Semiannual Progress Report Selection of Remedy – Burlington Generating Station

Burlington Generating Station
Burlington, Iowa

Prepared for:

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SCS ENGINEERS

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1.0 INTRODUCTION AND PURPOSE

The Semiannual Progress Report for remedy selection at the Interstate Power and Light Company (IPL) Burlington Generating Station (BGS) was prepared to comply with U.S. Environmental Protection Agency (USEPA) regulations regarding the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities [40 CFR 257.50-107], or the "CCR Rule" (Rule). Specifically, the selection of remedy process was initiated to fulfill the requirements of 40 CFR 257.97.

1.1 BACKGROUND

The Assessment of Corrective Measures (ACM) for the four BGS CCR units was completed on September 12, 2019. The ACM was completed in response to the detection of lithium and molybdenum at statistically significant levels (SSLs) above the Groundwater Protection Standard (GPS) in groundwater samples from downgradient monitoring wells. Lithium concentrations exceeded the GPS at the following downgradient compliance monitoring wells: MW-302, MW-303, MW-307, and MW-308. Molybdenum concentrations exceeded the GPS at the following downgradient compliance monitoring wells: MW-302, MW-307, and MW-308. An ACM Addendum was completed on November 24, 2020.

This Semiannual Progress Report summarizes data collected and remedy evaluation progress made since the September 2019 ACM and November 2020 ACM Addendum, and outlines planned future activities to complete the selection of remedy process. This semiannual progress report covers the 6-month period of March 2022 through August 2022.

1.2 SITE INFORMATION AND MAPS

BGS is located along the west bank of the Mississippi River, about 5 miles south of the City of Burlington, in Des Moines County, Iowa (**Figure 1**). The address of the generating station is 4282 Sullivan Slough Road, Burlington, Iowa. In addition to the generating station, the property also contains a coal yard formerly used for the plant, natural gas fueled combustion turbines, hydrated fly ash storage area within the bottom ash pond, upper ash pond, lower pond, economizer ash pond, bottom ash pond, and ash seal pond. The facility no longer generates CCR, but non-CCR wastewaters are still directed to the economizer ash pond and upper ash pond in accordance with 40 CFR 257.103(f)(2).

The four CCR units at the facility (upper ash pond, economizer ash pond, bottom ash pond, and ash seal pond) are monitored with a multi-unit groundwater monitoring system and are the subject of this Semiannual Progress Report. A map showing the CCR units and all background (or upgradient) and downgradient monitoring wells with identification numbers for the CCR groundwater monitoring program is provided as **Figure 2**. An additional supplemental background monitoring well, MW-314, is located to the south of the site as shown on **Figure 3**.

Groundwater flow at the site is generally to the south-southeast, and the groundwater flow direction and water levels fluctuate seasonally due to the proximity to the river. Depth to groundwater as measured in the site monitoring wells varies from less than 1 to 15 feet below ground surface due to topographic variations across the facility and seasonal variations in water levels.

2.0 SUMMARY OF WORK COMPLETED

Work completed to support remedy selection for the BGS CCR units is summarized in Table 1. Activities completed within the 6-month period of March 2022 through August 2022 covered by this semiannual report are discussed in more detail below.

2.1 MONITORING NETWORK CHANGES

There were no additional changes to the BGS monitoring well network between March 2022 and August 2022. The monitoring well locations are shown on Figures 2 and 3.

2.2 GROUNDWATER MONITORING

Since the March 2022 semiannual update, groundwater samples were collected during April 2022.

- The April 2022 monitoring event was part of the routine semiannual assessment monitoring program.

- The wells sampled included the 11 wells in the original monitoring system (MW-301 through MW-311), two additional wells (MW-312 and MW-313), six additional piezometers (MW-302A, MW-307A, MW-307B, MW-310A, MW-313A, and MW-313B), and one supplemental background monitoring well MW-314.

A summary of groundwater samples collected since submittal of the ACM is provided in Table 2.

2.3 STATISTICAL EVALUATION

Statistical evaluation of sampling results during the period will be covered in the 2022 Annual Groundwater Monitoring and Corrective Action Report dated January 2023.

Statistical evaluation of groundwater quality data during the period covered by this update included a comparison of Appendix IV parameter results to GPSs. In accordance with the Unified Guidance for Statistical Analysis of Groundwater Monitoring Data at Resource Conservation and Recovery Act (RCRA) Facilities (USEPA, 2009), the evaluation of whether a parameter has been detected at an SSL exceeding the GPS is based on a comparison of the lower confidence limit (LCL) for the mean, calculated from the assessment monitoring results, to the GPS. SSLs above the molybdenum GPS were identified in MW-302, MW-307, and MW-308 during the April 2022 Event. SSLs above the lithium GPS were identified in MW-302, MW-303, MW-304, MW-307, and MW-308 during the April 2022 event.

2.4 ASH POND CLOSURES

Closing the ash ponds is likely to be part of a holistic groundwater remedy at BGS. IPL completed permitting required for preconstruction testing and conducted the following activities in support of the corrective action alternatives (Table 3) during the current reporting period.

- In May and June 2022, a closure contractor mobilized to BGS to begin the ash pond closures. They installed erosion control best management practices (BMPs) and began developing infrastructure needed to support pond closure construction.

- In May and early June 2022, the closure contractor pumped surface water from the Main Ash Pond and Economizer Pond to the Upper Ash Pond.

- In June through August 2022, the pond closure contractor installed temporary groundwater dewatering wells around the Ash Seal Pond and Upper Ash Pond where CCR will be removed during closure. They also prepared areas of the Main Ash Pond and Economizer Pond where CCR will be consolidated for closure. The west, south, and north slopes of the Economizer Pond were regraded to support closure. Dewatering infrastructure development will continue into the next semiannual reporting period.

- In July 2022, the pond closure contractor began installing new infrastructure to divert non-CCR wastewater and stormwater away from the ash ponds. These efforts will continue into the next reporting period.

- In July 2022, vibrating wire piezometers were installed in the Main Ash Pond and Economizer Ash Pond in preparation of CCR consolidation.

- In July through early September 2022, the pond closure contractor established access to/from the Ash Seal Pond, developed dewatering infrastructure within the Ash Seal Pond, started dewatering activities, and began CCR removal. These efforts will continue into the next reporting period.

