CCR COMPLIANCE
CLOSURE ALTERNATIVES ANALYSIS REPORT
JOLIET 29 POND 2

Midwest Generation, LLC
Joliet #29 Generating Station
1800 Channahon Road
Joliet, Illinois

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November 8, 2021

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1.0 INTRODUCTION

Midwest Generation, LLC (Midwest Generation) currently operates the natural gas-fired generating station, referred to as Joliet #29 Generating Station, located in Joliet, Illinois ("site" or "generating station"). MWG converted the generating station from coal to natural gas in 2016. As part of the previous coal-fired operations, the station operated two ash ponds (Ponds 1 and 2) and a service water basin (Pond 3). Ponds 1 and 3 are not a CCR surface impoundments. MWG removed all of the coal combustion residuals ("CCR") from Pond 1 and decontaminated the liner before October 2015. Pond 1 is now a low volume wastewater pond.[1] Pond 3 was never a CCR surface impoundment. See Figure 1 for a site map of the facility. Pond 2 was used for CCR management/storage until 2019. In 2019, the CCR was removed and all other portions of the exposed liner have been decontaminated. Because Pond 2 was used as a CCR surface impoundment after October 2015, Pond 2 is regulated as an existing surface impoundment under the newly promulgated Ill. Adm. Code Title 35, Part 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (State CCR Rule). Pond 2 is not currently in service, and no liquids or wastewater is directed into the pond.

In accordance with 35 Illinois Administrative Code Part 845.710(b), a Facility (Owner/Operator) is required to initiate and complete a closure alternatives analysis prior to selecting a final closure method.

This Closure Alternative Analysis is structured to provide the following information:

- The proposed closure alternatives that will be analyzed,
- An analysis of the closure alternatives that meets the requirements set forth in Section 845.710(b)(1) through 845.710(b)(4),
- The results of groundwater contaminant modeling including how the modeled closure alternative will comply with the applicable groundwater protection standards, and
- A description of the fate and transport of contaminants associated with each closure alternative over time, including seasonal variations.

This document presents the results of the closure alternatives analysis for Pond 2 that was completed in accordance with 845.710.

[1] As a low volume wastewater pond, Pond 1 receives wastewater from other sources at the Station except CCR.

2.0 PHYSICAL SITE CONDITIONS

Pond 2 was formally used as a CCR surface impoundment. Pond 2 was constructed with embankments on the south, east, and west sides; the north side is incised. The original ground surface around Pond 2 ranged from 526 ft above mean sea level (amsl) to 535 ft amsl. The west embankment for Pond 2 is topped by the access road that divides Pond 1 from Pond 2 and the west side of the embankment is the outlet side/outlet structure of Pond 1. The original ground surface of the west embankment is approximately 535 ft amsl. The east embankment of Pond 2 is the outlet side/outlet structure of the pond and abuts an access road from Channahon Road that enters the station. The original ground elevation of the east embankment ranged from approximately 530 ft amsl to 536 ft amsl. The as-built elevation of the access road was documented to range from approximately 539 ft amsl to 535 ft amsl, which is equal to or greater than the east embankment crest elevation of 535 ft amsl.

The interior side slopes of Pond 2 were constructed with 3H:1V (horizontal:vertical) slopes, except for the concrete inlet apron which was constructed with slopes of 2H:1V. The exterior side slopes of Pond 2 along the south side were designed at 3H:1V based on the construction drawings. The interior side slopes and bottom of Pond 2 were originally designed with a 1-foot thick Poz-O-Pac liner system when the pond was built in 1978, but the concrete inlet apron does not have the Poz-O-Pac liner. The side slopes also had a bituminous curing coat applied to the Poz-O-Pac liner system. In 2008, Pond 2 was re-lined by removing the existing Poz-O-Pac liner and replacing with a 60-mil high density polyethylene (HDPE) liner topped with a warning layer consisting of 12 inches of sand and 6 inches of limestone screenings.

Pond 2 is approximately 3.2 acres in surface area when measured at the embankment crest. An access road runs along the north, west, and east sides of the pond with abandoned sluice pipes on the south side of the pond.

2.1 Summary of Geology and Hydrogeology

2.1.1 Geology

The physiography of Will County is made up of ground moraines, end moraines, outwash plains, stream terraces, flood plains and bogs. It is in the Till Plaines and Great Lakes Sections of the Central Lowland Province. Near surface soils in the vicinity of the subject impoundment have been grouped as Kankakee Fine Sandy Loam and Romeo Silt Loam. These soils are well to poorly drained, respectively. Organic content ranges from 2 to 5 percent and have a low to negligible accelerated erosion rate, a moderate to high corrosivity rate and a pH range from slightly acidic to slightly basic (5.6 to 8.4). Surface runoff class is low (Soil Survey of Will County Illinois). Based on the Surficial Geology Map of the Chicago Region (ISGS Circular No. 460, 1971) the surficial deposits in the vicinity of the subject surface impoundment are identified as part of the Henry Formation, which is generally described as sand and gravel with local beds of silt and/or exposed Silurian dolomite bedrock.

The general stratigraphy in the area consists of unconsolidated glacial deposits, which overlay Silurian dolomite. The Silurian dolomite is underlain by the Maquoketa Group, which includes the

Scales Shale, which is considered a regional aquitard separating the overlying Silurian dolomite from the deeper Cambro-Ordovician sandstone and limestone aquifers. To evaluate local stratigraphy and as part of groundwater model development in support of the Construction Permit being submitted under separate cover, water and test well logs were obtained for wells in the general vicinity of the Joliet #29 Generation Station (it is noted that all of these wells are upgradient or side gradient of the Station and two wells on property [see Section 2.1.1]). The depths of these wells range from 43 feet to 605 feet. The well logs were also used from the 11 monitoring wells that were installed in the vicinity of Pond 2 (MW-1 through MW-11) with those borings ranging in depth from 27.5 feet to 41 feet. See Figure 1 for the monitoring wells locations. Based on an evaluation of this data, the following general site-specific stratigraphy is defined:

- Fill (approx. 0' to 8.5' thick) – Consisting of a thin layer of top soil and/or coarse gravel fill.

- Silty clay to clay (approx. 0' – 15' thick) – Consisting of black/brown silty clay and clay with a trace of coarse gravel or sand. Not continuous across site along east-west transect.

- Sand and Gravel (approx. 14' to 40' thick) – Consisting of black/brown fine to coarse sand and gravel with limestone fragments noted throughout. May locally include some lenses or interlayering of black silty clay and/or tan silty sand.

- Sandy silt/silty clay (approx. 0' to 34' thick) – Consisting of black/gray sandy silt grading downward to a gray silty clay with coarse sand. Not continuous across site.

- Bedrock – Consisting of Silurian dolomite – Top of unit encountered at approximately 38.5 feet below ground surface (bgs) at boring location MW-6. Borings noted with increased limestone fragment at base interpreted to be at or near top of weathered bedrock surface. Description of the dolomite discussed in detail below.

Although no specific borings were extended into the dolomite bedrock at this facility, extensive drilling and investigation of the bedrock was completed at the Joliet #9 Station, Lincoln Stone Quarry facility immediately to the south of the Des Plaines River from the subject site. The Silurian dolomite formation is generally consistent regionally, especially over fairly short distances. Based on that work, the following additional bedrock information is provided.

The Silurian dolomite is divided into four units identified as a weathered bedrock rind, Joliet Formation dolomite, Kankakee Formation dolomite and the Elwood/Wilhelmi dolomite. Beneath the Silurian dolomite is the Ordovician age Maquoketa Group consisting of the Brainerd Shale, Fort Atkinson dolomite and the Scales Shale. Although the Brainerd Shale was identified at the above referenced Lincoln Stone Quarry facility with a thickness of approximately 10 feet, this unit is not necessarily regionally continuous; therefore, it may or may not be present beneath the subject site. The Scales Shale unit, however, is extensive and is a recognized regional aquitard, which hydraulically isolates the deeper bedrock aquifers from the shallower Silurian dolomite. Based on the available information, the dolomite bedrock thickness to the top of the Scales Shale beneath the Joliet #29 site is estimated to be 95 to 115 feet.

Regional and local studies and investigations document fractures in the Silurian dolomite describing a primary joint set that is vertical and oriented about N52ºE and N40ºW. The N40ºW joints are described as "more distinct". Natural spacing between the joint sets ranges from 3 to more than 10 feet, and joint apertures are described as less than 1/16th -inch. Bedding plane fractures are also described. Descriptions from various bedrock quarry walls and from cores obtained during drilling at the Lincoln Stone Quarry site show significant clay infilling of the vertical joints and bedding plane fractures. Evidence of water movement through fractures is interpreted from iron staining and mineralization (primarily calcite, with some pyrite and marcasite).

Silurian dolomite is a calcium-magnesium carbonate rock that includes horizons of cherty (silica) nodules and is documented both regionally and locally to include mineralization along fractures and within vugs. The mineralization includes, but is not limited to calcite (calcium carbonate) and various sulfide minerals such as pyrite, marcasite, etc. As such, the presence of these minerals and associated weathering products can also be expected within the overlying unconsolidated materials.

2.1.2 Hydrogeology

Based on information from the Soil Survey of Will County, the average annual precipitation is approximately 37 inches with about 63% of that total falling between April and October of any given year. The average seasonal snowfall is approximately just over 10 inches.

The nearest surface water body is the facility intake channel and Des Plaines River located to the south of the subject CCR unit (see Figure 1). This reach of river is further identified as the Lower Des Plaines River, which starts upstream of the site at the confluence of the river with the Chicago Ship and Sanitary Canal (CSSC) at the E.J. & E railroad bridge (river mile 290.1). The CSSC is the main tributary to this segment of river contributing approximately 80% of the flow to the river. The segment of river adjacent to the subject site is part of the Dresden Island Pool, which starts at the Brandon Road Lock and Dam (river mile 286) which is immediately upstream of the subject CCR surface impoundment. The Dresden Island Pool is 14 miles in length, approximately 800 feet wide with depth varying between 2 to 15 feet (Lower Des Plaines River Use Attainability Analysis Final Report, IEPA, December 2003). There are no drinking water intakes within the Dresden Island Pool and for that matter on any portion of the Des Plaines River downstream of the site (Meet Your Water – An Introduction to Understanding Drinking Water in Northeastern Illinois, Metropolitan Planning Council, 2017).

Groundwater beneath the subject unit occurs under water table conditions. Saturated conditions are generally encountered between 25 and 35 feet bgs, depending on the well location, within the lower portion of the above-defined sand and gravel unit. Some potential temporal fluctuations with the highest water levels generally occur within the second or third quarters of the year.

Previous site investigations have shown that groundwater flow is in a southerly direction towards the associated facility water intake channel and the Des Plaines River. The horizontal hydraulic gradient is fairly shallow.

As part of the modeling study being completed for the Construction Permit application, the hydraulic conductivity in monitoring wells MW-4, MW-6, and MW-9 were calculated. The geometric mean of the test data for these wells was calculated to be approximately 170 ft/d (1.97 x 10^{-3} ft/sec) for each well. The estimated effective porosity of the aquifer materials (0.35) was obtained from literature (Applied Hydrogeology, Fetter, 1980).

At this time, based on the geology discussion in Section 2.1.1 and the site-specific hydrogeology discussions above, the groundwater beneath the CCR surface impoundment is considered as Class I Potable Resource Groundwater in accordance with Section 620.210. It is noted, however, that a Groundwater Management Zone (GMZ) has been established in the vicinity of Pond 2 in accordance with Section 620.250 as part of a Compliance Commitment Agreement (CCA) between Midwest Generation and Illinois EPA. In general, the GMZ encompasses the area occupied by Pond 1, Pond 2, and Pond 3 in the east-west direction and from Channahon Road/Route 6 to the Intake Channel in the north-south direction.

A survey of all potable water sources within a 2,500 feet radius of the Midwest Generation Joliet #29 Generating Station was completed by Natural Resources Technology (NRT) in 2009. As part of the operating permit preparation, KPRG evaluated the NRT information and reviewed the new Illinois State Geological Survey database and interactive map references as "ILWATER". Fifteen potable/industrial use wells are within a 2,500-foot radius of the Station's Pond 2. There are no wells directly downgradient of Pond 2. Eight of the wells are located 1,500 to 2,500 feet north and northwest of Pond 2 (upgradient). Two wells, both owned by Midwest Generation, which service the Station, are located to the west and southwest (sidegradient). Both of these wells are greater than 1,500 feet deep and screened within the Cambro-Ordovician limestones/sandstones beneath the Maquoketa Shale. There are several wells south of the Des Plaines River, a hydrogeologic discharge boundary, which service the Joliet #9 Generating Station all of which are also greater than 1,500 feet deep. The well that is located within the Des Plaines River (well 00563) is incorrectly located within the ILWATER database and is actually part of the Olin Chemical operations located approximately 0.3 miles to the south.

