2018 Annual Groundwater Monitoring and Corrective Action Report

Coffeen Landfill – CCR Unit ID 105
Coffeen Power Station
134 Cips Lane
Coffeen, Illinois 62017

Illinois Power Generating Company

January 31, 2019

OBG
Part of Ramboll

JANUARY 31, 2019 | PROJECT #70099

2018 Annual Groundwater Monitoring and Corrective Action Report

Coffeen Landfill – CCR Unit ID 105
Coffeen Power Station
Coffeen, Illinois

Prepared for:
Illinois Power Generating Company

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ACRONYMS AND ABBREVIATIONS

ASD	Alternate Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
mg/L	milligrams per liter
NRT/OBG	Natural Resource Technology, an OBG Company
OBG	O'Brien & Gere Engineers, part of Ramboll
SSI	Statistically Significant Increase
S.U.	Standard Units
TDS	Total Dissolved Solids

SECTION 1: INTRODUCTION

This report has been prepared on behalf of Illinois Power Generating Company by O'Brien & Gere Engineers, part of Ramboll (OBG), to provide the information required by the Code of Federal Regulations (CFR) found in 40 CFR 257.90(e) for the Coffeen Landfill located at Coffeen Power Station near Coffeen, Illinois.

In accordance with 40 CFR § 257.90(e), the owner or operator of an existing Coal Combustion Residuals (CCR) unit must prepare an annual groundwater monitoring and corrective action report, for the preceding calendar year, that documents the status of the groundwater monitoring and corrective action program for the CCR unit, summarizes key actions completed, describes any problems encountered, discusses actions to resolve the problems, and projects key activities for the upcoming year. At a minimum, the annual report must contain the following information, to the extent available:

1. A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit.
2. Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken.
3. In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs.
4. A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels).
5. Other information required to be included in the annual report as specified in §§ 257.90 through 257.98[1].

This report provides the required information for the Coffeen Landfill for calendar year 2018.

[1] For calendar year 2018, corrective action and other information required to be included in the annual report as specified in §§ 257.96 through 257.98 is not applicable.

SECTION 2: MONITORING AND CORRECTIVE ACTION PROGRAM STATUS

Detection Monitoring Program sampling event dates and parameters collected are provided in the detection monitoring program summary table below. One sample was collected from each background and downgradient well in the monitoring system during the sampling events in October 2017, May 2018, and October 2018. Resampling was conducted in January and August 2018 on a subset of the Appendix III parameters. Analytical data was evaluated after each event in accordance with the Statistical Analysis Plan, Coffeen Power Station, Illinois Power Generating Company (NRT/OBG, 2017a) to identify any statistically significant increases (SSIs) of Appendix III parameters over background concentrations. The dates the SSIs were evaluated are provided in the detection monitoring program summary table below.

Detection Monitoring Program Summary

Sampling Dates	Parameters Collected	SSIs	ASD Completion
October 25, 26, and 28, 2017	Appendix III	Yes	April 9, 2018
January 25, 26, and 27, 2018	SSI Parameters	Not Applicable	Not Applicable
May 10 and 11, 2018	Appendix III	No	Not Applicable
August 9, 2018	SSI Parameters	Not Applicable	Not Applicable
October 24, 25, and 26, 2018 **November 2, 2018**	Appendix III	To Be Determined	To Be Determined

Potential alternate sources were evaluated as outlined in the 40 CFR § 257.94(e)(2). An alternate source demonstrations (ASD) was completed and certified by a qualified professional engineer. The date the ASD was completed is provided in the detection monitoring program summary table. The ASD is included in Appendix A.

Statistical background values are provided in Table 1. Analytical results from the events summarized in the detection monitoring program summary table above are included in Table 2.

The Coffeen Landfill remains in the Detection Monitoring Program in accordance with 40 CFR § 257.94.

SECTION 3: KEY ACTIONS COMPLETED IN 2018

Four groundwater monitoring events were completed in 2018 under the Detection Monitoring Program. These events occurred in the months of January, May, August, October, and November, and are detailed in Section 2. One sample was collected from each background and downgradient well in the monitoring system during the sampling events in May 2018, and October/November 2018. Resampling was conducted in January and August 2018 on a subset of the Appendix III parameters. All samples were collected and analyzed in accordance with the Sampling and Analysis Plan (NRT/OBG, 2017b). All monitoring data obtained under 40 CFR §§ 257.90 through 257.98 (as applicable) in 2018 are presented in Table 2.

The groundwater monitoring system, including the CCR unit and all background and downgradient monitoring wells, is presented in Figure 1.

SECTION 4: PROBLEMS ENCOUNTERED AND ACTIONS TO RESOLVE THE PROBLEMS

No problems were encountered with the groundwater monitoring program during 2018. Groundwater samples were collected and analyzed in accordance with the Sampling and Analysis Plan (NRT/OBG, 2017b), and all data was accepted.

SECTION 5: KEY ACTIVITIES PLANNED FOR 2019

The following key activities are planned for 2019:

