AECOM Imagine it. Delivered.

2019 Annual CCR Rule Groundwater Monitoring Report North Rail Loop Landfill

Gallatin Fossil Plant
Gallatin, Tennessee

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:

AECOM
1600 Perimeter Park
Morrisville, NC 27560
USA
aecom.com

January 2020

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 2019 and presents the monitoring activities planned for 2020.

Throughout the 2019 annual reporting period, the NRL Landfill has been in the Detection monitoring phase pursuant to 257.94. As explained below, there was one statistically significant increase (SSI) over background for boron in well NRL301B from the September 2019 Detection monitoring sampling event. However, the concentration leading to the SSI is consistent with the 2018 concentrations that were 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 2019:

- The 2018 Annual Groundwater Monitoring Report (AECOM, 2019) was completed in January 2019 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 2019, in April and September.
- The NRL Landfill Detection monitoring statistics were updated in 2019. The Appendix III intra-well background Upper Prediction Limits (UPLs) were updated for each of the downgradient wells in the compliance monitoring system. Additional details are provided in the "Statistical Evaluation" section below. Because the statistical methodology is consistent with the original certified statistical method, no re-certification is necessary.
- Detection monitoring results were evaluated in accordance with the CCR Rule (257.94).

Problems encountered and resolution:

- During the April and September site-wide groundwater gauging events, the depth to groundwater in well NRL230 was recorded incorrectly. The water levels reported here (Table 3) for this well were obtained on the day the well was sampled, prior to purging and sampling. This has no effect on the groundwater sampling results, or any other information presented in this report.
- No other problems were encountered during the 2019 CCR Rule groundwater monitoring at the NRL Landfill.

The following activities are planned for 2020 to comply with CCR Rule groundwater monitoring requirements:

- This 2019 Annual Groundwater Monitoring Report will be finalized in January 2020 and 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 2020, in accordance with 40 CFR 257.94.
- Detection monitoring results will be evaluated in accordance with the CCR Rule (257.94).
- The groundwater analytical data obtained in 2020 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'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 2020, will be completed in January 2021.

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 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. 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). As observed by Newcome (1958), “Practically all ground water in the Central Basin of Tennessee is confined under artesian pressure in solution channels in the limestone.”

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.

There were no changes to the monitoring system in 2019.

Groundwater Sampling and Laboratory Analytical Results

The data obtained during the CCR Rule compliance monitoring in 2019 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 2019, 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 2019. 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 0.011 feet per foot (ft/ft) in April 2019 and 0.005 to 0.006 ft/ft in September 2019, and an effective porosity of 5 percent. The calculated groundwater velocities beneath the NRL Landfill range from 0.15 to 0.35 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

In 2019, as noted in the 2018 Annual Report (AECOM, 2019), the statistics used for Detection monitoring were updated. The background concentrations of Appendix III parameters for the Lebanon aquifer were re-calculated using an intrawell Upper Prediction Limit (UPL) statistic in accordance with the statistical method certification. The updates to the UPLs consisted of including additional available background (pre-waste) data, and the use of two future samples to reflect the semi-annual sampling frequency. The revised intrawell background concentrations for each parameter at each well are provided in **Appendix A** and **Table 4**.

The sampling results for the two semi-annual Detection monitoring events in 2019 were compared to the revised UPLs (**Table 4**). The results of these comparisons are provided on **Table 4**. In the September sampling event, one SSI over background was found for boron in NRL301B. The concentration leading to this 2019 SSI is consistent with concentrations in 2018 that were successfully shown to originate from an Alternate Source (AECOM, 2019). Thus, the Detection monitoring results for 2019 continue to be below the UPLs and/or consistent with the concentrations that were the basis for the previous Alternate Source Demonstration (AECOM, 2019).

Narrative Discussion of Transition between Monitoring Programs

Semi-annual Detection monitoring was conducted in 2019. The Detection monitoring results for 2019 continue to be below the UPLs and/or consistent with the concentrations that were the basis for the previous Alternate Source Demonstration (AECOM, 2019). Therefore, the NRL Landfill remains in Detection monitoring.

