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KPRG and Associates, Inc.

CCR COMPLIANCE
ASSESSMENT OF CORRECTIVE MEASURES REPORT
LINCOLN STONE QUARRY

Midwest Generation, LLC
Joliet #9 Generating Station
1601 South Patterson Road
Joliet, Illinois

Prepared By: **KPRG and Associates, Inc.**
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May 31, 2019

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1.0 INTRODUCTION

In accordance with Title 40 of the Code of Federal Regulations, 40 CFR Part 257.96, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule dated April 17, 2015 (CCR Rule), a Facility (Owner/Operator) is required to initiate and complete an Assessment of Corrective Measure if there has been a statistically significant increase (SSI) detected above the Groundwater Protection Standard or detection of a release from the unit. This document satisfies and complies with the requirements of this section for the regulated unit (Lincoln Stone Quarry [LSQ]) monitoring wells located at the Midwest Generation, LLC (Midwest Generation) Joliet #9 Generating Station.

The initial Detection Monitoring requirements in 40 CFR Parts 257.94 of the CCR Rule, have been completed to meet the monitoring requirements of this section of the CCR Rule. The CCR monitoring well network consists of ten monitoring wells (R08S, G20S, G30S, R32S, G44S, G45S, G46S, G47S, G48S and T03S) as shown on Figure 1. Wells T03S and G45S are considered background monitoring wells. It is noted that Figure 1 also includes twelve extraction wells (X101 through X112) along the south side of the LSQ, which are part of an independent interim corrective action, which intercepts southward migration of groundwater from the LSQ.

The initial statistical evaluation completed for Appendix III detection monitoring parameters dated January 12, 2018 determined that there were statistically significant increases (SSIs) in downgradient monitoring wells relative to established background for various Appendix III parameters at various downgradient monitoring locations. It was recommended to transition to an assessment monitoring program to comply with Section 257.95.

In accordance with assessment monitoring requirements, a complete round of CCR well groundwater samples were collected and analyzed for the full list of parameters specified in both Appendix III and Appendix IV of the CCR Rule. This initial round of assessment monitoring data was evaluated and summarized in a letter report dated April 12, 2018.

In accordance with Section 257.95(d)(1), within 90 days of obtaining the initial assessment results, the CCR wells needed to be resampled for all parameters in Appendix III and all constituents in Appendix IV that were detected in the initial assessment sampling round. For Joliet #9, the detected Appendix IV parameters included arsenic, barium, cobalt, fluoride, lead, lithium, molybdenum, combined radium 226/228 and selenium.

The second round of assessment sampling was completed on May 16 through May 18, 2018 with the final analytical data (radium) being received on July 6, 2018. On October 4, 2018 a Statistical Evaluation Summary – CCR Groundwater Assessment Monitoring Joliet #9 Station was submitted which documented the statistical evaluations performed along with the development of applicable site-specific groundwater protection standards (GWPSs). Based on these results, the following recommendations were made to maintain CCR Rule compliance:

- Continue the assessment monitoring program with semi-annual sampling for both Appendix III and Appendix IV parameters.

- Complete a notification of the Appendix IV parameters that were found to exceed the established GWPSs and place the notification in the facilities operating record.

- Develop and implement a work plan to initiate an investigation of the nature and extent of the release and any relevant site conditions that may affect remedy selection.

- Within 90-days, initiate an assessment of corrective measures to prevent further releases, to remediate any releases and to restore the affected area to original conditions.

Assessment monitoring continued for both Appendix III and detected Appendix IV parameters with semi-annual monitoring in December 2018, which was also included in the required CCR Compliance Annual Groundwater Monitoring and Corrective Action Report dated January 31, 2019 for the Joliet #9 Generating Station. All CCR detection and assessment monitoring data generated to date are summarized in Tables 1 and 2. The most recent round of assessment semi-annual monitoring was completed in the first week of May 2019 and was not yet available for use in completing this report.

This Assessment of Corrective Measures Report is structured to provide the following information:

- A summary of the site geology/hydrogeology (including the site conceptual model) as a basis for evaluating various remedial options,

- The results of the extent of impacts study work performed to date in support of engineering evaluations, and

- An assessment of corrective measures that meets the requirements set forth in Section 257.96(c)(1) through 257.96(c)(3).

2.0 PHYSICAL SITE CONDITIONS

The Lincoln Stone Quarry facility consists of two portions. An older, inactive portion of the facility is referred to as the West Filled Area (WFA). The WFA occupies approximately 14 acres of the western portion of the facility. The Main Quarry, east and immediately adjacent to the WFA, is the active portion of the facility where bottom ash and slag have been sluiced and/or placed. Figure 1 provides a facility location map. The Main Quarry is considered the regulated unit under the CCR Rule and is approximately 43 acres in size.

2.1 Summary of Geology and Hydrogeology

2.1.1 Geology

The facility is underlain by approximately 20 to 30 feet of unconsolidated glacial overburden (this thickness may vary substantially across the site) which is underlain by Silurian age dolomite. 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. The Scales Shale unit is a recognized regional aquitard, which hydraulically isolates the deeper bedrock aquifers from the shallower units.

Regional and site-specific data from the cited studies and investigations document fractures in the Silurian dolomite. Site-specific and regional data are consistent in 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 the quarry walls and from cores obtained during drilling 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).

There is additional fracturing at the quarry wall and the fractures/joints tend to be more open at the wall. This is interpreted to be a localized phenomenon that is the result of the blasting and unloading from former quarry operations. This effect does not appear to extend greater than about 10 or 15 feet away from the quarry wall.

The dolomite beneath the facility is divided into a “shallow” zone and a “deep” zone. These two layers are separated by a “lower permeability” zone identified as the Brainerd Shale that is approximately 10 feet thick. The lower permeability zone is mappable across the site and has been used by the Illinois State Geological Survey (ISGS) as a tracer bed.

The shallow zone is about 140 to 150 feet thick. This places the bottom of the shallow zone and top of the lower permeability zone (Brainerd Shale) at approximately 430 to 440 feet above mean sea level (msl). The boundary between the bottom of the low permeability zone and the top of the deep zone is approximately 10 feet deeper, between about 420 to

430 feet above msl. The deep zone is 30 to 40 feet thick, so the boundary between the deep zone and the remaining Maquoketa Shale (Scales Shale member) unit is at approximately 380 to 400 feet above msl. For reference purposes, it is noted that the deepest portion of the bottom of Lincoln Stone Quarry is at approximately 477 feet above msl.

Recent groundwater assessment studies have identified a horizon of higher permeability within the shallow Silurian dolomite zone. The higher permeability zone extends from approximately 500 feet above msl down to approximately 430 feet above msl, which is at and below the base of Lincoln Stone Quarry. This feature is important in the understanding and interpretation of existing groundwater flow conditions beneath the site as further discussed in Section 2.2.2 below.

2.1.2 Hydrogeology

The water table beneath the site is encountered under unconfined conditions within the unconsolidated overburden and/or the upper portion of the shallow dolomite. There is sufficient potentiometric and chemical data from clustered piezometers around Lincoln Stone Quarry to indicate that the shallow dolomite zone and deep dolomite zone can be viewed as separate water bearing units. The intervening zone (Brainerd Shale) is of sufficiently lower permeability that it impedes downward migration and mixing of the groundwater. This is illustrated by the difference in the groundwater flow conditions within the shallow and deep zones, as discussed in the subsequent subsections of Section 2.0. The Scales Shale member of the Maquoketa Group, which defines the base of the deep dolomite, is widely accepted as a regional aquitard that hydraulically separates the groundwater in the overlying dolomite from deeper groundwater with in the older sandstone and carbonate units beneath it.

Natural groundwater flow in the area is from the south and east to the north and west. This flow pattern largely parallels surface drainage from topographically high areas to the Des Plaines River and likely represents a topographically driven groundwater flow system.

Initial hydrogeologic evaluations performed in support of the original permit and of the Adjusted Standard for the site identify the natural groundwater level in the vicinity of the Main Quarry to have been between 570 and 585 feet above msl. The water level in the Main Quarry was generally maintained at an elevation below 555 feet above msl with the primary operating levels historically being between 540 and 550 feet above msl. However, the level in the Main Quarry has been intentionally lowered starting in the 2nd quarter of 2008 in response to the potential dewatering of Boyd’s Quarry located immediately east of the facility. This was done to ensure maintaining an inward gradient along the east side of the Main Quarry. At this time, Main Quarry operating levels are targeted to be at or below approximately 545 feet above msl.

As described in the initial hydrogeologic studies, the difference between the operational water level in the Main Quarry and the natural water table generates a hydraulic gradient into the Main Quarry and/or the WFA from the south and east. The initial studies estimated that approximately 76% of the groundwater that flowed into the Main Quarry/WFA area eventually reached the Des Plaines River by pumping from the North Quarry settling pond pursuant to the NPDES discharge permit. The remaining 24% of the groundwater naturally discharges from the Silurian dolomite directly to the Des Plaines River.

2.1.3 Conceptual Site Model and Interim Remedial Action Evaluation/Implementation

The conceptual site model is shown on Figure 2 and highlights the depressurization in the lower portion of the Silurian Dolomite off the southeast corner of the Main Quarry toward the dewatered active mining operation of the Laraway Quarry. The conceptual model illustrates the Silurian and Ordovician carbonate strata above the Scales Shale of the Maquoketa Group on the southeast corner of the LSQ. The impermeable Scales Shale represents a regional aquitard. The strata above the Scales Shale consist of two aquifer layers; the Ordovician Fort Atkinson Dolomite immediately above the Scales Shale and the overlying Silurian dolomites of the Joliet and Kankakee Formations, with an intervening aquitard, the Ordovician Brainard Shale. This hydrogeologic interpretation is based upon descriptions of borings, hydraulic properties as tested in monitoring wells, head distributions, and water chemistry variations. The LSQ is excavated into the shallow Silurian aquifer. The deepest base elevation of LSQ is approximately 477 feet above amsl.

The overall groundwater flow pattern significant to LSQ is the topographically driven system conveying recharge from precipitation over the upland areas with ultimate discharge to the Des Plaines River. The bluffs along the Des Plaines River valley modify a simple pattern of topographic flow. Seeps and springs discharge groundwater from the faces and along the toes of the bluffs, documenting that portions of the groundwater system reach the Des Plaines River by surface flow as well as by groundwater base flow.

This natural groundwater flow pattern is modified by flow into or from a number of quarries in the area that have been excavated to varying depths. Some of these quarries are no longer active and have flooded (e.g., Boyd’s Quarry) and some are pumped down for active excavation (e.g., Vulcan Laraway Quarry). It is noted that Vulcan Laraway Quarry is not owned by Midwest Generation. Due to the varying depths, locations, and histories of the quarries, they may serve as sinks of groundwater extraction, sources of recharge to groundwater or both. Head data from monitoring wells around LSQ indicate that contemporary quarrying in strata above the Scales Shale is affecting local groundwater flow patterns to the southeast and southwest of the facility.

The major groundwater extraction for industrial and municipal/residential use in the area is typically from aquifers below the Maquoketa Formation. The lower units of the Maquoketa Formation are widespread shales that isolate these deep-water resources from the overlying Silurian dolomite aquifer into which LSQ is excavated. Within the Silurian and uppermost Ordovician strata being modeled, data do not indicate modification to the groundwater system due to deep well pumping below the regional aquitard represented by the Scales Shale.

The conceptual model was used to develop a nine-layer, three-dimensional numerical groundwater flow model for the site using Visual MODFLOW® Professional Edition, Version 4.1 (Waterloo Hydrogeologic, Inc). The numerical flow model was able to recreate the existing groundwater flow patterns as well as recreate historical flow conditions at the site. Once the groundwater flow model was calibrated and field validated, a contaminant transport package (MT3D; Mass Transport in 3 Dimensions) was added to the model to simulate chemical constituent movement through the groundwater flow system. Site-specific ash leachate chemistry data was used for input into the transport model. The model was shown to be able to recreate the distributions of various coal ash associated constituents that were observed in the field.

The model was subsequently used to assist in evaluating some various remedial alternatives for addressing the loss of hydraulic control to the southeast of the LSQ due to the active dewatering of the Vulcan Laraway Quarry and the associated off-site migration of coal ash constituents. Remedial alternatives evaluated included injection galleries, extraction galleries, cutoff walls and formation permeability reduction. The evaluations resulted in an interim corrective action (ICA) that was developed with, and approved by the Illinois Environmental Protection Agency (IEPA) and implemented at the site beginning in 2010. The ICA included the installation and operation of a hydraulic control pumping system along the southern boundary of the LSQ consisting of 12 extraction wells (X101 through X112) and the establishment of a Groundwater Management Zone (GMZ) to the south of the site as shown on Figure 1. The extraction system is currently operating and meeting its goal of re-establishing hydraulic control and managing the off-site groundwater impacts to the south within the boundaries of the approved GMZ. As part of the landfill operational permit for the LSQ, the efficacy of the extraction system is evaluated annually and that evaluation is submitted as an Application for Significant Modification to Permit – Assessment of Interim Corrective Action. The most recent assessment submittal dated March 12, 2019 indicated that extraction well X105 has been experiencing additional scaling and associated reduction of efficiency issues which have reflected in the noted groundwater quality data at monitoring well G47S located along the southern property boundary of the LSQ (within the GMZ). The report noted the following:

> "It should be noted that the system maintenance for extraction well X105 has increased because of the increased scaling issues. If the noted increased scaling issues at extraction well X105 continue to degrade the efficiency of this well causing additional extraction disruption at this location, the installation of an additional extraction well between wells X104 and X105 may need to be considered."

