Form CCR 1	Illinois Environmental Protection Agency CCR Residual Surface Impoundment Permit Application CCR Form 1 – General Provisions

Bureau of Water ID Number: **CCR Permit Number:** **Facility Name:** Joliet 29 Generating Station	For IEPA Use Only

SECTION 1: FACILITY, OPERATOR, AND OWNER INFORMATION (35 IAC 845.210(b))

Facility, Operator, and Owner Information

1.1	Facility Name		
	Joliet 29 Generating Station		
1.2	Illinois EPA CCR Permit Number (if applicable)		
	Initial Permit		
1.3	Facility Contact Information		
	Name (first and last) DeAndre Cooley	Title Environmental Specialist	Phone Number 779-279-2321
	Email address DeAndre.Cooley@NRG.com		
1.4	Facility Mailing Address		
	Street or P.O. box 1800 Channahon Road		
	City or town Joliet	State Illinois	Zip Code 60436
1.5	Facility Location		
	Street, route number, or other specific identifier 1800 Channahon Road		
	County name Will	County code (if known)	
	City or town Joliet	State Illinois	Zip Code 60436
1.6	Name of Owner/Operator		
	Midwest Generation, LLC		

Facility, Operator, and Owner Info

1.7 Owner/Operator Contact Information

Name (first and last)	Title	Phone Number
William Naglosky	Plant Manager	815-207-5412

Email address
william.naglosky@nrg.com

1.8 Owner/Operator Mailing Address

Street or P.O. box
804 Carnegie Center

City or town	State	Zip Code
Princeton	New Jersey	08540

SECTION 2: LEGAL DESCRIPTION (35 IAC 845.210(c))

Legal Description

2.1 Legal Description of the facility boundary

ALL THT PRT OF THE SE1/4 OF SEC 19, T35N-R10E., LYING S'LY OF THE CENTERLINE OF CHANNAHON RD; NW'LY OF A LINE DESCRIBED AS COMM AT THE SW COR OF THE SE1/4 OF SD SEC 19; THC RUNNING E ON THE S LN OF SD SEC 1629 FT; THC N 41 DEG 22' E, 249.3 FT; THC N 47 DEG 46' E, 587.6 FT; THC N 53 DEG 5' 30" E, 371.1 FT; THC N 64 DEG 28' 30" E, 545.9 FT TO A PT ON THE E LN OF SD SEC 19, WHICH IS 709.6 FT S OF THE CENTERLINE OF THE PUBLIC HIGHWAY KNOWN AS CHANNAHON RD. (EX THT PRT TAKEN BY THE STATE OF ILLINOIS BY DOC# R68-013815) & (EX THEREFROM THE FOLLOWING DESCRIBED PARCEL TO WIT: THT PRT OF THE SE1/4 OF SEC 19, T35N-R10E, DAF: COMM AT A PT ON THE S LN OF SD SEC 19, BEING A CONCRETE MONUMENT 1963.03 FT (RECORD) EAST (AS MEASURED ALG THE SOUTH LN OF SD SEC 19) OF THE SW COR OF SD SEC 19 SD MONUMENT BEING ON THE BOUNDARY LN PER THE BOUNDARY LN AGREEMENT RECORDED MARCH 21, 1951 AS DOC # 688037 BETWEEN CATERPILLAR TRACTOR CO. & PUBLIC SERVICE CO. OF NORTHERN ILLINOIS; THC N 01 DEG 48' 09" W ALG THE SD BOUNDARY LN 594.54 FT; THC N 73 DEG 47' 26" E ALG THE S ROW OF RTE 6 (FORMERLY KNOWN AS CHANNAHON RD) AS HERETOFORE CONVEYED TO THE STATE OF ILLINOIS PER QUIT CLAIM AUGUST 19, 1968 AS DOC# R68-13815, A DIST OF 870.57 FT TO A PT OF CURVATURE; THC E'LY ALG THE ARC OF CURVE CONCAVE TO THE NORTH, BEING THE S ROW LN OF SD RTE 6, HAVING A RADIUS OF 38,307.20 FT, HAVING A CHORD BEARING OF N 73 DEG 38' 36" E, 196.99 FT FOR A POB; THC CONT E'LY ALG THE ARC OF A CURVE CONCAVE TO THE N, BEING THE SD S'LY ROW LN OF RTE 6, HAVING A RADIUS OF 38,307.20 FT, HAVING A CHORD BEARING OF N 72 DEG 43' 48" E, 1024.21 FT; THC S 37 DEG 17' 59" E, 391.37 FT; THC S 42 DEG 57' 20" W, 785.70 FT; THC N 55 DEG 05' 38" W, 553.84 FT; THC N 40 DEG 21' 51" W, 348.30 FT TO THE POB. NEW PARCEL ASSESSMENT DESCRIPTION NDA.

SECTION 3: PUBLICLY ACCESSIBLE INTERNET SITE REQUIREMENTS (35 IAC 845.810)

Internet Site

3.1 Web Address(es) to publicly accessible internet site(s) (CCR website)

https://midwestgenerationllc.com/illinois-ccr-rule-compliance-data-and-information/

3.2 Is/are the website(s) titled "Illinois CCR Rule Compliance Data and Information"

(Yes) (circled) No

SECTION 4: IMPOUNDMENT IDENTIFICATION

Impoundment Identification

4.1 List all the Impoundment Identification numbers for your facility and check the corresponding box to indicate that you have attached a written description for each impoundment.

Impoundment ID		
W1970450047-02	☑	Attached written description
	☐	Attached written description
	☐	Attached written description
	☐	Attached written description
	☐	Attached written description
	☐	Attached written description
	☐	Attached written description

	☐	Attached written description
	☐	Attached written description
	☐	Attached written description

SECTION 5: CHECKLIST AND CERTIFICATION STATEMENT

Checklist and Certification Statement

5.1 In Colum 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing.

Column 1		Column 2	
Section 1: Facility, Operator, and Owner Information	☑	w/attachments	☑
Section 2: Legal Description	☑	w/attachments	☐
Section 3: Publicly Accessible Internet Site Requirement	☑	w/attachments	☐
Section 4: Impoundment Identification	☑	w/attachments	☑

5.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name) of Owner/Operator	Official Title
William Naglosky	Plant Manager
Signature	**Date Signed**
[signature]	1/28/22

Form 2CC	Illinois Environmental Protection Agency CCR Surface Impoundment Permit Application Form CCR 2CC – Closure Construction

Bureau of Water ID Number: **CCR Permit Number:** **Facility Name:**	For IEPA Use Only

SECTION 1: DESIGN AND CONSTRUCTION PLANS (35 Ill. Adm. Code 845.220)

Design and Construction Plans (Construction History)

1.1	CCR surface impoundment name.
	Pond 2
1.2	Identification number of the CCR surface impoundment (if one has been assigned by the Agency).
	W1970450047
1.3	Describe the boundaries of the CCR surface impoundment (35 Ill. Adm. Code 845.210 (c)).
	ALL THT PRT OF THE SE1/4 OF SEC 19, T35N-R10E., LYING S'LY OF THE CENTERLINE OF CHANNAHON RD; NW'LY OF A LINE DESCRIBED AS COMM AT THE SW COR OF THE SE1/4 OF SD SEC 19; THC RUNNING E ON THE S LN OF SD SEC 1629 FT; THC N 41 DEG 22' E, 249.3 FT; THC N 47 DEG 46' E, 587.6 FT; THC N 53 DEG 5' 30" E, 371.1 FT; THC N 64 DEG 28' 30" E, 545.9 FT TO A PT ON THE E LN OF SD SEC 19, WHICH IS 709.6 FT S OF THE CENTERLINE OF THE PUBLIC HIGHWAY KNOWN AS CHANNAHON RD. (EX THT PRT TAKEN BY THE STATE OF ILLINOIS BY DOC# R68-013815) & (EX THEREFROM THE FOLLOWING DESCRIBED PARCEL TO WIT; THT PRT OF THE SE1/4 OF SEC 19, T35N-R10E. DAF: COMM AT A PT ON THE S LN OF SD SEC 19, BEING A CONCRETE MONUMENT 1963.03 FT (RECORD) EAST (AS MEASURED ALG THE SOUTH LN OF SD SEC 19) OF THE SW COR OF SD SEC 19 SD MONUMENT BEING ON THE BOUNDARY LN PER THE BOUNDARY LN AGREEMENT RECORDED MARCH 21, 1951 AS DOC # 688037 BETWEEN CATERPILLAR TRACTOR CO. & PUBLIC SERVICE CO. OF NORTHERN ILLINOIS; THC N 01 DEG 48' 09" W ALG THE SD BOUNDARY LN 594.54 FT; THC N 73 DEG 47' 26" E ALG THE S ROW OF RTE 6 (FORMERLY KNOWN AS CHANNAHON RD) AS HERETOFORE CONVEYED TO THE STATE OF ILLINOIS PER QUIT CLAIM AUGUST 19. 1968 AS DOC# R68-13815, A DIST OF 870.57 FT TO A PT OF CURVATURE; THC E'LY ALG THE ARC OF CURVE CONCAVE TO THE NORTH, BEING THE S ROW LN OF SD RTE 6, HAVING A RADIUS OF 38,307.20 FT, HAVING A CHORD BEARING OF N 73 DEG 38' 36" E, 196.99 FT FOR A POB; THC CONT E'LY ALG THE ARC OF A CURVE CONCAVE TO THE N, BEING THE SD S'LY ROW LN OF RTE 6, HAVING A RADIUS OF 38,307.20 FT, HAVING A CHORD BEARING OF N 72 DEG 43' 48" E, 1024.21 FT; THC S 37 DEG 17' 59" E, 391.37 FT; THC S 42 DEG 57' 20" W, 785.70 FT; THC N 55 DEG 05' 38" W, 553.84 FT; THC N 40 DEG 21' 51" W, 348.30 FT TO THE POB. NEW PARCEL ASSESSMENT DESCRIPTION NDA:
1.4	State the purpose for which the CCR surface impoundment is being used.
	Pond 2 is currently not in service and will not be used in the future for CCR storage.
1.5	How long has the CCR surface impoundment been in operation?
	41 years
1.6	List the types of CCR that have been placed in the CCR surface impoundment.
	Bottom ash

Design and Construction Plans (Continued)

1.7	List the name of the watershed within which the CCR surface impoundment is located.	
	Des Plaines watershed	
1.8	What is the size in acres of the watershed within which the CCR surface impoundment is located?	
	28,808 acres	
1.9	Check the corresponding boxes to indicate that you have attached the following:	
	☑	A description of the physical and engineering properties of the foundation and abutment materials on which the CCR surface impoundment is constructed.
	☑	A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR surface impoundment.
	☑	A statement of the method of site preparation and construction of each zone of the CCR surface impoundment.
	☑	A statement of the approximate dates of construction of each successive stage of construction of the CCR surface impoundment.
	☑	Drawings satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(1)(F).
	☑	A description of the type, purpose, and location of existing instrumentation.
	☑	Area capacity curves for the CCR impoundment.
	☑	A description of each spillway and diversion design features and capacities and provide the calculations used in their determination.
	☑	The construction specifications and provisions for surveillance, maintenance, and repair of the CCR surface impoundment.
1.10.1	Is there any record or knowledge of structural instability of the CCR surface impoundment?	
	☐ Yes ☑ No	
1.10.2	If you answered yes to Item 1.10.1, provide detailed explanation of the structural instability.	
	NA	

SECTION 2: NARRATIVE DESCRIPTION OF THE FACILITY (35 Ill. Adm. Code 845.220)			
Narrative Description	2.1	List the types of CCR expected in the CCR surface impoundments.	
		No CCR is expected in the pond because it is no longer in operation. Attached is the chemical analysis of the CCR that used to be in the pond	
	2.2	Have you attached a chemical analysis of each type of expected CCR?	
		☑	Yes
	2.3	Estimate of the maximum capacity of the surface impoundment in gallons or cubic yards.	
		53,590 cubic yards	
	2.4	The rate at which CCR and non-CCR waste streams currently enter the CCR impoundment in gallons per day and dry tons.	
		GPD	dTn
	2.5	Estimate length of time the CCR surface impoundment will receive CCR and non-CCR waste streams.	
		Pond 2 will no longer be used	
	2.6	Have you attached an on-site transportation plan that includes all existing and planned roads in the facility that will be used during the operation of the CCR surface impoundment?	
		☑	Yes

SECTION 3: MAPS (35 Ill. Adm. Code 845.220)			
Maps	3.1	Check the corresponding boxes to indicate that you have attached the following maps:	
		☑	A site location map on the most recent United Sates Geological Survey (USGS) quadrangle of the area from the 7 ½ minute series (topographic) or on another map whose scale clearly shows the information required in 35 Ill. Adm. Code 845.220(a)(3).
		☑	Site plans maps satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(4).