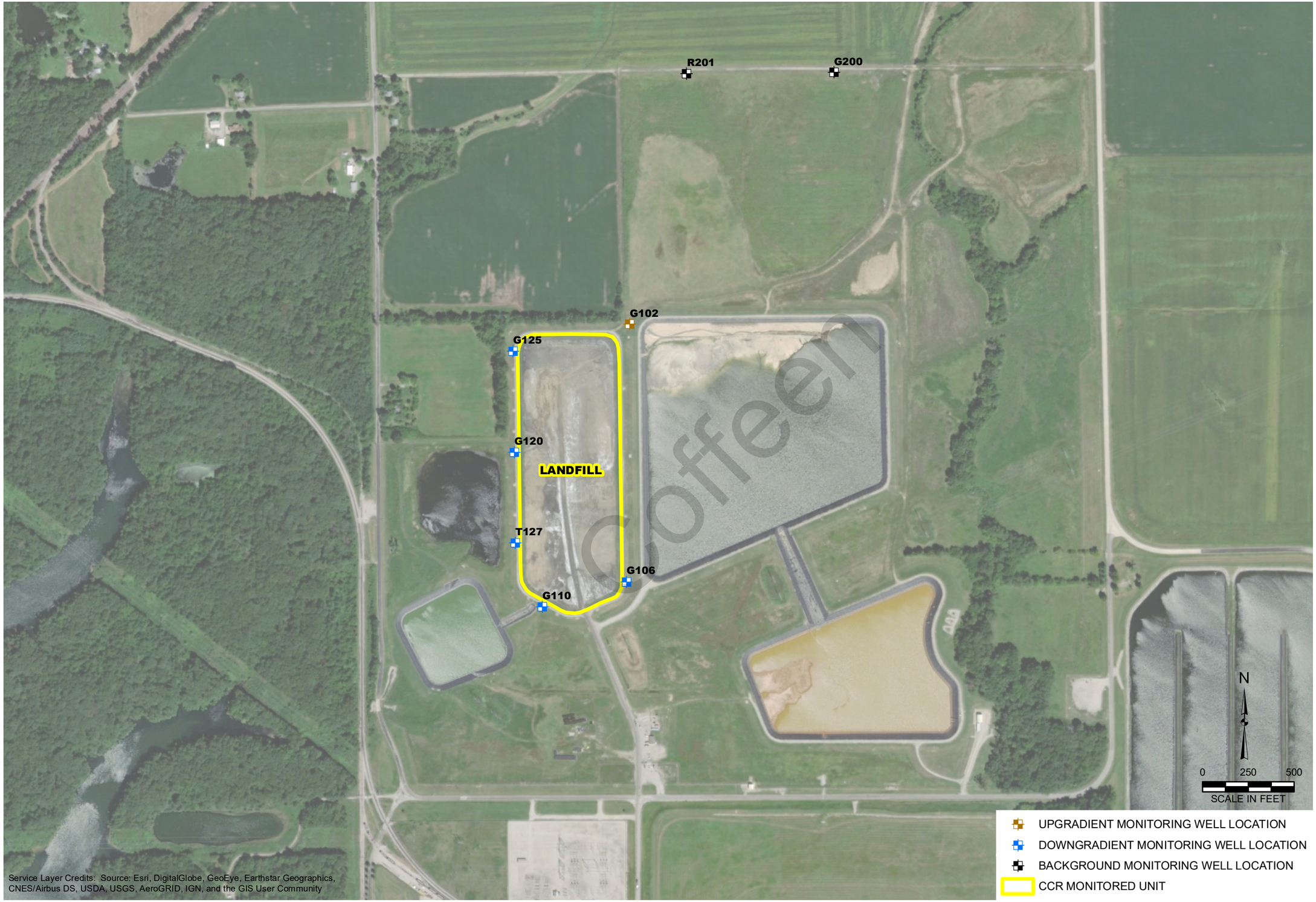
- Continuation of the Detection Monitoring Program with semi-annual sampling scheduled for the first and third quarters of 2019.
- Complete evaluation of analytical data from the downgradient wells, using background data to determine whether an SSI of Appendix III parameters over background concentrations has occurred.
- If an SSI is identified, potential alternate sources (i.e., a source other than the CCR unit caused the SSI or that SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality) will be evaluated. If an alternate source is demonstrated to be the cause of the SSI, a written demonstration will be completed within 90 days of SSI determination and included in the annual groundwater monitoring and corrective action report for 2019.
  - If an alternate source(s) is not identified to be the cause of the SSI, the applicable requirements of 40 CFR §§ 257.94 through 257.98 (e.g., assessment monitoring) as may apply in 2019 will be met, including associated recordkeeping/notifications required by 40 CFR §§ 257.105 through 257.108.

REFERENCES

Natural Resource Technology, an OBG Company, 2017a, Statistical Analysis Plan, Coffeen Power Station, Newton Power Station, Illinois Power Generating Company, October 17, 2017.

Natural Resource Technology, an OBG Company, 2017b, Sampling and Analysis Plan, Coffeen Landfill, Coffeen Power Station, Coffeen, Illinois, Project No. 2285, Revision 0, October 17, 2017.

Figures



GROUNDWATER SAMPLING WELL LOCATION MAP
COFFEEN LANDFILL
UNIT ID: 105

2018 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
VISTRA CCR RULE GROUNDWATER MONITORING
COFFEEN POWER STATION
COFFEEN, ILLINOIS

DRAWN BY/DATE:
SDS 11/28/18
REVIEWED BY/DATE:
RAB 1/24/19
APPROVED BY/DATE:
KLT 1/28/19

PROJECT NO: 70099

FIGURE NO: 1

OBG
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Tables

Table 1. Statistical Background Values

2018 Annual Groundwater Monitoring and Corrective Action Report

Coffeen Power Station

Unit ID 105 - Coffeen Landfill

Parameter	Statistical Background Value
Appendix III	
Boron (mg/L)	0.39
Calcium (mg/L)	139.963
Chloride (mg/L)	96
Fluoride (mg/L)	0.5
pH (S.U.)	6.9 / 7.4
Sulfate (mg/L)	329.4
TDS (mg/L)	891

[O: KLS 8/28/18, C: RAB 8/28/18]

