's publicly accessible CCR Rule website as required by 257.90(e) and 257.107(h)(1).
- Two semi-annual Detection monitoring events took place in April and September.

- Verification (confirmation) sampling was performed in June and November.
- Detection monitoring results were evaluated in accordance with the CCR Rule (257.94).
- Alternate Source Demonstrations were completed for calcium in wells NRL227 (**Appendix A**) and NRL230 (**Appendix B**), as described in more detail later in this report.
- The dedicated pump intake depth for well NRL221 was modified; **Table 1** reflects the revised intake setting.

Problems encountered and resolution:

- The dedicated pump for monitoring well NRL221 was removed to facilitate a dye trace study in the area. As a result, a non-dedicated pump was used in the April sampling event for collection of the groundwater sample. Upon completion of the dye trace study, the pump was replaced in the well. **Table 1** reflects the current pump intake setting. The dedicated pump was in place for the September sampling event.
- No other problems were encountered during the 2020 CCR Rule groundwater monitoring at the NRL Landfill.

The following activities are planned for 2021 to comply with CCR Rule groundwater monitoring requirements:

- This 2020 Annual Groundwater Monitoring Report will be posted on TVA's publicly accessible CCR Rule website, as required by 257.90(e) and 257.107(h)(1).
- Detection monitoring will continue with two semi-annual monitoring events in 2021, in accordance with 40 CFR 257.94.
- Detection monitoring results will be evaluated in accordance with the CCR Rule (257.94).
- Construction on NRL Landfill Cell 2 has been completed, and the cell is expected to begin accepting waste in 2021. The NRL Landfill groundwater monitoring system has been designed as a multi-unit monitoring system which covers all three of the proposed landfill cells. Thus, no modifications to the current monitoring system are needed as a result of the landfill expansion.
- The groundwater analytical data obtained in 2021 will be evaluated using appropriate statistical methods. Changes to the monitoring program will be implemented, as needed, to maintain compliance with 40 CFR 257.90 through 257.98.
- Alternate source(s), including natural variability, will continue to be evaluated where applicable in accordance with 40 CFR 257.94(e)(2).
- TVA plans to perform down-hole well inspection and maintenance activities in 2021. The NRL Landfill groundwater monitoring system may be recertified, if deemed necessary, to reflect the most accurate and up-to-date construction/survey information available for the wells.
- TVA's third-party Quality Assurance Program to evaluate groundwater analytical data will be continued and improved using best practices concerning field methods and validation techniques, as well as the application of the most appropriate statistical methods.
- TVA will comply with recordkeeping requirements as specified in 40 CFR 257.105(h), notification requirements specified in 40 CFR 257.106(h), and internet requirements as specified in 40 CFR 257.107(h).
- The next annual groundwater monitoring report, which will address groundwater monitoring activities undertaken in 2021, will be completed in January 2022.

Groundwater Monitoring System

GAF is located in north-central Tennessee, just south of Gallatin, Tennessee. The GAF property consists of approximately 1,950 acres of land encompassing the majority of Odoms Bend peninsula. GAF is surrounded by the Cumberland River between approximate river miles 240.5 and 246.

GAF is a coal-fired steam plant that operates four turbo-generating units. Prior to 2016, TVA managed its CCR by sluicing to surface impoundments. In the early 2010s, TVA started transitioning to dry ash handling. In 2016, in compliance with a permit issued by the Tennessee Department of Environment and Conservation (TDEC), TVA began trucking the combined dry fly ash and dry flue gas desulphurization (FGD) product from the newly constructed FGD 'scrubber' units to the newly constructed NRL Landfill. In 2019, the Interim Flow Management System began operation, and dry-handled bottom ash is also disposed in the NRL Landfill. The NRL Landfill is a lined landfill that meets RCRA subtitle D and CCR Rule requirements. Additional information about the NRL Landfill can be found on TVA's publicly accessible CCR Rule website at the following link: https://www.tva.com/Environment/Environmental-Stewardship/Coal-Combustion-Residuals/Gallatin.

GAF is located within the Central Basin Aquifer area of Middle Tennessee. This aquifer system is formed in Devonian to Ordovician-aged carbonates and shales through the erosion of the Nashville Dome. This aquifer system is an important source of drinking water for Middle Tennessee, as it supplies most of the rural domestic wells and many public drinking wells in the Central Basin and surrounding region (Brahana and Bradley, 1986). Groundwater in the Central Basin Aquifer system occurs primarily in a shallow flow system of solution channels. These channels are highly irregular in their distribution throughout the solid rock mass and generally occur within 300 feet of the land surface. The solution channels are openings along joints and bedding planes that locally may be enlarged by dissolution of the limestones. These channels represent zones of secondary porosity and permeability in an otherwise nonporous and impermeable rock mass. Bedding planes are thought to be the major control in the formation of solution cavities, which have typically been found to be horizontally elongated (Brahana and Bradley, 1986).

At Gallatin, the Devonian and Silurian formations have eroded. Leaving the Ordovician formations present, including (from youngest to oldest), the Hermitage Formation, Carters Limestone, and Lebanon Limestone. In the vicinity of the NRL Landfill, water-bearing fracture zones are typically encountered in the Lebanon Limestone and not the overlying formations.

The NRL Landfill groundwater monitoring system contains ten monitoring wells installed in the Lebanon Limestone aquifer, the uppermost aquifer in the area. The monitoring system includes four background monitoring wells, one upgradient monitoring well, and five downgradient monitoring wells. The monitoring well locations are shown on **Figure 1;** monitoring well construction information is provided on **Table 1**.

The background monitoring wells (GAF-412L, GAF-414L, GAF-426L, and GAF-427L) are located in the northern portion of TVA property and represent conditions unaffected by CCR (40 CFR 257.91(a)(1) and (c)(1)). These background wells are not located directly upgradient from the NRL Landfill. Per the CCR Rule 257.91(a)(1), establishing background water quality may include sampling of wells that are not hydraulically upgradient of the CCR management unit. NRL221 is located upgradient of the NRL Landfill and represents groundwater flowing beneath the unit. However, NRL221 is interpreted as being affected by CCR constituents from a different CCR unit, so the well does not meet the requirement of 257.91(a)(1) that background wells not

be influenced by CCR. As a result of these conditions, alternate, non-upgradient locations have been selected to represent background.

Monitoring wells located downgradient (NRL015, NRL220, NRL227, NRL230, and NRL301B) of active landfill Cell 1 and/or future Cells 2 and 3 monitor groundwater conditions near the waste boundary (40 CFR 257.91(a)(2) and (c)(1)).

The certification of the groundwater monitoring system required under 40 CFR 257.91(f) is included in the facility operating record and on the facility CCR Rule website at the following link: https://www.tva.com/Environment/Environmental-Stewardship/Coal-Combustion-Residuals/Gallatin.

The only minor change to the monitoring system in 2020 was the removal of the dedicated pump from monitoring well NRL221 to facilitate a dye trace study in the area. Upon completion of the dye trace study the pump was replaced in the well. **Table 1** reflects the current pump intake setting for NRL221. There were no other changes to the monitoring system in 2020.

