Prepared for
Illinois Power Resources Generating, LLC

Date
January 31, 2021

Project No.
1940074916

2020 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

DUCK CREEK GMF POND, DUCK CREEK POWER STATION

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2020 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK GMF POND, DUCK CREEK POWER STATION

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Prepared by	**Kristen L. Theesfeld**
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Approved by	**Lauren D. Cook**
Description	**Annual Report in Support of the CCR Rule Groundwater Monitoring Program**

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ACRONYMS AND ABBREVIATIONS

40 C.F.R.	Title 40 of the Code of Federal Regulations
ASD	Alternate Source Demonstration
CCR	Coal Combustion Residuals
CMA	Corrective Measures Assessment
GMF	Gypsum Management Facility
GWPS	Groundwater Protection Standards
SAP	Sampling and Analysis Plan
SSI	Statistically Significant Increase

EXECUTIVE SUMMARY

This report has been prepared to provide the information required by Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.90(e) for the Duck Creek Gypsum Management Facility (GMF) Pond located at Duck Creek Power Station near Canton, Illinois.

Groundwater is being monitored at Duck Creek GMF Pond in accordance with the Detection Monitoring Program requirements specified in 40 C.F.R. § 257.94.

No changes were made to the monitoring system in 2020 (no wells were installed or decommissioned).

The following Statistically Significant Increases (SSIs) of 40 C.F.R. Part 257 Appendix III parameter concentrations greater than background concentrations were determined:

- Calcium at wells G54S, G57S, and G60S
- Sulfate at well G60S
- Total Dissolved Solids at wells G54S, G57S, and G60S

Alternate Source Demonstrations (ASDs) were completed for the SSIs referenced above and Duck Creek GMF Pond remains in the Detection Monitoring Program.

1. INTRODUCTION

This report has been prepared by Ramboll on behalf of Illinois Power Resources Generating, LLC, to provide the information required by 40 C.F.R. § 257.90(e) for Duck Creek GMF Pond located at Duck Creek Power Station near Canton, Illinois.

In accordance with 40 C.F.R. § 257.90(e), the owner or operator of a 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 SSI relative to background levels).
5. Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.
6. A section at the beginning of the annual report that provides an overview of the current status of groundwater monitoring and corrective action programs for the CCR unit. At a minimum, the summary must specify all of the following:
    i. At the start of the current annual reporting period, whether the CCR unit was operating under the detection monitoring program in §257.94 or the assessment monitoring program in §257.95.
    ii. At the end of the current annual reporting period, whether the CCR unit was operating under the detection monitoring program in §257.94 or the assessment monitoring program in §257.95.
    iii. If it was determined that there was a SSI over background for one or more constituents listed in Appendix III of §257 pursuant to §257.94(e):
        A. Identify those constituents listed in Appendix III of §257 and the names of the monitoring wells associated with the SSI(s).
        B. Provide the date when the assessment monitoring program was initiated for the CCR unit.

iv. If it was determined that there was a Statistically Significant Level (SSL) above the Groundwater Protection Standard (GWPS) for one or more constituents listed in Appendix IV of §257 pursuant to §257.95(g) include all of the following:

   A. Identify those constituents listed in Appendix IV of §257 and the names of the monitoring wells associated with the SSL(s).

   B. Provide the date when the Corrective Measures Assessment (CMA) was initiated for the CCR unit.

   C. Provide the date when the public meeting was held for CMA for the CCR unit.

   D. Provide the date when the CMA was completed for the CCR unit.

v. Whether a remedy was selected pursuant to §257.97 during the current annual reporting period, and if so, the date of remedy selection.

vi. Whether remedial activities were initiated or are ongoing pursuant to §257.98 during the current annual reporting period.

This report provides the required information for Duck Creek GMF Pond for calendar year 2020.

2. MONITORING AND CORRECTIVE ACTION PROGRAM STATUS

No changes have occurred to the monitoring program status in calendar year 2020, and Duck Creek GMF Pond remains in the Detection Monitoring Program in accordance with 40 C.F.R. § 257.94.

3. KEY ACTIONS COMPLETED IN 2020

The Detection Monitoring Program is summarized in Table A. The groundwater monitoring system, including the CCR unit and all background and downgradient monitoring wells, is presented in Figure 1. No changes were made to the monitoring system in 2020. In general, one groundwater sample was collected from each background and downgradient well during each monitoring event.[1] All samples were collected and analyzed in accordance with the Sampling and Analysis Plan (SAP) (NRT/OBG, 2018). All monitoring data obtained under 40 C.F.R. §§ 257.90 through 257.98 (as applicable) in 2020, and analytical results for the July 2019 sampling event, are presented in Table 1. Analytical data were evaluated in accordance with the Statistical Analysis Plan (NRT/OBG, 2017) to determine any SSIs of Appendix III parameters relative to background concentrations.

Statistical background values are provided in Table 2.

[1] Sampling was limited to G57S and G60S during the November 2020 sampling event to confirm Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event to confirm SSIs, as allowed by the Statistical Analysis Plan.

Table A – 2019–2020 Detection Monitoring Program Summary

Sampling Date	Analytical Data Receipt Date	Parameters Collected	SSI(s)	SSI(s) Determination Date	ASD Completion Date
July 8 - 15, 2019	October 28, 2019	Appendix III	Calcium at wells G54S, G57S, and G60S; Sulfate at well G60S; Total Dissolved Solids at wells G54S, G57S, and G60S	January 27, 2020	April 27, 2020
January 6 - 15, 2020	April 16, 2020	Appendix III	Calcium at wells G54S, G57S, and G60S; Sulfate at well G60S; Total Dissolved Solids at wells G54S, G57S, and G60S	July 15, 2020	October 13, 2020
August 10 - 11, 2020	October 15, 2020	Appendix III	TBD	TBD	TBD
November 17, 2020 [1]	December 7, 2020	Appendix III Greater than Background [2]	NA	NA	NA

Notes:
NA: Not Applicable
TBD: To Be Determined
1. Sampling was limited to G57S and G60S during the November 2020 sampling event to confirm Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event to confirm SSIs, as allowed by the Statistical Analysis Plan.
2. Groundwater sample analysis was limited to Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event to confirm SSIs, as allowed by the Statistical Analysis Plan.

4. PROBLEMS ENCOUNTERED AND ACTIONS TO RESOLVE THE PROBLEMS

No problems were encountered with the Groundwater Monitoring Program during 2020. Groundwater samples were collected and analyzed in accordance with the SAP (NRT/OBG, 2018), and all data were accepted.

5. KEY ACTIVITIES PLANNED FOR 2021

The following key activities are planned for 2021:

- Continuation of the Detection Monitoring Program with semi-annual sampling scheduled for the first and third quarters of 2021.
- Complete evaluation of analytical data from the downgradient wells, using background data to determine whether an SSI of Appendix III parameters detected at concentrations greater than 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 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 2021 Annual Groundwater Monitoring and Corrective Action Report.
- If an alternate source(s) is not identified to be the cause of the SSI, the applicable requirements of 40 C.F.R. §§ 257.94 through 257.98 as may apply in 2021 (*e.g.*, Assessment Monitoring) will be met, including associated recordkeeping/notifications required by 40 C.F.R. §§ 257.105 through 257.108.

6. REFERENCES

Natural Resource Technology, an OBG Company (NRT/OBG), 2018, Sampling and Analysis Plan, Duck Creek GMF Pond, Duck Creek Power Station, Canton, Illinois, Project No. 2285, Revision 1, June 29, 2018.

Natural Resource Technology, an OBG Company (NRT/OBG), 2017. Statistical Analysis Plan, Duck Creek Power Station, Edwards Power Station, Illinois Power Resources Generating, LLC, October 17, 2017.

TABLES

TABLE 1.
ANALYTICAL RESULTS - GROUNDWATER ELEVATION AND APPENDIX III PARAMETERS
2020 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK POWER STATION
203 - GMF POND
CANTON, IL

Well ID	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Date	Depth to Groundwater (ft) 6020A	Groundwater Elevation (ft NAVD88) 6020A	Boron, total (mg/L) 6020A	Calcium, total (mg/L) 6020A	Chloride, total (mg/L) 9251	Fluoride, total (mg/L) 9214	pH (field) (STD) SM4500 H+B	Sulfate, total (mg/L) 9036	Total Dissolved Solids (mg/L) SM 2540C
G02S Background	40.51287877	-89.9911051	7/1/2019	10.87	611.06							
			7/8/2019			0.05	96	<5	0.394	7.0	<1	420
			1/3/2020	7.22	614.71							
			1/6/2020			0.044	100	<5	0.476	6.6	<1	440
			8/6/2020	11.04	610.89							
			8/11/2020			0.049	97	<5	0.27	6.4	<1	420
G50S Background	40.50867209	-89.99060666	7/1/2019	11.76	611.89							
			7/8/2019			0.018	88	9.6	0.351	7.4	34	420
			1/2/2020	11.4	612.25							
			1/13/2020			0.018	97	8.6	0.311	6.9	30	360
			8/6/2020	15.33	608.32							
			8/10/2020			0.016	91	8.5	0.28	6.8	38	370
G51S Background	40.50656002	-89.99086391	7/1/2019	12.72	606.94							
			7/8/2019			0.039	100	16	0.332	7.0	48	460
			1/2/2020	9.39	610.27							
			1/14/2020			0.016	100	13	<0.25	7.1	53	440
			8/6/2020	16.02	603.64							
			8/10/2020			0.01	99	8.2	<0.25	6.9	26	390
G54S Downgradient	40.50452516	-89.98894002	7/1/2019	35.02	587.96							
			7/15/2019			0.057	130	1.5	<0.25	7.1	46	590
			1/2/2020	33.72	589.26							
			1/14/2020			0.043	150	2.6	<0.25	6.9	45	620
			8/6/2020	31.59	591.39							
			8/10/2020			0.034	140	1.1	<0.25	6.8	21	460
G57S Downgradient	40.50560798	-89.98704316	7/1/2019	18.55	604.21							
			7/15/2019			0.055	140	18	0.327	7.1	55	680
			1/2/2020	21.43	601.33							
			1/14/2020			0.011	150	20	<0.25	6.8	55	700
			8/6/2020	22.11	600.65							
			8/10/2020			<0.01	150	15	0.292	6.6	51	600
			11/16/2020	26.48	596.28							

TABLE 1.
ANALYTICAL RESULTS - GROUNDWATER ELEVATION AND APPENDIX III PARAMETERS
2020 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK POWER STATION
203 - GMF POND
CANTON, IL

Well ID	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Date	Depth to Groundwater (ft) 6020A	Groundwater Elevation (ft NAVD88) 6020A	Boron, total (mg/L) 6020A	Calcium, total (mg/L) 6020A	Chloride, total (mg/L) 9251	Fluoride, total (mg/L) 9214	pH (field) (STD) SM4500 H+B	Sulfate, total (mg/L) 9036	Total Dissolved Solids (mg/L) SM 2540C
	40.50560798	-89.98704316	11/17/2020							7.0		
G60S Downgradient	40.50673174	-89.98681452	7/1/2019	25.22	589.81							
			7/15/2019			0.024	140	10	0.319	6.8	190	800
			1/2/2020	25.82	589.21							
			1/14/2020			0.026	150	11	<0.25	6.7	200	790
			8/6/2020	26.15	588.88							
			8/10/2020			0.015	140	6.8	<0.25	6.6	120	600
			11/16/2020	27.37	587.66							
			11/17/2020							6.8	110	630
G64S Downgradient	40.50836535	-89.98701092	7/1/2019	23.2	599.86							
			7/15/2019			0.023	100	3.2	0.333	7.2	25	490
			1/2/2020	24.46	598.6							
			1/15/2020			0.024	110	3.4	0.34	6.8	21	480
			8/6/2020	24.34	598.72							
			8/11/2020			0.019	100	3.7	0.287	7.0	26	440

Notes:
40 C.F.R. = Title 40 of the Code of Federal Regulations
ft = foot/feet
mg/L = milligrams per liter
NAVD88 = North American Vertical Datum of 1988
S.U. = Standard Units
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method; estimated concentrations below the reporting limit and associated qualifiers are not provided since not utilized in statistics to determine Statistically Significant Increases (SSIs) over background.
4-digit numbers below parameter represent SW-846 analytical methods and alpha-numeric values that begin with SM represent Standard Methods for the Examination of Water and Wastewater.