A search of the Illinois Department of Natural Resources dedicated nature preserve database (https://www2.illinois.gov/dnr/INPC/Pages/NaturePreserveDirectory.aspx) was performed to determine whether there may be a dedicated nature preserve nearby. No dedicated nature preserves were identified in the vicinity of Pond 2.

Based on the geology of the site presented in Section 2.1.1 and the above hydrogeology discussions, the primary contaminant migration pathway for a potential release from Pond 2 would be downward migration to groundwater within the unconsolidated sand and gravel aquifer. Due to its proximity to the facility intake channel and Des Plaines River, which is a hydrogeologic flow boundary, minimal to no downward vertical flow mixing would be anticipated within the aquifer. There are no other utility or man-made preferential pathway corridors that would act to potentially intercept the flow to move any contamination in a direction other than to the south. There are no potable water wells downgradient of the subject CCR surface impoundment screened within the aquifer of concern. Also, as previously discussed, there are no potable surface water intakes on the Des Plaines River either along or downstream of the station and Pond 2.

There is quarterly groundwater quality data associated with Pond 2 and the two other ponds in the area dating back to December 2011 associated with an Illinois EPA request for evaluation of potential ash pond groundwater impacts and subsequently the negotiated CCA. However, that Illinois EPA required parameter list was slightly different from that specified in Section 845.600 and included analysis of dissolved inorganic parameters rather than total inorganic parameters.

Pond 2 is subject to the federal requirements under Federal Register, Environmental Protection Agency, 40 CFR Parts 257.94, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule dated April 17, 2015 (Federal CCR Rule). As required under the Federal CCR Rule, eight rounds of background sampling were completed for the monitoring wells within the monitoring network for Pond 2 (MW-3 through MW-5 and MW-10). This included the full list of Appendix III (detection monitoring) and IV (assessment monitoring) parameters. Subsequently, quarterly groundwater monitoring of these wells was continued for only Appendix III detection monitoring parameters since there were no detections of Appendix III parameters above the established statistical background for those wells. Since the effective date of the new State CCR Rule, quarterly groundwater monitoring for the full list of parameters specified in 845.600, which includes all parameters in the Federal CCR Rule Appendix III/IV, has continued. This data is provided in Table 1 and Table 2.

3.0 IDENTIFICATION OF CLOSURE ALTERNATIVES

As stated in the Introduction, the CCR in Pond 2 was removed in the summer/fall of 2019 as part of converting the generating station to burning natural gas. The removal of the CCR was done in accordance with the requirements for clean closure in the Federal CCR Rule, 257.102(c), by removing the CCR down to the warning layer, cleaning and repairing, as needed, the existing geomembrane liner and decontaminating any areas of Pond 2 as needed. As indicated in Tables 1 and 2 and as stated at the end of the previous section, the groundwater monitoring results indicate that groundwater impacts are not present from Pond 2 and it has been closed by CCR removal in accordance with the Federal CCR Rule.

As part of the above-described closure, the warning layer was left in place. The closure by removal requirements in the new State CCR Rule Section 845.740 require the removal of CCR, the removal of containment system components such as the impoundment liner and contaminated subsoils, and impoundment structures and ancillary equipment. Based on a review of the closure by removal in accordance with the Federal CCR Rule and the requirements of closure by removal in the State CCR Rule Section 845.740, additional closure activities may be required for Pond 2 to comply with the State CCR Rule Section 845.740 closure by removal standards. On May 11, 2021, MWG filed a petition for an adjusted standard to reuse the liner in the pond, instead of the complete removal as required by Section 845.740. *In the Matter of: Midwest Generation LLC's Petition for Adjusted Standard*, PCB AS21-001. The Illinois EPA's recommendation in response to MWG's petition is due on November 22, 2021. A brief description of each closure alternative is presented below, including alternatives if the Board grants MWG's petition for an adjusted standard.

3.1 Complete Closure by Removal in Accordance with Section 845.740 and the Adjusted Standard Petition

The CCR has already been removed from Pond 2 and all that remains is the warning layer atop the base of the geomembrane liner, and the geomembrane liner on the base and side slopes. MWG filed a petition for an adjusted standard to allow it to decontaminate the liner instead of removal. If the Board grants MWG's petition, MWG would remove the warning layer and decontaminate the liner. The warning layer consists of 12 inches of sand topped with 6 inches of limestone screenings. The warning layer and sand total approximately 3,700 cubic yards (CY) which would be hauled and disposed at an off-site landfill. If MWG is not granted its petition for an adjusted standard, then it will also remove approximately 70,000 square feet of the geomembrane liner on the base and sides. Once the liner is removed, the subsurface will be visually examined for CCR impacts. The geomembrane liner will be cut into pieces and placed in either roll-off boxes for disposal or taken to the landfill for disposal along with the warning layer.

The estimated quantity of warning layer material that would require excavation, transportation, and hauling is 4,810 CY. This quantity is based on the in-place quantity of 3,700 CY swelling by approximately 30% once it is excavated and loaded for transportation. A more detailed discussion of this closure alternative relative to established evaluation criteria is provided in Section 4.0. Detailed cost estimates in accordance with Section 845.710(d)(1) are provided in Table 4.

Based on the location of Pond 2 and the limited remaining quantity of material to be removed, the only practical transportation option would be typical dump trucks or lower emission trucks. Pond 2 is close to the Des Plaines River, but no slip or loading point for a barge exists. A loading point could be constructed, but a structural evaluation of the bank would be required. In addition, the time required for permitting and loading onto a barge this limited quantity of material is not practical. Using rail to move such a small quantity of material also makes this mode of moving material impracticable to try and permit and construct.

An on-site landfill is not present at the Joliet 29 generating station and due to the time required for permitting, constructing an on-site landfill would be impractical for this limited quantity of material. Lincoln Stone Quarry (LSQ) is located just over a mile away on the south side of the river. All ash previously removed from Pond 2 was transported to and placed into the LSQ. The LSQ has not yet undergone closure and but because the LSQ is a monofil landfill permitted only for CCR, it is unlikely that it could be used to dispose of the warning layer or the liner. Accordingly, off-site disposal will need to be at the Prairie View Recycling & Disposal Facility landfill in Wilmington, Illinois which would be the closest facility that is currently not within an environmental justice area.

3.2 Closure in Place with a Final Cover System

The closure in place with a final cover system (FCS) alternative would consist of leaving the warning layer in place, placing additional fill material in Pond 2, and covering that material with a final cover system in accordance with 845.750. The final cover system would consist of a geomembrane low permeability layer, which is topped with an alternative final protective layer that provides equivalent performance to a soil final protective layer. The FCS would be sloped to allow for precipitation to runoff and drain into the existing Pond 2 discharge structure, which ultimately discharges into Pond 3. The water from Pond 3 is either re-used as part of the electrical generating process or discharged to the Des Plaines River through the permitted outfall in compliance with the existing NPDES permit.

The FCS product that would be used is the proprietary ClosureTurf cover system created by Watershed Geo. The ClosureTurf FCS consists of a geomembrane low permeability layer that also incorporates a drainage layer. The final protective layer is replaced with engineered synthetic turf that is infilled with sand/small aggregate to provide ballast to the synthetic turf. The infiltration layer will be a 60-mil HDPE geomembrane with a hydraulic conductivity that is no greater than $1x10^{-7}$ cm/sec. The engineered synthetic turf is comprised of polyethylene fibers that are tufted through a double layer of woven geotextiles that are highly UV and heat resistant. The engineered synthetic turf is then infilled with small aggregate that is approximately 1/8 inch to 1/4 inch diameter in size. The small aggregate is brushed into the synthetic turf to ensure that it settles to the bottom of the turf, which provides ballast and prevents the turf's movement during wind events.

Pond 2 has a crest embankment elevation that ranges between 534 and 535 ft amsl, a bottom elevation between 516 and 517 ft amsl, and the discharge structure has a weir elevation of approximately 532.85 ft amsl. Based on these elevations, Pond 2 is approximately 18 feet to 19 feet deep and if the FCS were to be placed directly on the warning layer, precipitation would accumulate unless the water was collected and mechanically removed. Adding fill material also prevents the need to mechanically evacuate the water from within Pond 2. In order to place the

FCS and prevent the accumulation of precipitation, Pond 2 will need fill material to be placed from the top of the warning layer up to the same elevation as the discharge structure weir elevation, which is 532.85 ft amsl. Approximately 69,300 CY of fill material is required. From this point, the surface would be sloped up towards the inlet structure of Pond 2 so water drains from the west towards the east and discharges into the discharge structure. The ClosureTurf FCS would then be placed on top of the sloped surface with the geomembrane being attached to the discharge structure, the synthetic turf placed on top of the geomembrane, and the turf infilled with sand/small aggregate. The surface of the final protective layer will be sloped towards the Pond 2 discharge structure to allow for drainage.

The soils used in the FCS will consist of clean material sourced from as close to Pond 2 as possible. Because of the quantity needed, multiple soil sources may be required. A discussion of this closure alternative option relative to established evaluation criteria is provided in Section 4.0.

4.0 CLOSURE ALTERNATIVES EVALUATION CRITERIA

The closure alternatives were evaluated based on requirements under State CCR Rule Part 845.710(b)(1) through 845.710(b)(4). The evaluation criteria consisted of the following:

- Long- and short-term effectiveness and protectiveness, including reliability;
- Effectiveness of controlling future releases;
- Ease or difficulty of Implementation; and
- The degree to which concerns of the community residents are addressed.

Each closure alternative was evaluated using the above criteria and that evaluation is provided in Table 3. The following highlights are provided from that evaluation. Groundwater modeling was performed in accordance with 845.710(d)(2) and 845.710(d)(3) to assist in evaluating the long- and short-term effectiveness of each closure alternative. A discussion of the groundwater modeling and the results are presented in Section 5.

Closure by Removal - Warning Layer Removal for Pond Re-use

- Assuming MWG is granted the petition for an adjusted standard, removing the warning layer from Pond 2 would require excavating and hauling 4,810 cubic yards, which would take about 7 days to execute based on 50 truckloads per day and 15 cubic yards per truck.

- Removing the warning layer would remove any remaining de minimis amounts of the CCR source. Groundwater monitoring has shown that impacts to groundwater are not present and any elevated constituents that have been detected in the groundwater are not from Pond 2. Removing the warning layer will not cause any adverse site impacts.

- Reuse of the liner would reduce the volume of material disposed at a landfill, and also reduce the number of trucks required to haul away the waste liner.

- Additionally, the truck traffic removing the CCR will not negatively affect the neighboring properties, including air quality and noise pollution, since the entrance and egress for the trucking would be directly via Channahon Road and not through any residential neighborhood.

- This option will require 3 years of post-closure monitoring.

Closure in Place - ClosureTurf Final Cover System

- ClosureTurf has successfully been used around the country to close CCR surface impoundments and landfills.

- The ClosureTurf final cover will require approximately 69,000 CY of clean fill material and more overall truck traffic to and from the site because Pond 2 has to be filled. It will require approximately 93 days to fill Pond 2 based on 50 truckloads per day and 15 CY per truck.

- The ClosureTurf and soil infill will cover any de minimis CCR on the surface of the warning layer and prevent any human or animal contact.

- The ClosureTurf option will require 30 years of post-closure monitoring.

- The existing CCR source has already been removed; therefore, future impacts to groundwater will not occur relative to a potential release from the unit (i.e., there is no source to result in a release). The existing geomembrane liner has shown to be effective, and the groundwater monitoring data has proven the geomembrane's reliability.

5.0 GROUNDWATER MODELING

This section discusses the results of the groundwater modeling and a description of the fate and transport of each closure alternative over time in accordance with 845.710(d)(2) and 845.710(d)(3). The CCR source material has already been removed, therefore the modeling that was conducted is based on a theoretical distribution of dissolved contaminants beneath Pond 2, assuming a source at the pond, to demonstrate the impact of removing the CCR source on the spread of contaminants.

