Selection of Remedy
OGS Ash Pond

Ottumwa Generating Station
Ottumwa, Iowa

Prepared for:

Alliant Energy

SCS ENGINEERS

25220083.00 | September 11, 2020

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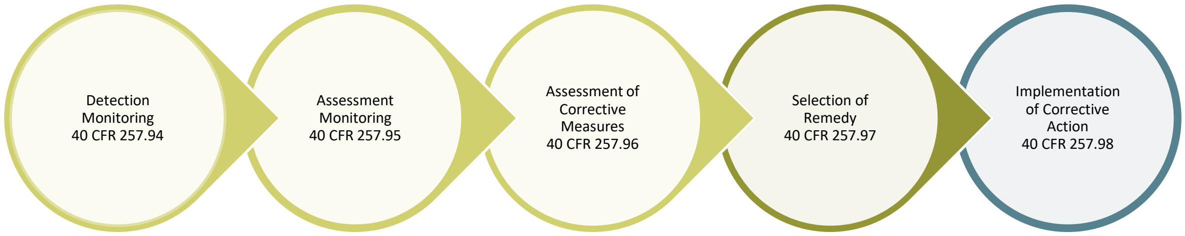
EXECUTIVE SUMMARY

Interstate Power and Light Company (IPL), an Alliant Energy company, operates two ash ponds at the Ottumwa Generating Station (OGS). The ponds are used to manage coal combustion residuals (CCR) and wastewater from the power plant, which burns coal to generate electricity.

IPL samples and tests the groundwater in the area of the ash ponds to comply with U.S. Environmental Protection Agency (USEPA) standards for the Disposal of CCR from Electric Utilities, or the "CCR Rule" (Rule).

Groundwater samples from two of the wells installed to monitor one of the ponds (OGS Ash Pond) contain cobalt at levels higher than the Groundwater Protection Standards (GPS) defined in the Rule. Cobalt occurs naturally and can also be present in coal and CCR.

IPL has prepared this Selection of Remedy Report in accordance with the requirements of the CCR Rule. The information in this report builds on the Assessment of Corrective Measures (ACM) Report issued in September 2019. The ACM was prepared in response to the groundwater sampling results at the OGS facility. The Selection of Remedy process is the next step in a series of steps defined in the Rule and shown below.



The Selection of Remedy Report provides an update to the nature and extent of groundwater impacts discussed in the ACM. Since the ACM was issued, IPL has continued to develop an understanding of the following:

- Types of soil and rock deposits in the area of the OGS facility.
- Depth of groundwater.
- Direction that groundwater is moving.
- Potential sources of the cobalt in groundwater.
- The area where cobalt levels are higher than the USEPA standards.
- The people, plants, and animals that may be affected by levels of cobalt in groundwater that are above the GPS.

IPL has installed new wells to evaluate groundwater concentrations beyond the location of the wells with GPS exceedances. Groundwater monitoring data continue to show cobalt is present in groundwater near the OGS Ash Pond, but the available data indicate that cobalt is present at levels below USEPA standards beyond the immediate area of the waste limits where downgradient compliance monitoring wells are located. Therefore, the available information does not indicate completion of an exposure pathway that would adversely impact people, plants, and animals.

Groundwater monitoring completed since the ACM was issued identified lithium and fluoride in deeper monitoring wells at levels higher than the GPS defined in the Rule. IPL is evaluating the lithium and fluoride detections (see Appendix B). An initial review of available information indicates that lithium and fluoride detected in groundwater samples is attributable to natural background conditions in the Mississippian bedrock aquifer, rather than a release from the OGS Ash Pond or other man-made sources.

The Selection of Remedy Report also presents the following:

- A comparison to the minimum criteria set forth in 40 CFR 257.97(b).
- A discussion of the evaluating criteria in 40 CFR 257.97(c) and the remedy selection scoring methodology used to help select an appropriate corrective measure.
- A summary of the selected remedy.

IPL has identified capping CCR in place with monitored natural attenuation (MNA) as the selected remedy for cobalt impacts to groundwater. The selected remedy meets the minimum criteria established in the Rule, and includes:

- Stopping all CCR and wastewater discharges to the OGS Ash Pond.
- Closing the pond with CCR in place according to 40 CFR 257.102(d).
- Implementing enhanced groundwater monitoring via MNA.

In accordance with 40 CFR 257.96(e), IPL held a public meeting with interested and affected parties to discuss the ACM as required by the Rule on June 4, 2020. Within 90 days of this Selection of Remedy Report, IPL will implement the selected remedy as required in 40 CFR 257.98(a). This report describes the status of remedy design and an anticipated construction schedule. Currently, OGS Ash Pond closure construction is anticipated to begin in 2021 and finish in 2023. A corrective action groundwater monitoring program that includes MNA will also be established and is expected to continue into early 2028.

For more information on Alliant Energy, view our 2020 Corporate Responsibility Report at http://www.alliantenergy.com/responsibility.

PE CERTIFICATION

9/11/20

I, Eric J. Nelson, hereby certify that the selected groundwater remedy described herein meets the requirements of 40 CFR 257.97. This Selection of Remedy report was prepared by me or under my direct supervision, and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

9/11/2020

(signature) (date)

Eric J. Nelson

(printed or typed name)

License number 23136

My license renewal date is December 31, 2020.

Pages or sheets covered by this seal:

Selection of Remedy Report dated 9/11/2020 excluding the drawings provided in Appendix C.

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1.0 INTRODUCTION AND PURPOSE

This Selection of Remedy report was prepared to support compliance with the groundwater monitoring requirements of the "Coal Combustion Residuals (CCR) Final Rule" published by the U.S. Environmental Protection Agency (USEPA) in the *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule*, dated April 17, 2015 (USEPA, 2015), and subsequent amendments. Specifically, this report was prepared to fulfill the requirements of a final report identified in 40 CFR 257.97(a) and identify the remedy selected to address the Groundwater Protection Standard (GPS) exceedances observed in the April, August, and October 2018 sampling events for the OGS Ash Pond, and identified in the Notification of Groundwater Protection Standard Exceedance dated February 13, 2019. This Selection of Remedy report includes a description of the selected remedy and how it meets the requirements of 40 CFR 257.97(b), which are described in **Section 3.1**.

This report also provides a brief summary of the activities completed to further define the nature and extent of the groundwater impacts attributed to the Ottumwa Generating Station (OGS) Ash Pond at OGS since the Assessment of Corrective Measures (ACM) report was issued in September 2019.

2.0 BACKGROUND

2.1 SITE INFORMATION AND MAP

OGS is located southwest of the Des Moines River, approximately 8 miles northwest of the City of Ottumwa in Wapello County, Iowa (**Figure 1**). The address of the plant is 20775 Power Plant Road, Ottumwa, Iowa. In addition to the coal-fired generating station, the property also contains the OGS Ash Pond, the OGS Zero Liquid Discharge (ZLD) Pond, a coal stockpile, and a hydrated fly ash stockpile.

The two CCR units at the facility (OGS Ash Pond and OGS ZLD Pond) are each monitored with single-unit groundwater monitoring systems. The OGS Ash Pond is the subject of this report.

The pending closure of the OGS Ash Pond was discussed in the Interstate Power and Light Company (IPL) Notification of Intent to Close CCR Surface Impoundment, dated April 3, 2019. 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**.

In accordance with 40 CFR 257.96(a), IPL prepared an ACM in response to the cobalt detected in groundwater samples above the GPS, which was issued in September 2019.

In accordance with 40 CFR 257.96(e), IPL held a public meeting to discuss the ACM on June 4, 2020. The meeting was open to interested and affected parties, and, due to the COVID-19 pandemic, was held virtually using an interactive online meeting platform.

2.2 UPDATED NATURE AND EXTENT OF GROUNDWATER IMPACTS

This section provides an update of the nature and extent of groundwater impacts since the ACM was completed. The additional work completed since the ACM was issued further defined the nature and extent of groundwater impacts and includes:

- Installation of deeper piezometers MW-305A, MW-310A, and MW-311A, which are nested with compliance well MW-305 and downgradient wells MW-310 and MW-311 located along the Des Moines River (see **Figure 2**).

- Establishment of a permanent benchmark for measuring the Des Moines River elevation (see **Figure 2**).

- Collection of several rounds of groundwater elevations from the new and existing monitoring wells. The April 13 and 14 water level measurements were used to create an updated potentiometric surface map for the wells near the top of the bedrock aquifer (see **Table 1** and **Figure 3**).

- Collection of three rounds of groundwater samples from new downgradient monitoring wells MW-310 and MW-311 in October 2019, February 2020, and April 2020 (see **Table 2**).

- Collection of two rounds of groundwater samples from the three new piezometers in March 2020 and April 2020 (see **Table 2**).

- Resample of monitoring well MW-311A for fluoride in June 2020. (see **Table 2**).

- Collection of select additional parameters in March 2020 to assist with the evaluation of monitored natural attenuation (MNA) (see **Table 2**).

- Collection of three rounds of groundwater samples from adjacent OGS ZLD monitoring network wells. Cobalt sample results from OGS ZLD Pond well MW-307 from December 2019, February 2020, and April 2020 exceed the cobalt GPS. Sample results for the ZLD Pond wells are summarized in **Table 3**, and are discussed further in the July 13, 2020, Assessment Groundwater Monitoring – Statistical Evaluation. MW-307 is located downgradient of cobalt impacted wells MW-305 and MW-306. MW-307 is immediately downgradient of the southern portion of the OGS ZLD Pond, which, based on pond geometry, is also downgradient of the OGS Ash Pond (see **Figure 2**). The other compliance wells monitoring the ZLD Pond (MW-308 and MW-309) have cobalt concentrations below the UPL and the GPS. The OGS ZLD Pond is not a suspected source of cobalt.

- Continuation of semiannual assessment monitoring in October 2019 and April 2020 for the original monitoring network, with new wells added as described above (see **Table 2**).

- Calculation of vertical gradients at well nest MW-305/MW-305A and the two downgradient well nests MW-310/MW-310A and MW-311/MW-311A (see **Table 4**).

2.2.1 Potential Sources

Although cobalt is present in shallow groundwater upgradient of the OGS Ash Pond, the OGS Ash Pond is still believed to be the likely source of the cobalt concentrations above the GPS in groundwater samples from the compliance wells. As described in the ACM, potential sources of cobalt or factors that may be contributing the groundwater impacts observed include:

- CCR discharged to and stored in the OGS Ash Pond.

- Storm water runoff into the OGS Ash Pond from surrounding areas.
- Low-volume plant wastewater managed via the OGS Ash Pond.

No additional sources have been identified since the ACM.

2.2.2 Updated Groundwater Assessment

When the ACM was completed in September 2019, monitoring wells MW-310 and MW-311 had been installed in the area between the current downgradient wells and the Des Moines River to fulfill the requirements of 40 CFR 257.95(g)(1). However, no groundwater samples had yet been collected.

Monitoring wells MW-305A, MW-310A, and MW-311A were also installed since the ACM as nested piezometers with monitoring wells MW-305, MW-310, and MW-311. The three additional piezometers were installed on February 25 through March 4, 2020, to provide additional vertical characterization of groundwater impacts and groundwater flow paths in support of the assessment of corrective measures. The wells were monitored as described above. Results of the groundwater sample analysis are located in Table 2. The significance of these GPS exceedances are discussed below.

The monitoring wells at the site are screened within the bedrock aquifer and/or alluvial sands that are in contact with bedrock. The groundwater elevations from these wells represent the potentiometric head within the bedrock aquifer and alluvial sands in contact with the bedrock, which are overlain by clay. The piezometers are screened within the bedrock aquifer.

The water table in the vicinity of the CCR unit lies within the clay unit located immediately above the bedrock aquifer. There are no monitoring wells screened within the clay unit since it is not part of the uppermost aquifer.

The depth to groundwater as measured in the site monitoring wells varies from approximately 2 to 28 feet below ground surface (bgs) due to topographic variations across the facility and seasonal variations in water levels (Table 1). Groundwater depth at the wells located in the berm around the OGS Ash Pond varies between 9 and 28 feet bgs. These depths represent the potentiometric head in the bedrock and alluvial sands, which lie below approximately 9 to 15 feet of native clay in the area near the pond. Up to 41 feet of total clay thickness was observed at monitoring wells drilled within the berm. Groundwater flow at the site is generally to the east-northeast, and the groundwater flow direction and water levels fluctuate seasonally due to the proximity to the river.

Concentrations of cobalt above the GPS in groundwater samples collected in October 2019, March 2020, and April 2020 are similar to the concentrations reported in the ACM (around 16 to 17 ug/L). The groundwater sample from MW-306 contained cobalt above the GPS (6.2 ug/L) in October 2019. Subsequent samples from MW-306 (April 2020) contained a lower cobalt concentration that was below the GPS (5.5 ug/L). None of the new groundwater samples collected from MW-305 or the other OGS Ash Pond wells contained cobalt at a concentration above the GPS.

Cobalt was not detected above the GPS in samples from the new wells (MW-305A, MW-310/ MW-310A, or MW-311/MW311A).

Lithium was detected above the GPS at new monitoring wells MW-310 (three of four samples collected), MW-310A, and MW-311A (two of two samples collected for both deep piezometers). Fluoride was also detected in the deep piezometer MW-311A at a concentration above the GPS in one of the three sampling events. These exceedances have not yet been determined to be statistically significant. Lithium and fluoride concentrations above the GPSs in these three wells are discussed in the technical memorandum provided in **Appendix B**, and are most likely due to natural background conditions in the Mississippian bedrock aquifer, rather than a release from the ash pond or other man-made source. Lines of evidence supporting this finding include:

- No lithium or fluoride GPS exceedances have been detected at monitoring wells MW-302, MW-304, MW-305, MW-306, or MW-305A, located adjacent to the OGS Ash Pond, as would be expected if the OGS Ash Pond was the source of elevated fluoride and lithium at wells located further downgradient.

- The lithium and fluoride concentrations detected in samples from MW-310A and MW-311A are well within the range of concentrations naturally present in the Mississippian aquifer based on results from background monitoring wells in the same aquifer at the nearby Ottumwa Midland Landfill (OML) located approximately 5 miles to the east-southeast.

- Analysis of major anions and cations indicates that the water quality in deep piezometers MW-310A and MW-311A is similar to regional water quality for the Mississippian aquifer and different from water quality in the shallower on-site wells.

- Vertical gradients at monitoring well pairs MW-310/MW-310A and MW-311/MW-311A during the two water level measurement events in April 2020 indicate that groundwater flow is at least intermittently upward from the Mississippian bedrock into the overlying unconsolidated material.

If the lithium and fluoride exceedances are determined to be statistically significant, IPL will be required to either prepare an alternative source demonstration (ASD) or initiate an Assessment of Corrective Measures for these constituents.

2.2.3 Updated Conceptual Site Model

Based on the additional investigations performed since the September 2019 ACM, the OGS Ash Pond continues to be identified as the likely source of the statistically significant exceedances above the GPS for cobalt. Cobalt remains the only constituent with a statistically significant exceedance of the GPS.

Groundwater samples collected from the piezometer nests installed downgradient of the OGS Ash Pond and adjacent to the Des Moines River did not contain cobalt at a concentration above the GPS. None of the additional information obtained since the ACM was issued suggests that cobalt is reaching the new wells, and our samples indicate that elevated concentrations of cobalt are only present near the pond. Therefore, we have not observed cobalt migrating to a location where it can impact human health or the environment. In other words, there is no pathway for exposure to cobalt.

The ACM listed the surface water/sediment, biota/food, and ecological exposure assessment as ongoing because the extent of groundwater impacts was still being evaluated. Based on the results of the additional investigation work performed since the ACM was prepared, there do not appear to be any remaining potential human or ecological health pathways related to the cobalt concentrations in groundwater related to the OGS Ash Pond that exceed the GPS.

In summary, cobalt is present in groundwater near the OGS Ash Pond but the available data do not indicate completion of an exposure pathway. Therefore, there are no current or expected adverse impacts to human health or ecological receptors.

3.0 CORRECTIVE MEASURES AND REMEDY SELECTION

Several corrective measure options were presented in detail in the Assessment of Corrective Measures OGS Ash Pond report, dated September 2019. This report identified the following corrective measure alternatives for the cobalt impacts to groundwater associated with the OGS Ash Pond:

- 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 Off Site with MNA

The following sections present:

- A comparison to the minimum criteria set forth in 40 CFR 257.97(b).
- A discussion of the evaluating criteria in 40 CFR 257.97(c) and our remedy selection scoring methodology.
- A summary of the selected remedy.

3.1 MINUMUM CRITERIA

The selected remedy must meet the minimum criteria set forth in 40 CFR 257.97(b). These criteria and the ability of the alternatives evaluated to satisfy the criteria is summarized in **Table 5**.

With the exception of the No Action alternative, each of the corrective measure alternatives meet the requirements in 40 CFR 257.97(b)(1) through (5) based on the information available at the current time.

3.2 EVALUATION FACTORS

Each alternative remedy was evaluated based on the criteria in 257.97(c) and assigned a score for each of the criteria. An individual score of "1" through "4" was assigned to each of the criteria. A score of "1" represents "least effective" and a score of "4" represents "most effective." The scoring is based on each option relative to the other remedies evaluated. This scoring was applied to the following evaluation factors:

- **Long- and Short-Term Effectiveness [257.97(c)(1)]**
  - Magnitude of reduction of existing risks.
  - Magnitude of residual risks in terms of likelihood of further released due to CCR remaining following implementation of a remedy.
  - The type and degree of long-term management required, including monitoring, operation, and maintenance.
  - Short-term risks:
    - Excavation
    - Transportation

        - Re-disposal
    - Potential for exposure for 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.
    - Long-term reliability of the engineering and institutional controls.
    - Potential need for replacement of the remedy.

- Source Control to Mitigate Future Releases [257.97(c)(2)]
    - The extent to which containment practices will reduce further releases.
    - The extent to which treatment technologies may be used.

- Implementation [257.97(c)(3)]
    - Degree of difficulty associated with constructing the technology.
    - Expected operation reliability of the technologies.
    - Need to coordinate with and obtain necessary approvals and permits from other agencies.
    - Availability of necessary equipment and specialists.
    - Available capacity and location of needed treatment, storage, and disposal.

- *Community Acceptance*
    - The degree to which community concerns are addressed by a potential remedy.

The scoring is detailed in Table 5. An individual score of "1" to "4" was applied to each item above. Individual scores were added to develop a total score for each alternative. There are 18 separate criteria allowing a lowest possible score of 18, and a highest possible score of 72. A high score represents a more favorable option based on the assessment criteria. A summary of the scoring is presented in Table 6.

3.3 SELECTED REMEDY

Alternative 2 - Close and Cap in Place with MNA - scored highest in the evaluation of factors defined in 257.97(c) and is presented below as the selected remedy.

3.3.1 Remedy Description

Alternative 2 includes stopping all CCR and wastewater discharges to the OGS Ash Pond and closing the pond with CCR in place. The OGS Ash Pond will be dewatered; existing on-site CCR, sediment, and soil will be placed or graded within the existing pond limits; the CCR materials will be covered with a low-permeability soil or geosynthetic cap; and vegetation, or an appropriate alternative erosion layer, will be established in accordance with the requirements for closure in place in 40 CFR 257.102(d). The closed OGS Ash Pond will be subject to enhanced groundwater monitoring via MNA. A discussion of how this alternative meets the minimum standards in 257.97(b) is provided below. Preliminary drawings showing the proposed closure of the OGS Ash Pond are provided in Attachment C.

3.3.2 Satisfying Minimum Criteria

The selected remedy is expected to meet the minimum criteria established in 257.97(b) and described in Section 3.1. Each criteria is discussed below.

257.97(b)(1) – Be protective of human health and the environment:

As discussed in the September 2019 ACM and **Section 2.2** above, the available data do not indicate completion of an exposure pathway for cobalt. Alternative 2 sustains or improves the current level of protectiveness by eliminating infiltration of plant wastewater discharges and precipitation.

In addition, the selected remedy minimizes the handling of CCR and therefore the exposure of construction workers and the public to CCR as well as secondary impacts from the remedy implementation such as fine particulates from fugitive dust (e.g., dust generated while travelling local gravel roads, particulate in equipment exhaust, etc.), noise, and traffic.

257.97(b)(2) – Attain the groundwater protection standard as specified pursuant to §257.95(h):

Ceasing wastewater discharges and closing the impoundments by capping is expected to address infiltration, which is likely a key contributor to groundwater impacts. MNA monitoring will identify the natural attenuation processes that reduce mass, toxicity, mobility, volume, or concentrations of the constituents of concern in groundwater. The selected remedy is capable of and expected to attain the GPS for cobalt.

257.97(b)(3) – 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:

The source of the cobalt release to groundwater is attributed to CCR and wastewater discharges to the OGS Ash Pond. The selected remedy eliminates CCR sluicing/plant process water discharges and, with the installation of a cap, will reduce vertical infiltration through the CCR. This is expected to address the major contributor to the observed GPS exceedances, which is exposure of CCR material to precipitation/surface water infiltration. MNA is part of the selected remedy to monitor changes in groundwater impacts and the effectiveness of degradation mechanisms on groundwater concentrations over time.

257.97(b)(4) – Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems:

No releases of CCR have been identified from the OGS Ash Pond. As described above, addressing infiltration in combination with MNA processes are expected to reduce cobalt impacts to groundwater.

257.97(b)(5) – Comply with standards for management of wastes as specified in §257.98(d):

All CCR or other waste generated during the OGS Ash Pond closure can be managed in accordance with Resource Conservation and Recovery Act (RCRA) requirements. The selected remedy will comply with the standards for management of wastes described in 257.98(d).

4.0 SCHEDULE

The anticipated schedule for implementing and completing the selected remedy includes:

- July 2020 – Complete OGS Ash Pond closure design.
- October 2020 – Establish and implement corrective action groundwater monitoring program, including MNA (within 90 days of selection of remedy).

- January 2021 – Complete procurement for closure construction.
- October 2021 – Complete state and local approvals.
- October 2023 – Complete closure construction.
- October 2028 – Evaluate MNA progress if compliance with GPS not yet achieved.

This schedule is based on the following considerations, as described in 257.97(d) and discussed below.

257.97(d)(1) – Extent and nature of contamination, as determined by the characterization required under §257.95(g):

Investigations of the nature and extent of cobalt in groundwater attributed to the OGS Ash Pond are complete. Groundwater monitoring will continue as the selected remedy is implemented, and, unless significant changes in the nature of the impacts are observed, the schedule described above will not be impacted.

257.97(d)(2) – Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under §257.95(h) and other objectives of the remedy:

The cessation of wastewater discharges and capping the OGS Ash Pond is expected to be a reliable method of attaining the groundwater protection standard for cobalt. Capping is a common practice and standard remedial method for site remediation and solid waste management projects. There is significant industry experience with the design and construction of this method. The evaluation of the natural attenuation processes that are active at OGS will continue as the remedy is implemented.

The combination of closure in place with a cap and MNA will require time to evaluate and achieve the GPS. It is reasonable to expect the selected remedy will achieve the GPS. It is also reasonable to expect that cobalt concentrations in groundwater may increase in the near term as CCR is disturbed during remedy implementation. Given the lack of human and ecological receptors, ongoing monitoring should be sufficiently protective of human health and the environment if local cobalt concentrations in groundwater increase during or shortly after closure construction is completed.

257.97(d)(3) – Availability of treatment or disposal capacity for CCR managed during implementation of the remedy:

The availability of treatment or disposal capacity is not a factor for the selected remedy schedule. The capacity to manage CCR from the OGS Ash Pond is available on site within the current footprint of the pond.

257.97(d)(4) – Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy:

There are no operational changes planned at OGS that would lead to a potential risk to human health and the environment from cobalt-impacted groundwater attributed to the OGS Ash Pond prior to the implementation of the selected remedy. Operational changes at OGS prior to implementation of the remedy are expected to reduce infiltration potential, further limiting the potential to complete an exposure pathway.

257.97(d)(5) – Resource value of the aquifer:

The aquifer in the area of cobalt impacts attributed to the OGS ash pond is not currently used as a water supply for human or animal consumption or irrigation. Surface waters, including the Des Moines River, are the source of most water supply in the area due to the low quality of groundwater supplies. As discussed in **Section 2.2**, the Des Moines River is not affected by cobalt attributable to the OGS Ash Pond.

257.97(d)(6) – Other relevant factors:

The schedule above reflects an initial 5-year post-closure period of enhanced groundwater monitoring for the ongoing evaluation of MNA. During this time, groundwater monitoring will be used to document and evaluate the natural attenuation processes active at OGS, and progress toward achieving the GPS. Groundwater monitoring, including ongoing MNA described in **Section 2.2**, will continue throughout implementation of the selected remedy, which will allow IPL to assess groundwater quality and human and ecological risk throughout the implementation period and implement other methods or techniques in accordance with 257.98(b).

5.0 REFERENCES

SCS Engineers, Assessment of Corrective Measures, OGS Ash Pond, September 2019.