TABLE 2.
STATISTICAL BACKGROUND VALUES
2020 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK POWER STATION
203 - GMF POND
CANTON, ILLINOIS
DETECTION MONITORING PROGRAM

Parameter	Statistical Background Value (UPL)
40 C.F.R. Part 257 Appendix III	
Boron (mg/L)	0.07
Calcium (mg/L)	110
Chloride (mg/L)	20.9
Fluoride (mg/L)	0.564
pH (S.U.)	6.5 / 7.6
Sulfate (mg/L)	97
Total Dissolved Solids (mg/L)	490

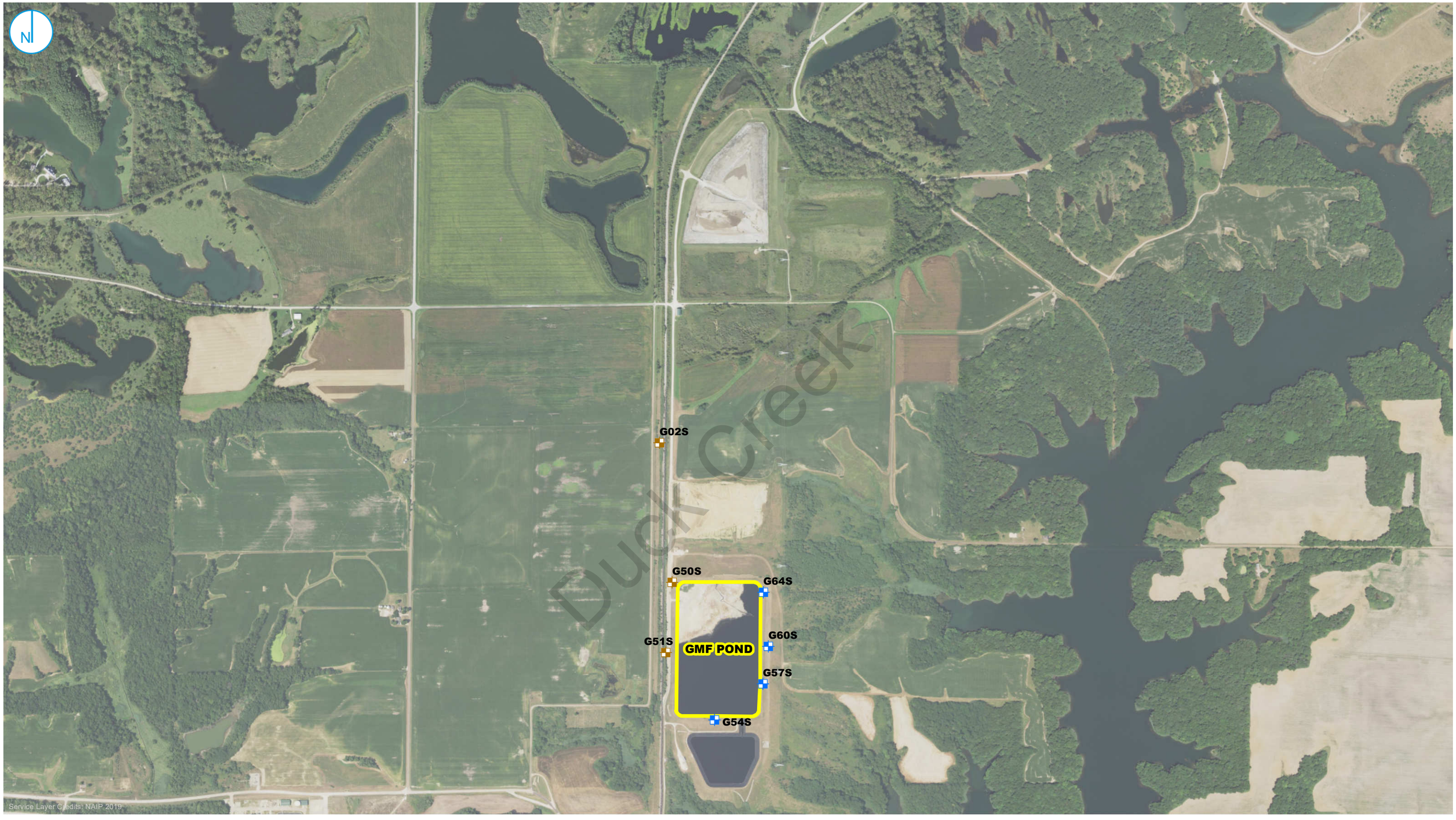
[O: RAB 12/20/19, C: KLT 12/23/19]

Notes:
40 C.F.R. = Title 40 of the Code of Federal Regulations
mg/L = milligrams per liter
S.U. = Standard Units
UPL = Upper Prediction Limit

FIGURES

Y:\Mapping\Projects\222285\MXD\2020_AnnualGWM_CAR\Figure 1_GWS_WellLoc_DuckCreek_GMFP.mxd

PROJECT: 1690000XXXX | DATED: 1/25/2021 | DESIGNER: galammc



BACKGROUND MONITORING WELL LOCATION
DOWNGRADIENT MONITORING WELL LOCATION
CCR MONITORED UNIT

0 500 1,000 Feet

MONITORING WELL LOCATION MAP
DUCK CREEK GMF POND
UNIT ID:203

2020 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
VISTRA CCR RULE GROUNDWATER MONITORING
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

APPENDICES

Intended for
Illinois Power Resources Generating, LLC

Date
April 27, 2020

Project No.
74916

40 C.F.R. § 257.95(g)(3)(ii): ALTERNATE SOURCE DEMONSTRATION

DUCK CREEK GYPSUM MANAGEMENT FACILITY POND

RAMBOLL Bright ideas. Sustainable change.

CERTIFICATIONS

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., a Ramboll Company
Date: April 27, 2020

I, Brian G. Hennings, 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.

Brian G. Hennings
Professional Geologist
196-001482
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CONTENTS

TABLES (IN TEXT)

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FIGURES (ATTACHED)

ACRONYMS AND ABBREVIATIONS

ASD	Alternate Source Demonstration
bgs	below ground surface
CCR	Coal Combustion Residuals
C.F.R.	Code of Federal Regulations
CV	coefficient of variation
ft	feet
GMF	Duck Creek Gypsum Management Facility
ISGS	Illinois State Geological Survey
mg/L	milligrams per liter
msl	above mean sea level North American Vertical Datum of 1988
NRT/OBG	Natural Resource Technology, an OBG Company
OBG	O'Brien & Gere Engineers, Inc., part of Ramboll
Site	Duck Creek Power Station
SSIs	Statistically Significant Increases
UPL	Upper Prediction Limit
USGS	United States Geological Survey

1. INTRODUCTION

Title 40 of the Code of Federal Regulations (C.F.R.) § 257.94(e)(2) allows the owner or operator of a Coal Combustion Residuals (CCR) unit 90 days from the date of determination of Statistically Significant Increases (SSIs) over background for groundwater constituents listed in Appendix III of 40 C.F.R. Part 257 to complete a written demonstration that a source other than the CCR unit being monitored caused the SSI(s), or that the SSI(s) resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality (Alternate Source Demonstration [ASD]).

This ASD has been prepared on behalf of Illinois Power Resources Generating, LLC by O'Brien & Gere Engineers, Inc., a Ramboll Company (Ramboll), to provide pertinent information pursuant to 40 C.F.R. § 257.94(e)(2) for the Duck Creek Gypsum Management Facility (GMF) Pond located near Canton, Illinois.

The fifth semi-annual detection monitoring samples (Detection Monitoring Round 5 [D5]) were collected on July 8th and 15th, 2019 and analytical data were received on October 28, 2019. In accordance with 40 C.F.R. § 257.93(h)(2), statistical analysis of the data to identify SSIs of 40 C.F.R. Part 257 Subpart D Appendix III parameters over background concentrations was completed by January 28, 2020, within 90 days of receipt of the analytical data. The statistical determination identified the following SSIs at downgradient monitoring wells:

- Calcium at wells G54S, G57S, and G60S
- Sulfate at well G60S
- TDS at wells G54S, G57S, and G60S

Pursuant to 40 C.F.R. § 257.94(e)(2), the following demonstrates that sources other than the GMF Pond were the cause of the SSIs listed above. This ASD was completed by April 27, 2020, within 90 days of determination of the SSIs, as required by 40 C.F.R. § 257.94(e)(2).

2. BACKGROUND

2.1 Site Location and Description

The Duck Creek Power Station (Site) is in Fulton County, located in central Illinois, approximately 9 miles southeast of the town of Canton. Duck Creek Cooling Pond is located east of the plant and GMF Pond with agricultural land surrounding the entire site.

2.2 Geology and Hydrogeology

The site geologic and hydrogeologic setting summarized below is from the Hydrogeologic Monitoring Plan (NRT/OBG, 2017).

2.2.1 Geology

Regionally, the Duck Creek Power Station is positioned on the glacial uplands above the Illinois River in the Ancient Illinois Floodplain of the Till Plains Section of the Central Lowland Province. The undisturbed unlithified materials consist of loess, diamictons, and lacustrine/alluvial deposits. The area is flat to gently rolling uplands that are dissected by deeply incised streams that are tributaries to major river systems.

Several large former surface coal mines are present in the vicinity; unlithified materials are present in the excavated strip mine spoils and have been mixed due to the surface mining activities. Mining operations in the area have ceased.

The uppermost bedrock stratum in the area is the Carbondale Formation of the Kewanee Group of the Pennsylvanian System. Bedrock in the area is identified as Pennsylvanian-age shale deposits. Bedrock occurs within approximately 50 feet of the ground surface in this area.

Quaternary deposits in the Canton area consist mainly of loess, diamictons, and lacustrine/alluvial deposits that were deposited during Illinoian and Wisconsinan glaciations. The following two unlithified water-bearing units are present beneath the GMF pond (beginning at the ground surface):

- Loess Zone – Moderate to high permeability silts and clayey silts, including: the Peoria and Roxanna Silt (Loess Units); underlain by the low permeability clayey diamictons of the Berry Clay and upper Radnor Till Members of the Glasford Formation.
- Shallow Sand Unit – Thin to moderately thick (6 to 18 ft), moderate to high permeability, medium-grained sand to silt with intercalated till seams; underlain by till sequences of the lower Radnor Till Member of the Glasford Formation.

2.2.2 Hydrogeology

The uppermost aquifer in the area consists of the Loess and Shallow Sand. These hydraulically connected units are underlain by the Radnor Till Member of the Glasford Formation.

Groundwater elevations in the uppermost aquifer across the GMF Pond ranged from 587.96 to 611.89 ft MSL (NAVD88) during D5 (Figure 1). The groundwater elevation contours shown on Figure 1 were measured on July 1, 2019 prior to a combined sampling event at Duck Creek Power Station for the three CCR units located there and for multiple monitoring programs required by both federal and state regulatory agencies. As noted above, groundwater sampling

for D5 occurred on July 8th and 15th, 2019. Overall groundwater flow within the Uppermost Aquifer under the GMF Pond is east southeast.

2.3 Groundwater and GMF Pond Monitoring

The CCR Rule groundwater monitoring system for the GMF Pond is shown on Figure 1. Monitoring wells G02S, G50S and G51S are used to monitor background water quality for the GMF Pond. These wells are located north (G02S), northwest (G50S) and west (G51S) of the GMF Pond. The downgradient monitoring wells are G54S, G57S, G60S, and G64S.

GMF Pond water samples are collected from the GMF Pond at location X301 (Figure 1). The most recent sample was collected on November 15, 2019.

3. ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

Lines of evidence supporting this ASD include the following:

The ionic composition of GMF Pond water is different from the ionic composition of groundwater.

Proximity of the GMF Pond to historic coal mining activity and related groundwater quality impacts.

Calcium was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current CCR compliance background concentrations.

TDS was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current CCR compliance background concentrations.

Concentrations of boron, a common indicator for CCR impacts to groundwater, are near or below background concentrations and are stable in downgradient wells.

These lines of evidence are described and supported in greater detail below.

3.1 LOE #1: The Ionic Composition of GMF Pond Water is Different from the Ionic Composition of Groundwater

Piper diagrams graphically represent ionic composition of aqueous solutions. A Piper diagram displays the position of water samples relative to their major cation and anion content on the two lower triangular portions of the diagram, providing the information which, when combined on the central, diamond-shaped portion of the diagram, identifies the compositional categories or groupings (hydrochemical facies). Figure A, below, is a Piper diagram that displays the ionic composition of groundwater samples from the background and downgradient monitoring wells associated with the GMF Pond and surface water samples collected from the GMF Pond. The ionic compositional groupings identified are shown in the black and green ellipses on the diamond portion of the Piper diagram. These are discussed in more detail below.