To conduct the support modeling a theoretical unit source with a concentration of "1" was established beneath Pond 2 and projected forward in time with advection and dispersion to establish an equilibrated distribution of contaminants in groundwater if Pond 2 were the source. The future predictive modeling runs indicated that after approximately 30 years, equilibrated contaminant mass distribution was established. The equilibrated distribution (base case) of the mass was then used as the initial concentrations in the groundwater for model runs to simulate the closure alternatives to evaluate corresponding improvement in groundwater quality from the base case scenario. From this initial equilibrated model run, the source was removed and the change in concentrations were modeled over 5-years, 25-years, 50-years, and 100-years; these model runs are shown in Figures 1 through 4 located in Attachment 1. On each figure the base case run is illustrated on the left side and the CCR removal scenario is illustrated on the right side. Reviewing Figure 2, which projects out 25-years indicates that groundwater impacts near the river have been reduced by approximately 50% (projected concentration of 0.5 which is half the starting theoretical concentration of 1). The 50-year and 100-year projections on Figures 3 and 4 indicated reductions in groundwater impacts by at least 90% (projected concentration of 0.1 which is 90% less than starting hypothetical concentration of 1). Figure 5 illustrates the above noted reduction in concentrations over time at a modeling point location near the river and shows that the initial, theoretical concentrations are reduced by approximately 90 percent within about 30 years at which point a relative equilibrium has been reached.

As further required by the State CCR Rule, seasonal fluctuations of the groundwater system were considered. To estimate the potential impacts on contaminant migration under a seasonally varying groundwater flow system, a 100-year transient flow model was simulated with alternating periods of higher and lower recharge to groundwater. The flow model simulated 5 months of higher recharge (April through August) and 7 months of lower recharge (September through March), reflecting trends in the long-term average monthly precipitation records. The initial equilibrated contaminant distribution again served as the starting conditions, the theoretical source was removed, and the concentrations were modeled with advection and dispersion. The results of this modeling are illustrated on Figure 6. As shown on Figure 6 and taking into account seasonal variations, the concentrations from the initial theoretical source are reduced to less than 0.1 (greater than 90%).

As demonstrated in the modeling runs, the removal of the CCR source reduces associated theoretical groundwater impacts in excess of 90% from a base case release scenario. These modeling runs are used as part of evaluating the long- and short-term effectiveness of each closure option, as shown in Table 3.

6.0 SUMMARY

Two closure options were evaluated as part of the closure alternatives analysis for closure of Pond 2 in accordance with 845.710(b). The two options evaluated are closure by removal and closure with the ClosureTurf FCS. The options were evaluated based on effectiveness/protectiveness, ease of implementation, and addressing the concerns of the community residents.

Closure by removal would require the excavation, transportation, and disposal of 4,810 CY of warning layer material and take approximately 7 days to complete. Once the warning layer is removed, the new geomembrane liner would be tested before Pond 2 is re-used. Once this portion of closure by removal is complete, groundwater monitoring in accordance 845.600 would occur for three (3) years.

The ClosureTurf FCS option requires filling Pond 2 and constructing the FCS on this fill material. The ClosureTurf FCS option would require Pond 2 to be filled with approximately 69,300 CY of additional material in order to bring the grade up to the proper elevation to allow precipitation to gravity flow off the FCS. The ClosureTurf system would then be placed on top of the fill material that is sloped towards Pond 2's existing discharge structure. This option would take approximately 93 days to complete and groundwater monitoring in accordance with 845.600 would occur for thirty (30) years.

The closure by removal option requires less overall truck traffic compared to the ClosureTurf FCS and less overall work time to complete. Because of the less time and overall work to excavate the warning layer, KPRG recommends closure by removal.

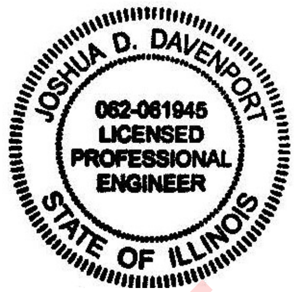
7.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This closure alternatives analysis has been prepared in accordance with 35 Ill. Adm. Code 845.710.

11/8/2021

Joshua D. Davenport, P.E.
Illinois Professional Engineer

SEAL



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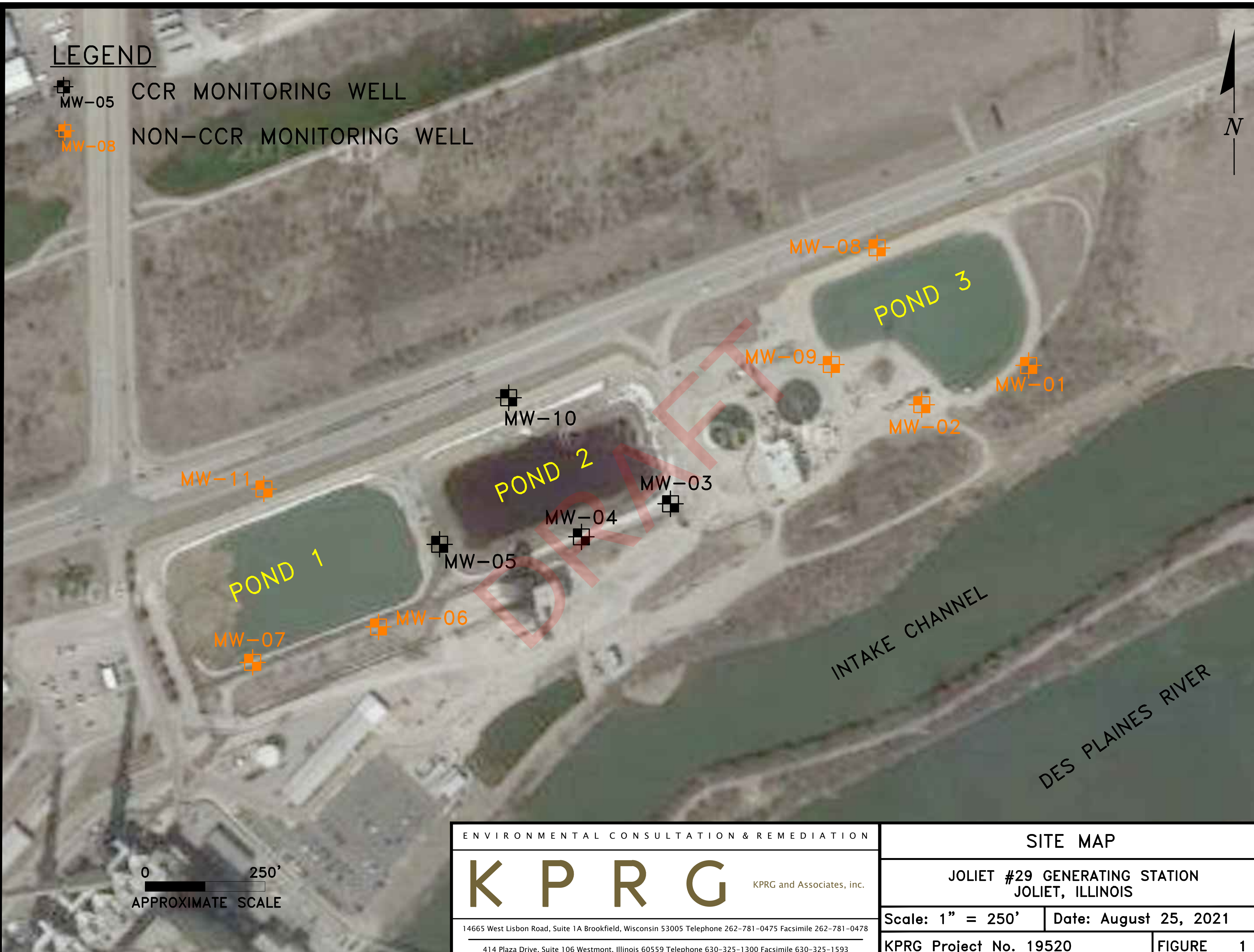
FIGURES



ENVIRONMENTAL CONSULTATION & REMEDIATION

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SITE MAP	
JOLIET #29 GENERATING STATION JOLIET, ILLINOIS	
Scale: 1" = 250'	Date: August 25, 2021
KPRG Project No. 19520	FIGURE 1

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TABLES

Table 1. Appendix III Analytical Groundwater Results through July 2021

Well	Date	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
MW-10 up-gradient	10/28/2015	0.47	100	200	0.41	7.04	84	790
	2/10/2016	0.41	100	210	0.44	7.17	120	820
	5/12/2016	0.29	100	300	0.42	7.02	110	920
	8/31/2016	0.36	89	170	0.46	6.95	100	760
	11/2/2016	0.48	100	130	0.45	6.99	95	720
	2/6/2017	0.44	120	190	0.36	6.99	88	820
	4/26/2017	0.35	120	200	0.35	7.27	87	760
	6/14/2017	0.29	91	160	0.43	7.47	75	690
	Pred. Limit*	**0.57**	**131**	**318**	**0.51**	**7.56-6.67**	**131**	**959**
	8/2/2017	0.45	97	170	0.38	7.23	110	750
	10/18/2017	**0.61**	120	140	0.41	7.11	130	820
	4/24/2018	0.4	110	260	0.39	7.28	120	910
	10/17/2018	**0.63**	120	180	0.42	7.30	110	810
	11/24/2018 R	0.44	NA	NA	NA	NA	NA	NA
	5/7/2019	0.56	130	**410**	0.39	7.17	95	**1,000**
	7/3/2019 R	NA	NA	230	NA	NA	NA	830
	11/7/2019	0.35	90	130	0.36	7.40	59	650
	5/20/2020	**0.85**	120	250	0.41	6.90	100	**960**
	6/11/2020 R	0.26	NA	NA	NA	NA	NA	770
	10/22/2020	0.34	110	230	0.41	7.11	93	850
	5/18/2021	0.33	**140**	**350**	0.39	7.16	**210**	**1,200**
	6/29/2021 R	NA	**160**	**420**	NA	NA	**190**	**1,300**
MW-03 down-gradient	10/28/2015	0.34	110	230	0.41	7.11	110	960
	2/10/2016	0.49	100	220	0.44	7.31	130	790
	5/10/2016	0.48	95	240	0.44	7.07	130	800
	8/31/2016	0.49	100	250	0.45	7.18	120	920
	11/2/2016	0.34	87	190	0.44	7.45	94	780
	2/6/2017	0.40	97	140	0.39	7.35	77	720
	4/26/2017	0.54	100	210	0.36	7.03	120	820
	6/14/2017	0.45	88	190	0.44	7.48	75	760
	Pred. Limit	**0.57**	**131**	**316**	**0.51**	**7.56-6.67**	**130**	**956**
	8/2/2017	0.41	99	200	0.40	7.34	110	850
	10/18/2017	0.35	93	160	0.42	7.11	100	850
	4/24/2018	0.52	100	220	0.42	7.2	**150**	930
	7/31/2018 R	NA	NA	NA	NA	NA	110	NA
	10/17/2018	0.25	100	250	0.4	7.04	110	870
	5/7/2019	0.43	120	280	0.4	7.27	**140**	880
	7/3/2019 R	NA	NA	NA	NA	NA	65	NA
	11/7/2019	0.34	100	150	0.4	7.32	65	660
	5/20/2020	0.38	100	230	0.42	7.56	78	**960**
	6/11/2020 R	NA	NA	NA	NA	NA	NA	930
	10/22/2020	0.32	110	180	0.43	7.23	90	770
	5/18/2021	0.28	130	290	0.4	7.13	**190**	**1,200**
	6/29/2021 R	NA	NA	NA	NA	NA	**210**	**1,300**
MW-04 down-gradient	10/28/2015	0.34	94	F1 200	0.45	7.07	83	740
	2/10/2016	0.32	97	210	0.47	7.22	140	810
	5/10/2016	0.47	100	260	0.46	6.71	150	900
	8/31/2016	0.42	100	210	0.45	7.07	120	890
	11/2/2016	0.32	98	160	0.43	7.25	83	750
	2/6/2017	0.40	110	200	0.37	7.19	98	790
	4/26/2017	0.33	100	220	0.37	7.46	89	770
	6/14/2017	0.37	92	190	0.47	7.43	80	770
	Pred. Limit	**0.57**	**131**	**316**	**0.51**	**7.56-6.67**	**130**	**956**
	8/2/2017	0.35	93	180	0.43	7.41	100	770
	10/18/2017	0.54	97	140	0.45	7.2	120	790
	4/24/2018	0.4	110	240	0.43	7.21	**160**	940
	7/31/2018 R	NA	NA	NA	NA	NA	120	NA
	10/17/2018	0.29	100	230	0.45	7.2	130	840
	5/7/2019	**0.76**	120	**340**	0.42	7.27	120	**1,000**
	7/3/2019 R	0.23	NA	250	NA	NA	NA	870
	11/6/2019	0.3	77	140	0.41	7.33	53	670
	5/20/2020	**0.79**	110	250	0.45	7.3	110	**1,100**
	6/11/2020 R	0.28	NA	NA	NA	NA	NA	850
	10/22/2020	0.33	100	190	0.48	7.15	83	770
	5/18/2021	0.22	120	280	0.42	7.3	**190**	**1,100**
	6/29/2021 R	NA	NA	NA	NA	NA	**190**	**1,200**
MW-05 down-gradient	10/28/2015	0.64	100	160	0.39	7.12	120	790
	2/10/2016	0.46	110	220	0.39	7.25	120	790
	5/10/2016	0.8	150	220	0.46	6.88	290	950
	8/31/2016	1.0	140	99	0.56	6.81	260	820
	11/2/2016	0.41	98	130	0.37	7.26	100	700
	2/6/2017	0.48	150	180	0.30	7.22	120	790
	4/26/2017	0.67	110	F1 190	0.37	7.28	170	770
	6/14/2017	0.44	75	150	0.46	7.45	110	670
	Pred. Limit	**0.57**	**131**	**316**	**0.51**	**7.56-6.67**	**130**	**956**
	8/2/2017	0.28	83	170	0.35	7.30	99	770
	10/18/2017	0.42	110	110	0.38	7.16	95	720
	4/24/2018	0.31	110	300	0.34	7.33	130	**1,000**
	7/31/2018 R	NA	NA	NA	NA	NA	NA	940
	10/17/2018	0.31	110	210	0.36	7.29	93	810
	5/6/2019	0.38	130	**500**	0.31	7.11	84	**1,300**
	7/3/2019 R	NA	NA	150	NA	NA	NA	890
	11/7/2019	0.31	**180**	130	0.3	7.44	64	590
	12/4/2019 R	NA	89	NA	NA	NA	NA	NA
	5/20/2020	0.32	100	270	0.37	7.03	67	890
	10/22/2020	0.52	92	180	0.38	7.16	85	720
	5/18/2021	0.37	130	**410**	0.3	7.00	**160**	**1,300**
	6/29/2021 R	NA	NA	**430**	NA	NA	**150**	**1,300**