ASTM International, ASTM E2616-09 - Standard Guide for Remedy Selection Integrating Risk-Based Corrective Action and Non-Risk Considerations, Reapproved 2014

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Tables

Table 1. Water Level Summary
IPL - Ottumwa Generating Station / SCS Engineers Project #25220083.00

Depth to Water in feet below top of well casing/reference elevation															
Raw Data	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-305A**	**MW-306**	**MW-307**	**MW-308**	**MW-309**	**MW-310**	**MW-310A**	**MW-311**	**MW-311A**	**River at Intake**
Measurement Date															
April 26, 2016	3.83	18.27	8.65	27.47	22.24	NI	12.61				NI	NI	NI	NI	NI
June 23, 2016	4.05	18.25	8.18	26.31	21.55	NI	12.83				NI	NI	NI	NI	NI
August 9, 2016	4.36	18.38	9.31	29.05	23.13	NI	13.12				NI	NI	NI	NI	NI
October 26-27, 2016	4.59	18.23	8.90	27.81	22.54	NI	13.26				NI	NI	NI	NI	NI
January 18-19, 2017	4.96	18.44	9.33	28.34	23.04	NI	13.58	8.75	7.97	8.28	NI	NI	NI	NI	NI
April 19-20, 2017	4.48	17.55	6.50	25.36	20.64	NI	12.78	3.94	4.30	4.78	NI	NI	NI	NI	NI
June 20-21, 2017	4.72	18.25	8.65	28.09	22.65	NI	13.53	7.71	7.13	7.34	NI	NI	NI	NI	NI
August 21-23, 2017	5.35	18.77	10.49	30.45	24.91	NI	14.70	11.78	12.27	13.12	NI	NI	NI	NI	NI
November 8, 2017	5.09	18.50	9.73	29.81	24.15	NI	14.43	10.19	10.40	10.74	NI	NI	NI	NI	NI
April 18, 2018	5.10	18.19	8.60	27.29	22.92	NI	14.55	7.90	7.48	7.29	NI	NI	NI	NI	NI
May 30, 2018	NM	NM	NM	NM	NM	NI	NM	5.11	4.34	3.96	NI	NI	NI	NI	NI
June 28, 2018	NM	NM	NM	NM	NM	NI	NM	4.69	3.96	3.47	NI	NI	NI	NI	NI
July 18, 2018	NM	NM	NM	NM	NM	NI	NM	5.29	4.72	4.25	NI	NI	NI	NI	NI
August 14-15, 2018	5.72	17.85	8.50	26.49	22.35	NI	14.81	NM	NM	NM	NI	NI	NI	NI	NI
August 29, 2018	5.54	18.01	6.00	25.02	NM	NI	NM	NM	NM	NM	NI	NI	NI	NI	NI
October 16, 2018	4.13	16.99	4.90	24.64	20.54	NI	13.23	3.43	NM	3.33	NI	NI	NI	NI	NI
January 8, 2019	4.41	17.87	6.42	26.56	21.78	NI	13.63	NM	NM	NM	NI	NI	NI	NI	NI
April 8, 2019	3.94	16.67	5.52	23.51	19.90	NI	12.51	2.66	1.69	1.39	NI	NI	NI	NI	NI
August 28, 2019	NM	NM	NM	NM	NM	NI	NM	NM	NM	NM	17.65	NI	12.08	NI	NI
October 23-24, 2019	3.56	13.76	7.21	25.13	20.70	NI	12.19	5.67	4.08	3.66	9.32	NI	6.38	NI	NI
December 11, 2019	NM	NM	NM	NM	NM	NI	NM	7.97	8.00	7.70	NM	NI	NM	NI	NI
February 5, 2020	3.33	NM	NM	NM	NM	NI	NM	7.68	5.27	6.60	13.92	NI	9.18	NI	NI
March 12-13, 2020	3.81	NM	NM	NM	22.50	32.39	NM	NM	NM	NM	13.18	40.09	10.00	29.43	NI
April 1, 2020	3.36	16.9	5.18	24.27	23.32	28.98	12.34	3.8	3.51	3.71	7.54	8.77	4.83	5.27	6.6
April 13-14, 2020	3.38	17.45	6.99	26.42	21.47	30.34	12.76	6.90	5.30	5.75	12.72	10.43	7.39	5.12	10.6
June 30, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	5.81	NM

Ground Water or Surface Water Elevation in feet above mean sea level (amsl)															
Well Number	**MW-301**	**MW-302**	**MW-303**	**MW-304**	**MW-305**	**MW-305A**	**MW-306**	**MW-307**	**MW-308**	**MW-309**	**MW-310**	**MW-310A**	**MW-311**	**MW-311A**	**River at Intake**
Top of Well Casing Elevation / Surface Water Reference Elevation (feet amsl)	686.63	673.90	661.07	682.84	683.91	684.03	683.47	657.56	655.39	654.94	658.63	657.93	654.18	653.54	656.31
Screen Length (ft)	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	NA
Total Depth (ft from top of casing)	17.0	25.8	17.5	52.3	51.5	81.91	36.6	28.0	25.0	27.5	25.9	55.55	17.9	47.68	NA
Top of Well Screen Elevation (ft)	679.63	653.10	648.57	635.54	637.41	607.12	651.87	634.56	635.39	632.44	637.76	607.38	641.24	610.86	NA
Measurement Date															
April 26, 2016	682.80	655.63	652.42	655.37	661.67	NI	670.86				NI	NI	NI	NI	NI
June 23, 2016	682.58	655.65	652.89	656.53	662.36	NI	670.64				NI	NI	NI	NI	NI
August 9, 2016	682.27	655.52	651.76	653.79	660.78	NI	670.35				NI	NI	NI	NI	NI
October 26-27, 2016	682.04	655.67	652.17	655.03	661.37	NI	670.21				NI	NI	NI	NI	NI
January 18-19, 2017	681.67	655.46	651.74	654.50	660.87	NI	669.89	648.81	647.42	646.66	NI	NI	NI	NI	NI
April 19-20, 2017	682.15	656.35	654.57	657.48	663.27	NI	670.69	653.62	651.09	650.16	NI	NI	NI	NI	NI
June 20-21, 2017	681.91	655.65	652.42	654.75	661.26	NI	669.94	649.85	648.26	647.60	NI	NI	NI	NI	NI
August 21-23, 2017	681.28	655.13	650.58	652.39	659.00	NI	668.77	645.78	643.12	641.82	NI	NI	NI	NI	NI
November 8, 2017	681.54	655.40	651.34	653.03	659.76	NI	669.04	647.37	644.99	644.20	NI	NI	NI	NI	NI
April 18, 2018	681.53	655.71	652.47	655.55	660.99	NI	668.92	649.66	647.91	647.65	NI	NI	NI	NI	NI
May 30, 2018	NM	NM	NM	NM	NM	NI	NM	652.45	651.05	650.98	NI	NI	NI	NI	NI
June 28, 2018	NM	NM	NM	NM	NM	NI	NM	652.87	651.43	651.47	NI	NI	NI	NI	NI
July 18, 2018	NM	NM	NM	NM	NM	NI	NM	652.27	650.67	650.69	NI	NI	NI	NI	NI
August 14-15, 2018	680.91	656.05	652.57	656.35	661.56	NI	668.66	NM	NM	NM	NI	NI	NI	NI	NI
August 29, 2018	681.09	655.89	655.07	657.82	NM	NI	NM	NM	NM	NM	NI	NI	NI	NI	NI
October 16, 2018	682.50	656.91	656.17	658.20	663.37	NI	670.24	654.13	NM	651.61	NI	NI	NI	NI	NI
January 8, 2019	682.22	656.03	654.65	656.28	662.13	NI	669.84	NM	NM	NM	NI	NI	NI	NI	NI
April 8, 2019	682.69	657.23	655.55	659.33	664.01	NI	670.96	654.90	653.70	653.55	NI	NI	NI	NI	NI
August 28, 2019	NM	NM	NM	NM	NM	NI	NM	NM	NM	NM	640.98	NI	642.10	NI	NI
October 23-24, 2019	683.07	660.14	653.86	657.71	663.21	NI	671.28	651.89	651.31	651.28	649.31	NI	647.80	NI	NI
December 11, 2019	NM	NM	NM	NM	NM	NI	NM	649.59	647.39	647.24	NM	NI	NM	NI	NI
February 5, 2020	683.30	NM	NM	NM	NM	NI	NM	649.88	650.12	648.34	644.71	NI	645.00	NI	NI
March 12-13, 2020	682.82	NM	NM	NM	661.41	651.64	NM	NM	NM	NM	645.45	617.84	644.18	624.11	NI
April 1, 2020	683.27	657.00	655.89	658.57	660.59	655.05	671.13	653.76	651.88	651.23	651.09	649.16	649.35	648.27	649.71
April 13-14, 2020	683.25	656.45	654.08	656.42	662.44	653.69	670.71	650.66	650.09	649.19	645.91	647.50	646.79	648.42	645.71
June 30, 2020	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	647.73	NM
Bottom of Well Elevation (ft)	669.63	648.10	643.57	630.54	632.41	602.12	646.87	629.56	630.39	627.44	632.76	602.38	636.24	605.86	--

Notes:
NM = not measured
NI= not installed

Created by: KAK Date: 5/1/2017
Last rev. by: NDK Date: 7/22/2020
Checked by: AJR Date: 7/22/2020
Proj Mgr QA/QC: EJN Date: 9/11/2020

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Table 2. Groundwater Analytical Results Summary
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Parameter Name	UPL Method	UPL	GPS	Background Well MW-301				Compliance Wells MW-302		MW-303		MW-304		MW-305			MW-305A		MW-306	
				10/24/2019	2/5/2020	3/12/2020	4/14/2020	10/24/2019	4/14/2020	10/24/2019	4/14/2020	10/23/2019	4/13/2020	#######	3/13/2020	4/13/2020	3/13/2020	4/14/2020	10/23/2019	4/14/2020
Appendix III																				
Boron, ug/L	P	820		680	540	--	700	1,200	1,200	440	420	970	1,000	880	--	920	250	280	980	1,000
Calcium, mg/L	P	78.7		78	68	--	84	180	180	170	170	120	130	100	--	100	100	130	77	73
Chloride, mg/L	P	86.8		110	120	--	140	220	220	35	47	280	250	280	--	270	40	89	47	41
Fluoride, mg/L	P	0.484		<0.23	--	--	<0.23	<0.23	<0.23	<0.23	<0.23	0.74	1.1	<0.23	--	0.35 J	0.77	0.73	<0.23	<0.23
Field pH, Std. Units	P	6.87		6.33	6.39	6.48	6.58	6.55	6.7	6.83	6.98	7.05	7.12	6.91	7.02	7.0	8.09	7.63	6.74	6.68
Sulfate, mg/L	P	199		130	130	--	140	810	790	180	180	190	220	76	--	63	40	93	280	310
Total Dissolved Solids, mg/L	P	628		510	570	--	550	1,600	1,500	810	810	1100	1,000	1000	--	960	400	570	870	820
Appendix IV		**UPL**	**GPS**																	
Antimony, ug/L	P*	0.22	6	<0.53	--	--	<0.58	<0.53	<0.58	<0.53	<0.58	<0.53	<0.58	<0.53	--	<0.58	1.3	0.88 J	<0.53	<0.58
Arsenic, ug/L	P*	0.53	10	<0.75	<0.88	--	<0.88	<0.75	<0.88	<0.75	<0.88	0.83 J	0.96 J	<0.75	--	<0.88	<0.88	<0.88	0.78 J	<0.88
Barium, ug/L	P	68.8	2,000	56	43	--	54	21	23	77	64	80	80	110	--	110	70	80	51	48
Beryllium, ug/L	DQ	DQ	4	<0.27	--	--	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	--	<0.27	<0.27	<0.27	<0.27	<0.27
Cadmium, ug/L	NP*	0.12	5	0.040	<0.039	--	<0.039	0.20	0.23	0.21	0.18	<0.039	<0.039	0.087 J	--	0.14	<0.039	<0.039	0.89	0.83
Chromium, ug/L	P	1.07	100	<0.98	<1.1	--	<1.1	<0.98	1.4 J	<0.98	<1.1	2 J	3.5 J	<0.98	--	<1.1	<1.1	<1.1	1.0 J	<1.1
Cobalt, ug/L	NP	4.1	6	0.60	1.1	0.43 J	0.52	2.7	5.3	1.2	0.87	0.5	0.57	**17**	**18**	**16**	2.4	2.7	6.2	5.5
Fluoride, mg/L	P	0.48	4	<0.23	--	--	<0.23	<0.23	<0.23		<0.23	0.74	1.1	<0.23	--	0.35 J	0.77	0.73	<0.23	<0.23
Lead, ug/L	NP*	0.10	15	<0.27	<0.27	--	<0.27	0.29 J	1.0	<0.27	<0.27	0.27 J	0.5	<0.27	-	0.27 J	0.68	<0.27	0.34 J	0.37 J
Lithium, ug/L	P	34.2	40	24	17	21	24	10	11	<2.7	4.7 J	2.8 J	4.8 J	<2.7	2.3 J	3.2 J	14	16	<2.7	<2.3
Mercury, ug/L	DQ	DQ	2	<0.10	--	--	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	--	<0.10	<0.10	<0.10	<0.10	<0.10
Molybdenum, ug/L	P	1.74	100	1.1	--	--	1.2 J	<1.1	<1.1	5.2	3.6	2.3	2	7.2	--	6.9	9	17	4.9	4.4
Selenium, ug/L	P	8.55	50	6.2	--	--	6.8	<1.0	<1.0	<1.0	5.0	<1.0	<1.0	<1.0	--	<1.0	2.3 J	1.7 J	<1.0	<1.0
Thallium, ug/L	NP*	0.14	2	<0.27	--	--	<0.26	<0.27	<0.26	<0.27	<0.26	<0.27	<0.26	0.38 J	--	0.35 J	<0.26	<0.26	<0.27	<0.26
Radium 226/228 Combined, pCI/L	P	2.15	5	0.956	0.228	--	0.315	0.79	1.26	0.336	0.229	3.03	2.46	0.46	--	0.909	1.97	1.26	0.624	0.0738
Additonal Parameters - Selection of Remedy																				
Cobalt - dissolved,#	UPL or GPS not applicable			--	--	0.32 J	0.44 J	--	0.81	--	0.37 J	--	0.37 J	--	16	16	2.1	2.8	--	5.4
Lithium - dissolved,#				--	--	22	--	--	--	--	--	--	--	--	<2.3	--	15	--	--	--
Iron, dissolved,# ug/L				--	--	<50	<50	--	<50	--	<50	--	4,600	--	51 J	66 J	<50	<50	--	140
Iron, ug/L				--	--	<50	50 J	--	500	--	280	--	5,200	--	390	330	720	64 J	--	590
Magnesium						--	33,000		50,000		23,000		43,000			47,000	--	28,000		26,000
Manganese, dissolved,# ug/L				--	--	17	16	--	110	--	220	--	3,700	--	3,100	3,400	150	240	--	16,000
Manganese, ug/L				--	--	16	19	--	200	--	260	--	3,700	--	3,200	3,300	180	260	--	16,000
Potassium, ug/L				--	--	--	1,500	--	1,500	--	960	--	7,700	--	--	7,600	--	3,800	--	3,700
Sodium, ug/L				--	--	--	77,000	--	250,000	--	100,000	--	210,000	--	--	210,000	--	46,000	--	160,000
Total Alkalinity, mg/L				--	--	--	150	--	61	--	440	--	370	--	--	460	--	270	--	280
Cabonate Alkalinity, mg/L				--	--	--	<1.9	--	<1.9	--	<1.9	--	<1.9	--	--	<1.9	--	<1.9	--	<1.9
Bicarbonate Alkalinity, mg/L				--	--	--	150	--	61	--	440	--	370	--	--	460	--	270	--	280

4.4	Blue highlighted cell indicates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	Yellow highlighted cell indicates the compliance well result exceeds the GPS.
17	Yellow highlighted cell with bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant(1).
17	Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

Blue highlighted cell indic
Yellow highlighted cell inc
Yellow highlighted cell wi
Grayscale indicates Addit

Table 2. Groundwater Analytical Results Summary
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

				Compliance Wells												
				MW-310				MW-310A		MW-311				MW-311A		
Parameter Name	UPL Method	UPL	GPS	10/24/2019	2/5/2020	3/13/2020	4/13/2020	3/13/2020	4/14/2020	10/24/2019	2/5/2020	3/13/2020	4/13/2020	3/13/2020	4/13/2020	6/30/2020
Appendix III																
Boron, ug/L	P	820		720	620	--	550	1500	1,600	<110	<100	--	<100	1400	1,500	NA
Calcium, mg/L	P	78.7		230	160	--	200	82	87	170	130	--	170	44	48	NA
Chloride, mg/L	P	86.8		150	120	--	130	140	130	13	14	--	13	130	140	NA
Fluoride, mg/L	P	0.484		0.31 J	0.85	--	1.1	1.7	1.8	<0.23	<0.23	--	<0.23	3.4	4.1	3.7
Field pH, Std. Units	P	6.87		7.15	7.08	6.89	7	7.73	7.85	6.95	6.72	7.11	6.86	7.85	8.4	7.64
Sulfate, mg/L	P	199		610	530	--	590	1200	1,100	47	54	--	54	1200	1,200	NA
Total Dissolved Solids, mg/L	P	628		260	1200	--	1,300	2300	2,300	530	520	--	570	2300	2,400	NA
Appendix IV		**UPL**	**GPS**													
Antimony, ug/L	P*	0.22	6	<0.53	<0.58	--	<0.58	<0.58	<0.58	<0.53	<0.58	--	<0.58	<0.58	<0.58	NA
Arsenic, ug/L	P*	0.53	10	0.78 J	<0.88	--	<0.88	<0.88	<0.88	<0.75	<0.88	--	<0.88	<0.88	<0.88	NA
Barium, ug/L	P	68.8	2,000	76	53	--	62	16	16	200	160	--	180	20	20	NA
Beryllium, ug/L	DQ	DQ	4	<0.27	<0.27	--	<0.27	<0.27	<0.27	<0.27	<0.27	--	<0.27	<0.27	<0.27	NA
Cadmium, ug/L	NP*	0.12	5	0.22	0.12	--	0.16	<0.039	<0.039	0.04 J	<0.039	--	<0.039	<0.039	<0.039	NA
Chromium, ug/L	P	1.07	100	<0.98	<1.1	--	<1.1	<1.1	<1.1	<0.98	<1.1	--	<1.1	<1.1	<1.1	NA
Cobalt, ug/L	NP	4.1	6	0.57	0.32 J	0.32 J	0.24 J	0.63	0.39 J	0.78	0.11 J	<0.091	<0.091	0.19 J	0.13 J	NA
Fluoride, mg/L	P	0.48	4	0.31 J	0.85	--	1.1	1.7	1.8	<0.23	<0.23	--	<0.23	3.4	4.1	3.7
Lead, ug/L	NP*	0.10	15	<0.27	<0.27	--	<0.27	<0.27	<0.27	<0.27	<0.27	--	<0.27	<0.27	<0.27	NA
Lithium, ug/L	P	34.2	40	35	42	46	48	250	290	4.7 J	2.9 J	4.7 J	6.2 J	260	310	NA
Mercury, ug/L	DQ	DQ	2	<0.10	<0.10	--	<.10	<0.10	<0.10	<0.10 F1	<0.10	--	<0.10	<0.10	<0.10	NA
Molybdenum, ug/L	P	1.74	100	26	29	--	31	2.6	2.7	<1.1	<1.1	--	<1.1	1.2 J	2.8	NA
Selenium, ug/L	P	8.55	50	5	3.3 J	--	4.5 J	<1.0	<1.0	<1.0	1.2 J	--	<1.0	<1.0	<1.0	NA
Thallium, ug/L	NP*	0.14	2	<0.27	<0.26	--	<0.26	<0.26	<0.26	<0.27	<0.26	--	<0.26	<0.26	<0.26	NA
Radium 226/228 Combined, pCI/L	P	2.15	5	0.411	0.0344	--	0.271	3.43	3.9	0.411	0.108	--	0.17	1.47	2.31	NA
Additonal Parameters - Selection of Remedy																
Cobalt - dissolved,#	UPL or GPS not applicable			--	--	0.31 J	0.23 J	0.67	0.40 J	--	--	0.11 J	<0.091	0.36 J	0.12 J	--
Lithium - dissolved,#				--	--	45	--	250	--	--	--	8.0 J	--	250	--	--
Iron, dissolved,# ug/L				--	--	<50	<50	<50	220	--	--	<50	<50	<50	<50	--
Iron, ug/L				--	--	<50	<50	99 J	230	--	--	<50	<50	<50	<50	--
Magnesium							86,000	--	41,000			--	40,000	--	23,000	--
Manganese, dissolved,# ug/L				--	--	250	280	53	39	--	--	21	39	20	22	--
Manganese, ug/L				--	--	260	280	51	38	--	--	20	41	20	13	--
Potassium, ug/L				--	--	--	12,000	--	9,900	--	--	--	620	--	9,000	--
Sodium, ug/L				--	--	--	100,000	--	630,000	--	--	--	5,000	--	710,000	--
Total Alkalinity, mg/L				--	--	--	190	--	320	--	--	--	460	--	360	--
Cabonate Alkalinity, mg/L				--	--	--	<1.9	--	<1.9	--	--	--	<1.9	--	<1.9	--
Bicarbonate Alkalinity, mg/L				--	--	--	190	--	320	--	--	--	460	--	360	--

4.4	ates the compliance well result exceeds the UPL (background) and the LOQ.
30.8	dicates the compliance well result exceeds the GPS.
17	th bold text indicates the compliance well result exceeds the GPS and the result was determined to be statistically significant(1).
17	tional Parameters sampled for selection of remedy and evaluation of MNA.

Table 2. Groundwater Analytical Results Summary
Ottumwa Generating Station Ash Pond / SCS Engineers Project #25220083.00

Abbreviations:

-- = Not Analyzed
mg/L = milligrams per liter
ug/L = micrograms per liter
J = Estimated concentration at or above the LOD and below the LOQ.
B = Analyte was detected in the associated Method Blank.
F1 = MS and/or MSD Recovery is outside acceptance limits.
# = Dissolved parameter samples collected for MNA data review
* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background.

LOD = Limit of Detection
LOQ = Limit of Quantitation
GPS = Groundwater Protection Standard
UPL = Upper Prediction Limit

P = Parametric UPL with 1-of-2 retesting
DQ = Double Quantification Rule (not detected in background)
NP = Nonparametric UPL (highest background value)

Notes:

1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. The cobalt GPS exceedances at MW-305 have been determined to be statistically significant. The cobalt GPS exceedance at MW-306 has been determined not to be statistically significant. Lithium and fluoride GPS exceedances have either been determined not to be statistically significant or the determination is ongoing. See the accompanying reporttext for additional information regarding determinations of statistical significance.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the values are from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

Created by:	NDK	Date:	5/1/2018
Last revision by:	NDK	Date:	7/30/2020
Checked by:	MDB	Date:	7/30/2020
Proj Mgr QA/QC:	TK	Date:	7/30/2020

Table 3. Groundwater Analytical Results Summary

Ottumwa Generating Station - Zero Liquid Discharge Pond (ZLDP) / SCS Engineers Project #25220083.00

			Background Well			Compliance Wells											
Parameter Name	**UPL**		**MW-301**			**MW-307**				**MW-308**				**MW-309**			
			10/24/2019	2/5/2020	4/14/2020	10/23/2019	12/11/2019	2/5/2020	4/14/2020	10/23/2019	12/11/2019	2/5/2020	4/14/2020	10/23/2019	12/11/2019	2/5/2020	4/14/2020
Appendix III		**UPL only**															
Boron, ug/L	820		680	540	700	200	190 J	200	240	220	160 J	220	210	1,300	1,100	1300	1400
Calcium, mg/L	78.7		78	68	84	230	230	210	240	240	220	210	240	150	150	130	150
Chloride, mg/L	86.8		110	120	140	220	200	220	230	160	150	160	170	74	66	68	69
Fluoride, mg/L	0.484		<0.23	--	<0.23	<0.23	<0.23	NA	<0.23	<0.23	<0.23	NA	<0.23	<0.23	<0.23	NA	0.36 J
Field pH, Std. Units	6.87		6.33	6.39	6.58	6.68	6.37	6.67	6.76	6.78	6.55	6.78	6.90	6.98	6.67	7.09	7.21
Sulfate, mg/L	199		130	130	140	95	92	100	99	300	280	300	290	400	370	370	390
Total Dissolved Solids, mg/L	628		510	570	550	1,000	1,000	970	980	1,100	1,100	1100	1,000	1,100	980	990	1000
Appendix IV	**UPL**	**GPS**															
Antimony, ug/L	0.22	6	<0.53	--	<0.58	NA	<0.53	NA	<0.58	NA	<0.53	NA	<0.58	NA	<0.53	NA	<0.58
Arsenic, ug/L	0.53	10	<0.75	<0.88	<0.88	--	<0.75	<0.88	<0.88	--	<0.75	<0.88	<0.88	--	1.1 J	<0.88	0.88 J
Barium, ug/L	68.8	2,000	56	43	54	--	140	130	140	--	130	130	140	--	54	46	50
Beryllium, ug/L	DQ	4	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27	--	<0.27
Cadmium, ug/L	0.12	5	0.040 J	<0.039	<0.039	--	<0.039	<0.039	<0.039	--	<0.039	<0.039	<0.039	--	0.090 J	<0.039	<0.039
Chromium, ug/L	1.07	100	<0.98	<1.1	<1.1	--	<0.98	<1.1	<1.1	--	5.9	<1.1	<1.1	--	1.7 J	<1.1	1.3 J
Cobalt, ug/L	4.1	6	0.60	1.1	0.52	--	11	13	20	--	0.26 J	0.14 J	0.14 J	--	3.7	2.3	3.2
Fluoride, mg/L	0.484	4	<0.23	--	<0.23	<0.23	<0.23	--	<0.23	<0.23	<0.23	--	<0.23	<0.23	<0.23	--	0.36 J
Lead, ug/L	0.1	15	<0.27	<0.27	<0.27	--	0.71	<0.27	0.31 J	--	0.52	<0.27	<0.27	--	2.8	0.63	1.6
Lithium, ug/L	34.2	40	24	17	24	--	12	9.1 J	13	--	16	12	17	--	8.2 J	6.3 J	9.6 J
Mercury, ug/L	DQ	2	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10	--	<0.10
Molybdenum, ug/L	1.74	100	1.1 J	--	1.2 J	--	<1.1	--	<1.1	--	<1.1	--	<1.1	--	<1.1	--	<1.1
Selenium, ug/L	8.55	50	6.2	--	6.8	--	<1.0	--	<1.0	--	<1.0	--	<1.0	--	<1.0	--	<1.0
Thallium, ug/L	0.14	2	<0.27	--	<0.26	--	<0.27	--	<0.26	--	<0.27	--	<0.26	--	<0.27	--	<0.26
Radium 226/228 Combined, pCI/L	2.15	5	0.956	0.228	0.315	--	2.46	2.23	2.06	--	2.73	2.13	1.69	--	1.77	1.02	0.957
Additonal Parameters - Selection of Remedy																	
Cobalt - dissolved,[#] ug/L	UPL or GPS not applicable		--	--	0.44 J	--	--	--	19	--	--	--	0.11 J	--	--	--	2.2
Iron, dissolved,[#] ug/L			--	--	<50	--	--	--	3,100	--	--	--	4,400	--	--	--	590
Iron, ug/L			--	--	50 J	--	--	--	3,800	--	--	--	5,100	--	--	--	1,900
Magnesium, ug/L			--	--	33,000	--	--	--	28,000	--	--	--	25,000	--	--	--	19,000
Manganese, dissolved,[#] ug/L			--	--	16	--	--	--	290	--	--	--	770	--	--	--	660
Manganese, ug/L			--	--	19	--	--	--	310	--	--	--	800	--	--	--	740
Potassium, total, ug/L			--	--	1,500	--	--	--	1,900	--	--	--	3,900	--	--	--	670
Sodium, total, ug/L			--	--	77,000	--	--	--	97,000	--	--	--	110,000	--	--	--	170,000
Total Alkalinity as CaCO3			--	--	150	--	--	--	520	--	--	--	380	--	--	--	290
Carbonate Alkalinity as CaCO3			--	--	<1.9	--	--	--	<1.9	--	--	--	<1.9	--	--	--	<1.9
Bicarbonate Alkalinity as CaCO3			--	--	150	--	--	--	520	--	--	--	380	--	--	--	290

Blue highlighted cell indicates the compliance well result exceeds the UPL and the LOQ.
Yellow highlighted cell indicates the compliance well result exceeds the GPS.
Grayscale indicates Additional Parameters sampled for selection of remedy and evaluation of MNA.

Table 3. Groundwater Analytical Results Summary
Ottumwa Generating Station - Zero Liquid Discharge Pond (ZLDP) / SCS Engineers Project #25220083.00

Abbreviations:

-- = Not Analyzed
mg/L = milligrams per liter
ug/L = micrograms per liter
J = Estimated concentration at or above the LOD and below the LOQ.
DQ = Double Quantification Rule (not detected in background)
UPL = Upper Prediction Limit
GPS = Groundwater Protection Standard
LOD = Limit of Detection
LOQ = Limit of Quantitation

= Dissolved parameter samples collected for MNA data review

* = UPL is below the LOQ for background sampling. For compliance wells, only results confirmed above the LOQ are evaluated as potential SSIs above background.

Notes:

1. An individual result above the UPL or GPS does not constitute a statistically significant increase (SSI) above background or statistically significant level above the GPS. See the accompanying letter text for identification of statistically significant results.
2. GPS is the United States Environmental Protection Agency (US EPA) Maximum Contamination Level (MCL), if established; otherwise, the values are from 40 CFR 257.95(h)(2).
3. Interwell UPLs calculated based on results from background well MW-301.

Created by:	NDK	Date:	6/12/2019
Last revision by:	MDB	Date:	6/16/2020
Checked by:	NDK	Date:	6/16/2020
Proj Mgr QA/QC:	EJN	Date:	9/11/2020

Table 4. Vertical Hydraulic Gradients at Well Clusters
Ottumwa Generating Station / SCS Engineers Project #25220083.00

Well Pair		Vertical Hydraulic Gradient (feet/foot)[1,2]	
Shallower Well	Deeper Well	April 1, 2020	April 13-14, 2020
MW-305	MW-305A	-0.183	-0.289
MW-310	MW-310A	-0.064	0.052
MW-311	MW-311A	-0.036	0.054

Notes:
(1) A negative value indicates a downward gradient; a positive value indicates an upward gradient.

Created by:	MDB	Date:	5/14/2020
Last rev. by:	MDB	Date:	5/14/2020
Checked by:	LMH	Date:	5/14/2020
Proj Mgr QA/QC:	TK	Date:	5/15/2020

I:\25220083.00\Data and Calculations\Tables\[4_Vertical Gradients_OGS.xls]Gradients

Table 5. Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	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	
CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b)										
Threshold Criteria	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**	**Score**	**Able to Meet Criteria?**
257.97(b)(1) Is remedy protective of human health and the environment?	0	No	1	Yes	1	Yes	1	Yes	1	Yes
257.97(b)(2) Can the remedy attain the groundwater protection standard?	0	Unlikely	1	Yes	1	Yes	1	Yes	1	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?	0	No	1	Yes	1	Yes	1	Yes	1	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?	N/A	Not Applicable - No release of CCR	N/A	Not Applicable - No release of CCR	N/A	Not Applicable - No release of CCR	N/A	Not Applicable - No release of CCR	N/A	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)?	0	Not Applicable	1	Yes	1	Yes	1	Yes	1	Yes
COMPOSITE SCORE	**0**		**1**		**1**		**1**		**1**	
DETERMINATION	**This alternative is eliminated from further consideration due to the inability to achieve threshold criteria.**		**This alternative is retained and assessed in further detail.**		**This alternative is retained and assessed in further detail.**		**This alternative is retained and assessed in further detail.**		**This alternative is retained and assessed in further detail.**	

NOTES:
1) Scoring for the CORRECTIVE ACTION ASSESSMENT - 40 CFR 257.97(b) is binary based on a score of "1" indicating that the threshold criteria is met, and a score of "0" indicating that the threshold criteria is not met. A composite (average) score of "1" is required for the Alternative to be retained for further consideration and evaluation.

