2018 Annual CCR Rule Groundwater Monitoring Report – North Rail Loop Landfill

Gallatin Fossil Plant
Gallatin, Tennessee

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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 2018 and presents the monitoring activities planned for 2019.

To comply with the CCR Rule, the following actions were taken in 2018:

- The 2017 Annual Groundwater Monitoring Report (AECOM, 2018) was completed in January 2018 and posted on TVA's publically accessible website as required by 257.90(e) and 257.107(h)(1).
- The NRL Landfill groundwater monitoring system certification was updated in June 2018, and the updated certification was posted on TVA's publically-accessible website.
- Additional baseline samples were collected from groundwater monitoring wells NRL230 and NRL301B to reach the minimum of eight baseline samples.
- Based on the results of the Detection monitoring completed in October 2017, verification sampling and error checking were conducted in February 2018, as specified in 40 CFR 257.94(e)(2).
- Alternate source(s) of Appendix III parameters, including natural variability, were evaluated in accordance with 40 CFR 257.94(e)(2). A notice of demonstration of alternate source(s), certified by a Professional Engineer, was placed in TVA's operating record in April 2018. The documentation of the Alternate Source Demonstration is included in this Annual Report.
- Two semi-annual Detection monitoring events took place in 2018, in April and September.
- Detection monitoring results were evaluated in accordance with the CCR Rule (257.94).

Problems encountered and resolution:

- No problems were encountered during the 2018 CCR Rule groundwater monitoring at the NRL Landfill.

The following activities are planned for 2019 to comply with CCR Rule groundwater monitoring requirements:

- Detection monitoring will continue with two semi-annual monitoring events in 2019, in accordance with 40 CFR 257.94.
- Detection monitoring results will be evaluated in accordance with the CCR Rule.
- It is anticipated that the statistics used for Detection monitoring will be updated in 2019. If the statistical method is modified, an updated certification of the method will be prepared.
- Alternate source(s), including natural variability, will continue to be evaluated where applicable in accordance with 40 CFR 257.94(e)(2).

- Further field and desktop Site-Characterization Investigations may be performed to improve the Conceptual Site Model (CSM).
- 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.
- The groundwater analytical data obtained in 2019 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.
- 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 2019, will be completed in January 2020.

Groundwater Monitoring System

GAF is located in north-central Tennessee on Odoms Bend peninsula, just south of Gallatin, Tennessee. The GAF property consists of approximately 1,950 acres of land encompassing the majority of the peninsula, which 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 their CCR by sluicing to surface impoundments. In the early 2010s, they 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. Additional information about the NRL Landfill can be found on TVA's publically-accessible website: https://www.tva.com/Environment/Environmental-Stewardship/Coal-Combustion-Residuals/Gallatin.

GAF is located within the Central Basin Aquifer area of Middle Tennessee. Groundwater in Central Tennessee that occurs within the stratigraphic interval between the bottom of the Devonian age Chattanooga Shale and the top of the Cambrian-Ordovician age Knox Group is known as the Central Basin Aquifer system. This aquifer system is an important source of drinking water for Central 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).

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**, and 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, and 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 website: https://www.tva.com/Environment/Environmental-Stewardship/Coal-Combustion-Residuals/Gallatin.

The monitoring well system certification was updated in June 2018 to include the new well (NRL230). NRL230 was in place at the time of the previous Annual Report (AECOM, 2018); there have been no changes to the monitoring system since that time.

Groundwater Sampling and Laboratory Analytical Results

The data obtained during the CCR Rule compliance monitoring in 2018 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 sampling events and activities are listed on **Table 2**.

In 2018, three additional baseline samples were collected from monitoring well NRL301B, and a full set of eight baseline samples was collected from well NRL230. The full set of baseline samples was not collected from these wells in 2016-2017 because of lack of water in the well (NRL301B), or the well had not been installed until January 2018 (NRL230). The additional baseline sampling dates are listed on **Table 2**.

In February 2018, a verification sampling event was conducted to verify the results of the initial Detection monitoring event in October 2017.

The semi-annual Detection monitoring events took place in April and September 2018 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 formation showing the generalized direction of the hydraulic gradient based on groundwater elevations measured in April 2018. 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 network.

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 0.007 to 0.018 feet per foot (ft/ft), and an effective porosity of 5 percent. The calculated groundwater velocities beneath the NRL Landfill range from 0.22 to 0.58 ft/day.

Sampling Results

Groundwater samples were submitted to TestAmerica Laboratories for analysis. The field parameters measured and the laboratory analytical results are presented in **Tables 4 and 5**.

Statistical Evaluation

In January 2018, in accordance with the statistical method certification for the NRL Landfill, the calculation of background concentrations of Appendix III parameters for the Lebanon aquifer was completed using an intrawell Upper Prediction Limit (UPL) statistic. UPLs were calculated for each parameter in each of the downgradient wells, using data from samples collected from these wells prior to waste placement in the landfill. The background dataset was based on data collected from sampling conducted between April 2015 and May 2016, representing a minimum of eight pre-waste sampling events (see Table 6 of the 2017 Annual Report (AECOM, 2018)). The calculated intrawell background concentrations for each parameter are provided in **Table 5**.