Notes: All units are in mg/l except pH is in standard units.
* - Intrawell Prediction Limit. All others are interwell comparisons with MW-10 as background..
Bold - Potential statistically significant increase.
F1 - MS and/or MSD Recovery outside of limits.
Pred. Limit - Prediction Limit
Italics Date - First round of Detection Monitoring and resample after statistical background establishment.
NA - Not analyzed. No confirmation resample required.
R - Resample

Table 2. Appendix IV Analytical Groundwater Results through July 2021

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226 + 228 Combined	Selenium	Thallium
Federal MCLs		0.006	0.01	2.0	0.004	0.005	0.01	NS	4.0	NS	NS	0.002	NS	5.0 pCi/L	0.05	0.002
State Standards		0.006	0.01	2.0	0.004	0.005	0.01	1.0	4.0	0.0075	NS	0.002	NS	40 pCi/L	0.05	0.002
MW-10 up-gradient	10/28/2015	< 0.003	< 0.001	0.041	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.41	< 0.0005	0.013	< 0.0002	0.0060	0.2981	< 0.0025	< 0.002
	2/10/2016	< 0.003	0.001	0.043	< 0.001	< 0.0005	< 0.005	< 0.001	0.44	< 0.0005	0.011	< 0.0002	0.0067	< 0.438	< 0.0025	< 0.002
	5/12/2016	< 0.003	< 0.001	0.046	< 0.001	< 0.0005	< 0.005	< 0.001	0.42	< 0.0005	0.012	< 0.0002	0.0051	< 0.414	< 0.0025	< 0.002
	8/31/2016	< 0.003	< 0.001	0.039	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.46	< 0.0005	0.010	< 0.0002	0.0077	< 0.394	< 0.0025	< 0.002
	11/2/2016	< 0.003	0.0018	0.035	< 0.001	< 0.0005	< 0.005	< 0.001	0.45	0.0014	0.011	< 0.0002	0.0061	0.626	< 0.0025	< 0.002
	2/6/2017	< 0.003	0.0011	0.048	< 0.001	< 0.0005	< 0.005	< 0.001	0.36	0.00086	0.014	< 0.0002	0.0056	< 0.389	< 0.0025	< 0.002
	4/26/2017	< 0.003	0.0015	0.046	< 0.001	< 0.0005	< 0.005	< 0.001	0.35	0.0012	< 0.01	< 0.0002	0.006	< 0.34	< 0.0025	< 0.002
	6/14/2017	< 0.003	< 0.001	0.034	< 0.001	< 0.0005	< 0.005	< 0.001	0.43	< 0.0005	0.012	< 0.0002	0.0072	< 0.356	< 0.0025	< 0.002
	8/2/2017	< 0.003	0.0011	0.036	< 0.001	< 0.0005	< 0.005	< 0.001	0.38	< 0.0005	0.011	< 0.0002	0.0079	0.429	< 0.0025	< 0.002
	10/18/2017	< 0.003	0.0012	0.04	< ^ 0.001	< 0.0005	< 0.005	< 0.001	0.41	0.00059	0.013	< 0.0002	0.0066	< 0.422	< 0.0025	< ^ 0.002
	Average	**< 0.003**	**0.0012**	**0.041**	**< 0.001**	**< 0.0005**	**< 0.005**	**< 0.001**	**0.41**	**0.0007**	**0.012**	**< 0.0002**	**0.0065**	**0.4093**	**< 0.0025**	**< 0.002**
	Std Dev	0.000	0.0003	0.005	0.000	0.0000	0.000	0.000	0.04	0.0004	0.001	0.0000	0.0010	0.0928	0.0000	0.000
	Coeff of Var	0.000	0.2462	0.127	0.000	0.0000	0.000	0.000	0.10	0.4932	0.115	0.0000	0.1480	0.2266	0.0000	0.000
	10/22/2020	< 0.003	0.001	0.043	< ^ 0.001	< 0.0005	< 0.005	< 0.001	0.41	< 0.0005	0.011	< 0.0002	0.0057	NA	< 0.0025	< 0.002
	5/18/2021	< 0.003	0.0014	0.060	< 0.001	< 0.0005	< 0.005	< 0.001	0.39	< 0.0005	0.015	< 0.0002	0.0055	< 0.4800	< 0.0025	< 0.002
MW-03 down-gradient	10/28/2015	< 0.003	0.0015	0.100	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.41	< 0.0005	0.013	< 0.0002	< 0.0050	0.41	< 0.0025	< 0.002
	2/10/2016	< 0.003	0.0017	0.100	< 0.001	< 0.0005	< 0.005	< 0.001	0.44	< 0.0005	0.011	< 0.0002	0.0060	< 1.68	0.0045	< 0.002
	5/10/2016	< 0.003	0.0011	0.095	< 0.001	< 0.0005	< 0.005	< 0.001	0.44	< 0.0005	0.012	< 0.0002	0.0062	< 0.326	0.0030	< 0.002
	8/31/2016	< 0.003	0.0013	0.095	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.45	< 0.0005	0.012	< 0.0002	0.0086	< 0.373	0.0051	< 0.002
	11/2/2016	< 0.003	0.0019	0.082	< 0.001	< 0.0005	0.0051	< 0.001	0.44	< 0.0005	< 0.010	< 0.0002	0.0059	0.965	0.0032	< 0.002
	2/6/2017	< 0.003	0.0019	0.093	< 0.001	< 0.0005	< 0.005	< 0.001	0.39	< 0.0005	0.012	< 0.0002	0.0066	< 0.356	0.0028	< 0.002
	4/26/2017	< 0.003	0.0017	0.11	< 0.001	< 0.0005	< 0.005	< 0.001	0.36	< 0.0005	0.010	< 0.0002	0.0088	< 0.411	0.0052	< 0.002
	6/14/2017	< 0.003	0.0014	0.09	< 0.001	< 0.0005	< 0.005	< 0.001	0.44	< 0.0005	0.012	< 0.0002	0.0072	< 0.358	0.0037	< 0.002
	8/2/2017	< 0.003	0.0022	0.10	< 0.001	< 0.0005	< 0.005	< 0.001	0.40	< 0.0005	0.011	< 0.0002	0.0065	0.414	0.005	< 0.002
	10/18/2017	< 0.003	0.0015	0.09	< ^ 0.001	< 0.0005	< 0.005	< 0.001	0.42	< 0.0005	0.012	< 0.0002	0.0055	< 0.417	0.0026	< ^ 0.002
	Average	**< 0.003**	**0.0016**	**0.096**	**< 0.001**	**< 0.0005**	**0.0050**	**< 0.001**	**0.42**	**< 0.0005**	**0.011**	**< 0.0002**	**0.0068**	**0.588**	**0.0039**	**< 0.002**
	Std Dev	0.000	0.0003	0.008	0.000	0.0000	0.0000	0.000	0.03	0.0000	0.001	0.0000	0.0013	0.454	0.0011	0.000
	Coeff of Var	0.000	0.2099	0.081	0.000	0.0000	0.0067	0.000	0.07	0.0000	0.089	0.0000	0.1855	0.772	0.2759	0.000
	10/22/2020	< 0.003	0.0014	0.1	<^ 0.001	< 0.0005	< 0.005	< 0.001	0.43	< 0.0005	0.01	< 0.0002	< 0.005	NA	< 0.0025	< 0.002
	5/18/2021	< 0.003	0.0016	0.14	< 0.001	< 0.0005	< 0.005	0.0011	0.40	< 0.0005	0.014	< 0.0002	< 0.0050	1.100	< 0.0025	< 0.002
MW-04 down-gradient	10/28/2015	< 0.003	0.0013	0.082	^ < 0.001	< 0.0005	< 0.005	0.0063	0.45	< 0.0005	0.013	< 0.0002	0.0065	0.741	< 0.0025	< 0.002
	2/10/2016	< 0.003	0.0018	0.088	< 0.001	< 0.0005	< 0.005	0.0074	0.47	0.00062	0.011	< 0.0002	0.0063	< 1.52	< 0.0025	< 0.002
	5/10/2016	< 0.003	0.0014	0.088	< 0.001	< 0.0005	< 0.005	0.0086	0.46	< 0.0005	0.012	< 0.0002	0.0088	< 0.365	< 0.0025	< 0.002
	8/31/2016	< 0.003	0.0014	0.086	^ < 0.001	< 0.0005	< 0.005	0.0035	0.45	< 0.0005	0.011	< 0.0002	0.0083	0.432	< 0.0025	< 0.002
	11/2/2016	< 0.003	0.0025	0.079	< 0.001	< 0.0005	< 0.005	0.0100	0.43	0.0012	0.012	< 0.0002	0.007	< 0.463	< 0.0025	< 0.002
	2/6/2017	< 0.003	0.0015	0.100	< 0.001	< 0.0005	< 0.005	0.0160	0.37	< 0.0005	0.013	< 0.0002	0.0071	< 0.356	< 0.0025	< 0.002
	4/26/2017	< 0.003	0.0021	0.095	< 0.001	< 0.0005	< 0.005	0.0078	0.37	0.00055	0.012	< 0.0002	0.0069	< 0.35	< 0.0025	< 0.002
	6/14/2017	< 0.003	0.0013	0.078	< 0.001	< 0.0005	< 0.005	0.0120	0.47	< 0.0005	0.013	< 0.0002	0.0085	< 0.309	< 0.0025	< 0.002
	8/2/2017	< 0.003	0.0013	0.077	< 0.001	< 0.0005	0.04	0.0031	0.43	< 0.0005	0.012	< 0.0002	0.0091	< 0.282	0.0029	< 0.002
	10/18/2017	< 0.003	0.0019	0.082	< ^ 0.001	< 0.0005	< 0.005	0.0046	0.45	0.00077	0.015	< 0.0002	0.0071	0.423	0.003	< ^ 0.002
	Average	**< 0.003**	**0.0016**	**0.0859**	**< 0.001**	**< 0.0005**	**< 0.009**	**0.0083**	**0.43**	**0.00060**	**0.012**	**< 0.0002**	**0.0076**	**0.535**	**< 0.0025**	**< 0.002**
	Std Dev	0.000	0.0004	0.0079	0.000	0.0000	0.012	0.0040	0.04	0.00023	0.001	0.0000	0.0011	0.393	0.0001	0.000
	Coeff of Var	0.000	0.2629	0.0916	0.000	0.0000	1.313	0.4877	0.09	0.38529	0.065	0.0000	0.1393	0.735	0.0524	0.000
	10/22/2020	< 0.003	0.0015	0.089	< ^ 0.001	< 0.0005	< 0.005	0.0082	0.48	< 0.0005	0.013	< 0.0002	0.0061	NA	< 0.0025	< 0.002
	5/18/2021	< 0.003	0.0019	0.12	< 0.001	< 0.0005	< 0.005	0.0037	0.42	< 0.0005	0.014	< 0.0002	< 0.0050	< 0.445	< 0.0025	< 0.002
MW-05 down-gradient	10/28/2015	< 0.003	0.0011	0.057	^ < 0.001	< 0.0005	< 0.005	0.0013	0.39	< 0.0005	0.018	< 0.0002	0.0088	0.6231	0.0031	< 0.002
	2/10/2016	< 0.003	0.0028	0.071	< 0.001	< 0.0005	0.0062	0.0013	0.39	0.0022	< 0.02	< 0.0002	F1 0.0053	1.09	< 0.0025	< 0.002
	5/10/2016	< 0.003	0.0023	0.075	< 0.001	< 0.0005	< 0.005	< 0.001	0.46	0.0022	0.014	< 0.0002	0.008	< 0.40	0.019	< 0.002
	8/31/2016	< 0.003	< 0.001	0.07	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.56	< 0.0005	< 0.01	< 0.0002	0.012	< 0.42	0.02	< 0.002
	11/2/2016	< 0.003	0.0022	0.056	< 0.001	< 0.0005	0.0051	< 0.001	0.37	0.0017	0.015	< 0.0002	0.0061	0.438	< 0.0025	< 0.002
	2/6/2017	< 0.003	0.0016	0.082	< 0.001	< 0.0005	< 0.005	< 0.001	0.30	0.0016	0.021	< 0.0002	< 0.005	0.564	0.0029	< 0.002
	4/26/2017	< 0.003	0.0014	0.063	< 0.001	< 0.0005	< 0.005	< 0.001	0.37	0.0008	< 0.01	< 0.0002	0.0066	< 0.411	0.013	< 0.002
	6/14/2017	< 0.003	0.0012	0.044	< 0.001	< 0.0005	< 0.005	< 0.001	0.46	< 0.0005	0.013	< 0.0002	0.0076	< 0.316	0.0029	< 0.002
	8/2/2017	< 0.003	< 0.001	0.054	< 0.001	< 0.0005	< 0.005	< 0.001	0.35	< 0.0005	0.014	< 0.0002	0.0053	0.659	< 0.0025	< 0.002
	10/18/2017	< 0.003	0.002	0.067	< ^ 0.001	< 0.0005	< 0.005	< 0.001	0.38	0.0023	0.018	< 0.0002	< 0.005	< 0.371	0.0029	< ^ 0.002
	Average	**< 0.003**	**0.0016**	**0.064**	**< 0.001**	**< 0.0005**	**0.0051**	**0.0011**	**0.41**	**0.0012**	**0.015**	**< 0.0002**	**0.0072**	**0.5468**	**0.0076**	**< 0.002**
	Std Dev	0.000	0.0007	0.012	0.000	0.0000	0.0004	0.0001	0.08	0.0008	0.004	0.0000	0.0022	0.2332	0.0075	0.000
	Coeff of Var	0.000	0.4051	0.188	0.000	0.0000	0.0772	0.1240	0.19	0.6443	0.265	0.0000	0.3112	0.4264	0.9927	0.000
	10/22/2020	< 0.003	0.0012	0.069	<^ 0.001	< 0.0005	< 0.005	< 0.001	0.38	< 0.0005	0.013	< 0.0002	0.0054	NA	0.003	< 0.002
	5/18/2021	< 0.003	0.0015	0.10	< 0.001	< 0.0005	< 0.0050	< 0.0010	0.30	< 0.0005	0.023	< 0.0002	< 0.005	< 0.5970	< 0.0025	< 0.002