Groundwater Sampling and Laboratory Analytical Results

The data obtained during the CCR Rule compliance monitoring in 2020 is presented in this section.

Groundwater Monitoring

Low-flow groundwater sampling and analysis activities were conducted in accordance with the sampling and analysis program developed per 40 CFR 257.93. The semi-annual Detection monitoring events took place in April and September 2020, and two verification (confirmation) sampling events took place in June and November 2020, as shown on **Table 2**.

Groundwater Flow

Groundwater levels were measured in each monitoring well prior to well purging/sampling as required by 40 CFR 257.93(c). The water level gauging dates for each event are presented in **Table 2**, and tabulated water level data and calculated hydraulic heads are presented in **Table 3**. **Figure 2** presents a map for the Lebanon Limestone showing the generalized direction of the hydraulic gradient based on groundwater elevations measured in September 2020.

Hydraulic gradients were characterized using the data in **Table 3** in addition to water levels measured in other wells at the site beyond those in the CCR Rule monitoring system. Based on available information, the hydraulic conductivity for the Lebanon Limestone fracture zone measured in the vicinity of the NRL Landfill ranges from 0.86 to 2.9 feet per day (ft/day), with a geometric mean of 1.6 ft/day. A range of average linear groundwater velocities was calculated using the geometric mean hydraulic conductivity, hydraulic gradients of 0.006 to 0.012 feet per foot (ft/ft) in April 2020 and 0.004 to 0.006 ft/ft in September 2020, and an effective porosity of 5 percent. The calculated groundwater velocities beneath the NRL Landfill range from 0.13 to 0.38 ft/day.

Sampling Results

Groundwater samples were submitted to TestAmerica Laboratories for analysis. The parameters measured in the field and the laboratory analytical results are presented on **Table 4**.

Statistical Evaluation

Background Upper Prediction Limits (UPLs) for Appendix III constituents at each downgradient well have previously been calculated in accordance with the certified statistical method (AECOM, 2020). The intrawell UPLs are provided on **Table 4**.

The sampling results for the two semi-annual Detection monitoring events and the confirmation (verification) results for 2020 are provided on **Table 4** along with the UPLs for comparison. Statistically significant increases (SSIs) over statistical background are summarized below:

Well ID	Sample Date(s)	Constituent with SSI	ASD Reference
NRL227	April 21, 2020 (a) September 17, 2020	Calcium	**Appendix A**
NRL301B	April 21, 2020	Boron	**Appendix C**
NRL227	September 17, 2020	Chloride	**Appendix C**
NRL230	September 17, 2020 (a)	Calcium	**Appendix B**

(a) SSI was confirmed in subsequent verification sampling.

The SSIs for boron at NRL301B and chloride at NRL227 were previously shown to be related to a source other than a release from the NRL Landfill through a successful Alternate Source Demonstration (ASD; AECOM, 2019). The PE certification of this ASD is included in **Appendix C**. The SSIs for these constituents in 2020 are for concentrations consistent with the previous findings.

In 2020, new SSIs were found in 2020 for calcium at two wells. As a result of these findings, alternate source evaluations were conducted, as described in the following section. The ASDs concluded that the SSIs were not caused by a release from the NRL Landfill. The PE certifications of these demonstrations are included in **Appendix A** and **Appendix B**.

Alternate Source Evaluations

The CCR Rule allows the facility operator to demonstrate that the SSIs are due to a source other than a release from the CCR unit (40 CFR 257.94(e)(2)), specifically: "The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. … If a successful demonstration is completed within the 90-day period, the owner or operator of the CCR unit may continue with a detection monitoring program under this section."

For the 2020 annual reporting period, two alternate source evaluations were completed, and the conclusions are presented in **Appendix A** (NRL227, April sampling event) and **Appendix B** (NRL230, September sampling event) of this Annual Report. The evaluations found that the NRL Landfill is unlikely to be the source for the SSIs identified in downgradient monitoring wells, based on the following lines of evidence:

The NRL Landfill is unlikely to be the source of the calcium SSI in NRL227 and NRL230:

- Only one of the landfill cells (Cell 1) is currently in use. Based on hydraulic heads and groundwater contour maps, NRL227 is not located downgradient from the portion of the

landfill where waste is present. Therefore, the SSI for calcium in this well cannot be due to a release from the landfill.

- There are increasing calcium concentrations in a number of NRL Landfill wells, most of which are not located downgradient from the only landfill cell currently in use (Cell 1). The increasing trend at NRL227, NRL230, and the other wells appears to be related to this overall general increase and not a release from the NRL Landfill.
- Other constituents that are elevated in the landfill leachate compared to groundwater at NRL227 and NRL230 (sulfate and chloride) do not show an increase in the April or the September sampling.
- Samples from the underdrain beneath the landfill, where a release from the landfill may initially be observed, do not have elevated concentrations of calcium, chloride, or sulfate compared to samples collected from the underdrain prior to placing waste in the landfill.

The alternate source for the calcium in NRL227 is natural variability of groundwater chemistry:

- The calcium SSI is only slightly higher (less than 3%) than the statistical background (pre-waste) concentration.
- The primary source of calcium in groundwater in this area is the limestone bedrock of the Lebanon Limestone formation where NRL227 is screened. Calcium concentrations in other wells at the NRL Landfill and elsewhere at Gallatin are higher than concentrations in NRL227, showing that the natural range includes higher concentrations.

The alternate source for the calcium in NRL230 is natural variability of groundwater chemistry:

- The Ash Pond Complex, located upgradient from the NRL Landfill, was evaluated as a potential source of the calcium SSI at NRL230. Boron has previously been identified as the primary indicator of CCR constituents in groundwater at the Ash Pond Complex, and boron concentrations are not increasing in groundwater beneath the NRL Landfill (no SSIs for boron). As a result, the Ash Pond Complex does not seem a likely source for the increase in calcium.
- The primary source of calcium in groundwater in this area is the limestone bedrock of the Lebanon Limestone formation where NRL230 is screened. Calcium concentrations in other wells at the NRL Landfill and in background wells are higher than concentrations in NRL230, showing that the natural range includes higher concentrations. NRL230 was installed later in time than the other NRL Landfill wells, so there is less data available to characterize the full range of concentration variability.

Based on the ASDs, semi-annual Detection monitoring is continuing at the NRL Landfill.

Narrative Discussion of Transition between Monitoring Programs

Semi-annual Detection monitoring was conducted in 2020. The Detection monitoring results for 2020 continue to be below the UPLs, and/or attributed to a source other than the NRL Landfill (AECOM, 2019; **Appendix A**; and **Appendix B**). Therefore, the NRL Landfill remains in Detection monitoring.

Two semi-annual Detection monitoring events will take place in 2021. The groundwater analytical data obtained in 2021 will be evaluated using appropriate statistical methods. Changes to the monitoring program will be implemented, as needed, to maintain compliance with 40 CFR 257.90 through 257.98.