Once the Laraway Quarry mining operations are ceased and dewatering activities are no longer performed, that quarry will close allowing it to fill up with water. Based on the groundwater flow and contaminant transport modeling, under those conditions the natural local flow conditions will be re-established from south to north and any impacted groundwater that is within the GMZ will move back into the LSQ. At that point, the ICA will be documented to be complete via ongoing groundwater monitoring.

2.2 Extent of Impacts Evaluation

The second round of assessment sampling completed on May 16 through May 18, 2018 with the final analytical data (radium) being received on July 6, 2018. On October 4, 2018 a Statistical Evaluation Summary – CCR Groundwater Assessment Monitoring Joliet #9 Station was submitted which documented the statistical evaluations performed along with the development of applicable site specific GWPSs.

The completed assessment monitoring statistical evaluations and data comparison to the established GWPSs for the site indicated several detected Appendix IV parameter concentrations above the GWPS for various wells. In accordance with Section 257.95(g)(1) of the CCR Rule requirements, KPRG has initiated an evaluation of the nature and extent of the release relative to the parameters detected above the GWPS. The expanded assessment sampling network included monitoring wells G31S and G33S located along the northern property boundary, and wells T01S, T02S, T04S, T05S, T06S, T08S and T09S (see Figure 1) located off-site to the south and east. It is noted that these wells are already in-place and were installed as part of hydrogeologic assessment activities associated with the IEPA landfill permit under which this facility operates in addition to the CCR Rule. All groundwater sampling procedures were completed in accordance with the CCR Compliance Monitoring Sampling and Analysis Plan dated October 10, 2017 for the Joliet #9 Generating Station.

As previously noted, the detected Appendix IV parameters include arsenic, barium, cobalt, fluoride, lead, lithium, molybdenum, combined radium 226/228 and selenium. The analytical data from the initial extent of impact monitoring is provided in Tables 3 and 4. Table 3 includes the Appendix III parameter data for the additional nature and extent assessment monitoring wells and Table 4 includes the Appendix IV parameter data for those wells. There were no detections above the GWPSs for barium, cobalt, fluoride, radium 226/228 or selenium in any of the routine or nature and extent assessment monitoring wells. There was also only one lead detection above its GWPS at well location G33S located on the north side of the Midwest Generation property.

The extent of detections of arsenic, lithium and molybdenum above their respective GWPSs are provided on Figures 3 through 5, respectively. A review of the extent of detections map for arsenic (Figure 3) indicates that all GWPS exceedances are to the southeast of the LSQ and within the existing interim GMZ established as part of the ICA.

The extent of lithium impacts map (Figure 4) indicates that all detections above the GWPS are on the west side of the LSQ and Midwest Generation and generally within the existing interim GMZ on the south side of the site and the operation permit established Zone of Attenuation (ZOA) on the north side of the site. However, minor additional delineation to the north-northwest of well T09S and to the west of well R08S may be needed.

The extent of molybdenum impacts map (Figure 5) indicates two general areas of main impact. Most of these detections are within the existing interim GMZ and ZOA, however some additional delineation is necessary to the south of T03S, to the north-northwest of T09S and to the west of wells R08S and G44S to determine whether expanding the current GMZ/ZOA boundaries may be necessary.

3.0 <u>IDENTIFICATION OF POTENTIAL CORRECTIVE MEASURES</u>

An assessment of corrective measures for closure of the Main Quarry was performed in accordance with 257.96(c)(1) to 257.96(c)(3) to address the above discussed water quality monitoring parameter detections above established groundwater protection standards. The four corrective measures assessed for closure of the Main Quarry were:

- Complete removal of all the CCR in the Main Quarry,
- Wet closure of the CCR in the Main Quarry,
- Dry closure of the CCR in the Main Quarry using a soil and geomembrane final cover system, and
- Dry closure of the CCR in the Main Quarry using the ClosureTurf cover system.

A brief description of each corrective measure is presented below.

The groundwater extraction system at the Quarry will continue to be used regardless of which corrective measure is selected as long as Vulcan Quarry continues its mining operations to the southeast of the Main Quarry. As noted in the discussions above, once the Vulcan Quarrying operations cease, that quarry will be allowed to naturally fill with water and the natural pre-Vulcan Quarry groundwater flow conditions will be re-established. At that point, based on groundwater modeling, within several years the groundwater quality within the interim GMZ will be returned to pre-Vulcan mining conditions and the ICA will be documented to be complete via ongoing groundwater monitoring.

3.1 Complete CCR Removal

Removing all the CCR from the Main Quarry and disposing it in a licensed off-site landfill facility was the first corrective measure assessed. This corrective measure would require the complete removal of approximately 2,600,000 cubic yards (CY) of CCR from the Main Quarry and hauling and disposing at an off-site landfill. A new haul road would be constructed inside the Main Quarry in order to remove the CCR down to the approximate bottom elevation of 477 feet above msl. It is also expected that the CCR would be hauled to multiple disposal sites and if this were not possible, a new disposal facility would have to be sited, permitted and constructed.

The estimated quantity of CCR that would require excavation, transportation, and hauling is 3,380,000 CY of CCR. This quantity is based on the in place quantity of 2,600,000 CY swelling by approximately 30% once it is excavated and loaded for transportation. The cost for excavation and transportation of the CCR is estimated at $95,030,000 based on 2019 construction costs. Disposal of all the CCR from the Main Quarry would cost in excess of $200,000,000 based on 2019 disposal costs and would require over 225,000 truckloads to remove it to an off-site landfill if adequate capacity is available. A more detailed discussion of this corrective measures option relative to established evaluation criteria is provided in Section 4.0.

3.2 Wet Closure

The wet closure option, as allowed under the current Adjusted Standard (AS-96-9) would consist of maintaining the Main Quarry as an impoundment with the water level over all the currently in-place CCR and below the adjacent groundwater level to maintain an inward gradient from the east and south sides. Executing the wet closure would require temporary dewatering to regrade the existing CCR to an elevation that allows the water level in the Main Quarry to be above the CCR but below the groundwater level adjacent to the east and south. Once the regrading is completed, the water level in the Main Quarry would be allowed to naturally re-establish itself above the regraded CCR. The Main Quarry water level would be controlled by discharging water to the North Quarry, where it is pumped to the Des Plaines River in compliance with the existing NPDES permit.

The groundwater level adjacent to the Main Quarry will be based on the maximum adjusted seasonal water table level, which is the maximum predicted water table level near the Quarry, determined at the time of closure.

For the wet closure, a final cover system would not be constructed and the remaining general closure requirements are not applicable. A more detailed discussion of this corrective measures option relative to established evaluation criteria is provided in Section 4.0.

3.3 Dry Closure

Dry closure of the Main Quarry would consist of leaving the CCR in place with the elevation of the CCR above the adjoining groundwater elevation and covered with a final cover system in accordance with 257.102(d). Executing the dry closure would consist of temporarily dewatering the Main Quarry to an extent to allow the CCR to be regraded to provide positive drainage from the south, east, and west perimeters of the Main Quarry towards the north where the existing gravity discharge pipes for the Main Quarry to the North Quarry settling pond are located. After the CCR has been regraded, the final cover system (FCS) would be installed and it would follow the same slope as the regraded CCR. The FCS either would be a landfill cover (geomembrane infiltration prevention layer with a soil erosion prevention layer) or, if approved as an Adjusted Standard by the Illinois Pollution Control Board (IPCB), the proprietary ClosureTurf cover system, created by Watershed Geosynthetics, LLC in conjunction with AGRU-America.

3.3.1 Soil and Geomembrane Final Cover System

The soil and geomembrane FCS would consist of a geomembrane infiltration prevention layer that is covered with a soil protection layer. The geomembrane would also incorporate a drainage layer that would transport stormwater that infiltrates through the soil protective layer to prevent ponding on the geomembrane. The soil protective layer would consist of clean soil obtained from borrow sources located as close to the Main Quarry, if possible. A more detailed discussion of this corrective measures option relative to established evaluation criteria is provided in Section 4.0

3.3.2 ClosureTurf Final Cover System

The ClosureTurf FCS consists of a geomembrane infiltration prevention layer that also incorporates a drainage layer. The soil protection layer is replaced with synthetic turf that is infilled with sand to provide ballast to the turf. A more detailed discussion of this corrective measures option relative to established evaluation criteria is provided in Section 4.0.

4.0 CORRECTIVE MEASURE EVALUATION CRITERIA

The four identified corrective measures options were evaluated based on requirements under CCR Rule Parts 257.96(c)(1) through 257.96(c)(3). The evaluation criteria consisted of the following:

- Performance
- Reliability
- Ease of Implementation
- Potential Impacts of Appropriate Potential Remedies
    - safety impacts
    - cross-media impacts
    - control of exposure to residual contamination
- Time Required to Begin and Complete the Remedy
- Institutional requirements, such as state or local permit requirements or other environmental or public requirements

Each corrective measure was evaluated using the above criteria and that evaluation is provided in Table 5. The following highlights are provided from that evaluation.

Complete CCR Removal

- Removing the CCR from the Main Quarry would require excavating and hauling 3.38 million cubic yards, which would take at least 31 years to execute based on 50 truckloads per day, 15 cubic yards per truck, and 240 working days per year.

- Groundwater impacts at the site are anticipated to be made worse over the anticipated 31 years of excavations. The continual disturbance of these materials on a daily basis over an extended period will be reflected in long-term degradation of the existing groundwater quality conditions. Additionally, the constant traffic of vehicles removing the CCR will negatively affect the neighboring properties, including air quality and noise pollution.

Wet Closure

- Executing the wet closure option would require re-grading the existing CCR to ensure it is below the water level within the Main Quarry and would not require constructing a final cover system.

- The wet closure option does not prevent infiltration into the existing CCR and will result in a larger volume of saturated CCR.

- The wet closure is expected to take about one year to complete.

Dry Closure-Soil and Geomembrane FCS

- Existing groundwater quality being managed is expected to be stable and improve since the volume of saturated CCR is kept at a minimum and infiltration is precluded through the unsaturated CCR.

- Additional groundwater impacts are expected to be minimal during construction of the soil and geomembrane FCS dry closure since the CCR in contact with groundwater will be less disturbed as would occur with the complete excavation option.

- The soil and geomembrane cover post-closure care maintenance cost is $8.3 million.

- This option is expected to take about two years to complete.

Dry Closure-ClosureTurf FCS

- The ClosureTurf final cover will require less overall truck traffic to and from the site compared to the soil/geomembrane dry cover and the closure by removal.

- The ClosureTurf post-closure care maintenance cost is $5.1 million.

- The ClosureTurf option is safer regarding construction and delivery of materials compared to the complete CCR removal, and soil and geomembrane FCS options.

- Existing groundwater quality being managed is expected to be stable and improve since the volume of saturated CCR is kept at a minimum and infiltration is precluded through the unsaturated CCR.

- Additional groundwater impacts are expected to be minimal during construction of the ClosureTurf FCS dry closure since the CCR in contact with groundwater will be less disturbed as would occur with the complete excavation option.

- This option is expected to take about two years to complete.

5.0 SUMMARY

Four closure options were evaluated as an assessment of corrective measures for closure of the Main Quarry in accordance with 257.96(c)(1) to 257.96(c)(3) to address the water quality monitoring parameter detections above established groundwater protection standards. The four options evaluated are closure by complete CCR removal, wet closure, dry closure with a soil and geomembrane FCS, and dry closure with the ClosureTurf FCS. The options were evaluated based on performance, reliability, ease of implementation, potential impacts, and institutional requirements.

Closure by complete CCR removal would require the excavation, transportation, and disposal of 3,380,000 CY of CCR and approximately 31 years to complete. This would require continued dewatering of the Main Quarry over those 31 years with the potential to dry-out the drinking water wells located northeast of the Main Quarry. The continual disturbance of CCR on a daily basis over 31 years is expected to degrade the groundwater quality conditions beneath the Main Quarry over that time. After completion, groundwater quality is anticipated to improve since the CCR for the most part will have been removed.

In contrast, the wet closure option would require regrading about 548,000 CY of CCR, would take about one year, and would only require dewatering for a portion of that time, which would not dry out the drinking water wells. Continued potential groundwater impacts may occur because it does not preclude infiltration from precipitation and will increase the saturated volume of CCR material.