A new well NRL230 was installed in January 2018, after the NRL Landfill was in operation. As a result, there are no samples from this well prior to waste emplacement. The CCR Rule minimum of eight baseline samples were collected from this well between April and November 2018 (see **Table 2**). These data were used to calculate a baseline UPL using the certified statistical method.

In January 2018, the calculated pre-waste background values (the UPLs) were compared to the October 2017 Detection monitoring sample results at each downgradient monitoring well as required by 40 CFR 257.93(h). Statistically Significant Increases (SSIs) over background were found in at least one downgradient monitoring well for at least one Appendix III parameter, as documented in the 2017 Annual Report (AECOM, 2018). As a result of these findings, an alternate source evaluation was conducted, as described below. The Alternate Source

Demonstration concluded that the SSIs were not caused by a release from the NRL Landfill. The PE certification of this demonstration is included in **Appendix A**.

The sampling results for the two semi-annual Detection monitoring events in 2018 continued to be compared to the calculated UPLs. The results of these comparisons are provided on **Table 5**. The Detection monitoring results for 2018 continue to be below the UPLs and/or consistent with the concentrations that were the basis for the Alternate Source Demonstration (**Appendix A**).

Alternate Source Evaluation

As detailed in the 2017 Annual Report, a Detection monitoring event was conducted 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 identifying at least one SSI over background concentrations in at least one downgradient well.

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."

An alternate source evaluation was completed, and the conclusions are presented in Appendix A of this Annual Report. The evaluation 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 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 calcium-sulfate 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 of the SSIs in NRL Landfill downgradient monitoring wells is variability in the background (pre-waste) groundwater chemistry that was not fully characterized in the pre-waste data, as demonstrated through the following lines of evidence:

- Data from 2012 sampling shows concentrations of parameters exceeding the calculated 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 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 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, 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.

Based on the Alternate Source Demonstration, semi-annual Detection monitoring is being conducted at the NRL Landfill.

Narrative Discussion of Transition between Monitoring Programs

Semi-annual Detection monitoring was continued in 2018 because the SSIs identified in 2017 were shown to not be related to a release from the CCR unit **(Appendix A)**. There was no transition in monitoring programs in 2018; two Detection monitoring events were conducted in 2018.

Two semi-annual Detection monitoring events will take place in 2019. The groundwater analytical data obtained in 2019 will be evaluated using appropriate statistical methods.

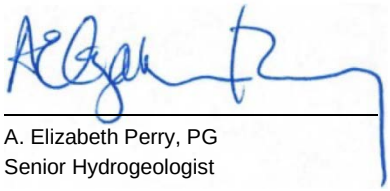
Changes to the monitoring program will be implemented, as needed, to maintain compliance with 40 CFR 257.90 through 257.98

References

AECOM, 2018. 2017 Annual CCR Rule Groundwater Monitoring Report – North Rail Loop Landfill, Gallatin Fossil Plant, Gallatin, Tennessee. January 2018.

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.