Two semi-annual Detection monitoring events will take place in 2020. The groundwater analytical data obtained in 2020 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

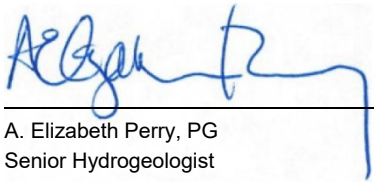
References

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

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.

Newcome, Roy, Jr. 1958, reprinted 1998. *Ground Water in the Central Basin of Tennessee*. State of Tennessee, Department of Conservation, Division of Geology, Report of Investigations No. 4.

Quality Information

Prepared by	Reviewed by	Reviewed by
		
Chris Garlington, PG Hydrogeologist	A. Elizabeth Perry, PG Senior Hydrogeologist	Gabriel W. Lang, PE Program Manager

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

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 16, 2019

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

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

DATE:	DEPT:
12/4/2019	FOSSIL AND HYDRO ENGINEERING

Document Path: Q:\DCS\Projects\L_URS\Jobs\1_Projects\TVA\Gallatin_General\EIP\11.0 GIS\generalized_hydro_gradients_lebanon_september_2019.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	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 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, 2019
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Sample Dates	Groundwater Gauging Date	Monitoring Program	Parameters Sampled	Number of Wells Sampled
April 16-23, 2019	April 15, 2019	Detection Monitoring (257.94(a))	Appendix III, major ions and field parameters	Background: 4 Upgradient: 1 Downgradient: 4
September 17-25, 2019	September 16, 2019	Detection Monitoring (257.94(a))	Appendix III, major ions and field parameters	Background: 4 Upgradient: 1 Downgradient: 4

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, 2019
CCR Rule Groundwater Monitoring
TVA Gallatin Fossil Plant
Gallatin, Tennessee

Gauging Date:	2019-04-15			2019-09-16		
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	25.65	451.93	477.58	27.46	450.12
GAF-414L	481.45	32.77	448.68	481.45	34.60	446.85
GAF-426L	506.83	45.44	461.39	506.83	51.99	454.84
GAF-427L	488.41	31.74	456.67	488.41	40.42	447.99
NRL015	546.65	88.25	458.40	546.65	90.30	456.35
NRL220	502.54	53.85	448.69	502.54	55.57	446.97
NRL221	478.90	20.08	458.82	478.90	22.26	456.64
NRL227	560.33	109.59	450.74	560.33	110.60	449.73
NRL230	511.70	53.46 (b)	458.24 (b)	511.70	56.55 (c)	455.15 (c)
NRL301B	498.15	97.72	400.43	498.15	84.20	413.95
Surface Water ID						
CUMBERLAND RIVER (a)	NA	NA	445.21	NA	NA	444.83

Notes:
AMSL - above mean sea level
ft - feet
NA - not applicable
(a) Data downloaded from TVA's iSite Central Database
(b) Measurement taken on 2019-04-17 prior to purging the well for sampling
(c) Measurement taken on 2019-09-24 prior to purging the well for sampling

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

		Monitoring Well	412L	412L	414L	414L	414L	426L	426L
		Sample Date	4/16/2019	9/19/2019	4/17/2019	4/17/2019	9/19/2019	4/17/2019	9/19/2019
		Well Location Designation	Background	Background	Background	Background	Background	Background	Background
		Sample ID	GAF-GW-412L-04162019	GAF-GW-412L-09192019	GAF-GW-414L-04172019	GAF-GW-903C-04172019	GAF-GW-414L-09192019	GAF-GW-426L-04172019	GAF-GW-426L-09192019
		Sample Type	N	N	N	FD	N	N	N
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Field Parameters									
Dissolved Oxygen	DO	MG/L	0.2	0.23	0.5		0.55	0.42	0.41
ORP	ORP	MV	-277.4	-322.7	-173.7		-165.4	-55.7	225.1
pH, Field	PHFLD	pH units	7.34	8.25	7.67		8.11	6.81	6.86
Specific Conductance, Field	CONDSPECFLD	umhos/cm	570	708	780		683	1205	729
Temperature	TEMP	deg c	15.3	17.6	15.4		17.7	15.3	16.9
Turbidity, field	TURB-FIELD	NTU	0.36	0.55	1.29		0.41	0.85	52.1
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	5.00 U
Alkalinity, Total as CaCO3	ALK	MG/L	360	308	320	308	298	396	354
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	360	308	320	308	298	396	354
Chloride	16887-00-6	MG/L	37.4	119	147	143	116	85.6	20.0
Fluoride	16984-48-8	MG/L	1.36	1.35	0.929	0.845	0.830	0.356	0.379
Sulfate	14808-79-8	MG/L	4.98	14.7	20.2 J	17.6 J	10.0	186 J	72.6
Total Dissolved Solids	TDS	MG/L	353	554	521	529	498	723	523
Metals, Total									
Boron	7440-42-8	MG/L	0.278	0.272	0.180	0.180	0.186	0.0673 J	0.0537 J
Calcium	7440-70-2	MG/L	30.3	43.3	54.1	55.3	60.4	123	131
Magnesium	7439-95-4	MG/L	19.1	24.9	24.7	25.5	27.2	31.9	22.9
Potassium	7440-09-7	MG/L	6.62	6.28	2.73	2.77	2.77	24.2	7.82
Sodium	7440-23-5	MG/L	100	135	104	107	107	69.4	31.3