Both the soil and geomembrane FCS and the ClosureTurf FCS options would require about two years to complete and would require shorter term dewatering which would not dry out the drinking water wells. Groundwater impacts are expected to be minimal during the construction of the dry closure options because the CCR in contact with the groundwater would be less disturbed as would occur with the complete removal option. The existing groundwater quality being managed is expected to be stable and improve since the volume of saturated CCR is kept at a minimum and infiltration is precluded through the unsaturated CCR by the infiltration prevention layer as part of both dry closure options.

The ClosureTurf FCS requires less overall traffic to and from the Main Quarry compared to the soil and geomembrane FCS and the complete CCR removal options. This less traffic will produce less particulate matter air emissions, about 24 pounds, compared to the soil and geomembrane FCS, 50 pounds, and the complete CCR removal, 6,480 pounds as noted in Table 5. In addition to the fewer air emissions, the potential for traffic accidents and fatal traffic accidents involving truck traffic is less with the ClosureTurf FCS.

6.0 PROFESSIONAL ENGINEER'S CERTIFICATION

This assessment of corrective measures has been prepared in accordance with 40 CFR 257.96(c)(1) through 257.96(c)(3).

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

SEAL

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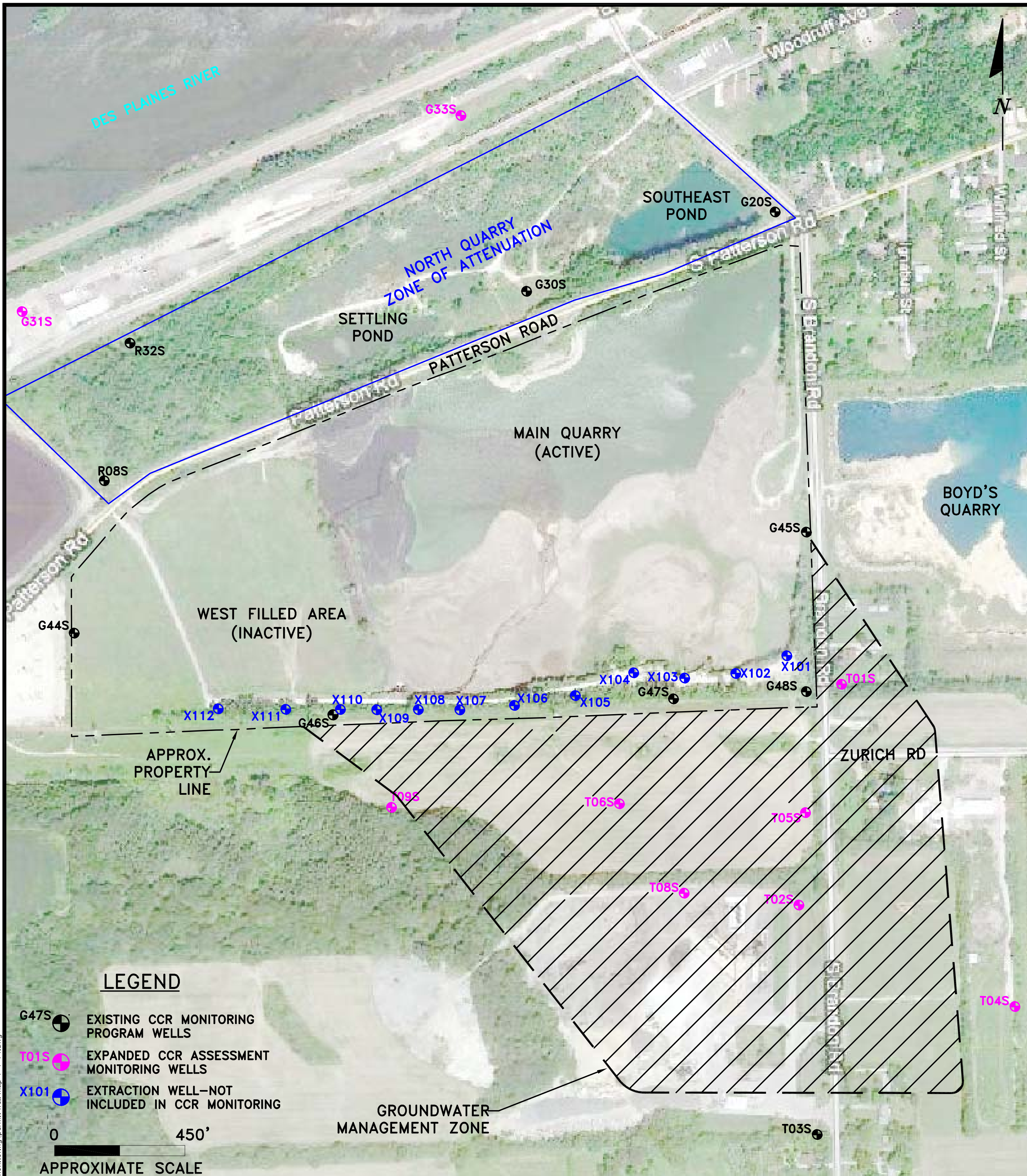
FIGURES



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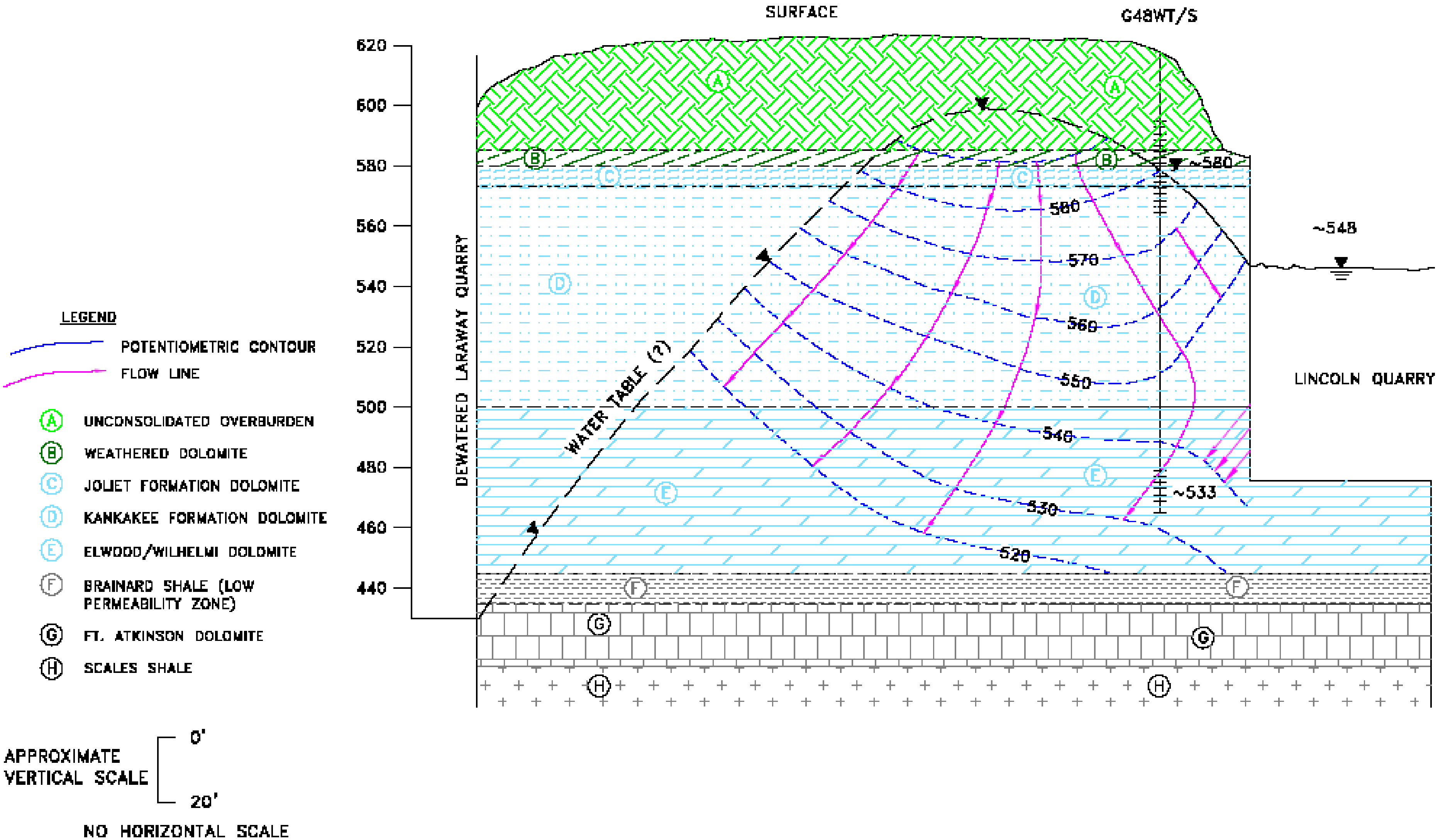
CCR MONITORING WELL NETWORK
WELL LOCATION MAP

LINCOLN STONE QUARRY
JOLIET, ILLINOIS

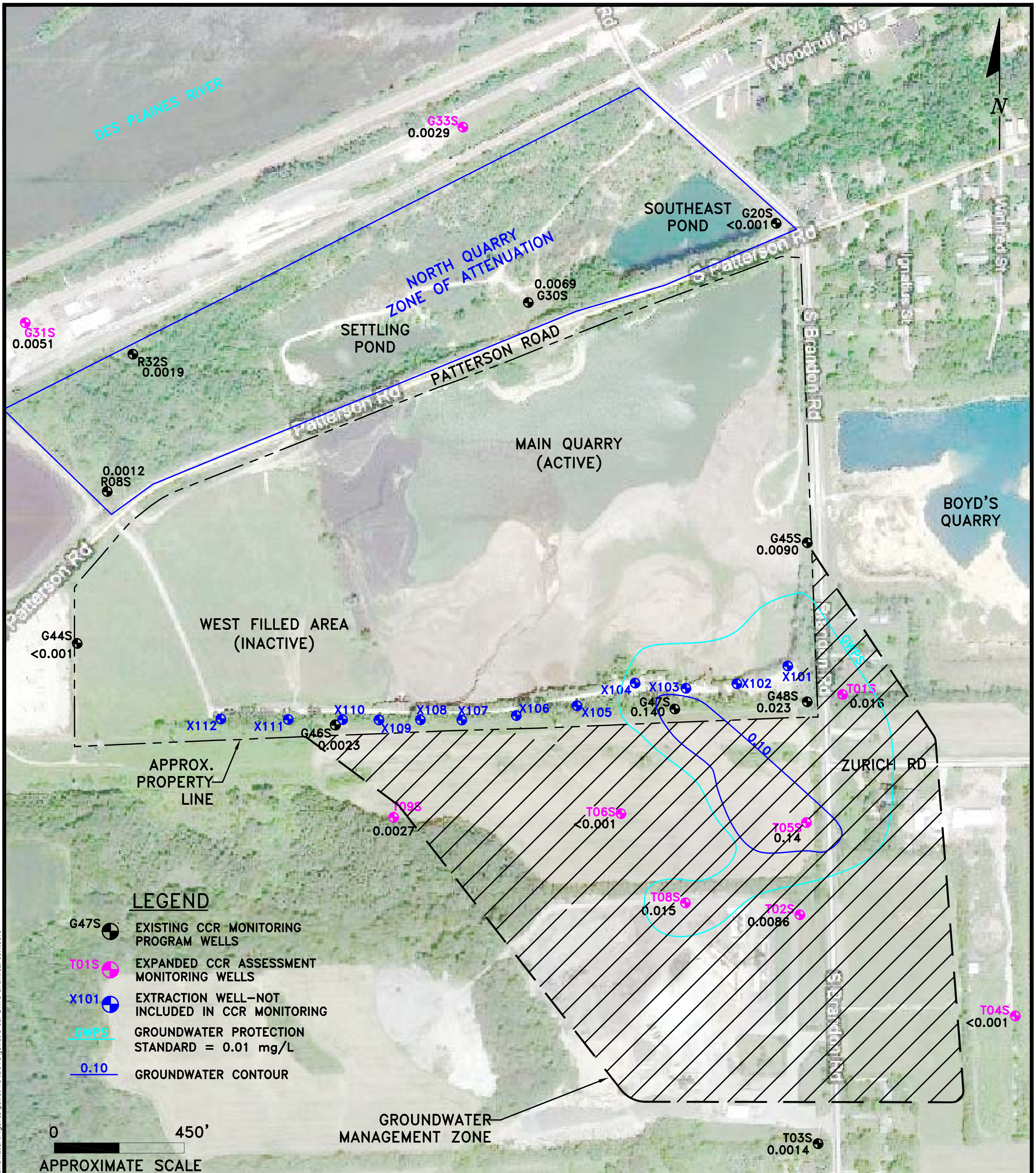
Scale: 1" = 450'	Date: May 17, 2019
KPRG Project No. 12313	FIGURE 1



GEO-HYDRO, INC
Consulting in Geology and Hydrogeology

KPRG

Figure 2
Conceptual Model
MidWest Generation – Lincoln Stone Quarry



W:\Projects\Midwest Generation\12313 Ash Pond Groundwater\Figures\Joliet #9\2018\joliet 9 ccr GWPS chemical contours