Quality Information

Prepared by	Reviewed by	Reviewed by
		
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Figures

Tables

Appendices

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

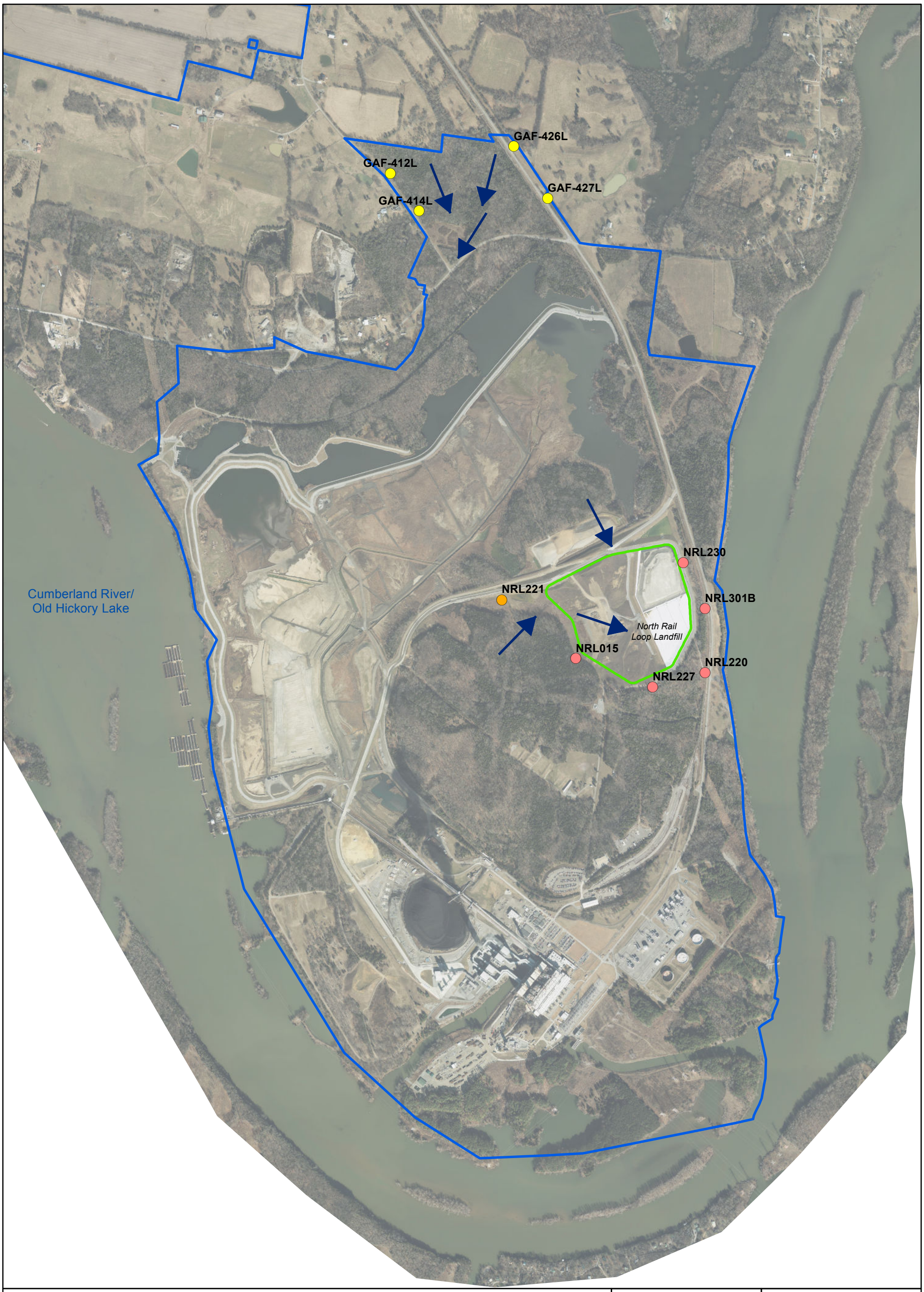
Figure 1

NORTH RAIL LOOP (NRL) LANDFILL
MONITORING SYSTEM WELLS

DRAWN BY:	REVIEWED BY:	APPROVED BY:	REVISION NUMBER:
MARK.P.SMITH	C.GARLINGTON		REV. 0

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

DATE:	DEPT:
1/4/2018	FOSSIL AND HYDRO ENGINEERING



LEGEND

- Hydraulic Gradient
- 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 2

GENERALIZED HYDRAULIC GRADIENTS - LEBANON AQUIFER, APRIL 16, 2018

DRAWN BY:	REVIEWED BY:	APPROVED BY:	REVISION NUMBER:
MARK.P.SMITH	C.GARLINGTON		REV. 0

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

DATE:	DEPT:
1/25/2019	FOSSIL AND HYDRO ENGINEERING

Tables

Table 1
Well Construction Information - North Rail Loop Landfill
CCR Rule Groundwater Monitoring System
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 Co-ordinates	
										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	124	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 co-ordinates based on North America Datum of 1927
Well construction information based on data provided by TVA Well Inventory, Revision 6, September 26, 2018.
ft btoc - feet below top of casing
in - inches (inside diameter)

Table 2
Groundwater Sampling Summary - North Rail Loop Landfill, 2018
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Sample Dates	Groundwater Gauging Date	Monitoring Program	Parameters Sampled	Number of Wells Sampled
February 22-23, 2018	February 20, 2018	Verification (Confirmation) Sampling (257.94 (e)(2))	Chloride (NRL015 and NRL227), Boron (NRL220 and NRL301B), and field parameters	Background: 0 Upgradient: 0 Downgradient: 4
April 17-20, 2018	April 16, 2018	Detection Monitoring (257.94(a))	Appendix III, major ions and field parameters	Background: 4 Upgradient: 1 Downgradient: 4
April 17-20, 2018	April 16, 2018	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions and field parameters	Background: 0 Upgradient: 0 Downgradient: 2
May 23, 2018	May 21, 2018	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions and field parameters	Background: 0 Upgradient: 0 Downgradient: 2
June 20, 2018	June 18, 2018	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions and field parameters	Background: 0 Upgradient: 0 Downgradient: 2
July 17, 2018	July 16, 2018	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions and field parameters	Background: 0 Upgradient: 0 Downgradient: 1
August 21, 2018	August 20, 2018	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions and field parameters	Background: 0 Upgradient: 0 Downgradient: 1
September 18-27, 2018	September 17, 2018	Detection Monitoring (257.94(a))	Appendix III, major ions and field parameters	Background: 4 Upgradient: 1 Downgradient: 4
September 18-27, 2018	September 17, 2018	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions and field parameters	Background: 0 Upgradient: 0 Downgradient: 1
October 23, 2018	October 16, 2018	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions and field parameters	Background: 0 Upgradient: 0 Downgradient: 1
November 12, 2018	November 13, 2017	Baseline Monitoring (257.94(b))	Appendix III, Appendix IV, major ions 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, 2018
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Gauging Date:	2018-02-20			2018-04-16			2018-05-21		
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)**	**Reference Elevation (ft AMSL)**	**Water Level Measurement (ft)**	**Hydraulic Head (ft AMSL)**
GAF-412L	477.58	25.45	452.13	477.58	25.55	452.03	477.58	26.63	450.95
GAF-414L	481.45	32.71	448.74	481.45	32.48	448.97	481.45	34.03	447.42
GAF-426L	506.83	42.35	464.48	506.83	44.18	462.65	506.83	47.91	458.92
GAF-427L	488.41	30.41	458.00	488.41	30.93	457.48	488.41	35.29	453.12
NRL015	546.65	87.30	459.35	546.65	87.69	458.96	546.65	88.39	458.26
NRL220	502.54	54.44	448.10	502.54	54.85	447.69	502.54	55.51	447.03
NRL221	478.90	19.36	459.54	478.90	19.72	459.18	478.90	20.45	458.45
NRL227	560.33	110.90	449.43	560.33	110.75	449.58	560.33	110.98	449.35
NRL230	511.70	52.53	459.17	511.70	52.89	458.81	511.70	53.64	458.06
NRL301B	498.15	131.90	366.25	498.15	121.93	376.22	498.15	125.86	372.29
Surface Water ID									
CUMBERLAND RIVER (a)	NA	NA	444.94	NA	NA	445.63	NA	NA	445.77

