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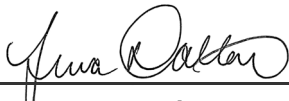
**2021 ANNUAL GROUNDWATER
MONITORING AND CORRECTIVE
ACTION REPORT**
GYPSUM MANAGEMENT FACILITY POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS
CCR UNIT 203

**2021 ANNUAL GROUNDWATER MONITORING AND
CORRECTIVE ACTION REPORT
DUCK CREEK POWER PLANT GYPSUM MANAGEMENT
FACILITY POND**

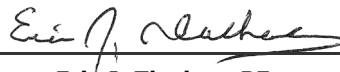
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Prepared by **Terra A Dalton**
Checked by **Lauren Cook**
Approved by **Eric J. Tlachac**
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Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
<https://ramboll.com>



Terra A. Dalton
Senior Project Scientist



Eric J. Tlachac, PE
Senior Managing Engineer

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ACRONYMS AND ABBREVIATIONS

| | |
|-----------|--|
| § | Section |
| 40 C.F.R. | Title 40 of the Code of Federal Regulations |
| ASD | Alternate Source Demonstration |
| CCR | coal combustion residuals |
| CMA | Corrective Measures Assessment |
| DCPP | Duck Creek Power Plant |
| GMFP | Gypsum Management Facility Pond |
| GWPS | groundwater protection standard |
| NA | not applicable |
| NRT/OBG | Natural Resource Technology, an OBG Company |
| Ramboll | Ramboll Americas Engineering Solutions, Inc. |
| SAP | Sampling and Analysis Plan |
| SSI | Statistically Significant Increase |
| SSL | Statistically Significant Level |
| TBD | to be determined |
| TDS | total dissolved solids |

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.) Section (§) 257.90(e) for the Gypsum Management Facility Pond (GMFP) located at Duck Creek Power Plant (DCPP) near Canton, Illinois.

Groundwater is being monitored at the GMFP 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 2021 (no wells were installed or decommissioned).

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

- Boron at well G60S
- Calcium at wells G54S, G57S, and G60S
- Sulfate at well G60S
- Total Dissolved Solids (TDS) at wells G54S, G57S, and G60S

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

1. INTRODUCTION

This report has been prepared by Ramboll Americas Engineering Solutions, Inc. (Ramboll) on behalf of Illinois Power Resources Generating, LLC, to provide the information required by 40 C.F.R. § 257.90(e) for the GMFP located at the DCCP 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 Statistically Significant Increase [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 the GMFP for calendar year 2021.

2. MONITORING AND CORRECTIVE ACTION PROGRAM STATUS

No changes have occurred to the monitoring program status in calendar year 2021 and the GMFP remains in the Detection Monitoring Program in accordance with 40 C.F.R. § 257.94.

3. KEY ACTIONS COMPLETED IN 2021

The Detection Monitoring Program is summarized in **Table A** on the following page. The groundwater monitoring system, including the CCR unit and all background and compliance monitoring wells, is presented in **Figure 1**. No changes were made to the monitoring system in 2021. In general, one groundwater sample was collected from each background and compliance well during each monitoring event.¹ All samples were collected and analyzed in accordance with the Sampling and Analysis Plan (SAP; Natural Resource Technology, an OBG Company [NRT/OBG], 2018). All monitoring data obtained under 40 C.F.R. § 257.90 through 257.98 (as applicable) in 2021, and analytical results for the August 2020 sampling event, are presented in **Tables 1** and **2**. 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 3**. The background values reported in **Table 3** are slightly different from those reported previously because different software was utilized to calculate these values in 2021.

Potential alternate sources were evaluated as outlined in the 40 C.F.R. § 257.94(e)(2). ASDs were completed and certified by a qualified professional engineer. The dates the ASDs were completed are provided in **Table A**. The ASDs are included in **Appendix A**.

¹ Sampling was limited to G54S and G64S during the June 2021 sampling event, and G54S and G60S during the November 2021 sampling event, to confirm SSIs of select Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event, as allowed by the Statistical Analysis Plan.

Table A. 2020-2021 Detection Monitoring Program Summary

| Sampling Date | Analytical Data Receipt Date | Parameters Collected | SSI(s) | SSI(s) Determination Date | ASD Completion Date |
|--------------------------------|------------------------------|--|--|---------------------------|---------------------|
| August 10 - 11, 2020 | October 15, 2020 | Appendix III | Calcium (G54S, G57S, G60S) Sulfate (G60S) TDS (G57S, G60S) | January 13, 2021 | April 13, 2021 |
| November 17, 2020 | December 7, 2020 | none | NA | NA | NA |
| February 19 - 24, 2021 | April 14, 2021 | Appendix III | Calcium (G54S, G57S, G60S) TDS (G54S, G57S, G60S) | July 13, 2021 | October 11, 2021 |
| June 21, 2021 ¹ | July 7, 2021 | pH at wells G54S and G64S TDS at wells G54S and G64S ² | NA | NA | NA |
| August 9 - 12, 2021 | September 1, 2021 | Appendix III | Boron (G60S) Calcium (G54S, G57S, G60S) TDS (G54S, G57S, G60S) | November 30, 2021 | TBD |
| November 18, 2021 ³ | December 6, 2021 | Boron at well G60S Calcium at well G60S pH at wells G54S and G60S TDS at well G54S ² | NA | NA | NA |

Notes:

NA: not applicable

TBD: to be determined

¹ Sampling was limited to G54S and G64S during the June 2021 sampling event to confirm SSIs of select Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event, as allowed by the Statistical Analysis Plan.

² Groundwater sample analysis was limited to select 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.

³ Sampling was limited to G54S and G60S during the November 2021 sampling event to confirm SSIs of select Appendix III parameters initially detected at concentrations greater than statistical background values in the preceding sampling event, 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 2021. Groundwater samples were collected and analyzed in accordance with the SAP (NRT/OBG, 2018), and all data were accepted.

5. KEY ACTIVITIES PLANNED FOR 2022

The following key activities are planned for 2022:

- All or part of the monitoring well network that was proposed for compliance with Title 35 of the Illinois Administrative Code § 845 is under evaluation for incorporation into the current monitoring system.
- Continuation of the Detection Monitoring Program with semi-annual sampling scheduled for the first and third quarters of 2022.
- Complete evaluation of analytical data from the compliance 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 the 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 2022 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 2022 (*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
GROUNDWATER ELEVATIONS
 2021 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
 DUCK CREEK POWER PLANT
 203 - GMF POND
 CANTON, IL