Notes:
All statistics use the detection limit for non-detect results.
All units are in mg/l except Radium is in pCi/L as noted.
Std Dev - Standard Deviation
Coeff of Var - Coefficient of Variance
NS - No Standard
NA - Not Analyzed
F1 - MS and/or MSD Recovery outside of limits.
^ - Denotes instrument related QC exceeds the control limits
State Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
Federal Maximum Contaminant Levels (MCLs) obtained from Code of Federal Regulations (CFR) Title 40, Chapter I, Subchapter D, Part 141.

Table 3 - Closure Alternatives Evaluation

35 Ill. Adm. Code Part 845.710(b)(1) through 845.710(b)(4) Requirements		Closure Alternatives	
		Closure by Removal for Pond Re-use	Closure-in-Place with a ClosureTurf Final Cover System
845.710(b)(1)(A)	Magnitude of existing risk reduction	The excavation and removal of the CCR from Pond 2 has removed the potential source. This will prevent about 37 inches per year of precipitation from passing through the unsaturated CCR into the groundwater. The groundwater modeling has shown that by previously removing the CCR source material, a reduction of at least 90% would occur in groundwater concentrations after 50 years.	Closing the warning layer in place with the ClosureTurf final cover system will prevent infiltration through any residual CCR material that may be present on the surface of the warning layer. The final cover system also eliminates human/animal exposure to any residual CCR in the warning layer, in addition to removing the hazard of an open pond. The final cover system would be constructed by filling Pond 2 with clean material and covering with a geomembrane infiltration layer that has a permeability of 1 x 10^{-13} cm/s, which is covered with a synthetic turf/sand infill erosion layer. This type of cover system has been used throughout the country since 2009 to effectively close CCR surface impoundments. The existing CCR source has been removed and the groundwater modeling has shown that a 10 time reduction of groundwater concentrations would occur. The groundwater modeling has shown that by previously removing the CCR source material, a reduction of at least 90% would occur in groundwater concentrations after 50 years.
845.710(b)(1)(B)	Likelihood of future CCR releases	Since the CCR has been removed from Pond 2, the likelihood of a future CCR release is eliminated. Previous site investigations have not identified CCR in the material used to construct Pond 2.	Since the CCR has been removed from Pond 2, the likelihood of a future CCR release is eliminated. Previous site investigations have not identified CCR in the material used to construct Pond 2. The material brought on-site would be tested to determine that it will cause a future release.
845.710(b)(1)(C)	Long-term management required	Long-term management off Pond 2 would be very minimal because the CCR has been removed and FCS is present. Therefore, there is no potential for future releases and no inspections required. Groundwater monitoring is required in accordance with 845.740(b) and 845.600. Groundwater monitoring is required for at least 3 years.	Post-closure activities will be required in accordance with 845.780 which includes regular inspections of the ClosureTurf FCS and groundwater monitoring. The post-closure period is at least 30 years.
845.710(b)(1)(D)	Short-term risks to the community during closure activities	The short-term risk to the community is very minimal to non-existent. The only potential risk would be from an increase in truck traffic hauling the warning layer for offsite disposal and truck traffic to the site that is delivering the new geomembrane material that would be used to replace the existing liner. Approximately 321 truck loads is required to haul the warning layer off-site for disposal and approximately 1 truck is required to deliver the geomembrane that would be used as part of the liner replacement. This has the potential to cause 0.006 traffic accident injuries and 0.0 traffic accident fatalities based on a 60-mile round trip for each truckload. 321 truckloads has the potential to produce approximately 10 lbs of particulate matter emissions.	The short-tem risk to the community is minimal and would come from the increased truck traffic bringing the fill material and ClosureTurf FCS supplies to the site. Filling Pond 2 to the required elevations would require approximately 69,300 CY of clean material and approximately 4,620 trucks to transport this material. This has the potential to cause 0.078 traffic accident injuries and 0.0 traffic accident fatalities based on a 60-mile round trip for each truckload. 4,620 truckloads has the potential to produce approximately 140 lbs of particulate matter emissions.
845.710(b)(1)(E)	Time to complete closure, post-closure or 845.740(b) groundwater monitoring	Excavation and disposal of the warning layer's 4,810 CY is estimated to take 93 days, based on disposing of 50 trucks/day of warning layer material. Post-closure activities are not required when closure by removal is performed, but groundwater monitoring must be conducted for at least 3 years after closure activities.	The total anticipated time to complete closure is 5 months and post-closure activities will take 30 years, which includes groundwater monitoring.
845.710(b)(1)(F)	Potential threat to human health and environment	The potential threat to human health and the environment is minimal to non-existent because the CCR source material has been removed. Groundwater monitoring has shown that impacts to groundwater from the previous operation of Pond 2 is not present.	The potential threat to human health and the environment is minimal to non-existent because the CCR source material has been removed and the potential for a de minimis amount of CCR to remain in the warning layer will not impact the environment. Groundwater monitoring has shown that impacts to groundwater from the previous operation of Pond 2 is not present.

845.710(b)(1)(G)	Long-term reliability of engineering/institutional controls	Having removed all the CCR source material and the warning layer is the most reliable alternative because the potential for any source material to remain is non-existent.	Geomembrane final cover systems and specifically ClosureTurf have been used throughout the country to effectively prevent CCR and other solid wastes from impacting human health and the environment.
845.710(b)(1)(H)	Potential for future corrective action	Because the CCR has already been removed, the need for future corrective actions is not present.	Because the CCR has already been removed, the need for future corrective actions is not present.
845.710(b)(2)(A)	The extent containment reduces further releases	The CCR has been removed from Pond 2 and the potential for further releases is non-existent. Groundwater monitoring has shown that a release from Pond 2 has not occurred.	The warning layer would remain within the confinements of Pond 2 and previous groundwater monitoring has shown that a release of CCR has not occurred. The geomembrane liner of Pond 2 and the geomembrane used in the FCS both prevent the migration of water thereby preventing any further release.
845.710(b)(2)(B)	Extent of the use of treatment technologies	Treatment will not be occurring as part of this closure alternative. The only technology used is the 60-mil HDPE geomembrane.	Treatment will not be occurring as part of this closure alternative. ClosureTurf technology will be used to create the FCS. ClosureTurf consists of a geomembrane liner with synthetic turf and sand/small aggregate on top of the geomembrane. ClosureTurf has been successfully used at other CCR surface impoundments and landfills as cover systems.
845.710(b)(3)(A)	Degree of difficulty associated with constructing technology	Removing and disposing of the warning layer will be moderately difficult because the warning layer material has consolidated and compacted, which may require some additional effort to excavate the material. In general, excavation and hauling material for disposal is not difficult. Repairing the geomembrane liner is not difficult and there are companies available to perform this type of work.	Filling, grading, and compacting clean soil into Pond 2 is not difficult. This is a process that has been occurring for many years and several construction companies in the area are capable of performing this work. The installation of the ClosureTurf system is not difficult, but the provider of ClosureTurf requires a certified company perform the work. This limits the availability of installation contractors because the certified list of contractors is a limited number. ClosureTurf has been successfully installed in over 17 states throughtout the country beginning in 2009. These states include New York, California, Minnesota, and Massachusetts.
845.710(b)(3)(B)	Expected operational reliability of the technologies	This closure alternative not require the operation of any technologies. The construction equipment that would be used to excavate and haul the warning layer material and the liner repair equipment are expected to operate without interruption.	ClosureTurf has operated reliably at the other installations around the country. ClosureTurf experienced a hurricane in South Carolina that produced a 26-inch rainfall, which did not damage the ClosureTurf and so minimally displaced the sand infill that no maintenance was required.
845.710(b)(3)(C)	Need to coordinate with and obtain necessary approvals and permits from other agencies	This closure alternative would require approval from the Illinois EPA.	This closure alternative would require approval from the Illinois EPA.

845.710(b)(3)(D)	Availability of necessary equipment and specialists	Equipment and personnel are easily available to excavate the warning layer material. Specialists are required to repair the geomembrane liner; however, these companies are available to perform the work.	This closure alternative would require a contractor that is approved by Watershed Geo to install ClosureTurf. Several contractors throughout the country have been certified to install ClosureTurf. The availability of a certified ClosureTurf installer is less than an earthwork contractor, but it should not be a concern.
845.710(b)(3)(E)	Available capacity and location of needed treatment, storage, and disposal services	The available capacity of disposal for 4,810 CY should not be difficult to obtain. The location for any disposal is unknown and would require contacting proper disposal facilities in the area to inquire about space availability.	This closure alternative does not require treatment, storage, or disposal services.
845.710(b)(4)	Degree to which community concerns are addressed	All the potential closure alternatives address the community concerns. The community is concerned about the potential for future groundwater contamination which is addressed by the closure alternatives. The removal and disposal of the warning layer would occur at an existing disposal facility which has already addressed the concerns of the community residents associated with these closure alternatives and would not create additional concerns.	All the potential closure alternatives address the community concerns. The community is concerned about the potential for future groundwater contamination which is addressed by the closure alternatives. The installation of a FCS would prevent the infiltration of precipitation which would prevent any contamination of groundwater from the de minimum amound of CCR present in the warning layer.
845.710(d)(4)	Assessment of Impacts to Waters in the State	Both closure alternatives do not impact the Des Plaines River or the station's intake channel. The groundwater modeling performed in support of this analysis has shown that any theoretical impacts to the river are reduced to less than 90% of the original concentration after 50 years. Existing groundwater monitoring has shown that impacts in downgradient monitoring wells are not present or not assoicated with Pond 2.	