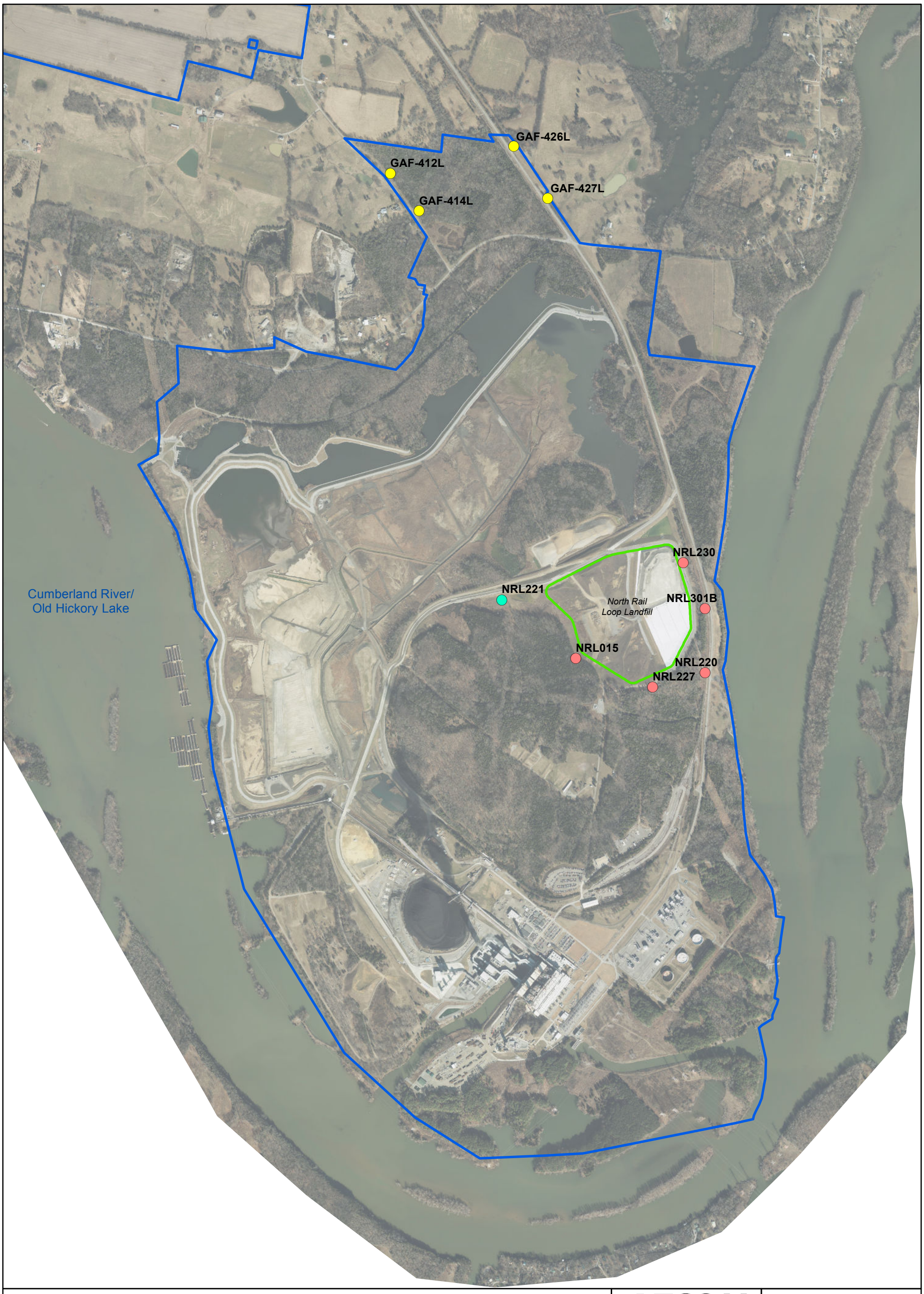
References

AECOM, 2019. 2018 Annual CCR Rule Groundwater Monitoring Report – North Rail Loop Landfill, Gallatin Fossil Plant, Gallatin, Tennessee. January 2020.

AECOM, 2020. 2019 Annual CCR Rule Groundwater Monitoring Report – North Rail Loop Landfill, Gallatin Fossil Plant, Gallatin, Tennessee. January 2020.

Brahana and Bradley, 1986. *Preliminary Delineation and Description of the Regional Aquifers of Tennessee – The Central Basin Aquifer System*. Prepared by the United States Geological Survey in cooperation with the USEPA. USGS Water Resources Investigations Report 82-4002.

Figures



LEGEND

- CCR Rule Monitoring System - Downgradient Well
- CCR Rule Monitoring System - Upgradient Well
- CCR Rule Monitoring System - Background Well
- TVA Gallatin Fossil Plant Property Boundary (Approximate)
- North Rail Loop (NRL) Landfill