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

		Monitoring Well	427L	427L	NRL015	NRL015	NRL015 Background UPL	NRL220	NRL220	NRL220 Background UPL
		Sample Date	4/18/2019	9/19/2019	4/18/2019	9/24/2019		4/18/2019	9/24/2019	
		Well Location Designation	Background	Background	Downgradient	Downgradient		Downgradient	Downgradient	
		Sample ID	GAF-GW-427L-04182019	GAF-GW-427L-09192019	GAF-GW-NRL015-04182019	GAF-GW-NRL015-09242019		GAF-GW-NRL220-04182019	GAF-GW-NRL220-09242019	
		Sample Type	N	N	N	N		N	N	
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**	**Result**		**Result**	**Result**	
Field Parameters										
Dissolved Oxygen	DO	MG/L	0.26	0.24	1.45	1.01		0.4	1.25	
ORP	ORP	MV	-22.8	-59.9	-171.4	-221.3		-352.8	-320.7	
pH, Field	PHFLD	pH units	7.08	7.09	6.99	7.29	*6.35 - 7.75	7.91	8.11	*7.50 - 9.51
Specific Conductance, Field	CONDSPECFLD	umhos/cm	612	560	998	739		1130	1144	
Temperature	TEMP	deg c	15.6	17.6	15.2	15.4		16.7	18.8	
Turbidity, field	TURB-FIELD	NTU	0.24	0.10	0.47	0.21		0.59	1.16	
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	340	313	434	413		408	427	
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	340	313	434	413		408	427	
Chloride	16887-00-6	MG/L	12.4	12.7	5.32	5.67	6.08	87.4	84.8	97.5
Fluoride	16984-48-8	MG/L	0.320	0.298	0.831	0.865	1.05	1.57	1.60	1.88
Sulfate	14808-79-8	MG/L	41.7	44.1	176	172	293	119	147	212
Total Dissolved Solids	TDS	MG/L	382	397	656	732	855	776	821	1020
Metals, Total										
Boron	7440-42-8	MG/L	0.0643 U*	0.0746 J	0.251	0.297	0.353	0.525	0.528	0.624
Calcium	7440-70-2	MG/L	86.8	97.5	121	115	129	4.23	4.14	5.58
Magnesium	7439-95-4	MG/L	28.1	30.0	64.1	60.0		2.68	2.54	
Potassium	7440-09-7	MG/L	1.83	1.76	10.2	9.63		9.73	9.62	
Sodium	7440-23-5	MG/L	11.2	11.6	48.0	44.9		317	300	