Table 4: Closure Alternatives Analysis Cost Estimates Comparison

Closure Costs of a ClosureTurf Final Cover System

Construction Activity	Cost
Mobilization/Demobilization	$20,000
Site Preparation	$18,118
Dewatering	$13,454
Pond 2 Fill	$1,711,416
ClosureTurf Cover System	$349,571
Construction Subtotal	$2,112,559

Construction Management (4.5%)	$95,065
Engineering & Design (10%)	$211,256
Owner Construction Supervision (4.5%)	$95,065
30% Contingency	$633,768

CLOSURE TOTAL	$633,768

Closure Costs for Closure By Removal & Disposal at Lincoln Stone Quarry

Construction Activity	Cost
Mobilization/Demobilization	$10,000
Site Preparation	$18,118
Dewatering	$13,454
Warning Layer Excavation	$57,817
Replace Bottom Liner	$170,845
Lincoln Stone Quarry Disposal	$30,303
Construction Subtotal	$300,537

Construction Management (4.5%)	$13,524
Engineering & Design (10%)	$27,023
Owner Construction Supervision (4.5%)	$13,524
30% Contingency	$90,161

CLOSURE TOTAL	$90,161

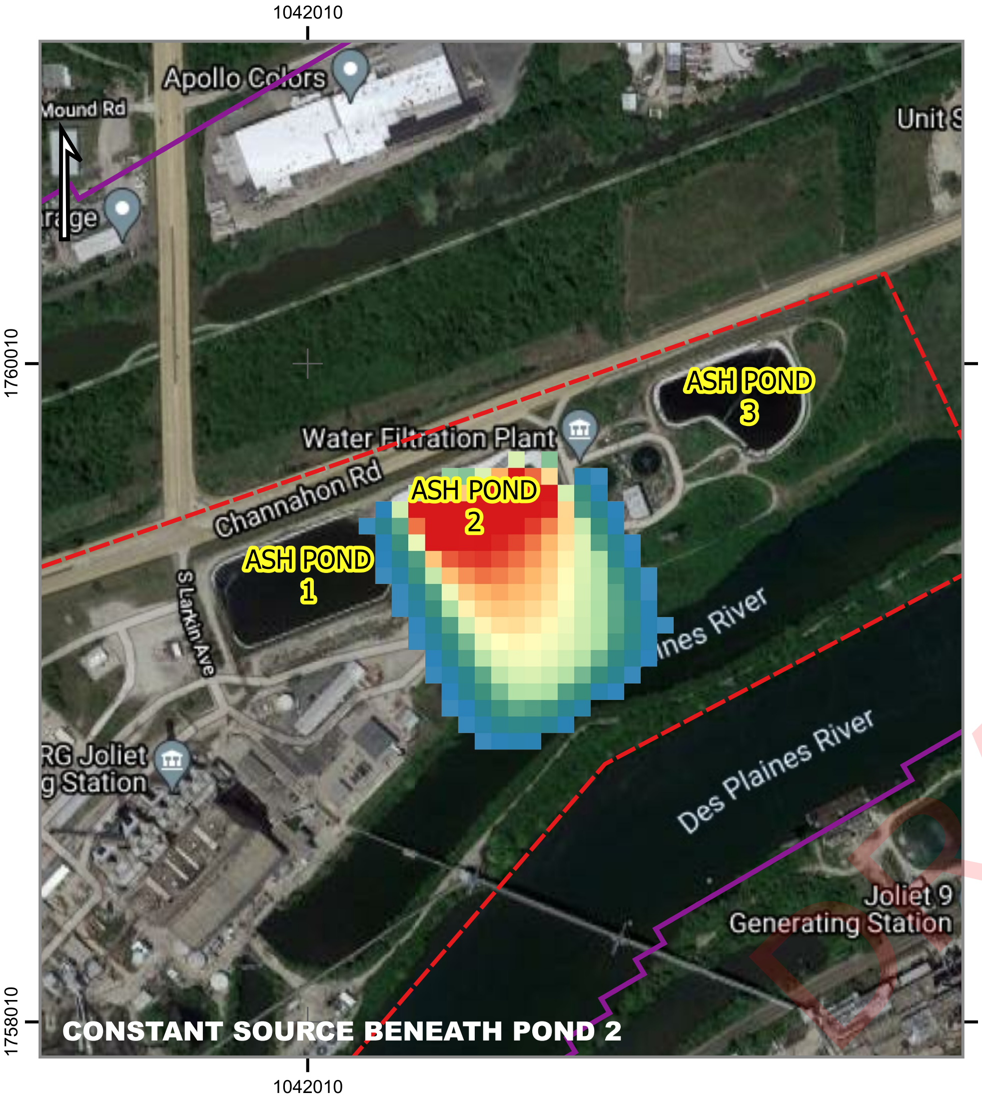
Closure Costs for Closure By Removal & Disposal at Lincoln Stone Quarry

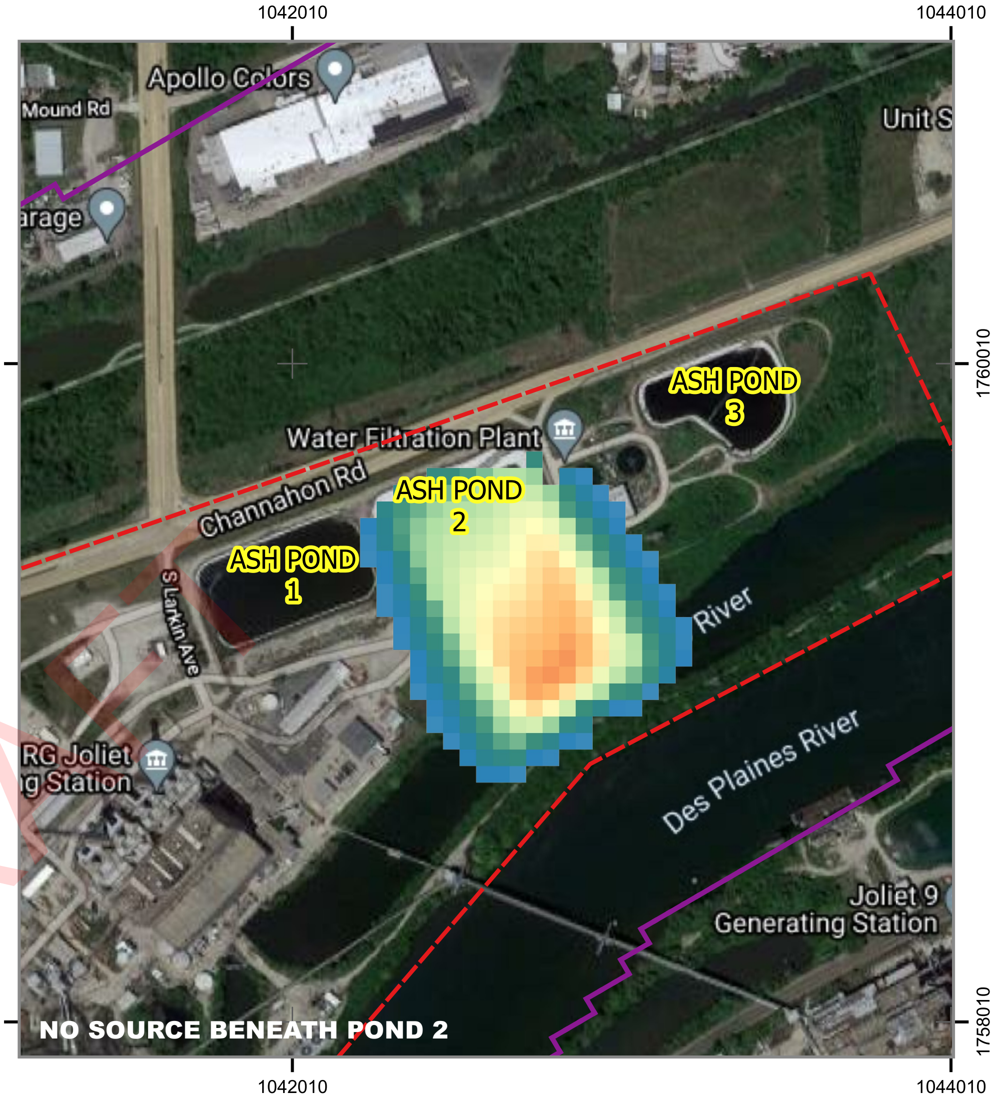
Construction Activity	Cost
Mobilization/Demobilization	$10,000
Site Preparation	$18,118
Dewatering	$13,454
Warning Layer Excavation	$57,817
Replace Bottom Liner	$170,845
Prairie View RDF Disposal	$72,391
Construction Subtotal	$342,625

Construction Management (4.5%)	$15,418
Engineering & Design (10%)	$27,023
Owner Construction Supervision (4.5%)	$15,418
30% Contingency	$102,787

CLOSURE TOTAL	$102,787

ATTACHMENT 1





LEGEND

MODEL BOUNDARY — APPROXIMATE SITE BOUNDARY

RELATIVE CONCENTRATION

0.00001	0.40000
0.00010	0.50000
0.00100	0.60000
0.01000	0.70000
0.10000	0.80000
0.20000	0.90000
0.30000	1.00000

BAS GROUNDWATER CONSULTING — KPRG

0 300 600 ft

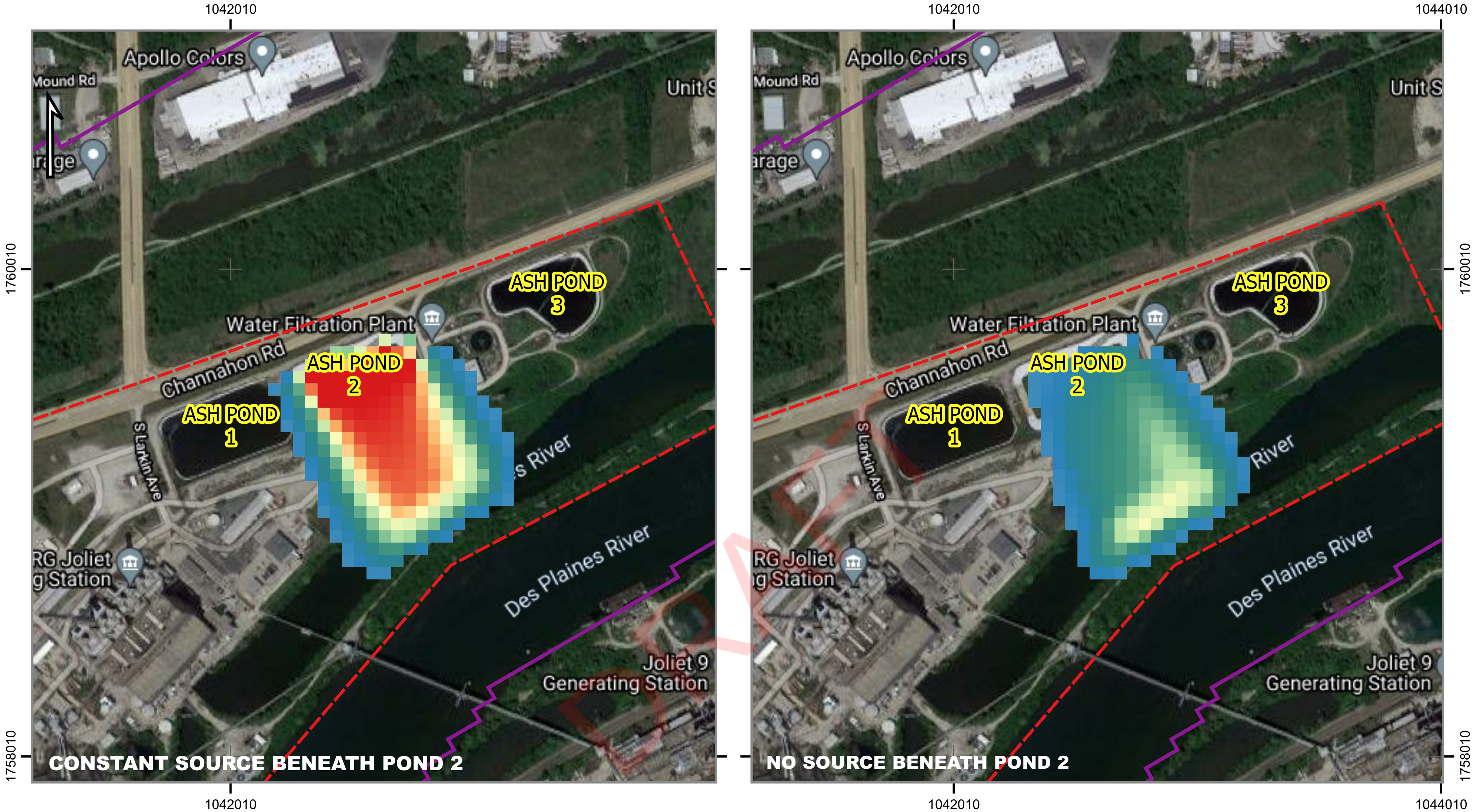
FEET

DRAFT

Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure1_5YearPlumeDistributions.qgz