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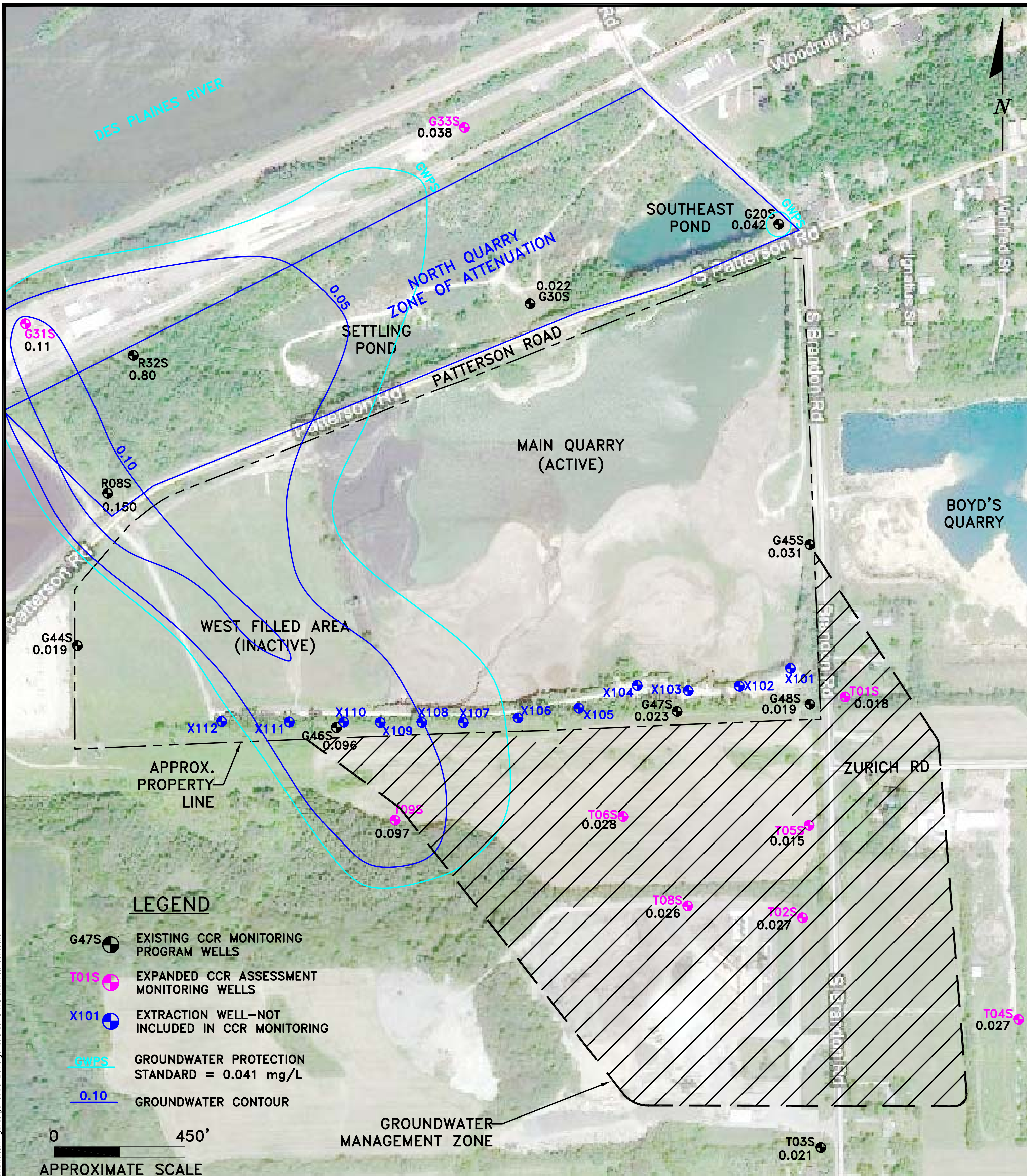
CCR ASSESSMENT EXTENT OF IMPACTS–ARSENIC

LINCOLN STONE QUARRY
JOLIET, ILLINOIS

Scale: 1" = 450'	Date: May 17, 2019
KPRG Project No. 18918	FIGURE 3



ENVIRONMENTAL CONSULTATION & REMEDIATION

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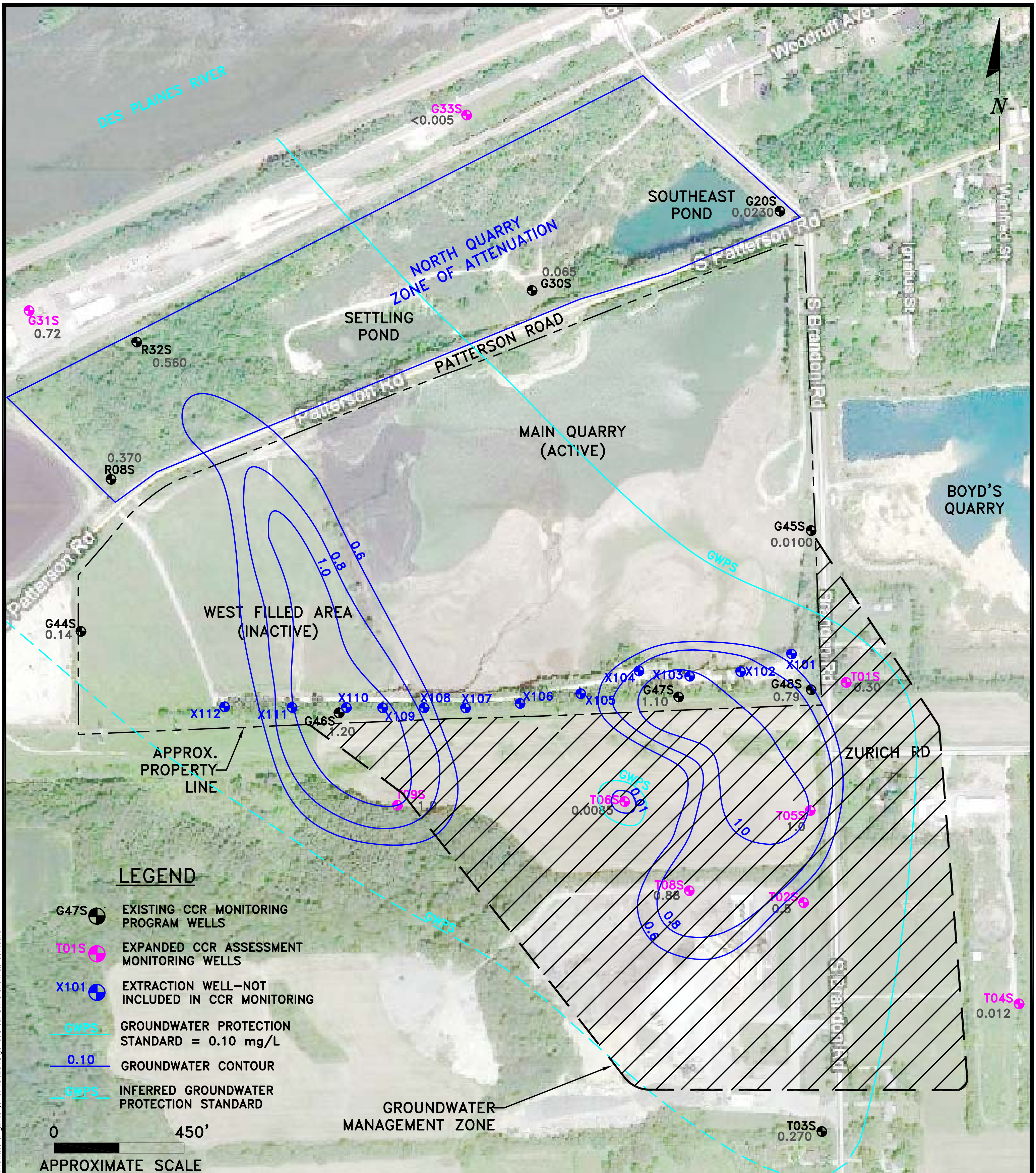
CCR ASSESSMENT EXTENT OF IMPACTS–LITHIUM

LINCOLN STONE QUARRY
JOLIET, ILLINOIS

Scale: 1" = 450'	Date: May 17, 2019
KPRG Project No. 18918	FIGURE 4

W:\Projects\Midwest Generation\12313 Ash Pond Groundwater\Figures\Joliet #9\2018\joliet 9 ccr GWPS chemical contours



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CCR ASSESSMENT EXTENT OF IMPACTS–MOLYBDENUM

LINCOLN STONE QUARRY
JOLIET, ILLINOIS

Scale: 1" = 450'	Date: May 17, 2019
KPRG Project No. 21406.12	FIGURE 5

W:\Projects\Midwest Generation\12313 Ash Pond Groundwater\Figures\Joliet #9\2018\joliet 9 ccr GWPS chemical contours

TABLES

Well	Date	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
	11/20/2015	0.81	120	180	0.35	7.20	360	810
	5/12/2016	0.68	110	140	0.34	7.37	230	860
	6/30/2016	0.48	87	110	0.34	7.50	170	670
	8/25/2016	0.47	94	100	0.35	7.28	170	790
	11/16/2016	0.41	91	90	0.33	7.34	170	620
	2/14/2017	0.43	97	97	0.32	7.36	160	620
G45S	5/23/2017	0.36	85	110	0.35	7.30	150	660
up-gradient	7/7/2017	0.42	94	120	< 0.1	7.21	150	600
	Pred. Limit*	**1.031**	**133.2**	**206.7**	**0.35**	**7.61-7.03**	**360**	**1,007**
	9/26/2017	0.43	110	130	0.3	7.21	160	790
	11/21/2017	0.34	96	130	0.33	7.29	180	700
	3/9/2018	0.38	97	110	0.32	7.18	180	710
	5/21/2018	0.76	110	150	0.33	**7.00**	230	970
	12/7/2018	0.46	91	120	0.33	**7.02**	100	740
	11/19/2015	0.5	110	75	0.22	7.07	250	710
	5/5/2016	0.84	100	100	0.21	7.16	190	820
	6/28/2016	0.98	100	94	0.19	7.30	180	910
	8/25/2016	1.1	110	99	0.20	7.32	180	880
	11/17/2016	1.3	120	100	0.19	7.14	150	860
	2/15/2017	1.0	98	110	0.19	7.36	230	810
T03S	5/22/2017	1.4	110	78	0.23	7.25	160	740
up-gradient	7/7/2017	1.1	100	F1 71	< 0.1	7.32	180	710
	Pred. Limit*	**1.85**	**129**	**134**	**0.26**	**7.55-6.93**	**292**	**1,030**
	9/26/2017	1.3	110	80	0.21	7.19	240	790
	11/20/2017	1.7	98	90	0.24	7.13	230	770
	3/7/2018	1.5	110	110	0.23	7.34	250	900
	5/17/2018	1.8	100	82	0.24	7.07	210	890
	12/11/2018	1.8	100	**140**	0.23	6.96	160	890
	11/23/2015	6.9	130	77	0.19	7.80	520	740
	5/6/2016	6.1	120	80	0.19	7.70	380	820
	6/28/2016	6.8	130	89	0.18	7.49	320	960
	8/25/2016	6.3	120	84	0.19	7.54	350	890
	11/21/2016	6.4	120	86	0.17	7.53	280	790
	2/14/2017	5.4	150	220	0.17	7.60	280	1,000
R08S	5/25/2017	12	250	90	0.17	7.56	340	830
down-gradient	7/6/2017	6.3	140	87	0.17	7.62	350	830
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/25/2017	7.3	**140**	81	0.15	**7.57**	**390**	840
	11/21/2017	7.3	**130**	89	0.15	**8.05**	**380**	800
	3/8/2018	7.4	**150**	83	0.14	**8.62**	**420**	850
	5/18/2018	7.7	**140**	82	0.14	**8.25**	320	920
	12/13/2018	7.7	**140**	79	0.15	**8.11**	240	800
	11/19/2015	1.2	59	12	0.82	7.73	110	410
	5/11/2016	1.2	53	12	0.81	7.52	77	410
	6/29/2016	1.2	54	12	0.82	7.38	69	460
	8/23/2016	1.3	56	13	0.81	7.41	67	420
	11/17/2016	1.3	59	11	0.74	7.44	55	420
	2/13/2017	1.2	54	13	0.69	7.30	93	400
G20S	5/24/2017	1.3	55	12	0.81	7.45	66	430
down-gradient	7/5/2017	1.3	61	12	0.76	7.37	70	400
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/25/2017	**1.3**	60	12	**0.78**	7.30	76	440
	11/20/2017	**1.3**	59	13	**0.78**	7.06	85	390
	3/6/2018	**1.4**	63	12	**0.76**	7.32	88	460
	5/16/2018	**1.2**	61	12	**0.75**	7.06	87	410
	12/07/18	**1.20**	58	12	**0.76**	7.41	65	480
	11/20/2015	5.80	63	190	1.3	7.46	580	1,000
	5/10/2016	5.4	53	190	1.30	7.68	390	1,100
	6/30/2016	5.2	60	F1 180	1.30	7.73	410	990
	8/25/2016	5.7	59	F1 180	1.30	7.70	390	1,100
	11/18/2016	6.4	57	170	1.2	8.04	320	1,100
	2/14/2017	5.4	62	190	1.2	7.70	450	1,000
G30S	5/25/2017	11	110	180	1.4	7.67	430	1,100
down-gradient	7/7/2017	6.6	54	190	1.3	7.48	410	1,100
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/26/2017	**6.7**	62	190	**1.3**	**8.07**	**460**	**1,100**
	11/20/2017	**6.1**	52	**210**	**1.3**	**7.77**	**440**	**1,100**
	3/7/2018	**5.1**	56	200	**1.3**	**7.97**	**470**	**1,100**
	5/17/2018	**5.7**	55	**210**	**1.2**	**7.77**	**540**	**1,100**
	12/15/2018	**5.8**	57	200	**1.2**	**7.99**	200	1100
	11/19/2015	1.3	99	88	0.28	7.32	210	640
	5/5/2016	1.9	100	140	0.32	7.38	210	810
	6/29/2016	2.5	110	110	0.35	7.53	280	860
	8/26/2016	3.0	120	100	0.4	7.30	330	850
	11/18/2016	3.3	120	99	0.34	7.38	270	830
	2/16/2017	F1 4.0	120	99	0.34	7.39	340	830
R32S	5/25/2017	8.3	240	88	0.42	7.54	320	850
down-gradient	7/7/2017	6.2	120	96	0.42	7.61	360	830
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/28/2017	**4.8**	**140**	78	**0.36**	7.29	290	870
	11/21/2017	**5.7**	120	97	**0.38**	7.50	**390**	900
	3/7/2018	**5.8**	**130**	86	0.32	**7.57**	350	880
	5/21/2018	**4.4**	120	77	0.29	7.13	310	**1,000**
	12/13/2018	**3.5**	120	F1 72	0.26	7.43	280	880