Notes:

mg/L = milligrams per liter

S.U. = Standard Units

TDS = Total Dissolved Solids

Table 2. Appendix III Analytical Results

2018 Annual Groundwater Monitoring and Corrective Action Report
Coffeen Power Station
Unit ID 105 - Coffeen Landfill

Sample Location	Date Sampled	B, total (mg/L)	Ca, total (mg/L)	Cl, total (mg/L)	F, total (mg/L)	pH (field) (S.U.)	SO4, total (mg/L)	TDS (mg/L)
Background / Upgradient Monitoring Wells								
G102	10/25/2017	0.014	56	54	0.366	7.1	130	540
	1/26/2018	NA	NA	46	<0.25	7.1	NA	NA
	5/10/2018	<0.01	56	14	0.295	7.2	74	330
	10/24/2018	0.018	85	40	0.322	7.0	130	510
G200	10/28/2017	0.340	81	65	0.328	7.2	100	520
	1/25/2018	NA	NA	71	0.303	7.2	NA	NA
	5/11/2018	<0.01	90	85	<0.25	7.0	100	460
	11/2/2018	0.011	95	61	0.391	7.0	100	480
R201	10/28/2017	0.017	93	30	0.380	7.1	89	660
	1/25/2018	NA	NA	31	0.338	7.0	NA	NA
	5/11/2018	<0.01	87	54	0.306	7.1	190	640
	11/2/2018	<0.01	82	24	0.419	7.1	110	470
Downgradient Monitoring Wells								
G106	10/25/2017	<0.01	72	48	0.470	7.3	45	410
	5/10/2018	<0.01	73	38	0.516	7.0	88	420
	8/9/2018	NA	NA	NA	0.460	7.0	NA	NA
	10/24/2018	0.014	85	35	0.441	6.8	75	480
G110	10/26/2017	<0.01	75	43	0.497	6.8	82	520
	1/26/2018	NA	NA	NA	NA	7.1	NA	NA
	5/10/2018	<0.01	82	44	0.354	6.9	83	470
	10/26/2018	<0.01	95	47	0.506	6.8	84	490
G120	10/26/2017	<0.01	81	100	0.431	7.1	34	500
	1/26/2018	NA	NA	100	NA	7.0	NA	NA
	5/10/2018	<0.01	77	94	0.344	7.2	39	440
	10/25/2018	0.028	92	100	0.362	7.2	34	460
G125	10/26/2017	<0.01	62	87	0.502	6.9	67	490
	1/26/2018	NA	NA	NA	0.420	7.1	NA	NA
	5/10/2018	<0.01	66	95	0.332	6.9	70	450
	10/25/2018	0.018	71	92	0.434	7.1	64	480
T127	10/26/2017	<0.01	70	53	0.557	7.1	93	530
	1/27/2018	NA	NA	NA	0.456	7.0	NA	NA
	5/10/2018	0.02	100	52	0.374	7.1	89	440
	10/26/2018	<0.01	81	56	0.598	7.2	84	450

[O: RAB 12/26/18, C: JQW 12/27/18][U: RAB 1/26/19]

Notes:

mg/L = milligrams per liter
NA = Not Analyzed
S.U. = Standard Units
TDS = Total Dissolved Solids
< = concentration is less than the reporting limit

Appendix A

Alternate Source Demonstration

April 9, 2018

This alternate source demonstration (ASD) report has been prepared on behalf of Illinois Power Generating Company by O'Brien & Gere Engineers, Inc. (OBG) to provide pertinent information pursuant to 40 CFR § 257.94(e)(2) for the Coffeen Power Station Landfill, located near Coffeen, Illinois.

Initial background groundwater monitoring consisting of a minimum of eight samples as required under 40 CFR § 257.94(b) was initiated in November 2015 and completed prior to October 17, 2017. The first semi-annual detection monitoring sample was collected on October 25 - 28, 2017. Statistical analysis of the first detection monitoring sample for statistically significant increases (SSIs) of 40 CFR Part 257 Appendix III parameters over background concentrations was completed within 90 days of sample collection and receipt of sample results. That determination identified SSIs at downgradient monitoring wells as follows:

- Chloride at well G120
- Fluoride at wells G125 and T127
- pH less than the background lower prediction limit at well G110

In accordance with the Statistical Analysis Plan,[1] to verify these SSIs, wells G110, G120, G125, and T127 were resampled on January 25-27, 2018 and analyzed for only the SSI parameters. Following evaluation of analytical data from the resamples for SSIs, only the following SSI remained:

- Chloride at well G120

40 CFR § 257.94(e)(2) allows the owner or operator 90 days from the date of an SSI determination to complete a written demonstration that a source other than the CCR unit caused the SSI or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality ("alternate source demonstration"). Pursuant to 40 CFR § 257.94(e)(2), the following demonstrates that the SSI for chloride, as previously determined on January 9, 2018, is not due to the Coffeen Landfill, but an alternate source. Multiple lines of evidence support this as described below. This ASD was completed within 90 days of determination of the SSIs (April 9, 2018) as required by 40 CFR § 257.94(e)(2).

ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

As allowed by 40 CFR § 257.94(e)(2), this ASD demonstrates that sources other than the Coffeen Landfill (the CCR unit) caused the SSI or that the apparent SSI was a result of natural variation in groundwater quality. Lines of evidence (LOE) supporting this ASD include the following:

1. Coffeen Landfill leachate is not the source because it is not in contact with groundwater based upon analysis of ionic composition in samples of leachate and groundwater.
2. Chloride concentrations in groundwater at G120 have not increased since CCR was first placed in the Coffeen Landfill.
3. Concentrations of boron and sulfate, common indicators for CCR impacts to groundwater, in the downgradient wells are stable and at, or below, concentrations in the background wells.

[1] Natural Resource Technology, an OBG Company, Statistical Analysis Plan, Coffeen Power Station, Newton Power Station, Illinois Power Generating Company, October 17, 2017.

These lines of evidence are described and supported in greater detail below. Monitoring wells and leachate sample locations are shown on Figure 1.

LOE #1: COFFEEN LANDFILL LEACHATE IS NOT THE SOURCE BECAUSE IT IS NOT IN CONTACT WITH GROUNDWATER BASED UPON ANALYSIS OF IONIC COMPOSITION IN SAMPLES OF LEACHATE AND GROUNDWATER

Piper diagrams graphically represent ionic composition of aqueous solutions. Figure 2 is a Piper diagram that includes the ionic composition of groundwater in the background and downgradient wells, as well as samples of leachate collected from leachate wells and samples collected from the underdrain in the Coffeen Landfill. The groupings identified are shown in the green and purple ellipses. These are discussed in more detail below.