Table 5. Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	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	
LONG- AND SHORT-TERM EFFECTIVENESS - 40 CFR 257.97(c)(1)										
Criteria	**Score**	**Assessment**	**Score**	**Assessment**	**Score**	**Assessment**	**Score**	**Assessment**	**Score**	**Assessment**
257.97(c)(1)(i) Magnitude of reduction of existing risks	–	No reduction of existing risk	4	Existing risk reduced by achieving GPS	4	Same as Alternative #2	4	Same as Alternative #2	4	Same as Alternative #2
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.	1	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	2	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	3	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	4	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
257.97(c)(1)(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance	–	Not Applicable	3	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	3	Same as Alternative #2	3	Same as Alternative #2	4	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
257.97(c)(1)(iv) Short-term risks - Implementation	–		11	Total of Below Criteria (Excavation / Transportation / Redisposal)	10	Total of Below Criteria (Excavation / Transportation / Redisposal)	5	Total of Below Criteria (Excavation / Transportation / Redisposal)	4	Total of Below Criteria (Excavation / Transportation / Redisposal)
Excavation	–	*None*	*4*	*Limited risk to community and environment due to limited amount of excavation (likely <200K cy) required to establish final cover subgrades and no off-site excavation*	*3*	*Same as Alternative #2 with increased risk to environment due to increased excavation volumes required for consolidation (likely >200K cy but <463K cy)*	*1*	*Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal*	*2*	*Same as Alternative #4 with reduced risk to environment from excavation due to limited on-site storage*
Transportation	–	*None*	*3*	*No risk to community or environment from off-site CCR transportation;* *Typical risk due to construction traffic delivering final cover materials to site*	*4*	*Same as Alternative #2 with reduced risk from construction traffic due to reduced final cover material requirements (smaller cap footprint)*	*2*	*Same as Alternative #2 with increased risk from construction traffic due to increased material import requirements (liner and cap construction required)*	*1*	*Highest level of community and environmental risk due to CCR volume export (~463K cy)*
Re-Disposal	–	*None*	*4*	*Limited risk to community and environment due to limited volume of CCR re-disposal (likely <200K cy)*	*3*	*Same as Alternative #2 with increased risk to environment due to increased excavation volumes (likely >200K cy but <463K cy) required for consolidation*	*2*	*Same as Alternative #3 with increased risk to environment due to increased excavation volumes (~463K cy) and temporary CCR storage during disposal site construction required for removal and on-site re-disposal*	*1*	*Same as Alternative #4 with increased risk to community and environment due to re-disposal of large CCR volume (~463K cy) at another facility;* *Re-disposal risks are managed by the receiving disposal facility*
257.97(c)(1)(v) Time until full protection is achieved	–	Unknown	4	Closure and capping can be completed by end of 2023. Groundwater protection timeframe to reach GPS potentially 2 to 10 years following closure construction, achievable within 30-year post-closure monitoring period.	4	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. Scoring is based on balance between potential increase or decrease due to factors listed.	2	Increased time required to implement remedy in comparison to Alternative #2. Anticipated increase in time required to identify, site and develop onsite disposal capacity if located outside of existing impoundment footprint. Increased time required for closure construction due CCR excavation, temporary storage, liner construction, and redisposal if completed within impoundment footprint. 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.	1	Increased time required to implement remedy in comparison to Alternative #2, and potentially the longest required time to implement closure. Implementation schedule extends the time required to achieve full protection. Extended implementation timeframe is driven by the time required to identifying and secure off-site disposal capacity, or develop the capacity at an existing Alliant-owned facility. If landfill capacity is not owned by Alliant, additional time may be required to permit and develop the necessary disposal capacity. Increased construction time likely required due to the capacity of the receiving site to unload and place material. 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.
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	4	Potential for exposure is low. Remaining waste is capped.	3	Similar to Alternative #2 with increased risk to construction workers during consolidation of CCR.	2	Similar to Alternative #2 with increased risk to construction workers during excavation and re-disposal. Increased risk over Alternative #3 due to higher material management volumes.	1	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 Highest level of risk due to excavation, transportation, and re-disposal for construction workers removing CCR and solid waste workers at receiving facility.
257.97(c)(1)(vii) Long-term reliability of the engineering and institutional controls	–	Not Applicable	2	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	3	Same as Alternative #2 with potentially increased reliability due to smaller footprint and reduced maintenance	3	Same as Alternative #3	4	Success of remedy at OGS 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
257.97(c)(1)(viii) Potential need for replacement of the remedy	–	Not Applicable	1	Limited potential for remedy replacement if maintained; Some potential for remedy enhancement due to residual groundwater impacts following source control	2	Same as Alternative #2 with reduced potential need for remedy enhancement with consolidated/smaller closure area footprint	3	Same as Alternative #2 with further reduction in potential need for remedy enhancement composite with liner	4	No potential for remedy replacement; Limited potential for remedy enhancement due to residual groundwater impacts following source control
LONG- AND SHORT-TERM EFFECTIVENESS SCORE	–		**30**		**31**		**25**		**26**	

Table 5. Evaluation of Corrective Measure Alternatives
Ottumwa Generating Station / SCS Engineers Project #25220083.00

	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	
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	1	Cap will reduce further releases by minimizing infiltration through CCR	2	Same as Alternative #2 with further reduction due to consolidated/smaller closure footprint	3	Same as Alternative #3 with further reduction due to composite liner and 5-foot groundwater separation required by CCR Rule	4	Removal of CCR prevents further releases at OGS; Receiving disposal site risk similar to Alternative #3
257.97(c)(2)(ii) The extent to which treatment technologies may be used	_	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies	4	Alternative does not rely on treatment technologies
SOURCE CONTROL SCORE	_		5		6		7		8	
IMPLEMENTATION - 40 CFR 257.97(c)(3)										
257.97(c)(3)(i) Degree of difficulty associated with constructing the technology	_	Not Applicable	4	Low complexity construction; Potentially lowest level of dewatering effort - dewatering required for cap installation only	3	Low complexity construction; Moderate degree of logistical complexity; Moderate level of dewatering effort - dewatering required for material excavation/placement and capping	2	Moderately complex construction due to composite liner and cover; High degree of logistical complexity due to excavation and on-site storage of ~463K cy of CCR while new lined disposal area is constructed; High level of dewatering effort - dewatering required for excavation of full CCR volume	1	Low complexity construction; High degree of logistical complexity including the excavation and off-site transport of ~463K cy of CCR and permitting/development of off-site disposal facility airspace; High level of dewatering effort - dewatering required for excavation o full CCR volume
257.97(c)(3)(ii) Expected operational reliability of the technologies	_	Not Applicable	4	High reliability based on historic use of capping as corrective measure	4	Same as Alternative #2	4	Same as Alternative #2	3	Success at OGS does not rely on operational reliability of technologies; Overall success relies on off-site disposal facility, which is likely same/similar to Alternative #2, but may not be controlled by the Owner.
257.97(c)(3)(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	_	Not Applicable	4	Need is low in comparison to other alternatives; State Closure Permit required	4	Same as Alternative #2	2	Need is high in comparison to other alternatives State Closure Permit required; State Landfill Permit may be required	1	Need is highest in comparison to other alternatives; State Closure Permit required; Approval of off-site disposal site owner required; May require State solid waste comprehensive planning approval; Local road use permits likely required
257.97(c)(3)(iv) Availability of necessary equipment and specialists	_	Not Applicable	4	Necessary equipment and specialists are highly available; Highest level of demand for cap construction material, which are readily available and accessible in the area.	3	Same as Alternative #2; Lowest level of demand for cap construction material. Potentially increased demand for dewatering, treatment and conditioning of CCR.	2	Same as Alternative #2; Moderate level of demand for liner and cap construction material. Increase in demand for specialty materials and services due to composite liner construction.	1	Availability of necessary equipment to develop necessary off-site disposal facility airspace and transport ~463K 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
257.97(c)(3)(v) Available capacity and location of needed treatment, storage, and disposal services	_	Not Applicable	4	Capacity and location of treatment, storage, and disposal services is not a factor for this alternative	3	Capacity and location of treatment, storage, and disposal services is unlikely to be a factor for this alternative	2	Available temporary on-site storage capacity for ~463K cy of CCR while composite liner is constructed is significant limiting factor	1	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.
IMPLEMENTATION SCORE	_		20		17		12		7	
COMMUNITY ACCEPTANCE - 40 CFR 257.97(c)(4)										
257.97(c)(4) The degree to which community concerns are addressed by a potential remedy	_	To be determined based on input obtained through public meetings/outreach to be completed	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.	4	No comments were received during the public meeting held on June 4, 2020. Assume all alternatives are acceptable to interested/affected parties.
COMMUNITY ACCEPTANCE SCORE	_		4		4		4		4	

NOTES:

1) Scoring between "1" and "4" is used to evaluate each remedy with respect to the others. A lower score "1" indicates that the remedy was assessed as less effective when compared to a remedy considered more effective "4". This scoring evaluation is relative to the remedies presented.

Created by: SK Date: 4/29/2020
Last revision by: EJN Date: 7/22/2020
Checked by: TK Date: 7/22/2020

I:\25220083.00\Deliverables\2020 Selection of Remedy Report\[Table 5-6_Evaluation of Assessment of Corrective Measure_OGS.xlsx]Table 5 - OGS_Evaluation Matrix

Table 6. Summary of Corrective Measure Alternative Scoring
Ottumwa Generating Station / SCS Engineers Project #25220083.00

Evaluation Factors	Potential Points	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
LONG- AND SHORT-TERM EFFECTIVENESS 40 CFR 257.97(c)(1)	40	Not Evaluated, Failed Minimum Criteria	30	31	25	26
SOURCE CONTROL TO MITIGATE FUTURE RELEASES 40 CFR 257.97(c)(2)	8	_	5	6	7	8
IMPLEMENTATION 40 CFR 257.97(c)(3)	20	_	20	17	12	7
COMMUNITY ACCEPTANCE 40 CFR 257.97(c)(4)	4	_	4	4	4	4
TOTAL SCORE	**72**	_	**59**	**58**	**48**	**45**

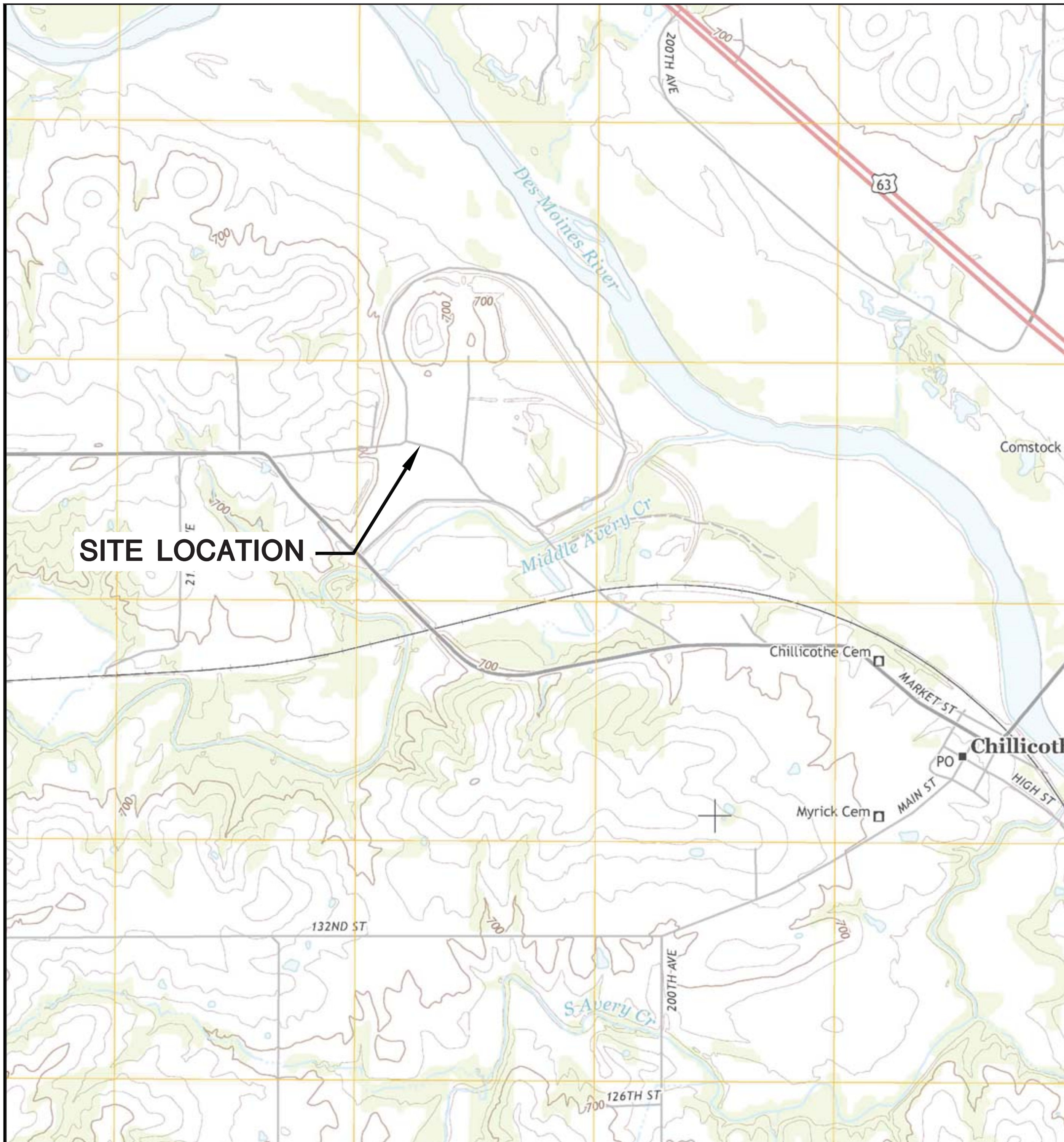
NOTES:

1) Scoring between "1" and "4" is used to evaluate each remedy with respect to the others. A lower score "1" indicates that the remedy was assessed as less effective when compared to a remedy considered more effective "4". This scoring evaluation is relative to the remedies presented.

Created by: SK Date: 4/29/2020
Last revision by: EJN Date: 7/22/2020
Checked by: TK Date: 7/22/2020

I:\25220083.00\Deliverables\2020 Selection of Remedy Report\[Table 5-6_Evaluation of Assessment of Corrective Measure_OGS.xlsx]Table 6 - Summary of Scores

Figures



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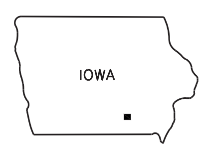
CHILLICOTHE QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2013
SCALE: 1" = 2,000'



CLIENT	SITE	
INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	OTTUMWA GENERATING STATION OTTUMWA, IOWA	SITE LOCATION MAP

				ENGINEER	FIGURE
PROJECT NO.	25218201.00	DRAWN BY:	AHB	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	1
DRAWN:	05/29/15	CHECKED BY:	KAK		
REVISED:	03/08/16	APPROVED BY:	TJK 09/10/19		

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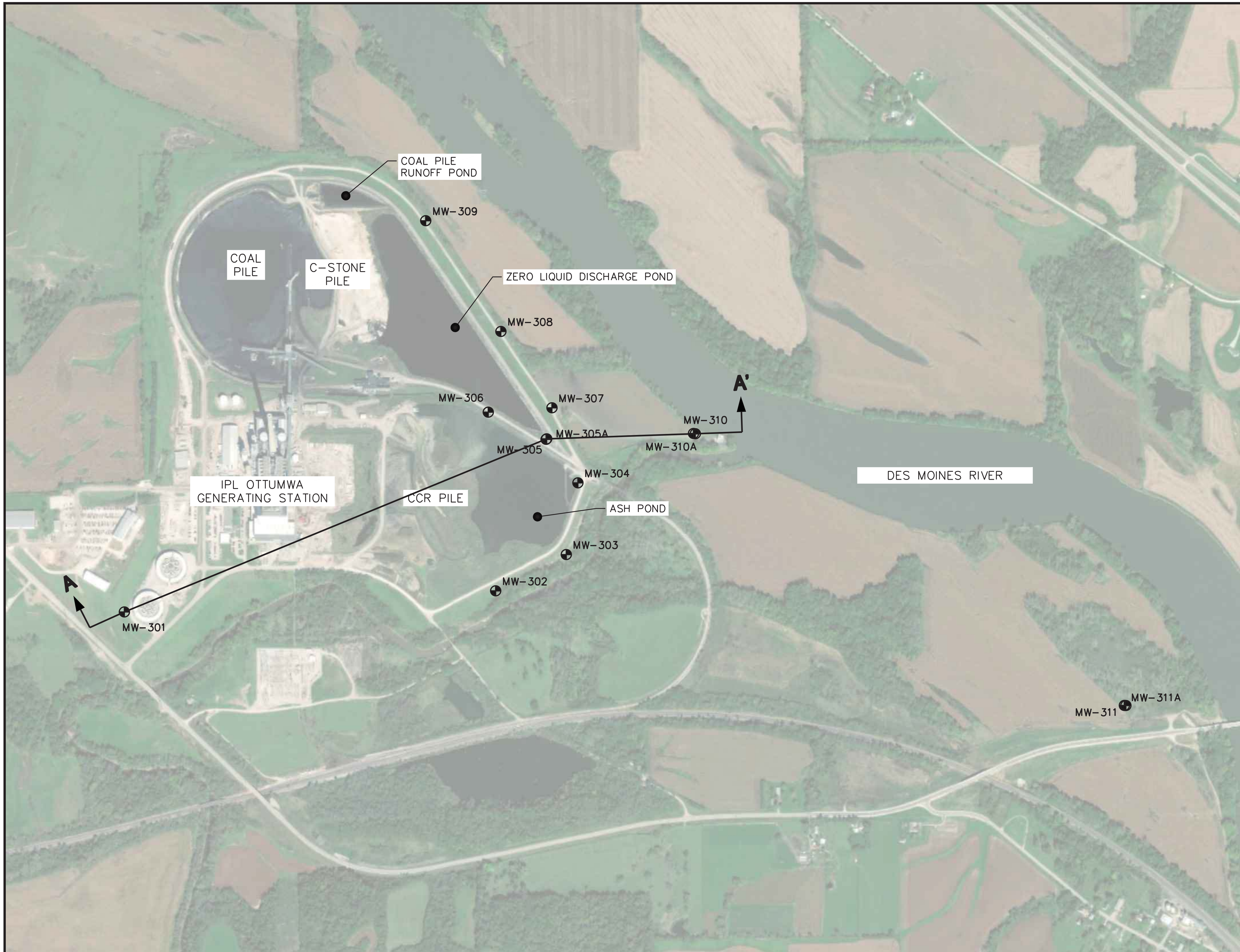


LEGEND

- MONITORING WELL
- GEOLOGIC CROSS SECTION

NOTES:

1. 2014 AERIAL PHOTOGRAPH SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY.
2. MONITORING WELLS MW-301, MW-302, AND MW-304, WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM NOVEMBER 11-12, 2015.
3. MONITORING WELLS MW-303 AND MW-305 WERE INSTALLED BY CASCADE DRILLING LLP. UNDER THE SUPERVISION OF SCS ENGINEERS ON DECEMBER 7-8, 2015.
4. MONITORING WELLS MW-307, MW-308, AND MW-309 WERE INSTALLED BY CASCADE DRILLING, LLP. UNDER THE SUPERVISION OF SCS ENGINEERS FROM OCTOBER 25-27, 2016.
5. MONITORING WELLS MW-310 AND MW-311 WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING ON AUGUST 27, 2019.
6. MONITORING WELLS MW-305A, MW-310A, AND MW-311A WERE INSTALLED BY ROBERTS ENVIRONMENTAL DRILLING BETWEEN FEBRUARY 27, 2020 AND MARCH 3, 2020.

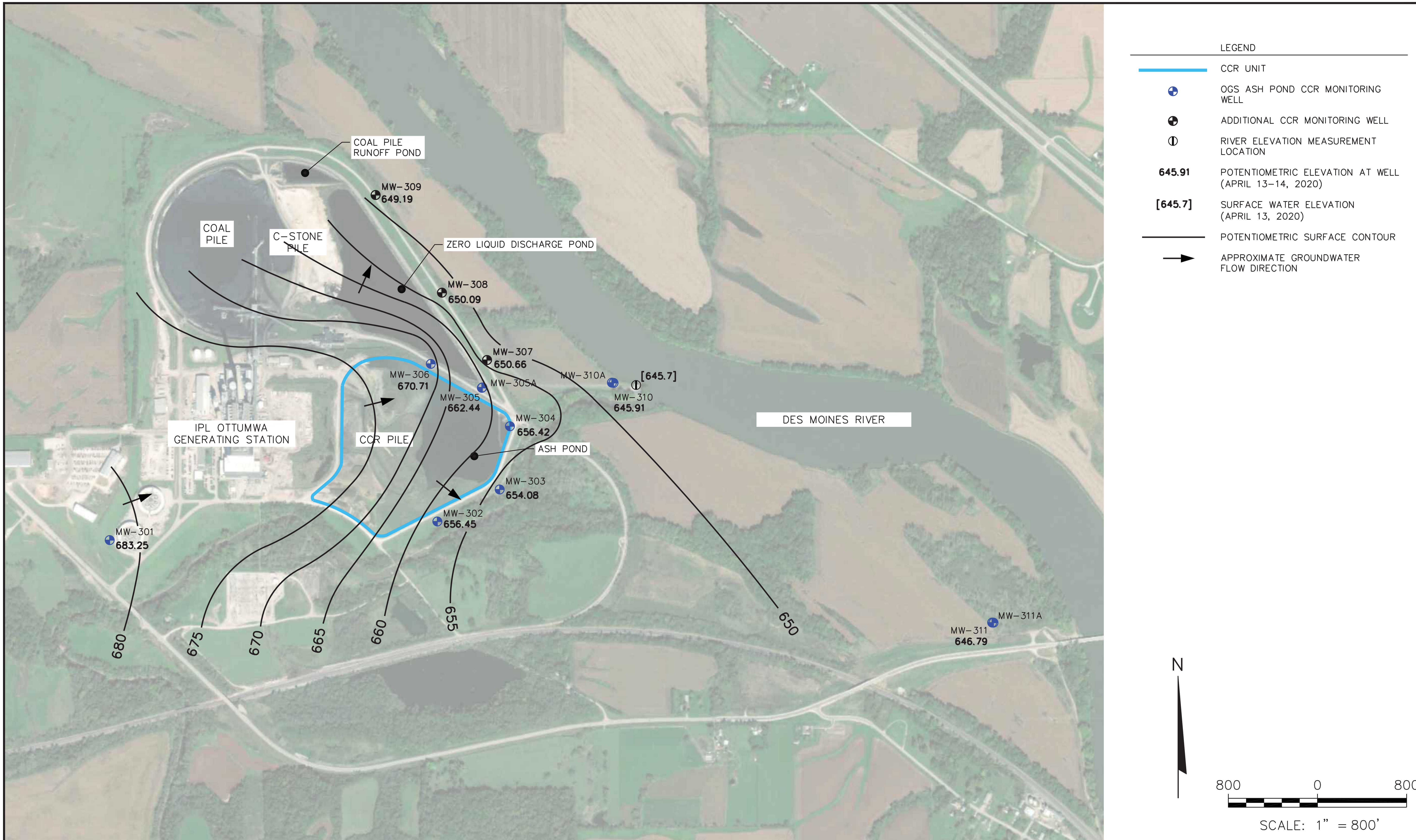
N

800 0 800

SCALE: 1" = 800'

PROJECT NO.	25220083.00	DRAWN BY:	BSS	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	CLIENT	INTERSTATE POWER AND LIGHT CO. 20775 POWER PLANT ROAD OTTUMWA, IA 52501	SITE	ALLIANT ENERGY OTTUMWA GENERATING STATION OTTUMWA, IOWA	SITE PLAN AND MONITORING WELL LOCATIONS	FIGURE 2
DRAWN:	11/15/2019	CHECKED BY:	MDB								
REVISED:	05/11/2020	APPROVED BY:	EJN 9/11/2020								

I:\25220083.00\Drawings\Site Plan and Monitoring Well Locations.dwg, 5/11/2020 7:55:48 AM



PROJECT NO.	25220072.00	DRAWN BY:	KP/BSS/RJG
DRAWN:	04/28/2020	CHECKED BY:	NDK/SCC
REVISED:	07/30/2020	APPROVED BY:	EJN 9/11/2020

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

CLIENT: INTERSTATE POWER AND LIGHT CO.
20775 POWER PLANT ROAD
OTTUMWA, IA 52501

SITE: ALLIANT ENERGY
OTTUMWA GENERATING STATION
OTTUMWA, IOWA

SHALLOW POTENTIOMETRIC SURFACE
APRIL 13–14, 2020

FIGURE 5

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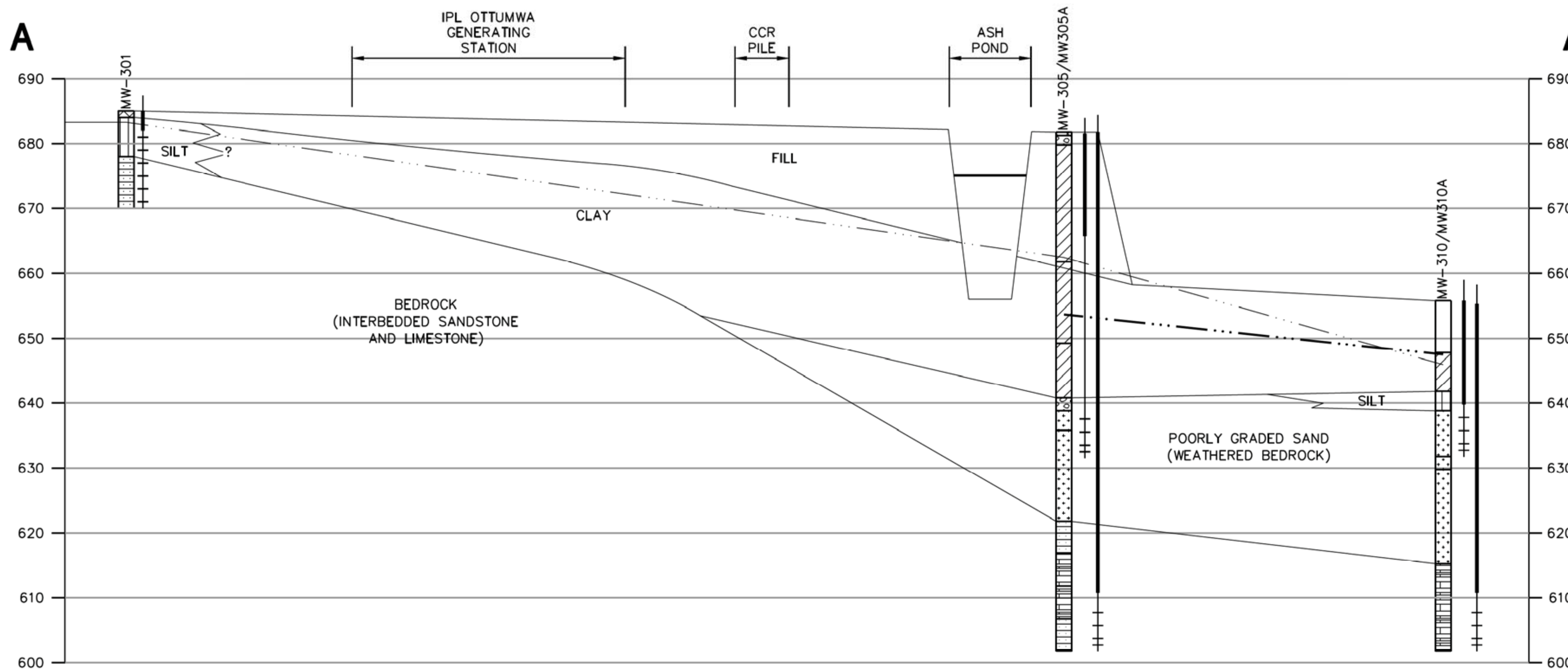
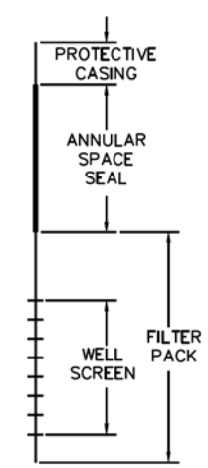


LEGEND

- TOPSOIL/FILL
- SAND, POORLY GRADED (SP)
- SILT, WITH SAND AND GRAVEL (ML)
- CLAY
- GRAVEL, POORLY GRADED, LITTLE OR NO FINES (GP)
- SANDSTONE
- LIMESTONE
- DEEP POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020
- SHALLOW POTENTIOMETRIC SURFACE MEASURED APRIL 13–14, 2020
- POND SURFACE ELEVATION MEASURED JUNE 10–11, 2019



WELL DETAIL

0 500

HORIZONTAL SCALE: 1" = 500'
VERTICAL SCALE: 1" = 20'
VERTICAL EXAGGERATION = 25X

NOTES:

1. MW-305 AND MW-305A WERE HYDROVACED TO APPROXIMATELY 8.5'. MW-310 AND MW-310A WERE HYDROVACED TO APPROXIMATELY 8.0'. HYDROVACING IS PERFORMED TO DETERMINE IF UNDERGROUND UTILITIES ARE PRESENT. HIGH PRESSURE WATER AND A VACUUM ARE USED TO CLEAR THE BOREHOLE AND GEOLOGIC SAMPLES ARE NOT COLLECTED. NATIVE SOIL IN THE VICINITY OF MW-307 IS CLAY.
2. ASH POND BOTTOM ELEVATION IS BASED ON THE EMBANKMENT CREST ELEVATION (681 FEET) AND INTERNAL STORAGE DEPTH (25 FEET) REPORTED IN THE HISTORY OF CONSTRUCTION REPORT ISSUED SEPTEMBER 29, 2016, BY HARD HAT SERVICES.