| Well ID | Well Type | Latitude (Decimal Degrees) | Longitude (Decimal Degrees) | Date | Depth to Groundwater (ft BMP) | Groundwater Elevation (ft NAVD88) |
|---------|------------|-------------------------------|--------------------------------|------------|----------------------------------|--------------------------------------|
| G02S | Background | 40.51288 | -89.99111 | 08/06/2020 | 11.04 | 610.89 |
| | | | | 11/16/2020 | 14.41 | 607.52 |
| | | | | 02/18/2021 | 8.69 | 612.97 |
| | | | | 04/14/2021 | 6.68 | 614.98 |
| | | | | 04/28/2021 | 7.72 | 613.94 |
| | | | | 05/10/2021 | 6.36 | 615.30 |
| | | | | 06/01/2021 | 7.81 | 613.85 |
| | | | | 06/10/2021 | 8.16 | 613.50 |
| | | | | 06/21/2021 | 7.82 | 613.84 |
| | | | | 07/12/2021 | 6.93 | 614.73 |
| | | | | 07/26/2021 | 7.73 | 613.93 |
| | | | | 08/05/2021 | 8.36 | 613.30 |
| | | | | 11/15/2021 | 7.72 | 613.94 |
| G50S | Background | 40.50867 | -89.99061 | 08/06/2020 | 15.33 | 608.32 |
| | | | | 11/16/2020 | 18.07 | 605.58 |
| | | | | 02/18/2021 | 13.35 | 610.30 |
| | | | | 04/14/2021 | 10.67 | 612.98 |
| | | | | 04/28/2021 | 12.11 | 611.54 |
| | | | | 05/10/2021 | 10.94 | 612.71 |
| | | | | 06/01/2021 | 11.78 | 611.87 |
| | | | | 06/10/2021 | 12.50 | 611.15 |
| | | | | 06/21/2021 | 12.08 | 611.57 |
| | | | | 07/12/2021 | 10.40 | 613.25 |
| | | | | 07/26/2021 | 11.59 | 612.06 |
| | | | | 08/05/2021 | 12.44 | 611.21 |
| | | | | 11/15/2021 | 12.13 | 611.52 |
| G51S | Background | 40.50656 | -89.99086 | 08/06/2020 | 16.02 | 603.64 |
| | | | | 11/16/2020 | 17.56 | 602.10 |
| | | | | 02/18/2021 | 12.62 | 607.04 |
| | | | | 04/14/2021 | 8.97 | 610.69 |
| | | | | 04/28/2021 | 10.31 | 609.35 |
| | | | | 05/10/2021 | 8.73 | 610.93 |
| | | | | 06/01/2021 | 10.22 | 609.44 |
| | | | | 06/10/2021 | 12.68 | 606.98 |
| | | | | 06/21/2021 | 10.29 | 609.37 |
| | | | | 07/12/2021 | 8.75 | 610.91 |
| | | | | 07/26/2021 | 10.82 | 608.84 |
| | | | | 08/05/2021 | 13.32 | 606.34 |
| | | | | 11/15/2021 | 10.10 | 609.56 |
| G54S | Compliance | 40.50453 | -89.98894 | 08/06/2020 | 31.59 | 591.39 |
| | | | | 11/16/2020 | 31.51 | 591.47 |
| | | | | 02/18/2021 | 32.46 | 590.52 |
| | | | | 04/14/2021 | 32.54 | 590.44 |
| | | | | 04/28/2021 | 32.46 | 590.52 |
| | | | | 05/10/2021 | 32.45 | 590.53 |
| | | | | 06/01/2021 | 32.18 | 590.80 |

**TABLE 1
GROUNDWATER ELEVATIONS**
2021 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
DUCK CREEK POWER PLANT
203 - GMF POND
CANTON, IL

| Well ID | Well Type | Latitude (Decimal Degrees) | Longitude (Decimal Degrees) | Date | Depth to Groundwater (ft BMP) | Groundwater Elevation (ft NAVD88) |
|---------|------------|-------------------------------|--------------------------------|------------|----------------------------------|--------------------------------------|
| G54S | Compliance | 40.50453 | -89.98894 | 06/10/2021 | 31.91 | 591.07 |
| | | | | 06/21/2021 | 31.75 | 591.23 |
| | | | | 07/12/2021 | 31.22 | 591.76 |
| | | | | 07/26/2021 | 31.00 | 591.98 |
| | | | | 08/05/2021 | 30.43 | 592.55 |
| | | | | 11/15/2021 | 28.38 | 594.60 |
| G57S | Compliance | 40.50561 | -89.98704 | 08/06/2020 | 22.11 | 600.65 |
| | | | | 11/16/2020 | 26.48 | 596.28 |
| | | | | 02/18/2021 | 26.55 | 596.21 |
| | | | | 04/14/2021 | 20.93 | 601.83 |
| | | | | 04/28/2021 | 20.77 | 601.99 |
| | | | | 05/10/2021 | 20.15 | 602.61 |
| | | | | 06/01/2021 | 18.87 | 603.89 |
| | | | | 06/10/2021 | 19.56 | 603.20 |
| | | | | 06/21/2021 | 20.24 | 602.52 |
| | | | | 07/12/2021 | 18.08 | 604.68 |
| | | | | 07/26/2021 | 18.35 | 604.41 |
| | | | | 08/05/2021 | 19.25 | 603.51 |
| | | | | 11/15/2021 | 20.97 | 601.79 |
| G60S | Compliance | 40.50673 | -89.98681 | 08/06/2020 | 26.15 | 588.88 |
| | | | | 11/16/2020 | 27.37 | 587.66 |
| | | | | 02/18/2021 | 27.68 | 587.35 |
| | | | | 04/14/2021 | 24.87 | 590.16 |
| | | | | 04/28/2021 | 25.27 | 589.76 |
| | | | | 05/10/2021 | 24.69 | 590.34 |
| | | | | 06/01/2021 | 24.49 | 590.54 |
| | | | | 06/10/2021 | 25.01 | 590.02 |
| | | | | 06/21/2021 | 25.55 | 589.48 |
| | | | | 07/12/2021 | 24.01 | 591.02 |
| | | | | 07/26/2021 | 24.32 | 590.71 |
| | | | | 08/05/2021 | 24.98 | 590.05 |
| | | | | 11/15/2021 | 24.60 | 590.43 |
| G64S | Compliance | 40.50837 | -89.98701 | 08/06/2020 | 24.34 | 598.72 |
| | | | | 11/16/2020 | 26.79 | 596.27 |
| | | | | 02/18/2021 | 26.93 | 596.13 |
| | | | | 04/14/2021 | 24.02 | 599.04 |
| | | | | 04/28/2021 | 23.68 | 599.38 |
| | | | | 05/10/2021 | 23.42 | 599.64 |
| | | | | 06/01/2021 | 22.78 | 600.28 |
| | | | | 06/10/2021 | 23.09 | 599.97 |
| | | | | 06/21/2021 | 23.55 | 599.51 |
| | | | | 07/12/2021 | 22.56 | 600.50 |
| | | | | 07/26/2021 | 22.46 | 600.60 |
| | | | | 08/05/2021 | 23.02 | 600.04 |
| | | | | 11/15/2021 | 23.59 | 599.47 |

Notes:

BMP = below measuring point
ft = foot/feet

NAVD88 = North American Vertical Datum of 1988

TABLE 2
ANALYTICAL RESULTS - APPENDIX III PARAMETERS
 2021 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
 DUCK CREEK POWER PLANT
 203 - GMF POND
 CANTON, IL

| Well ID | Well Type | Latitude (Decimal Degrees) | Longitude (Decimal Degrees) | Date | Boron, total (mg/L) | Calcium, total (mg/L) | Chloride, total (mg/L) | Fluoride, total (mg/L) | pH (field) (SU) | Sulfate, total (mg/L) | Total Dissolved Solids (mg/L) |
|---------|------------|-------------------------------|--------------------------------|------------|------------------------|--------------------------|---------------------------|---------------------------|--------------------|--------------------------|----------------------------------|
| G02S | Background | 40.51288 | -89.99111 | 08/11/2020 | 0.049 | 97 | <5 | 0.27 | 6.4 | <1 | 420 |
| | | | | 02/19/2021 | 0.037 | 95 | 2.6 | 0.411 | 6.5 | <1 | 340 |
| | | | | 08/09/2021 | 0.043 | 95 | 2.7 | 0.325 | 6.4 | <1 | 460 |
| G50S | Background | 40.50867 | -89.99061 | 08/10/2020 | 0.016 | 91 | 8.5 | 0.28 | 6.8 | 38 | 370 |
| | | | | 02/19/2021 | 0.015 | 95 | 12 | 0.335 | 7.0 | 41 | 330 |
| | | | | 08/10/2021 | 0.015 | 98 | 14 | 0.295 | 7.1 | 46 | 450 |
| G51S | Background | 40.50656 | -89.99086 | 08/10/2020 | 0.01 | 99 | 8.2 | <0.25 | 6.9 | 26 | 390 |
| | | | | 02/19/2021 | 0.022 | 100 | 19 | 0.316 | 7.2 | 52 | 410 |
| | | | | 08/10/2021 | 0.011 | 100 | 17 | 0.306 | 7.0 | 51 | 440 |
| G54S | Compliance | 40.50453 | -89.98894 | 08/10/2020 | 0.034 | 140 | 1.1 | <0.25 | 6.8 | 21 | 460 |
| | | | | 02/22/2021 | 0.045 | 120 | 2.5 | <0.25 | 6.8 | 39 | 500 |
| | | | | 06/21/2021 | -- | -- | -- | -- | 7.0 | -- | 590 |
| | | | | 08/11/2021 | 0.032 | 130 | 2.1 | <0.25 | 6.8 | 41 | 660 |
| | | | | 11/18/2021 | -- | -- | -- | -- | 6.4 | -- | 680 |
| G57S | Compliance | 40.50561 | -89.98704 | 08/10/2020 | <0.01 | 150 | 15 | 0.292 | 6.6 | 51 | 600 |
| | | | | 11/17/2020 | -- | -- | -- | -- | -- | -- | 590 |
| | | | | 02/22/2021 | 0.013 | 120 | 1.8 | 0.313 | 6.9 | 54 | 680 |
| | | | | 08/09/2021 | 0.011 | 150 | 18 | 0.299 | 6.8 | 50 | 770 |
| G60S | Compliance | 40.50673 | -89.98681 | 08/10/2020 | 0.015 | 140 | 6.8 | <0.25 | 6.6 | 120 | 600 |
| | | | | 11/17/2020 | -- | -- | -- | -- | -- | 110 | 630 |
| | | | | 02/23/2021 | 0.019 | 130 | 9.1 | <0.25 | 6.6 | 67 | 620 |
| | | | | 08/12/2021 | 0.15 | 150 | 7.1 | 0.264 | 6.9 | 73 | 650 |
| | | | | 11/18/2021 | 0.12 | 130 | -- | -- | 6.6 | -- | -- |
| G64S | Compliance | 40.50837 | -89.98701 | 08/11/2020 | 0.019 | 100 | 3.7 | 0.287 | 7.0 | 26 | 440 |
| | | | | 02/24/2021 | 0.021 | 100 | 3.6 | 0.385 | 7.0 | 22 | 500 |