SECTION 4: ATTACHMENTS			
Attachments	4.1	Check the corresponding boxes to indicate that you have attached the following:	
		☑	A narrative description of the proposed construction of, or modification to, a CCR surface impoundment and any projected changes in the volume or nature of the CCR or non-CCR waste streams.
		☑	Plans and specifications fully describing the design, nature, function, and interrelationship of each individual component of the facility.
		☑	The signature and seal of a qualified professional engineer.
		☑	Certification that the owner or operator of the CCR surface impoundment completed the public notification and public meetings required under 35 Ill. Adm. Code 845.240.

Attachments (Continued)			
		☑	A summary of the issues raised by the public during the public notification and public meetings.
		☑	A summary of any revisions, determinations, or other considerations made in response to those issues raised by the public during the public notification and public meetings.
		☑	A list of interested persons in attendance who would like to be added to the Agency's listserv for the facility.
		☑	Certification that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment are participants in a training program that is approved by and registered with the U.S. Department of Labor's Employment and Training Administration and that includes instruction in erosion control and environmental remediation.
		☑	Certification that all contractors, subcontractors, and installers utilized to construct, install, modify, or close a CCR surface impoundment are participants in a training program that is approved by and registered with the U.S. Department of Labor's Employment and Training Administration and that includes instruction in the operation of heavy equipment and excavation.

SECTION 5: GROUNDWATER MONITORING PROGRAM

Groundwater Monitoring			
	5.1	Indicate that you have attached the following components of a new groundwater monitoring program or any modifications to an existing groundwater monitoring program by checking the corresponding boxes:	
		☑	A hydrogeologic site investigation meeting the requirements of 35 Ill. Adm. Code 845.620, if applicable.
		☑	Design and construction plans of a groundwater monitoring system meeting the requirements of 35 Ill. Adm. Code 845.630.
		☑	A proposed groundwater sampling and analysis program that includes selection of the statistical procedures to be used for evaluating groundwater monitoring data as required by 35 Ill. Adm. Code 845.640 and 845.650.

SECTION 6: CLOSURE (35 Ill. Adm. Code 845.220(d))

Closure			
	6.1	What is the closure prioritization category under 35 Ill. Adm. Code 845.700(g), if applicable?	
		Category 3	
	6.2	Indicate that you have attached the following by checking the corresponding boxes:	
		☑	The final closure plan, as specified in 35 Ill. Adm. Code 845.720(b), which includes the closure alternatives analysis required by 35 Ill. Adm. Code 845.710.
		☑	Proposed schedule to complete closure.
		☐	Post-closure care plan as specified in 35 Ill. Adm. Code 845.780(d).

SECTION 7: GROUNDWATER MODELING (35 Ill. Adm. Code 845.220(d)(3))

Groundwater			
	7.1	Indicate that you have attached the following by checking the corresponding boxes:	
		☑	The results of groundwater contaminant transport modeling and calculations showing how the closure will achieve compliance with the applicable groundwater standards.
		☑	All modeling inputs and assumptions.
		☑	Description of the fate and transport of contaminants with the selected corrective action over time.

		☐	Capture zone modeling, if applicable.
		☑	Any necessary licenses and software needed to review and access both the model and the data contained within the model.

KPRG

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG and Associates, Inc.

APPLICATION FOR INITIAL CONSTRUCTION PERMIT

JOLIET #29 GENERATING STATION
MIDWEST GENERATION, LLC
JOLIET, ILLINOIS

Illinois EPA Site No. W1970450047-02

January 28, 2022

Submitted To:

Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62702

Prepared For:

Midwest Generation, LLC
1800 Channahon Rd.
Joliet, IL 60436

Prepared By:

KPRG and Associates, Inc.
14665 West Lisbon Road, Suite 1A
Brookfield, WI 53005

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FIGURES

ATTACHMENTS

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). MWG removed all of the coal combustion residuals ("CCR") from Pond 1 and decontaminated the liner before October 2015 and repurposed the pond as a low volume wastewater pond.[1] Pond 3 is a *de minimis* pond and is not a CCR surface impoundment. 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 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.

The objective of this submittal is to apply for the initial construction permit for Pond 2 at the Joliet #29 Generating Station. Midwest Generation seeks to receive the construction permit to close Pond 2 by removal in compliance with the State CCR Rule. The information required for a construction permit application for existing surface impoundments as specified under 35 Ill. Adm. Code 845.220 of the State CCR Rule is provided in the following sections.

The Permit is organized with supporting Tables and Figures that are referenced in the discussions being provided at the end of the full Permit text with the table numbers and figures tied to the Section number within which they are referenced with sequential numbering (e.g., Tables referenced in Section 9 are numbered 9-1, 9-2, etc. Figures referenced in Section 9 are numbered Figure 9-1, 9-2, etc.). Specific Attachments referenced within each Section are provided in a similar fashion (e.g., Attachment 1 information is tied to Section 1 of the Permit text, Attachment 2 information is tied to Section 2 of the Permit text, etc.). It should be noted that if a Section does not reference an Attachment then that Attachment number is not included as part of the permit application. For example, Section 6 does not reference an Attachment; therefore, there is no Attachment 6 in this permit application.

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

1.0 History of Construction, 845.220(a)(1)

The history of construction of the CCR surface impoundment as specified in Section 845.220(a)(1) is presented below.

1.1 CCR Surface Impoundment Identifying Information

The identifying information associated with the CCR surface impoundments at the generating station are listed in the table below.

Name	Owner/Operator	Impoundment ID Number
Ash Pond 2	Midwest Generation 804 Carnegie Center Princeton, NJ 08540	W1970450047-02

1.2 Purpose of CCR Surface Impoundment

Pond 2 formerly served as a settling pond for sluiced CCR and other process water associated with the electrical power generating process occurring at the site. As stated in the Introduction, MWG converted the generating station to natural gas and it no longer burns coal for electrical power generation. All CCR has been removed from Pond 2 down to the warning layer and all exposed liner has been decontaminated. Pond 2 is not in service and will not be used in the future for CCR storage.

1.3 CCR Surface Impoundment Length of Operation

Pond 2 was constructed circa 1978 and operated as a CCR surface impoundment until 2019, thus operated for approximately 41 years. The Notice of Intent to Initiate Closure was submitted on April 11, 2021.

1.4 Type of CCR in Surface Impoundment

The type of CCR formerly stored in Pond 2 was bottom ash that was sluiced into the impoundment. The chemical constituents that make up the bottom ash is discussed in further detail in Section 2.0.

1.5 Name and Size of the Watershed

Pond 2 is located within the Des Plaines River watershed, which is approximately 28,808 acres in size.

1.6 Description of CCR Surface Impoundment Foundation

The Geosyntec October 2016 Federal CCR Rule History of Construction submittal summarized the foundation for Pond 2 as follows:

> "Site observations and construction documents show Pond 2 is surrounded by embankments on the south, east, and west. There are no embankments on the north side of the pond where existing ground elevations generally increase to the north; however, Site investigations indicate that fill material may be present along the northern boundary. For engineering purposes, material located along the northern embankment is considered consistent with embankment fill. Native materials do not provide any lateral support for the embankments and therefore the pond does not contain abutments."

The following sections discuss the foundation materials' physical and engineering properties. KPRG reviewed the previously developed History of Construction for the East Ash Pond and the West Ash Pond, along with previously completed site investigations and concurred with Geosyntec's observations and conclusions.

1.6.1 Physical Properties of Foundation Materials

The physical properties of the foundation materials in which the pond is constructed ranges from clay to sand and gravel. Silurian Dolomite is noted at approximately 40 feet below the top of the pond embankments. This information was obtained from published geologic information and field investigations performed by KPRG (2005), Patrick Engineering, and Geosyntec (2015). No abutments are present.

1.6.2 Engineering Properties of Foundation Materials

The engineering properties for the foundation materials listed in the following table are from the periodic structural stability and safety factor assessments performed by Geosyntec for Pond 2. The properties were determined from the site investigation, published correlations, and laboratory testing of samples collected during the site investigations.

Material	Unit Weight (pcf)	Drained friction angle (degrees)	Effective cohesion (psf)
Sand/Gravel	125	38	25

Based on Geosyntec's structural stability analysis, engineering properties were not determined for the dolomite because of its negligible contributions to the structural stability of the pond. KPRG agrees with this assessment.

1.7 Description of the Construction Materials, Methods, and Dates

The descriptions of the construction materials, methods, and dates are based on the construction drawings created by NUS in 1978 and 1979, the liner replacement drawings created by NRT in 2007 and 2008 and various site investigations referenced as appropriate. The drawings discussed in the following sections are located in Attachment 1.

1.7.1 Physical and Engineering Properties of Construction Materials

Pond 2 was constructed with embankments on the south, east, and west sides, so the physical properties of the construction materials for this section are the same as the physical properties of the foundation materials. As described in Section 1.6.1, the physical properties for the foundation materials were described as clay to sand and gravel, so for this section, the physical properties for the construction materials will also be described as clay to sand and gravel. The pond inlet structure, outlet structure, and inlet apron are constructed of concrete. The liner was originally constructed as a 1-foot Poz-O-Pac liner system on the bottom and the side slopes with the addition of a bituminous curing coat applied on the Poz-O-Pac side slopes.

Engineering properties for the design and construction of the embankment materials were not available. Engineering properties were estimated by Geosyntec for use in the factor of safety assessment performed for the pond. Those engineering properties are listed in the following table:

Material	Unit Weight (pcf)	Drained friction angle (degrees)	Effective cohesion (psf)
Brown Clay	115	30	25
Silty Gravel	125	32	25

In 2008, MWG relined Pond 2 by removing the Poz-O-Pac liner system side slopes and covering the Poz-o-Pac liner bottom with the existing high-density polyethylene (HDPE) geomembrane liner system that is now present. In 2016, approximately 100 cubic yards of engineered fill was placed on the Pond 2 embankment crest in the southeast corner to provide additional freeboard for Pond 2.