N

0 1,200 2,400

Feet

NOTE: Aerial image dated February 2017

AECOM

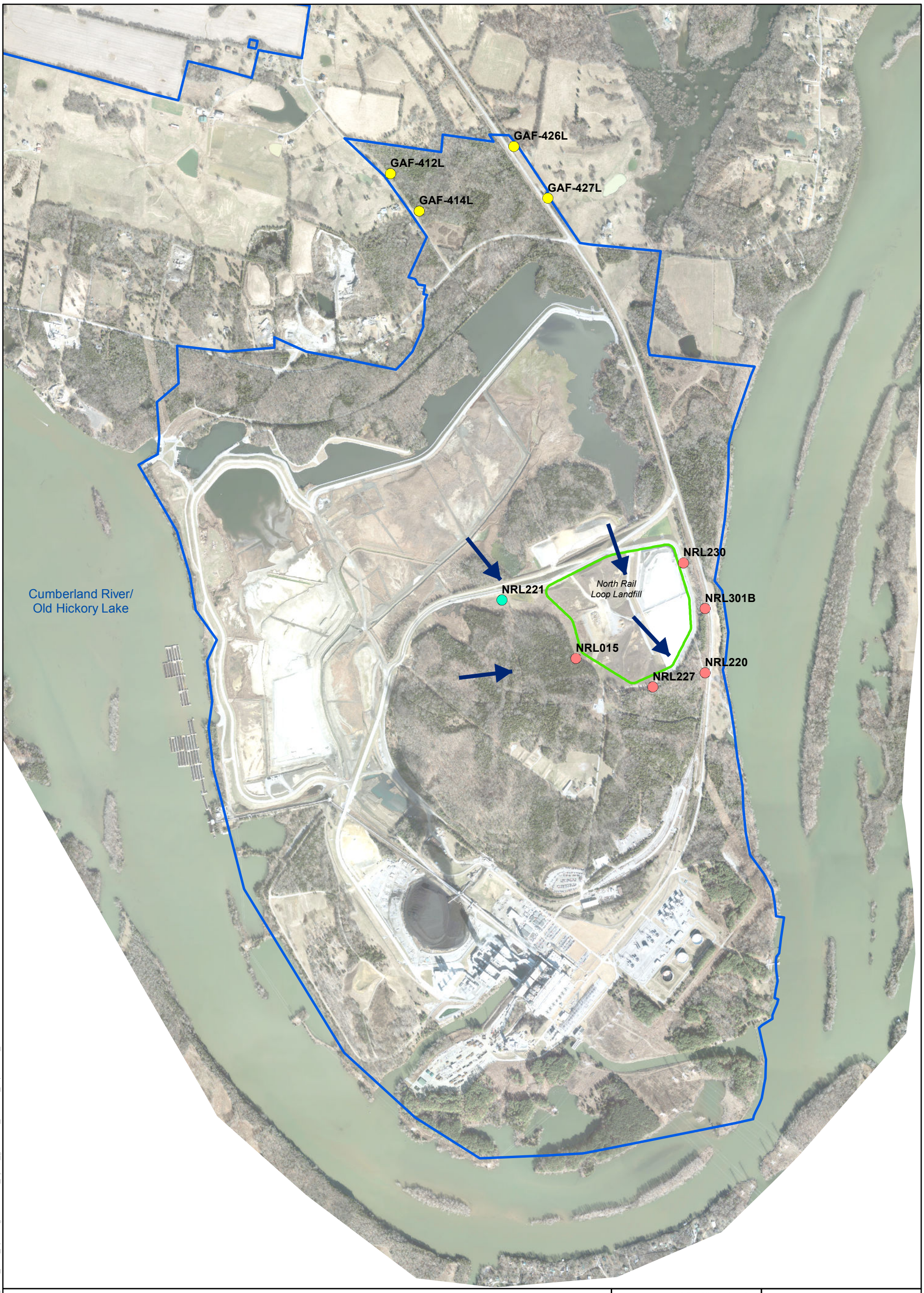
Figure 1

CCR RULE MONITORING SYSTEM
NORTH RAIL LOOP (NRL) LANDFILL

DRAWN BY:	REVIEWED BY:	APPROVED BY:	REVISION NUMBER:
MARK.P.SMITH	C.GARLINGTON		REV. 1

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

DATE:	DEPT:
12/2/2019	FOSSIL AND HYDRO ENGINEERING



LEGEND

- CCR Rule Monitoring System - Downgradient Well
- CCR Rule Monitoring System - Upgradient Well
- CCR Rule Monitoring System - Background Well
- TVA Gallatin Fossil Plant Property Boundary (Approximate)
- North Rail Loop (NRL) Landfill
- Groundwater Flow Direction

N

0 1,200 2,400

Feet

NOTE: Aerial image dated February 2017

AECOM

Figure 2

GENERALIZED HYDRAULIC GRADIENTS - LEBANON AQUIFER, SEPTEMBER 14, 2020

DRAWN BY:	REVIEWED BY:	APPROVED BY:	REVISION NUMBER:
CARRIE.SMITH	C.GARLINGTON		REV. 1

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

DATE:	DEPT:
12/9/2020	FOSSIL AND HYDRO ENGINEERING

Document Path: M:\Env\Data\Vol\TVA_GAF\11.0 GIS_2020_EAR_update\generalized_hydro_gradients_lebanon_september_2020.mxd

Tables

Table 1
Well Construction Information - North Rail Loop Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Well ID	UNID #	Position Relative to CCR Unit	Top of Casing Elevation (ft)	Ground Elevation (ft)	Screened Interval (ft btoc)	Screened Formation	Total Well Depth (ft btoc)	Pump Intake Depth (ft btoc)	Well Diameter (in) / Material	Well Coordinates	
										TN State Plane NAD27 Northing (ft)	TN State Plane NAD27 Easting (ft)
GAF-412L	GAF-00-GW-43-019	Background	477.58	473.7	109.5 - 129.5	Lebanon Limestone	129.5	123	4-in PVC	710929.65	1880028.63
GAF-414L	GAF-00-GW-43-021	Background	481.45	478.6	93.2 - 103.2	Lebanon Limestone	103.2	98	4-in PVC	710438.90	1880406.55
GAF-426L	GAF-00-GW-43-030	Background	506.83	502.6	176.7 - 186.7	Lebanon Limestone	187.0	183	2-in PVC	711281.94	1881642.00
GAF-427L	GAF-00-GW-43-032	Background	488.41	484.2	144.4 - 159.4	Lebanon Limestone	159.9	152	4-in PVC	710606.97	1882087.73
NRL015	GAF-00-GW-43-042	Downgradient	546.65	543.7	179.3 - 189.3	Lebanon Limestone	189.6	183	2-in PVC	704590.08	1882451.92
NRL220	GAF-00-GW-43-044	Downgradient	502.54	500.0	164.1 - 184.1	Lebanon Limestone	184.5	175	2-in PVC	704404.76	1884141.74
NRL221	GAF-00-GW-43-045	Upgradient	478.90	476.0	114.4 - 134.4	Lebanon Limestone	134.6	122	2-in PVC	705358.12	1881484.59
NRL227	GAF-00-GW-43-046	Downgradient	560.33	557.2	184.7 - 194.7	Lebanon Limestone	195.2	188	2-in PVC	704219.32	1883458.71
NRL230	GAF-00-GW-43-052	Downgradient	511.70	507.8	161.8 - 181.8	Lebanon Limestone	182.0	165	4-in PVC	705842.44	1883858.33
NRL301B	GAF-00-GW-43-048	Downgradient	498.15	495.3	140.0 - 170.0	Lebanon Limestone	170.2	168	2-in PVC	705244.23	1884140.36

Notes:
Elevation information from DDS Survey; elevation in National Geodetic Vertical Datum 1929.
Well coordinates based on North America Datum of 1927
Well construction information based on data provided by TVA Well Inventory, Revision 11, September 17, 2019.
ft btoc - feet below top of casing
in - inches (inside diameter)

Table 2
Groundwater Sampling Summary - North Rail Loop Landfill, 2020
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Sample Dates	Groundwater Gauging Date	Monitoring Program	Constituents Analyzed	Number of Wells Sampled
April 14-21, 2020	April 13, 2020	Detection Monitoring (257.94(a))	Appendix III, major ions and field parameters	Background: 4 Upgradient: 1 Downgradient: 5
June 19, 2020	June 15, 2020	Verification (Confirmation) Sampling (257.94(e)(2))	Calcium and field parameters	Background: 0 Upgradient: 0 Downgradient: 1
September 15-18, 2020	September 14, 2020	Detection Monitoring (257.94(a))	Appendix III, major ions and field parameters	Background: 4 Upgradient: 1 Downgradient: 5
November 12, 2020	November 12, 2020	Verification (Confirmation) Sampling (257.94(e)(2))	Calcium and field parameters	Background: 0 Upgradient: 0 Downgradient: 1

Notes:
Appendix III Constituents: Boron, Calcium, Chloride, Fluoride, pH, Sulfate, Total Dissolved Solids (TDS)
Appendix IV Constituents: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Fluoride, Lead, Lithium, Mercury, Molybdenum, Radium 226 + 228, Selenium, Thallium