CLIENT	MIDWEST GENERATION, LLC
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**5-YEAR PLUME DISTRIBUTION**

SCALE AT ANSI A: 1:7,000	DRAWN	DZF	11/09/2021
	CHECKED	BAS	11/09/2021
BAS PROJECT No. 21141301	FIGURE: 1		



LEGEND

MODEL BOUNDARY | APPROXIMATE SITE BOUNDARY

RELATIVE CONCENTRATION

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0.00010	0.50000
0.00100	0.60000
0.01000	0.70000
0.10000	0.80000
0.20000	0.90000
0.30000	1.00000

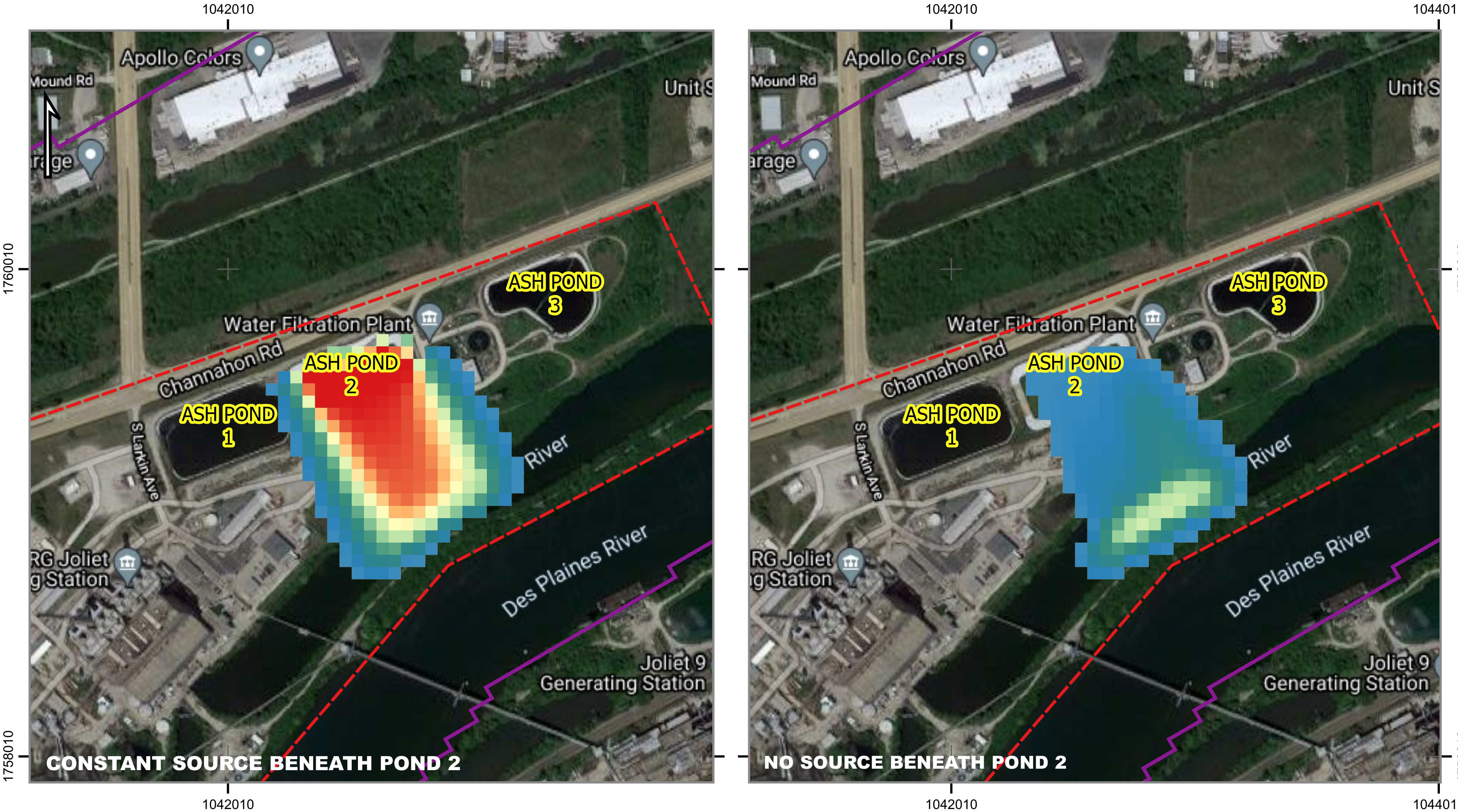
BAS GROUNDWATER CONSULTING KPRG

0 300 600 ft
FEET

DRAFT

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure2_25YearPlumeDistributions.qgz

CLIENT	MIDWEST GENERATION, LLC		
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL		
TITLE	**25-YEAR PLUME DISTRIBUTION**		
SCALE AT ANSI A 1:7,000	DRAWN DZF 11/09/2021 CHECKED BAS 11/09/2021		
BAS PROJECT No. 21141301	FIGURE: **2**		



LEGEND

MODEL BOUNDARY — APPROXIMATE SITE BOUNDARY

RELATIVE CONCENTRATION

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0.00010	0.50000
0.00100	0.60000
0.01000	0.70000
0.10000	0.80000
0.20000	0.90000
0.30000	1.00000

BAS GROUNDWATER CONSULTING

KPRG

0 300 600 ft

FEET

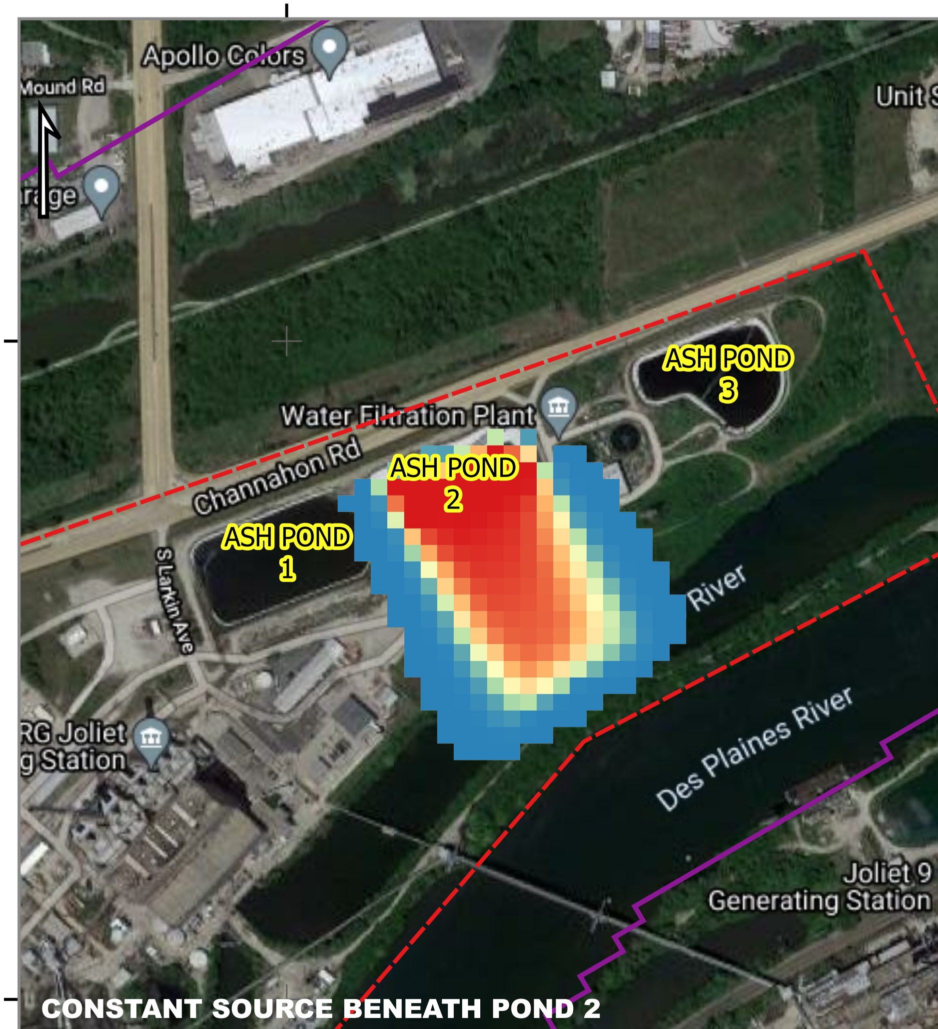
DRAFT

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure3_50YearPlumeDistributions.qgz

CLIENT	MIDWEST GENERATION, LLC
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**50-YEAR PLUME DISTRIBUTION**

SCALE AT ANSI A	DRAWN	DZF	11/09/2021
1:7,000	CHECKED	BAS	11/09/2021
BAS PROJECT No. 21141301		FIGURE: 3	

1042010



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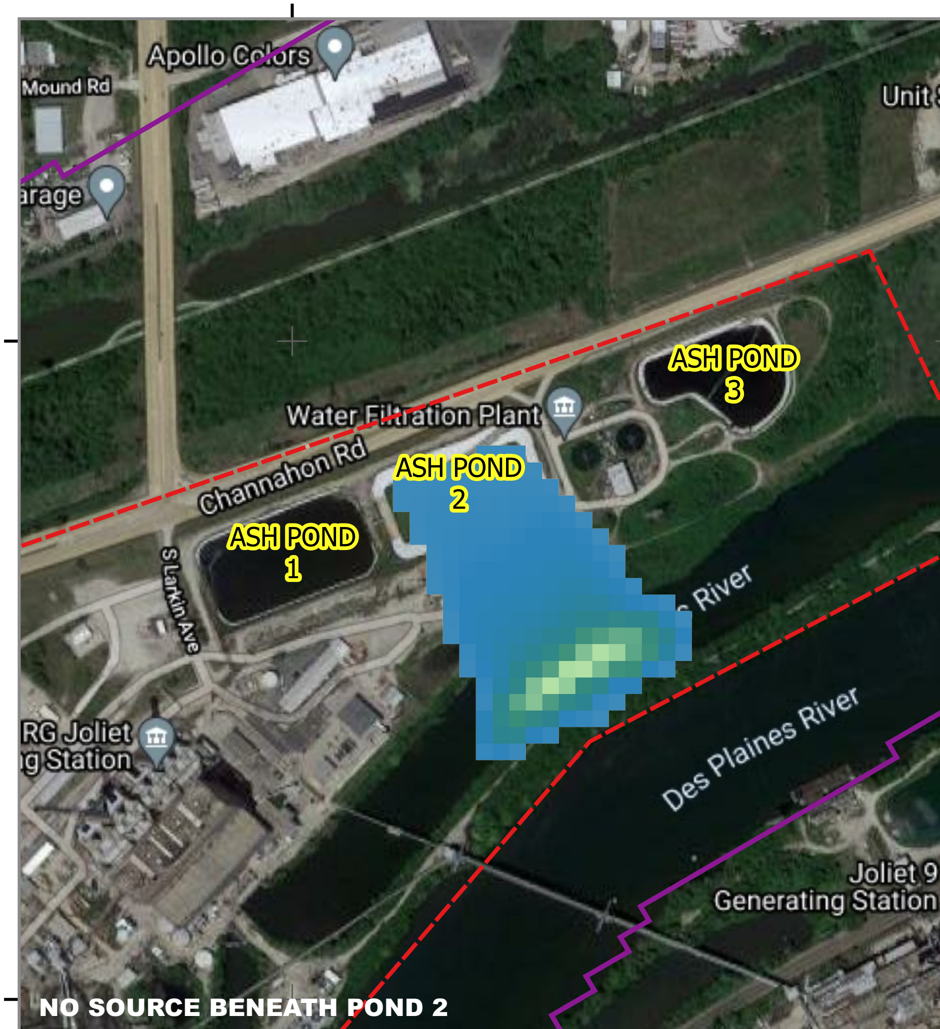