1.7.2 Construction Methods

Based on construction drawings by NUS, 1978 (Attachment 1-1), Pond 2 was constructed by excavating down from the original ground surface to achieve the side slopes and elevations. Reviewing the drawings shows the original ground surface ranged from 526 ft above mean sea level (amsl) to 535 ft amsl. Section S on drawing 5079 C 5019 Sheet 2 shows the original ground surface was approximately 531 ft amsl in the north-south direction. Section V on drawing 5079 C 5019 Sheet 3 shows the original ground surface was approximately 526 ft amsl on the east side of Pond 2, and Section W shown on drawing 5079 C 5019 Sheet 3 shows the original ground surface was approximately 535 ft amsl on the west side of Pond 2. The embankment crest of Pond 2 was constructed at approximately 535 ft amsl and the bottom was constructed at approximately 516 ft amsl. The construction drawings for Pond 2 indicate that the pond was not constructed with multiple zones of different soil types, therefore discussing the size and range of each construction zone is not applicable.

The interior side slopes of Pond 2 were designed with 3H:1V (horizontal:vertical) slopes, except for the concrete inlet apron which was designed 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 based on the 1978 NUS construction drawings; Pond 2’s 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.

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 was approximately 535 ft amsl and the as-built embankment elevation was documented to be 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.

1.7.3 Construction Dates

Based upon the available construction drawings, Pond 2 was likely built in 1978. As stated above, the original Poz-O-Pac liner was overlain in 2008 with a HDPE geomembrane liner and the improvements to the southeast corner of the embankment occurred in 2016.

1.8 Detailed Dimensional Drawings

The detailed dimensional drawings associated with the construction work that has occurred on Pond 2 are located in Attachment 1. The list of the drawings in Attachment 1 are as follows:

- Construction drawings prepared by NUS, dated 1977 and 1978 (Attachment 1-1);
- Liner replacement construction and as-built drawings prepared by NRT, dated 2007 with revision notes dated 2008 (Attachment 1-1);
- The as-built survey prepared by Ruettiger, Tonelli & Associates, Inc, dated 2008 (Attachment 1-1);
- The construction drawings for the liner replacement of Pond 1, which relates to the western boundary of Ash Pond 2, prepared by NRT, dated 2008 (Attachment 1-1); and
- The construction drawing for the improvements to the embankment's southeast corner, prepared by Geosyntec, dated 2016 (Attachment 1-1).

1.9 Instrumentation

A staff gauge will be installed within Pond 2 to allow for the determination of Pond 2's water level. The staff gauge installation is intended to meet new requirements under Section 845.650(b)(3) to allow water level estimates to be made concurrent with monthly groundwater level measurements. Because Pond 2 is not in service, low volume wastewater is not directed to Pond 2 and the water in the pond is either rainfall or runoff. There is no other instrumentation present at Pond 2.

1.10 Area-Capacity Curve

An area-capacity curve created by Geosyntec is provided as Figure 1.

1.11 Spillway and Diversion Capacities and Calculations

The only spillway and/or diversion features at Pond 2 is the existing outlet structure. The outlet structure consists of a rectangular structure in which the water flows over a concrete weir into a trough that is connected to the discharge piping. The outlet structure is gravity drained. Details of the outlet structure are located on Drawing No. 5079 C5503 created by NUS Corporation in

Attachment 1-1. The calculations for the design of the outlet structure are not available. The drainage capacity for the outlet structure and discharge pipe for Pond 2 have adequately discharged water from Pond 2 without affecting the functionality of the pond.

1.12 Surveillance, Maintenance, and Repair Construction Specifications

Specifications for the original construction of Pond 2 were not available for this application. The specifications that were available are from the 2008 replacement of the original liner with a HDPE geomembrane liner. The specifications are included as part of this application in Attachment 1-2. The specifications indicated that a 60-mil HDPE geomembrane be used along with the associated installation and quality control requirements.

The CCR material was removed from Pond 2 in 2019 and the geomembrane liner was repaired as needed and decontaminated. The specifications for the geomembrane liner repair are included in Attachment 1-3.

1.13 Record of Structural Instability

There is no record or knowledge of structural instability associated with Pond 2.

2.0 Narrative Description of the Facility, 845.220(a)(2)

2.1 CCR Chemical Analysis

The CCR in Pond 2 was removed in 2019 with the warning layer and the high-density polyethylene (HDPE) liner remaining. Prior to 2016 when the station was converted to natural gas, Pond 2 did occasionally receive bottom ash CCR when it could not be sluiced to Lincoln Stone Quarry. The bottom ash CCR that was sluiced to Lincoln Stone Quarry was sampled on August 31, 2021 and analyzed for the parameters listed in Section 845.600(a) except for total dissolved solids. The results of those analyses are presented in Table 2. The laboratory data package is included in Attachment 2.

2.2 Maximum Capacity

Pond 2 has a maximum water capacity of approximately 10,782,600 gallons or approximately 53,390 CY.

2.3 Waste Streams

Pond 2 is not in service and does not receive CCR or non-CCR waste streams at this time.

The non-CCR waste streams that entered Pond 2 when it was in service are service water/low volume wastewater from the reverse osmosis (RO) sand filter backwash, the west area basin, the former coal pile runoff pump discharge, and the plant drains, including the Station floor drains, and roof drains and area drains.

Pond 2 will no longer be used to manage CCR. On May 11, 2021, Midwest Generation 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. MWG is awaiting a decision on the adjusted standard by the IPCB. It should be noted that the petition was filed within 20 days of the Part 845 effective date of April 21, 2021; therefore, in accordance with Section 28.1(e) of the Act, the rule or regulation requiring removal of the liner is stayed pending the results of the petition. If the petition is granted, then Pond 2 will be used to manage non-CCR waste streams. The non-CCR waste streams would be the same non-CCR waste streams mentioned above. If the petition is granted, Pond 2 will be operated as long as the generating station is used to generate electricity. As of the date of this application, Midwest Generation intends to continue operating the station for the foreseeable future. If the petition is not granted, then Pond 2 will be closed.

2.4 On-Site Transportation Plan

The Joliet #29 generating station property is a secure facility. The property boundary is fenced with one main gate that is guarded 24 hours a day, 7 days a week, and 365 days a year. Access to the plant is controlled through the one main gate with visitors required to sign in and out with the guard personnel. Other gates are present at the facility, but they remain locked at all times with access only provided by Midwest Generation personnel.

Upon approval of this permit, Pond 2 will be closed and not used as a CCR surface impoundment. During the closure activities that main gate access road, mentioned above, and the road adjacent to Pond 2 will be used for access by construction personnel to bring materials and equipment that will be used, as shown on Figure 2. If larger truck vehicles are used, there are other roads at the site that can be used to access Pond 2, which are also shown on Figure 2. As needed, truck traffic will take a one way in and one way out traffic flow, which is also shown on Figure 2. The normal day to day operations of Pond 2 does not require access. Midwest Generation personnel use the adjacent road to perform inspections as needed to ensure that no issues arise. On a quarterly basis, groundwater sampling will be performed at the monitoring wells that surround Pond 2 and the adjacent roads will be used to access the wells. Each sampling event requires 2 to 3 days to perform.

As needed, intersections at the property are traffic controlled with stop signs and the speed limit on the property is 5 miles per hour. At intersections near the buildings with limited visibility, vehicle traffic is encouraged to honk their horn to alert pedestrians that may exit the buildings.

3.0 Site Location Map, 845.220(a)(3)

A site location map on the most recent United States Geological Survey (USGS) quadrangle of the area from the 7 ½ minute topographic series has been included in Attachment 3. This map includes details regarding the facility and adjacent properties boundaries extending 1,000 meters (3,280 feet), surface waters, the prevailing wind direction, and the limits of all 100-year floodplains. All natural areas designated as a Dedicated Illinois Nature Preserve under the Natural Areas Preservation Act, all historic and archaeological sites designated by the National Historic

Preservation Act and the Illinois Historic Sites Advisory Council Act, and all areas identified as critical habitat under the Endangered Species Protection Act of 1973 and the Illinois Endangered Species Protection Act are not present at the site or within 1,000 meters of the site and, therefore, not shown on this map.

4.0 Site Plan Map, 845.220(a)(1)(4)

Site plan maps in accordance with 845.220(a)(1)(4) are included in Attachment 4. The information required is depicted on multiple maps. Figure 4-1 shows the entire Joliet 29 Generating Station including the existing groundwater monitoring wells, the existing CCR surface impoundment (Pond 2), the other non-CCR surface impoundments (Pond 1 and Pond 3) and the main service corridors, transportation routes, and access roads. Cross-sectional maps showing the boundaries above and below ground level of the facility and CCR surface impoundments are included on Figures 4-2 through 4-4.

5.0 Construction Description, 845.220(a)(1)(5)

Midwest Generation has filed a petition for an adjusted standard to reuse the existing 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. MWG is awaiting a decision on the adjusted standard by the IPCB. It should be noted that the petition was filed within 20 days of the Part 845 effective date of April 21, 2021; therefore, in accordance with Section 28.1(e) of the Act, the rule or regulation requiring removal of the liner is stayed pending the results of the petition. The petition seeks to decontaminate the existing geomembrane liner and reuse the liner instead of removing it. If the petition is granted, then Pond 2 will be used to manage non-CCR waste streams. As of the date of application, it is written with the intention of decontaminating the liner and re-using the pond.

Executing the closure by removal for Pond 2 is a multi-step process. First, the remaining CCR was removed from the sides of the liner using an excavator to pull down as much of the material as possible from the slopes onto the warning layer. Next the liner side slopes were pressure washed to remove the rest of the material on the slope. The previously described work was completed in 2019. The next steps would be to remove the warning layer from the base of Pond 2 using an excavator or front-end loader and haul off-site for disposal. The excavator or front-end loader would also use a rubber surface on the edge of the bucket to protect the geomembrane as the material is scooped. Once the warning layer material is removed from the base, the entire slopes and base of Pond 2 would be pressure washed. The liner slopes and base would be visually inspected and any damages observed would be repaired. After the liner is clean and any necessary repairs are made, wipe samples would be collected and analyzed to confirm the geomembrane liner has been decontaminated. The wipe sampling would be performed in accordance with ASTM D6966-18 and laboratory testing would be performed for metals and other chemical constituents, as necessary. One wipe sample and test would be performed per acre of geomembrane liner in Pond 2. Specifications for the described work are included in Attachment 5. The above-described closure process was included in Midwest Generation's petition for an adjusted standard as Exhibit

3. The described closure process from the petition is included in Attachment 5 as part of this construction permit application in the expert opinion of David E. Nielson of Sargent & Lundy.

Once the liner decontamination process is complete and verified, Pond 2 will be used to manage the Joliet 29 station's non-CCR waste streams. These non-CCR waste streams include the service-water/low volume wastewater from the RO sand filter backwash, the west area basin, the former coal pile runoff pump discharge, and the plant drains, including the Station floor drains, and roof drains and area drains.

After contractors have been chosen to conduct the closure construction and prior to earth moving activities, the contractor certifications identified on permit form 2CC will be provided to IEPA.

6.0 Facility Component Plans and Specifications, 845.220(a)(6)

The station has two generating units that now use natural gas to generate electricity. When the station used coal to generate electricity, it would burn it in the boilers associated with the two generating units. Typically, the CCR generated in the boilers would be sluiced to LSQ using an aboveground piping system where the CCR would be ultimately disposed. At times, this piping system was not operational and the CCR could not be sluiced to LSQ. During these times, the CCR was removed from the boilers inside the station and sluiced to Pond 2 using water through aboveground piping. This section discusses the system that sluices the CCR to Pond 2; the system that sluices CCR to LSQ is discussed in the LSQ construction permit application.