TABLE 2
ANALYTICAL RESULTS - APPENDIX III PARAMETERS
 2021 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
 DUCK CREEK POWER PLANT
 203 - GMF POND
 CANTON, IL

| Well ID | Well Type | Latitude (Decimal Degrees) | Longitude (Decimal Degrees) | Date | Boron, total (mg/L) | Calcium, total (mg/L) | Chloride, total (mg/L) | Fluoride, total (mg/L) | pH (field) (SU) | Sulfate, total (mg/L) | Total Dissolved Solids (mg/L) |
|---------|------------|-------------------------------|--------------------------------|------------|------------------------|--------------------------|---------------------------|---------------------------|--------------------|--------------------------|----------------------------------|
| G64S | Compliance | 40.50837 | -89.98701 | 06/21/2021 | -- | -- | -- | -- | 7.1 | -- | 450 |
| | | | | 08/09/2021 | 0.02 | 99 | 3.8 | 0.339 | 7.0 | 26 | 460 |

Notes:
 mg/L = milligrams per liter
 SU = 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 they are not utilized in statistics to determine Statistically Significant Increases (SSIs) over background
 -- = not analyzed

TABLE 3
STATISTICAL BACKGROUND VALUES
 2021 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
 DUCK CREEK POWER PLANT
 203 - GMF POND
 CANTON, IL

| Parameter | Statistical Background Value (LPL/UPL) |
|---------------------------------|--|
| 40 C.F.R. Part 257 Appendix III | |
| Boron (mg/L) | 0.059 |
| Calcium (mg/L) | 112 |
| Chloride (mg/L) | 22.0 |
| Fluoride (mg/L) | 0.564 |
| pH (field) (SU) | 6.5/7.5 |
| Sulfate (mg/L) | 97.0 |
| Total Dissolved Solids (mg/L) | 499 |

Notes:
 40 C.F.R. = Title 40 of the Code of Federal Regulations
 LPL = Lower Prediction Limit (applicable for pH only)
 mg/L = milligrams per liter
 SU = Standard Units
 UPL = Upper Prediction Limit

FIGURES



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- BACKGROUND WELL
- COMPLIANCE WELL
- PART 257 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

MONITORING WELL LOCATION MAP

FIGURE 1

2021 ANNUAL GROUNDWATER MONITORING
AND CORRECTIVE ACTION REPORT
GMF POND
DUCK CREEK POWER PLANT
CANTON, ILLINOIS

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.



0 150 300
Feet

APPENDICES

APPENDIX A
ALTERNATE SOURCE DEMONSTRATIONS

Intended for
Illinois Power Resources Generating, LLC

Date
April 13, 2021

Project No.
1940100711-005

**40 C.F.R. § 257.95(g)(3)(ii):
ALTERNATE SOURCE DEMONSTRATION
DUCK CREEK GYPSUM MANAGEMENT
FACILITY POND**

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.
Date: April 13, 2021



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.
Date: April 13, 2021



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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 |
| CCR Rule | 40 C.F.R. Part 257 Subpart D |
| D7 | Detection Monitoring Round 7 |
| ft | feet |
| GMF | Duck Creek Gypsum Management Facility |
| ISGS | Illinois State Geological Survey |
| LOE | Line of Evidence |
| mg/L | milligrams per liter |
| NAVD88 | North American Vertical Datum of 1988 |
| NRT/OBG | Natural Resource Technology, an OBG Company |
| Site | Duck Creek Power Station |
| SSI | Statistically Significant Increase |
| 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 (SSI) 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. 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 seventh semi-annual detection monitoring samples (Detection Monitoring Round 7 [D7]) were collected between August 10 and 11, 2020 and analytical data were received on October 15, 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 (CCR Rule) Appendix III parameters over background concentrations was completed by January 13, 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 G57S and G60S

In accordance with the Statistical Analysis Plan (Natural Resource Technology, an OBG Company [NRT/OBG], 2017a), wells G57S and G60S were resampled on November 17, 2020 and analyzed only for the SSI parameters sulfate (at well G60S) and TDS (at wells G57S and G60S) to confirm the SSIs. Following evaluation of the analytical data from the resample for G57S and G60S, the following SSIs were confirmed:

- Calcium at wells G54S, G57S, and G60S
- Sulfate at well G60S
- TDS at wells 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 13, 2021, 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 geology and hydrogeology summarized below is from the Hydrogeologic Monitoring Plan (NRT/OBG, 2017b).

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 (referenced to North American Vertical Datum of 1988 [NAVD88]) in the Uppermost Aquifer across the GMF Pond are shown on Figure 1. Groundwater elevations were measured on August 6, 2020, prior to a combined D7 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. Groundwater elevations beneath the GMF Pond ranged from about 605 ft to

about 590 ft and overall groundwater flow within the Uppermost Aquifer under the GMF Pond was from northwest to 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 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. Downgradient concentrations of boron do not exceed background limits.

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 ellipse and green square 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 (green square) 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.

DC GMF Pond - D7

X301 collected June 2020



Figure A. Piper Diagram Showing Ionic Composition of Samples of Groundwater and Pond Water Associated with the GMF Pond. Brown = background wells, Blue = downgradient wells, Green = pond surface water.

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 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.