It is evident from the Piper diagram that the background and downgradient wells (enclosed within a black ellipse) are in the calcium-bicarbonate hydrochemical facies, and the water from the GMF Pond (enclosed within a green ellipse) is in the calcium-sulfate hydrochemical facies. The dissimilar ionic compositions of the GMF Pond background and downgradient groundwater and the GMF Pond surface water indicates that the GMF Pond surface water is not the source of CCR constituents detected in GMF Pond groundwater.

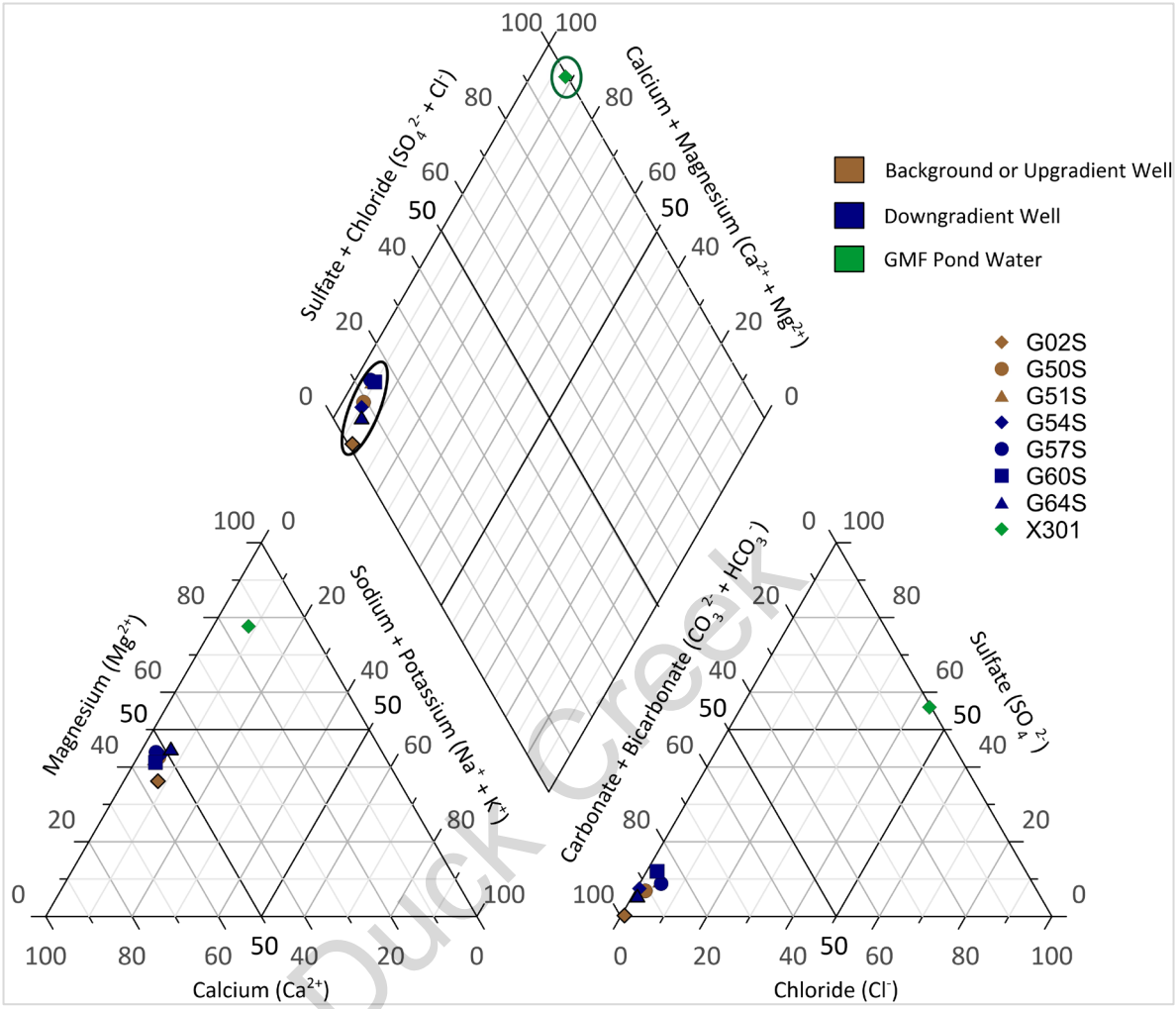


Figure A. Piper Diagram Showing Ionic Composition of Samples of Groundwater and Pond Water Associated with the Duck Creek GMF Pond.

3.2 LOE #2: Proximity of the GMF Pond to Historical Mining Activity and Related Groundwater Quality Impacts

The area surrounding the GMF Pond consists primarily of unmined coal and reclaimed surface mine land. The extent of nearby surface mines is shown in the attached Figure 2 The coal in this area has a sulfur content greater than 2.5 pounds (lbs) of sulfur per million BTUs, the highest sulfur classification used by Illinois State Geological Survey (ISGS, 1997).

The coal in the area varies in depth from 0 to 50 feet (ft) bgs. The CCR Rule groundwater monitoring wells for the Duck Creek GMF Pond are screened between 23 and 48 ft bgs. Potentiometric data indicates that groundwater flows to the southeast as shown on the attached Figure 1. The CCR monitoring wells are located approximately 2,000 to 4,000 ft south-southeast (downgradient) of the nearby surface mines (Figure 2).

A study of groundwater quality near surface coal mines, performed by the U.S. Geological Survey (USGS, 2006), provides data on the effects of mines on groundwater quality. The study evaluated

regional differences in major ionic composition of groundwater in unmined and mined areas using Piper diagrams (Figure B below). Groundwater samples collected from wells downgradient of the reclaimed mine areas in the study ranged from primarily calcium-magnesium carbonate-bicarbonate type (calcium-bicarbonate hydrochemical facies) to a lesser amount of calcium-magnesium sulfate type (calcium sulfate hydrochemical facies). The calcium-bicarbonate groundwater documented in the vicinity of reclaimed surface coal mines is similar to the ionic composition of groundwater samples collected from background and downgradient groundwater monitoring wells at the GMF Pond.

State of Illinois groundwater quality regulations (Illinois Administrative Code [IAC] Title 35 Part 620 Groundwater Quality) acknowledge that water quality is adversely affected in areas where coal mining activity has occurred. The groundwater quality standards for TDS, chloride, iron, manganese, sulfate, and pH within previously mined areas are the existing concentrations of these constituents in groundwater (35IAC § 620.440).

The proximity of the GMF Pond to historic coal mining activity and similarities in the ionic composition of groundwater in areas of reclaimed surface coal mines and in the GMF Pond groundwater samples demonstrate that historic mining activity has affected groundwater quality at the GMF Pond.

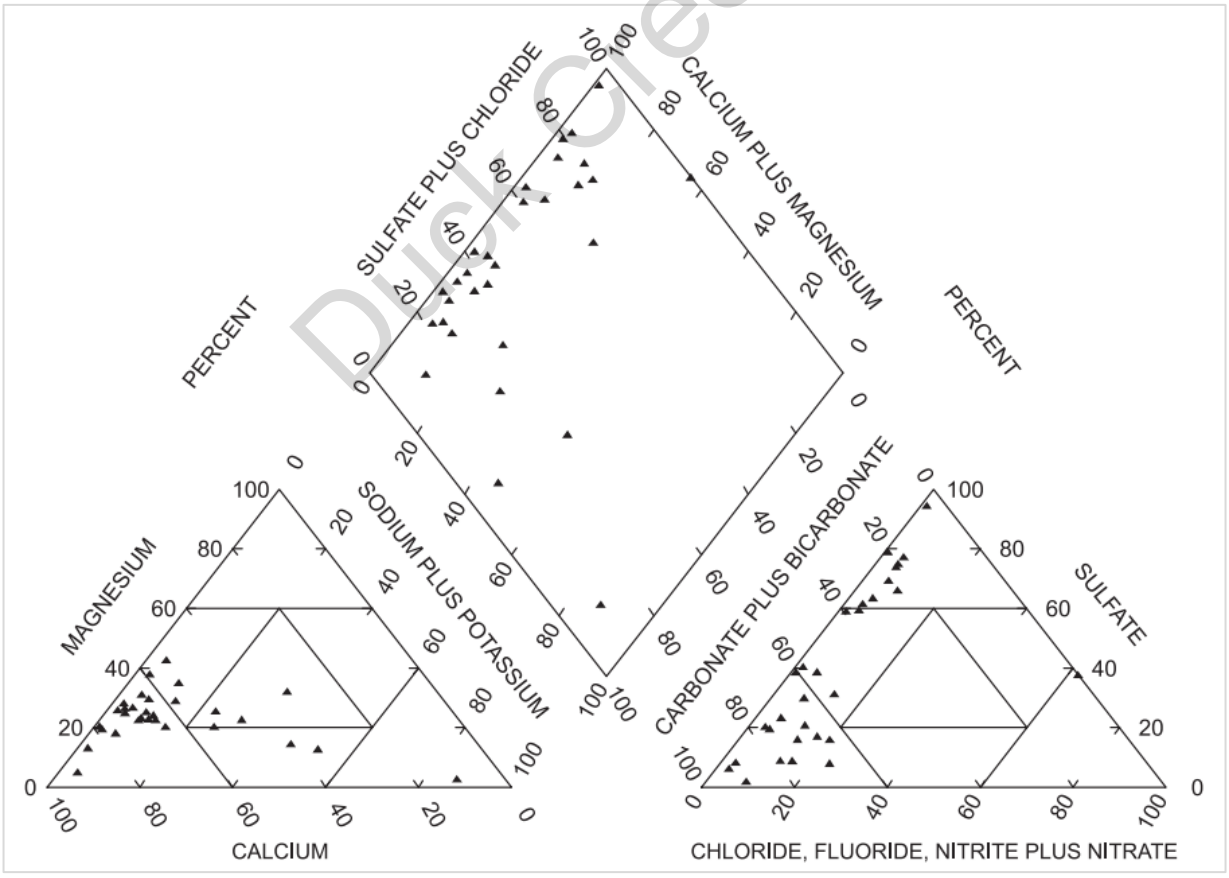


Figure B. Piper Diagram Showing Ionic Composition of Groundwater Downgradient of Reclaimed Surface Coal Mines in High-Sulfur Coal Regions (Modified from USGS).

3.3 LOE #3: Calcium was Present in Groundwater in the Vicinity of the GMF Pond Prior to the Unit Being Placed into Service at Concentrations that Exceeded Current Background Concentrations

The GMF Pond was placed in service in 2009. MW60S, a non-CCR rule monitoring well (Figure 1, attached), was present prior to 2009 and was located side - to downgradient of where the GMF Pond was constructed. A box plot of calcium concentrations observed in groundwater samples collected from MW60S between March 2007 and November 2008 is shown in Figure C below. Calcium concentrations ranged from 87 milligrams per liter (mg/L) to 150 mg/L, and the average and median observed concentrations were 116 mg/L and 120 mg/L, respectively. Calcium concentrations were most often between 94 mg/L (first quartile) and 133 mg/L (third quartile). The calcium concentrations detected in downgradient monitoring wells G54S, G57S, and G60S during D5 were 130 mg/L, 140 mg/L, and 140 mg/L respectively, above the background Upper Prediction Limit (UPL) of 110 mg/L, but within the range of concentrations observed in MW60S before the GMF Pond was placed into service.

The similarity between the calcium concentrations detected in downgradient monitoring wells G54S, G57S, G60S and those observed in groundwater in the area prior to the GMF Pond being placed into service indicates that the GMF Pond is not the source of calcium SSIs in downgradient monitoring wells.