Ash pond closure activities are included in the summary provided in **Table 1**.

2.5 EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

A qualitative assessment of potential Corrective Measure Alternatives using the selection criteria in 40 CFR 257.97(b) and (c) was provided in the September 2019 ACM and revised in the November 2020 ACM Addendum #1. **Table 3** summarizes the assessment completed for the ACM Addendum. No updates or changes to the assessment have been made based on additional information obtained since the issue of the ACM Addendum.

IPL continues to develop and evaluate preliminary remedy designs for the CCR units at BGS. Evaluation of possible augmentation of the CCR unit closures is underway and consists of the following:

1. Additional groundwater parameters have been and continue to be collected and analyzed for the purpose of providing additional information that may be needed for the development and evaluation of any groundwater treatment components of the corrective action. These additional parameters include carbonate and bicarbonate alkalinity, and the total and dissolved metals, lithium, iron, magnesium, manganese, molybdenum, and sodium.

2. A multi-phase groundwater treatability study was initiated in May 2021 and described in the March 2022 Semiannual Progress Report for the SOR. The treatability study was completed in July 2022. The description of the treatability study is included again in this progress report with updates to avoid the need to refer to the previous report to understand the background of the study. The primary focus of the treatability study is to support remedy evaluation for:

    - In-situ solidification or stabilization (ISS) of the CCR located below the water table.
        - This phase of the treatability study applies to part of Alternative #6 – Consolidate and Cap with Chemical Amendment.

- Permeable reactive barriers (PRBs) that reduce the groundwater concentrations of lithium and molybdenum at the waste boundary to levels below the GPS.
  - This portion of the treatability study applies to part of Alternative #8 – Consolidate and Cap with Barrier Wall.

The treatability study tasks completed prior to this semiannual progress report:

1. Sample collection, preparation, and baseline analysis
   a. Samples collected and stored under conditions to maintain anoxic conditions:
      i. Representative samples of CCR for ISS evaluation
      ii. Representative sample of CCR for PRB evaluation
      iii. Background groundwater
      iv. Impacted groundwater
   b. Sample preparation including mechanical homogenization and refrigerated storage
   c. Baseline analysis including:
      i. Laboratory analysis of lithium, molybdenum, and other component concentrations
      ii. Analysis of CCR leachate chemistry by a modified synthetic precipitation leaching procedure

2. Reagent evaluation and selection
   a. Literature review to identify reagents that could potentially sequester lithium and molybdenum
   b. Batch testing to evaluate the sequestration potential of selected reagents

3. In-situ CCR solidification and stabilization testing
   a. Dose evaluation of the selected solidification media
   b. Dose evaluation of the selected stabilization media
   c. Multiple extraction trials

4. Batch trials for PRB testing

The treatability study tasks completed during to this semiannual progress report include:

1. Column trials for PRB testing

2. Reporting

The CCR and groundwater collection Task 1 was performed in September 2021 after earlier samples obtained from previous site investigation activities were found to be unacceptable for the study due to the degree of oxidation that occurred in the samples during storage.

The literature review Task 2a was completed in May 2021. After reviewing eight different potential reagents, five were chosen to proceed with screening batch trials (Task 2b). These were alum, ferrous sulfate, Peroxychem, MetaFix, Redox Solutions, FerroBlack, and Zero Valent Iron (ZVI). Portland cement and TerraBond-FC were chosen to be evaluated as solidification agents.

Among the reagents potentially applicable to stabilization of lithium and molybdenum in the CCR (Task 3), ferrous sulfate and FerroBlack Fe+ were selected in December 2021 for further evaluation based on their performance during the batch testing Task 2b.

Among the reagents potentially applicable to PRB applications (Task 3), FerroBlack Fe+ and ZVI were selected in December 2021 for further evaluation because they were the only reagents that reduced both lithium and molybdenum concentrations.

Further solidification trials with Portland cement and TerraBond were postponed in December 2021 because test results showed a potential release of lithium from Portland cement and a prohibitively high dose of Terrabond was required to achieve solidification.

Stabilization with multiple extraction trials of ferrous sulfate and FerroBlack Fe+ were also performed. FerroBlack Fe+ was the best performing reagent for reducing the leaching of molybdenum, while both reagents produced at least some slight increase in lithium concentrations.

The PRB batch trials of FerroBlack Fe+ and ZVI found that ZVI provided more consistent and complete sequestration of lithium and molybdenum than FerroBlack Fe+ (Task 4a); however, a high dose of ZVI was required to reduce lithium concentrations below the GPS.

Based on the results of the PRB batch trials, column trials were initiated in February 2022 to evaluate the performance of ZVI under dynamic (flowing) conditions. The trials were performed under two different flow rates.

Resolution Partners completed the remainder of the column study and issued the final treatability study report in July 2022. The report concluded that columns amended with 15 percent by weight ZVI can reduce lithium concentrations with residence times of at least 2 days. However, the reductions were not significant enough to meet the 40 micrograms per liter (µg/L) remediation goal (equivalent to the GPS for lithium). The report concluded that the molybdenum remediation goal of 100 µg/L could be met when columns were amended with 15 percent ZVI.

Updates to the quantitative assessment discussed in the ACM and ACM Addendum will be completed in the future based on updates to the conceptual site model, delineation of the nature and extent of impacts, and collection of additional data relevant to remedy selection.

3.0 PLANNED ACTIVITIES

Planned activities related to the remedy selection process include the following:

- Continue semiannual assessment monitoring for the existing monitoring well network.
- Evaluate pilot testing for tested/recommended reagents based on the results described in Section 2.5.
- Perform bench scale testing for above-ground treatment of lithium and molybdenum impacted groundwater.
- Update conceptual site model based on additional findings of nature and extent investigation.
- Continue evaluation of remedial options and design.
- Continue dewatering, CCR removal, and CCR consolidation activities to advance the pond closures.

- Complete the rerouting low-volume wastewaters to cease the discharge of non-CCR wastewater to the CCR units.
- Hold an additional public meeting.
- Draft the Selection of Remedy Report.