Attachment 1-1 contains the drawings that show the extent of the Joliet 29 generating station and sections/details for the construction of the ponds, including Pond 2. Reviewing these documents shows that the piping that sluices CCR to the ponds emanate from the north side of the building, from which the pipe travels east underground for approximately 600 feet, at which point, the pipe rises aboveground and travels shortly north for approximately 100 feet when it turns east and runs adjacent to Pond 1 for approximately 550 feet. At this point, the pipe turns north for approximately 140 feet where it connects to the inlet structure for Pond 2. The sluice water enters Pond 2 on the west side through a concrete inlet flume and distribution trough that evenly distributes the water into Pond 2. Once the water enters Pond 2 it disperses over the approximate 3.2 acres which allows the CCR to settle and remain in the pond. The water is collected on the east side by a concrete weir structure where the water is discharged through an underground reinforced concrete pipe. This pipe gravity drains the Pond 2 effluent water into the Pond 3 service water basin. Pond 3 is used as a polishing pond that removes the silt and/or clay sized particles from the water. The water discharged from Pond 3 is returned to the generating station for reuse in the station's processes. The water is returned to the station via aboveground piping that travels from east to west adjacent to Pond 1 and Pond 2 for approximately 1,670 feet, where it turns southwest for approximately 340 feet, where it enters the station at the northeast corner. From this point the water is reused as part of the station's electricity generating process.

7.0 Closure Construction, 845.220(d)

7.1 Closure Prioritization Category

Based on Section 845.700(g), the category designation for Pond 2 is Category 3. The Category 3 designation for Pond 2 is based on the following:

- Pond 2 is an inactive surface impoundment;
- There are no potable wells or setbacks of existing water supply wells downgradient, and as such Midwest Generation, LLC ("MWG") is not aware of any imminent threat to human health or the environment;
- The Illinois EPA EJ Start tool found at https://illinois-epa.maps.arcgis.com/apps/webappviewer/index.html?id=f154845da68a4a3f837cd3b880b0233c was used to determine that Pond 2 is located within one mile of an area of environmental justice concern.

A Notice of Intent to Initiate Closure for Pond 2 was submitted on April 11, 2021 by Midwest Generation.

7.2 Final Closure Plan

According to the initial Closure Plan prepared by KPRG in October 2016, "the closure of Ash Pond 2 will be by removal of the CCR" as defined in 40 CFR 257.102(c). As indicated previously, the CCR was removed from Pond 2 in 2019 while the warning layer and HDPE liner remains. Midwest Generation has filed a Petition for an Adjusted Standard with the Illinois Pollution Control Board requesting that Midwest Generation may reuse the HDPE liner in Pond 2. *In the Matter of: Petition of Midwest Generation for an Adjusted Standard from 845.740(a) and Finding of Inapplicability of Part 845*, PCB AS21-02. With the petition, "Midwest Generation plans to keep the structure of the pond intact for use for non-CCR material". The previously completed Closure Plan has been revised to address the execution of the final closure for Pond 2 based upon MWG's petition. Pond 2 will be closed by removing the warning layer and decontaminating the liner in accordance with the requested adjusted standard. The Final Closure Plan is included as part of this application in Attachment 7-1.

7.3 Closure Alternatives Analysis

A closure alternatives analysis (CAA) was completed for Pond 2. The CAA evaluated closing Pond 2 by removal in accordance with 845.740 and closure in place in accordance with 845.750. The completed CAA is included in Attachment 7-2.

7.4 Proposed Closure Schedule

The proposed schedule to execute the closure of Pond 2 is included in the Final Closure Plan in Attachment 7-1. The initial closure activity is applying for and obtaining an IEPA construction permit and the final closure step is submitting a closure report and closure certification with the closure construction activities occurring in between. The total time to execute the closure activities is estimated to be 24 months, which includes time to obtain the construction permit and closure report approval.

7.5 Post-Closure Plan

Since Midwest Generation is seeking an Adjusted Standard to reuse the existing HDPE geomembrane liner as part of reusing Pond 2 and otherwise close Pond 2 by removal in accordance with 845.740(a). The CCR and the warning layer will be removed from Pond 2 and the liner will be decontaminated in accordance with Midwest Generation's Adjusted Standard Petition. As a result, a post-closure plan is not required and Pond 2 will conduct groundwater monitoring for at least three (3) years in accordance with the sampling program discussed in Section 9 below and in accordance with 35 Ill. Adm. Code 845 Subpart F.

8.0 Groundwater Modeling, 845.220(d)(3)

The groundwater modeling of the CCR surface impoundment as specified in Section 845.220(d)(3) is presented below.

8.1 Modeling Inputs and Parameters

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 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.

The groundwater modeling inputs and parameters are discussed further in the groundwater modeling report in Attachment 8.

8.2 Groundwater Modeling Results

From this initial equilibrated model run discussed in Section 8.1, 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 8. 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, located in Attachment 8, 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 located in Attachment 8. 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. The groundwater modeling results are discussed further in the groundwater modeling report in Attachment 8.

8.3 Capture Zone Modeling

Capture zone modeling is not applicable based on the selected method of closure.

8.4 Groundwater Modeling Software

The groundwater modeling was completed using standard publicly available platforms, which included MODFLOW-NWT and for contaminant transport MT3D-USGS. The graphical user interface is Groundwater Vistas. Both MODFLOW-NWT and MT3D-USGS are publicly available programs that can be downloaded from the USGS website https://water.usgs.gov/water-resources/software/modflow-nwt/ and https://www.usgs.gov/software/mt3d-usgs-groundwater-solute-transport-simulator-modflow, respectively.

9.0 Groundwater Monitoring Program, 845.220(a)(7)

The groundwater monitoring program of the CCR surface impoundment as specified in Section 845.220(a)(7) is presented below.

9.1 Hydrogeologic Site Characterization

The following subsections provide information on the geology and hydrogeology of the site as required under Section 845.620(b). Site geology and hydrogeology are discussed separately below.

9.1.1 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 9.1.2]). The depths of these wells range from 43 feet to 605 feet. The stratigraphy data from these boring logs and the well locations are provided in Attachment 9-1. In addition, well logs from 11 monitoring wells that were installed in the vicinity of the subject surface impoundment (MW-1 through MW-11; see Figure 9-1) with those borings ranging in depth from 27.5 feet to 41 feet. This information is also included in the stratigraphy table in Attachment 9-1. Boring logs for these monitoring wells are included in Attachment 9-2. Based on an evaluation of this data, the following general site-specific stratigraphy is defined and geologic cross-sections are provided as Figures 9-2, 9-3, and 9-4 based on the 11 on-site monitoring well boring logs:

- 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 (wells MW-1 and MW-2).

- 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.

There are no underground mines beneath the subject CCR surface impoundment.

9.1.2 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. More site-specific precipitation data from four water stations located in Joliet and Elgin, Illinois, is provided in Table 9-1.

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 9-1). 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. Table 9-2 provides groundwater elevation measurements obtained for the 11 on-site monitoring wells in the vicinity of the subject CCR surface impoundment which includes data for the monitoring wells associated specifically with the subject surface impoundment (Pond 2; upgradient well MW-10 and downgradient wells MW-3 thru MW-5). A hydrograph of water levels is provided as Figure 9-5. A review of the hydrograph shows some potential temporal fluctuations with the highest water levels generally occurring within the second or third quarters of the year.

Groundwater flow maps for the four quarters from 3rd quarter 2020 through the 2nd quarter 2021 are provided as Figures 9-6 through 9-9. The maps include groundwater elevation data from all 11 wells in the area, including the specific CCR monitoring wells associated with the subject surface impoundment. Based on a review of the maps, groundwater flow is in a southerly direction towards the associated facility water intake channel and the Des Plaines River. These maps are consistent with historical flow data for the site. The horizontal hydraulic gradient is fairly shallow. Table 9-3 provides a summary of the flow direction, gradient and an estimated rate of groundwater flow for each sampling event. The flow rate was calculated using the following equation:

$$V_s = \frac{K dh}{n_e dl}$$

Where:

V_s = seepage velocity (distance/time)
K = hydraulic conductivity (distance/time)
dh/dl = hydraulic gradient (unitless)
n_e = effective porosity (unitless)

Hydraulic conductivity values were initially estimated for monitor wells MW-4, -6, -9, and -11 from slug tests completed by Patrick Engineering in 2010. The geometric mean of the test data for these wells was approximately 310 feet per day (ft/d; 3.59×10^{-3} ft/sec) for each well, as calculated by Patrick Engineering in the Hydrogeologic Assessment Report – Joliet #29 Generating Station, February 2011. The slug test data were reviewed as part of the modeling study being completed for the Construction Permit application and the data were reanalyzed using corrected input values for the well casing and borehole dimensions and effective porosity of the sand filter pack material. The revised geometric mean of the test data for these wells decreased to approximately 170 ft/d (1.97×10^{-3} ft/sec) for each well. This revised value was used in Table 9-3. 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 9.1.1 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 the subject CCR surface impoundment in accordance with Section 620.250 as part of a Compliance Commitment Agreement (CCA) between Midwest Generation and Illinois EPA. The extent of the established and approved GMZ is provided on Figure 9-10.

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. The following databases and sources of information were utilized in order to determine community water source and water well locations and construction in the vicinity of the ash pond wastewater treatment systems:

- Illinois State Geological Survey (ISGS) -Water Well Database Query;
- Illinois State Water Survey (ISWS) Private Well Database and water well construction report request; and
- Illinois Division of Public Water Supply web-based Geographic System (GIS) files;

As part of this permit preparation, KPRG evaluated the NRT information and reviewed the new Illinois State Geological Survey database and interactive map references as "ILWATER". The survey results are provided on Figure 9-11. Fifteen potable/industrial use wells are within a 2,500-foot radius of the Station's subject CCR surface impoundment. There are no wells directly downgradient of the subject surface impoundment. Eight of the wells are located 1,500 to 2,500 feet north and northwest of the impoundment (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 1500 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 of the location shown on the figure.

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 the subject CCR surface impoundment.

Based on the geology of the site presented in Section 9.1.1 and the above hydrogeology discussions, the primary contaminant migration pathway for a potential release from the subject CCR surface impoundment 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 subject site.

There is quarterly groundwater quality data associated with the subject CCR surface impoundment 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. That historical water quality data is provided in Attachment 9-3.

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 the subject CCR surface impoundment (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 9-4. In addition, it is noted that Illinois EPA added turbidity measurements to the list with a required eight rounds of background of that parameter for each well in the monitoring network for the subject CCR surface impoundment. The turbidity data is provided in Table 9-5.

9.2 Groundwater Monitoring System Design and Construction Plans

A comprehensive monitoring well network that includes other ponds in the vicinity of Pond 2 was established in response to a previous Illinois EPA request in 2010. The well spacing was developed as part of a previous hydrogeologic assessment completed by Patrick Engineering, Inc. The well depths were determined based on depth to groundwater and the base elevations of the ponds being monitored and were approved by Illinois EPA. Groundwater flow in the area is generally to the south towards the facility water intake channel and Des Plaines River. Monitoring well MW-10 (see Figure 9-1) is the established up-gradient water quality monitoring point for Pond 2. Groundwater data from this well will be evaluated to provide a statistically representative upgradient water quality prior to that water passing beneath the regulated unit. Wells MW-3, MW-4 and MW-5, which are located essentially at the pond boundary, will serve as down-gradient monitoring points for Pond 2. This proposed monitoring well network will be utilized for determining whether potential pond leakage may be causing or contributing to groundwater impacts in the vicinity of the units.