Notes:

* - Intrawell Prediction Limit. All others are interwell comparisons.

All units are in mg/l except pH is in standard units.

F1 - MS and/or MSD Recovery outside of limits.

Pred. Limit - Prediction Limit

Italics Date - Detection Monitoring and resample after statistical background establishment.

** - Based on pooled background from G45S/T03S.

All others based on G45S as background.

Bold - Potential statistically significant increase.

Well	Date	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
	11/20/2015	1.0	120	43	0.21	7.11	220	640
	5/9/2016	0.91	110	37	0.18	7.39	120	690
	6/30/2016	0.69	100	32	0.18	7.59	99	620
	8/26/2016	0.9	120	36	0.19	7.12	110	710
	11/16/2016	0.82	120	26	0.17	7.15	88	530
	2/16/2017	0.86	120	30	0.15	7.38	120	620
G44S	5/24/2017	0.83	120	31	0.19	7.08	95	600
down-gradient	7/10/2017	0.83	110	30	< 0.1	7.00	110	700
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/28/2017	0.99	**130**	30	0.19	7.13	100	730
	11/21/2017	0.79	110	35	0.18	7.06	120	640
	3/7/2018	0.91	120	36	0.18	7.19	110	670
	5/17/2018	0.98	120	35	0.18	**7.02**	96	780
	12/10/2018	**1.1**	120	43	0.19	7.41	78	630
	11/23/2015	6.0	110	80	0.27	7.32	430	780
	5/9/2016	7.7	100	100	0.28	7.77	360	940
	6/30/2016	7.9	100	99	0.29	8.26	290	880
	8/26/2016	7.2	100	120	0.35	7.48	350	1,000
	11/18/2016	6.5	110	120	0.39	7.56	330	1,000
	2/16/2017	6.1	100	150	0.41	7.94	410	1,000
G46S	5/22/2017	6.8	100	130	0.44	7.37	350	970
down-gradient	7/6/2017	4.9	100	150	0.41	7.33	290	880
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/27/2017	**4.9**	88	160	**0.4**	7.28	270	890
	11/21/2017	**5.3**	78	170	**0.43**	**7.73**	270	800
	3/8/2018	**5.9**	110	140	**0.41**	**7.75**	350	940
	5/18/2018	**5.9**	110	120	**0.4**	**7.66**	260	**1,100**
	12/11/2018	**7.60**	120	110	**0.38**	**7.66**	270	**1,100**
	11/23/2015	4.6	11	160	0.45	9.22	480	700
	5/6/2016	5.0	7.8	140	0.72	9.86	410	910
	7/1/2016	6.4	8.4	150	0.68	9.32	340	860
	8/24/2016	9.3	9.2	140	0.67	9.19	300	830
	11/16/2016	15	1.3	F1 150	1.8	10.08	620	1,700
	2/15/2017	7.6	4.4	160	1.1	9.26	540	1,200
G47S	5/23/2017	18	0.93	160	2.2	10.03	720	1,800
down-gradient	7/10/2017	18	1.2	150	2.1	10.06	780	1,800
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/27/2017	**18**	1.1	150	**2.0**	**10.15**	**750**	**1,900**
	11/22/2017	**21**	1.1	150	**2.1**	**10.56**	**710**	**1,800**
	3/8/2018	**18**	1.1	170	**2.1**	**10.67**	**780**	**1,900**
	5/18/2018	**3.7**	1.1	160	**1.7**	**7.79**	**570**	**1,800**
	12/11/2018	**13**	2.8	140	**1.1**	**10.14**	**440**	**1,300**
	11/20/2015	11.00	6.9	120	1.5	9.08	760	1,100
	5/5/2016	9.30	5.9	120	1.5	9.53	560	1,200
	7/1/2016	9.50	4.2	120	1.4	9.60	480	1,100
	8/24/2016	10.00	5.5	120	1.4	9.31	420	1,100
	11/16/2016	9.80	10	110	1.4	9.61	340	1,100
	2/15/2017	8.40	8.3	120	1.2	9.63	490	1,100
G48S	5/23/2017	9.20	8.1	120	1.3	9.49	470	1,100
down-gradient	7/10/2017	7.80	11	110	1.2	8.77	460	1,000
	Pred. Limit	**1.01**	**126****	**203**	**0.35**	**7.52-7.04****	**360****	**955**
	9/27/2017	**7.60**	18	100	**1.1**	**8.94**	**480**	**1,100**
	11/22/2017	**8.60**	12	120	**1.2**	**9.42**	**450**	**1,000**
	3/8/2018	**5.30**	62	100	**0.85**	**8.13**	**450**	**1,000**
	5/18/2018	**5.90**	53	100	**0.92**	**7.79**	**370**	**1,100**
	12/11/2018	**7.30**	23	110	**1.1**	**8.42**	310	**1,000**

Notes:
* - Intrawell Prediction Limit. All others are interwell comparisons.
All units are in mg/l except pH is in standard units.
F1 - MS and/or MSD Recovery outside of limits.
Pred. Limit - Prediction Limit
Italics Date - Detection Monitoring and resample after statistical background establishment.

** - Based on pooled background from G45S/T03S.
All others based on G45S as background.
Bold - Potential statistically significant increase.