Tables

Table 1. Timeline for Completed Work - Selection of Remedy
Burlington Generating Station / SCS Engineers Project #25220081.00

Date	Activity
Work Completed During Previous Reporting Periods	
May 2019	Additional monitoring wells installed to investigate nature and extent (MW-312 and MW-313).
June 2019	Sampled new monitoring wells (MW-312 and MW-313).
September 2019	Completed the Well Documentation Report for the new wells.
September 2019	Completed ACM.
October 2019	Conducted semiannual assessment monitoring event, including second round of sampling for the new wells (MW-312 and MW-313).
January 2020	Completed Statistical Evaluation of October 2019 groundwater monitoring results.
January 2020	Completed 2019 Annual Groundwater Monitoring and Corrective Action Report
November 2019 to spring 2020	Planning, permitting, and access arrangements for installation of four additional monitoring wells (piezometers) to investigate the vertical extent of impacts.
December 2019/ January 2020	Execute source area and geotechnical field investigation.
March 2020	Completed Semiannual Progress Report for Selection of Remedy.
June 2020	Completed field work for geotechnical study of impoundments.
June-July 2020	Additional monitoring wells (piezometers) installed to investigate vertical groundwater flow and groundwater quality.
September 2020	Conducted additional assessment monitoring following piezometer well installation.
September 2020	Completed Semiannual Progress Report for Selection of Remedy.
October 2020	Conducted semiannual assessment monitoring event.
October 2020	Held public ACM meeting.
November 2020	Completed ACM Addendum No. 1.
November 2020	Submitted application to EPA for a site-specific alternative deadline to initiate ash pond closures.
January 2021	Completed 2020 Annual Groundwater Monitoring and Corrective Action Report.
February 2021	Complete permit level designs for the development of new wastewater treatment pond.
March 2021	Completed Semiannual Progress Report for Selection of Remedy.
March 2021	Conducted additional assessment monitoring event for select parameters.
March 2021	Conducted surface water sampling at two locations on the Mississippi River. One sample was obtained upriver from the plant and the other was obtained from a downriver location.
March 2021	Issued a Request for Proposal (RFP) to pond closure contractors to conduct pre-construction services.

Table 1. Timeline for Completed Work - Selection of Remedy
Burlington Generating Station / SCS Engineers Project #25220081.00

Date	Activity
March - April 2021	Obtained proposals for closure of the Ash Seal Pond and construction of a new wastewater treatment pond.
April 2021	Alliant Energy provided a notification to the Iowa Department of Natural Resources in accordance with 40 CFR 257.95(g)(2).
April - May 2021	Evaluated proposals for closure of the Ash Seal Pond and construction of a new wastewater treatment pond.
May 2021	Installed new piezometers MW-307B and MW-313B. Drilled boring B-302B.
May 2021	Groundwater treatability study initiated with literature-vendor review of reagents.
May - July 2021	Obtained permits for closure of the Ash Seal Pond.
June - July 2021	Evaluated existing, stored soil and CCR material samples for potential use in the groundwater treatability study.
June - July 2021	Modified low-volume wastewater treatment approach. Developed preliminary plans for new suspended solids treatment and wastewater reroute.
July 2021	Conducted assessment monitoring events for new wells MW-307B and MW-313B.
July 2021	Selected a contractor to provide preconstruction services for ash pond closures.
August 2021	Completed Well documentation report for the new piezometers MW-307B and MW-313B.
August 2021	Conducted design reviews and site visits with pond closure preconstruction services contractor. Evaluating permitting needs for preconstruction field testing plans.
September 2021	Completed Semiannual Progress Report for Selection of Remedy.
September 2021	Conducted ash samples collection from the Main Ash Pond and groundwater sampling at MW-304 and MW-310, in support of the Treatability Study.
September 2021 - February 2022	Additional background monitoring well location identification, design, and permitting.
October 2021	Performed test pits in and around the four impoundments and the coal yard to evaluate site conditions and CCR behavior during excavation, moisture conditioning, and placement.
October 2021	Conducted ash samples collection from the Economizer Pond and Main Ash Pond in support of the Treatability Study.
October 2021 - December 2021	Installed two groundwater dewatering pilot test wells at the Upper Ash Pond and Ash Seal Pond and completed a pump test at each location to evaluate the design of a groundwater dewatering system for the closure of the Upper Ash Pond and Ash Seal Pond.
October 2021 - December 2021	Performed batch testing of reagents to evaluate sequestration potential for groundwater treatability study.
December 2021	Ferrous sulfate and FerroBlack Fe+ were selected for further stabilization evaluation based on their performance during the batch testing. FerroBlack Fe+ and ZVI were selected for further treatability study evaluation as potential Permeable Reactive Barrier reagents.
December 2021	Further solidification trials with Portland Cement and TerraBond were terminated because test results showed a potential release of lithium from Portland Cement and a prohibitively high dose of TerraBond was required to achieve solidification.
November 2021 - February 2022	Incorporated preconstruction testing into impoundment closure design (ongoing effort).

Table 1. Timeline for Completed Work - Selection of Remedy
Burlington Generating Station / SCS Engineers Project #25220081.00

Date	Activity
January 2022	Completed 2021 Annual Groundwater Monitoring and Corrective Action Report.
January - August 2022	Developed Upper Ash Pond closure permit applications (ongoing effort).
February 2022	Evaluated groundwater dewatering pump test discharge data (ongoing effort).
February 2022	Received Interim Groundwater Treatability Study Report and approved recommendation to proceed with column studies.
February 2022	Additional assessment monitoring event at monitoring wells MW-307 and MW-313B and arsenic sample at monitoring well MW-302.
February 2022	Obtained well permit and floodplain development permit for installation of monitoring well MW-314.
February 2022	Performed utility clearance and installed additional background monitoring well MW-314.
Work Completed During Current Reporting Period	
March 2022	Completed Semiannual Progress Report for Selection of Remedy.
April 2022	Conducted semiannual assessment monitoring event.
May - June 2022	Erosion controls installed and graded portion of the coal yard completed. Pumped surface water from Main Ash Pond to the Upper Ash Pond.
June 2022	Completed Statistical Evaluation of February 2022 groundwater monitoring results.
June 2022	Completed the Well Documentation Report for the new well MW-314.
June -August 2022	Temporary dewatering wells installed around the Ash Seal Pond and Upper Ash Pond. Grading the C stone and Bottom Ash Pile in the Main Ash Pond. Regraded Economizer Pond west, south, and north slopes.
July 2022	Vibrating wire piezometers were installed in the Main Ash Pond and Economizer Ash Pond in preparation of CCR consolidation. Monitoring is ongoing.
July 2022	Completed Statistical Evaluation of April 2022 groundwater monitoring results.
July 2022	Finalized Groundwater Treatability Study Report following completion of column studies.
July 2022	Groundwater treatability study initiated with literature-vendor review of reagents.
August 2022	Began excavating CCR from the Ash Seal Pond and placing in Main Ash Pond and Economizer Pond Closure Areas. Began hauling coal/coal impacted material to Main Ash Pond (Ongoing Effort).