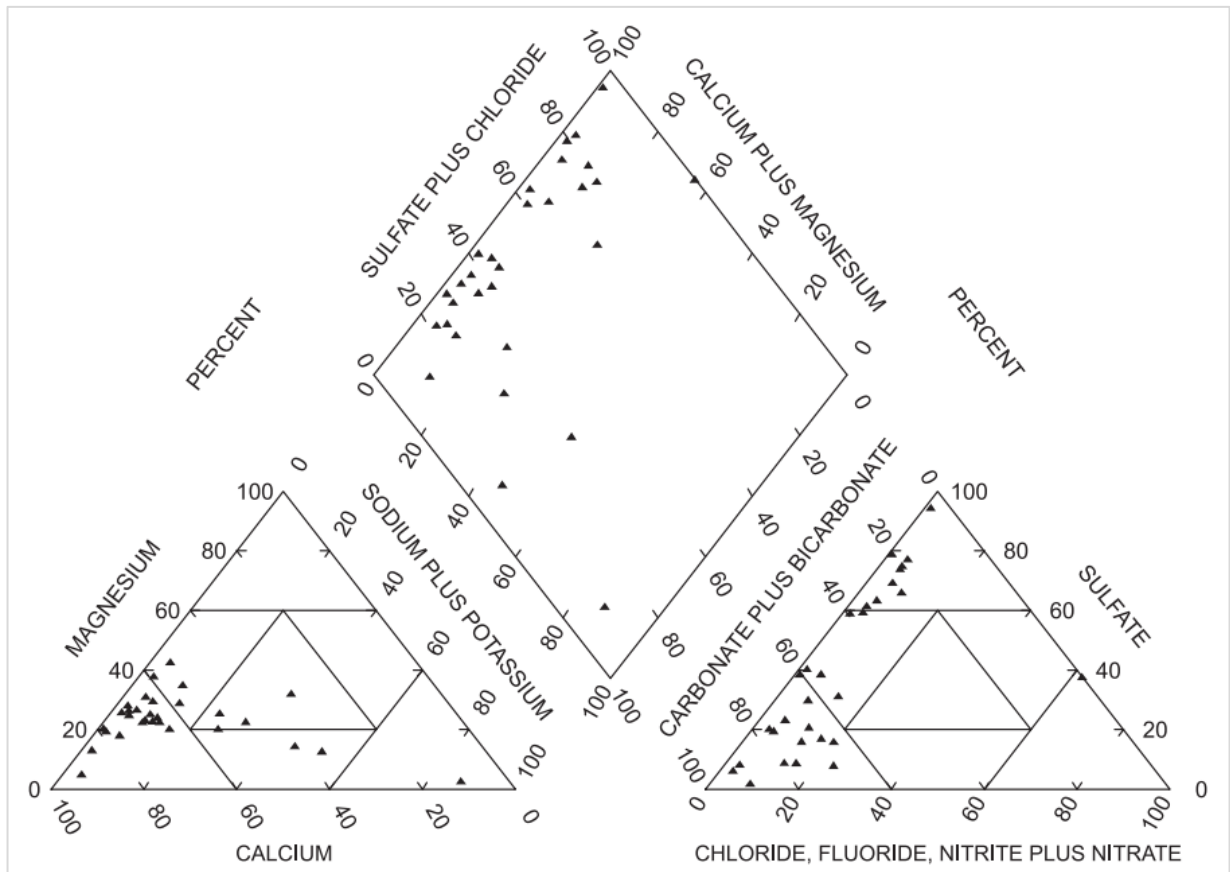


Figure B. Piper Diagram Showing Ionic Composition of Groundwater Downgradient of Reclaimed Surface Coal Mines in High-Sulfur Coal Regions (Modified from USGS).

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 D7 were 140 mg/L, 150 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.

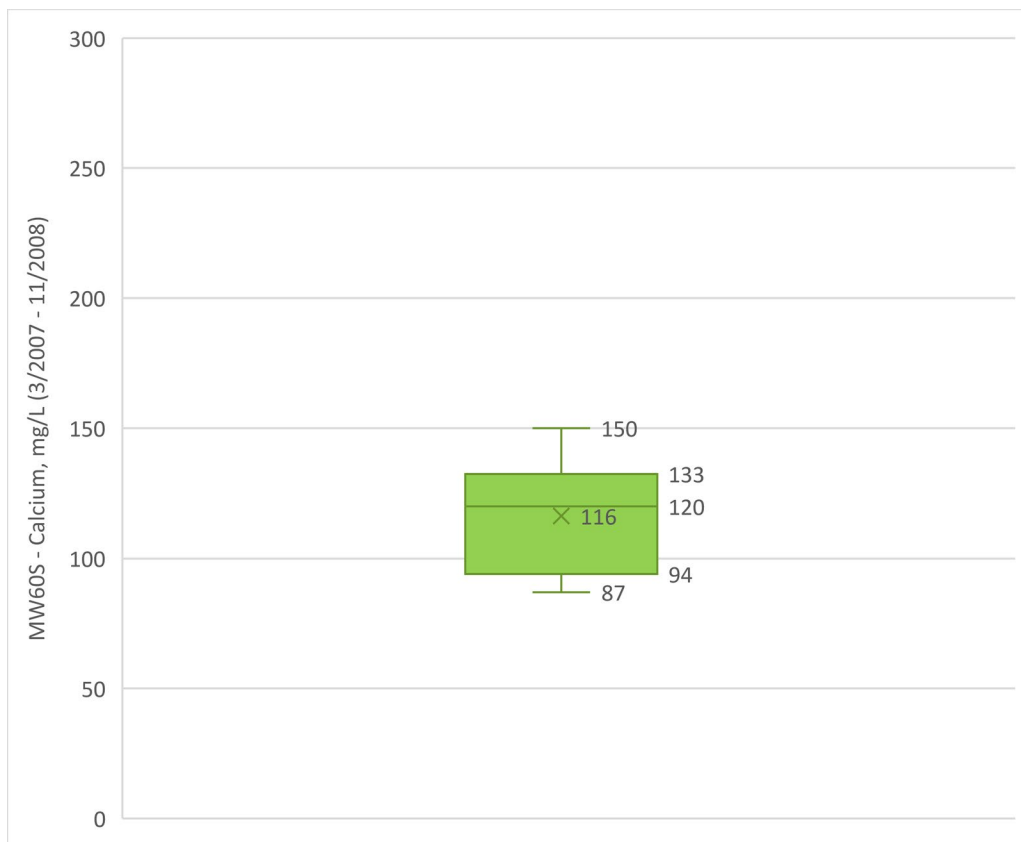


Figure C. Box plot of Calcium Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

3.4 LOE #4: Downgradient Concentrations of Boron Do Not Exceed Background Limits

Boron is an indicator of CCR impacts to groundwater due to its leachability from CCR and mobility in groundwater. If the groundwater downgradient of the GMF Pond has been impacted by discharge of CCR from the unit, boron would be expected to be elevated above UPLs. The UPL is an upper bound on background concentrations calculated for comparing downgradient measurements to background. Downgradient monitoring wells having SSIs had concentrations of boron below the UPL for boron (0.07 mg/L) (Table A).

Table A. Summary Statistics for Boron in Groundwater (December 2015 to August 2020).

| Location | Boron (UPL = 0.07 mg/L) | |
|----------|-------------------------|---------|
| | Minimum | Maximum |
| G54S | 0.022 | 0.059 |
| G57S | <0.010 | 0.055 |
| G60S | <0.010 | 0.040 |

In downgradient monitoring wells with SSIs, concentrations of boron below the UPL indicates that these wells have not been affected by CCR. Therefore, the GMF Pond is not the source of the SSIs.

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 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 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.
4. Downgradient concentrations of boron do not exceed background limits.

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 GMF Pond. Therefore, an assessment monitoring program is not required and the GMF Pond will remain in detection monitoring.