1760010 1758010

1042010 1044010

LEGEND

MODEL BOUNDARY APPROXIMATE SITE BOUNDARY

RELATIVE CONCENTRATION

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0.00100	0.60000
0.01000	0.70000
0.10000	0.80000
0.20000	0.90000
0.30000	1.00000

BAS GROUNDWATER CONSULTING

KPRG

0 300 600 ft

FEET

DRAFT

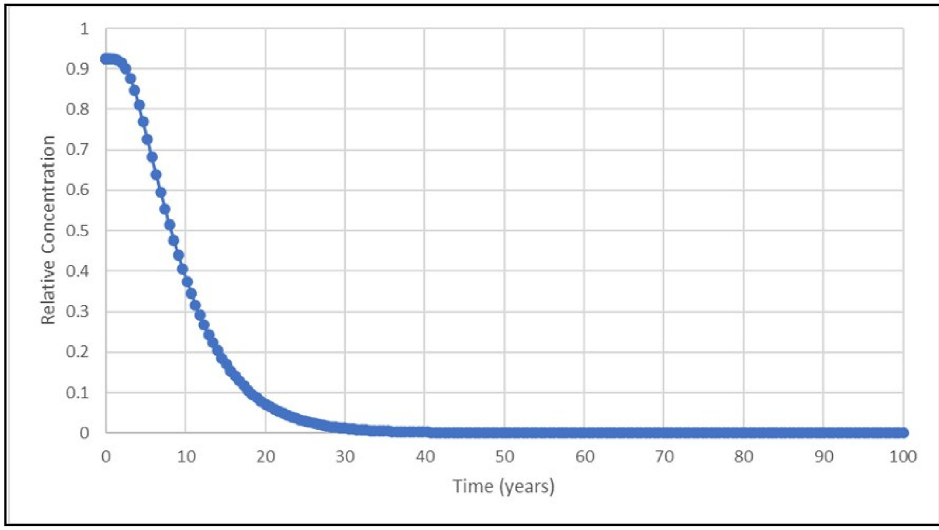
Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure4_100YearPlumeDistributions.qgz

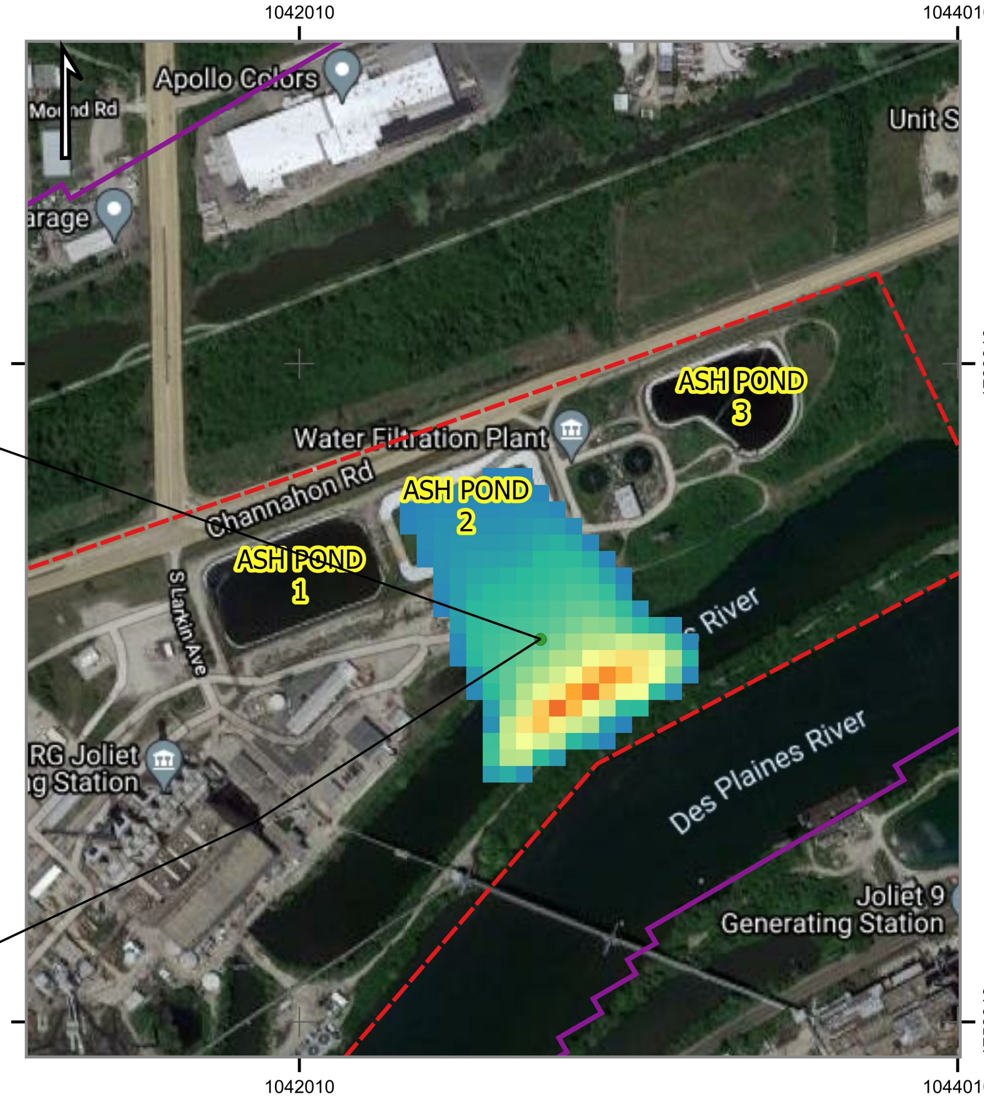
CLIENT	MIDWEST GENERATION, LLC
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**100-YEAR PLUME DISTRIBUTION**

SCALE AT ANSI A 1:7,000	DRAWN	DZF	11/09/2021
	CHECKED	BAS	11/09/2021
BAS PROJECT No. 21141301		FIGURE: 4	

100-YEAR PLUME DISTRIBUTION

- 100-YEAR CONCENTRATION DISTRIBUTION USED AS INITIAL CONCENTRATIONS
- NO SOURCE BENEATH POND 2





LEGEND

MODEL BOUNDARY
APPROXIMATE SITE BOUNDARY

RELATIVE CONCENTRATION

- 0.00001
- 0.0001
- 0.001
- 0.01
- 0.1
- 0.2

BAS GROUNDWATER CONSULTING

K P R G

0 300 600 ft
FEET

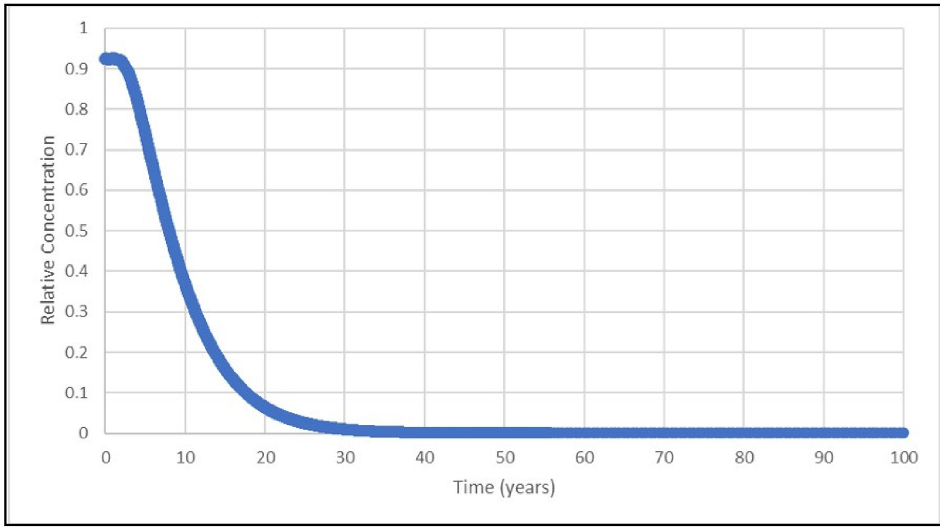
DRAFT

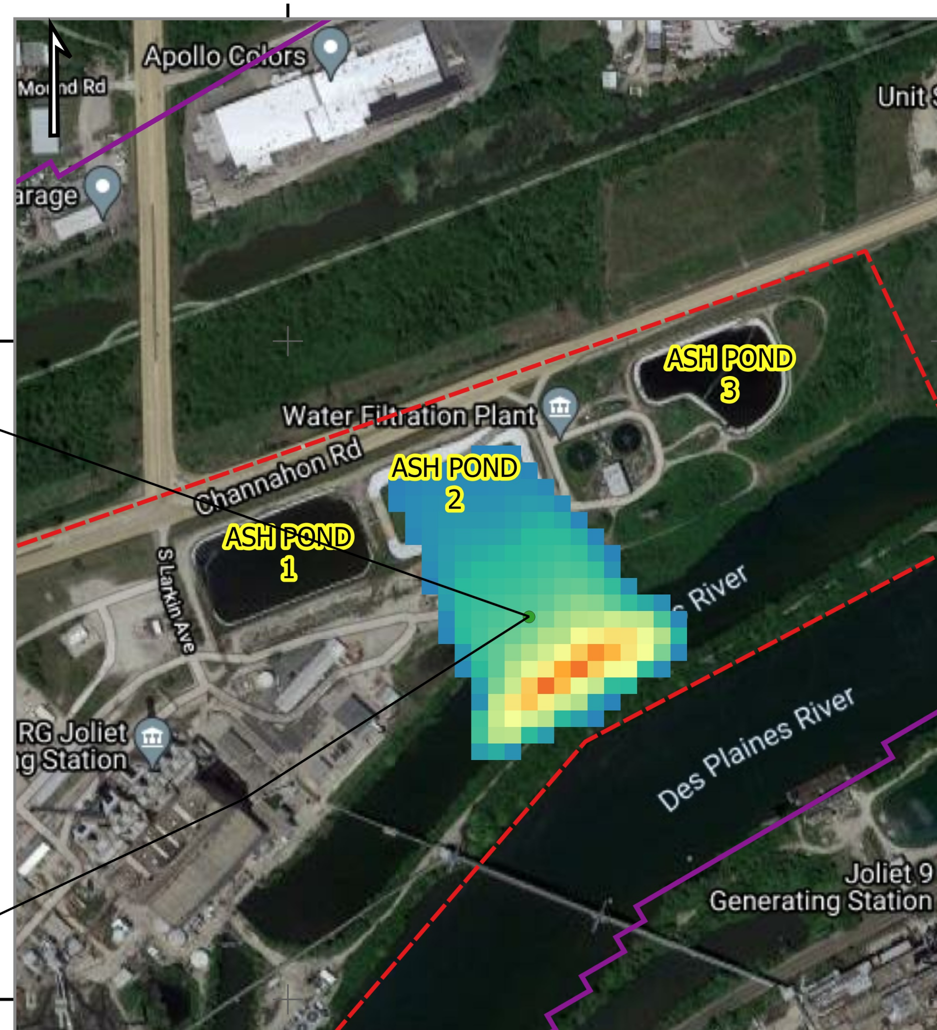
Coordinate System:
Project File: Figure5_ConcentrationsOverTime.qgz

CLIENT	MIDWEST GENERATION, LLC		
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL		
TITLE	**CONCENTRATIONS OVER TIME**		
SCALE AT ANSI A 1:	DRAWN	DZF	11/09/2021
	CHECKED	BAS	11/09/2021
BAS PROJECT No. 21141301		FIGURE: **5**	

100-YEAR PLUME DISTRIBUTION

- 100-YEAR CONCENTRATION DISTRIBUTION USED AS INITIAL CONCENTRATIONS
- NO SOURCE BENEATH POND 2
- SEASONAL FLUCTUATIONS IN RECHARGE





LEGEND

MODEL BOUNDARY
APPROXIMATE SITE BOUNDARY

RELATIVE CONCENTRATION

- 0.00001
- 0.0001
- 0.001
- 0.01
- 0.1
- 0.2

BAS GROUNDWATER CONSULTING

KPRG

0 300 600 ft

FEET

DRAFT

Coordinate System:

Project File: Figure6_SeasonalSensitivityTest.qgz

CLIENT	MIDWEST GENERATION, LLC
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**SEASONAL SENSITIVITY TEST**

SCALE AT ANSI A 1:	DRAWN	DZF	11/09/2021
	CHECKED	BAS	11/09/2021
BAS PROJECT No. 21141301		FIGURE: **6**	