Notes:
*: Spring semiannual sampling events are typically completed in April; the spring 2020 event was delayed due to the COVID-19 pandemic.

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Table 2. CCR Rule Groundwater Samples Summary - Events Since ACM Submittal
Burlington Generating Station
SCS Engineers Project #25220081.00

	Compliance Wells		Delineation Well	Compliance Wells					Delineation Well		Compliance Wells		Delineation Well				Background Well	Delineation Well	Background Well	Supplemental Background Well
Sample Dates	MW-301	MW-302	MW-302A	MW-303	MW-304	MW-305	MW-306	MW-307	MW-307A	MW-307B	MW-308	MW-309	MW-312	MW-313	MW-313A	MW-313B	MW-310	MW-310A	MW-311	MW-314
10/10-11/2019	A	A	NI	A	A	A	A	A	NI	NI	A	A	A	A	NI	NI	A	NI	A	--
6/2-4/2020	A	A	NI	A	A	A	A	A	NI	NI	A	A	A	A	NI	NI	A	NI	A	--
9/9/2020	--	--	A	--	--	--	--	--	A	NI	--	--	--	--	A	NI	--	A	--	--
10/14-16/2020	A	A	A	A	A	A	A	A	A	NI	A	A	A	A	A	NI	A	A	A	--
3/1-3/2021	Add.	Add.	Add.	Add.	Add.	Add.	Add.	Add.	Add.	NI	Add.	Add.	Add.	Add.	Add.	NI	--	Add.	Add.	--
4/19-20/2021	A	A	A	A	A	A	A	A	A	NI	A	A	A	A	A	NI	A	A	A	--
7/1/2021	--	--	--	--	--	--	--	--	--	A	--	--	--	--	--	A	--	--	--	--
10/11-14/2021	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	--
2/22/2022	--	Add.	--	--	--	--	--	--	--	A	--	--	--	--	--	A	--	--	--	--
4/4-6/2022	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Total Samples	7	8	6	7	7	7	7	7	6	4	7	7	7	7	6	4	6	6	7	1

Abbreviations:
A = Assessment Monitoring Program
NI = Not Installed
Add. = Additional Assessment Monitoring Event

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Table 3. Preliminary Evaluation of Corrective Measure Alternatives
Burlington Generating Station / SCS Engineers Project #25220081.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-site Landfill	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b)								
257.97(b)(1) Is remedy protective of human health and the environment?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(2) Can the remedy attain the groundwater protection standard?	Unlikely	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(3) Can the remedy control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
257.97(b)(4) Can the remedy remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible?	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR	Not Applicable - No release of CCR
257.97(b)(5) Can the remedy comply with standards for management of wastes as specified in §257.98(d)?	Not Applicable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1)								
257.97(c)(1)(i) Magnitude of reduction of existing risks	No reduction of existing risk	Existing risk reduced by achieving GPS	Same as Alternative #2	Same as Alternative #2	Same as Alternative #2	Similar to Alternative #2. Long-term risk may be reduced with additional source control and in-situ stabilization/fixation of CCR that may be in contact with groundwater.	Similar to Alternative #2. Groundwater extraction and treatment presents an additional risk and potential exposure pathways via surface release or disruption of treatment processes.	Similar to Alternative #2. Long-term risk may be reduced with additional containment offered by barrier wall.
257.97(c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy	No reduction of existing risk. Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors.	Magnitude of residual risk of further releases is lower than current conditions due to final cover eliminating infiltration through CCR; Residual risk is limited for all alternatives due to limited extent of impacts and lack of receptors	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to composite liner and cover; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #3 with potential further reduction in release risk due to removal of CCR from site; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk is further reduced by way of chemical / physical alteration of the source of impacts. However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk is potentially reduced by way of the ability to respond to potential future/ongoing releases from CCR that might be in contact with groundwater following closure. However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.	Same as Alternative #2 with potential further reduction in release risk due to CCR material footprint; Residual risk of source material in contact with groundwater is further reduced by the containment of groundwater impacts provided by barrier walls; However, limited to no overall risk reduction is provided due to lack of current/anticipated future receptors for groundwater impacts.
257.97(c)(1)(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	Not Applicable	30-year post-closure groundwater monitoring; Groundwater monitoring network maintenance and as-needed repair/replacement; Final cover maintenance (e.g., mowing and as-needed repair); Periodic final cover inspections; Additional corrective action as required based on post-closure groundwater monitoring	Same as Alternative #2	Same as Alternative #2	No on-site long-term management required; Limited on-site post-closure groundwater monitoring until GPS are achieved; Receiving disposal facility will have same/similar long-term monitoring, operation, and maintenance requirements as Alternative #2	Same as Alternative #2	Same as Alternative #2 with additional effort for groundwater pump operation and maintenance (O&M), groundwater treatment system O&M, and treatment system discharge monitoring/reporting.	Same as Alternative #2 with additional monitoring of wall performance.