PROJECT NO.	25220083.00	DRAWN BY:	BSS/KP	ENGINEER: SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718-6751 PHONE: (608) 224-2830	CLIENT: INTERSTATE POWER AND LIGHT CO. 15300 130th STREET OTTUMWA, IA 52501
DRAWN:	07/03/2019	CHECKED BY:	NDK/MDB		
REVISED:	05/13/2020	APPROVED BY:	EJN 9/11/2020		

SITE: OTTUMWA GENERATING STATION 20775 POWER PLANT ROAD OTTUMWA, IOWA

GEOLOGIC CROSS SECTION A–A'

FIGURE 4

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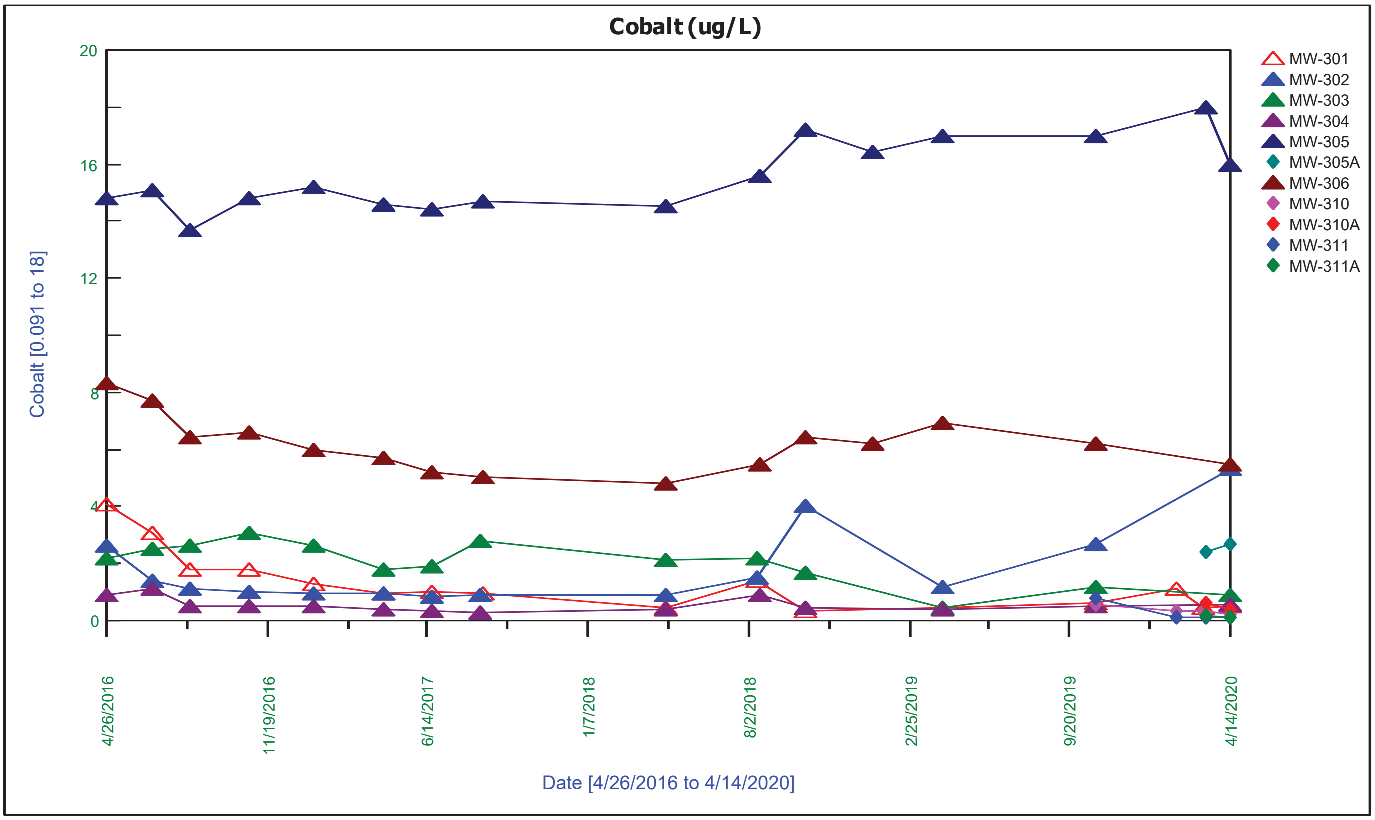
Appendix A

Time Series Plots


Cobalt (ug/L)
20
16
12
8
4
0
Cobalt [0.091 to 18]
4/26/2016
11/19/2016
6/14/2017
1/7/2018
8/2/2018
2/25/2019
9/20/2019
4/14/2020
Date [4/26/2016 to 4/14/2020]
MW-301
MW-302
MW-303
MW-304
MW-305
MW-305A
MW-306
MW-310
MW-310A
MW-311
MW-311A

Appendix B

Technical Memorandum – Lithium and Fluoride Detections

September 11, 2020
File No. 25220083.00

TECHNICAL MEMORANDUM

TO: Eric Nelson, PE

FROM: Meg Blodgett and Sherren Clark

SUBJECT: Alternative Source Evaluation for Lithium and Fluoride

This Technical Memorandum provides an evaluation of the source of lithium and fluoride concentrations above the Groundwater Protection Standards (GPSs) in groundwater sampling performed for the Selection of Remedy (SOR) process for the Ottumwa Generating Station (OGS) Ash Pond. These exceedances have not yet been determined to be statistically significant; therefore, a formal Alternative Source Demonstration in accordance with §257.95(g)(3) is not required at this time. Nonetheless, evaluation of the source of these constituents is relevant to the selection of a remedy for the site. The source evaluation and supporting technical data are provided in this memorandum for inclusion in the Selection of Remedy Report.

BACKGROUND

Background information regarding the OGS Ash Pond site history, geology, hydrogeology, and monitoring results is provided in the text, tables, and figures of the SOR report.

The monitoring well locations are shown on **SOR Figure 2**. A potentiometric surface map for April 13-14, 2020, is provided on **SOR Figure 3**, and a geologic cross section is provided on **SOR Figure 4**.

LITHIUM AND FLUORIDE RESULTS ABOVE THE GPS

Lithium was detected above the GPS at new monitoring wells MW-310 (three of four samples collected), MW-310A, and MW-311A (two of two samples collected for both deep piezometers). Fluoride was also detected in the deep piezometer MW-311A at a concentration above the GPS in one of the three sampling events. Monitoring results are summarized in **SOR Table 2**. These exceedances have not yet been determined to be statistically significant.

POTENTIAL ALTERNATIVE SOURCE EVALUATION

To evaluate the potential that the lithium and fluoride detections above the GPSs were due to a source other than the OGS Ash Pond, we used a two-step evaluation process. First, the sample collection and laboratory analysis methods and quality control data were reviewed to identify any potential error or issue that led to the exceedances. Second, potential alternative sources, including natural variation and man-made sources other than the Ash Pond, were evaluated.

Sampling and Field Analysis Review

Based on a review of the field notes and results, we did not identify any evidence that the lithium and fluoride GPS exceedances were due to a sampling error.

Based on a review of the laboratory reports, we did not identify any evidence that the GPS exceedances were due to a laboratory analysis error. There were no laboratory quality control flags or issues identified in the laboratory report that affect the usability of the data for detection monitoring.

Potential Alternative Source Review

Man-made alternative sources that could potentially contribute to the reported fluoride and lithium concentrations could include the inactive OGS ZLDP CCR unit, c-stone pile, coal pile runoff pond, coal storage area, impacts associated with roads or rail lines, or other on-site or off-site sources. Based on the groundwater flow directions and available groundwater quality data, none of these sources currently appears likely to be the primary cause of the observed GPS exceedances.

Fluoride and lithium are naturally present in the aquifer based on results from the nearby Ottumwa-Midland Landfill (OML) site. Based on regional and local information, discussed below, variation in natural background appears to be a likely source of the fluoride and lithium results above the GPSs.

LINES OF EVIDENCE FOR NATURAL SOURCE

Based on the regional and local information discussed below, lithium and fluoride concentrations above the GPSs in wells MW-310, MW-310A, and MW-311A are most likely due to natural background conditions in the Mississippian bedrock aquifer, rather than a release from the OGS Ash Pond or other man-made source. Lines of evidence supporting this conclusion include the following:

1. No lithium or fluoride GPS exceedances have been detected at monitoring wells located adjacent to the OGS Ash Pond, as would be expected if the OGS Ash Pond was the source of elevated fluoride and lithium at wells located further downgradient.

2. The lithium and fluoride concentrations detected in samples from MW-310A and MW-311A are well within the range of concentrations naturally present in the Mississippian aquifer based on results from background monitoring wells in the same aquifer at nearby OML.

3. Analysis of major anions and cations indicates that the water quality in deep piezometers MW-310A and MW-311A is similar to regional water quality for the Mississippian aquifer and different from water quality in the shallower on-site wells.

4. Vertical gradients at monitoring well pairs MW-310/MW-310A and MW-311/MW-311A during the two water level measurement events in April 2020 indicate that groundwater flow is at least intermittently upward from the Mississippian bedrock into the overlying unconsolidated material.

Distribution in Groundwater at OGS

No lithium or fluoride GPS exceedances have been detected at monitoring wells MW-302, MW-304, MW-305, MW-306, or MW-305A, located adjacent to the OGS Ash Pond, as would be expected if the OGS Ash Pond was the source of elevated fluoride and lithium. Lithium and fluoride have only been detected at concentrations above the GPSs in bedrock wells installed closer to the river. Fluoride and lithium results for all site monitoring wells, including background monitoring results, are shown on the times series plots in **Attachment A.** The detected concentrations of fluoride at piezometer MW-310A and of lithium at piezometers MW-310A and MW-311A are well above current and historical concentrations at the wells immediately downgradient of both the Ash Pond and the ZLDP.

Natural Background Concentrations in Bedrock Aquifer

The lithium and fluoride concentrations detected above the GPS at OGS are within the range of concentrations naturally present in the Mississippian aquifer, based on results from background monitoring wells in the same aquifer at OML. CCR Rule background monitoring wells at OML, located approximately 5 miles east of OGS, are screened in the upper portion of the Mississippian bedrock aquifer, which is the same formation as the wells at OGS. The fluoride concentrations detected in samples from MW-311A and lithium concentrations detected in samples from MW-310A and MW-311A are within the range of concentrations observed in background wells at OML that are unaffected by CCR. This indicates that lithium and fluoride are naturally present in the aquifer. Fluoride and lithium concentrations detected in the background monitoring wells at OML are summarized in **Table 1.**

Correlation with Regional Bedrock Water Quality

Analysis of major anions and cations indicates that the water quality in deep piezometers MW-310A and MW-311A is similar to regional water quality for the Mississippian aquifer and different from water quality in the shallower on-site wells.

Regional water quality data for the Mississippian aquifer is available from U.S. Geological Survey (USGS) Open File Report 82-1014, Hydrology of Area 38, Western Region, Interior Coal Province, Iowa and Missouri. An excerpt from this report is included in **Attachment C.** The report indicates that sulfate and sodium are the dominant ionic species, total dissolved solids concentrations are relatively high (370 to 8220 mg/l), and the water is generally not potable. Large concentration ranges were reported for several parameters within the Mississippian aquifer in the study area, including:

- Chloride concentrations ranging from 0.5 to 3,570 milligrams per liter (mg/L), with an average of 137 mg/L
- Sulfate concentrations ranging from 22 to 4,500 mg/L, with an average of 1,697 mg/L
- Sodium concentrations ranging from 6.8 to 2,660 mg/L, with an average of 584 mg/L

The Piper and Stiff diagrams in **Attachment B** show major cations and anions in groundwater samples from shallow and deep monitoring wells, and also show the average cation and anion concentrations in the Mississippian aquifer as reported in USGS Open File Report 82-1014. These plots show that the dominant ions detected in samples from MW-310A and MW-311A are more similar to those in the regional aquifer than to those at the shallower wells.

In the Piper diagram, MW-310A and MW-311A plot near the average for the Mississippian aquifer, near the lower right corner of the cation ternary plot (high sodium) and near the top of the anion ternary plot (high sulfate). Comparing the deep downgradient piezometers (MW-310A and MW-311A) to the shallower wells, the Piper diagram illustrates differences in the general water chemistry. The dominant cations in deep monitoring wells MW-310A and MW-311A are sodium and potassium, while the dominant cations in samples from the shallower wells are calcium and magnesium. The dominant anion in deep monitoring wells MW-310A and MW-311A is sulfate, while the samples from the shallower wells show a mix of carbonate/bicarbonate, chloride, and sulfate. This difference is less pronounced at MW-310/MW-310A, consistent with the effects of mixing due to intermittent upward groundwater flow discussed below.

In the Stiff diagrams, the sodium-sulfate dominance for MW-310A, MW-311A, and for the Mississippian aquifer average, is shown by the sodium vertex extending on the lower left side of the Stiff diagram and the sulfate vertex extending on the upper right side. The shape of the Stiff diagram for these three samples is distinctly different than the shapes for the other monitoring wells. This indicates that the groundwater sampled at MW-310A and MW-311A is likely representative of natural background conditions in the regional flow system in the Mississippian aquifer.

Vertical Groundwater Flow Patterns

Vertical gradients at monitoring well pairs MW-310/MW-310A and MW-311/MW-311A during the two water level measurement events in April 2020 indicate that groundwater flow is at least intermittently upward from the Mississippian bedrock into the overlying unconsolidated material (SOR Table 4). This flow pattern further supports the idea that groundwater quality at deeper wells MW-310A and MW-311A reflects regional groundwater flow discharging to the river, and the lithium and fluoride levels above the GPS are due to natural background.

The upward flow is also consistent with the pattern of lithium concentrations detected at MW-310/MW-310A. Concentrations detected at MW-310 are higher than at other shallow monitoring wells on site, but lower than concentrations detected at MW-310A. This indicates that the elevated concentrations at MW-310 are likely due to mixing between shallow groundwater with lower lithium concentrations and groundwater with higher lithium concentrations intermittently flowing upward from the Mississippian bedrock.

CONCLUSION

The lines of evidence discussed above regarding the source of the fluoride concentration above the GPS in downgradient monitoring well MW-311A and the lithium concentrations above the GPS in downgradient monitoring wells MW-310A and MW-311A demonstrate that these results are likely due to naturally occurring fluoride and lithium in the Mississippian aquifer at the OGS site. Therefore, these constituents do not need to be addressed in the selection of a remedy for the Ash Pond CCR unit.

MDB/jsn/SCC

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Table

1 Analytical Results - CCR Detection Monitoring Program, IPL - Ottumwa Midland Landfill

Table 1. Analytical Results - CCR Detection Monitoring Program
IPL - Ottumwa Midland Landfill
Ottumwa, Iowa

Well Group	Well	Collection Date	Fluoride (mg/L)	Lithium (µg/L)
Background	MW-102M	5/4/2016	4.2	46.7
		6/22/2016	4.2	80.7
		8/10/2016	4.4	52.3
		10/26/2016	4.6	75.4
		1/18/2017	4.1	71.8
		4/20/2017	4.0	73.6
		6/21/2017	4.6	52.7
		8/22/2017	4.5	54
		11/8/2017	4.6	--
		4/17/2018	4.5	--
		10/16/2018	4.7	--
		4/18/2019	5.7	--
		10/15/2019	4.5	--
	MW-122M	5/5/2016	1.1	450
		6/23/2016	0.89	332
		8/10/2016	0.74	601
		10/26/2016	0.48	544
		1/18/2017	<0.027	679
		4/20/2017	0.88	643
		6/21/2017	1.1	640
		8/22/2017	0.6	667
		11/8/2017	0.5	--
		4/17/2018	<0.063	--
		10/16/2018	<0.19	--
		4/17/2019	0.7	--
		10/15/2019	<0.23	--

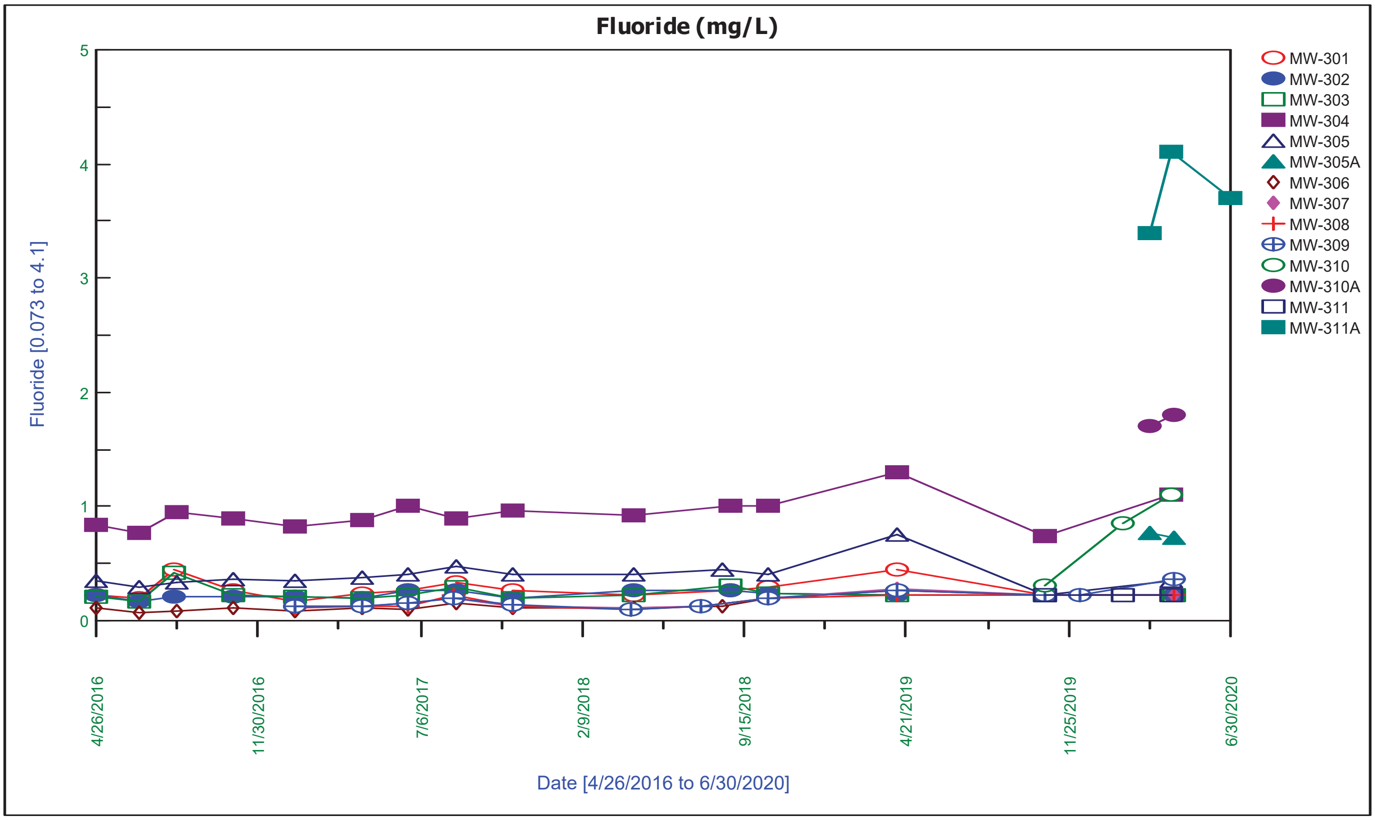
Abbreviations:
µg/L = micrograms per liter or parts per billion (ppb)
mg/L = milligrams per liter or parts per million (ppm)
-- = not analyzed

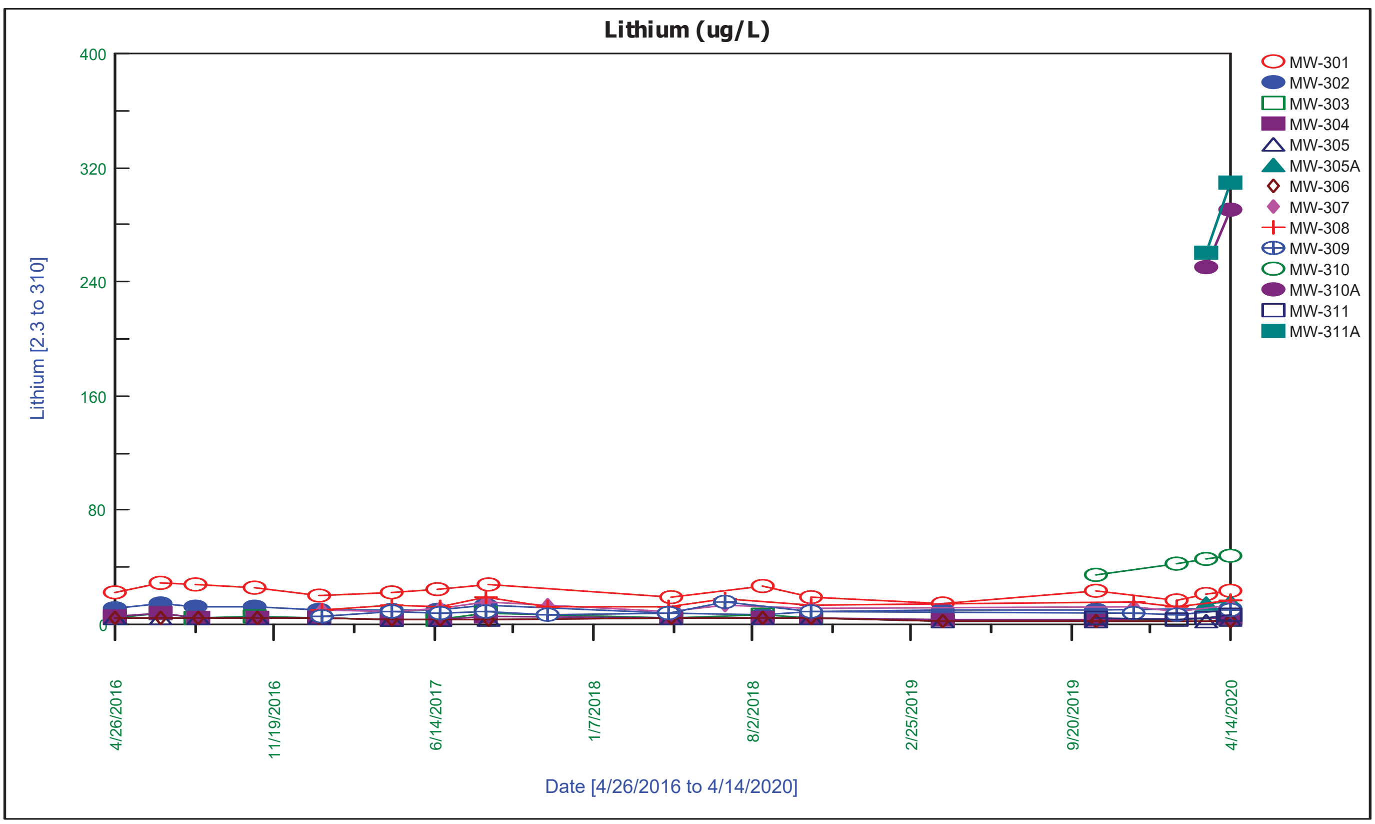
Created by: MDB Date: 5/26/2020
Last revision by: MDB Date: 5/26/2020
Checked by: NDK Date: 5/28/2020

I:\25220072.00\Deliverables\2020 OGS Li and F ASD -draft\[Tables 2 3 and 5_OGS ASD Tables.xlsx]Table 5 OML Background

Attachment A

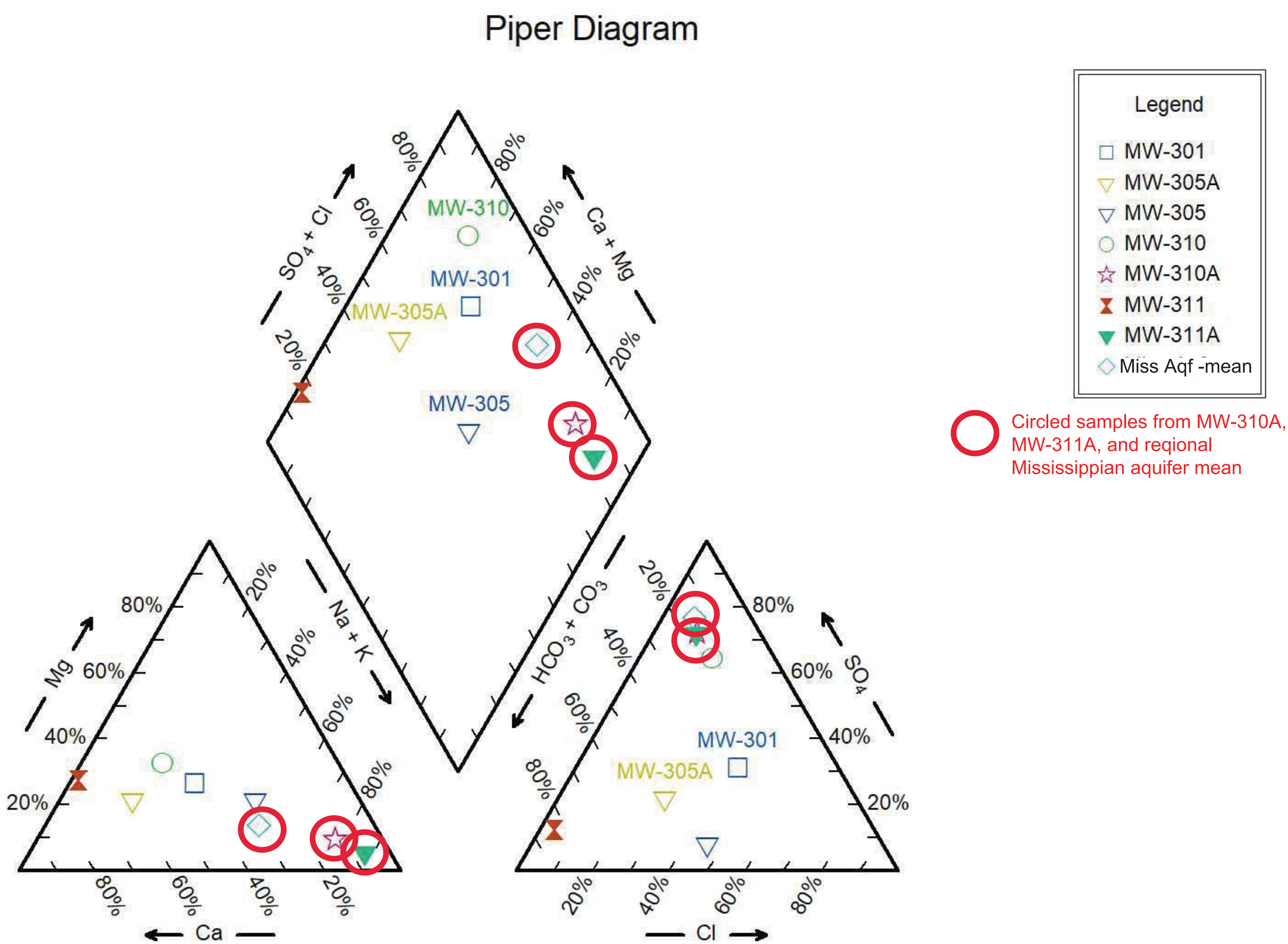
Time Series Plots


Fluoride (mg/L)
Fluoride [0.073 to 4.1]
5
4
3
2
1
0
4/26/2016
11/30/2016
7/6/2017
2/9/2018
9/15/2018
4/21/2019
11/25/2019
6/30/2020
Date [4/26/2016 to 6/30/2020]
MW-301
MW-302
MW-303
MW-304
MW-305
MW-305A
MW-306
MW-307
MW-308
MW-309
MW-310
MW-310A
MW-311
MW-311A


Lithium (ug/L)
Lithium [2.3 to 310]
400
320
240
160
80
0
4/26/2016
11/19/2016
6/14/2017
1/7/2018
8/2/2018
2/25/2019
9/20/2019
4/14/2020
Date [4/26/2016 to 4/14/2020]
MW-301
MW-302
MW-303
MW-304
MW-305
MW-305A
MW-306
MW-307
MW-308
MW-309
MW-310
MW-310A
MW-311
MW-311A