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226 + 228 Combined	Selenium	Thallium
	11/20/2015	< 0.003	0.0081	0.044	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.35	< 0.0005	0.036	< 0.0002	0.0120	1.76	< 0.0025	< 0.002
	5/12/2016	< 0.003	0.0076	0.041	< 0.001	< 0.0005	< 0.005	< 0.001	0.34	< 0.0005	0.036	< 0.0002	0.0100	3.01	< 0.0025	< 0.002
	6/30/2016	< 0.003	0.0075	0.031	< 0.001	< 0.0005	< 0.005	< 0.001	0.34	< 0.0005	0.034	< 0.0002	0.008	2.05	< 0.0025	< 0.002
	8/25/2016	< 0.003	0.0076	0.036	< 0.001	< 0.0005	< 0.005	< 0.001	0.35	< 0.0005	0.031	< 0.0002	0.0086	1.91	< 0.0025	< 0.002
	11/16/2016	< 0.003	0.0079	0.033	< 0.001	< 0.0005	< 0.005	< 0.001	0.33	< 0.0005	0.028	< 0.0002	0.0094	2.04	< 0.0025	< 0.002
	2/14/2017	< 0.003	0.0093	0.037	< 0.001	< 0.0005	< 0.005	< 0.001	0.32	< 0.0005	0.029	< 0.0002	0.0083	1.85	< 0.0025	< 0.002
G45S up-gradient	5/23/2017	< 0.003	0.0082	0.033	< 0.001	< 0.0005	< 0.005	< 0.001	0.35	< 0.0005	0.027	< 0.0002	0.0093	1.40	< 0.0025	< 0.002
	7/7/2017	< 0.003	0.0086	0.035	< 0.001	< 0.0005	< 0.005	< 0.001	< 0.1	< 0.0005	0.030	< 0.0002	0.007	1.88	< 0.0025	< 0.002
	9/26/2017	< 0.003	0.0096	0.04	< 0.001	< 0.0005	< 0.005	< 0.001	0.3	< 0.0005	0.029	< 0.0002	0.0079	2.14	< 0.0025	< 0.002
	11/21/2017	< 0.003	0.0094	0.038	< 0.001	< 0.0005	< 0.005	< 0.001	0.33	< 0.0005	0.028	< 0.0002	0.0072	8.45	< 0.0025	< 0.002
	3/9/2018	< 0.003	0.0093	0.036	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.32	< 0.0005	0.028	^ < 0.0002	0.008	1.89	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/21/2018	NA	0.0072	0.047	NA	NA	NA	< 0.001	0.33	< 0.0005	0.033	NA	0.013	2.37	< 0.0025	NA
	12/7/2018	NA	0.0090	0.034	NA	NA	NA	< 0.001	0.330	< 0.0005	0.031	NA	0.0100	1.910	< 0.0025	NA
	11/19/2015	< 0.003	0.0019	0.063	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.22	< 0.0005	0.019	< 0.0002	0.0260	1.101	< 0.0025	< 0.002
	5/5/2016	< 0.003	0.0013	0.081	< 0.001	< 0.0005	< 0.005	< 0.001	0.21	< 0.0005	0.018	< 0.0002	0.03	1.43	< 0.0025	< 0.002
	6/28/2016	< 0.003	0.0011	0.086	< 0.001	< 0.0005	< 0.005	0.0011	0.19	< 0.0005	0.017	< 0.0002	0.037	1.18	< 0.0025	< 0.002
	8/25/2016	< 0.003	< 0.001	0.086	< 0.001	< 0.0005	< 0.005	< 0.001	0.2	< 0.0005	0.016	< 0.0002	0.043	1.54	< 0.0025	< 0.002
	11/17/2016	< 0.003	0.0012	0.096	< 0.001	< 0.0005	< 0.005	0.0012	0.19	< 0.0005	0.022	< 0.0002	0.14	1.61	< 0.0025	< 0.002
	2/15/2017	< 0.003	0.0011	0.086	< 0.001	< 0.0005	< 0.005	0.0013	0.19	< 0.0005	< 0.05	< 0.0002	0.12	0.938	< 0.0025	< 0.002
T03S up-gradient	5/22/2017	< 0.003	0.0017	B 0.088	^ < 0.001	< 0.0005	< 0.005	0.0015	0.23	0.0023	0.019	< 0.0002	0.13	1.21	< 0.0025	< 0.002
	7/7/2017	< 0.003	< 0.001	0.078	< 0.001	< 0.0005	< 0.005	< 0.001	< 0.1	< 0.0005	0.019	< 0.0002	0.099	1.11	< 0.0025	< 0.002
	9/26/2017	< 0.003	0.0011	0.086	< 0.001	< 0.0005	< 0.005	0.0013	0.21	< 0.0005	0.018	< 0.0002	0.14	1.33	< 0.0025	< 0.002
	11/20/2017	< 0.003	0.0014	0.087	< 0.001	< 0.0005	< 0.005	< 0.001	0.24	< 0.0005	0.02	< 0.0002	0.2	1.59	< 0.0025	< 0.002
	3/7/2018	< 0.003	0.0023	0.093	< 0.001	< 0.0005	< 0.005	0.0013	0.23	< 0.0005	0.022	< 0.0002	0.26	1.30	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/17/2018	NA	0.001	0.087	NA	NA	NA	0.0013	0.24	< 0.0005	0.021	NA	**0.240**	1.25	< 0.0025	NA
	12/11/2018	NA	0.0014	0.095	NA	NA	NA	0.0012	0.230	< 0.0005	0.021	NA	**0.270**	1.31	< 0.0025	NA
	11/23/2015	< 0.003	0.0019	0.052	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.19	< 0.0005	0.14	< 0.0002	0.410	1.608	0.0061	< 0.002
	5/6/2016	< 0.003	0.0013	0.052	< 0.001	< 0.0005	< 0.005	< 0.001	0.19	< 0.0005	0.14	< 0.0002	0.390	1.08	0.0079	< 0.002
	6/28/2016	< 0.003	0.0019	0.056	< 0.001	< 0.0005	< 0.005	< 0.001	0.18	< 0.0005	0.14	< 0.0002	0.37	1.87	F1 0.0074	< 0.002
	8/25/2016	< 0.003	0.0015	0.053	< 0.001	< 0.0005	< 0.005	< 0.001	0.19	< 0.0005	0.13	< 0.0002	0.33	1.50	0.0032	< 0.002
	11/21/2016	< 0.003	0.0016	0.052	< 0.001	< 0.0005	< 0.005	< 0.001	0.17	< 0.0005	0.140	< 0.0002	0.36	2.13	0.0037	< 0.002
	2/14/2017	< 0.003	0.002	0.081	< 0.001	< 0.0005	< 0.005	< 0.001	0.17	< 0.0005	0.120	< 0.0002	0.3	2.71	0.0029	< 0.002
R08S down-gradient	5/25/2017	< 0.006	0.0028	0.092	^ < 0.002	< 0.001	< 0.01	< 0.002	0.17	< 0.001	0.250	< 0.0002	0.64	0.821	0.021	< 0.004
	7/6/2017	< 0.003	0.002	0.052	< 0.001	< 0.0005	< 0.005	< 0.001	0.17	^ < 0.0005	0.140	< 0.0002	0.35	1.15	0.0054	^ < 0.002
	9/25/2017	< 0.003	0.002	0.048	< 0.001	< 0.0005	< 0.005	< 0.001	0.15	0.00067	0.130	< 0.0002	0.38	1.27	0.0079	< 0.002
	11/21/2017	< 0.003	0.0017	0.046	< 0.001	< 0.0005	< 0.005	< 0.001	0.15	< 0.0005	0.140	< 0.0002	0.34	1.09	0.015	< 0.002
	3/8/2018	< 0.003	0.0016	0.05	< 0.001	< 0.0005	< 0.005	< 0.001	0.14	< 0.0005	0.150	< 0.0002	0.37	1.55	0.012	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/18/2018	NA	0.0013	0.046	NA	NA	NA	< 0.001	0.14	< 0.0005	**0.150**	NA	**0.35**	1.22	0.017	NA
	12/13/2018	NA	0.0012	0.046	NA	NA	NA	< 0.001	0.150	< 0.0005	**0.150**	NA	**0.370**	1.450	0.0170	NA
	11/19/2015	< 0.003	< 0.001	0.049	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.82	< 0.0005	0.036	< 0.0002	0.0068	2.078	< 0.0025	< 0.002
	5/11/2016	< 0.003	< 0.001	0.049	< 0.001	< 0.0005	< 0.005	< 0.001	0.81	< 0.0005	0.037	0.00027	0.011	2.52	< 0.0025	< 0.002
	6/29/2016	< 0.003	< 0.001	0.051	< 0.001	< 0.0005	< 0.005	0.0011	0.82	< 0.0005	0.04	< 0.0002	0.014	2.79	< 0.0025	< 0.002
	8/23/2016	< 0.003	< 0.001	0.047	< 0.001	< 0.0005	< 0.005	< 0.001	0.81	< 0.0005	0.039	< 0.0002	0.017	3.67	< 0.0025	< 0.002
	11/17/2016	< 0.003	< 0.001	0.056	< 0.001	< 0.0005	< 0.005	0.0018	0.74	< 0.0005	0.042	< 0.0002	0.019	1.98	< 0.0025	< 0.002
	2/13/2017	< 0.003	< 0.001	0.046	< 0.001	< 0.0005	< 0.005	< 0.0010	0.69	< 0.0005	0.04	< 0.0002	0.018	2.44	< 0.0025	< 0.002
G20S down-gradient	5/24/2017	< 0.003	< 0.001	0.046	^ < 0.001	< 0.0005	< 0.005	< 0.0010	0.81	< 0.0005	0.038	< 0.0002	0.017	2.15	< 0.0025	< 0.002
	7/5/2017	< 0.003	< 0.001	0.054	< 0.001	< 0.0005	< 0.005	0.0021	0.76	^ < 0.0005	0.04	< 0.0002	0.019	1.83	< 0.0025	^ < 0.002
	9/25/2017	< 0.003	< 0.001	0.051	< 0.001	< 0.0005	< 0.005	0.0015	0.78	< 0.0005	0.036	< 0.0002	0.022	2.19	< 0.0025	< 0.002
	11/20/2017	< 0.003	< 0.001	0.051	< 0.001	< 0.0005	< 0.005	0.0022	0.78	< 0.0005	0.041	< 0.0002	0.021	2.50	< 0.0025	< 0.002
	3/6/2018	< 0.003	< 0.001	0.049	^ < 0.001	< 0.0005	< 0.005	< 0.0010	0.76	< 0.0005	0.042	< 0.0002	0.021	2.83	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/16/2018	NA	< 0.001	0.049	NA	NA	NA	0.0024	0.75	^ < 0.0005	0.04	NA	0.019	2.12	< 0.0025	NA
	12/7/2018	NA	< 0.001	0.048	NA	NA	NA	0.0010	0.760	0.0048	**0.042**	NA	0.0230	2.26	< 0.0025	NA
	11/20/2015	< 0.003	0.014	0.041	^ < 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.022	< 0.0002	0.33	1.484	< 0.0025	< 0.002
	5/10/2016	< 0.003	0.017	0.039	< 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.021	< 0.0002	0.3	1.41	< 0.0025	< 0.002
	6/30/2016	< 0.003	0.013	0.04	< 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.023	< 0.0002	0.3	1.17	< 0.0025	< 0.002
	8/25/2016	< 0.003	0.015	0.039	< 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.02	< 0.0002	0.31	1.87	< 0.0025	< 0.002
	11/18/2016	< 0.003	0.016	0.043	< 0.001	< 0.0005	< 0.005	< 0.001	1.2	< 0.0005	0.023	< 0.0002	0.33	2.36	< 0.0025	< 0.002
	2/14/2017	< 0.003	0.011	0.042	< 0.001	< 0.0005	< 0.005	< 0.001	1.2	< 0.0005	0.021	< 0.0002	0.24	1.84	< 0.0025	< 0.002
G30S down-gradient	5/25/2017	< 0.006	0.019	0.078	^ < 0.002	< 0.001	< 0.01	< 0.002	1.4	< 0.001	0.04	< 0.0002	0.45	1.76	< 0.005	< 0.004
	7/7/2017	< 0.003	0.011	0.039	< 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.021	< 0.0002	0.26	1.59	< 0.0025	< 0.002
	9/26/2017	< 0.003	0.011	0.041	< 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.021	< 0.0002	0.2	1.41	< 0.0025	< 0.002
	11/20/2017	< 0.003	0.01	0.04	< 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.019	< 0.0002	0.19	1.73	< 0.0025	< 0.002
	3/7/2018	< 0.003	0.011	0.043	< 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.019	< 0.0002	0.14	1.94	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/17/2018	NA	**0.011**	0.043	NA	NA	NA	< 0.001	1.2	< 0.0005	0.021	NA	**0.13**	1.57	F1 < 0.0025	NA
	12/14/2018	NA	0.0069	0.041	NA	NA	NA	< 0.001	1.2	< 0.0005	0.022	NA	0.065	2.04	< 0.0025	NA
	11/19/2015	< 0.003	0.0018	0.033	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.28	< 0.0005	0.04	< 0.0002	0.16	1.928	< 0.0025	< 0.002
	5/5/2016	< 0.003	0.0034	0.039	< 0.001	< 0.0005	< 0.005	< 0.001	0.32	0.0005	0.069	< 0.0002	0.29	2.26	< 0.0025	< 0.002
	6/29/2016	< 0.003	0.0021	0.042	< 0.001	< 0.0005	< 0.005	< 0.001	0.35	< 0.0005	0.065	< 0.0002	0.43	2.12	< 0.0025	< 0.002
	8/26/2016	< 0.003	0.0014	0.043	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.4	< 0.0005	0.056	< 0.0002	0.48	2.39	< 0.0025	< 0.002
	11/18/2016	< 0.003	0.0016	0.042	< 0.001	< 0.0005	< 0.005	< 0.001	0.34	< 0.0005	0.063	< 0.0002	0.55	3.17	< 0.0025	< 0.002
	2/16/2017	< 0.003	0.002	0.039	< 0.001	< 0.0005	< 0.005	< 0.001	0.34	< 0.0005	0.064	< 0.0002	0.57	1.76	F1 < 0.0025	< 0.002
R32S down-gradient	5/25/2017	< 0.006	0.0042	0.075	^ < 0.002	< 0.001	< 0.01	< 0.002	0.42	< 0.001	0.14	< 0.0002	1.4	1.82	< 0.005	< 0.004
	7/7/2017	< 0.003	0.0043	0.04	< 0.001	< 0.0005	< 0.005	< 0.001	0.42	< 0.0005	0.1	< 0.0002	0.87	2.08	< 0.0025	< 0.002
	9/28/2017	< 0.003	0.003	0.044	< 0.001	< 0.0005	< 0.005	< 0.001	0.36	< 0.0005	0.086	< 0.0002	0.57	1.79	< 0.0025	< 0.002
	11/21/2017	< 0.003	0.0037	0.041	< 0.001	< 0.0005	< 0.005	< 0.001	0.38	< 0.0005	0.11	< 0.0002	0.74	1.82	< 0.0025	< 0.002
	3/7/2018	< 0.003	0.0029	0.042	< 0.001	< 0.0005	< 0.005	< 0.001	0.32	< 0.0005	0.11	< 0.0002	0.67	2.56	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/21/2018	NA	0.0024	0.04	NA	NA	NA	< 0.001	0.29	< 0.0005	**0.1**	NA	**0.64**	2.22	< 0.0025	NA
	12/13/2018	NA	0.0019	0.043	NA	NA	NA	< 0.001	0.260	0.0017	**0.080**	NA	**0.560**	2.23	< 0.0025	NA

Notes:
All units are in mg/l except Radium is in pCi/L as noted.
NC - Not calculated since not detected compound in first round of assessment monitoring.
NYR- Data not yet received.
F1 - MS and/or MSD Recovery outside of limits.
B - Compound was found in the blank and sample.
NA- Not Analyzed; non-detect in previous monitoring
^ - Denotes instrument related QC exceeds the control limits
GWPS - Groundwater Protection Standard.
BOLD - Above GWPS.