Table 3
Groundwater Elevation Summary - North Rail Loop Landfill, 2020
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Gauging Date:	4/13/2020			6/15/2020		
Well ID	**Reference Elevation (ft AMSL)**	**Water Level Measurement (ft)**	**Hydraulic Head (ft AMSL)**	**Reference Elevation (ft AMSL)**	**Water Level Measurement (ft)**	**Hydraulic Head (ft AMSL)**
GAF-412L	477.58	23.66	453.92	477.58	27.12	450.46
GAF-414L	481.45	27.41	454.04	481.45	34.38	447.07
GAF-426L	506.83	42.25	464.58	506.83	49.00	457.83
GAF-427L	488.41	28.04	460.37	488.41	36.89	451.52
NRL015	546.65	87.07	459.58	546.65	88.57	458.08
NRL220	502.54	53.31	449.23	502.54	55.72	446.82
NRL221	478.90	19.12	459.78	478.90	20.65	458.25
NRL227	560.33	108.30	452.03	560.33	110.22	450.11
NRL230	511.70	52.24	459.46	511.70	54.94	456.76
NRL301B	498.15	72.67	425.48	498.15	83.08	415.07
Surface Water ID						
CUMBERLAND RIVER (a)	NA	NA	> 446.74	NA	NA	444.98

Notes:
AMSL - above mean sea level
ft - feet
NA - not applicable
(a) Data downloaded from TVA's iSite Central Database

Table 3
Groundwater Elevation Summary - North Rail Loop Landfill, 2020
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Gauging Date:	9/14/2020			11/12/2020		
Well ID	**Reference Elevation (ft AMSL)**	**Water Level Measurement (ft)**	**Hydraulic Head (ft AMSL)**	**Reference Elevation (ft AMSL)**	**Water Level Measurement (ft)**	**Hydraulic Head (ft AMSL)**
GAF-412L	477.58	25.20	452.38	477.58	27.25	450.33
GAF-414L	481.45	30.87	450.58	481.45	34.73	446.72
GAF-426L	506.83	47.00	459.83	506.83	51.72	455.11
GAF-427L	488.41	33.62	454.79	488.41	39.99	448.42
NRL015	546.65	88.38	458.27	546.65	89.01	457.64
NRL220	502.54	55.12	447.42	502.54	56.17	446.37
NRL221	478.90	20.52	458.38	478.90	21.13	457.77
NRL227	560.33	109.52	450.81	560.33	110.89	449.44
NRL230	511.70	53.88	457.82	511.70	54.48	457.22
NRL301B	498.15	71.27	426.88	498.15	88.39	409.76
Surface Water ID						
CUMBERLAND RIVER (a)	NA	NA	445.68	NA	NA	444.42

Notes:
AMSL - above mean sea level
ft - feet
NA - not applicable
(a) Data downloaded from TVA's iSite Central Database

Table 4
Detection Monitoring Groundwater Analytical Results - North Rail Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well	412L	412L	414L	414L	426L	426L
		Sample Date	4/16/2020	9/16/2020	4/16/2020	9/16/2020	4/15/2020	9/16/2020
		Well Location Designation	Background	Background	Background	Background	Background	Background
		Sample ID	GAF-GW-412L-04162020	GAF-GW-412L-09162020	GAF-GW-414L-04162020	GAF-GW-414L-09162020	GAF-GW-426L-04152020	GAF-GW-426L-09162020
		Sample Type	N	N	N	N	N	N
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Field Parameters								
Dissolved Oxygen	DO	MG/L	0.18	0.48	0.29	0.01	0.43	3.12
ORP	ORP	MV	-251.0	-276.5	-125.8	-136.9	-1.4	124.9
pH, Field	PHFLD	pH units	8.30	8.04	7.34	7.53	6.86	6.87
Specific Conductance, Field	CONDSPECFLD	umhos/cm	627	730	880	900	900	726
Temperature	TEMP	deg c	13.9	17.5	14.5	15.7	16.1	17.9
Turbidity, field	TURB-FIELD	NTU	1.97	3.93	1.57	0.28	16.8	2.31
General Chemistry								
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
Alkalinity, Total as CaCO3	ALK	MG/L	241	291	250	298	343	313
Alkalinity, Bicarbonate (CaCO3)	ALKB	MG/L	241	291	250	298	343	313
Chloride	16887-00-6	MG/L	29.3	59.9	110	125	12.5	8.24
Fluoride	16984-48-8	MG/L	1.36	1.43	0.540	0.653	0.328	0.415
Sulfate	14808-79-8	MG/L	22.4	27.0	8.85	17.9	47.2	80.5
Total Dissolved Solids	TDS	MG/L	356	543	638	660	446	435
Metals, Total								
Boron	7440-42-8	MG/L	0.261	0.278	0.180 U*	0.183	0.0418 U*	0.0792 J
Calcium	7440-70-2	MG/L	22.1	30.0	61.7	65.9	117	135
Magnesium	7439-95-4	MG/L	16.3	18.1	25.8	27.2	24.4	16.4
Potassium	7440-09-7	MG/L	31.6	13.5	1.97	2.33	4.30 J	2.42
Sodium	7440-23-5	MG/L	85.2	113	91.0	97.0	18.8 J	9.58

Table 4
Detection Monitoring Groundwater Analytical Results - North Rail Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well	**427L**	**427L**	**NRL015**	**NRL015**	**NRL015**	**NRL015 Background UPL**
		Sample Date	**4/20/2020**	**9/16/2020**	**4/20/2020**	**9/18/2020**	**9/18/2020**	
		Well Location Designation	**Background**	**Background**	**Downgradient**	**Downgradient**	**Downgradient**	
		Sample ID	**GAF-GW-427L-04202020**	**GAF-GW-427L-09162020**	**GAF-GW-NRL015-04202020**	**GAF-GW-NRL015-09182020**	**GAF-GW-903B-09182020**	
		Sample Type	**N**	**N**	**N**	**N**	**FD**	
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	
Field Parameters								
Dissolved Oxygen	DO	MG/L	0.45	0.42	0.33	0.28		
ORP	ORP	MV	3.6	25.0	-258.3	-299.7		
pH, Field	PHFLD	pH units	7.07	7.04	7.45	7.11		*6.35 - 7.75
Specific Conductance, Field	CONDSPECFLD	umhos/cm	710	647	880	910		
Temperature	TEMP	deg c	14.7	17.0	15.1	15.3		
Turbidity, field	TURB-FIELD	NTU	0.45	0.26	0.26	0.15		
General Chemistry								
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	
Alkalinity, Total as CaCO3	ALK	MG/L	285	301	395	394	404	
Alkalinity, Bicarbonate (CaCO3)	ALKB	MG/L	285	301	395	394	404	
Chloride	16887-00-6	MG/L	11.9	11.5	4.47	5.60	5.51	6.08
Fluoride	16984-48-8	MG/L	0.362	0.302	0.814	0.848	0.836	1.05
Sulfate	14808-79-8	MG/L	42.3	44.2	136	148	147	293
Total Dissolved Solids	TDS	MG/L	403	371	714	772	676	855
Metals, Total								
Boron	7440-42-8	MG/L	0.0656 U*	0.0749 J	0.298	0.279 U*	0.274 U*	0.353
Calcium	7440-70-2	MG/L	86.2	95.3	117	122	122	129
Magnesium	7439-95-4	MG/L	25.0	28.4	52.8	55.2	56.7	
Potassium	7440-09-7	MG/L	1.49	1.62	8.02	8.06	8.17	
Sodium	7440-23-5	MG/L	8.94	9.68	35.6	37.6	38.0	