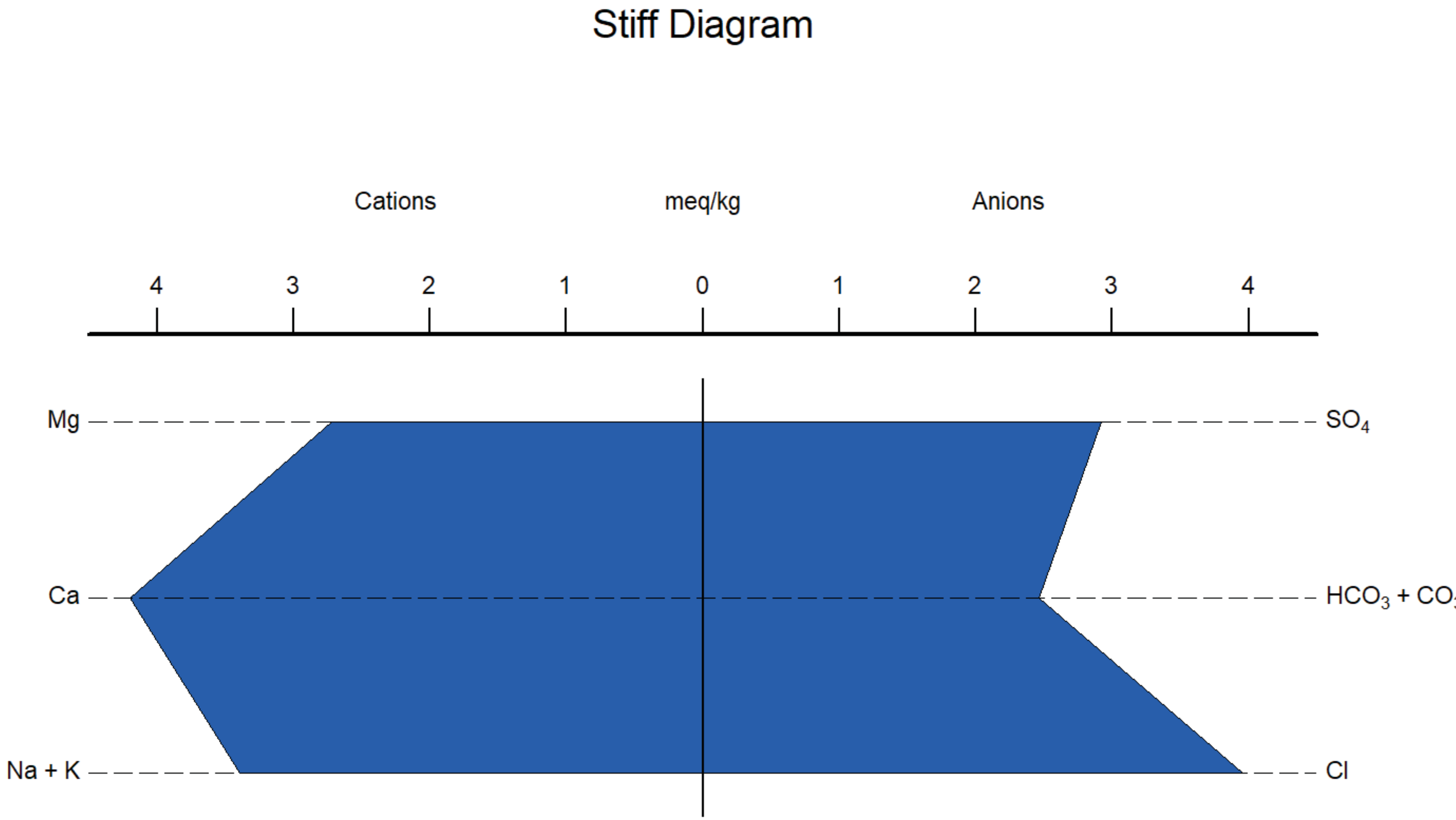
Attachment B

Piper and Stiff Diagrams



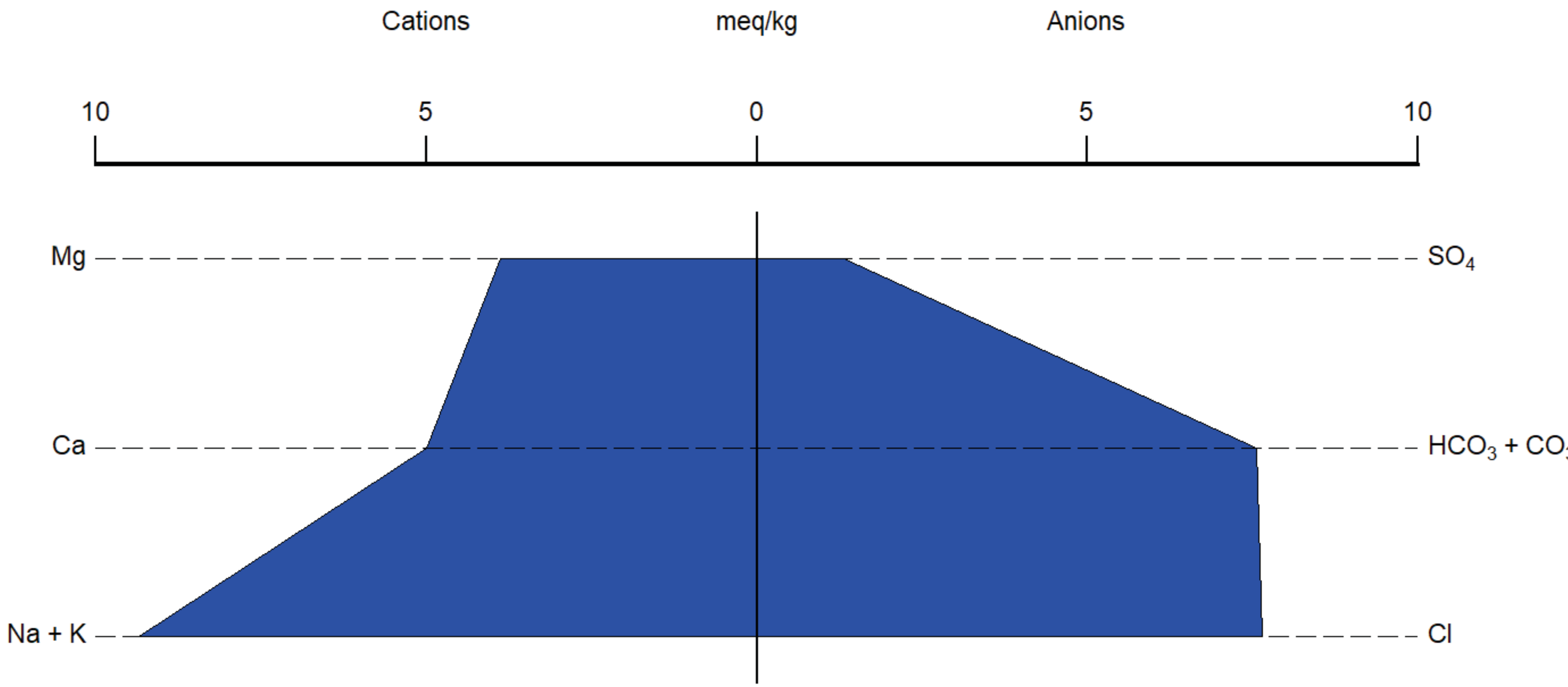
Data Sources: MW-301, MW-305, MW-305A, MW-310, MW-310A, MW-311, MW-311A - April 2020 groundwater sampling results Mississippian Aquifer data - USGS Open File Report 82-1014

MW-301 - Background well



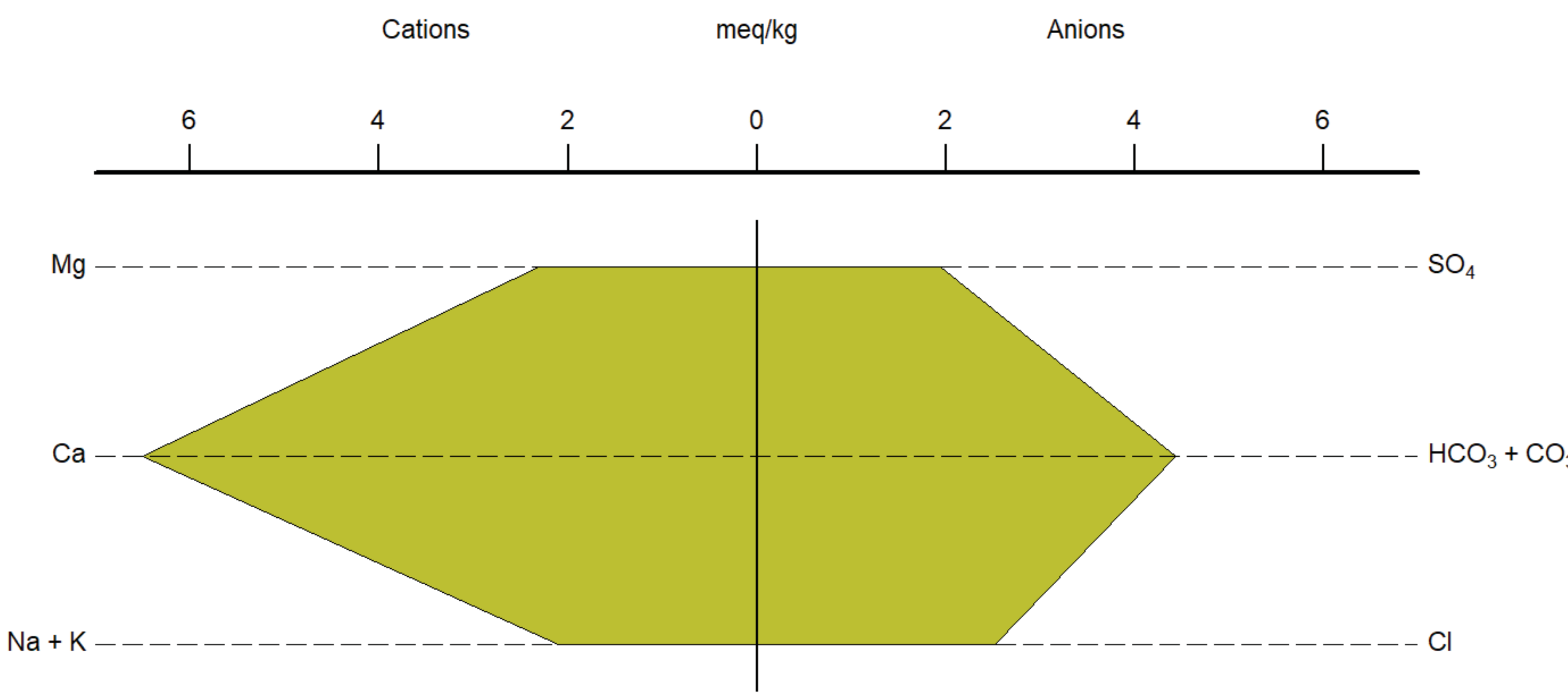
MW-305

Stiff Diagram

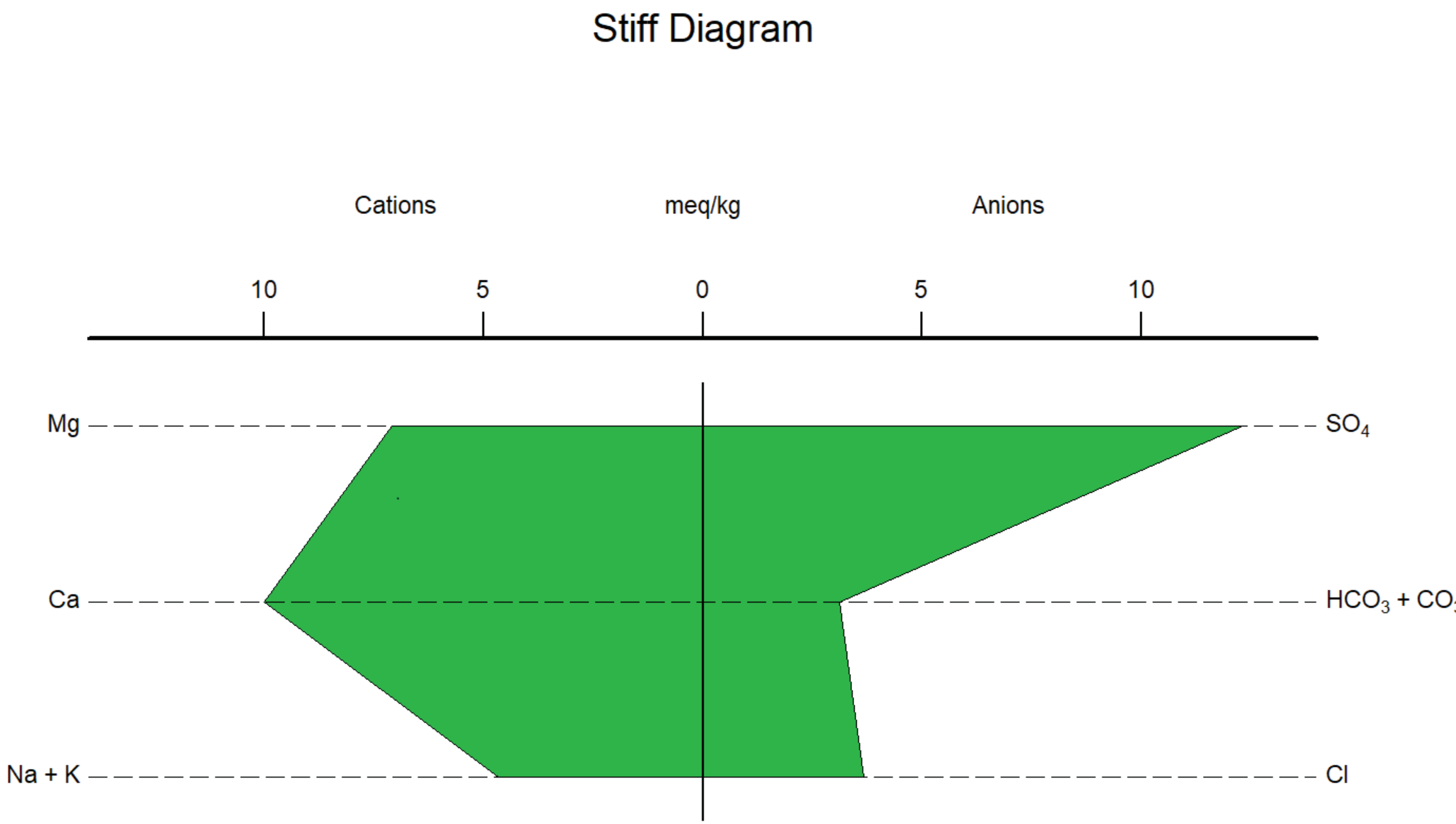


MW-305A

Stiff Diagram

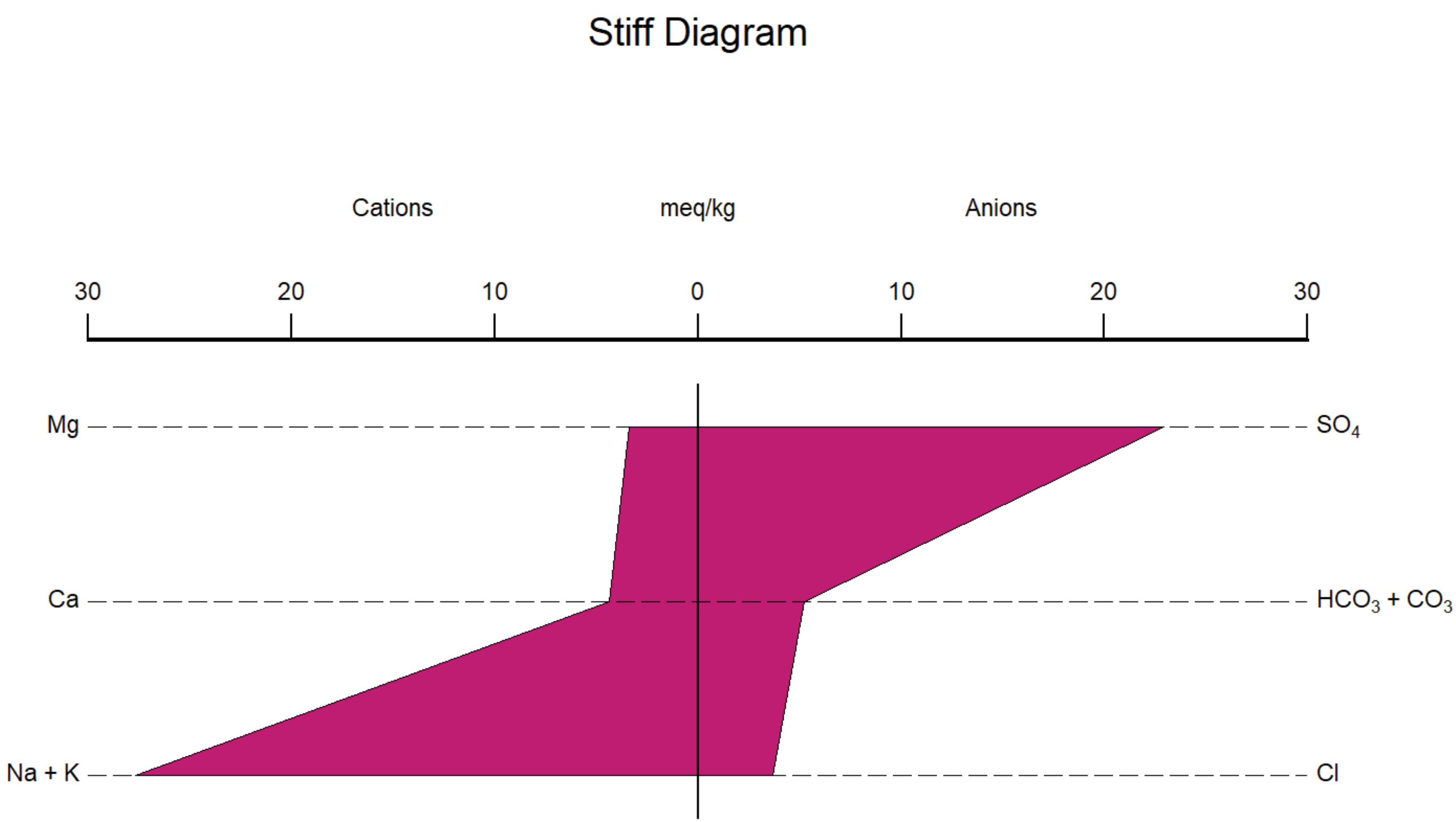


MW-310



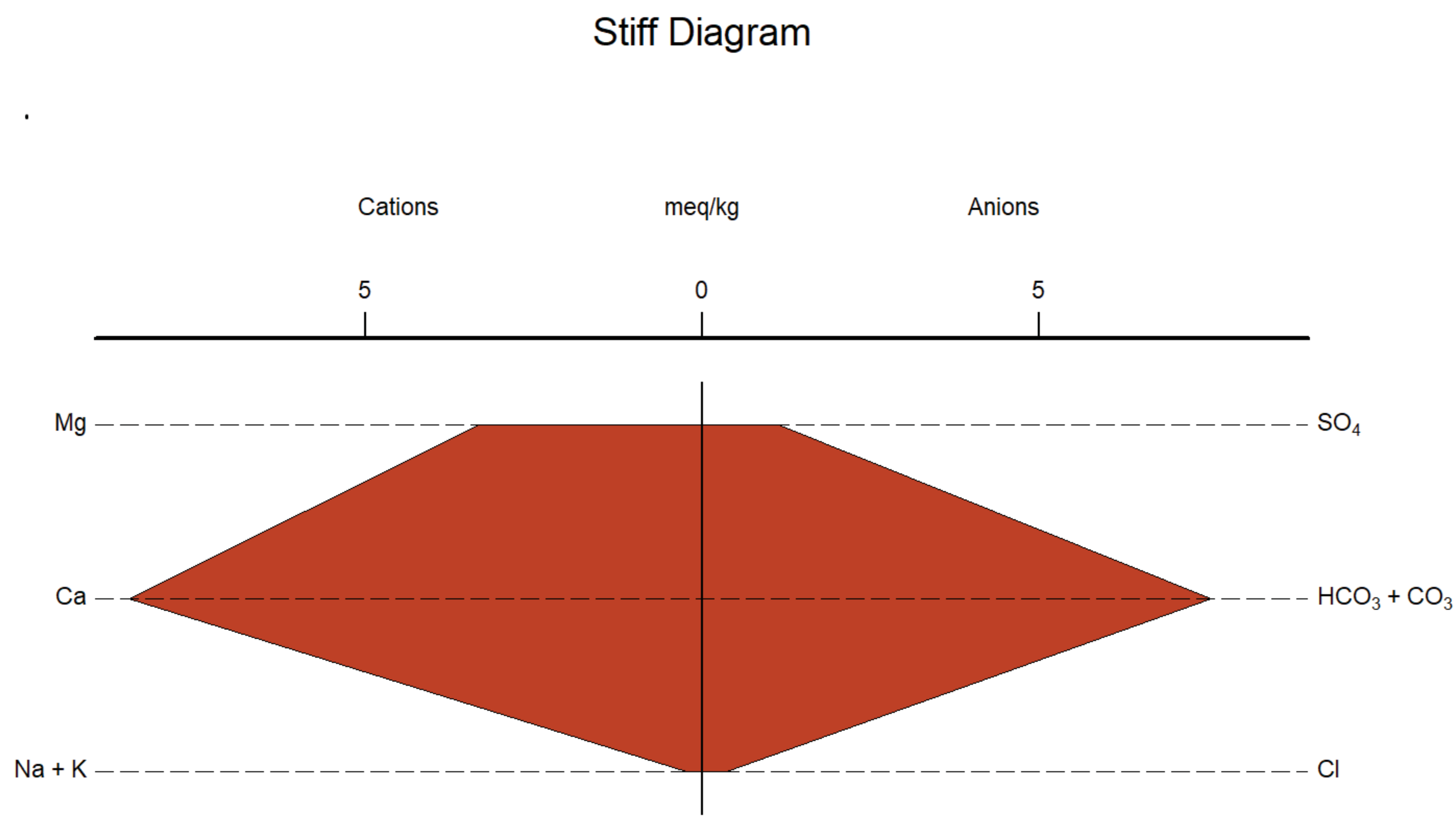
10/08/2020 - Classification: Internal - ECRM7750491

MW-310A



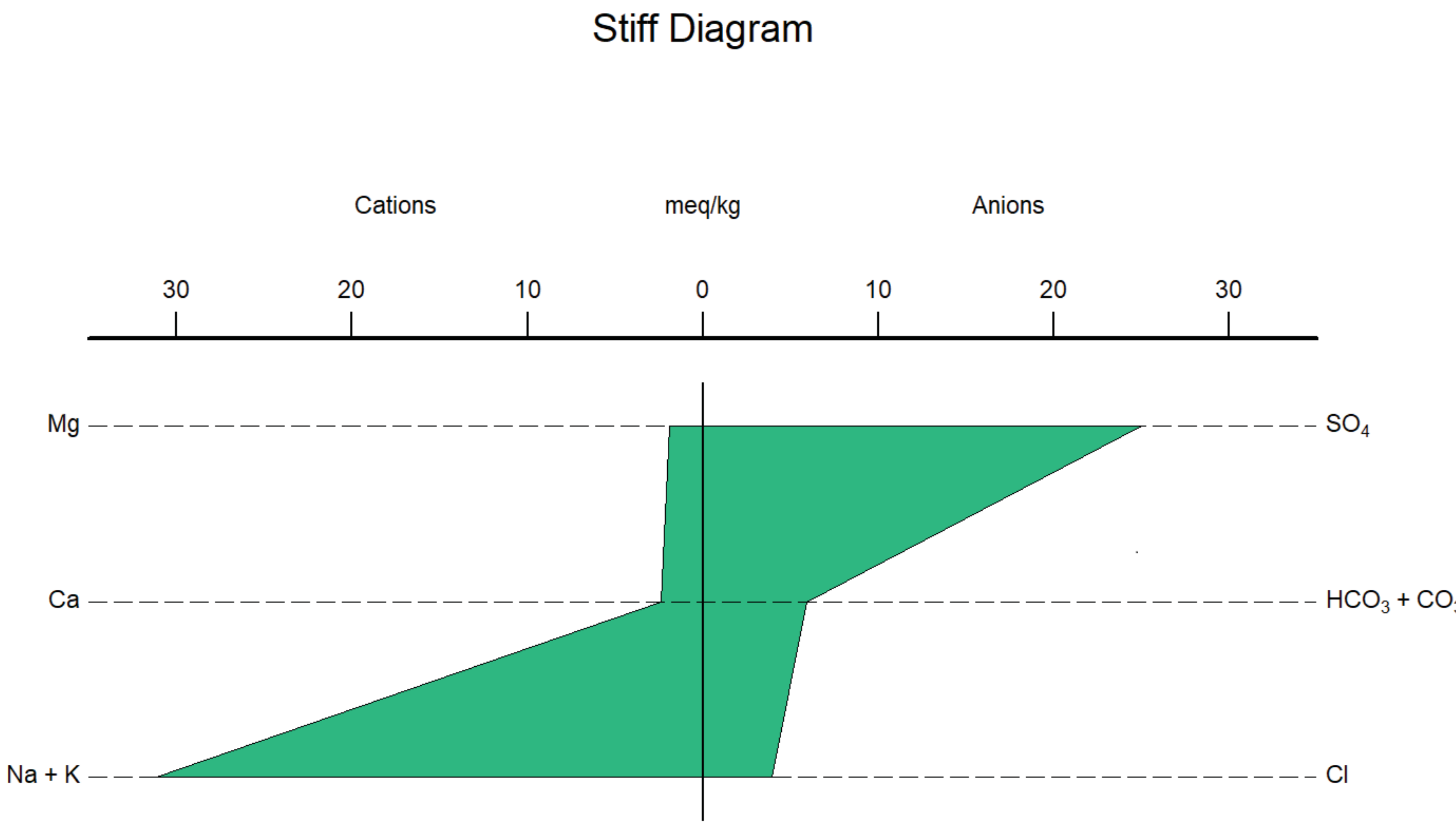
Stiff Diagram
Cations
meq/kg
Anions
30
20
10
0
10
20
30
Mg
Ca
Na + K
SO4
HCO3 + CO3
Cl

MW-311

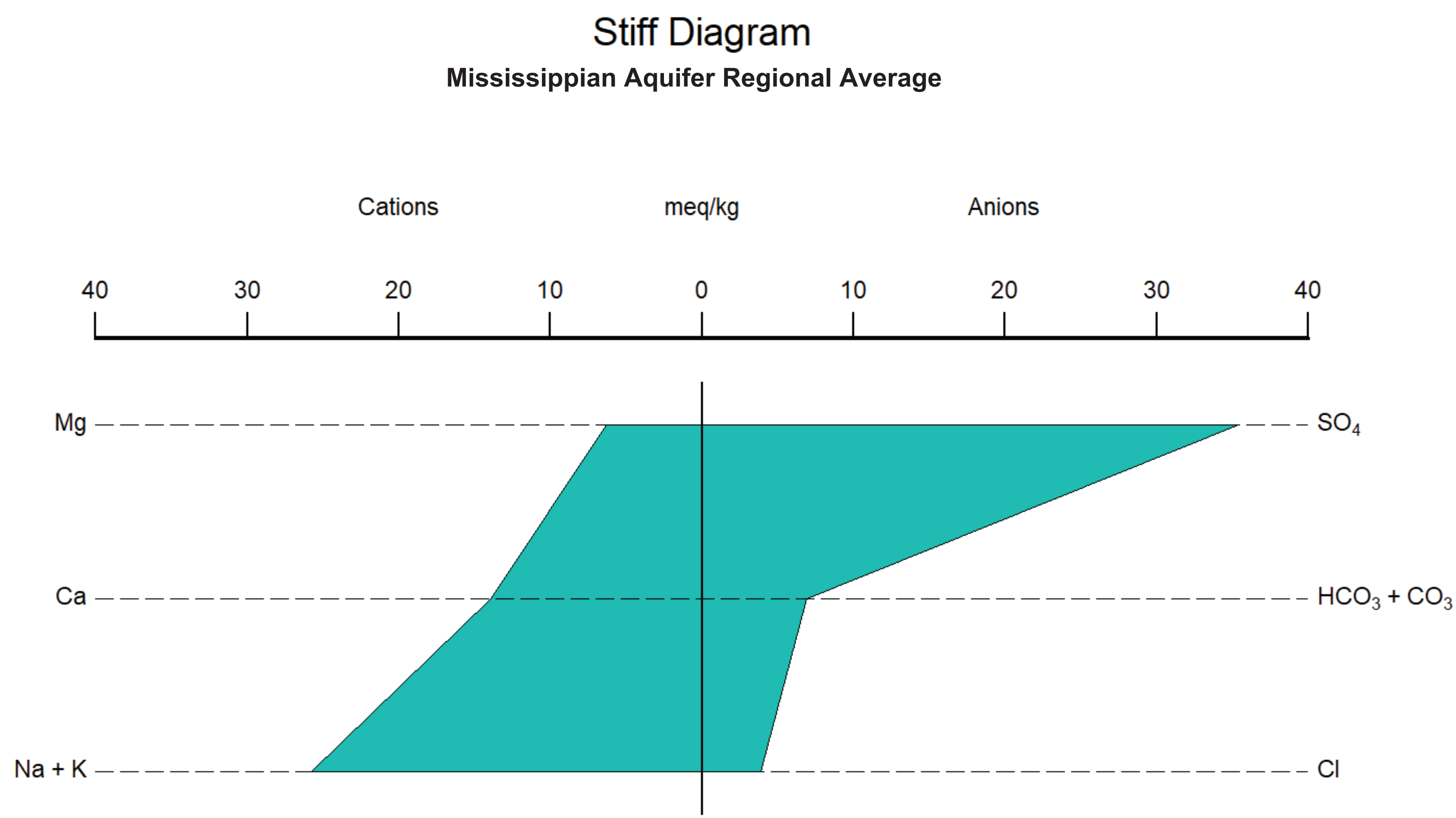


10/08/2020 - Classification: Internal - ECRM7750491

MW-311A



10/08/2020 - Classification: Internal - ECRM7750491

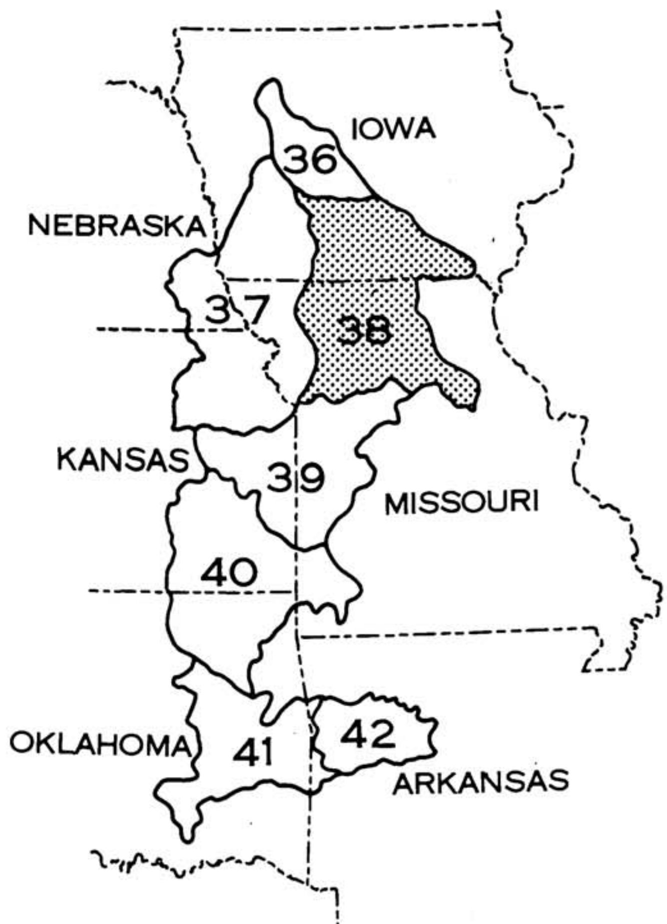


Data Source: USS Open File Report 82-1014. Note that carbonate concentrations were not included in this report, so HCO_3 + CO_3 represents HCO_3 concentrations only.