MW-3, MW-4, MW-5, and MW-10, installed in 2010, were drilled using 4.25-inch hollow stem augers. The wells were completed with standard 2-inch inner-diameter PVC casing with 10-feet of 0.010 slot PVC screen. Filter sand pack around each screen was extended to approximately 2-feet above the top of the well screen. The remainder of the annulus was backfilled with bentonite. Surface completions include stick-up (above grade two to three feet) locking protector casings set in concrete aprons. The wells are further protected by traffic bollards, as necessary. Boring logs and well construction summaries for these wells are provided in Attachment 9-2. Ground surface and top-of-casing elevations were surveyed by an Illinois licensed surveyor and are included in the previously referenced groundwater elevation table (Table 9-2).

MW-3, MW-4, MW-5, and MW-10 are outfitted with a dedicated sampling system. Specifically, each well has a QED Environmental Systems (QED) Well Wizard Model P1101M dedicated sampling pump with Model No. 37789 intake screens (0.010-inch slot). The screens are set within approximately one-foot of the base of the monitoring well.

In accordance with requirements under Section 845.630(g), Attachment 9-4 includes an Illinois licensed Professional Engineer certification of the above-defined monitoring system.

9.3 Groundwater Sampling and Analysis Program

9.3.1 Sample Frequency

Pond 2 is regulated under the Federal CCR Rule. As such, all of the above defined monitoring wells (upgradient and down-gradient) have been sampled on a quarterly basis starting the 4th quarter of 2015 for eight consecutive quarters for both Appendix III and Appendix IV parameters specified in the Federal CCR Rule, which is the same parameter listing as provided under the State CCR Rule Section 845.600(a) plus calcium. This dataset will facilitate the development of proper statistical evaluation procedures for the site and use in development of applicable site-specific Groundwater Protection Standards (GWPSs) for each constituent pursuant to Section 845.600(b) as presented in Section 9.4 below. Additional monitoring data collected since the initial eight rounds of background sampling will also be evaluated to determine whether an expanded dataset can be used in developing an appropriate and representative background for the State CCR Rule compliance. Illinois EPA added turbidity as an additional parameter that will require development of a statistical background. Since this parameter was not included within the Federal CCR Rule, eight rounds of turbidity measurements were obtained within the 180-day period since the effective date of the State Rule. However, this restricted period of background data collection does not facilitate evaluation of potential seasonal variations during the development of statistical background for this parameter.

Currently, all wells within this CCR monitoring network are being sampled on a quarterly basis for all parameters specified in Section 845.600(a) plus calcium and turbidity. Between quarterly monitoring events, groundwater level measurements from all designated CCR monitoring wells will be also obtained and recorded on a monthly basis. During the initial rounds of monthly groundwater level measurements after the enactment of the State CCR Rule, surface impoundment measurements were not collected because the instrumentation for these measurements was not yet in-place and available for recording the data.

Quarterly groundwater monitoring will continue during the active life of the impoundment and the post-closure care period or, if closure is by removal, then in accordance with monitoring frequency requirements under Section 845.740(b). It is noted that if after 5 years of quarterly monitoring it can be demonstrated that the facility meets the requirements specified in Section 845.650(b)(4), the owner can petition the Illinois EPA to shift the monitoring frequency to semi-annual.

9.3.2 Sampling Preparation and Calibrations

Prior to any sampling event, the Station's designated Environmental Specialist shall be notified in advance of sampling crew arrival so that any arrangements can be made, including security clearance and training.

Prior to sampling activities, and at intervals recommended by the manufacturer, all non-dedicated equipment shall be cleaned and calibrated. Specifically, the field parameter water quality meter to be used for pH, specific conductance, turbidity and temperature will be calibrated using standard reference solutions. In addition, an operational check of the electronic water level probe will also be performed by placing the probe into a bucket of water and ensuring that the audio signal is triggered when the sensor meets the water interface. The associated tape measure of the probe will also be checked for wear.

The monitoring network consists of all dedicated sampling equipment (QED Well Wizard P1101M). The controller used to operate individual bladder pumps will be checked and maintained prior to arrival at the site based on manufacturer specifications.

All lab ware shall be obtained directly from an Illinois certified laboratory. Upon arrival to the site, the monitoring wells will be assessed for structural integrity. Each well cover (either stick-up or flush mount) will be inspected for proper labels, locks, any damage and be cleared of any flora or fauna that may be on the well or in the vicinity that would affect the sample or the sampling operation. In addition to any other notable observations, all of the above shall be entered on the sampling sheets. Once the well is uncovered and unlocked, and the well casing inspected, the well head shall be inspected for damage and cleanliness. At that point, the well will be considered ready for sampling per procedures described below.

9.3.3 Groundwater Sample Collection

Prior to initiating sampling, a round of groundwater levels will be collected from each monitoring well using an electronic water level probe. The timeframe over which these water levels are collected should be minimized and should not exceed 8 hours. The depth to water will be measured to the nearest one-hundredth of a foot from the top of casing using an electronic water level meter. The water level probe should be properly decontaminated between each reading using procedures specified in Section 9.3.4.

All of the monitoring wells at this Station are equipped with dedicated, down-hole, bladder pumps. At the top of casing for each well is a manifold with air and water quick connects and a port for a water level meter probe to fit so that an undisturbed water level can be obtained. Immediately prior to sampling, the depth to water will be measured again to the nearest one-hundredth of a foot from the top of casing using an electronic water level indicator and recorded onto the sampling sheets. Once recorded, an air compressor and flow controller will be attached to the air side quick connect and disposable tubing attached to the discharge connection. The discharge tubing will be run to a flow-through cell of the water quality meter. A discharge line from the flow-through cell will be placed into a vessel to allow for the measurement of the volume of groundwater removed. The water quality meter will be attached within the flow-through cell that allows for real time readings of pH, specific conductivity and temperature. It is noted that a calibration check of the water quality meter should be performed at the start and end of each day of sampling and recorded in the field notes. If the meter calibration-check shows drift outside of manufacturer specifications, the meter should be recalibrated in the field using standard solutions per manufacturer requirements.

The air controller will be set to the necessary pressure and to the slowest pumping interval, approximately 50 second refill and 10 second pump (flow rates at this setting tend to be less than 100 milliliters/minute), and the compressor will be started. The intent of the low flow pumping will be to minimize drawdown in the well with an ideal goal of keeping the drawdown to 0.30 feet or less. Once the water has filled the flow-through cell, a reading of the parameters will be recorded. Readings will continue to be recorded until such time as all parameters are deemed stable for three consecutive measurements at which point a sample will be collected from the tubing prior to the flow-through cell. An unfiltered groundwater sample shall be collected directly from the water tubing after it is disconnected from the flow-through cell. The laboratory provided bottles shall be properly filled. Once the sample is collected, the bottles shall be properly labeled and placed on ice as necessary.

If the well would pump dry prior to the field parameter readings stabilizing, the well will be allowed to recover for up to 24-hours at which point water sample collection will be initiated.

In the event that a dedicated bladder pump fails to work, the following procedures should be implemented:

- Pull the dedicated tubing and pump from the well and ensure that the tubing does not contact the ground.

- Visually inspect the intake of the pump for clogging from sedimentation. If clogging is noted, clean the intake with distilled water. If there is no clogging, dismantle the pump casing and inspect the bladder for any holes, cracks or tears.

- If the bladder is determined to be compromised (i.e., wear has resulted in cracking or tearing), remove the bladder and replace it with a new bladder. Properly clean all parts of the pump using procedures described in Section 9.3.4, reassemble the pump and slowly lower it back down hole. Continue sampling as described above.

- If the entire pump is determined to have failed, a new pump will need to be ordered for replacement and a modified sampling procedure will be implemented as described below.

In the case of bladder pump failure, at a specific well during a sampling event, the alternate sampling method will be the use of a portable peristaltic pump (the pump itself does not go down-hole) assuming depth to water is less than 23 feet bgs. Clean disposable polyethylene tubing will be attached to the pump and the tubing will be slowly lowered down hole along with the water level probe. The pump will be operated at the lowest rate possible to achieve the same goals as for sampling described above (generally below 300 milliliters/minute, which is within the range of standard low flow protocols). Water will be collected in a clean glass jar for field parameter readings. Once stable field parameters are recorded, the sample will be collected directly onto laboratory prepared containers for analysis. Upon completion of sample collection, the water level meter and tubing should be removed from the well. The polyethylene tubing should be disconnected from the pump and discarded. The water level meter should be properly decontaminated as specified in Section 9.3.4. If depth to water is such that a peristaltic pump cannot be used, a submersible pump will need to be used. The submersible pump must be properly cleaned as specified in Section 9.3.4 prior to placement down the well. All subsequent procedures will be the same as above. The alternate sampling pump use will be recorded on the field data sheet for that well and noted in any subsequent reporting summary.

9.3.4 Equipment Decontamination

Any equipment that is used down-hole at more than one sampling location must be thoroughly decontaminated between uses. Based on procedures described above, only the water level meter is anticipated to be in this category, however, if a submersible pump needs to be used during a particular sampling event due to dedicated pump failure (see Section 9.3.3), these procedures will also apply. The water level meter probe and any measuring tape, or any other non-dedicated equipment that may need to be placed down the well that extended below the water surface, will need to be cleaned with an Alconox solution, or equivalent, wash followed by a double rinse with distilled water. Any pump tubing that is not dedicated should be discarded and only clean tubing should be used down-hole.

9.3.5 Sample Preservation, Chain-of-Custody and Shipment

Since measurement of total recoverable metals is required by the State CCR Rule, the samples will not be filtered prior to collection. This will facilitate the analysis to capture both the particulate fraction and dissolved fraction of metals in natural groundwater. Groundwater samples will be collected directly into Illinois certified laboratory provided containers. Those containers will be prepared by the laboratory to contain any necessary chemical preservation. The samples shall be stored at temperatures required by the lab following sample collection. Table 9-6 includes a summary of sample bottle requirements, preservatives and holding times

All groundwater samples collected shall be transferred to the laboratory under proper COC procedures. The laboratory provided COC, completed with all pertinent information, shall be maintained from sample collection through receipt by the laboratory. The information shall include, but is not limited to, the following:

- Project name and number, state samples collected in, sample name and type, time and date collected, analysis requested, and printed name and signatures of person(s) sampling.

The COC shall be completed and properly relinquished by the field sampler(s) with all samples clearly printed or typed.

All samples will be either delivered directly to the laboratory or be shipped using Federal Express or a similar overnight service. It should be noted that Total Dissolved Solids (TDS) analysis has a 7-day holding time. TDS samples should be shipped to the laboratory within 72 hours after collection. All other holding times for the specified parameters are long enough to facilitate one shipment after the full round of sampling is complete.

9.3.6 Analytical Methods

A list of the analytical methods to be used by the laboratory for each specified parameter is included in the above referenced Table 9-6. Individual detection limits for the parameters may change slightly from sample to sample depending on potential matrix interferences with a sample (e.g., amount of suspended solids/sediment) and/or the concentration of the constituent in the sample. However, the base detection limits will be set at or below the applicable standards as defined in Section 845.600(a)(1) for that compound, which are also provided in Table 9-6.