Table 4
Detection Monitoring Groundwater Analytical Results - North Rail Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well	NRL220	NRL220	NRL220 Background UPL	NRL221	NRL221	NRL221
		Sample Date	4/21/2020	9/18/2020		4/21/2020	4/21/2020	9/18/2020
		Well Location Designation	Downgradient	Downgradient		Upgradient	Upgradient	Upgradient
		Sample ID	GAF-GW-NRL220-04212020	GAF-GW-NRL220-09182020		GAF-GW-NRL221-04212020	GAF-GW-903C-04212020	GAF-GW-NRL221-09182020
		Sample Type	N	N		N	FD	N
Analyte	**CAS**	**Units**	**Result**	**Result**		**Result**	**Result**	**Result**
Field Parameters								
Dissolved Oxygen	DO	MG/L	0.44	1.24		0.25		0.45
ORP	ORP	MV	-292.9	-378.3		-48.1		-85.6
pH, Field	PHFLD	pH units	8.07	8.22	*7.50 - 9.51	6.76		6.88
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1120	1319		1270		1090
Temperature	TEMP	deg c	16.5	17.3		15.8		16.9
Turbidity, field	TURB-FIELD	NTU	0.27	0.63		3.69		0.34
General Chemistry								
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U	5.00 U		5.00 U	5.00 U	5.00 U
Alkalinity, Total as CaCO3	ALK	MG/L	378	419		374	374	389
Alkalinity, Bicarbonate (CaCO3)	ALKB	MG/L	378	419		374	374	389
Chloride	16887-00-6	MG/L	91.7	84.4	97.5	5.74	5.80	5.42
Fluoride	16984-48-8	MG/L	1.60	1.55	1.88	0.646	0.649	0.612
Sulfate	14808-79-8	MG/L	133	129	212	296	296	319
Total Dissolved Solids	TDS	MG/L	747	806	1020	858	874	871
Metals, Total								
Boron	7440-42-8	MG/L	0.527 J	0.551	0.624	1.80 J	1.92 J	1.79
Calcium	7440-70-2	MG/L	5.37	4.80	5.58	184	193	186
Magnesium	7439-95-4	MG/L	2.67	2.50		64.7	68.0	60.3
Potassium	7440-09-7	MG/L	9.64	8.73		8.56	8.85	6.30
Sodium	7440-23-5	MG/L	299	276		23.6	24.6	18.6

Table 4
Detection Monitoring Groundwater Analytical Results - North Rail Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well	**NRL227**	**NRL227**	**NRL227**	**NRL227 Background UPL**
		Sample Date	**4/21/2020**	**6/19/2020**	**9/17/2020**	
		Well Location Designation	**Downgradient**	**Downgradient**	**Downgradient**	
		Sample ID	**GAF-GW-NRL227-04212020**	**GAF-GW-NRL227-06192020**	**GAF-GW-NRL227-09172020**	
		Sample Type	**N**	**N**	**N**	
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**	
Field Parameters						
Dissolved Oxygen	DO	MG/L	0.95	3.05	0.01	
ORP	ORP	MV	-179.3	23.7	-138.1	
pH, Field	PHFLD	pH units	7.03	7.07	7.02	*6.35 - 7.79
Specific Conductance, Field	CONDSPECFLD	umhos/cm	900	1053	940	
Temperature	TEMP	deg c	15.8	20.0	16.8	
Turbidity, field	TURB-FIELD	NTU	0.09	0.23	0.13	
General Chemistry						
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U		5.00 U	
Alkalinity, Total as CaCO3	ALK	MG/L	380		395	
Alkalinity, Bicarbonate (CaCO3)	ALKB	MG/L	380		395	
Chloride	16887-00-6	MG/L	7.73		**8.18**	8.02
Fluoride	16984-48-8	MG/L	0.716		0.785	1.05
Sulfate	14808-79-8	MG/L	155 J		165	205
Total Dissolved Solids	TDS	MG/L	612		671	711
Metals, Total						
Boron	7440-42-8	MG/L	1.17 J		1.24	1.79
Calcium	7440-70-2	MG/L	**119**	**118**	**121**	116
Magnesium	7439-95-4	MG/L	58.6		58.1	
Potassium	7440-09-7	MG/L	10.5		10.5	
Sodium	7440-23-5	MG/L	47.5		52.3	

Table 4
Detection Monitoring Groundwater Analytical Results - North Rail Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well	**NRL230**	**NRL230**	**NRL230**	**NRL230 Background UPL**	**NRL301B**	**NRL301B**	**NRL301B Background UPL**
		Sample Date	**4/21/2020**	**9/17/2020**	**11/12/2020**		**4/21/2020**	**9/18/2020**	
		Well Location Designation	**Downgradient**	**Downgradient**	**Downgradient**		**Downgradient**	**Downgradient**	
		Sample ID	**GAF-GW-NRL230-04212020**	**GAF-GW-NRL230-09172020**	**GAF-GW-NRL230-11122020**		**GAF-GW-NRL301B-04212020**	**GAF-GW-NRL301B-09182020**	
		Sample Type	**N**	**N**	**N**		**N**	**N**	
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**		**Result**	**Result**	
Field Parameters									
Dissolved Oxygen	DO	MG/L	0.73	0.37	0.41		2.26	0.90	
ORP	ORP	MV	-246.1	-238.7	-292.6		-328.9	-343.2	
pH, Field	PHFLD	pH units	7.35	7.25	7.35	*6.21 - 7.60	7.39	7.21	*6.53 - 7.96
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1280	1271	1272		8583	8574	
Temperature	TEMP	deg c	19.0	17.0	16.7		17.0	16.3	
Turbidity, field	TURB-FIELD	NTU	0.60	0.38	0.52		3.02	1.55	
General Chemistry									
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U	5.00 U			5.00 U	5.00 U	
Alkalinity, Total as CaCO3	ALK	MG/L	427	458			527	534	
Alkalinity, Bicarbonate (CaCO3)	ALKB	MG/L	427	458			527	534	
Chloride	16887-00-6	MG/L	35.0	30.1		43.1	2650	2260	3920
Fluoride	16984-48-8	MG/L	1.46	1.24		2.00	4.00	3.90	5.56
Sulfate	14808-79-8	MG/L	156	166		296	151	156	430
Total Dissolved Solids	TDS	MG/L	750	792		859	5360	6000	7380
Metals, Total									
Boron	7440-42-8	MG/L	0.684	0.696		0.962	**3.00 J**	1.45	1.68
Calcium	7440-70-2	MG/L	43.7	**56.6**	**57.1**	48.3	137	67.5	503
Magnesium	7439-95-4	MG/L	21.2	29.4			32.7	30.2	
Potassium	7440-09-7	MG/L	19.4	21.5			34.1	31.6	
Sodium	7440-23-5	MG/L	220	204			3540	1820	

Table 4
Detection Monitoring Groundwater Analytical Results - North Rail Loop Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Bolded and **Underlined** concentrations indicate a Statistically Significant Increase (SSI) over the Background Upper Prediction Limit (UPL)
Gray shaded wells are background/upgradient wells

Notes and Acronymns

*	-	a pH value outside of the Lower Prediction Limit (LPL) - UPL range represents a statistically significant increase
FD	-	field duplicate sample
MG/L	-	milligrams per liter
MV	-	millivolts
N	-	primary sample
NA	-	not analyzed for the specified analysis or not applicable for field duplicate (field parameters)
NTU	-	nephelometric turbidity units
pCi/L	-	picoCuries per liter
umhos/cm	-	microMhos per centimeter
UPL	-	upper prediction limit

Qualifier Definitions

U	-	The analyte was analyzed for but not detected. The associated numerical value is at or below the reporting limit.
U*	-	This 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	-	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.