Attachment C

Excerpt from U.S. Geological Survey (USGS) Open File Report 82-1014, Hydrology of Area 38, Western Region, Interior Coal Province, Iowa and Missouri

HYDROLOGY OF AREA 38, WESTERN REGION, INTERIOR COAL PROVINCE IOWA AND MISSOURI



- CHARITON RIVER
- DES MOINES RIVER
- THOMPSON RIVER
- GRAND RIVER
- ELK FORK SALT RIVER

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 82-1014

Chemical Quality of Water from Mississippian and Pennsylvanian Aquifers is Variable and Generally Not Potable

Dissolved-solids concentrations in water from the Mississippian aquifer ranged from 370 to 8,220 milligrams per liter and in water from the Pennsylvanian aquifer dissolved-solids concentrations ranged from 250 to 6,790 milligrams per liter; sulfate and sodium are the dominant ionic species in water from both aquifers.

The quality of water in the Mississippian and Pennsylvanian aquifers is variable from place to place, but the water generally is not potable. The areal extent of Mississippian and Pennsylvanian bedrock throughout Area 38 is significant (figure 7.3-1). Neither the Pennsylvanian nor the Mississippian aquifer is a significant source of potable water in Area 38. Limited data for bedrock wells make it difficult to adequately define the characteristics of bedrock water throughout Area 38; however a general data analysis has been provided.

Minimum, maximum and average values for major chemical constituents in water from the Mississippian and Pennsylvanian aquifers are shown in tables 7.3-1 and 7.3-2. Ion-distribution diagrams are shown in figures 7.3-2 and 7.3-3 for both bedrock aquifers. These diagrams are designed to represent simultaneously the total solute concentration and the proportions assigned to each ionic species for a group of analyses.

Concentrations of dissolved solids averaged 3,140 mg/L (milligrams per liter) in water from wells completed in the Mississippian aquifer. The median pH was 7.2, and the average alkalinity was 345 mg/L. Sulfate concentrations ranged from 22 to 4,500 mg/L and sodium concentrations ranged from 6.8 to 2,660 mg/L. Sulfate and sodium are the dominant ionic species as they comprise 40 and 27 percent of the total solute concentration (93 milliequivalents per liter) in water from a typical well. Results of 70 chemical analyses of water from wells completed in the Mississippian aquifer in Iowa were used to compile figure 7.3-2.

The Mississippian aquifer is composed principally of carbonate rocks (limestone and dolomite). In Iowa, the aquifer can be divided into upper and lower units. The upper unit contains some gypsum and anhydrite beds that significantly affect the chemical quality of water (Cagle and Heinitz, 1978).

Concentrations of dissolved solids averaged 2,340 mg/L in water from wells completed in the Pennsylvanian aquifer. The median pH was 7.5 and the average alkalinity was 360 mg/L. Sulfate concentrations ranged from 1 to 4,000 mg/L and sodium concentrations ranged from 5.5 to 2,400 mg/L. Sodium and sulfate are the dominant ionic species as they comprise 35 and 31 percent of the total solute concentration (72 milliequivalents per liter) in water from a typical well. Results of 98 chemical analyses of water from wells completed in the Pennsylvanian aquifer, 76 in Iowa and 22 in Missouri, were used to compile figure 7.3-3.

The Pennsylvanian bedrock in Area 38 is composed predominately of impermeable shale beds, which are a regional confining bed that separates the surficial aquifer from underlying aquifers. However, limestone and sandstone beds are aquifers of local and subregional extent in parts of south-central Iowa (Cagle and Heinitz, 1978). Sources of the sodium and sulfate ions are ion exchange for sodium and pyrite for sulfate. Wells that penetrate clay and shale generally obtain water with excessive dissolved solids directly from the shale layers, which have large cation-exchange capabilities (Hem, 1970). Pyrite is commonly associated with biogenic deposits such as coal, which were deposited under extreme reducing conditions.

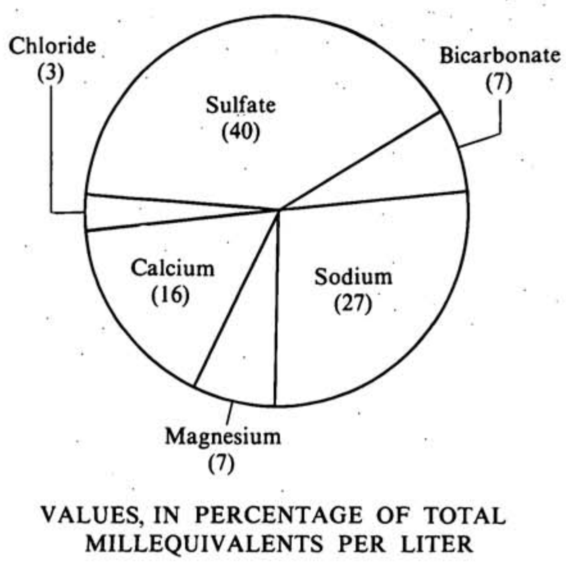


Figure 7.3-2 Average chemical composition for water from wells in the Mississippian aquifer.

Table 7.3-1 Summary of water-quality data available for the Mississippian aquifer.

[Concentrations in milligrams per liter unless otherwise specified; < = less than]

Constituent	Range	Average	Number of samples
Iron (Fe)	0.02 - 50	6.3	70
Manganese (Mn)	0.01 - 1.4	0.17	70
Calcium (Ca)	10 - 642	279	70
Magnesium (Mg)	3.1 - 340	77	70
Sodium (Na)	6.8 - 2,660	584	70
Potassium (K)	0.2 - 45	14	68
Bicarbonate (HCO_3)	168 - 1,350	420	70
Sulfate (SO_4)	22 - 4,500	1,697	70
Chloride (Cl)	0.5 - 3,570	137	70
Nitrate (NO_3)	<0.1 - 150	4.5	70
pH	6.3 - 8.0	(median)7.2	66
Hardness ($CaCO_3$)	38 - 2,950	1,029	69
Alkalinity ($CaCO_3$)	138 - 1,100	345	70
Dissolved solids	370 - 8,220	3,138	66
Specific conductance (micromhos per centimeter at 25° Celsius)	370 - 9,000	3,850	63

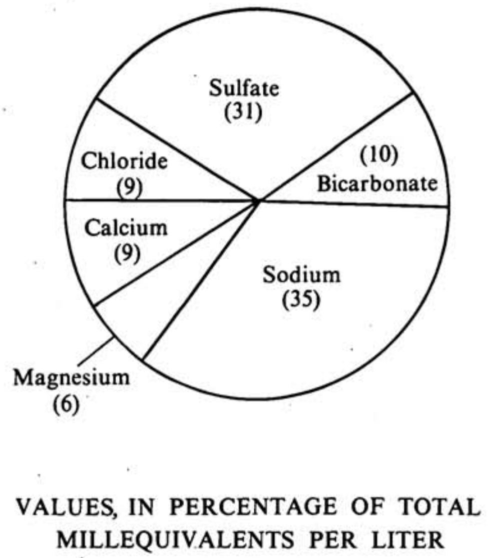


Figure 7.3-3 Average chemical composition for water from wells in the Pennsylvanian aquifer.

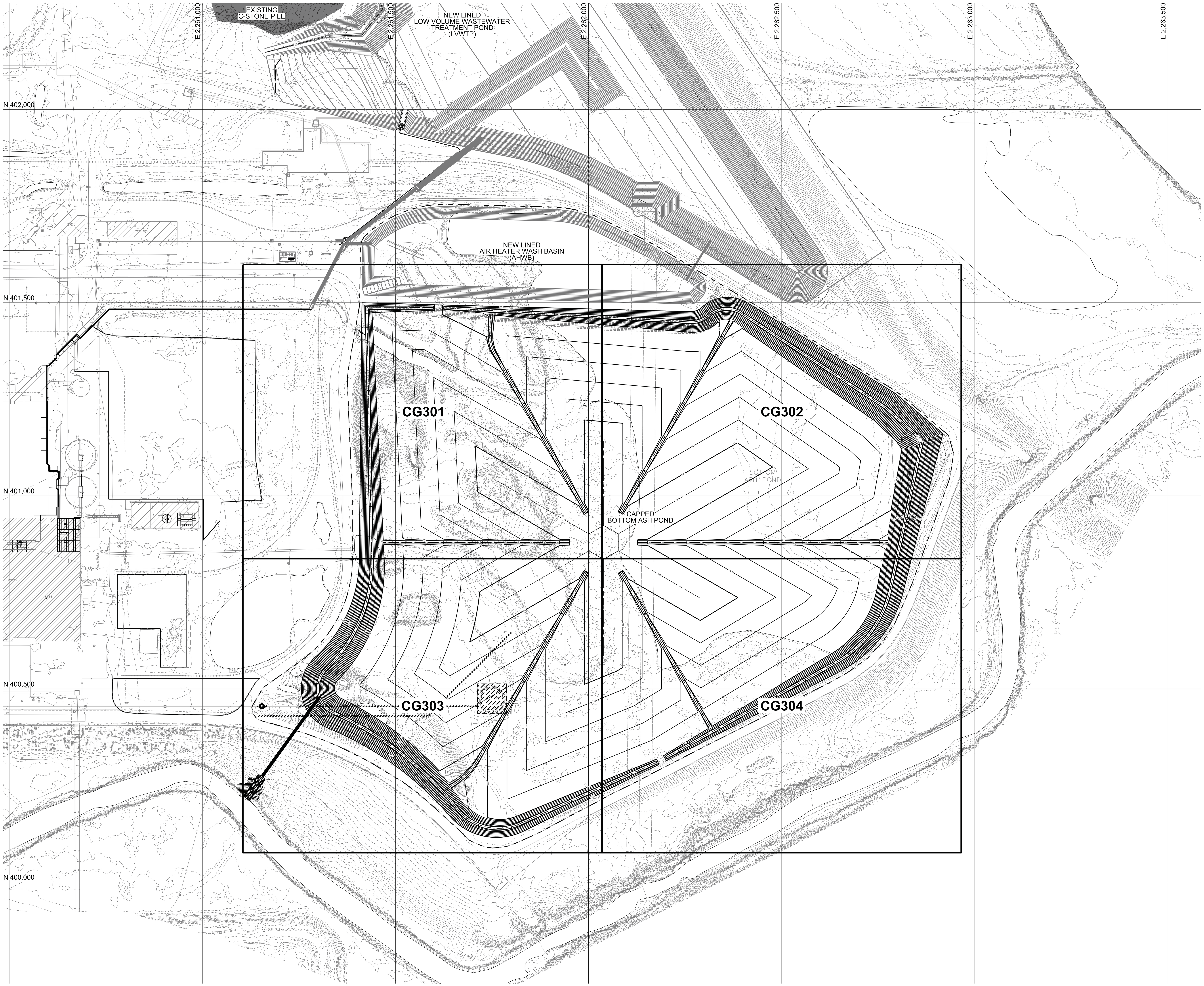
Table 7.3-2 Summary of water-quality data available for the Pennsylvanian aquifer.

[Concentrations in milligrams per liter unless otherwise specified; < = less than]

Constituent	Range	Average	Number of samples
Iron (Fe)	0.01 - 22	2.5	96
Manganese (Mn)	0.01 - 2.3	0.16	95
Calcium (Ca)	2.4 - 460	133	97
Magnesium (Mg)	1.5 - 394	48	97
Sodium (Na)	5.5 - 2,400	574	96
Potassium (K)	0.9 - 38	8.5	84
Bicarbonate (HCO_3)	120 - 1,240	437	94
Sulfate (SO_4)	1 - 4,000	1,046	97
Chloride (Cl)	0.5 - 3,060	222	98
Nitrate (NO_3)	<0.1 - 200	4.3	97
pH	6.5 - 8.3	(median)7.5	95
Hardness ($CaCO_3$)	29 - 2,000	528	96
Alkalinity ($CaCO_3$)	98 - 1,080	360	98
Dissolved solids	250 - 6,790	2,339	98
Specific conductance (micromhos per centimeter at 25° Celsius)	350 - 7,700	3,075	75

Appendix C

Preliminary OGS Ash Pond Closure Drawings



NOTES:

1. DESIGN CONTOURS SHOWN ARE TO GRADE TO NEAR ORIGINAL POND BOTTOM ELEVATIONS MINUS 1-FOOT OF OVEREXCAVATION.

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.

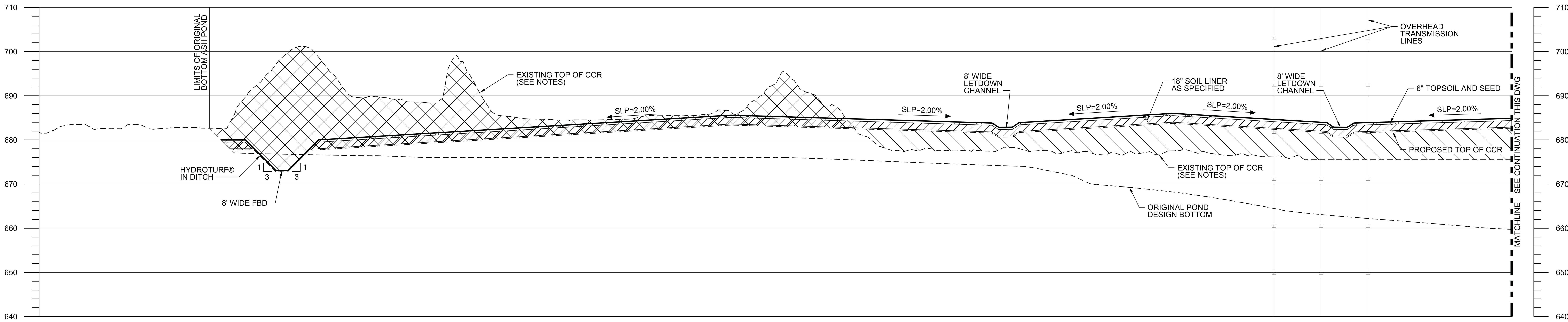
designed: A. MUCKENTHALER | detailed: J. RIDDER

Alliant Energy.
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT
OTTUMWA, IA

BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING PLAN - KEY PLAN

project: 110321 | contract: 8120
drawing: CG300 | rev. — 0
sheet of sheets
file 110321CG300.DGN

7/13/2020



SECTION (A) CG301, CG302

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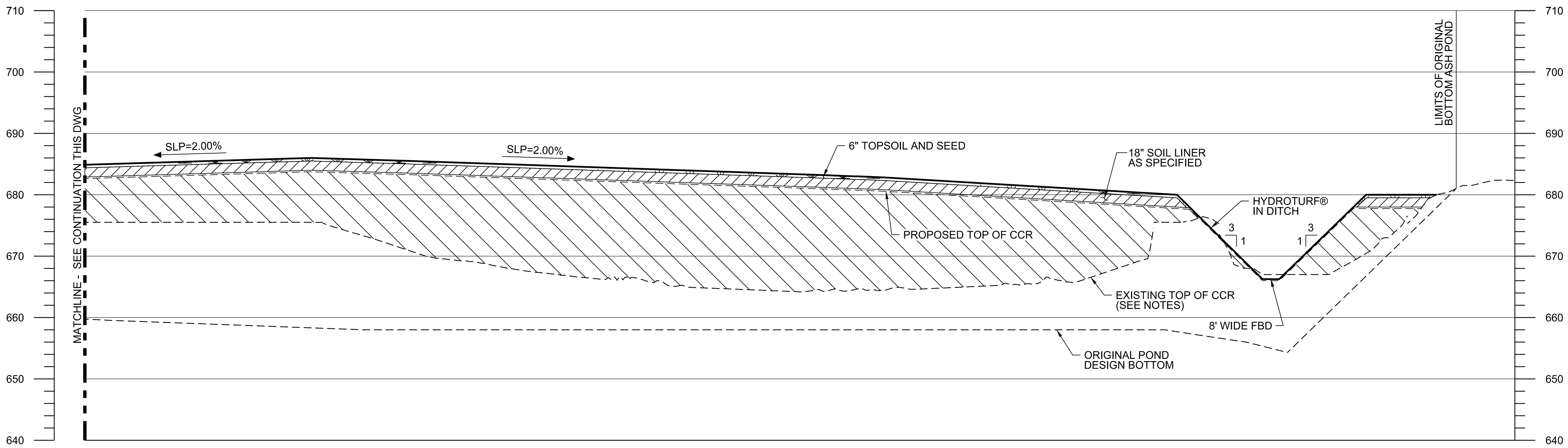
VERT: 0 10' 20' SCALE IN FEET



SECTION (A) CG301, CG302

HORIZ: 0 30' 60' SCALE IN FEET

VERT: 0 10' 20' SCALE IN FEET

NOTES: 1

1. VOLUME OF CCR TO BE MOVED FROM ZLD POND = 97,300 CU YD; PLUS 49,800 CU YD ACCOUNTING FOR ASSUMED 1' OF OVER EXCAVATION
2. VOLUME OF CCR TO BE MOVED FROM WEST SIDE OF BOTTOM ASH POND TO EAST SIDE OF BOTTOM ASH POND = 175,000 CU YD
3. TOTAL VOLUME OF MATERIAL TO BE MOVED = 322,100 CU YD BULK; ASSUMING A 10% SHRINGAKE FACTOR 289,900 CU YD INPLACE
4. THE CURRENT DESIGN VOLUME BETWEEN EXISTING TOP OF CCR AND PROPOSED TOP OF CCR = 227,000 CU YD
5. VOLUME OF 18" CAP = 77,200 CU YD
6. VOLUMES ARE ESTIMATES FROM LIDAR SURVEYS (DATED JUNE 6, 2019) AND BATHYMETRIC SURVEYS (DATED JULY 17, 2019). THESE VALUES MAY DEVIATE FROM THE ACTUAL FIELD CONDITIONS AT THE TIME OF CLOSURE. PER THE CONSTRUCTION SPECIFICATIONS, CONTRACTOR SHALL PERFORM FIELD VERIFICATION SURVEYS PRIOR TO AND FOLLOWING MOVEMENT OF MATERIAL. ONCE THE VOLUMES ARE CONFIRMED, ENGINEER WILL EVALUATE THE NEED TO MODIFY THE GRADING PLAN TO ACCOMMODATE ANY DISCREPANCIES.
7. SEE REFERENCE DRAWINGS 1-2035-1-D-C1018, 1-2035-1-D-C1019, 1-2035-1-D-C1020, AND 1-2035-1-D-C1021 FOR THE ORIGINAL POND DESIGN TO ESTIMATE POND BOTTOM.

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no.	date	by	ckd	description
1	08/21/20	RNO	ETT	REVISED NOTES. ISSUED FOR BID
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Alliant Energy.
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OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT
OTTUMWA, IA

BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING SECTIONS - SHEET 1

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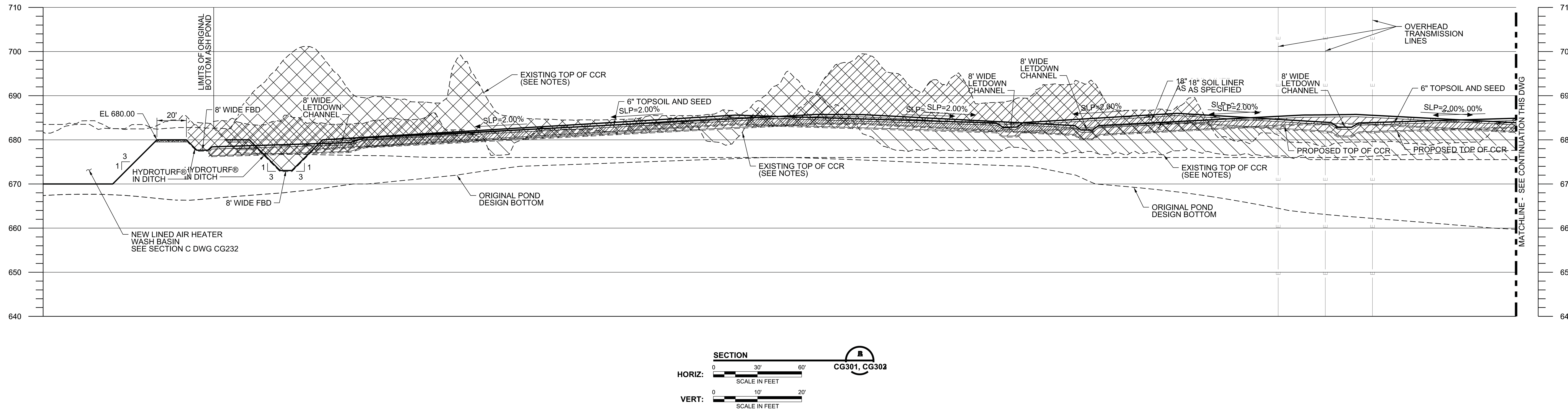

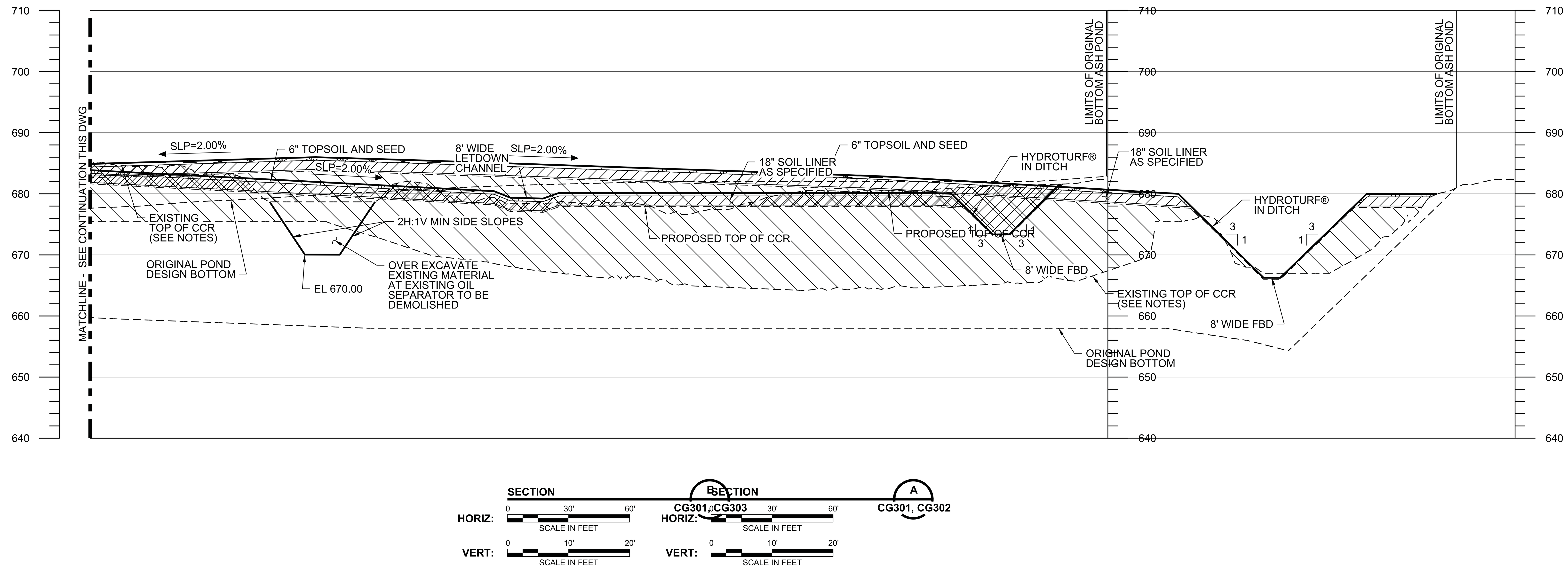

NOTES: 1

1. VOLUME OF CCR TO BE MOVED FROM ZLD POND = 97,300 CU YD; PLUS 49,800 CU YD ACCOUNTING FOR ASSUMED 1' OF OVER EXCAVATION
2. VOLUME OF CCR TO BE MOVED FROM WEST SIDE OF BOTTOM ASH POND TO EAST SIDE OF BOTTOM ASH POND = 175,000 CU YD
3. TOTAL VOLUME OF MATERIAL TO BE MOVED = 322,100 CU YD BULK; ASSUMING A 10% SHRINGAKE FACTOR 289,900 CU YD INPLACE
4. THE CURRENT DESIGN VOLUME BETWEEN EXISTING TOP OF CCR AND PROPOSED TOP OF CCR = 227,000 CU YD
5. VOLUME OF 18" CAP = 77,200 CU YD
6. VOLUMES ARE ESTIMATES FROM LIDAR SURVEYS (DATED JUNE 6, 2019) AND BATHYMETRIC SURVEYS (DATED JULY 17, 2019). THESE VALUES MAY DEVIATE FROM THE ACTUAL FIELD CONDITIONS AT THE TIME OF CLOSURE. PER THE CONSTRUCTION SPECIFICATIONS, CONTRACTOR SHALL PERFORM FIELD VERIFICATION SURVEYS PRIOR TO AND FOLLOWING MOVEMENT OF MATERIAL. ONCE THE VOLUMES ARE CONFIRMED, ENGINEER WILL EVALUATE THE NEED TO MODIFY THE GRADING PLAN TO ACCOMMODATE ANY DISCREPANCIES.
7. SEE REFERENCE DRAWINGS 1-2035-1-D-C1018, 1-2035-1-D-C1019, 1-2035-1-D-C1020, AND 1-2035-1-D-C1021 FOR THE ORIGINAL POND DESIGN TO ESTIMATE POND BOTTOM.