9.3.7 Quality Assurance and Quality Control

Laboratory

Only an Illinois certified analytical laboratory will be used for sample analysis. The laboratory will be conducting their work under their specific approved Quality Assurance and Quality Control (QA/QC) program. A copy of their program can be available upon request. A standard Level II data documentation package will be included in all subsequent reporting, however, the lab will be requested to also provide a Level IV data documentation package (i.e., U.S. EPA Contract Laboratory Protocol equivalent) in the event more detailed data validation/evaluation is deemed necessary.

Field

The QA/QC program for fieldwork will include the collection of blind duplicates and the use of a laboratory supplied trip blank. The blind duplicate will be collected from a random well during every sampling event in which more than three (3) samples are collected. The duplicate will be blind in the manner that there will be no way for the laboratory to determine from which well or point the sample was collected.

Upon receipt of the analytical data, a determination will be made if the duplicate is consistent with the sample collected from the well/point. A generally acceptable range for groundwater samples is +/- 30 percent. If outside the acceptable range, a resample may be determined to be necessary and reanalyzed. The trip blank analytical data will be reviewed for any values other than non-detect. If there are any questions regarding the duplicate, trip blank, or other reported analytical QA/QC runs, the laboratory will be contacted to determine the effect on data quality, if any, and usability. If necessary, a specific well may need to be re-sampled.

9.3.8 Statistical Methods
A proposed statistical evaluation plan meeting the requirements specified in Section 845.640(f) is provided in Attachment 9-5 along with a certification of the plan by an Illinois licensed Professional Engineer.

9.4 Groundwater Monitoring Program

The groundwater sample and water level collection frequency is discussed in Section 9.3.1 above.

As previously noted, the monitoring well system for the subject unit consist of four monitoring wells as follows:

- MW-10 – Upgradient
- MW-3 through MW-5 – Downgradient

Eight rounds of background sampling for the purposes of statistical evaluation and background determination is available from the initial groundwater sampling which occurred starting in 2015 in compliance with the Federal CCR Rule requirements. Subsequent groundwater sampling has also occurred on a quarterly basis for the seven detection monitoring parameters listed under Appendix III of the Federal CCR Rule detection monitoring requirements. All available CCR monitoring data through the end of the second quarter 2021 is summarized in Table 9-5 and the eight rounds of turbidity data collected since the enactment of the State CCR Rule in April 2021 are provided in Table 9-6.

Using the currently available data for the subject CCR surface impoundment, site specific Groundwater Protection Standards (GWPSs) have been established in accordance with Section 845.600(b) and are summarized in Table 9-7. The background concentrations noted in Table 9-7 were calculated using the statistical evaluation approach noted in Section 9.3.8 and provided in Attachment 9-5. A presentation of the statistical evaluations, which resulted in the background concentration calculations is provided in Attachment 9-6.

Once the proposed GWPSs presented in this permit application are approved by Illinois EPA, these values will be used for all subsequent groundwater monitoring data comparisons. Monitoring will continue on a quarterly basis for all constituents specified in Section 845.600(a)(1) plus calcium and turbidity. In accordance with Section 845.610(b)(3)(D), a data summary report will be submitted to Illinois EPA within 60-days of receipt of all analytical data which will include a groundwater flow map for the quarterly sampling event, summary of water level elevations collected during the reporting period (monthly measurements), and a data summary including summary data tables with a comparison against the established/approved GWPSs. This report will be placed the facility’s operating record.

If during a monitoring event, a constituent(s) is/are detected above an established/approved GWPS, that well will be resampled for the specific constituent(s) in accordance with the statistical evaluation procedures outlined in Attachment 9-5. If the resample data confirms that the constituent(s) concentration(s) is/are above the GWPS then the following will occur:

- Characterize the nature and extent of the potential release and any relevant site conditions that may affect the remedy evaluation/selection. This characterization must meet the requirements set forth under Section 845.650(d)(1).

- If groundwater impacts extend off-site, provide off-site landowner/resident notifications as specified under Section 845.650(d)(2) and place the notifications into the facility's operating record. This must occur within no more than 30-days of determination that a GWPS has been exceeded.

- An Alternate Source Demonstration (ASD) may be initiated and completed for submittal to Illinois EPA review/approval as allowed under Section 845.650(e). Place the ASD into the facility's operating record.

- Within 90-days of determining that a constituent(s) was detected above an established/approved GWPS at a downgradient waste boundary monitoring point, initiate an assessment of corrective measures meeting the requirements specified under Section 845.660 unless an ASD is submitted in accordance with Section 845.650(d)(2) and subsequently approved by the Illinois EPA.

By no later January 31st of each year, an Annual Groundwater Monitoring and Corrective Action Report will be prepared for inclusion as part of an Annual Consolidated Report for the facility. The Annual Groundwater Monitoring and Corrective Action Report will meet the requirements set forth under Section 845.610(e)(1 through 4). The Annual Consolidated Report will be placed into the facility's operating record.

10.0 Professional Engineer Certification, 845.220(a)(8)

This construction permit application has been prepared to meet the requirements of 35 Ill. Adm. Code 845.220(a) and 845.220(d).

1/28/22

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

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11.0 Owner Certification, 845.220(a)(9)

A certification stating that the owner or operator of the CCR surface impoundment has completed the public notification and public meetings that are required under the Ill. Adm. Code Title 35, Part 845 Section 240 is included in Attachment 11. Also included is a summary of the issues raised by the public and a summary of any revisions, determinations, or other considerations made in response to those issues. A list of interested persons in attendance who would like to be added to the Agent's list for the facility.

OPERATING PERMIT TABLES

Table 2. Joliet 29 Generating Station
Pond 2 CCR Chemical Constituents Analytical Results

Parameter Name	Bottom Ash Sample 8/31/2021
Antimony	<1.8 F1
Arsenic	1.5 F1
Barium	3,000
Beryllium	1.5 F1
Boron	130 F1 V
Cadmium	<0.18
Calcium	100,000
Chloride	<20
Chromium	12 F1
Cobalt	15
Fluoride	<1.0
Lead	5.6
Lithium	20 V
Mercury	<0.016
Molybdenum	1.1 F1
Selenium	<0.89 F1
Sulfate	560
Thallium	2.9
Radium 226	1.54
Radium 228	1.63
Radium 226 & 228	3.17

Notes:

All results are in milligrams per kilogram (mg/kg), except for radium, which pCi/L

F1 - MS and/or MSD recovery exceeds control limits

V - Serial Dilution exceeds the control limits

Table 9-1. Summary of Local Precipitation Data - Midwest Generation, LLC, Joliet #29 Generating Station, Joliet, Illinois.

Joliet #29 Station	
Month	**Average Monthly Precipitation* (inches)**
January	1.09
February	1.27
March	2.01
April	3.66
May	3.9
June	4.65
July	4.41
August	4.08
September	3.02
October	3.09
November	2.4
December	1.81

Notes:
* - Historical precipitation data was obtained from the National Oceanic and Atmospheric Administration. Precipitation data was averaged from four stations located within Joliet and Elgin, Illinois. Dates of precipitation data range from 1894-2020.

Table 9-2. Groundwater Elevations - Midwest Generation, LLC, Joliet Station #29, Joliet, IL.

Well ID	Date	Top of Casing (TOC) Elevation (ft above MSL)	Ground Elevation (ft above MSL)	Groundwater Elevation (ft above MSL)	Sampling Groundwater Elevation (ft above MSL)	Bottom of Well Elevation (ft above MSL)	Depth to Groundwater (ft below TOC)	Sampling Depth to Groundwater (ft below TOC)	Depth to Bottom of Well (ft below TOC)
MW-01	02/10/15	534.76	531.46	NM	NM	504.88	NM	NM	29.88
	05/27/15	534.76	531.46	NM	NM	504.88	NM	NM	29.88
	08/04/15	534.76	531.46	NM	NM	504.88	NM	NM	29.88
	10/27/15	534.76	531.46	NM	NM	504.88	NM	NM	29.88
	02/09/16	534.03	531.56	NM	NM	505.50	NM	NM	28.53
	05/10/16	534.03	531.56	505.90	506.18	505.50	28.13	27.85	28.53
	08/30/16	534.03	531.56	506.85	506.91	505.50	27.18	27.12	28.53
	11/01/16	534.03	531.56	505.89	505.53	505.50	28.14	28.50	28.53
	02/06/17	534.03	531.56	NM	NM	505.50	NM	NM	28.53
	04/25/17	534.03	531.56	NM	NM	505.50	NM	NM	28.53
	08/01/17	534.03	531.56	506.59	506.53	505.50	27.44	27.50	28.53
	10/17/17	534.03	531.56	508.87	508.85	505.50	25.16	25.18	28.53
	02/21/18	534.03	531.56	506.37	509.54	505.50	27.66	24.49	28.53
	04/25/18	534.03	531.56	505.89	505.58	505.50	28.14	28.45	28.53
	07/31/18	534.03	531.56	505.75	505.50	505.50	28.28	28.53	28.53
	10/16/18	534.03	531.56	506.22	505.93	505.50	27.81	28.10	28.53
	02/04/19	534.03	531.56	505.73	NM	505.50	28.30	NM	28.53
	05/06/19	534.03	531.56	509.00	509.00	505.50	25.03	25.03	28.53
	08/06/19	534.03	531.56	505.88	NM	505.50	28.15	NM	28.53
	11/06/19	534.03	531.56	507.38	NM	505.50	26.65	NM	28.53
	02/12/20	534.03	531.56	505.69	NM	505.50	28.34	NM	28.53
	05/21/20	534.03	531.56	511.60	NM	505.50	22.43	NM	28.53
	07/30/20	534.03	531.56	505.74	NM	505.50	28.29	NM	28.53
	10/21/20	534.03	531.56	505.73	NM	505.50	28.30	NM	28.53
	02/11/21	534.03	531.56	505.73	NM	505.50	28.30	NM	28.53
	05/17/21	534.03	531.56	505.76	NM	505.50	28.27	NM	28.53
MW-02	02/10/15	534.28	531.19	505.17	510.69	504.05	29.11	23.59	30.23
	05/27/15	534.28	531.19	505.34	505.32	504.05	28.94	28.96	30.23
	08/04/15	534.28	531.19	505.14	505.13	504.05	29.14	29.15	30.23
	10/27/15	534.28	531.19	504.89	505.09	504.05	29.39	29.19	30.23
	02/09/16	534.30	531.17	505.59	505.57	504.07	28.71	28.73	30.23
	05/10/16	534.30	531.17	505.89	506.09	504.07	28.41	28.21	30.23
	08/30/16	534.30	531.17	506.83	506.97	504.07	27.47	27.33	30.23
	11/01/16	534.30	531.17	505.90	505.89	504.07	28.40	28.41	30.23
	02/06/17	534.30	531.17	505.46	505.74	504.07	28.84	28.56	30.23
	04/25/17	534.30	531.17	505.69	505.70	504.07	28.61	28.60	30.23
	08/01/17	534.30	531.17	506.59	506.52	504.07	27.71	27.78	30.23
	10/17/17	534.30	531.17	508.82	508.82	504.07	25.48	25.48	30.23
	02/21/18	534.30	531.17	506.35	509.65	504.07	27.95	24.65	30.23
	04/25/18	534.30	531.17	505.87	505.81	504.07	28.43	28.49	30.23
	08/01/18	534.30	531.17	505.22	505.14	504.07	29.08	29.16	30.23
	10/16/18	534.30	531.17	506.17	506.11	504.07	28.13	28.19	30.23
	02/04/19	534.30	531.17	505.68	505.65	504.07	28.62	28.65	30.23
	05/06/19	534.30	531.17	508.95	508.29	504.07	25.35	26.01	30.23
	08/06/19	534.30	531.17	505.16	NM	504.07	29.14	NM	30.23
	11/06/19	534.30	531.17	507.27	NM	504.07	27.03	NM	30.23
	02/12/20	534.30	531.17	505.49	NM	504.07	28.81	NM	30.23
	05/21/20	534.30	531.17	510.37	NM	504.07	23.93	23.94	30.23
	07/30/20	534.30	531.17	504.98	NM	504.07	29.32	NM	30.23
	10/21/20	534.30	531.17	505.25	NM	504.07	29.05	NM	30.23
	02/11/21	534.30	531.17	505.15	NM	504.07	29.15	NM	30.23
	05/17/21	534.30	531.17	505.68	NM	504.07	28.62	NM	30.23
MW-03	02/10/15	538.78	535.54	505.19	505.20	494.68	33.59	33.58	44.10
	05/27/15	538.78	535.54	505.36	505.35	494.68	33.42	33.43	44.10
	08/04/15	538.78	535.54	505.22	505.22	494.68	33.56	33.56	44.10
	10/27/15	538.78	535.54	504.91	505.04	494.68	33.87	33.74	44.10
	02/09/16	538.79	535.53	505.62	505.51	494.68	33.17	33.28	44.10
	05/10/16	538.79	535.53	505.97	505.99	494.68	32.82	32.80	44.10
	08/30/16	538.79	535.53	506.91	507.22	494.68	31.88	31.57	44.10
	11/01/16	538.79	535.53	505.91	505.94	494.68	32.88	32.85	44.10
	02/06/17	538.79	535.53	505.54	505.54	494.68	33.25	33.25	44.10
	04/26/17	538.79	535.53	505.73	505.78	494.68	33.06	33.01	44.10
	08/01/17	538.79	535.53	506.43	506.44	494.68	32.36	32.35	44.10
	10/18/17	538.79	535.53	508.76	508.54	494.68	30.03	30.25	44.10
	02/20/18	538.79	535.53	506.38	506.56	494.68	32.41	32.23	44.10
	04/24/18	538.79	535.53	505.96	505.96	494.68	32.83	32.83	44.10
	07/31/18	538.79	535.53	505.23	505.25	494.68	33.56	33.54	44.10
	10/17/18	538.79	535.53	506.21	506.09	494.68	32.58	32.70	44.10
	02/04/19	538.79	535.53	505.74	505.81	494.68	33.05	32.98	44.10
	05/06/19	538.79	535.53	508.84	508.61	494.68	29.95	30.18	44.10
	08/06/19	538.79	535.53	505.26	505.29	494.68	33.53	33.50	44.10
	11/06/19	538.79	535.53	505.41	505.29	494.68	33.38	33.50	44.10
	02/12/20	538.79	535.53	505.61	505.29	494.68	33.18	33.50	44.10
	05/20/20	538.79	535.53	511.66	511.66	494.68	27.13	27.13	44.10
	07/30/20	538.79	535.53	505.06	505.04	494.68	33.73	33.75	44.10
	10/21/20	538.79	535.53	505.27	505.46	494.68	33.52	33.33	44.10
	02/11/21	538.79	535.53	504.23	505.46	494.68	34.56	33.33	44.10
	05/17/21	538.79	535.53	505.74	505.73	494.68	33.05	33.06	44.10