Appendix A

Alternate Source Demonstration – NRL227 Calcium

NOTICE OF DEMONSTRATION OF ALTERNATE SOURCE(S)
GALLATIN FOSSIL PLANT
NORTH RAIL LOOP LANDFILL

In accordance with the provisions of 40 C.F.R. 257.94(e)(2), Tennessee Valley Authority (TVA) commissioned an Alternate Source Demonstration (ASD) study for the above-named coal combustion residual (CCR) unit located within the Gallatin Fossil Plant's reservation. The study concluded that the ASD of the Appendix III constituent measured was due to a source other than the CCR unit named above. As required by 40 C.F.R. 257.94(e)(2), TVA will include the demonstration, as certified by the qualified Professional Engineer (PE) named below, in its "Annual Groundwater Monitoring Report" for 2020. TVA will continue its detection monitoring program for the North Rail Loop Landfill.

QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Gabriel W. Lang, being a Registered Professional Engineer in good standing in the State of Tennessee do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification is prepared in accordance with the accepted practice of engineering; that the information contained herein is accurate as of the date of my signature below; and that the ASD as described in the attached summary meets the requirements of 40 CFR § 257.94(e)(2). Opinions relating to this ASD, environmental, geologic, and hydrogeologic conditions or other conclusions are based on available data; actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

SIGNATURE: _____

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Attachments:

Summary of Alternate Source Demonstration, TVA Gallatin Fossil Plant, North Rail Loop Landfill

DATE: 8/7/2020

SUMMARY OF ALTERNATE SOURCE DEMONSTRATION
TVA GALLATIN FOSSIL PLANT
NORTH RAIL LOOP LANDFILL

This document presents a summary of the Alternate Source Demonstration (ASD) prepared for the Tennessee Valley Authority (TVA) North Rail Loop (NRL) Landfill at the Gallatin Fossil Plant (GAF) located in Gallatin, Tennessee. The ASD was prepared in accordance with the US Environmental Protection Agency coal combustion residual (CCR) Rule (40 CFR 257.94(e)(2)).

Semi-annual Detection monitoring was conducted at the NRL Landfill in April 2020. Sampling results were evaluated in using the certified statistical methods in accordance with 40 CFR 257.93(h). The statistical analysis resulted in the identification of one Statistically Significant Increase (SSI) over background in one downgradient well.

The completed ASD presents the justification of an alternate source for the SSI identified in the downgradient well, and demonstrates it is due to variability of groundwater chemistry and not to a release from the landfill. In summary:

The NRL Landfill is unlikely to be the source of the calcium SSI in NRL227:

- Only one of the landfill cells (Cell 1) is currently in use. Based on hydraulic heads and groundwater contour maps, NRL227 is not located downgradient from the portion of the landfill where waste is present.
- Other parameters that are elevated in the landfill leachate compared to groundwater at NRL227 (sulfate and chloride) do not show an increase in the April sampling.
- Samples from the underdrain beneath the landfill, where a release from the landfill may initially be observed, do not have elevated concentrations of calcium compared to samples collected prior to placing waste in the landfill.

The alternate source for the calcium in NRL227 is natural variability of groundwater chemistry:

- The calcium SSI is only slightly higher (less than 3%) than the statistical background (pre-waste) concentration.
- The primary source of calcium in groundwater in this area is the limestone bedrock of the Lebanon Limestone formation where NRL227 is screened. Calcium concentrations in other wells at the NRL Landfill and elsewhere at Gallatin are higher than concentrations in NRL227, showing that the natural range includes higher concentrations.

Appendix B

Alternate Source Demonstration – NRL230 Calcium

NOTICE OF DEMONSTRATION OF ALTERNATE SOURCE(S)
GALLATIN FOSSIL PLANT
NORTH RAIL LOOP LANDFILL

In accordance with the provisions of 40 C.F.R. 257.94(e)(2), Tennessee Valley Authority (TVA) commissioned an Alternate Source Demonstration (ASD) study for the above-named coal combustion residual (CCR) unit located within the Gallatin Fossil Plant's reservation. The study concluded that the ASD of the Appendix III constituent measured was due to a source other than the CCR unit named above. As required by 40 C.F.R. 257.94(e)(2), TVA will include the demonstration, as certified by the qualified Professional Engineer (PE) named below, in its "Annual Groundwater Monitoring Report" for 2020. TVA will continue its detection monitoring program for the North Rail Loop Landfill.

QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, David E. Skeggs, being a Registered Professional Engineer in good standing in the State of Tennessee do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification is prepared in accordance with the accepted practice of engineering; that the information contained herein is accurate as of the date of my signature below; and that the ASD as described in the attached summary meets the requirements of 40 CFR § 257.94(e)(2). Opinions relating to this ASD, environmental, geologic, and hydrogeologic conditions or other conclusions are based on available data; actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

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Summary of Alternate Source Demonstration, TVA Gallatin Fossil Plant, North Rail Loop Landfill

DATE: 1/5/2021

SUMMARY OF ALTERNATE SOURCE DEMONSTRATION
TVA GALLATIN FOSSIL PLANT
NORTH RAIL LOOP LANDFILL

This document presents a summary of the Alternate Source Demonstration (ASD) prepared for the Tennessee Valley Authority (TVA) North Rail Loop (NRL) Landfill at the Gallatin Fossil Plant (GAF) located in Gallatin, Tennessee. The ASD was prepared in accordance with the US Environmental Protection Agency coal combustion residual (CCR) Rule (40 CFR 257.94(e)(2)).

Semi-annual Detection monitoring was conducted at the NRL Landfill in September 2020. Sampling results were evaluated using the certified statistical methods in accordance with 40 CFR 257.93(h). The statistical analysis resulted in the identification of one Statistically Significant Increase (SSI) over background in one downgradient well.