5. REFERENCES

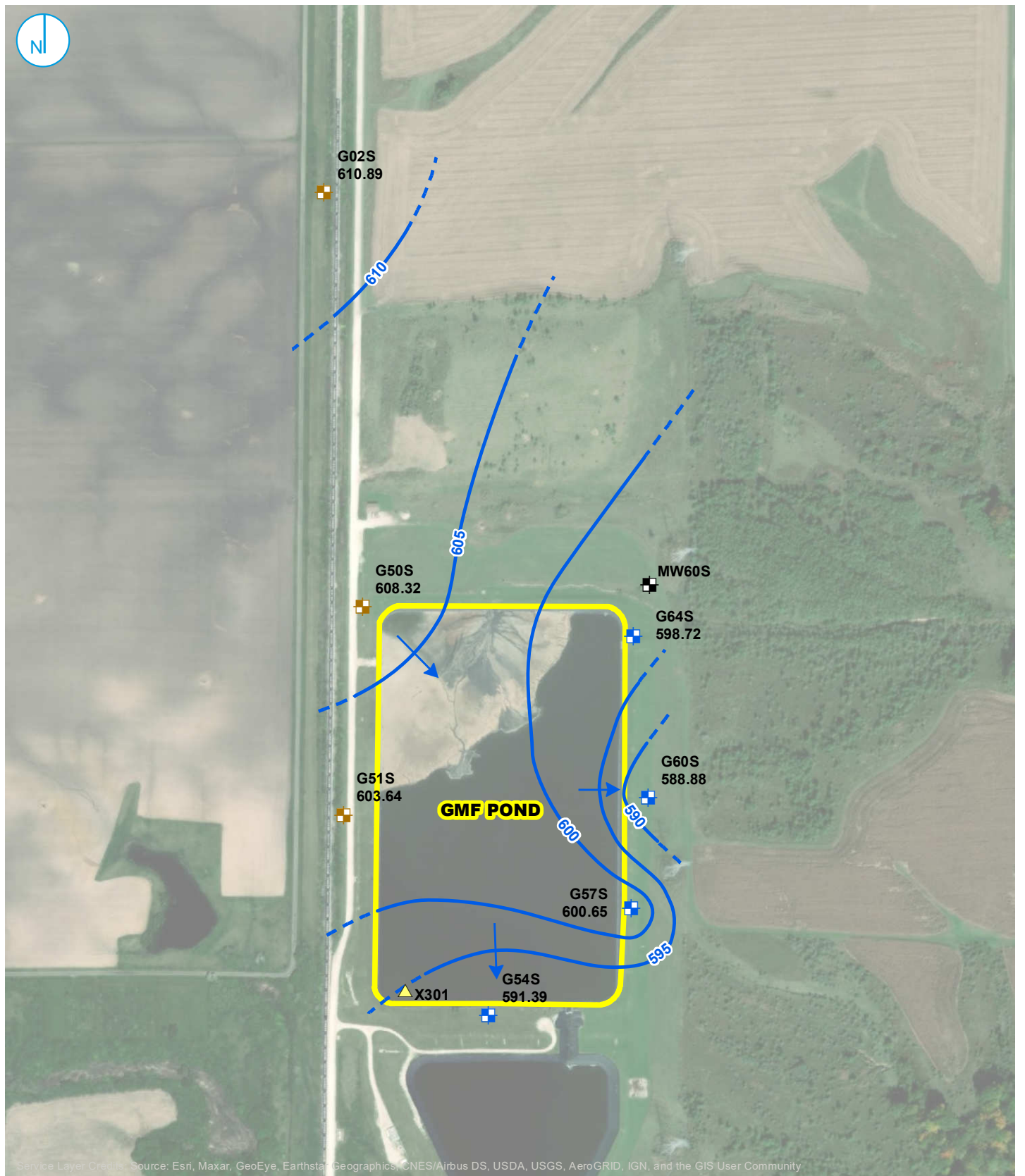
Illinois State Geological Survey (ISGS), 1997. Illinois Coal Reserves Assessment and Database Development: Final Report, Open File Series 1997-4, Illinois State Geological Survey, Coal Section.

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

Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017b. 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



- CCR RULE DOWNGRADE 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
- 0 250 500 Feet

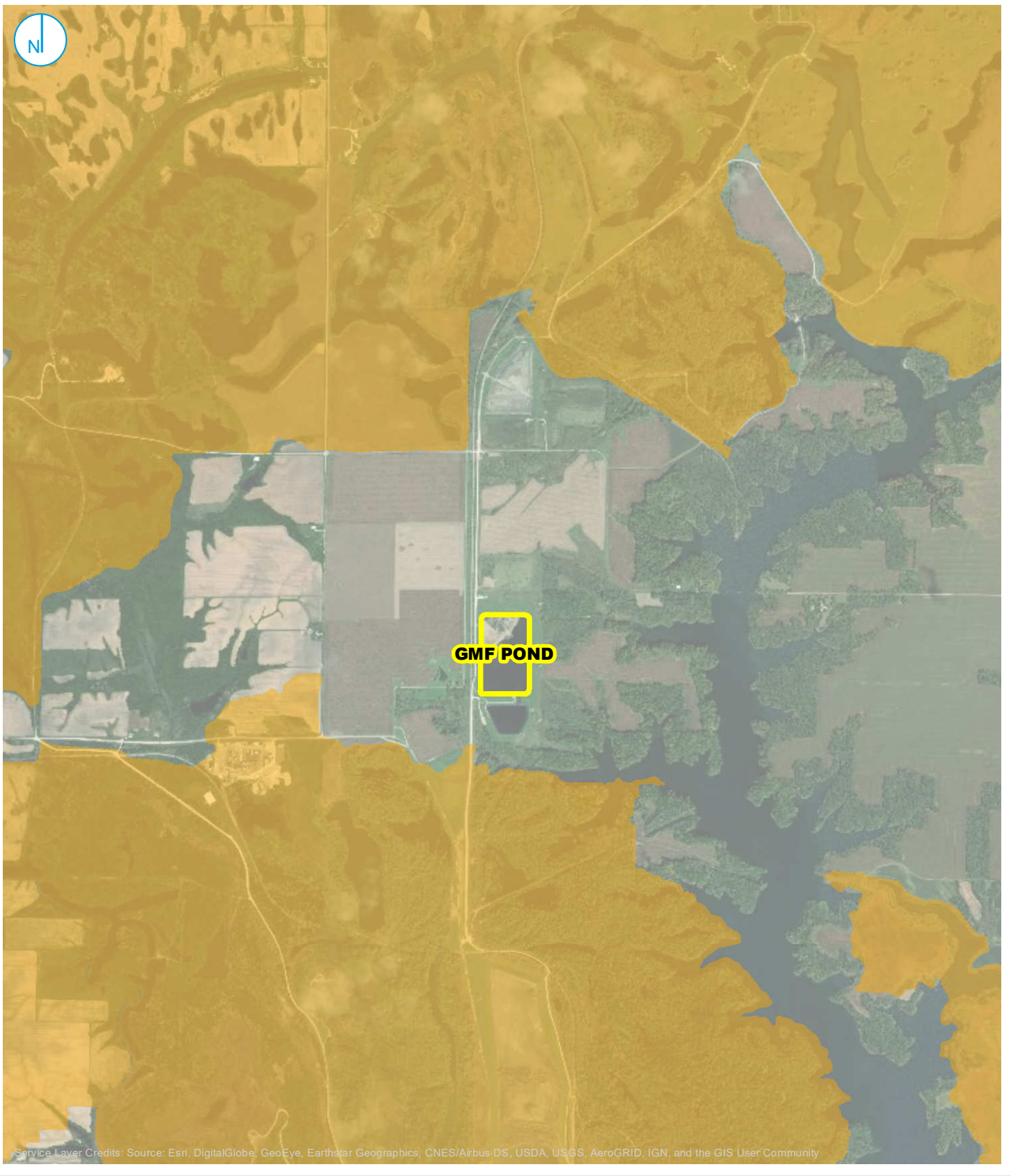
**GROUNDWATER ELEVATION
CONTOUR MAP
AUGUST 6, 2020**

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

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY





Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- 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.



COAL MINE COVERAGE AREA

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

FIGURE 2

RAMBOLL AMERICAS
 ENGINEERING SOLUTIONS, INC.
 A RAMBOLL COMPANY



Intended for
Illinois Power Resources Generating, LLC

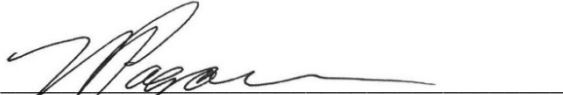
Date
October 11, 2021

Project No.
1940100711-005

**40 C.F.R. § 257.94(E)(2): ALTERNATE
SOURCE DEMONSTRATION
DUCK CREEK POWER PLANT
GYPSUM MANAGEMENT FACILITY POND
CCR UNIT 203**

CERTIFICATIONS

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 other than for its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.



Nicole M. Pagano
Professional Geologist
196-000750
Illinois
Ramboll Americas Engineering Solutions, Inc.
Date: October 11, 2021



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 other than for 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.
Date: October 11, 2021



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| 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 | 9 |
| 3.4 | LOE #4: Boron Concentrations in Compliance Groundwater Monitoring Wells Do Not Exceed Background Limits | 10 |
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FIGURES (IN TEXT)

| | |
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| Figure A | Piper Diagram Showing Ionic Composition of Samples of Groundwater and Pond Water Associated with 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). |
| Figure C | Box plot of Calcium Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008. |

FIGURES (ATTACHED)

| | |
|----------|--|
| Figure 1 | Groundwater Elevation Contour Map – February 18, 2021. |
| Figure 2 | Coal Mine Coverage Area |

ACRONYMS AND ABBREVIATIONS

| | |
|-----------|--|
| 35 I.A.C. | Title 35 of the 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 |
| CCR Rule | 40 C.F.R. § 257 Subpart D |
| D8 | Detection Monitoring Round 8 |
| GMF | Gypsum Management Facility |
| ISGS | Illinois State Geological Survey |
| LOE | Line of Evidence |
| mg/L | milligrams per liter |
| NAVD88 | North American Vertical Datum of 1988 |
| NRT/OBG | Natural Resource Technology, an OBG Company |
| Site | Duck Creek Power Plant |
| SSI | Statistically Significant Increase |
| TDS | total dissolved solids |
| 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 (SSI) over background for groundwater constituents listed in Appendix III of 40 C.F.R. § 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. to provide pertinent information pursuant to 40 C.F.R. § 257.94(e)(2) for the Duck Creek Power Plant (DCPP) Gypsum Management Facility (GMF) Pond located near Canton, Illinois.