Table 3. Preliminary Evaluation of Corrective Measure Alternatives
Burlington Generating Station / SCS Engineers Project #25220081.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-site Landfill	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1) (continued)								
257.97(c)(1)(iv) Short-term risks - Implementation								
Excavation	None	Limited risk to community and environment due to limited amount of excavation (<100K cy) required to establish final cover subgrades and no off-site excavation	Same as Alternative #2 with increased risk to environment due to increased excavation volumes (>100K cy, <300K cy) required for consolidation	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (>1M cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with reduced risk to environment from excavation due to limited on-site storage	Similar to Alternative #3 with some increased potential risk due to exposure during the application of the chemical amendment.	Similar to Alternative #3 with some increased construction risk due to drilling, trenching, and excavation for groundwater pumping and treatment system construction.	Similar to Alternative #3 with some increased construction risk due to excavation or installation of the barrier wall.
Transportation	None	No risk to community or environment from off-site CCR transportation; Typical risk due to construction traffic delivering final cover materials to site	Same as Alternative #2 with reduced risk from construction traffic due to reduced final cover material requirements (smaller cap footprint)	Same as Alternative #2 with increased risk from construction traffic due to increased material import requirements (liner and cap construction required)	Highest level of community and environmental risk due to CCR volume export (>1M cy)	Similar to Alternative #3 with increased risk from importing chemical material for stabilization/treatment.	Similar to Alternative #3 with increased risk from importing groundwater pumping and treatment system materials.	Similar to Alternative #3 with increased risk from importing barrier wall system materials.
Re-Disposal	None	Limited risk to community and environment due to limited volume of CCR re-disposal (<100K cy)	Same as Alternative #2 with increased risk to environment due to increased excavation volumes (>100K cy, <300K cy) required for consolidation	Same as Alternative #3 with increased risk to environment due to increased excavation volumes (>1M cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal	Same as Alternative #4 with increased risk to community and environment due to re-disposal of large CCR volume (>1M cy) at another facility; Re-disposal risks are managed by the receiving disposal facility	Similar to Alternative #3 with some increased potential risk due to exposure during the application of the chemical amendment.	Same as Alternative #3	Same as Alternative #3
257.97(c)(1)(v) Time until full protection is achieved	Unknown	To be evaluated further during remedy selection. Closure and capping anticipated by end of 2022. Groundwater protection timeframe to reach GPS potentially 2 to 10 years following closure construction, achievable within 30-year post-closure monitoring period.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential for decrease in time to reach GPS due to consolidation of CCR.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to source isolation within liner/cover system.	Similar to Alternative #2. Potential for increase in time to reach GPS due to significant source disturbance during construction. Potential decrease in time to reach GPS due to impounded CCR source removal.	Similar to Alternative #2. Potential for reduction in time to reach GPS due to chemical/physical stability of CCR.	Similar to Alternative #2. Potential decrease in time to reach GPS at property line from implementation of groundwater pumping.	Similar to Alternative #2. Potential decrease in time to reach GPS upon implementation of barrier wall.
257.97(c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	No change in potential exposure	Potential for exposure is low. Remaining waste is capped.	Same as Alternative #2	Same as Alternative #2	No potential for on-site exposure to remaining waste since no waste remains on site; Risk of potential exposure is transferred to receiving disposal facility and is likely similar to Alternative #2	Same as Alternative #2	Similar to Alternative #2 with potential for secondary impacts from releases of extracted groundwater or disruption in treatment.	Same as Alternative #2
257.97(c)(1)(vii) Long-term reliability of the engineering and institutional controls	Not Applicable	Long-term reliability of cap is good; Significant industry experience with methods/ controls; Capping is common practice/industry standard for closure in place for remediation and solid waste management	Same as Alternative #2 with potentially increased reliability due to smaller footprint and reduced maintenance	Same as Alternative #3	Success of remedy at BGS does not rely on long-term reliability of engineering or institutional controls; Overall success relies on reliability of the engineering and institutional controls at the receiving facility.	Same as Alternative #3.	Same as Alternative #3. Remedy relies upon active equipment that will require additional operations and maintenance.	Same as Alternative #3. Remedy relies on continued hydraulic conductivity of the selected barrier. Breaches or short circuiting can develop and must be monitored.
257.97(c)(1)(viii) Potential need for replacement of the remedy	Not Applicable	Limited potential for remedy replacement if maintained; Some potential for remedy enhancement due to residual groundwater impacts following source control	Same as Alternative #2 with reduced potential need for remedy enhancement with consolidated/smaller closure area footprint	Same as Alternative #2 with further reduction in potential need for remedy enhancement composite with liner	No on-site potential for remedy replacement; Limited potential for remedy enhancement due to residual groundwater impacts following source control	Similar to Alternative #3, with further reduction in potential need for remedy enhancement due to stabilized/solidified CCR material.	Similar to Alternative #2, with reduced potential of remedy replacement, but added expectation for pump, conveyance system and treatment system replacement.	Similar to Alternative #2, with reduced potential of remedy replacement, but added expectation for potential replenishment of consumptive barrier product.

Table 3. Preliminary Evaluation of Corrective Measure Alternatives
Burlington Generating Station / SCS Engineers Project #25220081.00