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226 + 228 Combined	Selenium	Thallium
	11/20/2015	< 0.003	0.0012	0.053	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.21	< 0.0005	0.017	< 0.0002	0.1000	1.161	< 0.0025	< 0.002
	5/9/2016	< 0.003	< 0.001	0.049	< 0.001	< 0.0005	< 0.005	< 0.001	0.18	< 0.0005	0.015	< 0.0002	0.046	< 0.415	< 0.0025	< 0.002
	6/30/2016	< 0.003	< 0.001	0.044	< 0.001	< 0.0005	< 0.005	< 0.001	0.18	< 0.0005	0.014	< 0.0002	0.025	0.879	< 0.0025	< 0.002
	8/26/2016	< 0.003	< 0.001	0.053	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.19	< 0.0005	0.014	< 0.0002	0.047	0.816	< 0.0025	< 0.002
	11/16/2016	< 0.003	< 0.001	0.048	< 0.001	< 0.0005	< 0.005	< 0.001	0.17	< 0.0005	0.011	< 0.0002	0.041	0.475	< 0.0025	< 0.002
	2/16/2017	< 0.003	< 0.001	0.051	< 0.001	< 0.0005	< 0.005	< 0.001	0.15	< 0.0005	0.014	< 0.0002	0.044	0.729	< 0.0025	< 0.002
G44S down-gradient	5/24/2017	< 0.003	< 0.001	0.048	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.19	< 0.0005	0.011	< 0.0002	0.031	1.02	< 0.0025	< 0.002
	7/10/2017	< 0.003	< 0.001	0.049	< 0.001	< 0.0005	< 0.005	< 0.001	< 0.1	< 0.0005	0.012	< 0.0002	0.061	0.667	< 0.0025	< 0.002
	9/28/2017	< 0.003	< 0.001	0.048	< 0.001	< 0.0005	< 0.005	< 0.001	0.19	< 0.0005	0.014	< 0.0002	0.081	0.614	< 0.0025	< 0.002
	11/21/2017	< 0.003	< 0.001	0.051	< 0.001	< 0.0005	< 0.005	< 0.001	0.18	< 0.0005	0.016	< 0.0002	0.055	0.913	< 0.0025	< 0.002
	3/7/2018	< 0.003	0.0014	0.053	< 0.001	< 0.0005	< 0.005	< 0.001	0.18	< 0.0005	0.017	< 0.0002	0.049	1.31	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/17/2018	NA	< 0.001	0.054	NA	NA	NA	< 0.001	0.18	< 0.0005	0.016	NA	0.071	0.714	< 0.0025	NA
	12/10/2018	NA	< 0.001	0.057	NA	NA	NA	< 0.001	0.19	< 0.0005	0.019	NA	**0.14**	0.454	< 0.0025	NA
	11/23/2015	< 0.003	0.0033	0.064	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.27	< 0.0005	0.073	< 0.0002	0.5	1.468	< 0.0025	< 0.002
	5/9/2016	< 0.003	0.0018	0.099	< 0.001	< 0.0005	< 0.005	< 0.001	0.28	0.0005	0.11	< 0.0002	0.7	1.85	< 0.0025	< 0.002
	6/30/2016	< 0.003	0.0014	0.098	< 0.001	< 0.0005	< 0.005	< 0.001	0.29	< 0.0005	0.13	< 0.0002	0.71	1.94	< 0.0025	< 0.002
	8/26/2016	< 0.003	0.0027	0.054	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.35	< 0.0005	0.12	< 0.0002	1.2	1.17	< 0.0025	< 0.002
	11/18/2016	< 0.003	0.0025	0.051	< 0.001	< 0.0005	< 0.005	< 0.0010	0.39	< 0.0005	0.13	< 0.0002	1.8	< 0.601	< 0.0025	< 0.002
	2/16/2017	< 0.003	0.0024	0.053	< 0.001	< 0.0005	< 0.005	< 0.0010	0.41	< 0.0005	0.091	< 0.0002	1.4	1.07	< 0.0025	< 0.002
G46S down-gradient	5/22/2017	< 0.003	0.0033	B 0.046	^ < 0.001	< 0.0005	< 0.005	< 0.0010	0.44	< 0.0005	0.11	< 0.0002	1.4	0.683	< 0.0025	< 0.002
	7/6/2017	< 0.003	0.0034	0.044	< 0.001	< 0.0005	< 0.005	0.0010	0.41	^ < 0.0005	0.076	< 0.0002	0.92	0.709	< 0.0025	^ < 0.002
	9/27/2017	< 0.003	0.0043	0.031	< 0.001	< 0.0005	< 0.005	< 0.0010	0.4	< 0.0005	0.091	< 0.0002	0.63	0.754	< 0.0025	< 0.002
	11/21/2017	< 0.003	0.0055	0.032	< 0.001	< 0.0005	< 0.005	< 0.0010	0.43	< 0.0005	0.11	< 0.0002	0.68	0.776	< 0.0025	< 0.002
	3/8/2018	< 0.003	0.0039	0.049	< 0.001	< 0.0005	< 0.005	< 0.0010	0.41	0.00053	0.093	< 0.0002	0.82	1.29	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/18/2018	NA	0.0028	0.048	NA	NA	NA	< 0.0010	0.4	< 0.0005	**0.073**	NA	**0.84**	1.07	< 0.0025	NA
	12/11/2018	NA	0.0023	0.055	NA	NA	NA	< 0.001	0.380	< 0.0005	**0.096**	NA	**1.20**	1.22	< 0.0025	NA
	11/23/2015	< 0.003	0.018	0.018	^ < 0.001	< 0.0005	< 0.005	< 0.001	0.45	< 0.0005	0.036	< 0.0002	0.32	0.898	0.003	< 0.002
	5/6/2016	< 0.003	0.034	0.017	< 0.001	< 0.0005	< 0.005	< 0.001	0.72	< 0.0005	0.033	< 0.0002	0.41	0.736	0.0033	< 0.002
	7/1/2016	< 0.003	0.022	0.019	< 0.001	^ < 0.0005	< 0.005	< 0.001	0.68	< 0.0005	0.038	< 0.0002	0.53	1.01	< 0.0025	< 0.002
	8/24/2016	< 0.003	0.017	0.023	< 0.001	< 0.0005	< 0.005	< 0.001	0.67	< 0.0005	0.028	< 0.0002	0.41	1.06	< 0.0025	< 0.002
	11/16/2016	< 0.003	0.14	0.0091	< 0.001	< 0.0005	< 0.005	< 0.001	1.8	< 0.0005	0.015	< 0.0002	1.4	< 1.38	0.0038	< 0.002
	2/15/2017	< 0.003	0.059	0.016	< 0.001	< 0.0005	< 0.005	< 0.001	1.1	< 0.0005	< 0.05	< 0.0002	0.57	0.716	0.0035	< 0.002
G47S down-gradient	5/23/2017	< 0.003	0.18	0.0081	^ < 0.001	< 0.0005	< 0.005	< 0.001	2.2	< 0.0005	0.013	< 0.0002	1.3	< 0.361	0.0025	< 0.002
	7/10/2017	< 0.003	0.17	0.0085	< 0.001	< 0.0005	< 0.005	< 0.001	2.1	< 0.0005	0.013	< 0.0002	1.2	0.733	< 0.0025	< 0.002
	9/27/2017	< 0.003	0.21	0.0085	< 0.001	< 0.0005	< 0.005	< 0.001	2	< 0.0005	0.014	< 0.0002	1.3	0.836	0.0027	< 0.002
	11/22/2017	< 0.003	0.23	0.009	< 0.001	< 0.0005	< 0.005	< 0.001	2.1	< 0.0005	0.012	< 0.0002	1.5	0.692	0.0044	< 0.002
	3/8/2018	< 0.003	0.25	0.009	< 0.001	< 0.0005	< 0.005	< 0.001	2.1	< 0.0005	0.014	< 0.0002	1.4	0.790	0.0042	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/18/2018	NA	**0.23**	0.0087	NA	NA	NA	< 0.001	1.7	< 0.0005	0.015	NA	**1.5**	1.01	0.0039	NA
	12/11/2018	NA	**0.140**	0.0110	NA	NA	NA	< 0.001	1.10	< 0.0005	0.023	NA	**1.10**	0.597	0.0031	NA
	11/20/2015	< 0.003	0.03	0.015	^ < 0.001	< 0.0005	< 0.005	< 0.001	1.5	< 0.0005	0.015	< 0.0002	1.4	0.8512	< 0.0025	< 0.002
	5/5/2016	< 0.003	0.046	0.014	< 0.001	< 0.0005	< 0.005	< 0.001	1.5	< 0.0005	0.016	< 0.0002	1.2	0.800	< 0.0025	< 0.002
	7/1/2016	< 0.003	0.038	0.011	< 0.001	^ < 0.0005	< 0.005	< 0.001	1.4	< 0.0005	0.013	< 0.0002	1.2	1.01	< 0.0025	< 0.002
	8/24/2016	< 0.003	0.032	0.014	< 0.001	< 0.0005	< 0.005	< 0.001	1.4	< 0.0005	0.012	< 0.0002	1.1	1.16	< 0.0025	< 0.002
	11/16/2016	< 0.003	0.03	0.018	< 0.001	< 0.0005	< 0.005	< 0.001	1.4	< 0.0005	0.016	< 0.0002	1.1	1.65	< 0.0025	< 0.002
	2/15/2017	< 0.003	0.038	0.015	< 0.001	< 0.0005	< 0.005	< 0.001	1.2	< 0.0005	0.014	< 0.0002	0.79	0.824	< 0.0025	< 0.002
G48S down-gradient	5/23/2017	< 0.003	0.03	0.014	^ < 0.001	< 0.0005	< 0.005	< 0.001	1.3	< 0.0005	0.016	< 0.0002	0.95	0.661	< 0.0025	< 0.002
	7/10/2017	< 0.003	0.022	0.017	< 0.001	< 0.0005	< 0.005	< 0.001	1.2	< 0.0005	0.016	< 0.0002	0.84	1.39	< 0.0025	< 0.002
	9/27/2017	< 0.003	0.024	0.019	< 0.001	< 0.0005	< 0.005	< 0.001	1.1	< 0.0005	0.019	< 0.0002	0.72	1.32	< 0.0025	< 0.002
	11/22/2017	< 0.003	0.027	0.015	< 0.001	< 0.0005	< 0.005	< 0.001	1.2	< 0.0005	0.016	< 0.0002	0.77	1.27	< 0.0025	< 0.002
	3/8/2018	< 0.003	0.017	0.031	< 0.001	< 0.0005	< 0.005	< 0.001	0.85	< 0.0005	0.023	< 0.0002	0.51	2.30	< 0.0025	< 0.002
	GWPS	**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.10**	**5**	**0.05**	**NC**
	5/18/2018	NA	**0.022**	0.023	NA	NA	NA	< 0.001	0.92	< 0.0005	0.023	NA	**0.49**	0.962	< 0.0025	NA
	12/11/2018	NA	**0.023**	0.016	NA	NA	NA	< 0.001	1.1	0.0049	0.019	NA	**0.79**	0.921	< 0.0025	NA

Notes:
All units are in mg/l except Radium is in pCi/L as noted.
NC - Not calculated since not detected compound in first round of assessment monitoring.
F1 - MS and/or MSD Recovery outside of limits.
B - Compound was found in the blank and sample.
NA- Not Analyzed; non-detect in previous monitoring
^ - Denotes instrument related QC exceeds the control limits
GWPS - Groundwater Protection Standard.
BOLD - Above GWPS.

Table 3. Nature-Extent Assessment Monitoring Well Sampling - Appendix III Parameters

Well	Date	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
	Prediction Limit	1.006	126*	203.2	0.35	7.52-7.04*	360*	955
G31S down-gradient	12/10/2018	**4.4**	**130**	170	0.26	7.17	290	**1,000**
G33S down-gradient	12/10/2018	0.6	36	6.3	**0.98**	7.41	50	410
T01S down-gradient	12/13/2018	**3.3**	56	110	**1.1**	7.37	240	900
T02S down-gradient	12/14/2018	**4.90**	53	110	**0.47**	**7.55**	210	870
T04S down-gradient	12/19/2018	0.24	93	8.7	0.24	**7.89**	67	510
T05S down-gradient	12/19/2018	**13.0**	1.4	150	**1.8**	**10.37**	**410**	**1,600**
T06S down-gradient	12/18/2018	0.7	88	18	**0.38**	7.36	66	530
T08S down-gradient	12/12/2018	**7.5**	33	120	**0.89**	**8.21**	260	950
T09S down-gradient	12/18/2018	**6.6**	120	120	0.35	**7.54**	270	**1,000**

Notes:
All Statistics use the detection limit for non-detect results.
All units are in mg/l except pH is in standard units.
Bold - Potential statistically significant increase.

* - Based on pooled background from G45S/T03S.
All others based on G45S as background.

Table 4. Nature-Extent Assessment Monitoring Well Sampling - Appendix IV Parameters

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226 + 228 Combined	Selenium	Thallium
GWPS		**NC**	**0.01**	**2.0**	**NC**	**NC**	**NC**	**0.006**	**4.0**	**0.015**	**0.041**	**NC**	**0.1**	**5 pCi/L**	**0.05**	**NC**
G31S down-gradient	12/10/2018	NA	0.0051	0.051	NA	NA	NA	< 0.001	0.26	0.0012	0.11	NA	**0.72**	3.53	< 0.0025	NA
G33S down-gradient	12/10/2018	NA	0.0029	0.45	NA	NA	NA	< 0.001	0.98	**0.016**	0.038	NA	< 0.005	2.28	< 0.0025	NA
T01S down-gradient	12/13/2018	NA	**0.016**	0.084	NA	NA	NA	0.0037	1.1	0.0053	0.018	NA	**0.30**	1.12	< 0.0025	NA
T02S down-gradient	12/14/2018	NA	0.0086	0.063	NA	NA	NA	0.0016	0.47	0.0070	0.027	NA	**0.5**	1.2	< 0.0025	NA
T04S down-gradient	12/19/2018	NA	< 0.001	0.056	NA	NA	NA	< 0.0010	0.24	0.0018	0.027	NA	0.012	0.768	< 0.0025	NA
T05S down-gradient	12/19/2018	NA	**0.14**	0.01	NA	NA	NA	< 0.0010	1.8	< 0.00050	0.015	NA	**1.0**	0.928	0.0026	NA
T06S down-gradient	12/18/2018	NA	< 0.001	0.035	NA	NA	NA	< 0.0010	0.38	< 0.00050	0.028	NA	0.0085	2.18	< 0.0025	NA
T08S down-gradient	12/12/2018	NA	**0.015**	0.041	NA	NA	NA	< 0.001	0.89	0.0005	0.026	NA	**0.88**	0.674	< 0.0025	NA
T09S down-gradient	12/18/2018	NA	0.0027	0.093	NA	NA	NA	0.0011	0.35	0.0017	**0.097**	NA	**1.0**	3.31	< 0.0025	NA

Notes:

NS - No Standard

All units are in mg/l except Radium is in pCi/L as noted.

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.

Not calculated since not detected compound in first round of detection monitoring

GWPS - Groundwater Protection Standard

F1 - MS and/or MSD Recovery outside of limits.

B - Compound was found in the blank and sample.