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

		Monitoring Well	NRL221	NRL221	NRL227	NRL227	NRL227 Background UPL
		Sample Date	4/18/2019	9/23/2019	4/18/2019	9/24/2019	
		Well Location Designation	Upgradient	Upgradient	Downgradient	Downgradient	
		Sample ID	GAF-GW-NRL221-04182019	GAF-GW-NRL221-09232019	GAF-GW-NRL227-04182019	GAF-GW-NRL227-09242019	
		Sample Type	N	N	N	N	
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**	**Result**	
Field Parameters							
Dissolved Oxygen	DO	MG/L	0.29	0.41	1.76	1.64	
ORP	ORP	MV	-97.4	-110.1	-181.3	-186.1	
pH, Field	PHFLD	pH units	6.85	6.73	7.14	7.19	*6.35 - 7.79
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1097	1034	930	751	
Temperature	TEMP	deg c	15.7	17.2	17.0	16.9	
Turbidity, field	TURB-FIELD	NTU	0.36	0.81	0.62	0.82	
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	410	408	454	434	
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	410	408	454	434	
Chloride	16887-00-6	MG/L	5.03	5.29	6.91	7.60	8.02
Fluoride	16984-48-8	MG/L	0.699	0.627	0.812	0.823	1.05
Sulfate	14808-79-8	MG/L	286	309	151	155	205
Total Dissolved Solids	TDS	MG/L	842	890	597	662	711
Metals, Total							
Boron	7440-42-8	MG/L	1.74	1.79	0.943	1.04	1.79
Calcium	7440-70-2	MG/L	163	168	103	103	116
Magnesium	7439-95-4	MG/L	65.4	63.2	58.0	58.2	
Potassium	7440-09-7	MG/L	6.63	6.70	11.3	12.1	
Sodium	7440-23-5	MG/L	19.2	19.0	49.8	54.6	

Table 4
Detection Monitoring Groundwater Analytical Results - North Rail Loop 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	4/17/2019	9/24/2019	9/24/2019		4/18/2019	9/24/2019	
		Well Location Designation	Downgradient	Downgradient	Downgradient		Downgradient	Downgradient	
		Sample ID	GAF-GW-NRL230-04172019	GAF-GW-NRL230-09242019	GAF-GW-903B-09242019		GAF-GW-NRL301B-04182019	GAF-GW-NRL301B-09242019	
		Sample Type	N	N	FD		N	N	
Analyte	**CAS**	**Units**	**Result**	**Result**	**Result**		**Result**	**Result**	
Field Parameters									
Dissolved Oxygen	DO	MG/L	0.41	0.77			0.3	0.99	
ORP	ORP	MV	-260.5	-261.2			-353.0	-333.2	
pH, Field	PHFLD	pH units	7.51	7.28		*6.21 - 7.60	7.41	7.43	*6.53 - 7.96
Specific Conductance, Field	CONDSPECFLD	umhos/cm	1137	1074			7220	7401	
Temperature	TEMP	deg c	17.5	16.9			15.8	21.1	
Turbidity, field	TURB-FIELD	NTU	0.88	1.52			2.16	7.56	
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	566	473	470		626	585	
Alkalinity,Bicarbonate (CaCO3)	ALKB	MG/L	566	473	470		626	585	
Chloride	16887-00-6	MG/L	32.9	29.7	29.8	43.1	2500	2410	3920
Fluoride	16984-48-8	MG/L	1.67	1.32	1.29	2.00	4.28	4.06	5.56
Sulfate	14808-79-8	MG/L	141 J	156	155	296	101 J	141	430
Total Dissolved Solids	TDS	MG/L	739	804	806	859	4470	4240	7380
Metals, Total									
Boron	7440-42-8	MG/L	0.676	0.622	0.647	0.962	1.64	**1.88**	1.68
Calcium	7440-70-2	MG/L	27.1	39.9	41.0	48.3	53.3	57.2	503
Magnesium	7439-95-4	MG/L	15.6	23.7	24.1		31.1	32.9	
Potassium	7440-09-7	MG/L	18.1	21.2	21.4		32.4	34.7	
Sodium	7440-23-5	MG/L	265	210	215		1780	1880	