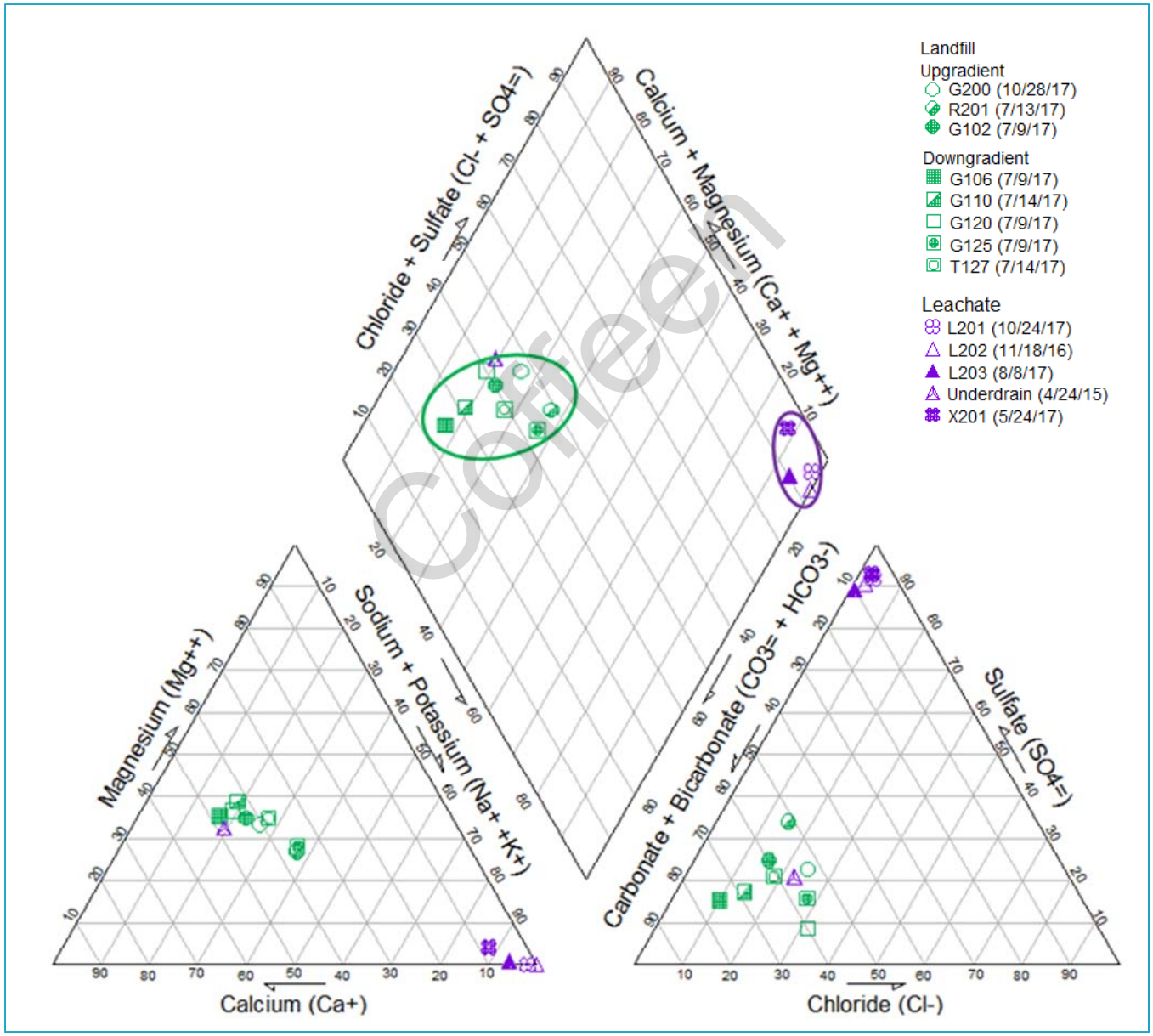


Figure 2. Piper diagram showing ionic composition for groundwater samples collected from G102, G106, G110, G120, G125, G200, R201, T127, and leachate samples collected from L201, L202, L203, X201, and samples collected from the Coffeen Landfill underdrain

The ionic characteristics of these samples are provided in Table 1 below:

Grouping	Green Ellipse		Purple Ellipse	
Locations	Downgradient wells, background wells, and underdrain		Leachate	
	G200	G106	G125	L201
	R201	G110	T127	L202
	G102	G120	Underdrain	L203
				X201
Dominant Cation	No dominant cation		Very high sodium-potassium	
Dominant Anion	Moderately high carbonate-bicarbonate		Very high sulfate	

Table 1. Summary of Ionic Classification

The samples in each ellipse are very tightly grouped, indicating very similar ionic composition. The tight groupings, and the lack of points between the groups, indicates that the two groups are not mixing and that leachate is not in contact with either the groundwater or the underdrain. The Coffeen Landfill is constructed with a composite liner with leachate collection system that meets or exceeds the landfill liner performance standards of 40 CFR § 257.70.

LOE #2: CHLORIDE CONCENTRATIONS IN GROUNDWATER AT G120 HAVE NOT INCREASED SINCE CCR WAS FIRST PLACED IN THE COFFEEN LANDFILL

The time series presented in Figure 3 includes dissolved chloride concentrations in samples of groundwater collected from G120 and Coffeen Landfill leachate, both collected since 2010, and total chloride concentrations in samples of groundwater collected from G120 since 2015.