	Alternative #1 No Action	Alternative #2 Close and Cap in place with MNA	Alternative #3 Consolidate on Site and Cap with MNA	Alternative #4 Excavate and Dispose on site with MNA	Alternative #5 Excavate and Dispose in Off-site Landfill	Alternative #6 Consolidate and Cap with Chemical Amendment	Alternative #7 Consolidate and Cap with Groundwater Collection	Alternative #8 Consolidate and Cap with Barrier Wall
SOURCE CONTROL TO MITIGATE FUTURE RELEASES - 40 CFR 257.97(c)(2)								
257.97(c)(2)(i) The extent to which containment practices will reduce further releases	No reduction in further releases	Cap will reduce further releases by minimizing infiltration through CCR	Same as Alternative #2 with further reduction due to consolidated/smaller closure footprint	Same as Alternative #3 with further reduction due to composite liner and 5-foot groundwater separation required by CCR Rule	Removal of CCR prevents further releases at BGS; Receiving disposal site risk similar to Alternative #3	Similar to Alternative #3 with further reduction due to lower mobility of contaminants in residual source material as a result of chemical amendment.	Similar to Alternative #3 with the added ability to contain or restore groundwater impacts if MNA mechanisms are not active or site attenuation capacity is not adequate.	Similar to Alternative #3 with the added ability to contain groundwater impacts if MNA mechanisms are not active or site attenuation capacity is not adequate.
257.97(c)(2)(ii) The extent to which treatment technologies may be used	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative does not rely on treatment technologies	Alternative relies on the identification and availability of a suitable chemical amendment. Implementation of and contact with physical/chemical stabilizing agent will require specialized field implementation methods and health and safety measures.	This alternative relies on conventional pump and treat remediation.	Alternative relies on the identification and availability of a suitable barrier wall technology (e.g., permeable reactive barrier material or slurry wall). Implementation of and contact with barrier wall materials will require specialized field implementation methods and health and safety measures.
IMPLEMENTATION - 40 CFR 257.97(c)(3)								
257.97(c)(3)(i) Degree of difficulty associated with constructing the technology	Not Applicable	Low complexity construction; Potentially lowest level of dewatering effort - dewatering required for cap installation only	Low complexity construction; Moderate degree of logistical complexity; Moderate to low level of dewatering effort - dewatering required for material excavation/placement and capping	Moderate complexity construction due to composite liner and cover; High degree of logistical complexity due to excavation and on-site storage of >1M cy of CCR while new lined disposal area is constructed; Moderate to high level of dewatering effort - dewatering required for excavation of full CCR volume	Low complexity construction; High degree of logistical complexity including the excavation and off-site transport of >1M cy of CCR and permitting/development of off-site disposal facility airspace; Moderate to high level of dewatering effort - dewatering required for excavation of full CCR volume	Moderate complexity construction due to the equipment required to apply the selected amendment; requirements to ensure consistent contact and dosing of amendment; Medium degree of logistical complexity involving the import of specialty chemicals; Moderate to low level of dewatering effort - dewatering required for material excavation/placement and capping	Low complexity construction; Moderate degree of logistical complexity; Moderate to low level of dewatering effort - dewatering required for material excavation/placement and capping. Moderate complexity construction for the installation of extraction wells and conveyance to a site-specific groundwater treatment plant.	High complexity construction; Barrier walls require specialty installation equipment and knowledge. Highly specialized and experience contractors required to achieve proper installation. Moderate degree of logistical complexity; Moderate to low level of dewatering effort - dewatering required for material excavation/placement and capping.
257.97(c)(3)(ii) Expected operational reliability of the technologies	Not Applicable	High reliability based on historic use of capping as corrective measure	Same as Alternative #2	Same as Alternative #2	Success at BGS does not rely on operational reliability of technologies; Overall success relies on off-site disposal facility, which is likely same/similar to Alternative #2	Similar to Alternative #2; however, success at BGS relies on the successful application of specialty chemicals.	Similar to Alternative #2; however, success of this remedy relies on the successful operation of a site-specific groundwater treatment plant.	Similar to Alternative #2; however, success this remedy relies on continued hydraulic conductivity of the selected barrier. Breaches or short circuiting can develop and must be monitored.
IMPLEMENTATION - 40 CFR 257.97(c)(3) (continued)								
257.97(c)(3)(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	Not Applicable	Need is moderate in comparison to other alternatives State Closure Permit required; Federal/State/Local Floodplain permitting required; State and local erosion control/construction stormwater management permits required; Federal/State wetland permitting potentially required	Need is lowest in comparison to other alternatives; State Closure Permit required; State and local erosion control/construction stormwater management permits required; Federal/State/Local Floodplain permitting likely required	Need is high in comparison to other alternatives State Closure Permit required; State Landfill Permit may be required; Federal/State/Local Floodplain permitting likely required; State and local erosion control/construction stormwater management permits required; Federal/State wetland permitting likely required	Need is highest in comparison to other alternatives; State Closure Permit required; State and local erosion control/construction stormwater management permits required; Approval of off-site disposal site owner required; May require State solid waste comprehensive planning approval; Federal/State/Local Floodplain permitting likely required; Federal/State wetland permitting likely required; Local road use permits likely required	Need is moderate in comparison to other alternatives; State Closure Permit required; Underground Injection Control Permit may be required if chemical materials placed within groundwater. State and local erosion control/construction stormwater management permits required; Federal/State/Local Floodplain permitting likely required.	Need is moderate in comparison to other alternatives; State Closure Permit required; Well permitting for extraction well installation; NPDES Permit for groundwater treatment and discharge; State and local erosion control/construction stormwater management permits required; Federal/State/Local Floodplain permitting likely required.	Need is moderate in comparison to other alternatives; State Closure Permit required; Well permitting for barrier wall monitoring; Federal/State/Local Floodplain permitting required; State and local erosion control/construction stormwater management permits required; Federal/State wetland permitting potentially required
257.97(c)(3)(iv) Availability of necessary equipment and specialists	Not Applicable	Necessary equipment and specialists are highly available; Highest level of demand for cap construction material	Same as Alternative #2; Lowest level of demand for cap construction material	Same as Alternative #2; Moderate level of demand for liner and cap construction material	Availability of necessary equipment to develop necessary off-site disposal facility airspace and transport >1M cy of CCR to new disposal facility will be a limiting factor in the schedule for executing this alternative; No liner or cover material demands for on-site implementation of remedy	Similar to Alternative #3; Moderate level of demand for liner and cap construction material. Specialized mixing equipment likely required to apply chemical amendment and achieve required dosing.	Similar to Alternative #3; Moderate level of demand for liner and cap construction material. A site-specific, trained employee will be required to operate the groundwater treatment system.	Similar to Alternative #3; Moderate level of demand for liner and cap construction material; Availability of the necessary specialized equipment and extensive experience required for barrier installation is potentially low or in high demand.
257.97(c)(3)(v) Available capacity and location of needed treatment, storage, and disposal services	Not Applicable	Capacity and location of treatment, storage, and disposal services is not a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Available temporary on-site storage capacity for >1M cy of CCR while composite liner is constructed is significant limiting factor	off-site disposal capacity, facility logistical capacity, or the time required to develop the necessary off-site disposal and logistical capacity is a significant limiting factor.	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative
COMMUNITY ACCEPTANCE - 40 CFR 257.97(c)(4)								
257.97(c)(4) The degree to which community concerns are addressed by a potential remedy (Anticipated)	Not Applicable	No comments were received during the public meeting held on October 14, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on October 14, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on October 14, 2020. Assume all alternatives are acceptable to interested/affected parties.	No comments were received during the public meeting held on October 14, 2020. Assume all alternatives are acceptable to interested/affected parties.	To be determined. Alternative added after public meeting held on October 14, 2020.	To be determined. Alternative added after public meeting held on October 14, 2020.	To be determined. Alternative added after public meeting held on October 14, 2020.