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no.	date	by	ckd	description
1	08/21/20	RNO	ETT	REVISED NOTES. ISSUED FOR BID
0	07/17/20	RNO	ETT	ISSUED FOR BID

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Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER | detailed: J. RIDDER

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OTTUMWA GENERATING STATION
POND CLOSURE AND WASTEWATER TREATMENT PROJECT
OTTUMWA, IA

BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING SECTIONS - SHEET 2

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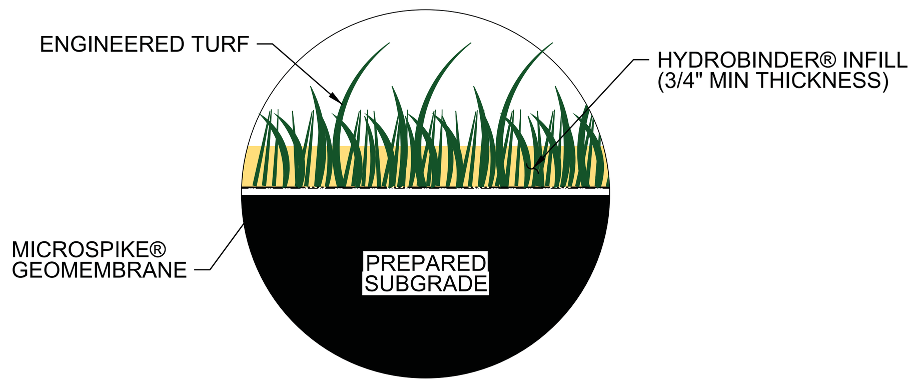
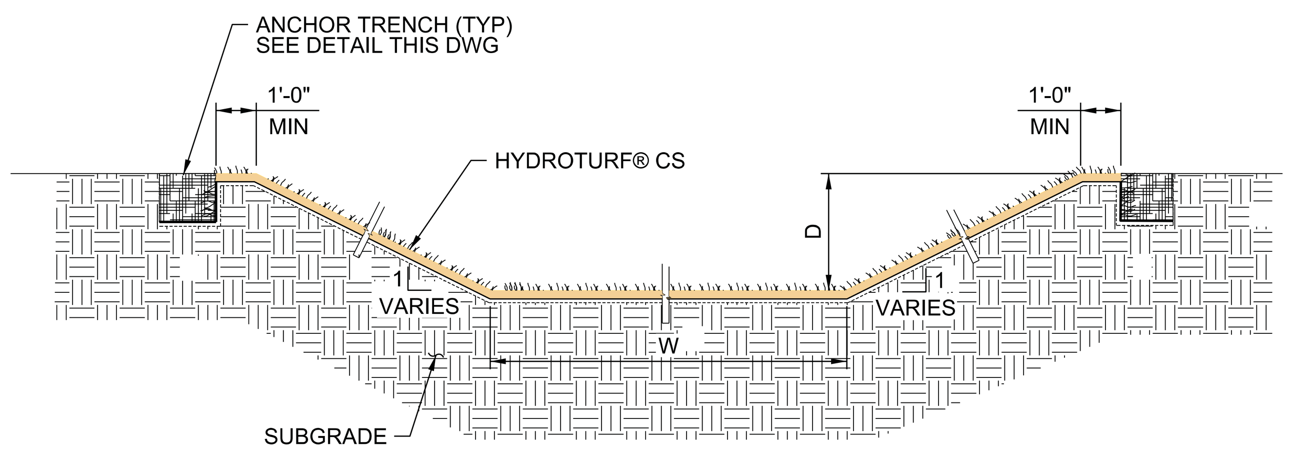
8/21/2020



HYDROTURF® CS TYPICAL SECTION
WITH MICROSPIKE GEOMEMBRANE
NOT TO SCALE



HYDROTURF® CHANNEL REVETMENT
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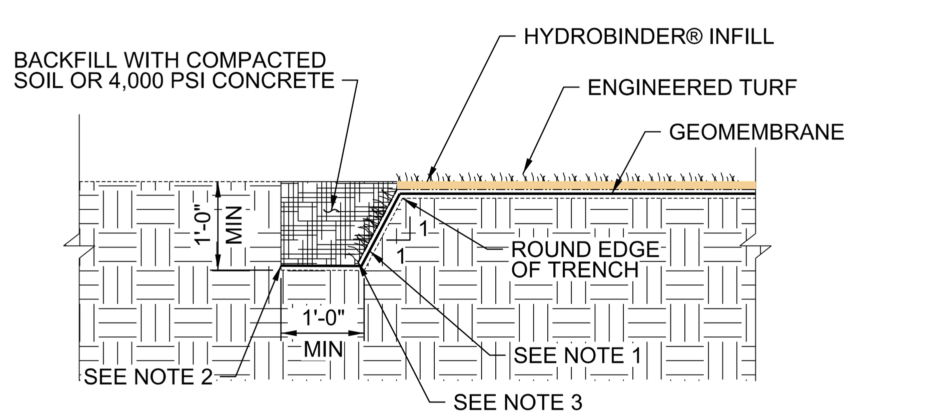
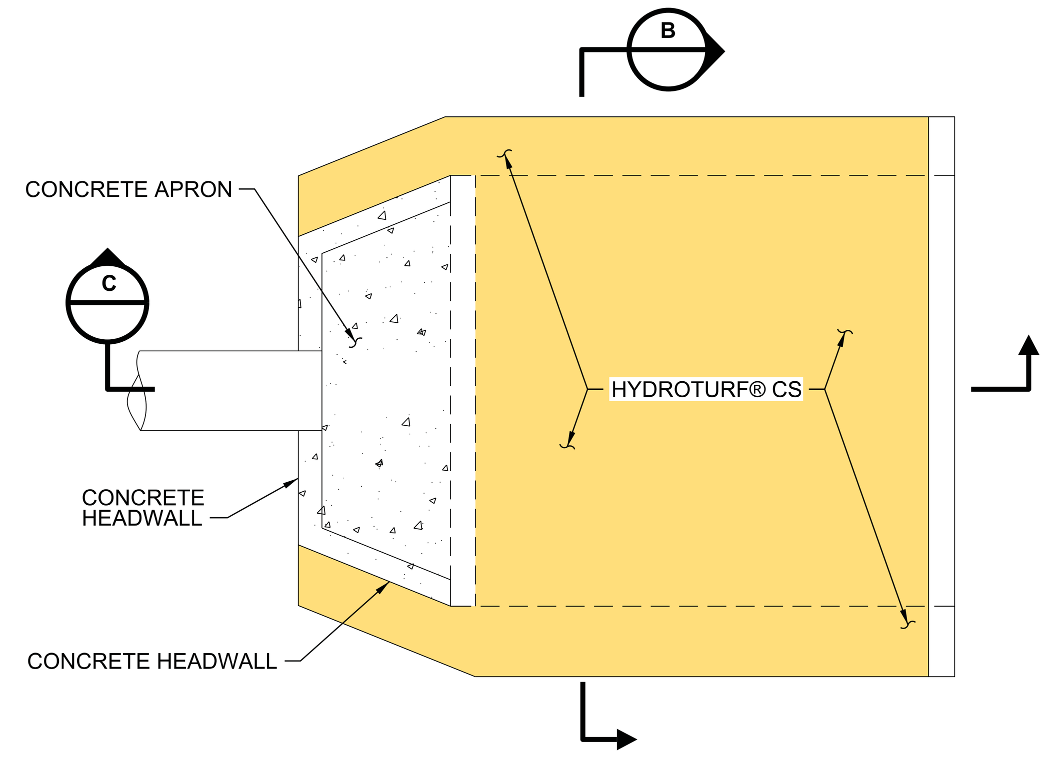


NOTES:

1. THE GEOMEMBRANE COMPONENT OF HYDROTURF® CS SHALL BE IN INTIMATE CONTACT WITH THE ANCHOR TRENCH INSIDE WALL AND BOTTOM. WRINKLES, RIPPLES, FISH MOUTHS, AND / OR BUNCHING SHALL BE REMOVED AND PROPERLY PATCHED. DURING FILLING OF THE ANCHOR TRENCH WITH THE COMPACTED SOIL OR CONCRETE BACKFILL, THE CONTRACTOR SHALL MAINTAIN THAT THE GEOMEMBRANE IS IN INTIMATE CONTACT WITH THE TRENCH WALL AND BOTTOM. CONCRETE BACKFILL SHALL BE VIBRATED IN PLACE IN ACCORDANCE WITH STANDARD INDUSTRY TECHNIQUES.
2. THE GEOMEMBRANE SHALL NOT EXTEND UP THE OUTSIDE WALL OF THE ANCHOR TRENCH. IT SHALL BE TRIMMED SHORT OF THE OUTSIDE WALL AND SHALL EXTEND A MINIMUM OF 3/4 OF THE WIDTH OF THE ANCHOR TRENCH.
3. THE ENGINEERED TURF COMPONENT OF HYDROTURF® CS SHALL BE IN INTIMATE CONTACT WITH THE GEOMEMBRANE. WRINKLES, RIPPLES, FISH MOUTHS, AND / OR BUNCHING SHALL BE REMOVED AND PROPERLY PATCHED. THE ENGINEERED SYNTHETIC TURF SHALL BE TRIMMED SO THAT IT DOES NOT EXTEND ONTO THE BOTTOM OF THE ANCHOR TRENCH. IT SHALL BE TRIMMED JUST SHORT OF THE BOTTOM AND SHALL EXTEND A MINIMUM OF 3/4 OF THE DEPTH OF THE ANCHOR TRENCH.

HYDROTURF® CS TYPICAL
ANCHOR TRENCH TERMINATION
NOT TO SCALE



PLAN
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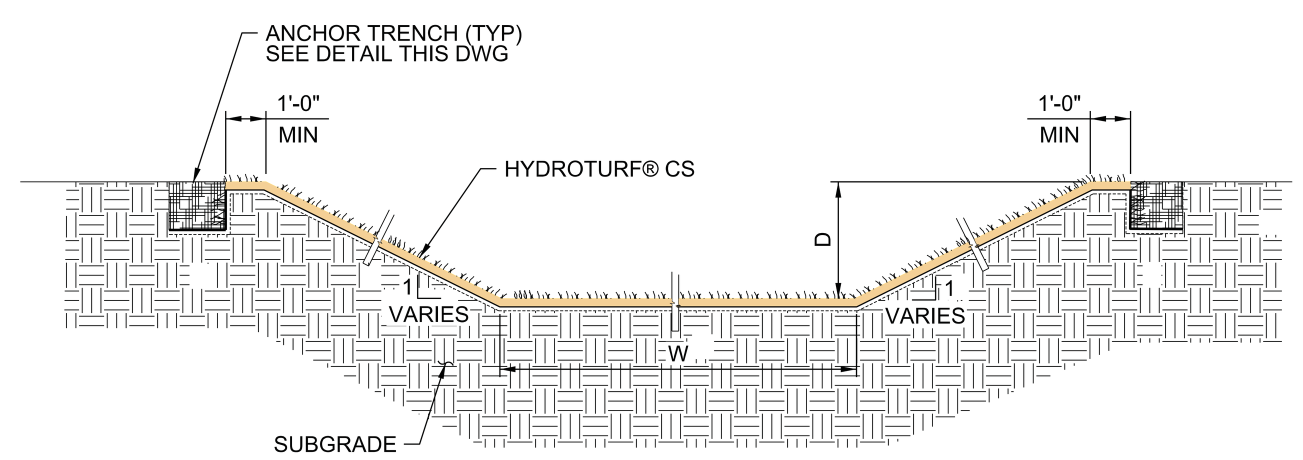

SECTION B
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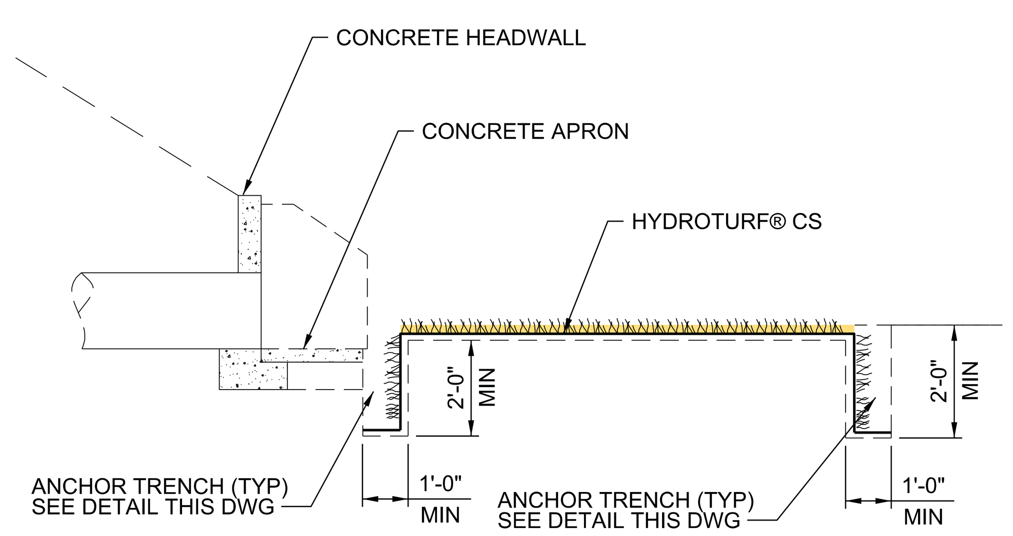

SECTION C
NOT TO SCALE

HYDROTURF REVETMENT SYSTEM
OUTFALL STRUCTURE WITH HEADWALL
NOT TO SCALE

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER
detailed: J. RIDDER

Alliant Energy.
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT
OTTUMWA, IA

BOTTOM ASH POND CAP AND CLOSURE
FINISH GRADING DETAILS - SHEET 2

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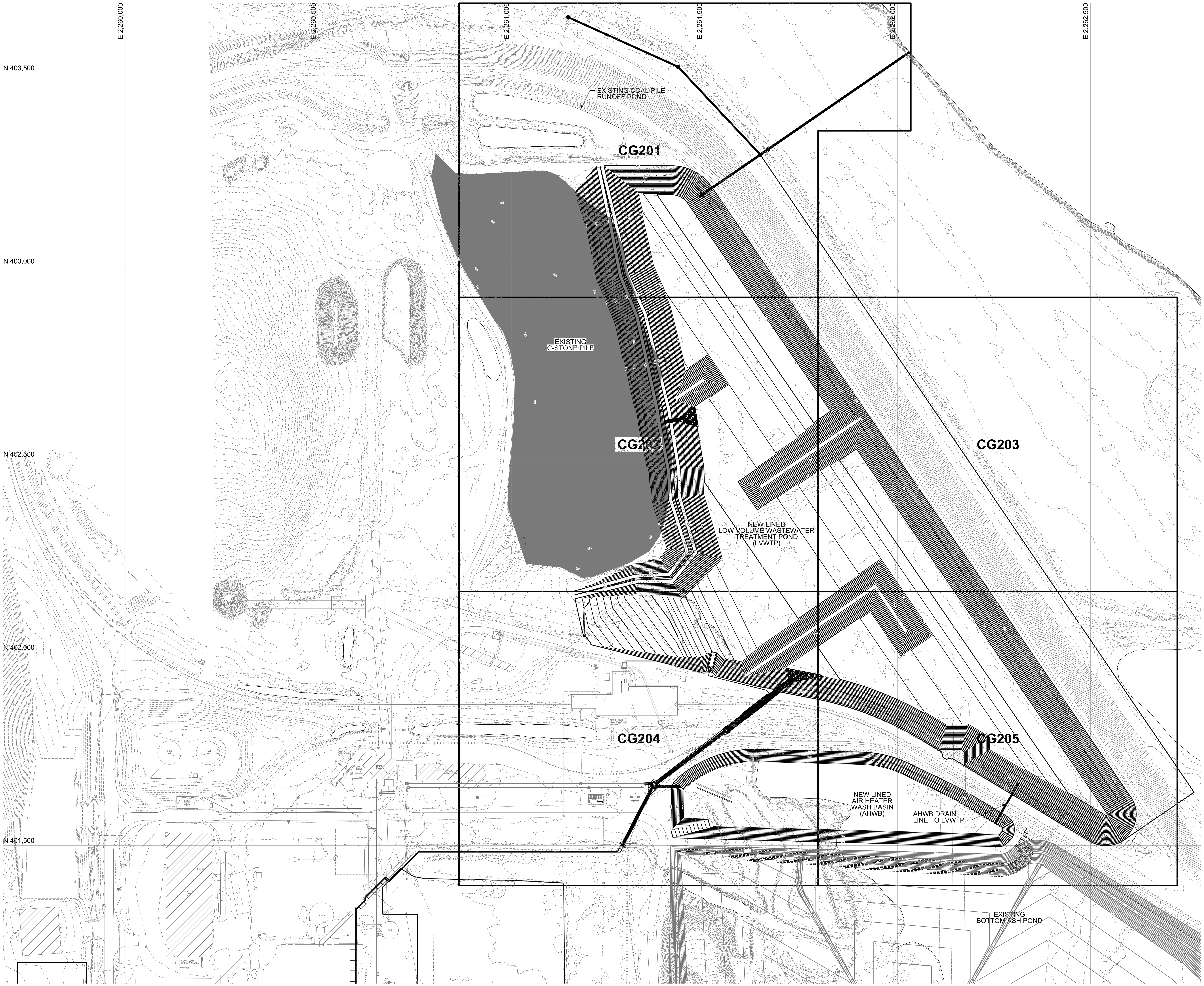
contract: 8120
drawing: CG342
rev.: 0
sheet — of — sheets
file 110321CG342.DGN



NOTES:

1. SHADED AREA SHOWS LIMITS OF EXISTING C-STONE MATERIAL. C-STONE MATERIAL IS ASSUMED TO BE REMOVED BY OTHERS. CCR MATERIAL UNDER THIS C-STONE TO BE REMOVED AND PLACED IN BOTTOM ASH POND. THIS QUANTITY IS INCLUDED IN VOLUME CALCULATIONS.
2. CONTOURS SHOWN REPRESENT EXCAVATION GRADE, AND ARE APPROXIMATE. EXCAVATION SHALL REMOVE ALL CCR MATERIAL. EXCAVATION GRADE IS DEFINED AS THE ORIGINAL POND BOTTOM MINUS 1-FOOT OF OVEREXCAVATION.

CONSTRUCTION SEQUENCING:

1. DEWATER ENTIRE ZLD POND. OWNER HAS APPROVED WATER CAN PUMPED TO TO MAIN ASH POND.
2. INSTALL DEWATERING SYSTEM FOR ZLD POND IF NECESSARY TO DEWATER CCR MATERIAL IN POND LIMITS. OWNER HAS APPROVED WATER CAN PUMPED TO MAIN ASH POND.
3. SURVEY ZLD POND LIMITS ON 100' GRID ONCE TO DETERMINE BASELINE FOR CCR REMOVAL.
4. BEGIN EXCAVATING MATERIAL FROM ZLD POND. OWNER HAS APPROVED THE MAIN ASH POND LIMITS TO STOCKPILE MATERIAL AND FOR FINAL GRADING OF THE CCR MATERIAL LOCATED WITHIN THE MAIN ASH POND. DO NOT BLOCK FLOW FROM EXISTING BOTTOM ASH SLUICING OPERATION UNTIL NEW DRY BOTTOM ASH SYSTEM IS OPERATIONAL.
5. OWNER'S REPRESENTATIVE TO PERFORM VISUAL INSPECTION OF CCR REMOVAL TO DETERMINE NO CCR MATERIAL REMAINS IN ZLD POND BOTTOM.
6. NOTIFY OWNER/ENGINEER IF THERE IS A MAJOR DESCREPENCY FROM THE ORGINAL POND BOTTOM DESIGN PROVIDED IN REFERENCE FILES 1-2035-1-D-C1018, C1019, C1020 AND C1021.
7. SURVEY BASIN ON 100' GRID ONCE CCR MATERIAL HAS BEEN REMOVED FOR PAYMENT PURPOSES FOR AMOUNT OF CCR MATERIAL MOVED TO MAIN ASH POND.
8. ONCE IT IS DETERMINED CCR MATERIAL IS REMOVED, OVEREXCAVATE 1-FOOT OF MATERIAL TO BE STOCKPILED IN MAIN ASH POND LIMITS.

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no.	date	by	ckd	description
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BURNS McDONNELL
9400 WARD PARKWAY
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816-333-9400
Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER
detailed: J. RIDDER

Alliant Energy
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT
OTTUMWA, IA

LVWTP AND AHWB CONSTRUCTION
FINISH GRADING PLAN - KEY PLAN

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contract: 8120
drawing: CG200 — rev. 0
sheet of sheets
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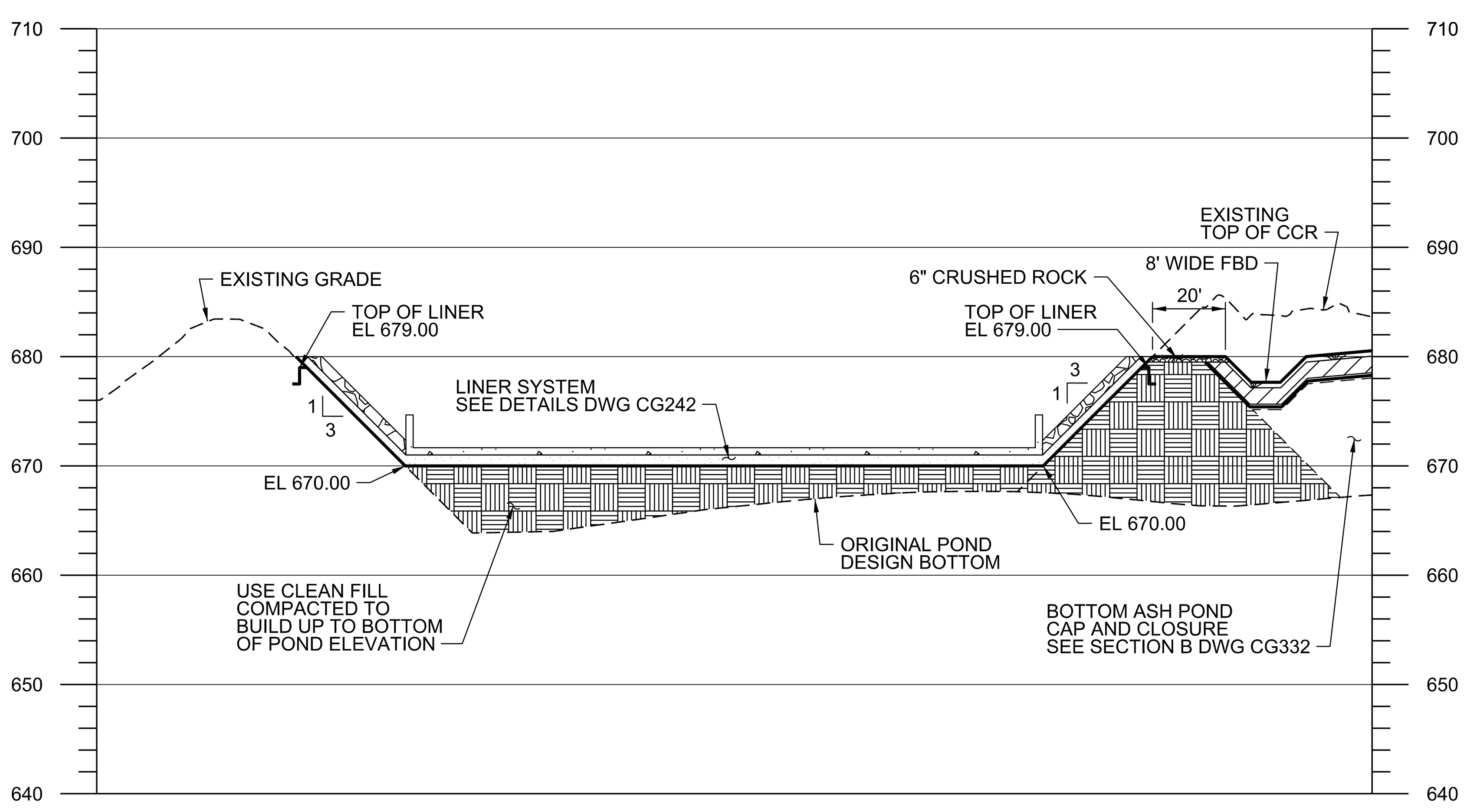
7/13/2020



SECTION C / CG204

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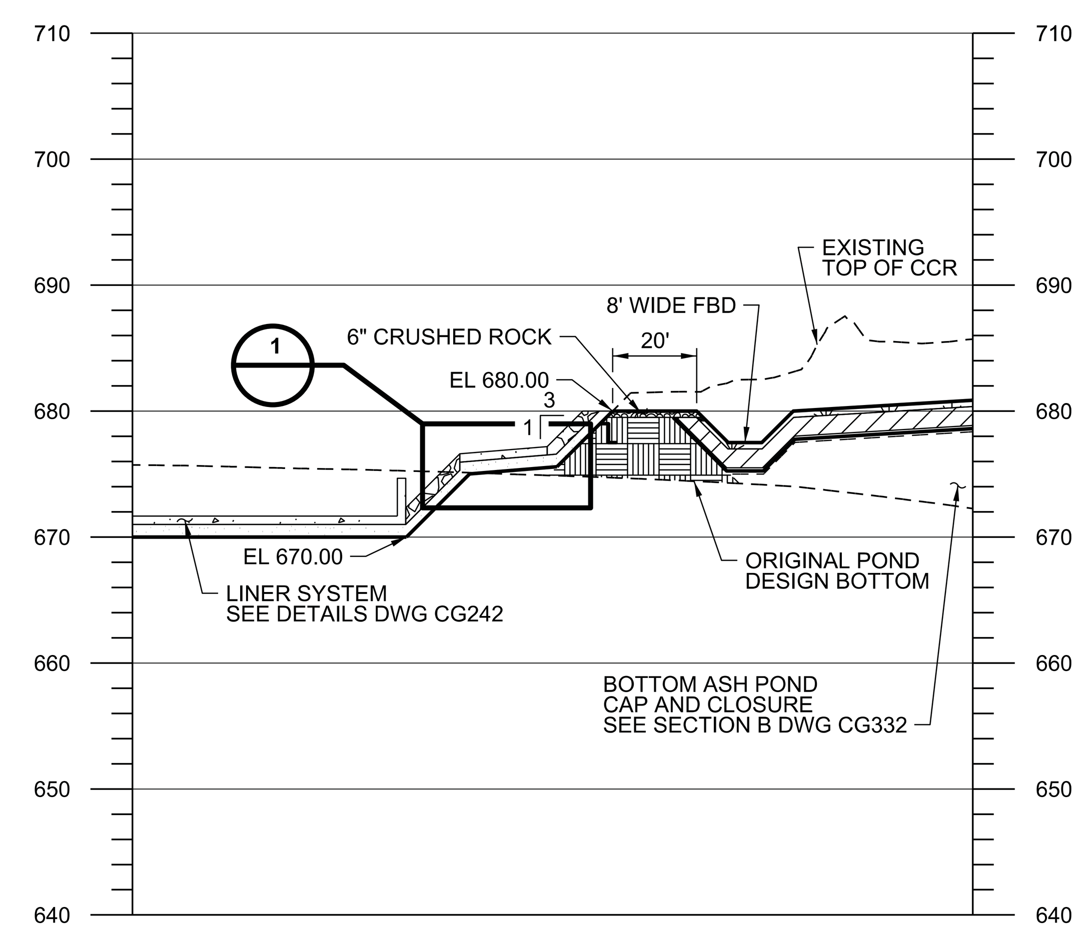

SECTION D / CG204

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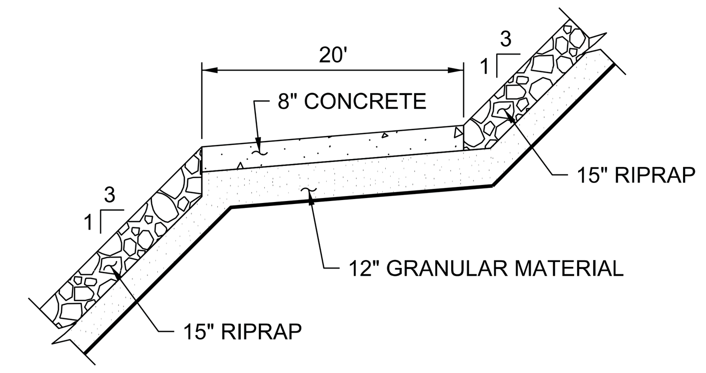

DETAIL 1

NOT TO SCALE

NOTES:

1. SEE REFERENCE DRAWINGS 1-2035-1-D-C1018, 1-2035-1-D-C1019, 1-2035-1-D-C1020, AND 1-2035-1-D-C1021 FOR THE ORIGINAL POND DESIGN TO ESTIMATE POND BOTTOM FOR EXTENT OF CCR MATERIAL TO BE REMOVED FOR THE CLEAN CLOSURE OF THE AIR HEATER WASH BASIN. CCR MATERIAL AND 1-FOOT OF OVEREXCAVATION MUST BE REMOVED TO THE EXTENT TO CONSTRUCT THE NEW BERM FOR THE SOUTH AND EAST SIDES OF THE BASIN WITH CLEAN BACKFILL MATERIAL FROM THE 1-FOOT OVEREXCAVATION TO THE TOP OF THE NEW BERM WITH 3H:1V SIDE SLOPES.