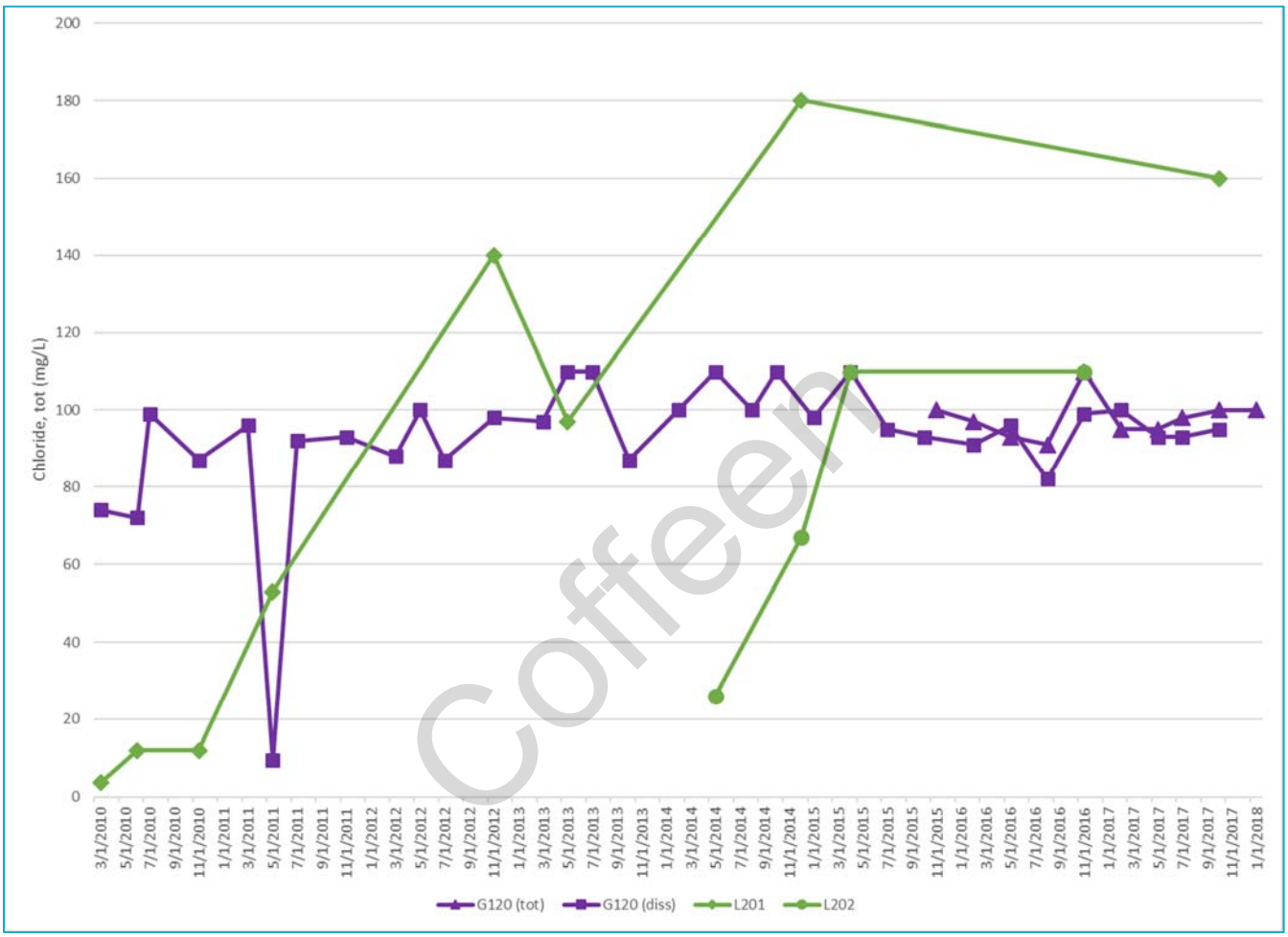


Figure 3. Time series with total & dissolved Cl concentrations in groundwater samples collected from G120, and leachate samples collected from L201 and L202

Figure 3 demonstrates the following:

- Total chloride concentrations in groundwater collected from G120 from 2015-2017 are similar to the dissolved concentrations, indicating the dissolved concentrations are representative of total concentrations prior to 2015.
- Chloride concentrations in groundwater at well G120 have remained stable relative to chloride concentrations in leachate since 2010 when CCR disposal at the Coffeen Landfill commenced. A trend analysis (linear regression) was performed (Attachment A) to confirm that the chloride concentrations in groundwater at G120 are neither increasing or decreasing. An increasing trend in chloride concentrations in groundwater would be expected if leachate was being released from the Coffeen Landfill to groundwater.

LOE #3: CONCENTRATIONS OF BORON AND SULFATE, COMMON INDICATORS FOR CCR IMPACTS TO GROUNDWATER, IN THE DOWNGRADIENT WELLS ARE STABLE AND AT, OR BELOW, CONCENTRATIONS IN THE BACKGROUND WELLS

Boron and sulfate are common indicators of CCR impacts to groundwater due to their leachability from CCR and mobility in groundwater; however, downgradient concentrations of both are at, or below, concentrations in background wells (and upper prediction limits [UPLs]) as shown in Figures 4 and 5.