The eighth semi-annual detection monitoring samples (Detection Monitoring Round 8 [D8]) were collected between February 19 and 24, 2021 and analytical data were received on April 14, 2021. In accordance with 40 C.F.R. § 257.93(h)(2), statistical analysis of the data to identify SSIs of 40 C.F.R. § 257 Subpart D (CCR Rule) Appendix III parameters over background concentrations was completed by July 13, 2021, within 90 days of receipt of the analytical data. The statistical determination identified the following SSIs at compliance monitoring wells:

- Calcium at wells G54S, G57S, and G60S
- Total dissolved solids (TDS) at wells G54S, G57S, G60S, and G64S

In accordance with the Statistical Analysis Plan (Natural Resource Technology, an OBG Company [NRT/OBG], 2017a), wells G54S and G64S were resampled on June 21, 2021 and analyzed only for the SSI parameter TDS to confirm the SSIs. Following evaluation of the analytical data from the resample for G54S and G64S, the following SSIs were confirmed:

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

Pursuant to 40 C.F.R. § 257.94(e)(2), the following lines of evidence (LOEs) demonstrate that sources other than the GMF Pond were the cause of the SSIs listed above. This ASD was completed by October 11, 2021, within 90 days of determination of the SSIs (July 13, 2021), as required by 40 C.F.R. § 257.94(e)(2).

2. BACKGROUND

2.1 Site Location and Description

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

2.2 Geology and Hydrogeology

The DCPD geology and hydrogeology summarized below is from the Hydrogeologic Monitoring Plan (NRT/OBG, 2017b).

2.2.1 Geology

Regionally, the DCPD 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 feet), 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 (referenced to North American Vertical Datum of 1988 [NAVD88]) in the Uppermost Aquifer across the GMF Pond are shown on Figure 1. Groundwater elevations were measured on February 18, 2021, prior to a combined D8 sampling event at the DCPD for the three CCR units located there, and for multiple monitoring programs required by both federal and state regulatory agencies. Groundwater elevations beneath the GMF Pond ranged from

approximately 610 to 587 feet and overall groundwater flow within the Uppermost Aquifer under the GMF Pond was from northwest to southeast.

2.3 Groundwater, GMF Pond and Porewater 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 compliance monitoring wells are G54S, G57S, G60S, and G64S.

GMF Pond water samples are collected from the GMF Pond at locations X301 and XTPW02. Location X301 is a riser pipe from the ring drain beneath the pond, while XTPW02 is a porewater sample collected from a monitoring well installed in the gypsum within the pond (Figure 1). The most recent pond water sample was collected from X301 on February 24, 2021, while the porewater sample collected from XTPW02 was collected on June 23, 2021.

3. ALTERNATE SOURCE DEMONSTRATION: LINES OF EVIDENCE

As allowed by 40 C.F.R. § 257.94(e)(2), this ASD demonstrates that sources other than the GMF Pond (the CCR unit) caused the SSIs. LOEs supporting this ASD include the following:

1. The ionic composition of potential GMF Pond source 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. Boron concentrations in compliance groundwater monitoring wells do not exceed background limits.

These LOEs are described and supported in greater detail below.

3.1 LOE #1: The Ionic Composition of Potential GMF Pond Source 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, on the following page, is a Piper diagram that displays the ionic composition of groundwater samples from the background and compliance wells associated with the GMF Pond and potential source waters. Potential source water samples were collected from the ring drain (X301) underlying the GMF Pond and a porewater sample collected from a monitoring well installed in the gypsum within the pond (XTPW02). The ionic compositional groupings identified are shown in the black ellipse and green square 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 compliance wells (enclosed within a black ellipse) are in the calcium-bicarbonate hydrochemical facies, and the potential source waters (green symbols) are in the calcium-sulfate hydrochemical facies. The dissimilar ionic compositions of the GMF Pond background and compliance groundwater and the potential GMF Pond source water indicate that the GMF Pond is not the source of CCR constituents detected in GMF Pond groundwater.

Duck Creek Part 257 - D8

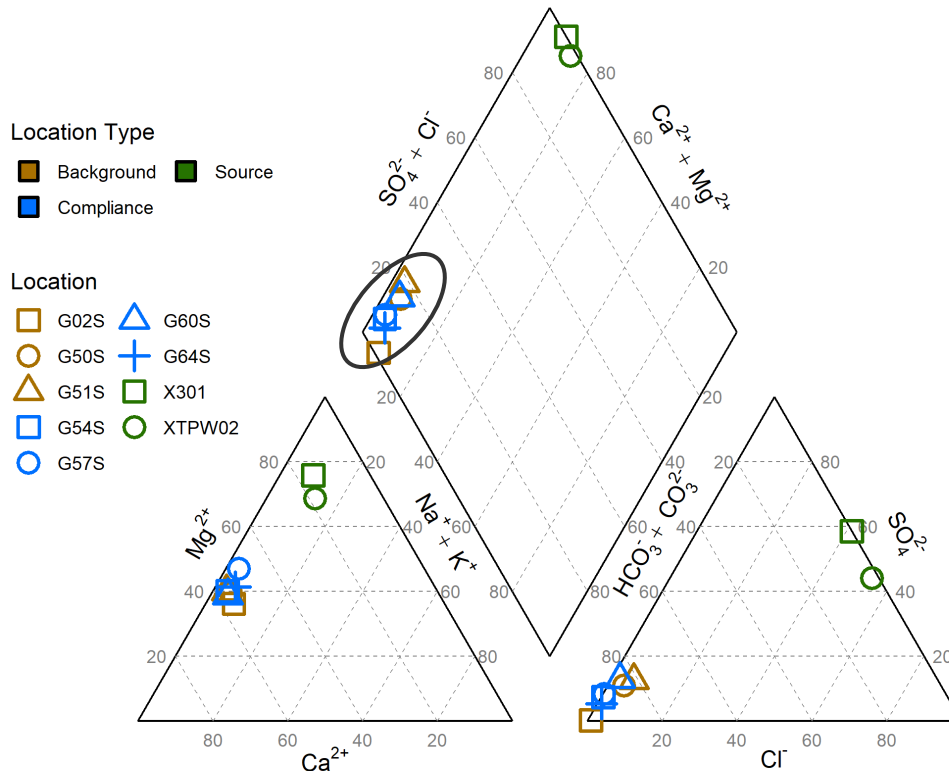


Figure A. Piper Diagram Showing Ionic Composition of Samples of Groundwater and Pond Water Associated with the GMF Pond (Brown = background wells, Blue = compliance wells, Green = potential source water).

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 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 feet below ground surface (bgs). The CCR Rule groundwater monitoring wells for the GMF Pond are screened between 23 and 48 feet bgs. Potentiometric data indicate that groundwater flows to the east and south as shown on the attached Figure 1. The compliance monitoring wells are located approximately 2,000 to 4,000 feet south-southeast (downgradient) of the nearby surface mines (Figure 2).

A study of groundwater quality near surface coal mines, performed by the United States 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 both background and compliance groundwater monitoring wells at the GMF Pond.

State of Illinois groundwater quality regulations (Title 35 of the Illinois Administrative Code [35 I.A.C.] § 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 I.A.C. § 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.