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
Burns & McDonnell Engineering Co, Inc.

designed: A. MUCKENTHALER
detailed: J. RIDDER

Alliant Energy.
INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT
OTTUMWA, IA

LVWTP AND AHWB CONSTRUCTION
FINISH GRADING SECTIONS - SHEET 2

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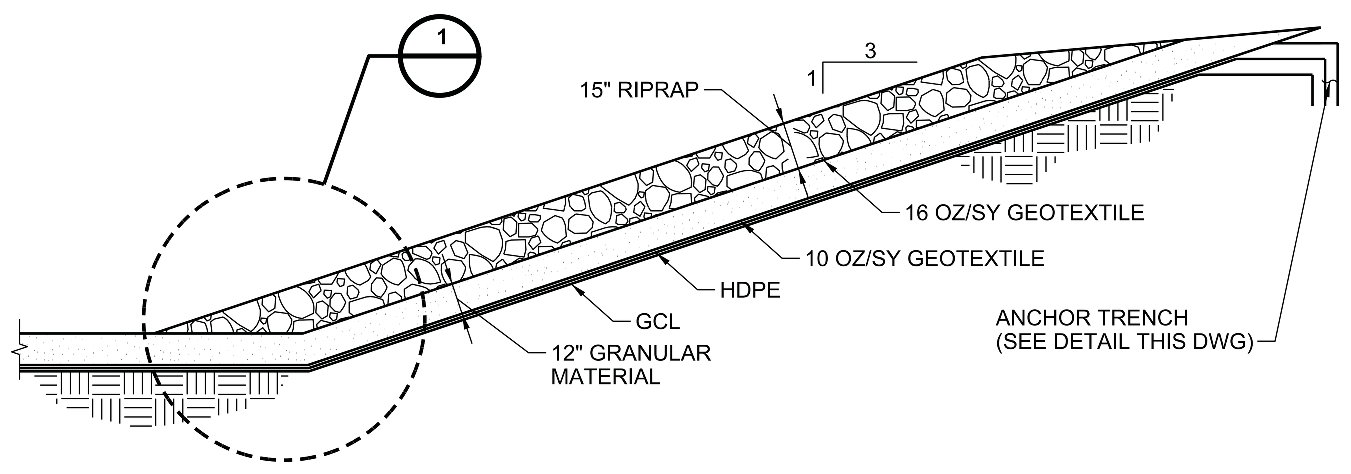
10/08/2020 Classification: Internal - ECRM7758493

7/13/2020



LOW VOLUME WASTEWATER TREATMENT POND LINING SYSTEM
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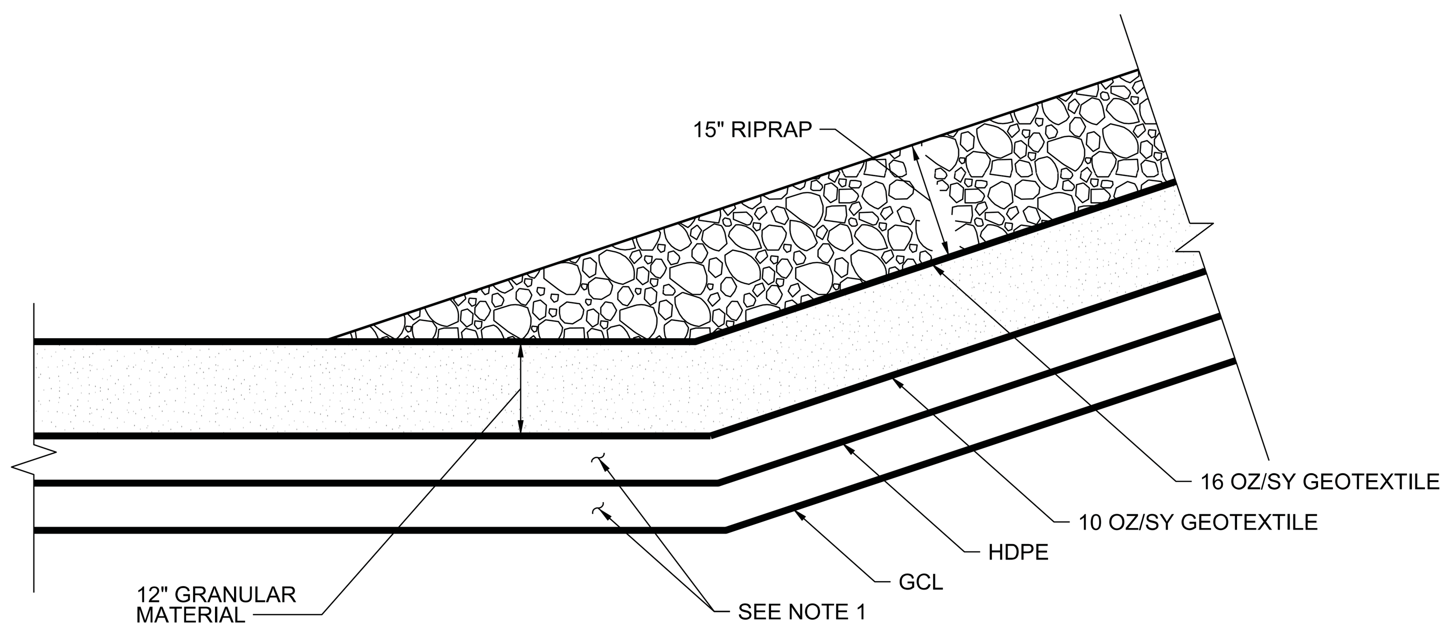
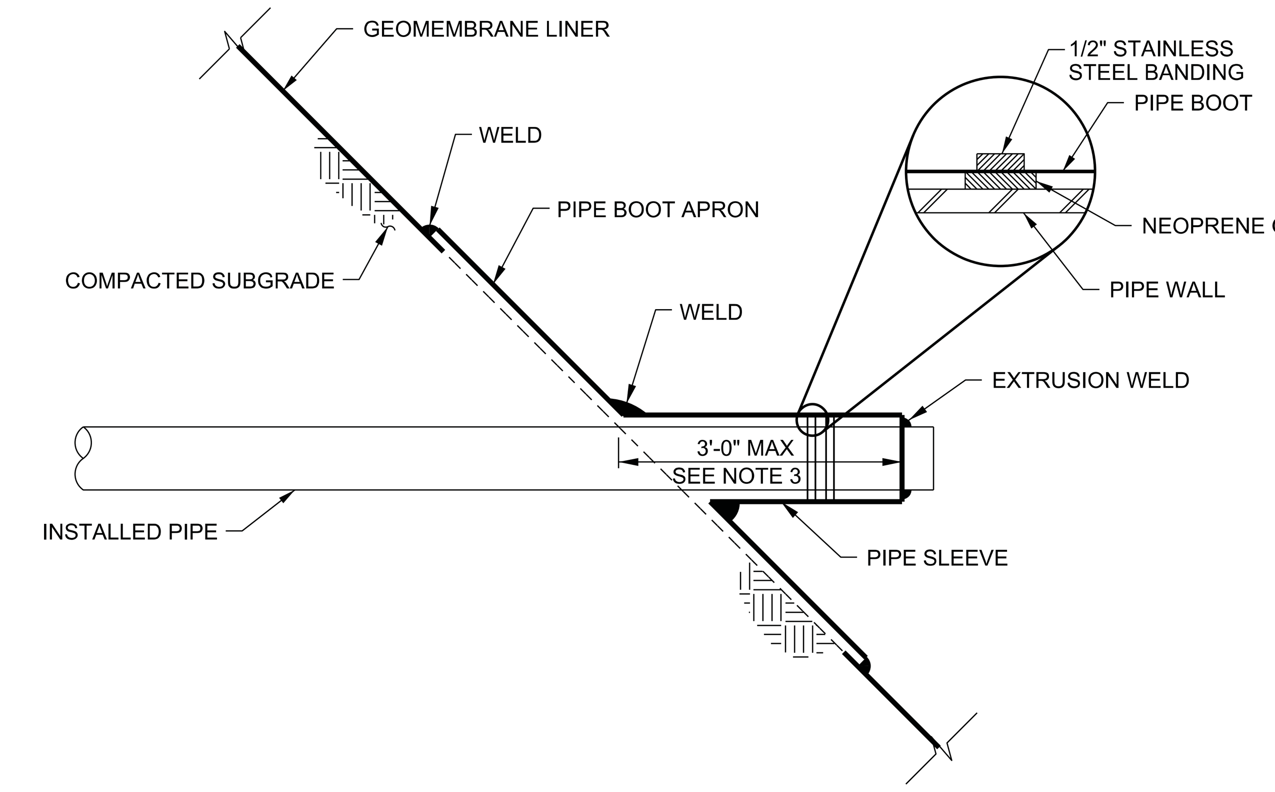


NOTES: (DETAIL 1)

1. SPACING IS SHOWN FOR CLARITY.

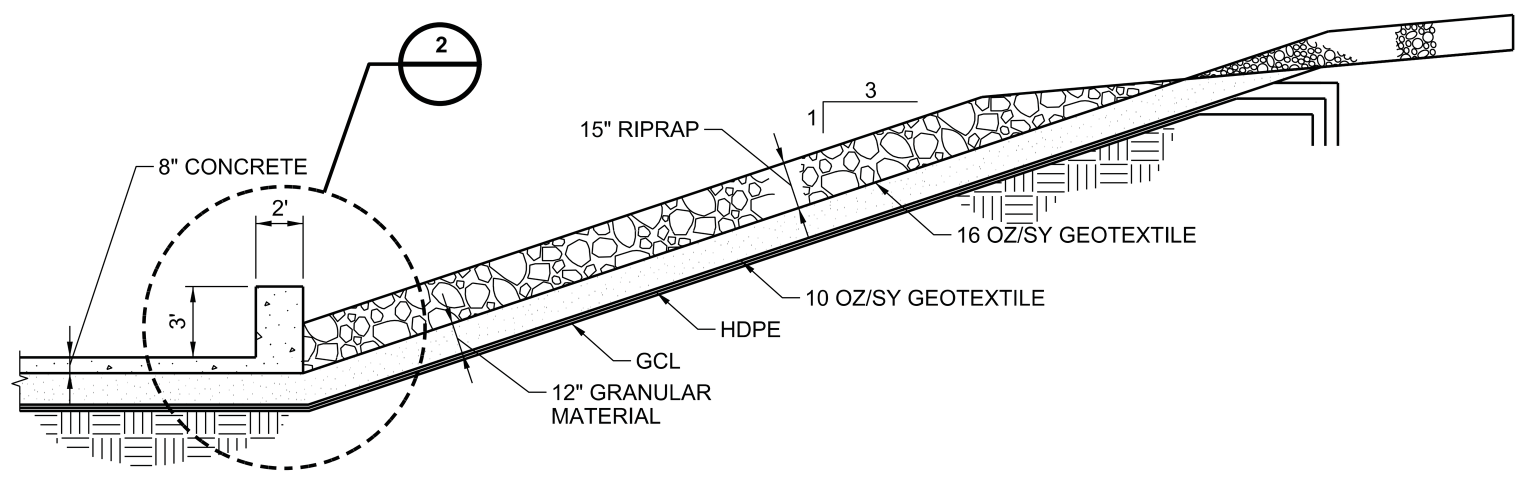
DETAIL (1)
NOT TO SCALE



NOTES: (PIPE PENETRATION DETAIL)

1. SEE PIPE PENETRATION ISOMETRIC THIS DWG FOR LIMITS OF PIPE BOOT APRON.
2. BOOT SHALL BE OF SAME MATERIAL AND THICKNESS AS MAIN GEOMEMBRANE LINER.
3. LINER COVER MATERIAL NOT SHOWN FOR THE SAKE OF CLARITY. SEE PLANS, SECTIONS, AND DETAILS FOR LINER COVER REQUIREMENTS. NO LINER MATERIAL SHALL BE EXPOSED ON THE SLOPE.

PIPE PENETRATION DETAIL
NOT TO SCALE



AIR HEATER WASH BASIN SECTION
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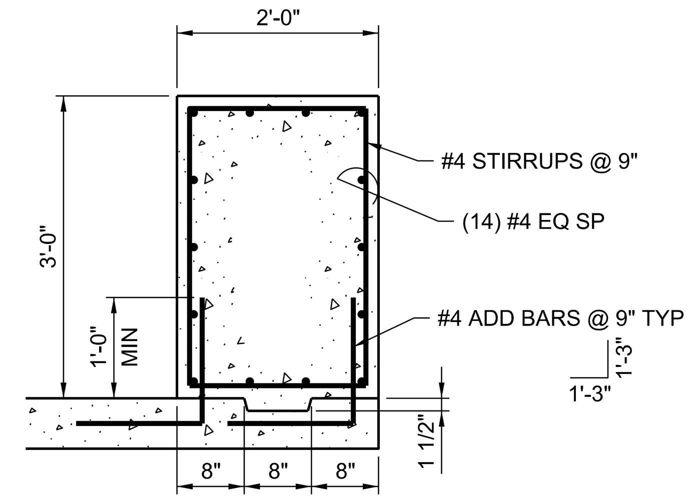
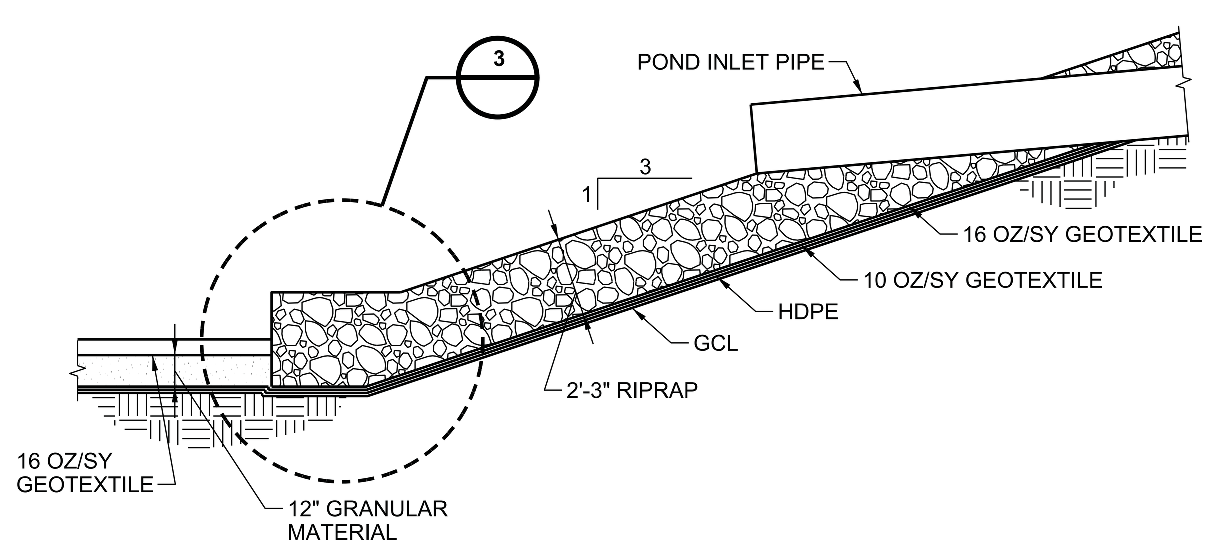


NOTES: (AIR HEATER WASH POND CURB REINFORCING)

1. INSTALL EXPANSION JOINT IN CURB AT ALL LOCATIONS WHERE THE CONCRETE PAVEMENT HAS A DOWELED CONTRACTION JOINT. MATCH THICKNESS AND TYPE OF COMPRESSIBLE MATERIAL AND JOINT SEALER.

AIR HEATER WASH BASIN CURB REINFORCING

DETAIL (2)
NOT TO SCALE



POND INLET RIPRAPPED SLOPE
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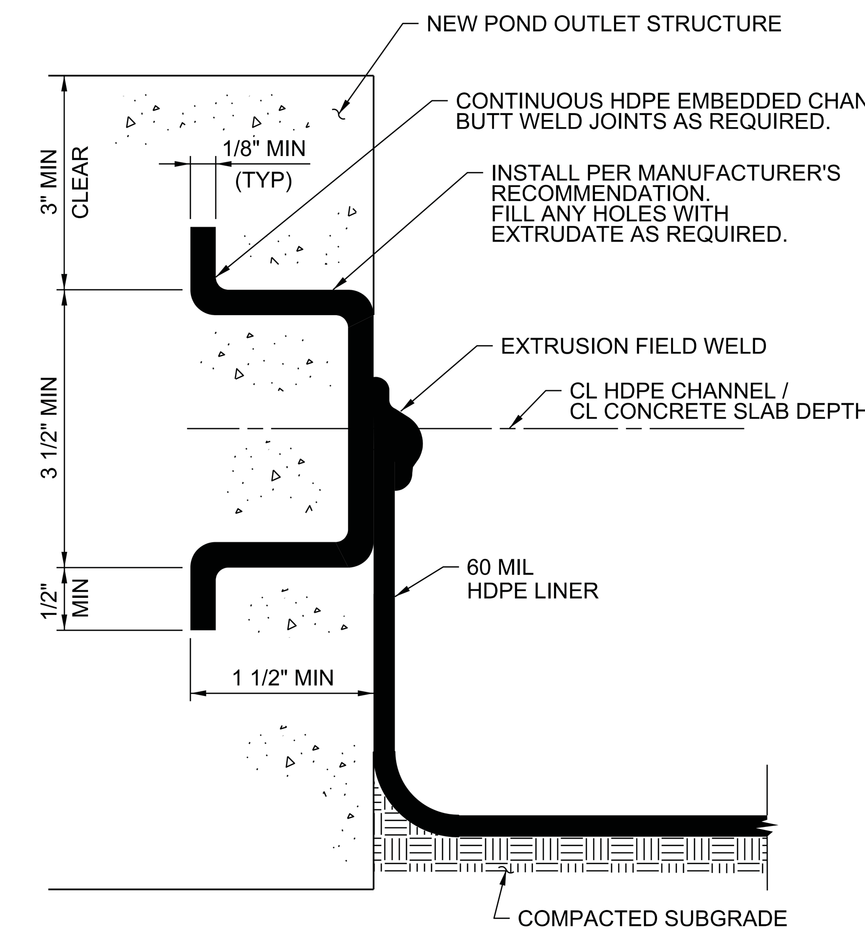
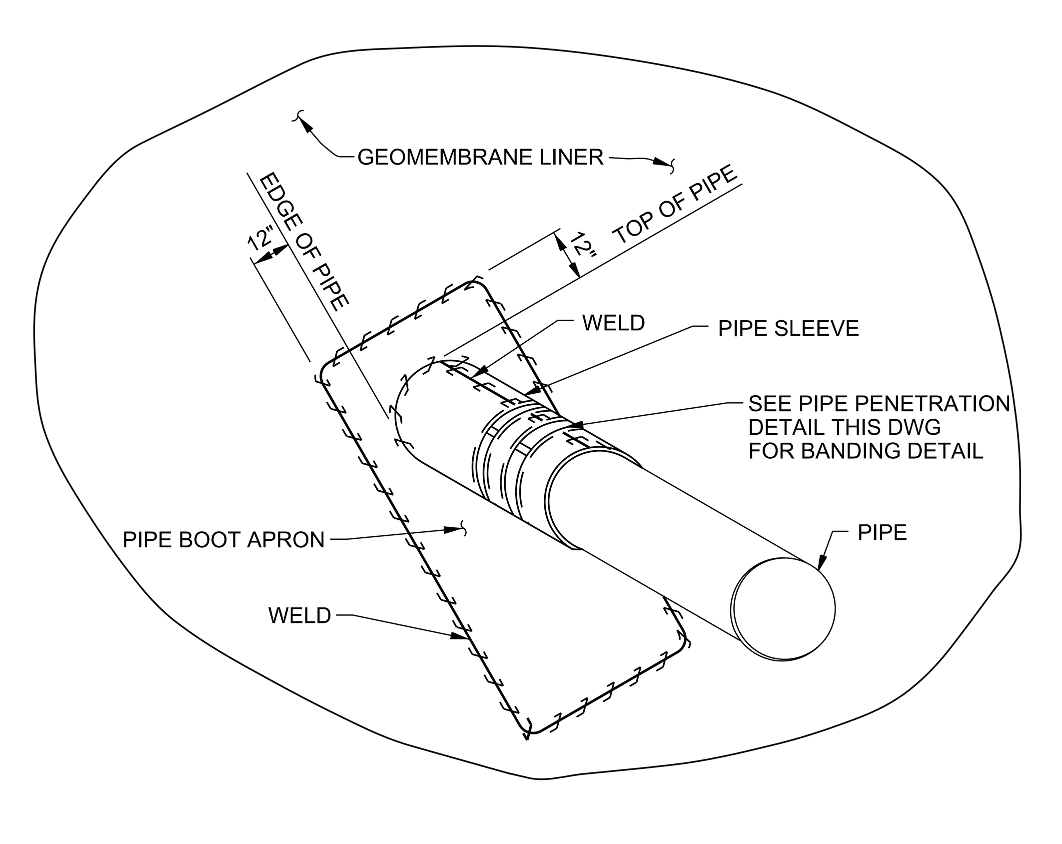


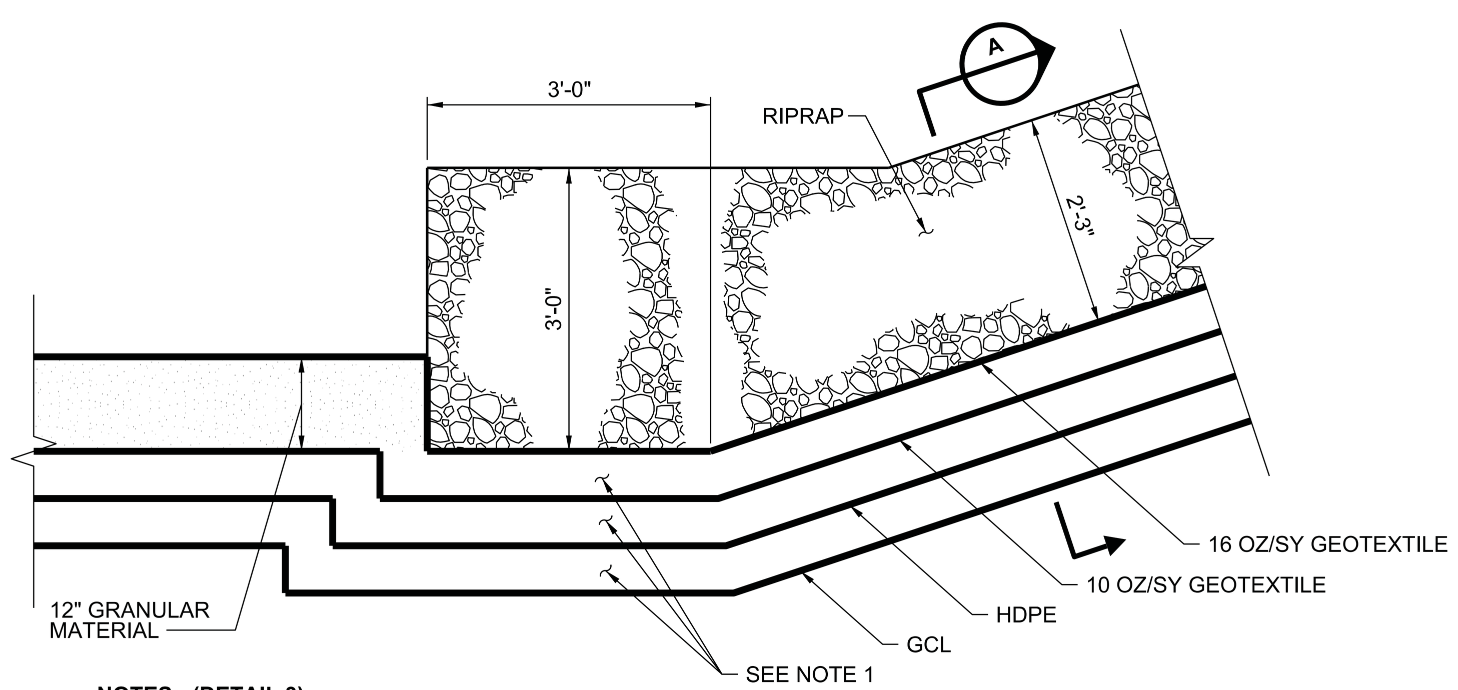
LINER ANCHOR TO NEW CONCRETE STRUCTURE
NOT TO SCALE



NOTES: (PIPE PENETRATION ISOMETRIC)

1. SEE PIPE PENETRATION DETAIL THIS DWG FOR LIMITS OF PIPE SLEEVE.
2. BOOT SHALL BE OF SAME MATERIAL AND THICKNESS AS MAIN GEOMEMBRANE LINER.
3. LINER COVER MATERIAL NOT SHOWN FOR THE SAKE OF CLARITY. SEE PLANS, SECTIONS, AND DETAILS FOR LINER COVER REQUIREMENTS. NO LINER MATERIAL SHALL BE EXPOSED ON THE SLOPE.

PIPE PENETRATION ISOMETRIC
NOT TO SCALE



NOTES: (DETAIL 3)

1. SPACING IS SHOWN FOR CLARITY.

DETAIL (3)
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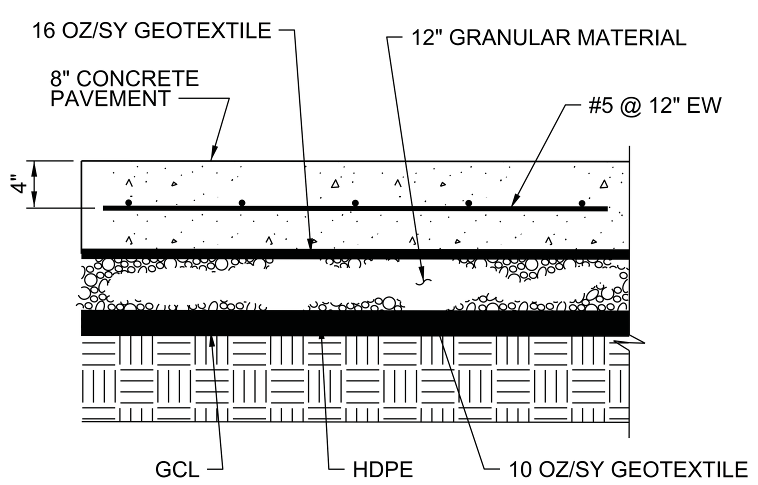

AIR HEATER WASH BASIN CONCRETE PAVEMENT DETAIL
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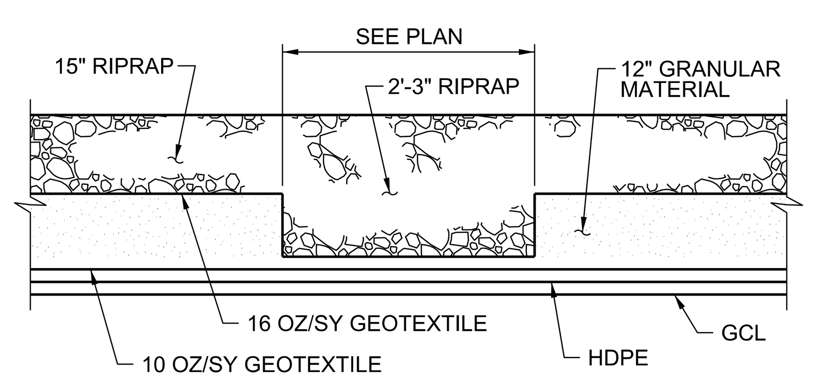

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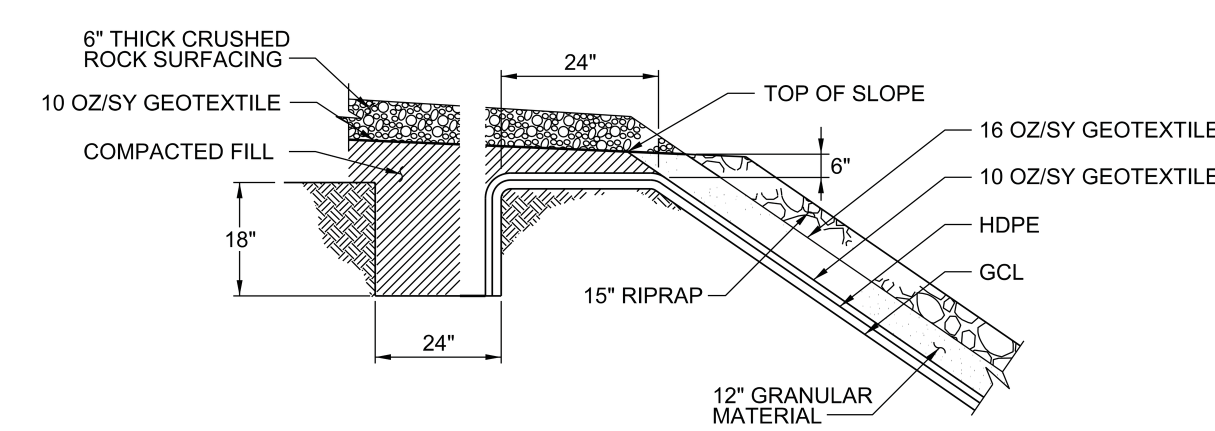

TYPICAL ANCHOR TRENCH DETAIL
NOT TO SCALE

FOR BID - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
0	07/17/20	RNO	ETT	ISSUED FOR BID

no.	date	by	ckd	description

BURNS McDONNELL
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INTERSTATE POWER & LIGHT
OTTUMWA GENERATING STATION
POND CLOSURE AND
WASTEWATER TREATMENT PROJECT
OTTUMWA, IA

LVWTP AND AHWB CONSTRUCTION
FINISH GRADING DETAILS - SHEET 2

project: 110321
contract: 8120
drawing: CG242
rev.: 0
sheet — of — sheets
file 110321CG242.DGN