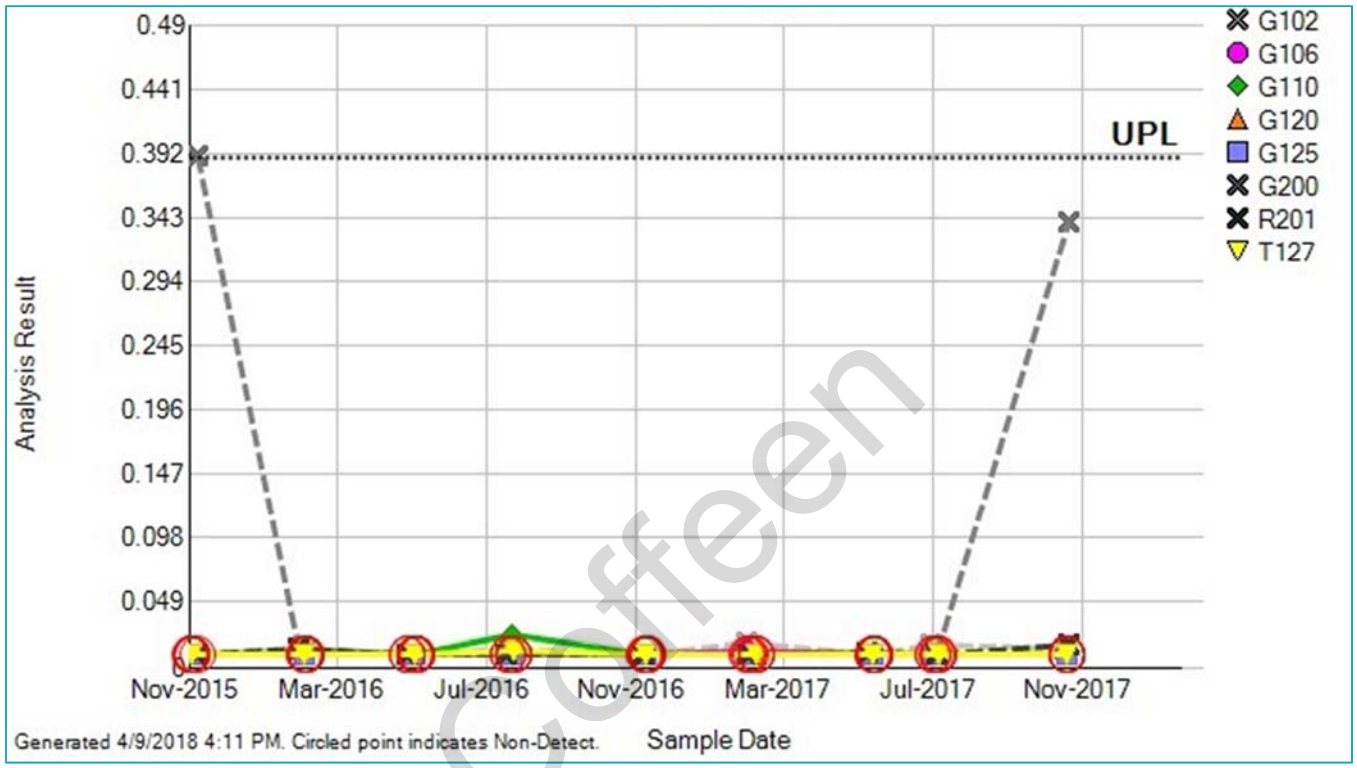


Figure 4. Boron time series

Figure 4 demonstrates the following about the downgradient wells:

- Boron concentrations are very near or below detection limits. As listed in the statistical summary provided in Attachment B (rightmost column), boron was not detected in 89 to 100 percent of the samples at each well. Only 4 of 45 downgradient water samples had a detected boron concentration.
- The median boron concentration at each of the five downgradient wells was 0.010 mg/L, or approximately four times lower than the UPL for boron.
- Boron concentrations are very stable as evident by the lack of detects.