The completed ASD presents the justification of an alternate source for the SSI identified in the downgradient well, and demonstrates it is due to variability of groundwater chemistry and not due to a release from the landfill. In summary:

The NRL Landfill is unlikely to be the source of the calcium SSI in NRL230:

- There are increasing calcium concentrations in a number of NRL Landfill wells, most of which are not located downgradient from the only landfill cell currently in use (Cell 1). The increasing trend at NRL230 and the other wells appears to be related to this overall general increase and not a release from the NRL Landfill.
- Other constituents that are elevated in the landfill leachate compared to groundwater at NRL230 (chloride and sulfate) do not show an increase in the September sampling.
- Samples from the underdrain beneath the landfill, where a release from the landfill may initially be observed, do not have elevated concentrations of calcium, chloride, or sulfate compared to samples collected from the underdrain prior to placing waste in the landfill.

The APC, located upgradient from the NRL Landfill, was evaluated as a potential source of the calcium SSI at NRL230. Boron has previously been identified as the primary indicator of CCR constituents in groundwater at the APC, and boron concentrations are not increasing in groundwater beneath the NRL Landfill (no SSIs for boron). As a result, based on data available at this time, the APC does not seem a likely source for the increase in calcium.

The alternate source for the calcium in NRL230 is natural variability of groundwater chemistry:

- The primary source of calcium in groundwater in this area is the limestone bedrock of the Lebanon Limestone formation where NRL230 is screened. Calcium concentrations in other wells at the NRL Landfill and in background wells are higher than concentrations in NRL230,

showing that the natural range includes higher concentrations. NRL230 was installed later in time than the other NRL Landfill wells, so there is less data available to characterize the full range of concentration variability.

Appendix C

Previous Alternate Source Demonstration(s)

NOTICE OF DEMONSTRATION OF ALTERNATE SOURCE(S)
GALLATIN FOSSIL PLANT
NORTH RAIL LOOP LANDFILL

In accordance with the provisions of 40 C.F.R. 257.94(e)(2), Tennessee Valley Authority (TVA) commissioned an Alternate Source Demonstration (ASD) study for the above-named Coal Combustion Residual (CCR) unit located within the Gallatin Fossil Plant's reservation. The study concluded that the ASD of Appendix III constituents measured were due to sources other that the CCR unit named above. As required by 40 C.F.R. 257.94(e)(2), TVA will include the demonstration, as certified by the qualified Professional Engineer (PE) named below, in its "Annual Groundwater Monitoring and Corrective Action Report." TVA will continue its detection monitoring program for the North Rail Loop Landfill.

QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Gabriel W. Lang, being a Registered Professional Engineer in good standing in the State of Tennessee do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification is prepared in accordance with the accepted practice of engineering; that the information contained herein is accurate as of the date of my signature below; and that the ASD as described in the attached summary meets the requirements of 40 CFR § 257.94(e)(2). Opinions relating to this ASD, environmental, geologic, and hydrogeologic conditions or other conclusions are based on available data; actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

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SUMMARY OF ALTERNATE SOURCE DEMONSTRATION, TVA GALLATIN FOSSIL PLANT, NORTH RAIL LOOP LANDFILL

DATE: 4/12/2018

SUMMARY OF ALTERNATE SOURCE DEMONSTRATION

TVA GALLATIN FOSSIL PLANT

NORTH RAIL LOOP LANDFILL

This document presents a summary of the Alternate Source Demonstration (ASD) prepared for the Tennessee Valley Authority (TVA) North Rail Loop (NRL) Landfill at the Gallatin Fossil Plant (GAF) located in Gallatin, Tennessee. The ASD was prepared in accordance with the United States Environmental Protection Agency coal combustion residual (CCR) Rule (40 Code of Federal Regulations [CFR] 257.94(e)(2)).

As detailed in the 2017 Annual Report, a detection monitoring event was conducted for the NRL in October 2017, and the results were evaluated using the certified statistical methods in accordance with 40 CFR 257.93(h). The statistical analysis resulted in the identification of at least one Statistically Significant Increase (SSI) over background concentrations in at least one downgradient well.

The ASD report for the NRL presents the justification of an alternate source for the SSIs identified in wells downgradient from the NRL Landfill, and demonstrates they are due to variability of groundwater chemistry and not to a release from the landfill. In summary:

The NRL Landfill is unlikely to be the source for the SSIs identified in downgradient monitoring wells, based on the following lines of evidence:

- The landfill is new, fully lined with a geosynthetic/clay-composite liner and leachate collection system. It has only been in operation for a short period of time.
- The landfill cannot be the source of the SSIs for chloride in NRL227 or boron in NRL220, because the leachate concentrations are not elevated relative to the groundwater concentrations. The landfill cannot be the source of the SSI for boron in NRL301B, because the leachate concentration is lower than the concentration in groundwater.
- While SSIs were found for boron and chloride, the parameters most consistently elevated in the leachate relative to groundwater are calcium and sulfate (and total dissolved solids [TDS]). No SSIs were identified for these parameters.
- The major ion ratios for leachate are dominated by calcium and sulfate. None of the groundwater samples have a similar ratio signature, nor do they show any suggestion of mixing with Ca-SO_4 water compared to background (pre-waste) samples, indicating no influence from landfill leachate.
- Sampling from the underdrain beneath the landfill shows no evidence of a release from the landfill.

The alternate source identified for the SSIs in the NRL Landfill downgradient monitoring wells is variability in the background (pre-waste) groundwater chemistry that was not fully characterized in the pre-waste data-set, as demonstrated through the following lines of evidence:

- Data from 2012 sampling shows concentrations of parameters exceeding the calculated Upper Prediction Limits (UPLs), demonstrating that the UPLs do not fully capture the pre-waste groundwater conditions.
- Data from wells that were sampled in 2012 but which no longer exist also shows greater variation in groundwater chemistry than indicated by the UPLs.
- The chemistry in downgradient well NRL301B is unusual and not encountered at any other wells at GAF. The TDS is high (typically 5,000 milligrams per liter [mg/L] or greater), and the major ions are dominated by sodium and chloride. In addition, the well has extremely poor yield, with water levels not recovering between sampling events. The chemistry and the poor yield indicate the well is screened in old groundwater that is not part of the circulating freshwater groundwater system. The elevated concentrations of the constituents in this well are associated with the old, saline water where the well is screened.
- Where the Detection Monitoring and/or confirmation data showed SSIs for chloride (NRL015, NRL227), the concentrations of chloride in these wells is low, less than 10 mg/L. Data collected at GAF during the Environmental Investigation (TVA, 2017a) from wells that cannot be affected by CCR show similar ranges in chloride concentrations. These concentrations are also typical of groundwater in the Ordovician limestone formations of the Central Basin Aquifer system where GAF is located. These data show the chloride concentrations are typical of GAF groundwater in general, even if slightly elevated compared to the pre-waste sampling dataset.
- The boron above the UPL at NRL220 shows similar patterns as elevated boron in samples from regional studies of the Central Basin aquifer system (Hileman and Lee, 1993; USGS NWIS database), with the higher boron found in association with higher concentrations of strontium, fluoride, and/or lithium, and non-calcium/magnesium-bicarbonate water types.
- Data from wells upgradient of NRL220 have boron concentrations greater than the NRL220 UPL, and this was also the case prior to landfill operation. The source of the higher boron in these upgradient wells is believed to be the Ash Pond Complex. The higher boron concentrations found at these upgradient wells could be contributing to the boron above its UPL at NRL220.

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