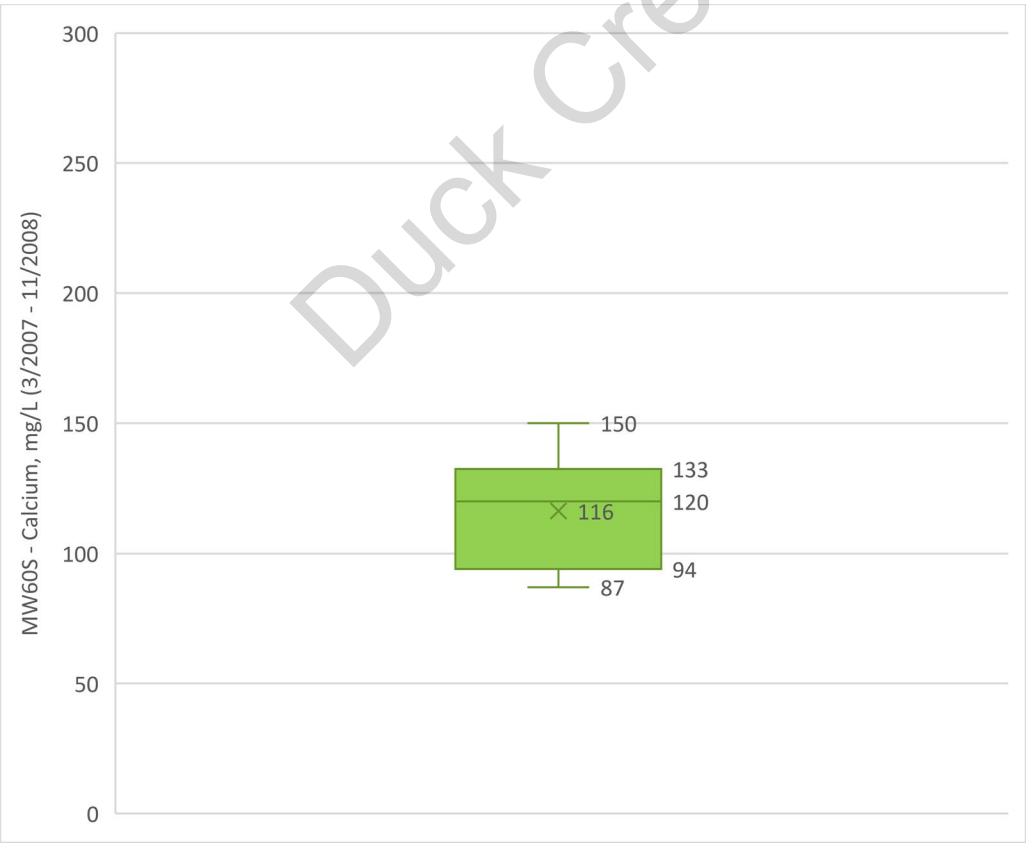


Figure C. Box plot of Calcium Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

3.4 LOE #4: TDS was Present in Groundwater in the Vicinity of the GMF Pond Prior to the Unit Being Placed into Service at Concentrations that Exceeded Current Background Concentrations

TDS was detected at elevated concentrations in groundwater samples collected from MW60S prior to the GMF Pond being placed into service in 2009. A box plot of TDS concentrations in groundwater samples collected at MW60S between March 2007 and November 2008 is shown in Figure D below. TDS concentrations range from 460 mg/L to 690 mg/L, with the average and median being 555 mg/L and 560 mg/L, respectively. TDS concentrations were most often between 530 mg/L (first quartile) to 580 mg/L (third quartile).

The TDS concentrations detected at downgradient monitoring wells G54S and G57S during D5 were 590 mg/L and 680 mg/L, respectively, above the background UPL of 490 mg/L, but within the range of concentrations observed in MW60S before the GMF Pond was placed into service. The TDS concentration detected at downgradient monitoring well G60S was 800 mg/L.

The similarity between the TDS concentrations detected in downgradient monitoring wells G54S and G57S and those observed in groundwater in the area prior to the GMF Pond being placed into service, suggests that the GMF Pond is not the source of TDS SSIs in downgradient monitoring wells.

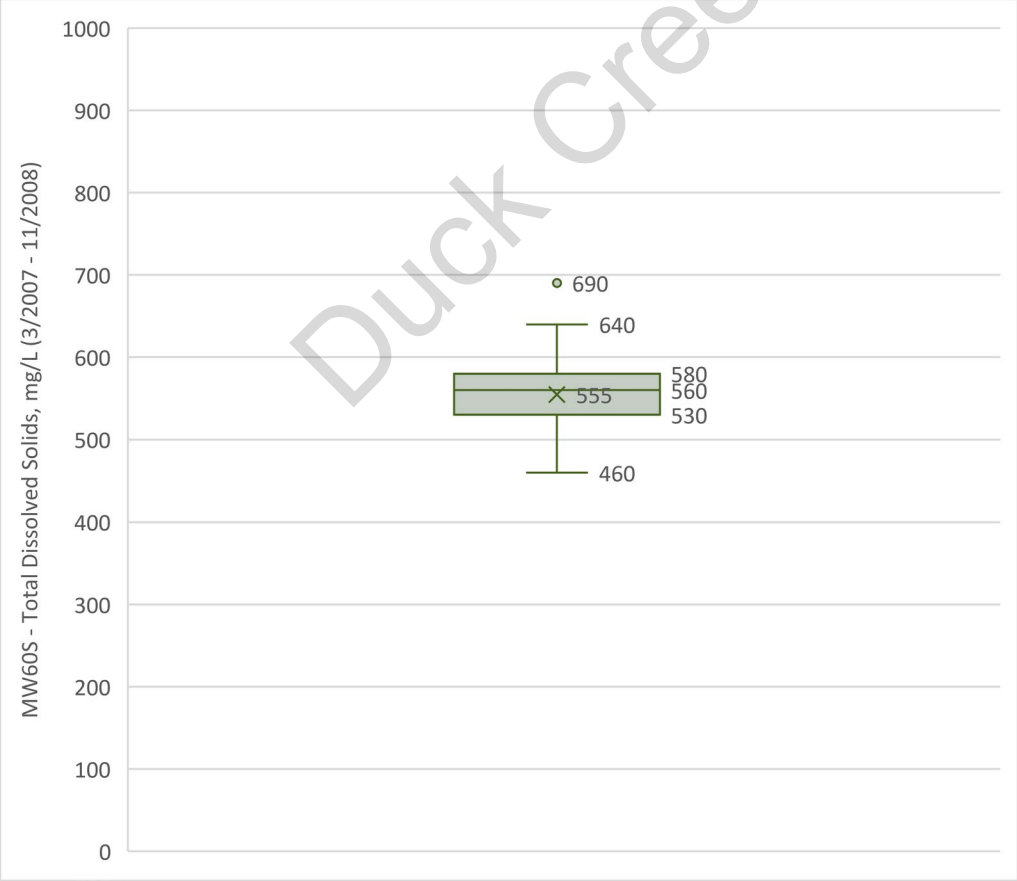


Figure D. Box Plot of TDS Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

3.5 LOE #5: Concentrations of Boron, a Common Indicator for CCR Impacts to Groundwater, are Near or Below Background Concentrations and are Stable in Downgradient Wells

Boron is a common indicator of CCR impacts to groundwater due to its leachability from CCR and mobility in groundwater. If a CCR constituent other than boron is identified as an SSI; but boron is not also identified as elevated over background, it is unlikely that the CCR unit is the source of the SSI. Concentrations of boron in monitoring wells downgradient from the GMF Pond are below concentrations in background wells (and below the upper prediction limit [UPL] for boron).

Boron concentrations measured in groundwater at downgradient wells between 2015 and 2019 range from 0.01 mg/L to 0.059 mg/L, below the UPL of 0.07 mg/L. A time series plot for boron is provided in Figure E below and box plots are shown in Figure F below.

The time series plot and box plots demonstrate the following observations:

- All boron concentrations in downgradient wells are below the UPL of 0.07 mg/L, determined from background monitoring wells G02S, G50S and G51S.
- There is little variability over time in the boron concentrations in each well, as shown by the height of the box plots. The upper and lower lines of the boxes are the 25th and 75th quartiles, the closer these two lines are to each other, the lower the overall variability is for that location.

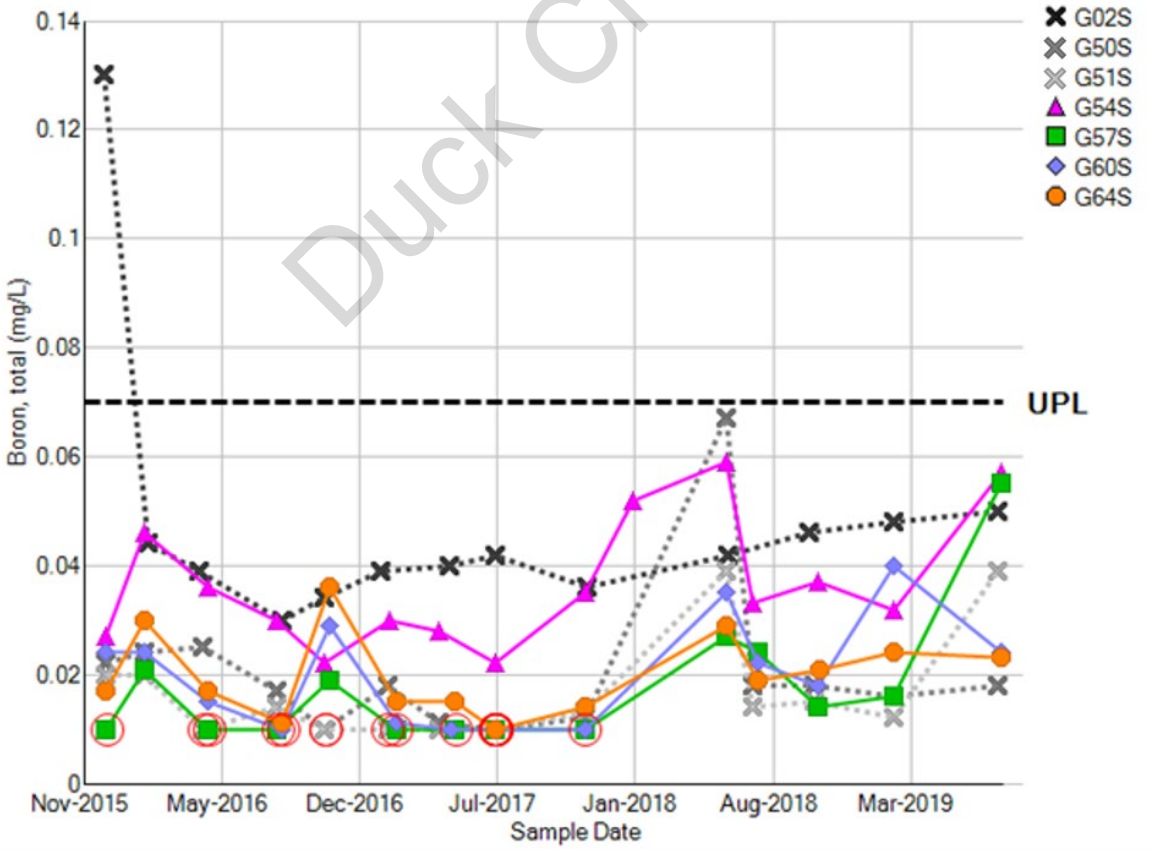


Figure E. Boron Time Series

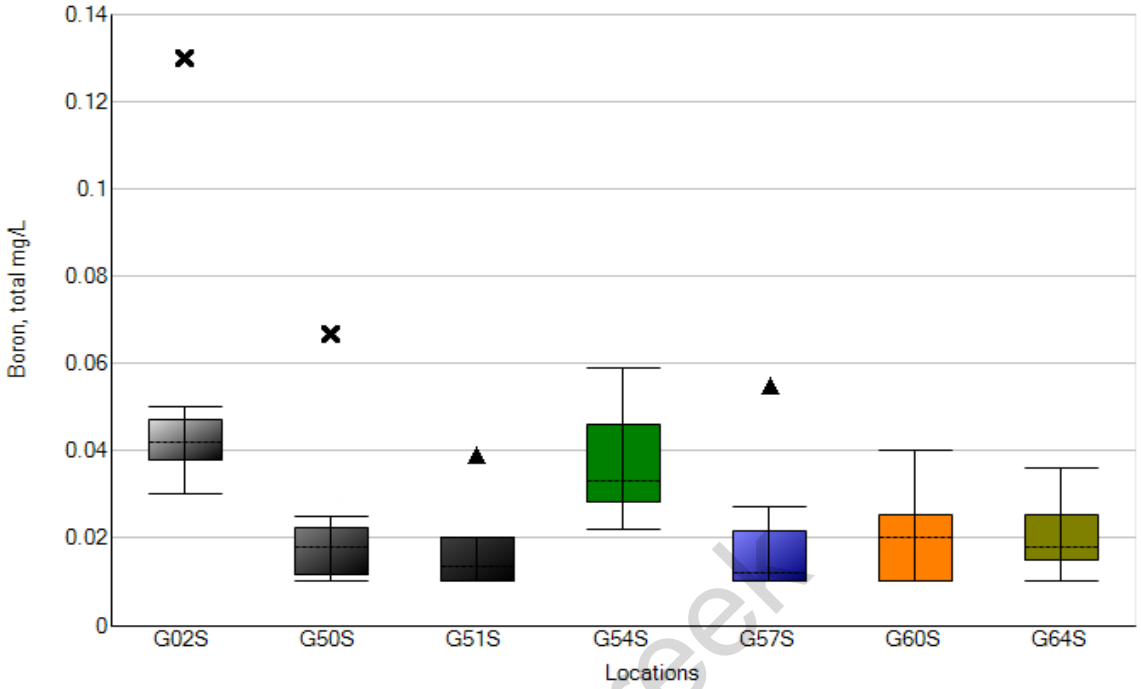


Figure F. Boron Box Plots

Mann-Kendall trend analysis tests were performed to determine if boron concentrations at each well are increasing, decreasing or stable (i.e., no statistically significant upward or downward trend). If the Mann-Kendall test did not identify a trend, the coefficient of variation (CV) was calculated to determine if the concentrations are too variable to identify a trend (i.e., CV greater than or equal to 1). Boron concentrations are stable in background and downgradient wells with exception of G57S, at which a statistically significant upward trend was identified. Although the boron trend at G57S was determined to be significant based on the Mann-Kendall test, the concentrations demonstrated low variability (CV less than or equal to 1), suggesting a low-magnitude trend. Table A below provides summary statistics, including variability and trend by well.