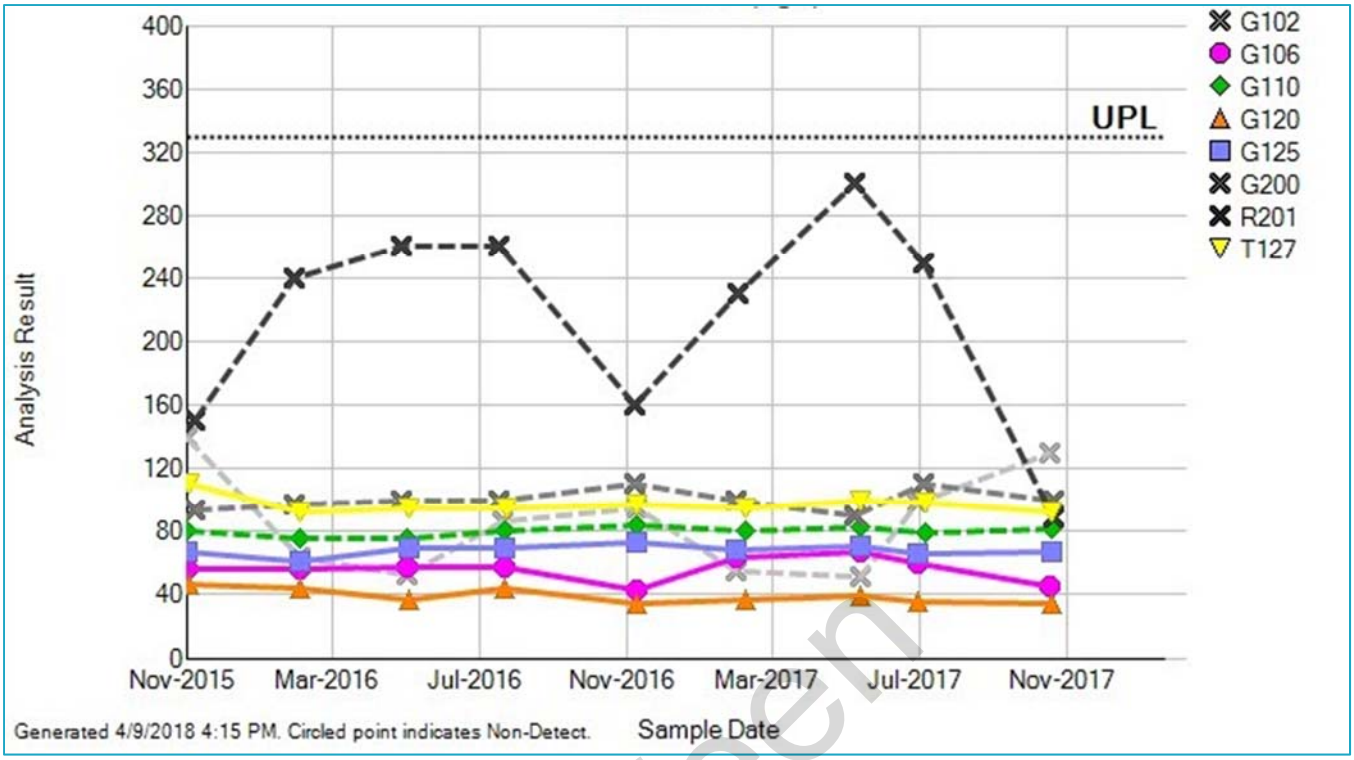


Figure 5. Sulfate time series

Sulfate concentrations in downgradient wells versus background wells are shown on Figure 5. All sulfate concentrations in downgradient wells are substantially below the UPL of 329.4 mg/L, determined from concentrations in background monitoring wells G200 and R201. Maximum sulfate concentrations measured in groundwater at downgradient wells in 2015-2017 ranged from 47 to 110 mg/L, or three to seven times lower than the UPL.

Sulfate is very stable in downgradient wells. Linear regression lines calculated for the data at each monitoring well (straight lines with formulas as shown on Figure 6) show that concentrations from 2015 to 2017 have slight upward or downward slopes, meaning that concentrations over time may be increasing or decreasing. To evaluate these slopes, a Mann-Kendall trend analysis test (results provided in Attachment C) was performed to determine if these upward or downward slopes were statistically significant. None of the slopes (i.e. trends) were determined to be statistically significant using the Mann-Kendall test, except for the downward slope at well G120. The downward trend of sulfate at G120 is a significant trend based on the Mann-Kendall test; however, this downgradient well has the lowest sulfate concentrations of all CCR monitoring wells at the Coffeen Landfill.

The elevated chloride concentration in ground water is surmised to be from either naturally occurring conditions or potential anthropogenic impacts located upgradient (north) of the Coffeen Power Station, or a combination of both.

Figure 6 – Sulfate trends with linear regression lines at downgradient wells

Based on these lines of evidence, it has been demonstrated that the chloride SSI in G120 is not due to the Coffeen Landfill.

This information serves as the written alternate source demonstration report prepared in accordance with 40 CFR § 257.94(e)(2) that the SSI observed during the detection monitoring program was not due to the CCR unit, but was from naturally occurring conditions and/or potential anthropogenic impacts located upgradient (north) of the Coffeen Power Plant. Therefore, an assessment monitoring program is not required and the Coffeen Landfill will remain in detection monitoring.

Attachment A Chloride Trend Analysis, Monitoring Well G120
Attachment B Boron Statistical Summary for Downgradient Monitoring Wells
Attachment C Sulfate Trend Analysis for Downgradient Monitoring Wells

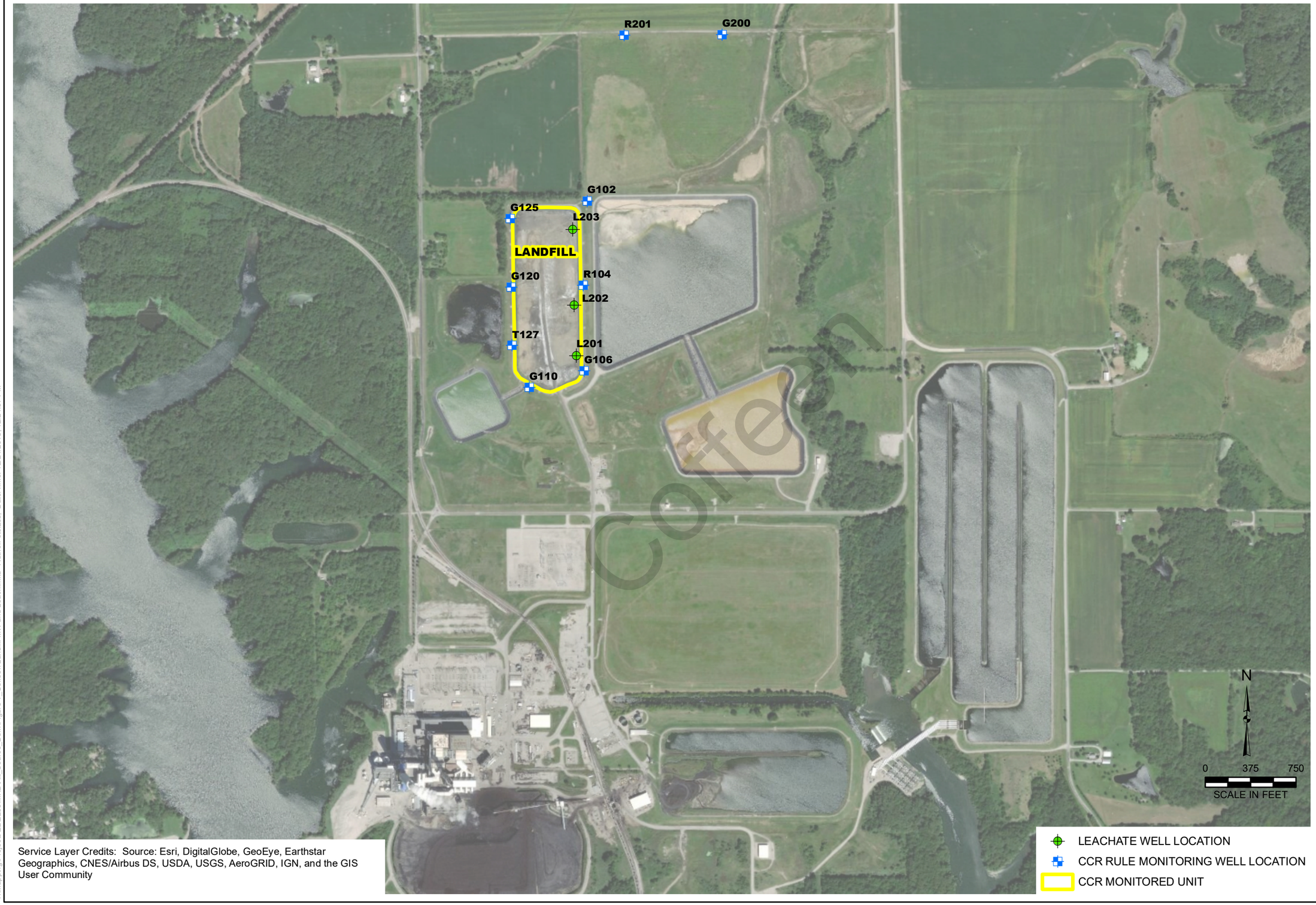
I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
O'Brien & Gere Engineers, Inc.
Date: April 9, 2018