Notes:
AMSL - above mean sea level
ft - feet
NA - not applicable

(a) Data downloaded from TVA's iSite Central Database
(b) Field measurement suspect

Table 3
Groundwater Elevation Summary - North Rail Loop Landfill, 2018
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Gauging Date:	2018-06-18			2018-07-16			2018-08-20		
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)**	**Reference Elevation (ft AMSL)**	**Water Level Measurement (ft)**	**Hydraulic Head (ft AMSL)**
GAF-412L	477.58	27.63	449.95	477.58	27.61	449.97	477.58	27.28	450.30
GAF-414L	481.45	35.26	446.19	481.45	36.03	445.42	481.45	34.95	446.50
GAF-426L	506.83	51.58	455.25	506.83	53.49	453.34	506.83	54.47	452.36
GAF-427L	488.41	39.79	448.62	488.41	41.37	447.04	488.41	41.95	446.46
NRL015	546.65	89.73	456.92	546.65	89.73	456.92	546.65	90.81	455.84
NRL220	502.54	56.14	446.40	502.54	55.87	446.67	502.54	55.22	447.32
NRL221	478.90	21.86	457.04	478.90	21.84	457.06	478.90	22.58	456.32
NRL227	560.33	112.30	448.03	560.33	112.09	448.24	560.33	111.69	448.64
NRL230	511.70	55.08	456.62	511.70	56.21	455.49	511.70	55.83	455.87
NRL301B	498.15	126.45	371.70	498.15	131.64	366.51	498.15	122.42	375.73
Surface Water ID									
CUMBERLAND RIVER (a)	NA	NA	444.50	NA	NA	444.91	NA	NA	444.92

Notes:
AMSL - above mean sea level
ft - feet
NA - not applicable

(a) Data downloaded from TVA's iSite Central Database
(b) Field measurement suspect

Table 3
Groundwater Elevation Summary - North Rail Loop Landfill, 2018
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Gauging Date:	2018-09-17			2018-10-16			2018-11-12		
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)**	**Reference Elevation (ft AMSL)**	**Water Level Measurement (ft)**	**Hydraulic Head (ft AMSL)**
GAF-412L	477.58	28.13	449.45	477.58	25.66	451.92	477.58	27.69	449.89
GAF-414L	481.45	35.81	445.64	481.45	32.67	448.78	481.45	34.17	447.28
GAF-426L	506.83	55.33	451.50	506.83	50.18	456.65	506.83	49.31	457.52
GAF-427L	488.41	42.77	445.64	488.41	35.55	452.86	488.41	35.81	452.60
NRL015	546.65	93.21	453.44	546.65	89.83	456.82	546.65	91.90	454.75
NRL220	502.54	54.89	447.65	502.54	54.09	448.45	502.54	54.52	448.02
NRL221	478.90	25.21	453.69	478.90	25.86 (b)	453.04 (b)	478.90	23.29	455.61
NRL227	560.33	111.15	449.18	560.33	109.73	450.60	560.33	110.69	449.64
NRL230	511.70	58.51	453.19	511.70	55.39	456.31	511.70	56.22	455.48
NRL301B	498.15	117.08	381.07	498.15	123.81	374.34	498.15	132.78	365.37
Surface Water ID									
CUMBERLAND RIVER (a)	NA	NA	444.45	NA	NA	445.53	NA	NA	444.65

Notes:
AMSL - above mean sea level
ft - feet
NA - not applicable

(a) Data downloaded from TVA's iSite Central Database
(b) Field measurement suspect