Table A. Summary Statistics and Mann-Kendall Trend Analysis Results for Boron in Groundwater (December 2015 to July 2019).

Monitoring Well	Boron (mg/L)					
	Minimum	Maximum	Median	Standard Deviation	Trend	CV
G02S	0.03	0.13	0.042	0.025	Stable	0.52
G50S	<0.010	0.067	0.018	0.014	Stable	0.70
G51S	<0.010	0.039	0.014	0.010	Stable	0.59
G54S	0.022	0.059	0.033	0.012	Stable	0.33
G57S	<0.010	0.055	0.012	0.012	Upward	0.67
G60S	<0.010	0.040	0.020	0.010	Stable	0.50
G64S	<0.010	0.036	0.018	0.008	Stable	0.40

Relatively stable boron concentrations in downgradient monitoring wells below background concentrations demonstrate that the GMF Pond is not the source of CCR constituents detected in the downgradient monitoring wells.

4. CONCLUSIONS

Based on the five lines of evidence below, it has been demonstrated that the Duck Creek GMF Pond is not the source of SSIs of calcium at G54S. G57S, and G60S; of sulfate at G60S; and of TDS at G54S, G57S, and G60S.

1. The ionic composition of GMF Pond water is different from the ionic composition of groundwater.
2. Proximity of the GMF Pond to historic coal mining activity and related groundwater quality impacts.
3. Calcium was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current CCR compliance background concentrations.
4. TDS was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current CCR compliance background concentrations.
5. Concentrations of boron, a common indicator for CCR impacts to groundwater, are near or below background concentrations and are stable in downgradient wells.

This information serves as the written alternate source demonstration prepared in accordance with 40 C.F.R. § 257.94(e)(2) that the SSIs observed during the detection monitoring program were not due to the Duck Creek GMF Pond. Therefore, an assessment monitoring program is not required and the Duck Creek GMF Pond will remain in detection monitoring.

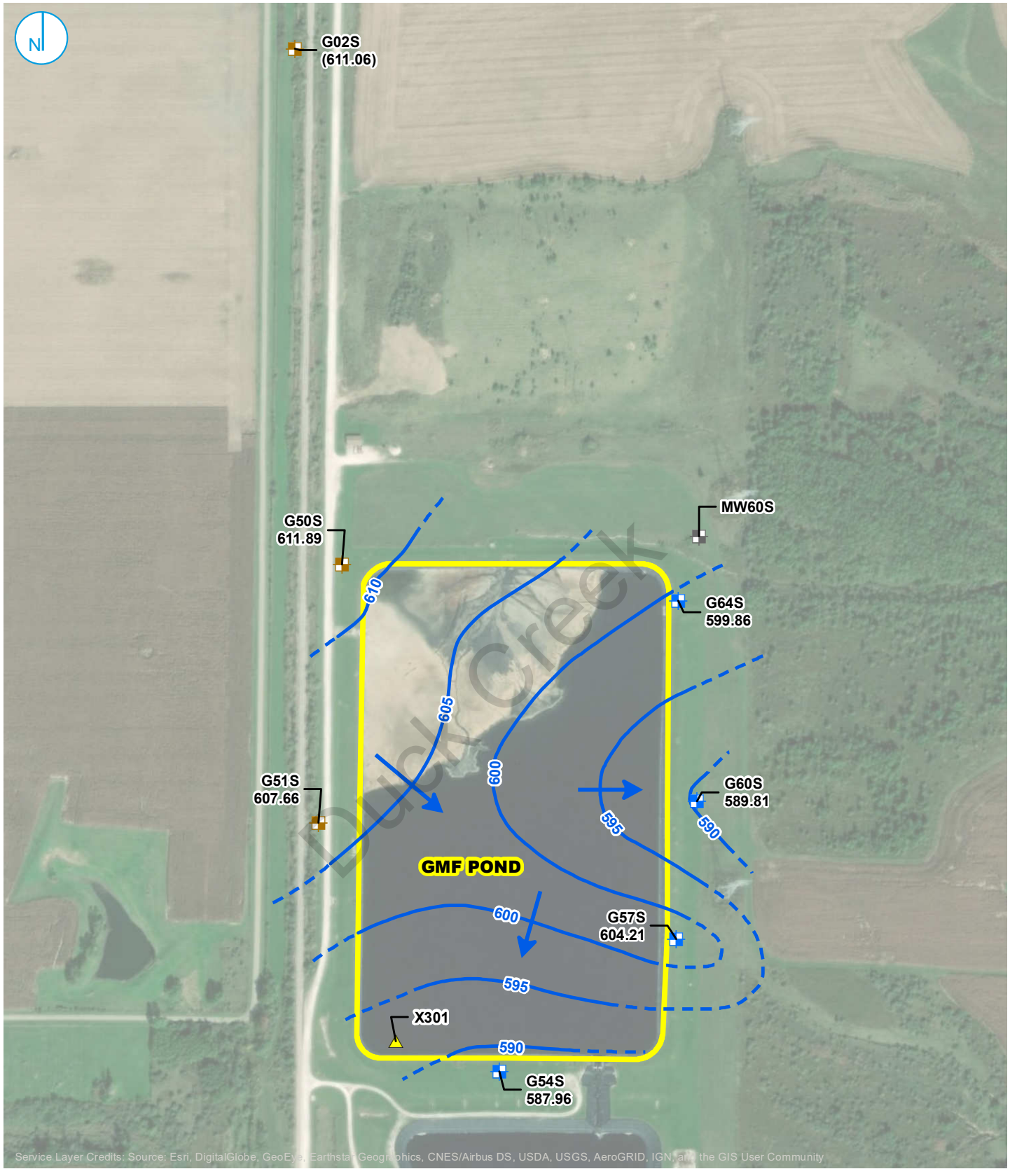
5. REFERENCES

Natural Resource Technology, an OBG Company (NRT), October 17, 2017. Hydrogeologic Monitoring Plan. Duck Creek GMF Pond – CCR Unit ID 203, Duck Creek Landfill – CCR Unit ID 204. Duck Creek Power Station, Canton, Illinois. Illinois Power Resources Generating, LLC.

Illinois State Geological Survey (ISGS), 1997. Illinois Coal Reserves Assessment and Database Development: Final Report, Open File Series 1997-4, Illinois State Geological Survey, Coal Section.

United States Geological Survey (USGS), 2006. Ground-Water Quality in Unmined Areas and Near Reclaimed Surface Coal Mines in the Northern and Central Appalachian Coal Regions, Pennsylvania and West Virginia, Scientific Investigations Report 2006-5059, US Geological Survey.

FIGURES



Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\DC_GMF\Figure 1_GWE Contours_D5_DC203.mxd

PROJECT: 74916 | DESIGNER: galanmc

- CCR RULE DOWNGRADIENT MONITORING WELL LOCATION
- CCR RULE BACKGROUND MONITORING WELL LOCATION
- NON-CCR RULE MONITORING WELL LOCATION
- SURFACE WATER SAMPLE LOCATION
- GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- CCR MONITORED UNIT

0 200 400 Feet

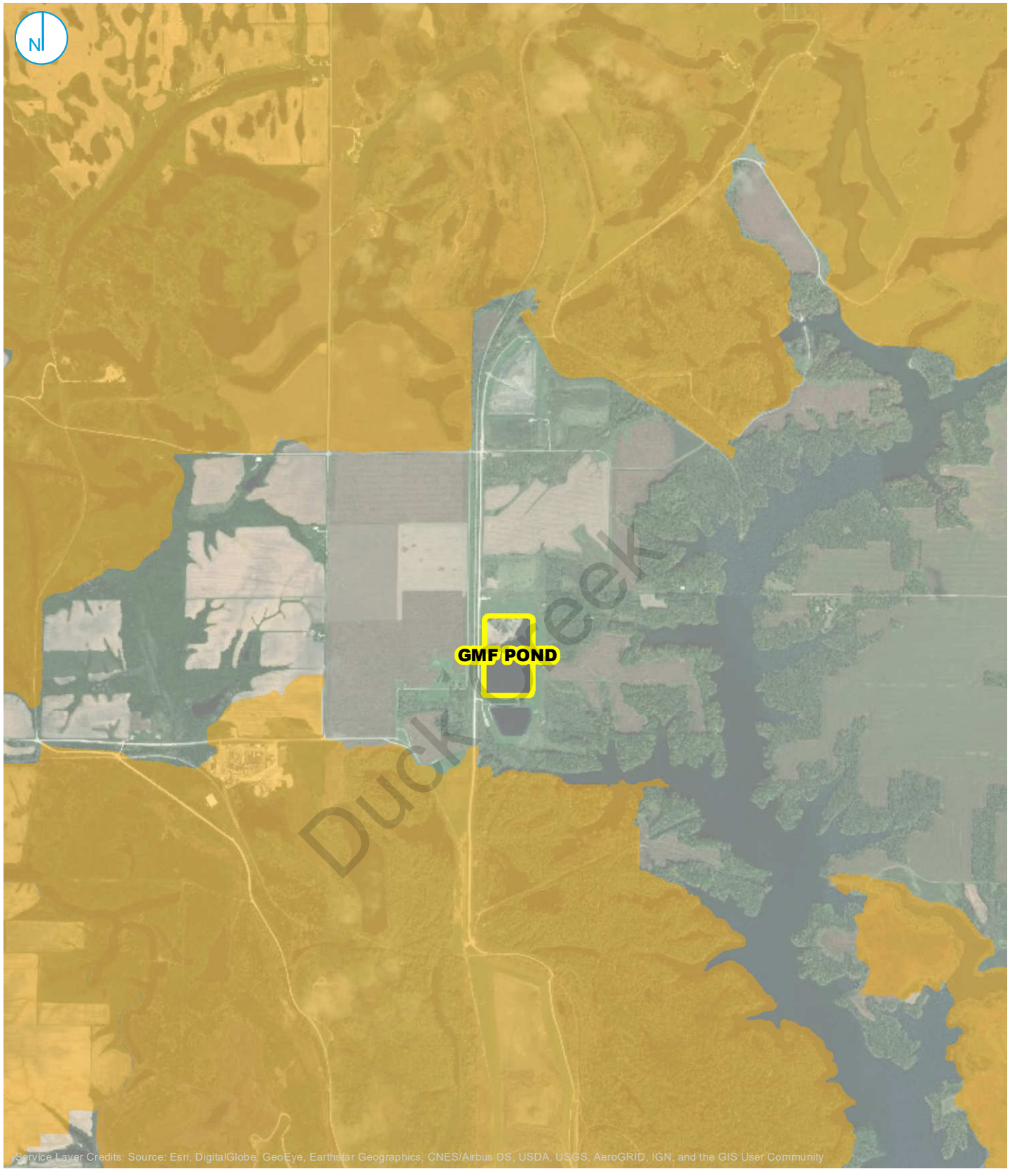
GROUNDWATER ELEVATION CONTOUR MAP
JULY 1, 2019

DUCK CREEK GMF POND (UNIT ID: 203)
ALTERNATE SOURCE DEMONSTRATION
VISTRA ENERGY
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE 1

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL



Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\DC_GMF\Figure 2_Coal Mine Coverage_D5_DC203.mxd

PROJECT: 74916 | DESIGNER: galarnmc

CCR MONITORED UNIT

MINE COVERAGE AREA

MINING COVERAGE AREA SOURCE:
LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

0 1,250 2,500 Feet

COAL MINE COVERAGE AREA

DUCK CREEK GMF POND (UNIT ID: 203)
ALTERNATE SOURCE DEMONSTRATION
VISTRA ENERGY
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE 2

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL

Intended for
Illinois Power Resources Generating, LLC

Date
October 13, 2020

Project No.
1940074916

40 C.F.R. § 257.95(g)(3)(ii): ALTERNATE SOURCE DEMONSTRATION

DUCK CREEK GYPSUM MANAGEMENT FACILITY POND

RAMBOLL Bright ideas. Sustainable change.