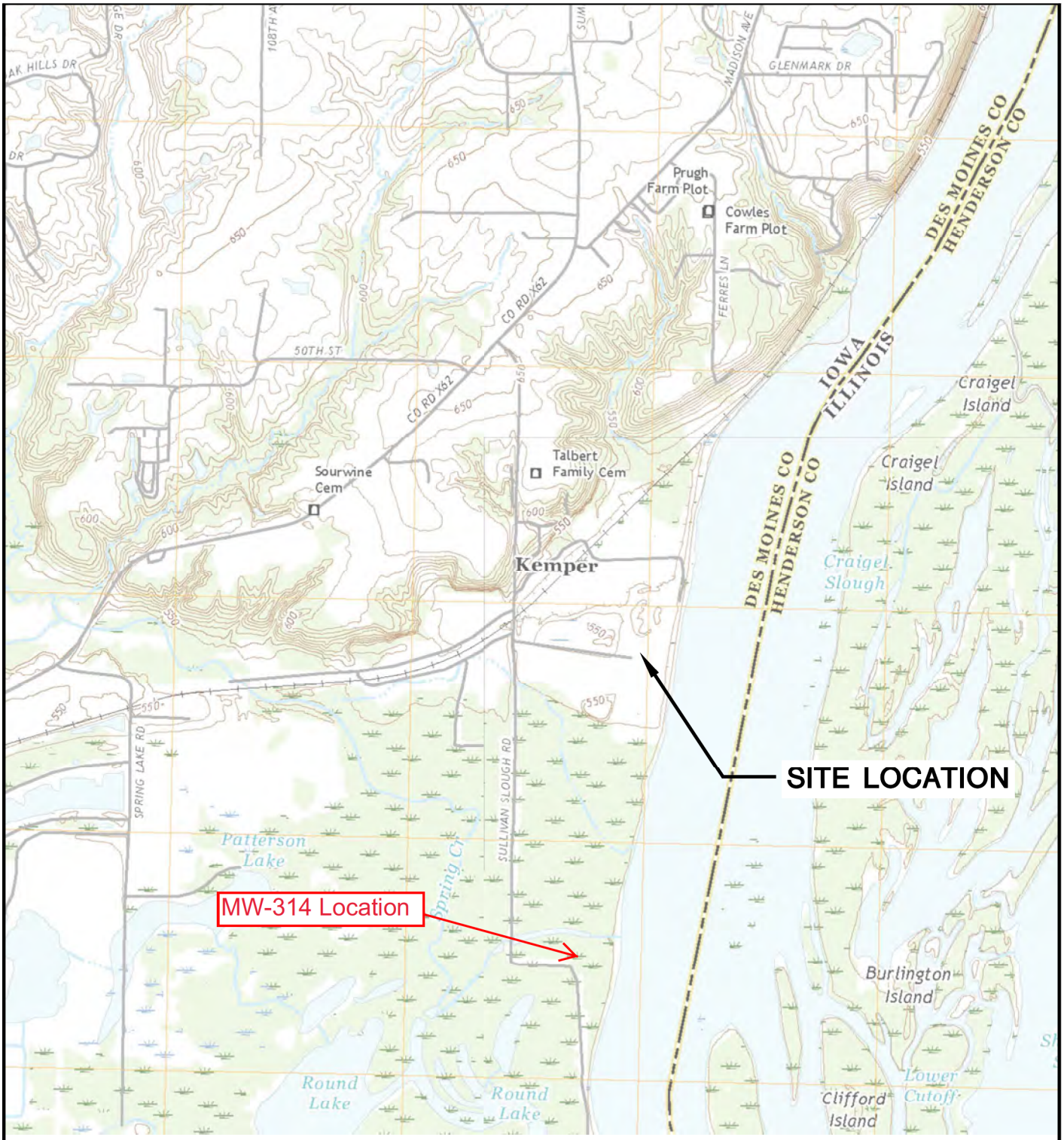
NOTES:

1) Alternatives #1 through #5 were developed and submitted within the Assessment of Corrective Measures Report (ACM), dated September 2019
2) Alternatives #6 through #8 were added in November 2020 as part of Addendum #1 to the September 2020 ACM Report

Created by: LAB/SK Date: 6/20/2019
Last revision by: SKK Date: 2/23/2021
Checked by: EJN Date: 11/19/2020

I:\25220081.00\Deliverables\2022 Semiannual - Selection of Remedy\2022 September Semiannual Update\Tables\[Table 3_Evaluation of Assessment of Corrective Measure_BGS.xlsx]BGS_Evaluation Matrix

Figures



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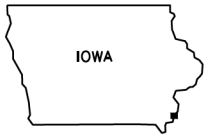
LOMAX QUADRANGLE
ILLINOIS / IOWA–DES MOINES CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2018
SCALE: 1" = 2,000'



CLIENT	ALLIANT ENERGY 4902 N. BILTMORE LANE, #1000 MADISON, WI 53718	SITE	ALLIANT ENERGY BURLINGTON GENERATING STATION BURLINGTON, IOWA

SITE LOCATION MAP

PROJECT NO.	25219066.00	DRAWN BY:	BSS
DRAWN:	11/14/2019	CHECKED BY:	MDB
REVISED:	01/14/2020	APPROVED BY:	TK 01/30/2020

ENGINEER

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

FIGURE
1

I:\25219066.00\Drawings\CCR 2019 Annual Report\Site Location Map.dwg, 1/30/2020 3:35:22 PM

LEGEND

- EXISTING CCR RULE MONITORING WELL
- CCR RULE PIEZOMETER
- CCR UNITS

NOTES:

1. MONITORING WELLS MW-303 THROUGH MW-308 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 15-17, 2015.
2. MONITORING WELLS MW-301, MW-302, AND MW-309 THROUGH MW-311 WERE INSTALLED BY DIRECT PUSH ANALYTICAL SERVICES CORP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM FEBRUARY 29, 2016 TO MARCH 1, 2016.
3. MONITORING WELLS MW-312 AND MW-313 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING IN MAY 2019.
4. PIEZOMETERS MW-302A, MW-307A, MW-310A, AND MW-311A WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING IN JUNE-JULY 2020.
5. PIEZOMETERS MW-307B AND MW-313B INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM AMY 10-12, 2021.
6. 2018 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
7. MW-314 IS LOCATED APPROXIMATELY 4,000 FEET SOUTH OF THE PLANT.