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

		Monitoring Well ID	NRL230	NRL230	NRL230	NRL230	NRL230	NRL230
		Sample Date	4/20/2018	5/23/2018	6/20/2018	7/18/2018	8/21/2018	9/24/2018
	Well Location Designation		Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
		Sample ID	GAF-GW-NRL230-04202018	GAF-GW-NRL230-05232018	GAF-GW-NRL230-06202018	GAF-GW-NRL230-07182018	GAF-GW-NRL230-08212018	GAF-GW-NRL230-09242018
		Sample Type	N	N	N	N	N	N
Analyte	**CASNO**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Field Parameters								
Dissolved Oxygen	DO	MG/L	0.35	1.10	0.46	0.42	0.45	0.89
ORP	ORP	MV	-279.2	-295.6	-256.9	-256.0	-279.2	-199.7
pH, Field	PHFLD	SU	7.43	7.60	6.65	7.23	6.21	7.43
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1224	1240	1127	1253	1261	1115
Temperature	TEMP	deg C	16.5	17.4	20.1	18.5	18.2	17.6
Turbidity, field	TURB-FIELD	NTU	1.65	0.51	1.35	1.29	0.54	0.80
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	608	583	556	537	530	570
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	608	583	556	537	530	570
Chloride	16887-00-6	MG/L	32.8	25.2	29.8	28.6	18.9	23.0
Fluoride	16984-48-8	MG/L	1.59	1.62	1.66	1.43	1.42	1.37
Sulfate	14808-79-8	MG/L	126	122	153	151	127	138
Total Dissolved Solids	TDS	MG/L	768	778	781	778	717	718
Metals, Total								
Antimony	7440-36-0	MG/L	0.00112 U	0.00112 U	0.00112 U	0.00112 U	0.00112 U	0.00112 U
Arsenic	7440-38-2	MG/L	0.000752 J	0.000779 U*	0.000472 U*	0.000323 U	0.000364 U*	0.000323 U
Barium	7440-39-3	MG/L	0.0363	0.0322	0.0312	0.0301	0.0283	0.0312
Beryllium	7440-41-7	MG/L	0.0000570 U	0.0000570 U	0.0000570 U	0.0000570 U	0.0000570 U	0.0000570 U
Boron	7440-42-8	MG/L	0.731	0.714	0.676	0.600	0.506	0.696
Cadmium	7440-43-9	MG/L	0.000125 U	0.000125 U	0.000125 U	0.000125 U	0.000125 U	0.000174 J
Calcium	7440-70-2	MG/L	24.4	23.1 J	25.6	25.5	36.6	32.9
Chromium	7440-47-3	MG/L	0.00117 U*	0.00184 U*	0.00182 U*	0.000631 U	0.00152 U*	0.000975 U*
Cobalt	7440-48-4	MG/L	0.0000750 U	0.0000750 U	0.0000750 U	0.000197 U*	0.0000750 U	0.0000750 U
Lead	7439-92-1	MG/L	0.0000940 U	0.0000940 U	0.000262 J	0.000287 U*	0.0000940 U	0.0000940 U
Lithium	7439-93-2	MG/L	0.214	0.244	0.244	0.186	0.144	0.189
Magnesium	7439-95-4	MG/L	11.3	11.7	12.9	14.9	20.8	17.7
Mercury	7439-97-6	MG/L	0.0000653 U	0.0000653 U	0.0000653 U	0.0000653 U	0.0000653 U	0.0000653 U
Molybdenum	7439-98-7	MG/L	0.000477 J	0.000474 U	0.000474 U	0.00155 U*	0.000474 U	0.000474 U
Potassium	7440-09-7	MG/L	13.5	15.8	16.4	17.9	19.3	18.7
Selenium	7782-49-2	MG/L	0.000813 U	0.000813 U	0.000813 U	0.000813 U	0.000813 U	0.000813 U
Sodium	7440-23-5	MG/L	255	261	251	216	179	190
Thallium	7440-28-0	MG/L	0.0000630 U	0.0000630 U	0.0000630 U	0.0000860 J	0.0000630 U	0.0000630 U
Radiological								
Radium-226 + Radium-228	RA226/228	pCi/L	0.728 U	0.653 UJ	0.126 U	0.450 U	1.63 J	0.796 U
Radium-228	15262-20-1	pCi/L	0.214 U	0.296 U	-0.1870 U	0.211 U	1.13	0.672 U
Radium-226	13982-63-3	pCi/L	0.514 U	0.356 UJ	0.126 U	0.239 U	0.498 J	0.124 U