CERTIFICATIONS

I, Brian G. Hennings, 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.

Brian G. Hennings
Professional Geologist
196-001482
Illinois
Ramboll Americas Engineering Solutions, Inc., f/k/a O'Brien & Gere Engineers, Inc.
Date: October 13, 2020

I, Anne Frances Ackerman, 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.

Anne Frances Ackerman
Qualified Professional Engineer
062-060586
Illinois
Ramboll Americas Engineering Solutions, Inc., f/k/a O'Brien & Gere Engineers, Inc.
Date: October 13, 2020

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CONTENTS

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ACRONYMS AND ABBREVIATIONS

35 IAC	Title 35 Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
ASD	Alternate Source Demonstration
bgs	below ground surface
BTU	British Thermal Unit
CCR	Coal Combustion Residuals
CV	coefficient of variation
f/k/a	formerly known as
ft	feet
GMF	Duck Creek Gypsum Management Facility
ISGS	Illinois State Geological Survey
LOE	Line of Evidence
mg/L	milligrams per liter
NRT/OBG	Natural Resource Technology, an OBG Company
Site	Duck Creek Power Station
SSIs	Statistically Significant Increases
UPL	Upper Prediction Limit
USGS	United States Geological Survey

1. INTRODUCTION

Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257.94(e)(2) allows the owner or operator of a Coal Combustion Residuals (CCR) unit 90 days from the date of determination of Statistically Significant Increases (SSIs) over background for groundwater constituents listed in Appendix III of 40 C.F.R. Part 257 to complete a written demonstration that a source other than the CCR unit being monitored caused the SSI(s), or that the SSI(s) resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality (Alternate Source Demonstration [ASD]).

This ASD has been prepared on behalf of Illinois Power Resources Generating, LLC by Ramboll Americas Engineering Solutions, Inc., formerly known as (f/k/a) O'Brien & Gere Engineers, Inc. to provide pertinent information pursuant to 40 C.F.R. § 257.94(e)(2) for the Duck Creek Gypsum Management Facility (GMF) Pond located near Canton, Illinois.

The sixth semi-annual detection monitoring samples (Detection Monitoring Round 6 [D6]) were collected between January 13 – 15, 2020 and analytical data were received on April 16, 2020. In accordance with 40 C.F.R. § 257.93(h)(2), statistical analysis of the data to identify SSIs of 40 C.F.R. Part 257 Subpart D Appendix III parameters over background concentrations was completed by July 15, 2020, within 90 days of receipt of the analytical data. The statistical determination identified the following SSIs at downgradient monitoring wells:

- Calcium at wells G54S, G57S, and G60S
- Sulfate at well G60S
- TDS at wells G54S, G57S, and G60S

Pursuant to 40 C.F.R. § 257.94(e)(2), the following demonstrates that sources other than the GMF Pond were the cause of the SSIs listed above. This ASD was completed by October 13, 2020, within 90 days of determination of the SSIs, as required by 40 C.F.R. § 257.94(e)(2).

2. BACKGROUND

2.1 Site Location and Description

The Duck Creek Power Station (Site) is in Fulton County, located in central Illinois, approximately 9 miles southeast of the town of Canton. Duck Creek Cooling Pond is located east of the plant and GMF Pond with agricultural land surrounding the entire Site.

2.2 Geology and Hydrogeology

The Site geologic and hydrogeologic setting summarized below is from the Hydrogeologic Monitoring Plan (Natural Resource Technology, an OBG Company [NRT/OBG], 2017).

2.2.1 Geology

Regionally, the Duck Creek Power Station is positioned on the glacial uplands above the Illinois River in the Ancient Illinois Floodplain of the Till Plains Section of the Central Lowland Province. The undisturbed unlithified materials consist of loess, diamictons, and lacustrine/alluvial deposits. The area is flat to gently rolling uplands that are dissected by deeply incised streams that are tributaries to major river systems.

Several large former surface coal mines are present in the vicinity; unlithified materials are present in the excavated strip mine spoils and have been mixed due to the surface mining activities. Mining operations in the area have ceased.

The uppermost bedrock stratum in the area is the Carbondale Formation of the Kewanee Group of the Pennsylvanian System. Bedrock in the area is identified as Pennsylvanian-age shale deposits. Bedrock occurs within approximately 50 feet (ft) of the ground surface in this area.

Quaternary deposits in the Canton area consist mainly of loess, diamictons, and lacustrine/alluvial deposits that were deposited during Illinoian and Wisconsinan glaciations. The following two unlithified water-bearing units are present beneath the GMF pond (beginning at the ground surface):

- Loess Zone – Moderate to high permeability silts and clayey silts, including: the Peoria and Roxanna Silt (Loess Units); underlain by the low permeability clayey diamictons of the Berry Clay and upper Radnor Till Members of the Glasford Formation.
- Shallow Sand Unit – Thin to moderately thick (6 to 18 ft), moderate to high permeability, medium-grained sand to silt with intercalated till seams; underlain by till sequences of the lower Radnor Till Member of the Glasford Formation.

2.2.2 Hydrogeology

The uppermost aquifer in the area consists of the Loess and Shallow Sand. These hydraulically connected units are underlain by the Radnor Till Member of the Glasford Formation.

Groundwater elevations (reference to NAVD 88) in the uppermost aquifer across the GMF Pond are shown on Figure 1. Groundwater elevations ranged from 589.21 to 612.25 ft on January 2-3, 2020, prior to a combined D6 sampling event at the Site for the three CCR units located there, and for multiple monitoring programs required by both federal and state regulatory agencies. As

noted above, groundwater sampling for D6 occurred on January 13–15, 2020. Overall groundwater flow within the Uppermost Aquifer under the GMF Pond was east to south.

2.3 Groundwater and GMF Pond Monitoring

The CCR Rule groundwater monitoring system for the GMF Pond is shown on Figure 1. Monitoring wells G02S, G50S and G51S are used to monitor background groundwater quality for the GMF Pond. These wells are located north (G02S), northwest (G50S) and west (G51S) of the GMF Pond. The downgradient monitoring wells are G54S, G57S, G60S, and G64S.

GMF Pond water samples are collected from the GMF Pond at location X301 (Figure 1). The most recent pond water sample was collected on June 9, 2020.

3. ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

Lines of evidence (LOE) supporting this ASD include the following:

1. The ionic composition of GMF Pond water is different from the ionic composition of groundwater.
2. Proximity of the GMF Pond to historical mining activity and related groundwater quality impacts.
3. Calcium was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current background concentrations.
4. Concentrations of boron, a common indicator for CCR impacts to groundwater, are below background concentrations and are stable in downgradient wells.

These LOEs are described and supported in greater detail below.

3.1 LOE #1: The Ionic Composition of GMF Pond Water is Different from the Ionic Composition of Groundwater

Piper diagrams graphically represent ionic composition of aqueous solutions. A Piper diagram displays the position of water samples relative to their major cation and anion content on the two lower triangular portions of the diagram, providing the information which, when combined on the central, diamond-shaped portion of the diagram, identifies the compositional categories or groupings (hydrochemical facies). Figure A, below, is a Piper diagram that displays the ionic composition of groundwater samples from the background and downgradient monitoring wells associated with the GMF Pond and surface water samples collected from the GMF Pond. The ionic compositional groupings identified are shown in the black and green ellipses on the diamond portion of the Piper diagram. These are discussed in more detail below.

It is evident from the Piper diagram that the background and downgradient wells (enclosed within a black ellipse) are in the calcium-bicarbonate hydrochemical facies, and the water from the GMF Pond (enclosed within a green ellipse) is in the calcium-sulfate hydrochemical facies. The dissimilar ionic compositions of the GMF Pond background and downgradient groundwater and the GMF Pond surface water indicates that the GMF Pond surface water is not the source of CCR constituents detected in GMF Pond groundwater.

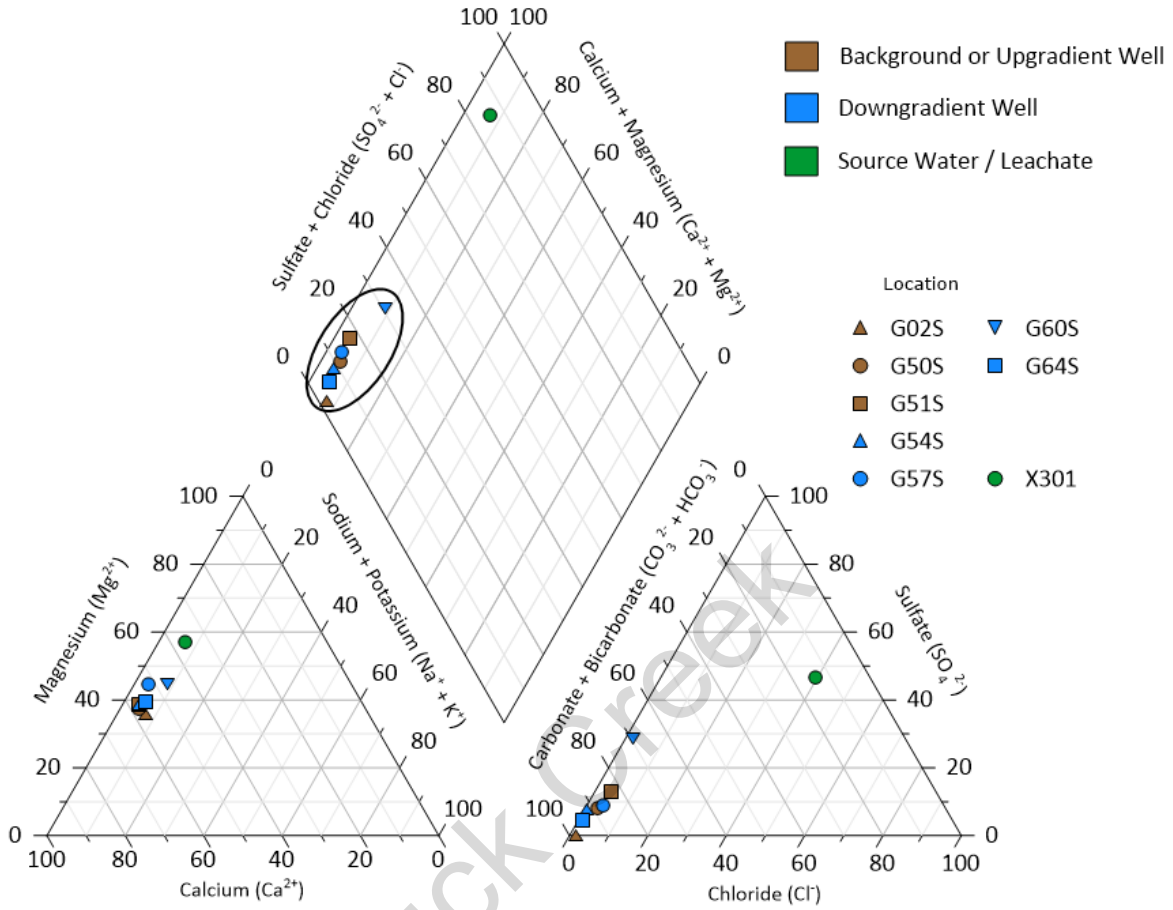


Figure A. Piper Diagram Showing Ionic Composition of Samples of Groundwater and Pond Water Associated with the Duck Creek GMF Pond.

3.2 LOE #2: Proximity of the GMF Pond to Historical Mining Activity and Related Groundwater Quality Impacts

The area surrounding the GMF Pond consists primarily of unmined coal and reclaimed surface mine land. The extent of nearby surface mines is shown in the attached Figure 2. The coal in this area has a sulfur content greater than 2.5 pounds (lbs) of sulfur per million British Thermal Units (BTU), the highest sulfur classification used by Illinois State Geological Survey (ISGS, 1997).

The coal in the area varies in depth from 0 to 50 ft below ground surface (bgs). The CCR Rule groundwater monitoring wells for the Duck Creek GMF Pond are screened between 23 and 48 ft bgs. Potentiometric data indicates that groundwater flows to the east and south as shown on the attached Figure 1. The CCR monitoring wells are located approximately 2,000 to 4,000 ft south-southeast (downgradient) of the nearby surface mines (Figure 2).