Table 9-2. Groundwater Elevations - Midwest Generation, LLC, Joliet Station #29, Joliet, IL.

Well ID	Date	Top of Casing (TOC) Elevation (ft above MSL)	Ground Elevation (ft above MSL)	Groundwater Elevation (ft above MSL)	Sampling Groundwater Elevation (ft above MSL)	Bottom of Well Elevation (ft above MSL)	Depth to Groundwater (ft below TOC)	Sampling Depth to Groundwater (ft below TOC)	Depth to Bottom of Well (ft below TOC)
MW-04	02/10/15	539.03	535.80	505.19	505.18	496.13	33.84	33.85	42.90
	05/27/15	539.03	535.80	505.39	505.37	496.13	33.64	33.66	42.90
	08/04/15	539.03	535.80	505.19	505.19	496.13	33.84	33.84	42.90
	10/27/15	539.03	535.80	504.98	505.00	496.13	34.05	34.03	42.90
	02/09/16	539.01	535.83	505.59	505.44	496.11	33.42	33.57	42.90
	05/10/16	539.01	535.83	505.94	505.95	496.11	33.07	33.06	42.90
	08/30/16	539.01	535.83	506.93	507.19	496.11	32.08	31.82	42.90
	11/01/16	539.01	535.83	505.85	505.87	496.11	33.16	33.14	42.90
	02/06/17	539.01	535.83	505.50	505.52	496.11	33.51	33.49	42.90
	04/26/17	539.01	535.83	505.72	505.74	496.11	33.29	33.27	42.90
	08/01/17	539.01	535.83	506.92	506.39	496.11	32.09	32.62	42.90
	10/18/17	539.01	535.83	508.73	508.50	496.11	30.28	30.51	42.90
	02/20/18	539.01	535.83	505.37	506.69	496.11	33.64	32.32	42.90
	04/24/18	539.01	535.83	505.91	505.92	496.11	33.10	33.09	42.90
	07/31/18	539.01	535.83	505.20	505.22	496.11	33.81	33.79	42.90
	10/17/18	539.01	535.83	506.16	506.03	496.11	32.85	32.98	42.90
	02/04/19	539.01	535.83	505.72	505.72	496.11	33.29	33.29	42.90
	05/06/19	539.01	535.83	509.18	508.57	496.11	29.83	30.44	42.90
	08/06/19	539.01	535.83	505.22	505.21	496.11	33.79	33.80	42.90
	11/06/19	539.01	535.83	507.36	505.21	496.11	31.65	33.80	42.90
	02/12/20	539.01	535.83	505.56	505.26	496.11	33.45	33.75	42.90
	05/20/20	539.01	535.83	511.61	511.61	496.11	27.40	27.40	42.90
	07/30/20	539.01	535.83	505.01	505.04	496.11	34.00	33.97	42.90
	10/21/20	539.01	535.83	505.53	505.46	496.11	33.48	33.55	42.90
	02/11/21	539.01	535.83	505.16	505.46	496.11	33.85	33.55	42.90
	05/17/21	539.01	535.83	505.69	505.69	496.11	33.32	33.32	42.90
MW-05	02/11/15	539.69	536.43	505.12	505.12	494.64	34.57	34.57	45.05
	05/27/15	539.69	536.43	505.26	505.25	494.64	34.43	34.44	45.05
	08/04/15	539.69	536.43	505.14	505.14	494.64	34.55	34.55	45.05
	10/27/15	539.69	536.43	504.78	504.95	494.64	34.91	34.74	45.05
	02/09/16	539.64	536.36	505.46	505.33	494.59	34.18	34.31	45.05
	05/10/16	539.64	536.36	505.83	505.86	494.59	33.81	33.78	45.05
	08/30/16	539.64	536.36	506.82	507.09	494.59	32.82	32.55	45.05
	11/01/16	539.64	536.36	505.74	505.74	494.59	33.90	33.90	45.05
	02/06/17	539.64	536.36	505.41	505.40	494.59	34.23	34.24	45.05
	04/26/17	539.64	536.36	505.60	505.66	494.59	34.04	33.98	45.05
	08/01/17	539.64	536.36	506.52	506.24	494.59	33.12	33.40	45.05
	10/18/17	539.64	536.36	508.61	508.59	494.59	31.03	31.05	45.05
	02/20/18	539.64	536.36	506.35	506.74	494.59	33.29	32.90	45.05
	04/24/18	539.64	536.36	505.85	505.82	494.59	33.79	33.82	45.05
	07/31/18	539.64	536.36	505.10	505.11	494.59	34.54	34.53	45.05
	10/17/18	539.64	536.36	506.03	505.91	494.59	33.61	33.73	45.05
	02/04/19	539.64	536.36	505.97	505.96	494.59	33.67	33.68	45.05
	05/06/19	539.64	536.36	509.09	508.98	494.59	30.55	30.66	45.05
	08/06/19	539.64	536.36	505.09	505.09	494.59	34.55	34.55	45.05
	11/06/19	539.64	536.36	507.24	505.09	494.59	32.40	34.55	45.05
	02/12/20	539.64	536.36	505.48	504.59	494.59	34.16	35.05	45.05
	05/20/20	539.64	536.36	511.48	511.48	494.59	28.16	28.16	45.05
	07/30/20	539.64	536.36	504.87	504.88	494.59	34.77	34.76	45.05
	10/21/20	539.64	536.36	505.12	506.09	494.59	34.52	33.55	45.05
	02/11/21	539.64	536.36	505.04	506.09	494.59	34.60	33.55	45.05
	05/17/21	539.64	536.36	505.59	505.54	494.59	34.05	34.10	45.05
MW-06	02/10/15	539.06	535.86	505.23	505.23	496.86	33.83	33.83	42.20
	05/28/15	539.06	535.86	505.46	505.45	496.86	33.60	33.61	42.20
	08/05/15	539.06	535.86	505.11	505.12	496.86	33.95	33.94	42.20
	10/27/15	539.06	535.86	504.88	504.93	496.86	34.18	34.13	42.20
	02/09/16	539.05	535.89	505.61	505.46	496.85	33.44	33.59	42.20
	05/10/16	539.05	535.89	506.00	506.94	496.85	33.05	32.11	42.20
	08/30/16	539.05	535.89	506.96	507.36	496.85	32.09	31.69	42.20
	11/01/16	539.05	535.89	505.88	505.91	496.85	33.17	33.14	42.20
	02/06/17	539.05	535.89	505.56	505.57	496.85	33.49	33.48	42.20
	04/27/17	539.05	535.89	505.74	505.77	496.85	33.31	33.28	42.20
	08/01/17	539.05	535.89	506.65	506.28	496.85	32.40	32.77	42.20
	10/19/17	539.05	535.89	508.74	508.14	496.85	30.31	30.91	42.20
	02/21/18	539.05	535.89	506.57	509.45	496.85	32.48	29.60	42.20
	04/25/18	539.05	535.89	505.94	505.86	496.85	33.11	33.19	42.20
	07/31/18	539.05	535.89	505.27	505.25	496.85	33.78	33.80	42.20
	10/18/18	539.05	535.89	506.16	506.00	496.85	32.89	33.05	42.20
	02/04/19	539.05	535.89	506.12	506.12	496.85	32.93	32.93	42.20
	05/06/19	539.05	535.89	509.19	508.22	496.85	29.86	30.83	42.20
	08/06/19	539.05	535.89	505.26	505.33	496.85	33.79	33.72	42.20
	11/06/19	539.05	535.89	507.36	505.33	496.85	31.69	33.72	42.20
	02/12/20	539.05	535.89	505.63	505.60	496.85	33.42	33.45	42.20
	05/21/20	539.05	535.89	511.51	511.45	496.85	27.54	27.60	42.20
	07/30/20	539.05	535.89	505.08	505.08	496.85	33.97	33.97	42.20
	10/21/20	539.05	535.89	505.30	505.37	496.85	33.75	33.68	42.20
	02/11/21	539.05	535.89	505.22	505.37	496.85	33.83	33.68	42.20
	05/17/21	539.05	535.89	505.73	505.73	496.85	33.32	33.32	42.20
MW-07	02/10/15	539.35	535.86	505.24	505.24	496.12	34.11	34.11	43.23
	05/28/15	539.35	535.86	505.50	505.50	496.12	33.85	33.85	43.23
	08/05/15	539.35	535.86	505.18	505.17	496.12	34.17	34.18	43.23
	10/27/15	539.35	535.86	504.93	505.00	496.12	34.42	34.35	43.23
	02/09/16	539.35	535.87	505.66	505.51	496.12	33.69	33.84	43.23
	05/10/16	539.35	535.87	506.34	507.02	496.12	33.01	32.33	43.23
	08/30/16	539.35	535.87	507.04	507.41	496.12	32.31	31.94	43.23
	11/01/16	539.35	535.87	505.91	505.93	496.12	33.44	33.42	43.23
	02/06/17	539.35	535.87	505.59	505.62	496.12	33.76	33.73	43.23
	04/27/17	539.35	535.87	505.77	505.82	496.12	33.58	33.53	43.23
	08/01/17	539.35	535.87	506.68	506.30	496.12	32.67	33.05	43.23
	10/19/17	539.35	535.87	508.76	508.07	496.12	30.59	31.28	43.23
	02/21/18	539.35	535.87	506.67	509.64	496.12	32.68	29.71	43.23
	04/25/18	539.35	535.87	505.98	505.89	496.12	33.37	33.46	43.23
	08/01/18	539.35	535.87	505.30	505.31	496.12	34.05	34.04	43.23
	10/18/18	539.35	535.87	506.17	506.03	496.12	33.18	33.32	43.23
	02/04/19	539.35	535.87	506.19	506.19	496.12	33.16	33.16	43.23
	05/06/19	539.35	535.87	509.22	508.51	496.12	30.13	30.84	43.23
	08/06/19	539.35	535.87	505.33	505.33	496.12	34.02	34.02	43.23
	11/06/19	539.35	535.87	507.40	505.33	496.12	31.95	34.02	43.23
	02/12/20	539.35	535.87	505.65	505.65	496.12	33.70	33.70	43.23
	05/21/20	539.35	535.87	511.53	511.53	496.12	27.82	27.82	43.23
	07/30/20	539.35	535.87	505.14	505.14	496.12	34.21	34.21	43.23
	10/21/20	539.35	535.87	505.32	505.65	496.12	34.03	33.70	43.23
	02/11/21	539.35	535.87	505.25	505.65	496.12	34.10	33.70	43.23
	05/17/21	539.35	535.87	505.63	505.60	496.12	33.72	33.75	43.23