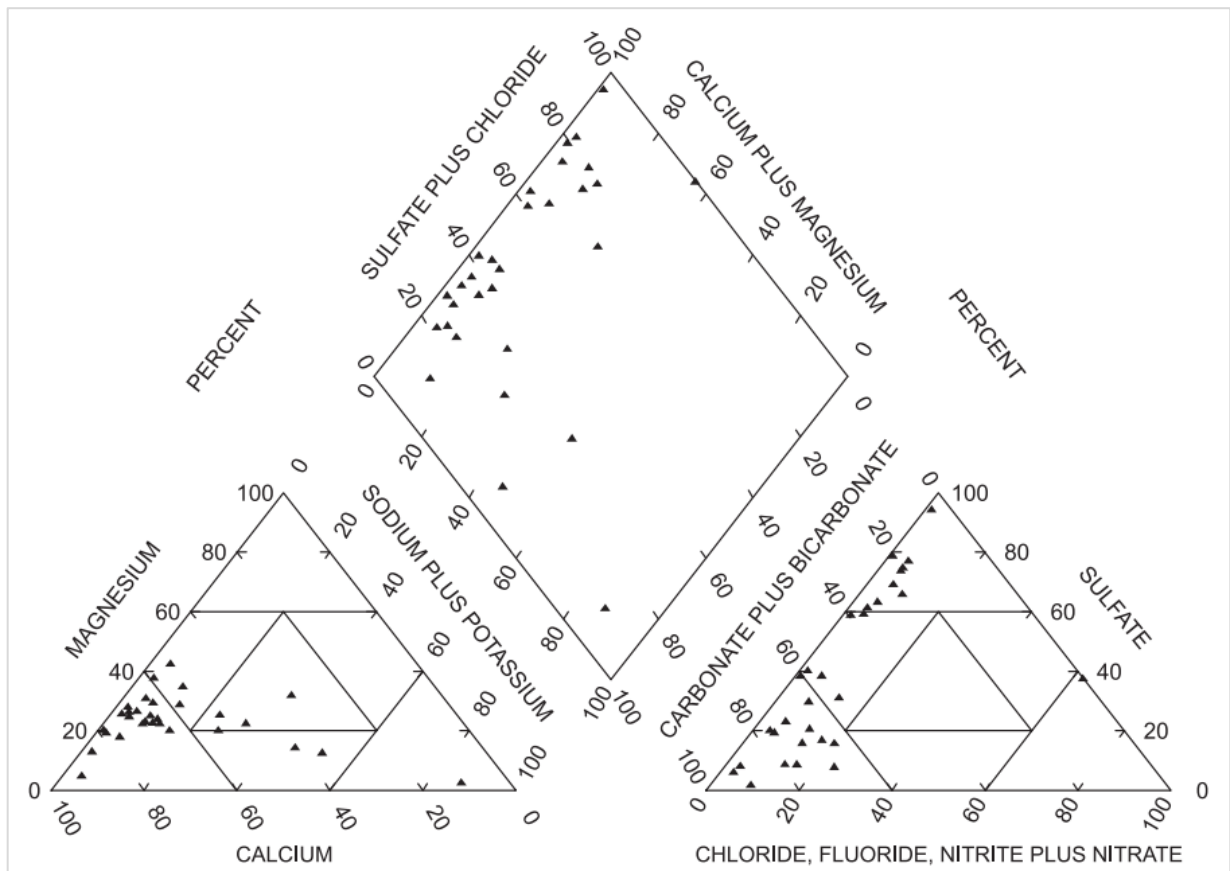


Figure B. Piper Diagram Showing Ionic Composition of Groundwater Downgradient of Reclaimed Surface Coal Mines in High-Sulfur Coal Regions (Modified from USGS).

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 to 150 milligrams per liter (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 compliance monitoring wells G54S, G57S, and G60S during D8 were 120 mg/L, 120 mg/L, and 130 mg/L respectively, above the background Upper Prediction Limit (UPL) of 111.5 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 compliance 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 the compliance wells.

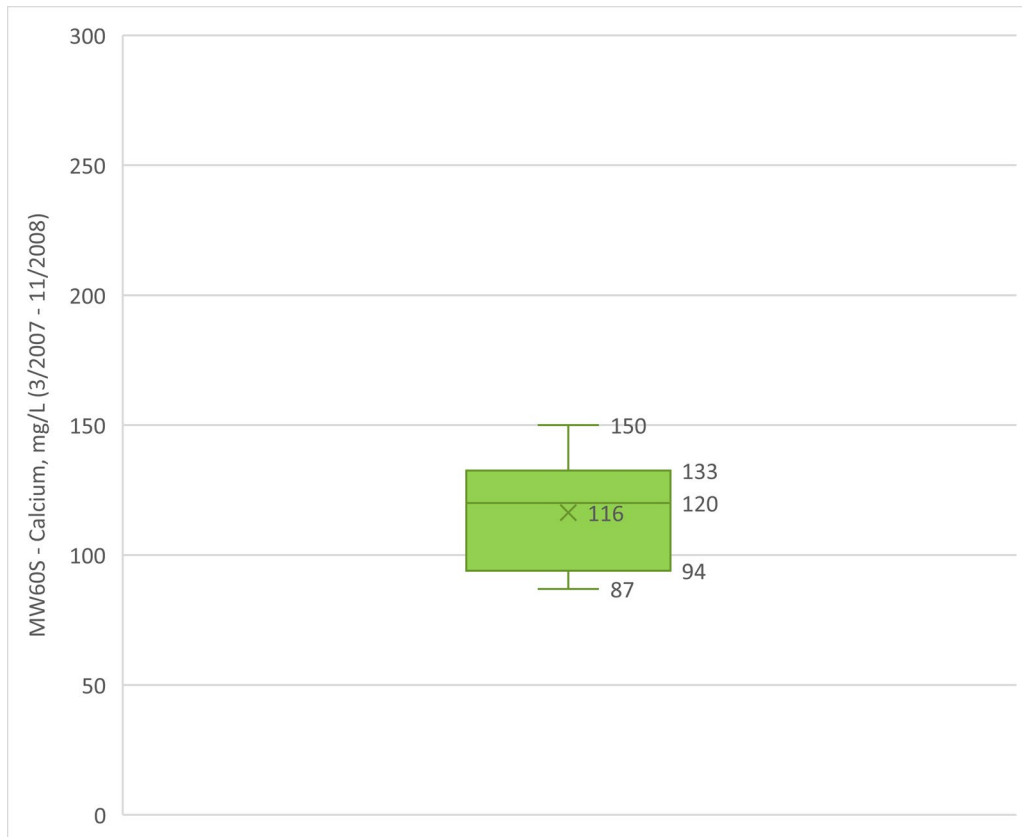


Figure C. Box plot of Calcium Concentrations Observed in Groundwater Samples Collected from MW60S Between March 2007 and November 2008.

3.4 LOE #4: Boron Concentrations in Compliance Groundwater Monitoring Wells Do Not Exceed Background Limits

Boron is an indicator of CCR impacts to groundwater due to its leachability from CCR and mobility in groundwater. If the groundwater downgradient of the GMF Pond had been impacted by discharge of CCR from the unit, boron would be expected to be elevated above the UPL. The UPL is an upper bound on background concentrations calculated for comparing compliance well results to background. Boron concentrations detected in compliance monitoring wells G54S, G57S, and G60S during D8 were 0.045 mg/L, 0.013 mg/L, and 0.019 mg/L. Compliance wells having SSIs had concentrations of boron at or below the UPL (0.059 mg/L). In compliance wells with SSIs, concentrations of boron at or below the UPL indicates that these wells have not been affected by CCR. Therefore, the GMF Pond is not the source of the SSIs.

4. CONCLUSIONS

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

1. The ionic composition of potential GMF Pond source 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.
4. Boron concentrations in compliance groundwater monitoring wells do not exceed background limits.

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 GMF Pond. Therefore, an assessment monitoring program is not required and the 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.