A study of groundwater quality near surface coal mines, performed by the U.S. Geological Survey (USGS, 2006), provides data on the effects of mines on groundwater quality. The study evaluated regional differences in major ionic composition of groundwater in unmined and mined areas using Piper diagrams (Figure B below). Groundwater samples collected from wells downgradient of the reclaimed mine areas in the study ranged from primarily calcium-magnesium carbonate-bicarbonate type (calcium-bicarbonate hydrochemical facies) to a lesser amount of calcium-magnesium sulfate

type (calcium sulfate hydrochemical facies). The calcium-bicarbonate groundwater documented in the vicinity of reclaimed surface coal mines is similar to the ionic composition of groundwater samples collected from background and downgradient groundwater monitoring wells at the GMF Pond.

State of Illinois groundwater quality regulations (Title 35 Illinois Administrative Code [35 IAC] Part 620 Groundwater Quality) acknowledge that water quality is adversely affected in areas where coal mining activity has occurred. The groundwater quality standards for TDS, chloride, iron, manganese, sulfate, and pH within previously mined areas are the existing concentrations of these constituents in groundwater (35 IAC § 620.440).

The proximity of the GMF Pond to historic coal mining activity and similarities in the ionic composition of groundwater in areas of reclaimed surface coal mines and in the GMF Pond groundwater samples demonstrate that historic mining activity has affected groundwater quality at the GMF Pond.

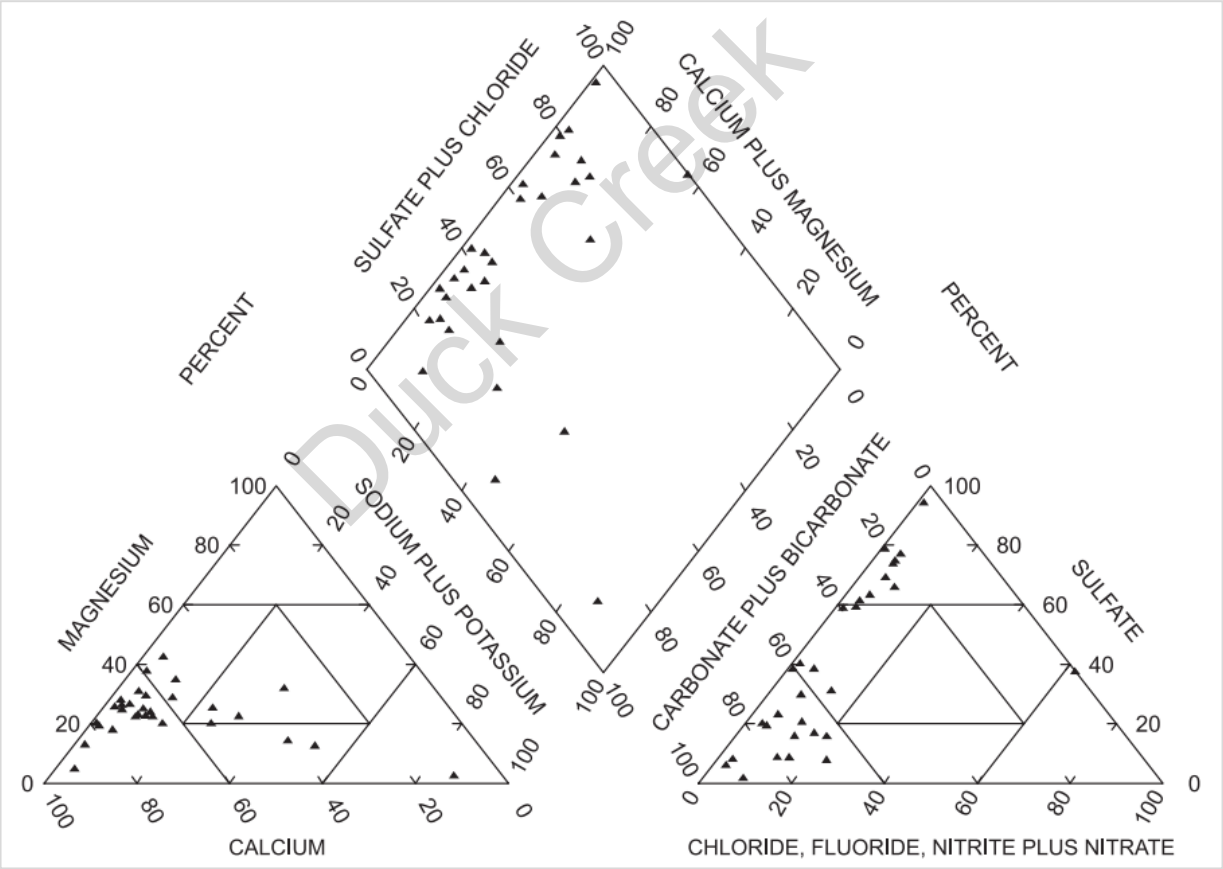


Figure B. Piper Diagram Showing Ionic Composition of Groundwater Downgradient of Reclaimed Surface Coal Mines in High-Sulfur Coal Regions (Modified from USGS).

3.3 LOE #3: Calcium was Present in Groundwater in the Vicinity of the GMF Pond Prior to the Unit Being Placed into Service at Concentrations that Exceeded Current Background Concentrations

The GMF Pond was placed in service in 2009. MW60S, a non-CCR rule monitoring well (Figure 1), was present prior to 2009 and was located side - to downgradient of where the GMF Pond was constructed. A box plot of calcium concentrations observed in groundwater samples collected from MW60S between March 2007 and November 2008 is shown in Figure C below. Calcium concentrations ranged from 87 milligrams per liter (mg/L) to 150 mg/L, and the average and median observed concentrations were 116 mg/L and 120 mg/L, respectively. Calcium concentrations were most often between 94 mg/L (first quartile) and 133 mg/L (third quartile). The calcium concentrations detected in downgradient monitoring wells G54S, G57S, and G60S during D6 were 150 mg/L, 150 mg/L, and 150 mg/L respectively, above the background Upper Prediction Limit (UPL) of 110 mg/L, but within the range of concentrations observed in MW60S before the GMF Pond was placed into service.

The similarity between the calcium concentrations detected in downgradient monitoring wells G54S, G57S, G60S and those observed in groundwater in the area prior to the GMF Pond being placed into service indicates that the GMF Pond is not the source of calcium SSIs in downgradient monitoring wells.

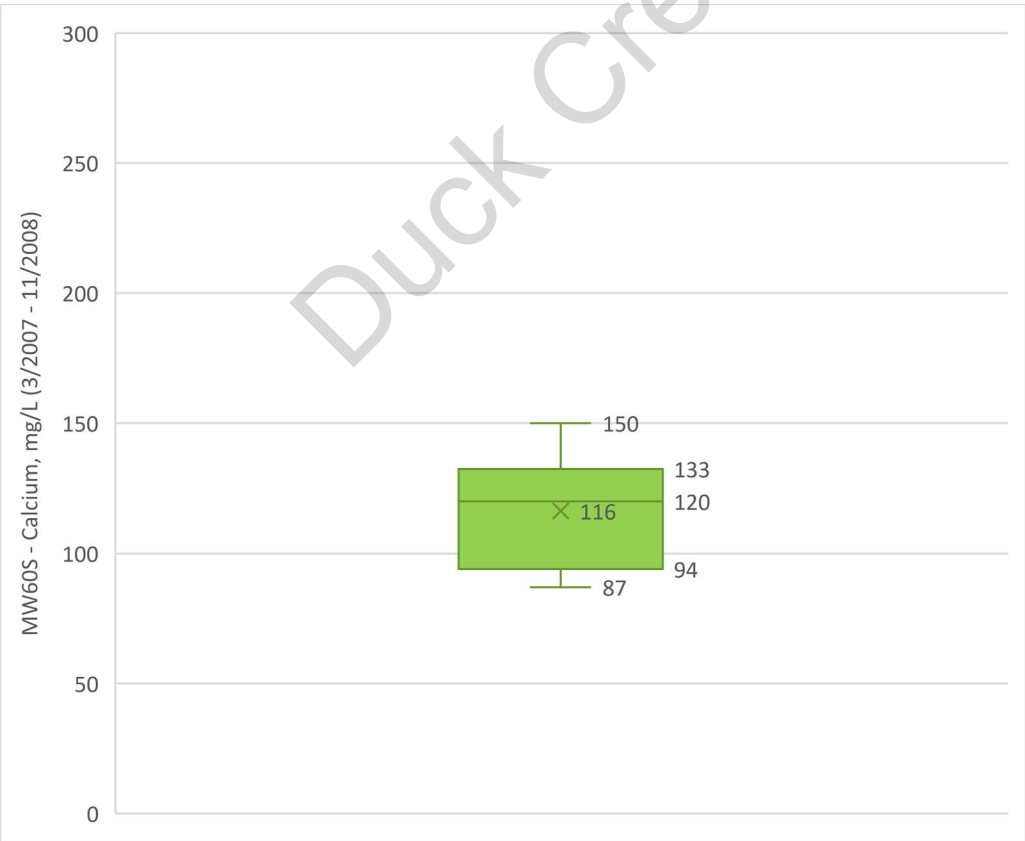


Figure C. Box plot of Calcium Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

3.4 LOE #4: Concentrations of Boron, a Common Indicator for CCR Impacts to Groundwater, are Below Background Concentrations and are Stable in Downgradient Wells

Boron is a common indicator of CCR impacts to groundwater due to its leachability from CCR and mobility in groundwater. If a CCR constituent other than boron is identified as an SSI; but boron is not also identified as elevated over background, it is unlikely that the CCR unit is the source of the SSI. Concentrations of boron in monitoring wells downgradient from the GMF Pond are below concentrations in background wells (and below the UPL that represents background concentrations of boron).

Boron concentrations measured in groundwater at downgradient wells between 2015 and 2020 range from 0.01 mg/L to 0.059 mg/L, below the UPL of 0.07 mg/L determined from background monitoring wells G02S, G50S and G51S. A time series plot for boron is provided in Figure D below.

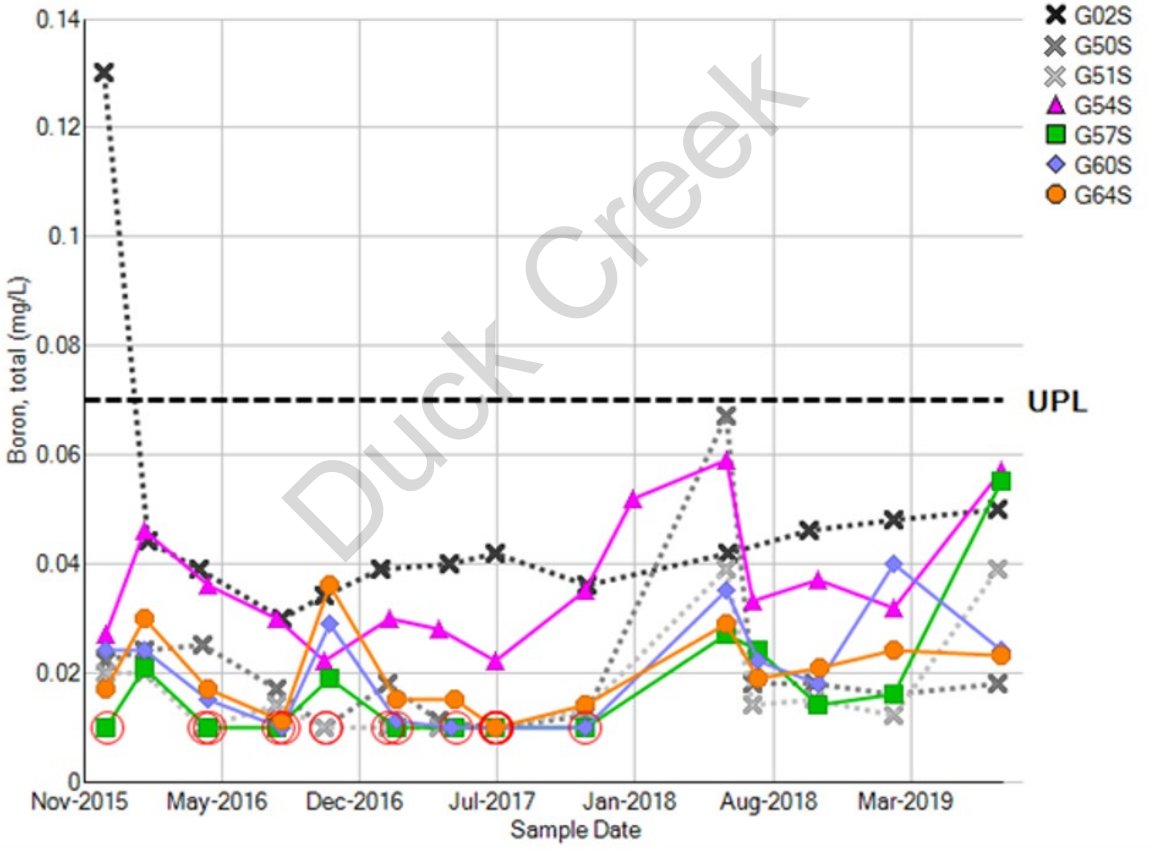


Figure D. Boron Time Series

Mann-Kendall trend analysis tests were performed to determine if boron concentrations at each well are increasing, decreasing, or stable (i.e., no statistically significant upward or downward trend). If the Mann-Kendall test did not identify a trend, the coefficient of variation (CV) was calculated to determine if the concentrations are too variable to identify a trend (i.e., CV greater than or equal to 1). Boron concentrations are stable in background and downgradient wells with the exception of G57S, at which a statistically significant downward trend was identified. Table A below provides summary statistics, including variability and trend by well.