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

		Monitoring Well ID	NRL230	NRL230	NRL301B	NRL301B	NRL301B
		Sample Date	10/23/2018	11/13/2018	4/17/2018	5/23/2018	6/20/2018
	Well Location Designation		Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
		Sample ID	GAF-GW-NRL230-10232018	GAF-GW-NRL230-11132018	GAF-GW-NRL301B-04172018	GAF-GW-NRL301B-05232018	GAF-GW-NRL301B-06202018
		Sample Type	N	N	N	N	N
Analyte	**CASNO**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Field Parameters							
Dissolved Oxygen	DO	MG/L	1.70	0.76	0.48	1.48	0.44
ORP	ORP	MV	-288.3	-210.1	-326.8	-290.2	-334.2
pH, Field	PHFLD	SU	7.58	7.45	7.02	6.90	6.65
Specific Conductance, Field	CONDSPECFLD	umhos/cm	983	1181	9357	8732	7837
Temperature	TEMP	deg C	15.6	13.9	16.2	20.0	18.0
Turbidity, field	TURB-FIELD	NTU	0.55	2.03	4.06	1.40	2.18
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	493	450	675	665	618
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	493	450	675	665	618
Chloride	16887-00-6	MG/L	23.7	29.2	2920	2320	2680
Fluoride	16984-48-8	MG/L	1.40	1.68	4.34	3.62	4.26
Sulfate	14808-79-8	MG/L	154	220	175	126	186
Total Dissolved Solids	TDS	MG/L	719	748	4940	4970	4740
Metals, Total							
Antimony	7440-36-0	MG/L	0.00112 U	0.00112 U	0.00112 U	0.00112 U	0.00114 J
Arsenic	7440-38-2	MG/L	0.000323 U	0.000431 U*	0.000610 U*	0.000584 U*	0.000457 U*
Barium	7440-39-3	MG/L	0.0307	0.0286	0.104	0.103	0.102
Beryllium	7440-41-7	MG/L	0.0000570 U	0.0000570 U	0.0000570 U	0.000570 U	0.0000570 U
Boron	7440-42-8	MG/L	0.551	0.711	1.05	1.11	1.67
Cadmium	7440-43-9	MG/L	0.000125 U	0.000125 U	0.000125 U	0.000125 U	0.000125 U
Calcium	7440-70-2	MG/L	34.5	30.6	68.2	62.0 J	64.0
Chromium	7440-47-3	MG/L	0.000886 U*	0.00255 U*	0.00156 U*	0.00218 U*	0.00253 U*
Cobalt	7440-48-4	MG/L	0.0000750 U	0.0000750 U	0.0000750 U	0.0000750 U	0.0000750 U
Lead	7439-92-1	MG/L	0.0000940 U	0.0000940 U	0.0000940 U	0.0000940 U	0.0000940 U
Lithium	7439-93-2	MG/L	0.190	0.178	2.45	1.66	2.53
Magnesium	7439-95-4	MG/L	19.8	17.8	33.1	32.9	32.8
Mercury	7439-97-6	MG/L	0.0000653 U	0.0000653 U	0.0000653 U	0.0000653 U	0.0000653 U
Molybdenum	7439-98-7	MG/L	0.000474 U	0.000474 U	0.000474 U	0.000474 U	0.000474 U
Potassium	7440-09-7	MG/L	19.6	18.8	34.1	32.7	32.9
Selenium	7782-49-2	MG/L	0.000813 UJ	0.000813 U	0.000813 UJ	0.000813 U	0.000813 U
Sodium	7440-23-5	MG/L	213	219	1810	1830	1770
Thallium	7440-28-0	MG/L	0.0000630 U	0.0000630 U	0.0000630 U	0.0000630 U	0.0000630 U
Radiological							
Radium-226 + Radium-228	RA226/228	pCi/L	1.55 J	(a)	2.67	1.80 J	1.84
Radium-228	15262-20-1	pCi/L	0.839 J	(a)	0.658	0.988	1.20
Radium-226	13982-63-3	pCi/L	0.709	(a)	2.01	0.816 J	0.643

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

Notes and Acronymns

(a)	-	Radium analytical data not yet available; re-analysis by laboratory is in progress.
MG/L	-	milligrams per liter
MV	-	millivolts
N	-	primary sample
NTU	-	nephelometric turbidity units
pCi/L	-	picoCuries per liter
umhos/cm	-	microMhos per centimeter

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.

Table 5
Confirmation and Detection Monitoring Groundwater Analytical Results - North Rail Loop Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well ID	412L	412L	414L	414L	426L	426L
		Sample Date	4/19/2018	9/19/2018	4/19/2018	9/19/2018	4/20/2018	9/20/2018
		Well Location Designation	Background	Background	Background	Background	Background	Background
		Sample ID	GAF-GW-412L-04192018	GAF-GW-412L-09192018	GAF-GW-414L-04192018	GAF-GW-414L-09192018	GAF-GW-426L-04202018	GAF-GW-426L-09202018
		Sample Type	N	N	N	N	N	N
Analyte	**CASNO**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Field Parameters								
Dissolved Oxygen	DO	MG/L	0.29	0.23	0.48	0.48	0.43	0.86
ORP	ORP	MV	-294.2	-190.2	-141.2	50.5	-144.5	-109.1
pH, Field	PHFLD	pH units	7.56	7.45	7.48	7.50	6.64	6.86
Specific Conductance, Field	CONDSPECFLD	umhos/cm	657	933	1139	959	1191	1251
Temperature	TEMP	deg C	15.1	17.6	14.6	16.0	13.9	20.2
Turbidity, field	TURB-FIELD	NTU	0.28	0.18	0.87	0.46	0.93	0.43
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	358	308	323	302	475	420
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	358	308	323	302	475	420
Chloride	16887-00-6	MG/L	44.9	111	208	190	83.6	92.4
Fluoride	16984-48-8	MG/L	1.57	1.21	0.824	0.672	0.403	0.328
Sulfate	14808-79-8	MG/L	7.44	11.5	17.3	33.4	155	209
Total Dissolved Solids	TDS	MG/L	378	571	635	732	767	839 J
Metals, Total								
Boron	7440-42-8	MG/L	0.283	0.282	0.207	0.221	0.0707 J	0.0793 J
Calcium	7440-70-2	MG/L	30.6	43.3	83.6	84.9	136	128
Magnesium	7439-95-4	MG/L	17.8	24.3	35.6	34.6	30.7	31.1
Potassium	7440-09-7	MG/L	6.06	6.22	3.14	3.43	24.8	30.9
Sodium	7440-23-5	MG/L	98.3	135	124	110	85.2	92.2