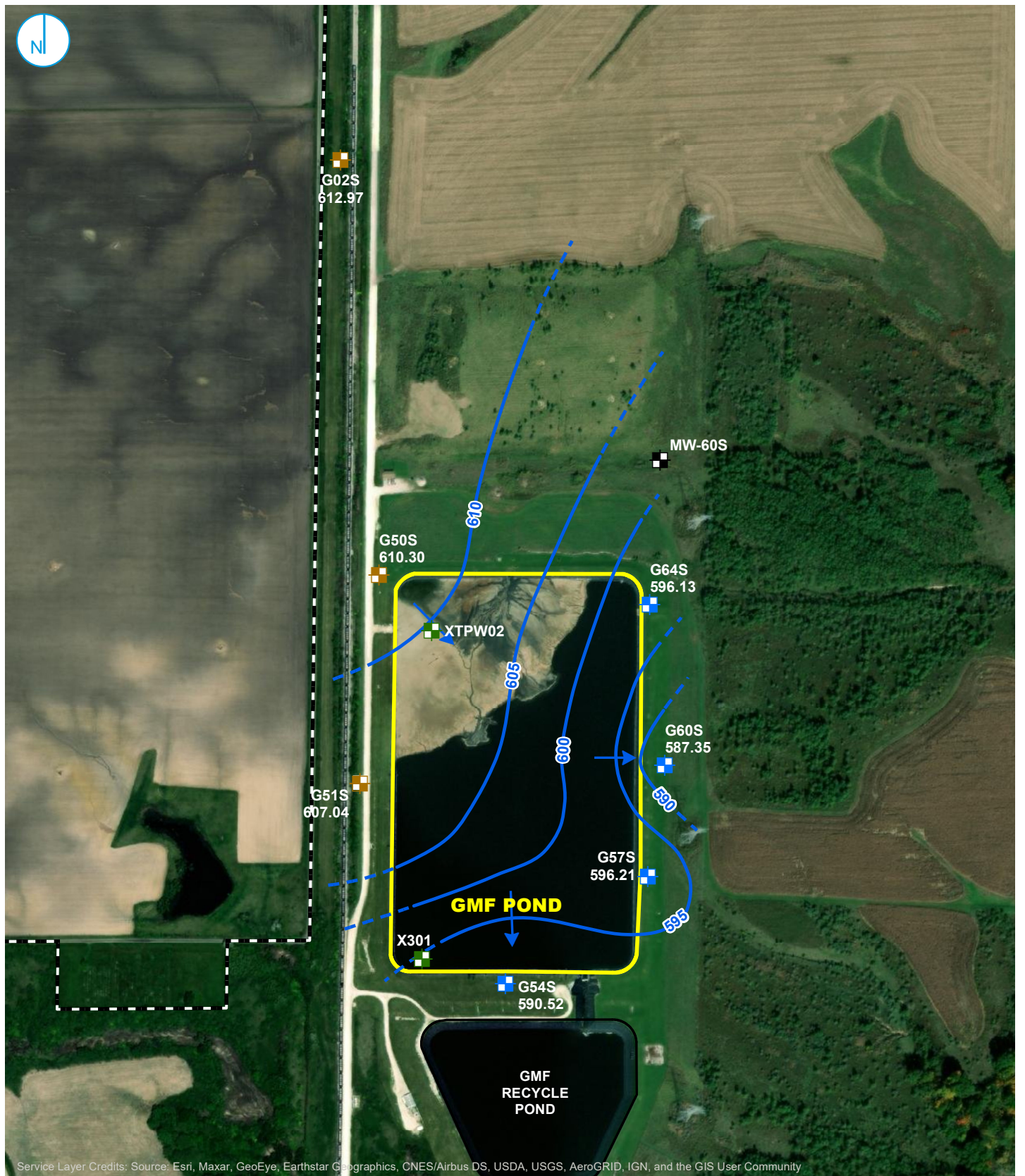
Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017a. Statistical Analysis Plan, Duck Creek Power Station, Edwards Power Station, Illinois Power Resources Generating, LLC.

Natural Resource Technology, an OBG Company (NRT/OBG), October 17, 2017b. 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 Environmental Protection Agency, 2020. Disposal of Coal Combustion Residuals from Electric Utilities, 40 C.F.R. § 257 Subpart D, published April 17, 2015, updated 2020. Accessed from URL <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-I/part-257/subpart-D#page-top>

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



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- COMPLIANCE WELL
- BACKGROUND WELL
- SOURCE SAMPLE
- MONITORING WELL
- PART 257 REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE

- GROUNDWATER ELEVATION CONTOUR (5-FT CONTOUR INTERVAL, NAVD88)
- INFERRED GROUNDWATER ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION
- PROPERTY BOUNDARY

GROUNDWATER ELEVATION CONTOUR MAP
FEBRUARY 18, 2021

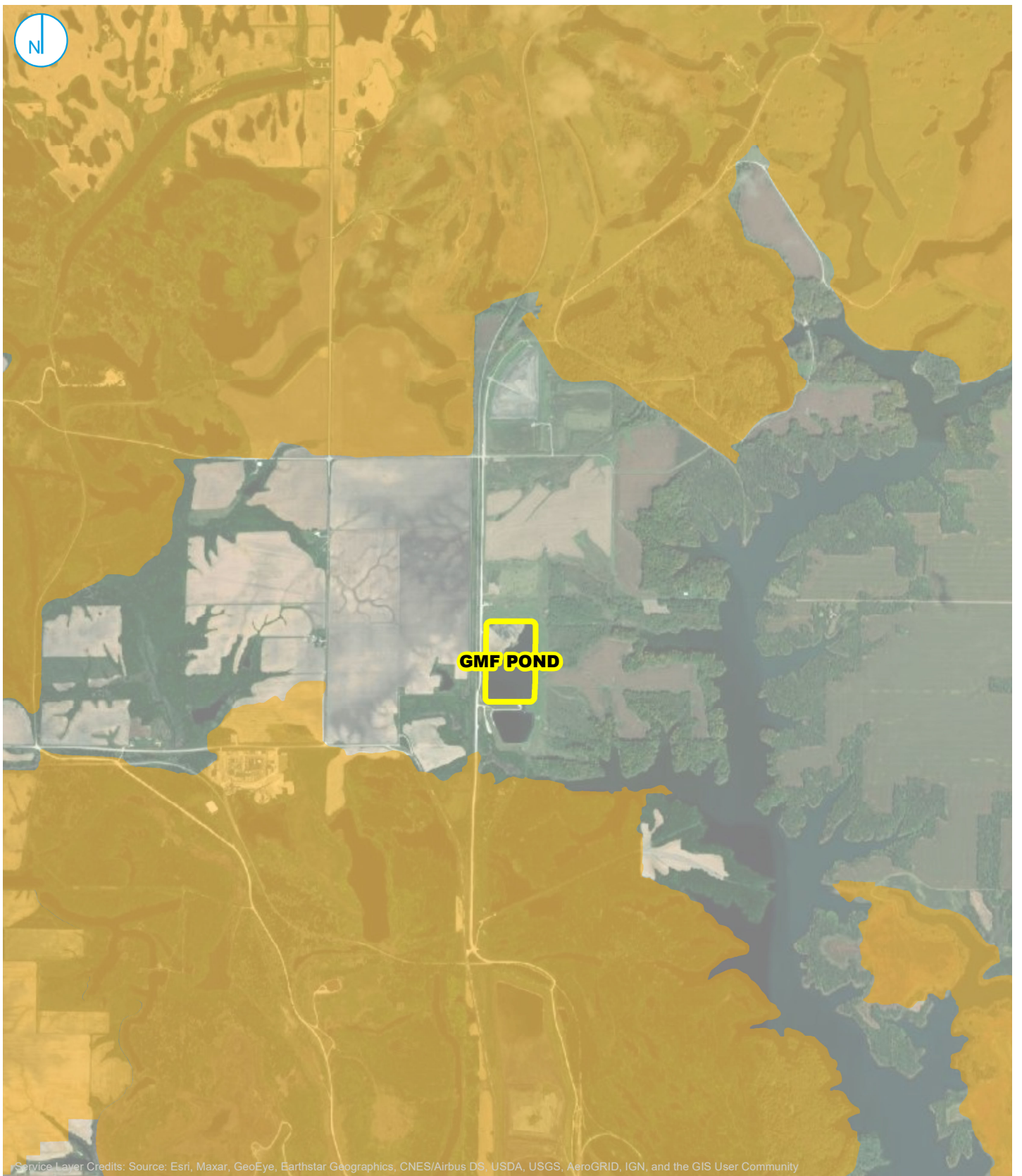
ALTERNATE SOURCE DEMONSTRATION
GMF POND (UNIT ID: 203)
 DUCK CREEK POWER PLANT
 CANTON, ILLINOIS



FIGURE 1

RAMBOLL AMERICAS
 ENGINEERING SOLUTIONS, INC.





Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- CCR MONITORED UNIT
- MINE COVERAGE

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

FIGURE 2

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

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