NA- Not Analyzed; non-detect in previous monitoring

^ - Denotes instrument related QC exceeds the control limits

Bold - Above GWPS

Table 5 - Assessment of Corrective Measures Evaluation

40 CFR Part 257.96 Requirements		Potential Corrective Measure: Closure by CCR Removal	CCR Closure-in-Place with Wet Closure	CCR Closure-in-Place with a Soil/Geomembrane Final Cover System	CCR Closure-in-Place with a ClosureTurf Final Cover System
		257.96(c) Requirements & Objectives Compliance			
257.96(c)(1)	Performance	Excavating and removing the CCR from the Main Quarry would remove the source of the groundwater impacts. This will prevent the CCR from contacting the approximate 16,077 cubic feet/day of groundwater that flows through the Main Quarry and about 37 inches per year of precipitation from passing through the unsaturated CCR into the groundwater.	The wet closure method will effectively prevent the direct contact pathway of the CCR. Waterfowl and small animals may access the water which will be in contact with CCR. This closure method is less effective at minimizing infiltration than the other methods evaluated. Proceeding with this closure will stop any additional CCR from being placed within the unit. Existing impacted groundwater conditions would continue to be managed and monitored for stable to improving conditions.	Closing the CCR-in-place with a soil/geomembrane final cover system will prevent infiltration through the unsaturated CCR material helping to keep stable and improve the existing groundwater quality impacts currently being managed. The final cover system also eliminates human/animal exposure to CCR. The final cover system would be constructed with a geomembrane infiltration prevention layer that has a low permeability no greater than 1×10^{-7} cm/s, which is covered by a vegetated soil protection layer. This type of cover system has been used throughout the country to effectively close landfills. Regular inspections and maintenance are required to prevent/minimize the degradation of the soil erosion layer and keep the geomembrane from being exposed to UV degradation.	Closing the CCR-in-place with the ClosureTurf final cover system will prevent infiltration through the unsaturated CCR material helping to keep stable and improve the existing groundwater quality impacts currently being managed. The final cover system also eliminates human/animal exposure to CCR. The final cover system would be constructed with a geomembrane infiltration prevention layer that has a low permeability no greater than 1×10^{-7} cm/s, which is covered with a synthetic turf that includes a sand infill protection layer. This type of cover system has been used throughout the country since 2009 to close landfills and CCR ponds effectively.
257.96(c)(1)	Reliability	Closure by removing all the CCR from the Main Quarry is reliable at eliminating the source and preventing further exposure to humans and the environment. Closure by removal would prevent further groundwater impacts from infiltration. This corrective measure would not absolutely remove all of the CCR from the Main Quarry due to the irregularities in the shape of the Main Quarry bottom. As a result some small quantity of the CCR will remain after the excavation activities were complete, however, 99.9% of CCR would be removed.	The wet closure would reliably prevent direct contact with the CCR. This corrective measure would not prevent infiltration through the CCR. The CCR will reliably stay under water because of an inward gradient associated with the surrounding area hydrology and hydrogeology will be maintained using the water level in the Main Quarry and maintaining it below that of Boyd's Quarry located to the east (property also owned and controlled by Midwest Generation).	Using final cover systems as outlined in 257.102(d) has been effective at landfills and impoundments throughout the country for many years. The geomembrane used will achieve the necessary permeability of no greater than 1×10^{-7} cm/s as long as the soil layer keeps the geomembrane protected from UV degradation. The Geosynthetic Institute (GSI) has presented research that determined geomembranes are resistant to damage associated with freeze-thaw cycles. The estimated lifetime prediction for the geomembrane based on Joliet weather conditions is over 100 years. The soil layer used as the protection layer is more likely to experience erosion from high intensity storms compared to the synthetic turf/sand infill erosion layer in the ClosureTurf option.	ClosureTurf has been demonstrated to be as effective as, and in some cases more effective, than a two part final cover system that uses soil and a geomembrane. The sand infill and synthetic turf used as the erosion layer is specifically designed to prevent erosion, even during high intensity storms. ClosureTurf experienced a hurricane at a landfill in South Carolina. The area received 26 inches of rain over a couple day period. With ClosureTurf, there was enough coverage of sand intact that sand did not have to be redistributed or replaced. Conversely, many nearby traditional soil-capped landfills were left with significant and costly erosion. Testing performed in Arizona determined that the synthetic turf used in ClosureTurf would still retain 50% of its tensile strength after 100 years of UV exposure. Also, the Geosynthetic Institute has presented research that determined geomembranes are resistant to damage associated with freeze-thaw cycles.
257.96(c)(1)	Ease of Implementation	Implementing closure by removal of CCR is very difficult because of the following three main factors: 1) the Main Quarry currently holds 2.6 million cubic yards (CY) of CCR in place that will swell by about 30% upon excavation, requiring transporting and disposal of 3.38 million CY of CCR, 2) disposing of 3.38 million CY of CCR material would require multiple facilities or constructing a new disposal facility, and 3) removing 3.38 million CY would require extensive dewatering. Removing and transporting 3.38 million CY would require over 225,000 truckloads based on 15 CY per truckload. It would cost an estimated \$95 million to excavate and haul the CCR and disposal at an offsite licensed facility would cost about \$200 million. Excavating the CCR from the Main Quarry would require dewatering 500,000 to 600,000 gallons per day for at least 31 years. This prolonged dewatering could cause the water wells to the northeast to go dry.	Implementation of the wet closure is the simplest of the four closure options. Regrading of approximately 548,000 CY of the existing CCR would be needed to ensure its elevation is below that of the proposed closure water level elevation. The water level control system currently exists to fill the Main Quarry up to the proper water level after the regrading is complete. The construction of a formal soil cover system is not completed as part of this corrective measure. The existing access roads will need minor improvements to accommodate accessing the CCR for regrading.	A soil/geomembrane final cover system is the typical cover system used for landfill and pond closures throughout the country. This type of cover system has been successfully used for many years and numerous contractors throughout the country are qualified to install it. This type of cover is requires more effort to implement than the ClosureTurf cover system option and the wet closure method, but less effort than closure by removal. This cover system will require approximately 250,000 CY of soil for the soil erosion prevention layer and approximately 16,700 truckloads (based on 15 CY/truck) to deliver it to the site for placement. Locating borrow sources that will provide the needed quantity and quality of soil to construct the cover will make it more difficult to implement this cover system. Implementation of all closure activities are estimated to take up to 24 months.	ClosureTurf has been successfully used in at least seventeen other states throughout the country. The proprietors of ClosureTurf have designated several construction companies throughout the country as certified installers of the product. Performing the other required closure activities such as dewatering, re-grading the CCR and constructing an access road are typical construction industry activities that do not require specialized equipment or personnel. ClosureTurf will require less post-closure care than the dry closure with a soil/geomembrane cover, the estimated 30 year post-closure cost for ClosureTurf is \$5.1 million and the soil/geomembrane cover option is \$8.3 million.
257.96(c)(1)	Potential Impacts (safety, cross-media, etc.)	Injuries are possible because of the heavy-duty construction equipment used for site activities and truck travel for offsite CCR disposal. Based on current available statistics from the U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) 2017, excavation work with 3 crew members at the site could take approximately 31 years to complete which could result in 0.4249 construction related fatal injuries. Disposing of 3.38 million CY of CCR at an offsite facility could cause 4.2 traffic accident injuries and 0.197 traffic accident fatalities based on a 60-mile round trip for each truckload. If a traffic accident occurs, it is likely that CCR is going to spill out of the truck and could cause dust exposure and potentially surface water impacts. Impacts to surface water will not occur during excavation because of the surface elevation where the excavation work will take place. Groundwater impacts at the site will probably be made worse over the anticipated 31 years of excavations. The existing groundwater impacts reflect static/equilibrium conditions between the saturated CCR and groundwater. The continual disturbance of these materials on a daily basis over an extended period of time will be reflected in temporary degradation of the existing groundwater quality conditions. In addition, if the landfill facility to which the CCR is being transferred develops a leak over time, then another currently unimpacted area of groundwater will be degraded in the vicinity of that facility. Additional air quality impacts are also anticipated with 225,000 truckloads of CCR having the potential to produce approximately 6,480 lbs of particulate matter emissions. The quantified emissions are from truck traffic, there will also be 31 years worth of construction equipment emissions compared to only 2 years worth of construction equipment emissions for the dry closure methods.	Potential safety concerns are present with any open water body. A 7-feet high fence is present around the entire property, which has barbed wire across the top with locked access gates. The potential for continued future groundwater impacts is present because infiltration is not limited and a larger volume of saturated CCR will result by this option. This corrective measure has concerns for worker safety during construction, similar to the other corrective measures.	Injuries are possible because of the heavy-duty construction equipment used for site activities and truck travel for material/soil delivery. Installation of the soil/geomembrane cover is estimated at up to 750 working days which could result in up to 0.143 construction related fatal injuries based on current available statistics from the U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) 2017. Delivering the necessary geomembrane and soil could result in 0.0340 traffic accident injuries and 0.0016 traffic accident fatalities based on a 6-mile round trip for each truckload of soil and the geomembrane being delivered from South Carolina. Delivering the geomembrane/soil to the site could produce approximately 50 lbs of particulate matter associated with the truck transport. Impacts to surface water will not occur during cover construction because the surface elevation where the regrading of the CCR and final cover installation will take place is 30 feet below the surrounding surface elevation. Additional groundwater impacts are expected to be minimal during construction since the ash at depth (in contact with groundwater) will be less disturbed as would occur with the complete excavation option. Existing groundwater quality being managed is expected to be stable and improve since the volume of saturated CCR is kept at a minimum and infiltration is precluded through the unsaturated CCR.	Injuries are possible because of the heavy-duty construction equipment used for site activities and truck travel for material delivery. Installation of the ClosureTurf final cover system is estimated at 250 working days which could result in 0.0475 construction related fatal injuries based on current available statistics from the U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFOI) 2017. Delivering the necessary ClosureTurf materials could result in 0.0143 traffic accident injuries and 0.0007 traffic accident fatalities based on the materials being delivered from South Carolina and Georgia. Delivering the ClosureTurf materials to the site could produce approximately 24 lbs of particulate matter associated with truck transport. Impacts to surface water will not occur during construction because the surface elevation where the regrading of the CCR and ClosureTurf final cover installation will take place is 30 feet below the surrounding surface elevation. Additional groundwater impacts are expected to be minimal during construction since the ash at depth (in contact with groundwater) will be less disturbed as would occur with the complete excavation option. Existing groundwater quality being managed is expected to be stable and improve since the volume of saturated CCR is kept at a minimum and infiltration is precluded through the unsaturated CCR.
257.96(c)(1)	Control of Exposure to Residual Impacts	The residual impacts are present in the groundwater beneath the Main Quarry, which flows north towards the Des Plaines River. Whether the CCR is closed in place or closed by removal, the potential for exposure to the residual impacts is not present. Groundwater wells will not be installed on the property and the nearby groundwater wells are not located downgradient of the Main Quarry, but are located upgradient and sidegradient. Groundwater wells would not be located downgradient of the Main Quarry because Midwest Generation controls all the land located between the Main Quarry and the Des Plaines River, therefore they could prevent the construction of a groundwater well in this area. This could further be accomplished by use of institutional controls to preclude any future potential for the installation of a water well within this area. In addition, statistical analyses have demonstrated that groundwater discharges from the Main Quarry to the Des Plaines River do not cause a measurable increase in the concentration of any constituent in the River. The existing groundwater extraction system limits/controls the migration of impacted groundwater to the south due to active dewatering operations at the Vulcan Quarry mining facility. Any potable water wells within the impacted portion of the aquifer to the south/southeast have been abandoned and replaced with deeper wells completed within the Cambrian-Ordovician aquifer below the Scales Shale unit which is a well documented regional aquitard which isolates the deeper aquifers from the more shallow groundwater impacts within the Silurian Dolomite. Relative to the water wells located to the northeast of the Main Quarry, maintaining a lower groundwater elevation within the Main Quarry compared to the surrounding area (Boyd's Quarry which is also owned and controlled by Midwest Generation) prevents potential impacted groundwater migration in that direction. IEPA sampling of private water wells in that area confirms that impacted groundwater from the Main Quarry has not migrated in that direction.			
257.96(c)(2)	Time Required to Begin & Complete Remedy	Excavation and disposal alone of 3.38 million CY of CCR is estimated to take 31 years, based on disposing of 50 trucks/day of CCR material with 15 CY per load and 240 working days/yr.	The total anticipated time to execute this option is 12 months.	The total anticipated time to execute this option is 24 months.	The total anticipated time to execute this option is 24 months.
257.96(c)(3)	Institutional Requirements	The anticipated institutional control for this option is groundwater monitoring to document achieving the groundwater protection standard. Closure by removal is except from the deed notice requirement.	The institutional requirements for this option are a deed notice and complying with the post-closure requirements as outlined in 257.104. The deed notice identifies the post-closure use of the property and prevents its disturbance of the final cover and the function of the monitoring systems.	The institutional requirements for this option are a deed notice and complying with the post-closure requirements as outlined in 257.104. The deed notice identifies the post-closure use of the property and prevents its disturbance of the final cover and the function of the monitoring systems.	The institutional requirements for this option are a deed notice and complying with the post-closure requirements as outlined in 257.104. The deed notice identifies the post-closure use of the property and prevents its disturbance of the final cover and the function of the monitoring systems.