Table 5
Confirmation and Detection Monitoring Groundwater Analytical Results - North Rail Loop Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well ID	427L	427L	NRL015	NRL015	NRL015	NRL015 Background UPL
		Sample Date	4/20/2018	9/26/2018	2/22/2018	4/18/2018	9/21/2018	
		Well Location Designation	Background	Background	Downgradient	Downgradient	Downgradient	
		Sample ID	GAF-GW-427L-04202018	GAF-GW-427L-09262018	GAF-GW-NRL015-20180222	GAF-GW-NRL015-04182018	GAF-GW-NRL015-09212018	
		Sample Type	N	N	N	N	N	
Analyte	**CASNO**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	
Field Parameters								
Dissolved Oxygen	DO	MG/L	0.36	0.71	0.37	0.44	0.73	
ORP	ORP	MV	-23.8	-152.3	-201.6	-239.1	-263.0	
pH, Field	PHFLD	pH units	6.90	7.18	7.01	6.93	6.93	7.72
Specific Conductance, Field	CONDSPECFLD	umhos/cm	632	669	1058	1061	1001	
Temperature	TEMP	deg C	14.9	17.7	14.5	15.2	16.5	
Turbidity, field	TURB-FIELD	NTU	1.91	0.54	0.55	0.30	0.13	
General Chemistry								
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U	5.00 U	NA	5.00 U	5.00 U	
Alkalinity, Total as CaCO3	ALK	MG/L	345	316	NA	517	466	
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	345	316	NA	517	466	
Chloride	16887-00-6	MG/L	14.0	10.8	5.30	5.04	3.47	6.00
Fluoride	16984-48-8	MG/L	0.354	0.273	NA	0.905	0.825	1.04
Sulfate	14808-79-8	MG/L	47.4	47.1	NA	249	203	285
Total Dissolved Solids	TDS	MG/L	372	406	NA	745	718	838
Metals, Total								
Boron	7440-42-8	MG/L	0.0730 J	0.0720 J	NA	0.277	0.346	0.349
Calcium	7440-70-2	MG/L	99.1	91.5	NA	127	115	127
Magnesium	7439-95-4	MG/L	29.4	25.9	NA	63.8	59.3	
Potassium	7440-09-7	MG/L	1.65	1.64	NA	9.04	8.95	
Sodium	7440-23-5	MG/L	11.7	11.0	NA	37.4	35.5	

Table 5
Confirmation and Detection Monitoring Groundwater Analytical Results - North Rail Loop Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

		Monitoring Well ID	NRL220	NRL220	NRL220	NRL220	NRL220	NRL220	NRL220 Background UPL
		Sample Date	2/22/2018	2/22/2018	4/18/2018	4/18/2018	9/24/2018	9/24/2018	
		Well Location Designation	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	
		Sample ID	GAF-GW-NRL220-20180222	GAF-GW-903-20180222	GAF-GW-NRL220-04182018	GAF-GW-903A-04182018	GAF-GW-NRL220-09242018	GAF-GW-903-09242018	
		Sample Type	N	FD	N	FD	N	FD	
Analyte	**CASNO**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	
Field Parameters									
Dissolved Oxygen	DO	MG/L	0.45	NA	0.45	NA	0.93	NA	
ORP	ORP	MV	-355.9	NA	-292.3	NA	-250.5	NA	
pH, Field	PHFLD	pH units	8.19	NA	8.00	NA	8.25	NA	9.47
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1219	NA	1259	NA	1200	NA	
Temperature	TEMP	deg C	15.4	NA	17.9	NA	16.2	NA	
Turbidity, field	TURB-FIELD	NTU	2.40	NA	1.32	NA	0.61	NA	
General Chemistry									
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	NA	NA	5.00 U	5.00 U	5.00 U	5.00 U	
Alkalinity, Total as CaCO3	ALK	MG/L	NA	NA	481	473	414	416	
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	NA	NA	481	473	414	416	
Chloride	16887-00-6	MG/L	NA	NA	92.3	92.9	76.3	76.7	96.0
Fluoride	16984-48-8	MG/L	NA	NA	1.60	1.61	1.40	1.39	1.87
Sulfate	14808-79-8	MG/L	NA	NA	132	143	127	126	244
Total Dissolved Solids	TDS	MG/L	NA	NA	790	790	800	798	1020
Metals, Total									
Boron	7440-42-8	MG/L	**0.618**	**0.618**	0.548	0.542	0.546	0.561	0.617
Calcium	7440-70-2	MG/L	NA	NA	4.39	4.42	4.01	4.10	5.76
Magnesium	7439-95-4	MG/L	NA	NA	2.53	2.60	2.45	2.52	
Potassium	7440-09-7	MG/L	NA	NA	9.00	9.22	9.01	9.31	
Sodium	7440-23-5	MG/L	NA	NA	282	292	257	264	