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

Revised Appendix III Intra-well Stastical UPLs – North Rail Loop Landfill

Well ID	Appendix III Parameter	Number of Samples	FOD (Frequency of Detect)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Data Distribution	Background 99% UPL - 2 Future Predictions (mg/L)
Intra-well Pre-Waste Statistics (April 2015 to May 2016)							
NRL015	Boron - Total	9	9:9	0.268	0.317	Normal	0.353
	Calcium - Total	9	9:9	113	122	Normal	129
	Chloride	9	9:9	5.26	5.76	Normal	6.08
	Fluoride	9	9:9	0.916	0.993	Normal	1.05
	pH - Upper Limit	9	9:9	6.83	7.49	Normal	7.75
	pH - Lower Limit	9	9:9	-7.49	-6.83	Normal	6.35
	Sulfate	9	9:9	213	260	Normal	293
	Total Dissolved Solids	9	9:9	679	777	Normal	855
NRL220	Boron - Total	9	9:9	0.495	0.569	Normal	0.624
	Calcium - Total	9	9:9	3.26	4.67	Normal	5.58
	Chloride	9	9:9	84.6	91.5	Normal	97.5
	Fluoride	9	9:9	1.47	1.70	Normal	1.88
	pH - Upper Limit	9	9:9	8.15	9.09	Normal	9.51
	pH - Lower Limit	9	9:9	-9.09	-8.15	Normal	7.50
	Sulfate	9	9:9	86.3	160	Normal	212
	Total Dissolved Solids	9	9:9	692	925	Normal	1020
NRL221	Boron - Total	9	9:9	2.28	2.77	Normal	3.14
	Calcium - Total	9	9:9	151	171	Normal	179
	Chloride	9	9:9	4.37	4.90	Normal	5.42
	Fluoride	9	9:9	0.609	0.758	Normal	0.851
	pH - Upper Limit	9	9:9	6.64	7.12	Normal	7.46
	pH - Lower Limit	9	9:9	-7.12	-6.64	Normal	6.25
	Sulfate	9	9:9	32.6	330	Nonparametric	330
	Total Dissolved Solids	9	9:9	773	1010	Normal	1130
NRL227	Boron - Total	9	9:9	1.10	1.51	Normal	1.79
	Calcium - Total	9	9:9	96.6	109	Normal	116
	Chloride	9	9:9	7.16	7.63	Normal	8.02
	Fluoride	9	9:9	0.767	0.939	Normal	1.05
	pH - Upper Limit	9	9:9	6.84	7.52	Normal	7.79
	pH - Lower Limit	9	9:9	-7.52	-6.84	Normal	6.35
	Sulfate	9	9:9	158	186	Normal	205
	Total Dissolved Solids	9	9:9	615	679	Normal	711
NRL301B	Boron - Total	8	8:8	1.50	1.68	Nonparametric	1.68
	Calcium - Total	8	8:8	52.8	241	Lognormal	503
	Chloride	8	8:8	2580	3320	Normal	3920
	Fluoride	8	8:8	3.41	4.48	Normal	5.56
	pH - Upper Limit	8	8:8	6.86	7.51	Normal	7.96
	pH - Lower Limit	8	8:8	-7.51	-6.86	Normal	6.53
	Sulfate	8	8:8	29.0	247	Normal	430
	Total Dissolved Solids	7	7:7	4490	5980	Normal	7380
Intra-well Statistics (April 2018 to November 2018)							
NRL230	Boron - Total	8	8:8	0.506	0.731	Normal	0.962
	Calcium - Total	8	8:8	23.1	36.6	Normal	48.3
	Chloride	8	8:8	18.9	32.8	Normal	43.1
	Fluoride	8	8:8	1.37	1.68	Normal	2.00
	pH - Maximum	8	8:8	6.21	7.60	Nonparametric	7.60
	pH - Minimum	8	8:8	-7.60	-6.21	Nonparametric	6.21
	Sulfate	8	8:8	122	220	Lognormal	296
	Total Dissolved Solids	8	8:8	717	781	Normal	859

Notes:
Field Duplicates were not included in statistical calculations
Frequency of Detect (FOD) is the ratio of samples with a detection to the total number of samples collected
Data presented in this table are intrawell pre-waste statistical calculations from samples collected from April 2015 to May 2016, except for NRL230
(see 2018 Annual Report for additional details (AECOM, 2019))

AECOM is built to deliver a better world. We design, build, finance, and operate infrastructure assets for governments, businesses, and organizations in more than 150 countries. As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges. From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM had revenue of approximately $17.4 billion during fiscal year 2016. See how we deliver what others can only imagine at aecom.com and @AECOM.

AECOM
1600 Perimeter Park
Morrisville, NC 27560
T: 919.461.1100
aecom.com