I, Nicole M. Pagano, a professional geologist in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Nicole M. Pagano
Professional Geologist
196-000750
O'Brien & Gere Engineers, Inc.
Date: April 9, 2018

Figures



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SDS 3/29/18
REVIEWED BY/DATE:
NMP 3/29/18
APPROVED BY/DATE:
NMP 3/30/18

MONITORING WELL AND LEACHATE LOCATION MAP
COFFEEN LANDFILL

ALTERNATE SOURCE DEMONSTRATION 2017
COFFEEN POWER STATION
COFFEEN, ILLINOIS

PROJECT NO: 67719

FIGURE NO: 1

Attachment A

Chloride Trend Analysis, Monitoring Well G120

Coffeen Landfill
Linear Regression of Conc vs. Time

User Supplied Information

Date Range:	**11/16/2015 to 10/30/2017**	**Option for LT Pts:**	**x 1.00**
Confidence Level:	**95.00%**	**Slope Test:**	**slope > 0**
Compliance Locations:	**G120**		

B1_Year

Based on equation c = b0 + b1 * t

Location: **G120** Type: Class:

Parameter	Code	Units	Number of Samples	Time Units
Chloride, total	00940	mg/L	9	year

Intercept, b0	Slope, b1	R square	Test statistic for slope, Ts	Critical Value, Tcr	P level of test
0.954	0.82759	0.010	0.2638	1.8946	0.6002

Test Results: The test hypothesis of slope (slope > 0) is rejected.

Coffeen Landfill
Linear Regression of Conc vs. Time

User Supplied Information

Date Range:	**11/16/2015 to 10/30/2017**	**Option for LT Pts:**	**x 1.00**
Confidence Level:	**95.00%**	**Slope Test:**	**slope < 0**
Compliance Locations:	**G120**		

B1_Year

Based on equation c = b0 + b1 * t

Location: **G120** Type: Class:

Parameter	Code	Units	Number of Samples	Time Units
Chloride, total	00940	mg/L	9	year

Intercept, b0	Slope, b1	R square	Test statistic for slope, Ts	Critical Value, Tcr	P level of test
0.954	0.82759	0.010	0.2638	-1.8946	0.3998

Test Results: The test hypothesis of slope (slope < 0) is rejected.

Attachment B

Boron Statistical Summary for Downgradient Monitoring Wells

Coffeen Landfill
Statistical Summary for Multiple Parameters (100)

User Supplied Information

Date Range: 11/16/2015 to 10/30/2017 **Option for LT Pts: x 1.00**
Locations: G106,G110,G120,G125,T127
Parameter **Units**
B, tot **mg/L**

Location	Class	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
T127	Compliance	9	0.010	0.010	0.013	0.010	0.001	0.00	No / No	88.89
G125	Compliance	9	0.010	0.010	0.010	0.010	0.000	0.00	No / No	100.00
G120	Compliance	9	0.010	0.010	0.010	0.010	0.000	0.00	No / No	88.89
G110	Compliance	9	0.012	0.010	0.025	0.010	0.005	0.00	No / No	88.89
G106	Compliance	9	0.010	0.010	0.012	0.010	0.001	0.00	No / No	88.89

Shapiro-Wilk Normality test performed at 0.05 significance level.

Attachment C

Sulfate Trend Analysis for Downgradient Monitoring Wells

Coffeen Landfill
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G106**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 10/01/2015 to 12/30/2017		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	-0.001670	mg/L per day
R-Squared error of fit:	0.002693	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.006283	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.023745	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.019853	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.738
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Coffeen Landfill
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G110**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 10/01/2015 to 12/30/2017		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.006042	mg/L per day
R-Squared error of fit:	0.277955	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.005636	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.002513	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.013474	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.963
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Coffeen Landfill
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G120**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 10/01/2015 to 12/30/2017		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	-0.015044	mg/L per day
R-Squared error of fit:	0.617320	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	-0.016006	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.023346	mg/L per day
Upper Confidence Limit of Slope, M2+1:	-0.003485	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	-2.214
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	Downward

Coffeen Landfill
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**G125**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 10/01/2015 to 12/30/2017		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	0.003528	mg/L per day
R-Squared error of fit:	0.061849	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.002823	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.010056	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.012478	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.210
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

Coffeen Landfill
Mann-Kendall Trend Analysis

User Supplied Information

Location ID:	**T127**	**Parameter Code:**	**00945**
Location Class:		**Parameter:**	**SO4, tot**
Location Type:		**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**1 month(s)**
Date Range: 10/01/2015 to 12/30/2017		**Limit Name:**	
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	-0.007542	mg/L per day
R-Squared error of fit:	0.115501	

Sen's Non-parametric estimate of the slope (One-Sided Test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.021768	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.013002	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	0.000
Z test:	1.645
At the 95.0 % Confidence Level (One-Sided Test):	None

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