Table 5
Confirmation and Detection Monitoring Groundwater Analytical Results - North Rail Loop Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Monitoring Well ID			NRL221	NRL221	NRL227	NRL227	NRL227	NRL227 Background UPL
Sample Date			4/17/2018	9/24/2018	2/23/2018	4/19/2018	9/27/2018	
Well Location Designation			Upgradient	Upgradient	Downgradient	Downgradient	Downgradient	
Sample ID			GAF-GW-NRL221-04172018	GAF-GW-NRL221-09242018	GAF-GW-NRL227-20180223	GAF-GW-NRL227-04192018	GAF-GW-NRL227-09272018	
Sample Type			N	N	N	N	N	
Analyte	**CASNO**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	
Field Parameters								
Dissolved Oxygen	DO	MG/L	0.39	0.82	1.41	0.46	3.33	
ORP	ORP	MV	-192.4	-101.8	-203.5	-203.4	-148.3	
pH, Field	PHFLD	pH units	6.62	6.79	6.71	6.97	7.14	7.74
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1716	1041	1005	951	1021	
Temperature	TEMP	deg C	15.4	16.8	16.3	13.3	16.5	
Turbidity, field	TURB-FIELD	NTU	0.40	0.51	0.98	0.32	0.40	
General Chemistry								
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U	5.00 U	NA	5.00 UR	5.00 U	
Alkalinity, Total as CaCO3	ALK	MG/L	507	420	NA	438 J	422	
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	507	420	NA	438 J	422	
Chloride	16887-00-6	MG/L	5.15	3.57	**8.37**	**8.36**	7.94	7.94
Fluoride	16984-48-8	MG/L	0.703	1.02	NA	0.894	0.966	1.04
Sulfate	14808-79-8	MG/L	286	270	NA	161	156	206
Total Dissolved Solids	TDS	MG/L	812	828	NA	621	640	684
Metals, Total								
Boron	7440-42-8	MG/L	2.13	2.22	NA	0.964	0.918	1.70
Calcium	7440-70-2	MG/L	165	164	NA	109	104	116
Magnesium	7439-95-4	MG/L	57.7	56.3	NA	55.0	53.3	
Potassium	7440-09-7	MG/L	6.24	6.40	NA	9.94	11.0	
Sodium	7440-23-5	MG/L	17.6	17.6	NA	47.6	49.0	

Table 5
Confirmation and Detection Monitoring Groundwater Analytical Results - North Rail Loop Landfill
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Monitoring Well ID			NRL230	NRL230	NRL230 Background UPL	NRL301B	NRL301B	NRL301B	NRL301B Background UPL
Sample Date			4/20/2018	9/24/2018		2/23/2018	4/17/2018	9/25/2018	
Well Location Designation			Downgradient	Downgradient		Downgradient	Downgradient	Downgradient	
Sample ID			GAF-GW-NRL230-04202018	GAF-GW-NRL230-09242018		GAF-GW-NRL301B-20180223	GAF-GW-NRL301B-04172018	GAF-GW-NRL301B-09252018	
Sample Type			N	N		N	N	N	
Analyte	**CASNO**	**Units**	**Result**	**Result**		**Result**	**Result**	**Result**	
Field Parameters									
Dissolved Oxygen	DO	MG/L	0.35	0.89		1.01	0.48	2.73	
ORP	ORP	MV	-279.2	-199.7		-321.6	-326.8	-253.4	
pH, Field	PHFLD	pH units	7.43	7.43	7.60	6.92	7.02	7.37	7.72
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1224	1115		8710	9357	7993	
Temperature	TEMP	deg C	16.5	17.6		17.0	16.2	17.3	
Turbidity, field	TURB-FIELD	NTU	1.65	0.80		4.68	4.06	0.59	
General Chemistry									
Alkalinity, Carbonate (CaCO3)	ALKC	MG/L	5.00 U	5.00 U		NA	5.00 U	5.00 U	
Alkalinity, Total as CaCO3	ALK	MG/L	608	570		NA	675	566	
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	608	570		NA	675	566	
Chloride	16887-00-6	MG/L	32.8	23.0	40.7	NA	2920	2600	3900
Fluoride	16984-48-8	MG/L	1.59	1.37	1.93	NA	4.34	4.60	5.19
Sulfate	14808-79-8	MG/L	126	138	267	NA	175	174	1490
Total Dissolved Solids	TDS	MG/L	768	718	843	NA	4940	5170	7060
Metals, Total									
Boron	7440-42-8	MG/L	0.731	0.696	0.917	**3.82**	1.05	1.17	1.68
Calcium	7440-70-2	MG/L	24.4	32.9	50.3	NA	68.2	60.5	445
Magnesium	7439-95-4	MG/L	11.3	17.7		NA	33.1	32.7	
Potassium	7440-09-7	MG/L	13.5	18.7		NA	34.1	35.2	
Sodium	7440-23-5	MG/L	255	190		NA	1810	1820	

Table 5
Confirmation and 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

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

Appendix III Alternate Source Demonstration – North Rail Loop Landfill

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.

SIGNATURE: _____

PRINTED NAME: Gabriel W. Lang, PE

ADDRESS: AECOM
1600 Perimeter Park Drive, Suite 400
Morrisville, NC 27560

TELEPHONE: 919-461-1344

Attachments:
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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