Table A. Summary Statistics and Mann-Kendall Trend Analysis Results for Boron in Groundwater (December 2015 to January 2020).

Monitoring Well	Boron (mg/L)					
	Minimum	Maximum	Median	Standard Deviation	Trend	CV
G02S	0.030	0.13	0.042	0.024	Stable	0.51
G50S	<0.010	0.067	0.018	0.014	Stable	0.70
G51S	<0.010	0.039	0.014	0.010	Stable	0.59
G54S	0.022	0.059	0.034	0.012	Stable	0.32
G57S	<0.010	0.055	0.011	0.012	Stable	0.71
G60S	<0.010	0.040	0.022	0.010	Downward	0.48
G64S	<0.010	0.036	0.019	0.007	Stable	0.35

Relatively stable boron concentrations in downgradient monitoring wells below background concentrations demonstrate that the GMF Pond is not the source of CCR constituents detected in the downgradient monitoring wells.

4. CONCLUSIONS

Based on the four LOEs below, it has been demonstrated that the Duck Creek GMF Pond is not the source of SSIs of calcium at G54S, G57S, and G60S; of sulfate at G60S; and of TDS at G54S, G57S, and G60S.

5. The ionic composition of GMF Pond water is different from the ionic composition of groundwater.
6. Proximity of the GMF Pond to historical mining activity and related groundwater quality impacts.
7. Calcium was present in groundwater in the vicinity of the GMF Pond prior to the unit being placed into service at concentrations that exceeded current background concentrations.
8. Concentrations of boron, a common indicator for CCR impacts to groundwater, are below background concentrations and are stable in downgradient wells.

This information serves as the written ASD prepared in accordance with 40 C.F.R. § 257.94(e)(2) that the SSIs observed during the detection monitoring program were not due to the Duck Creek GMF Pond. Therefore, an assessment monitoring program is not required and the Duck Creek GMF Pond will remain in detection monitoring.

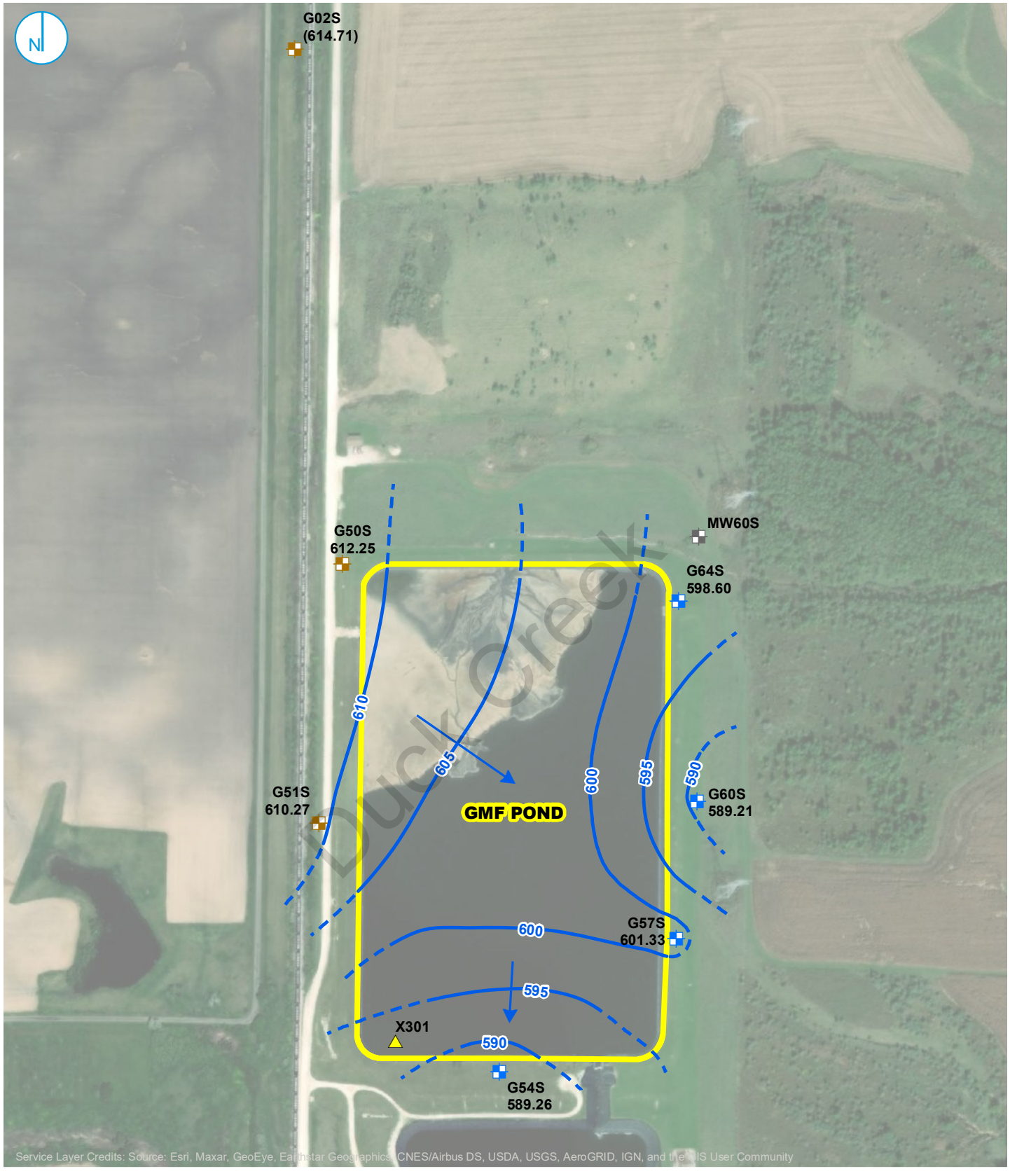
5. REFERENCES

Illinois State Geological Survey (ISGS), 1997. Illinois Coal Reserves Assessment and Database Development: Final Report, Open File Series 1997-4, Illinois State Geological Survey, Coal Section.

Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017. Hydrogeologic Monitoring Plan. Duck Creek GMF Pond – CCR Unit ID 203, Duck Creek Landfill – CCR Unit ID 204. Duck Creek Power Station, Canton, Illinois. Illinois Power Resources Generating, LLC.

United States Geological Survey (USGS), 2006. Ground-Water Quality in Unmined Areas and Near Reclaimed Surface Coal Mines in the Northern and Central Appalachian Coal Regions, Pennsylvania and West Virginia, Scientific Investigations Report 2006-5059, US Geological Survey.

FIGURES



Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\DC_GMF\Figure 1_GWE Contours_D6_DC203.mxd

PROJECT: 74916 | DESIGNER: STOLZSD

CCR RULE DOWNGRADIENT MONITORING WELL
CCR RULE BACKGROUND MONITORING WELL
NON-CCR RULE MONITORING WELL
SURFACE WATER SAMPLE LOCATION
GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION
CCR MONITORED UNIT

0 200 400 Feet

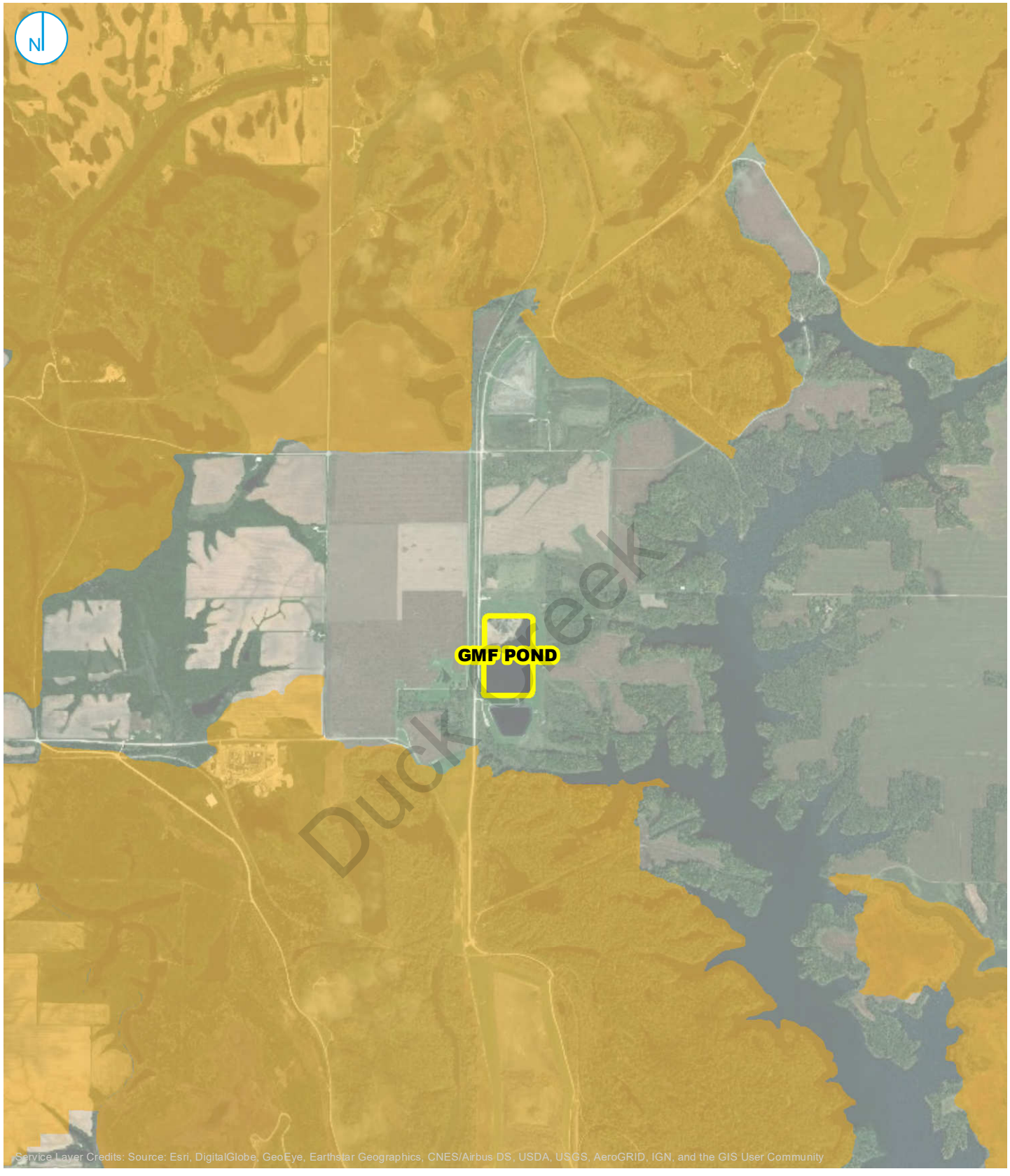
GROUNDWATER ELEVATION CONTOUR MAP
JANUARY 2-3, 2020

DUCK CREEK GMF POND (UNIT ID: 203)
ALTERNATE SOURCE DEMONSTRATION
VISTRA ENERGY
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE 1

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL



Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\DC_GMF\Figure 2_Coal Mine Coverage_D5_DC203.mxd

PROJECT: 74916 | DESIGNER: galarnmc

CCR MONITORED UNIT

MINE COVERAGE AREA

MINING COVERAGE AREA SOURCE:
LOUCHIOS, A., ELRICK, S., KOROSE, C, AND MORSE, D., OCTOBER 28, 2009. SPRINGFIELD COAL THICKNESS FULTON COUNTY, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN.

0 1,250 2,500 Feet

COAL MINE COVERAGE AREA

DUCK CREEK GMF POND (UNIT ID: 203)
ALTERNATE SOURCE DEMONSTRATION
VISTRA ENERGY
DUCK CREEK POWER STATION
CANTON, ILLINOIS

FIGURE 2

O'BRIEN & GERE ENGINEERS, INC.
A RAMBOLL COMPANY

RAMBOLL