N

300 0 300

SCALE: 1" = 300'

PROJECT NO.	25221066.00	DRAWN BY:	BSS/KRG
DRAWN:	09/14/2020	CHECKED BY:	NDK
REVISED:	08/31/2022	APPROVED BY:	TK 9/2/2022

ENGINEER: SCS ENGINEERS
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PHONE: (608) 224-2830

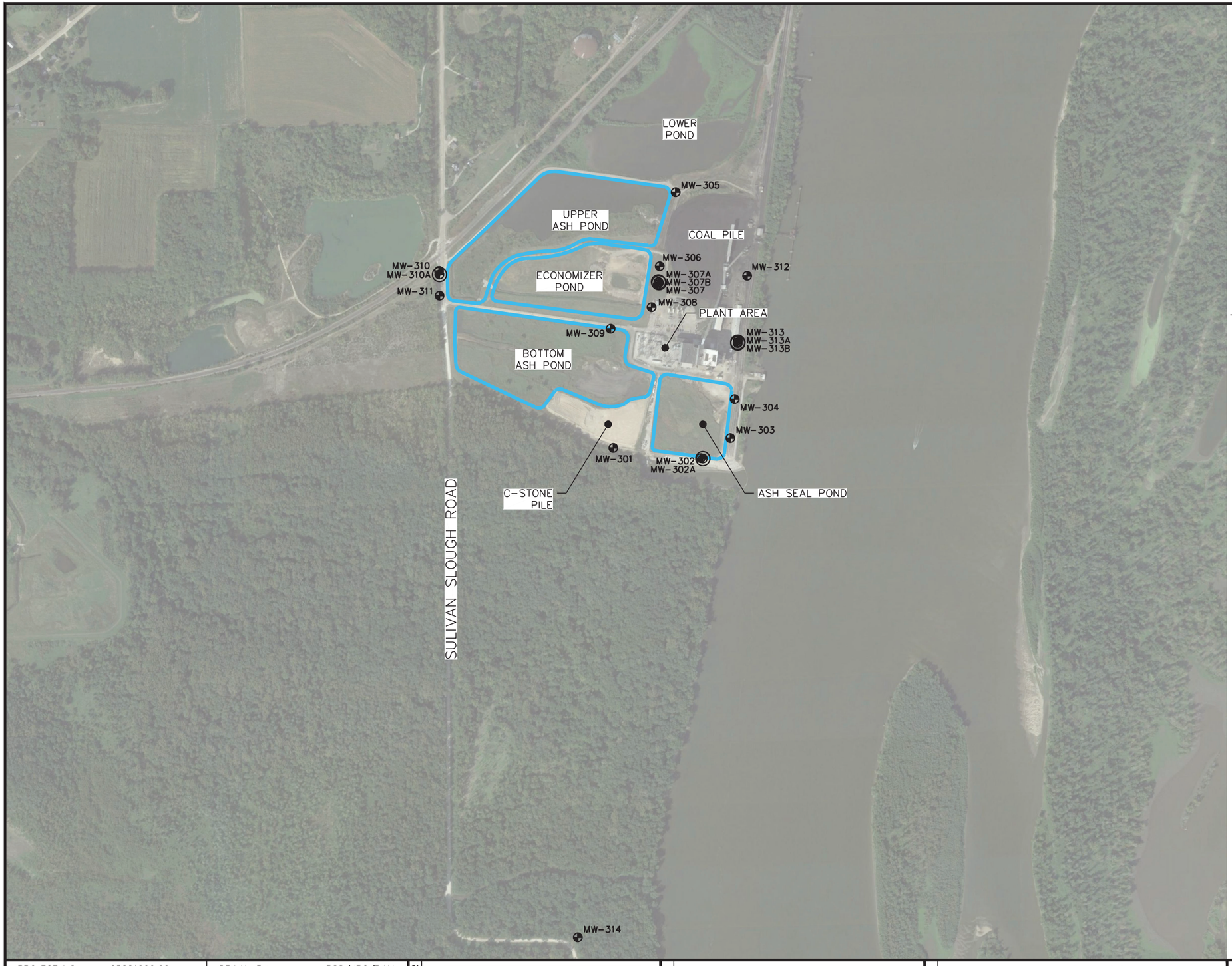
CLIENT: ALLIANT ENERGY
4902 N. BILTMORE LANE, #1000
MADISON, WI 53718

SITE: ALLIANT ENERGY
BURLINGTON GENERATING STATION
BURLINGTON, IOWA

SITE PLAN AND MONITORING WELL LOCATIONS

FIGURE 2

\\10.2.18.8\data\Projects\25221066.00\Drawings\Site Plan and Monitoring Well Locations.dwg, 8/31/2022 12:49:42 PM



LEGEND

- EXISTING CCR RULE MONITORING WELL
- CCR RULE PIEZOMETER
- CCR UNITS

NOTES:

1. MONITORING WELLS MW-303 THROUGH MW-308 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 15-17, 2015.
2. MONITORING WELLS MW-301, MW-302, AND MW-309 THROUGH MW-311 WERE INSTALLED BY DIRECT PUSH ANALYTICAL SERVICES CORP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM FEBRUARY 29, 2016 TO MARCH 1, 2016.
3. MONITORING WELLS MW-312 AND MW-313 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING IN MAY 2019.
4. PIEZOMETERS MW-302A, MW-307A, MW-310A, AND MW-311A WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING IN JUNE-JULY 2020.
5. PIEZOMETERS MW-307B AND MW-313B INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM AMY 10-12, 2021.
6. MONITORING WELL MW-314 INSTALLED BY TERRACON CONSULTANTS, INC. UNDER THE SUPERVISION OF SCS ENGINEERS ON FEBRUARY 25, 2022.
7. MW-314 IS LOCATED APPROXIMATELY 4,000 FEET SOUTH OF THE PLANT.
8. 2017 AERIAL PHOTOGRAPH SOURCES: GOOGLE EARTH DATED SEPTEMBER 14, 2017.

N

700 0 700

SCALE: 1" = 700'

PROJECT NO.	25221060.00	DRAWN BY:	BSS/KRG/BWM
DRAWN:	09/14/2020	CHECKED BY:	NDK
REVISED:	08/31/2022	APPROVED BY:	TK 9/2/2022

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PHONE: (608) 224-2830

CLIENT

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4902 N. BILTMORE LANE, #1000
MADISON, WI 53718

SITE

ALLIANT ENERGY
BURLINGTON GENERATING STATION
BURLINGTON, IOWA

SITE PLAN AND MONITORING WELL LOCATION – MW-314

FIGURE 3

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