Table 9-2. Groundwater Elevations - Midwest Generation, LLC, Joliet Station #29, Joliet, IL.

Well ID	Date	Top of Casing (TOC) Elevation (ft above MSL)	Ground Elevation (ft above MSL)	Groundwater Elevation (ft above MSL)	Sampling Groundwater Elevation (ft above MSL)	Bottom of Well Elevation (ft above MSL)	Depth to Groundwater (ft below TOC)	Sampling Depth to Groundwater (ft below TOC)	Depth to Bottom of Well (ft below TOC)
	02/10/15	536.87	533.72	505.18	505.19	498.81	31.69	31.68	38.06
	05/27/15	536.87	533.72	505.36	505.38	498.81	31.51	31.49	38.06
	08/04/15	536.87	533.72	505.19	505.20	498.81	31.68	31.67	38.06
	10/27/15	536.87	533.72	504.93	504.98	498.81	31.94	31.89	38.06
	02/09/16	536.96	533.77	505.72	505.72	498.90	31.24	31.24	38.06
	05/10/16	536.96	533.77	498.00	498.24	498.90	38.96	38.72	38.06
	08/30/16	536.96	533.77	507.05	507.09	498.90	29.91	29.87	38.06
	11/01/16	536.96	533.77	506.01	506.03	498.90	30.95	30.93	38.06
	02/06/17	536.96	533.77	505.58	505.62	498.90	31.38	31.34	38.06
	04/25/17	536.96	533.77	505.74	505.79	498.90	31.22	31.17	38.06
	08/01/17	536.96	533.77	506.78	506.76	498.90	30.18	30.20	38.06
	10/17/17	536.96	533.77	509.02	508.99	498.90	27.94	27.97	38.06
MW-08	02/20/18	536.96	533.77	506.00	506.55	498.90	30.96	30.41	38.06
	08/01/18	536.96	533.77	505.23	505.26	498.90	31.73	31.70	38.06
	10/16/18	536.96	533.77	506.36	506.35	498.90	30.60	30.61	38.06
	02/04/19	536.96	533.77	506.04	506.04	498.90	30.92	30.92	38.06
	05/06/19	536.96	533.77	509.22	509.13	498.90	27.74	27.83	38.06
	08/06/19	536.96	533.77	505.27	505.27	498.90	31.69	31.69	38.06
	11/06/19	536.96	533.77	507.54	507.16	498.90	29.42	29.80	38.06
	02/12/20	536.96	533.77	505.56	505.56	498.90	31.40	31.40	38.06
	05/20/20	536.96	533.77	511.82	511.63	498.90	25.14	25.33	38.06
	07/30/20	536.96	533.77	505.13	505.12	498.90	31.83	31.84	38.06
	10/28/20	536.96	533.77	505.29	505.41	498.90	31.67	31.55	38.06
	02/11/21	536.96	533.77	505.26	505.41	498.90	31.70	31.55	38.06
	05/17/21	536.96	533.77	505.81	505.76	498.90	31.15	31.20	38.06
	02/10/15	534.44	531.13	505.22	504.70	496.29	29.22	29.74	38.15
	05/27/15	534.44	531.13	505.37	504.98	496.29	29.07	29.46	38.15
	08/04/15	534.44	531.13	505.22	504.91	496.29	29.22	29.53	38.15
	10/27/15	534.44	531.13	504.96	504.83	496.29	29.48	29.61	38.15
	02/09/16	534.41	531.08	505.64	505.49	496.26	28.77	28.92	38.15
	05/10/16	534.41	531.08	505.90	506.39	496.26	28.51	28.02	38.15
	08/30/16	534.41	531.08	506.98	506.94	496.26	27.43	27.47	38.15
	11/01/16	534.41	531.08	505.89	505.32	496.26	28.52	29.09	38.15
	02/06/17	534.41	531.08	505.51	505.66	496.26	28.90	28.75	38.15
	04/25/17	534.41	531.08	505.66	505.54	496.26	28.75	28.87	38.15
	08/01/17	534.41	531.08	506.64	506.27	496.26	27.77	28.14	38.15
	10/17/17	534.41	531.08	508.89	508.73	496.26	25.52	25.68	38.15
MW-09	02/20/18	534.41	531.08	506.39	506.99	496.26	28.02	27.42	38.15
	04/26/18	534.41	531.08	505.89	505.58	496.26	28.52	28.83	38.15
	08/01/18	534.41	531.08	505.18	505.05	496.26	29.23	29.36	38.15
	10/16/18	534.41	531.08	506.23	506.12	496.26	28.18	28.29	38.15
	02/04/19	534.41	531.08	506.02	505.99	496.26	28.39	28.42	38.15
	05/06/19	534.41	531.08	509.08	508.09	496.26	25.33	26.32	38.15
	08/06/19	534.41	531.08	505.23	504.61	496.26	29.18	29.80	38.15
	11/06/19	534.41	531.08	507.42	504.61	496.26	26.99	29.80	38.15
	02/12/20	534.41	531.08	505.53	504.89	496.26	28.88	29.52	38.15
	05/20/20	534.41	531.08	511.06	510.76	496.26	23.35	23.65	38.15
	07/30/20	534.41	531.08	505.02	505.05	496.26	29.39	29.36	38.15
	10/21/20	534.41	531.08	505.28	505.05	496.26	29.13	29.36	38.15
	02/11/21	534.41	531.08	505.21	505.05	496.26	29.20	29.36	38.15
	05/17/21	534.41	531.08	505.73	505.36	496.26	28.68	29.05	38.15
	02/11/15	540.03	536.95	505.27	505.27	496.10	34.76	34.76	43.93
	05/28/15	540.03	536.95	505.48	505.48	496.10	34.55	34.55	43.93
	08/04/15	540.03	536.95	505.29	505.30	496.10	34.74	34.73	43.93
	10/27/15	540.03	536.95	504.93	505.07	496.10	35.10	34.96	43.93
	02/09/16	540.02	536.98	505.70	505.61	496.09	34.32	34.41	43.93
	05/10/16	540.02	536.98	506.00	506.66	496.09	34.02	33.36	43.93
	08/30/16	540.02	536.98	507.05	507.38	496.09	32.97	32.64	43.93
	11/01/16	540.02	536.98	505.98	505.97	496.09	34.04	34.05	43.93
	02/06/17	540.02	536.98	505.60	505.62	496.09	34.42	34.40	43.93
	04/26/17	540.02	536.98	505.80	505.84	496.09	34.22	34.18	43.93
	08/01/17	540.02	536.98	506.84	506.50	496.09	33.18	33.52	43.93
	10/18/17	540.02	536.98	508.89	508.61	496.09	31.13	31.41	43.93
MW-10	02/21/18	540.02	536.98	506.19	509.42	496.09	33.83	30.60	43.93
	04/24/18	540.02	536.98	506.05	506.02	496.09	33.97	34.00	43.93
	08/01/18	540.02	536.98	505.27	505.27	496.09	34.75	34.75	43.93
	10/17/18	540.02	536.98	506.29	506.14	496.09	33.73	33.88	43.93
	02/04/19	540.02	536.98	506.11	506.10	496.09	33.91	33.92	43.93
	05/06/19	540.02	536.98	509.44	508.82	496.09	30.58	31.20	43.93
	08/06/19	540.02	536.98	505.32	505.32	496.09	34.70	34.70	43.93
	11/06/19	540.02	536.98	507.60	505.32	496.09	32.42	34.70	43.93
	02/12/20	540.02	536.98	505.67	505.67	496.09	34.35	34.35	43.93
	05/20/20	540.02	536.98	511.83	511.86	496.09	28.19	28.16	43.93
	07/30/20	540.02	536.98	505.14	505.12	496.09	34.88	34.90	43.93
	10/21/20	540.02	536.98	505.30	505.30	496.09	34.72	34.72	43.93
	02/11/21	540.02	536.98	505.25	505.30	496.09	34.77	34.72	43.93
	05/17/21	540.02	536.98	505.79	505.78	496.09	34.23	34.24	43.93
	02/11/15	539.47	536.52	505.49	505.49	497.14	33.98	33.98	42.33
	05/28/15	539.47	536.52	505.96	505.97	497.14	33.51	33.50	42.33
	08/04/15	539.47	536.52	505.65	505.64	497.14	33.82	33.83	42.33
	10/27/15	539.47	536.52	505.16	505.32	497.14	34.31	34.15	42.33
	02/09/16	539.41	536.62	506.10	505.88	497.08	33.31	33.53	42.33
	05/10/16	539.41	536.62	507.33	506.60	497.08	32.08	32.81	42.33
	08/30/16	539.41	536.62	508.27	508.85	497.08	31.14	30.56	42.33
	11/01/16	539.41	536.62	506.32	506.28	497.08	33.09	33.13	42.33
	02/06/17	539.41	536.62	505.90	505.92	497.08	33.51	33.49	42.33
	04/26/17	539.41	536.62	506.17	506.17	497.08	33.24	33.24	42.33
	08/01/17	539.41	536.62	507.47	507.38	497.08	31.94	32.03	42.33
	10/19/17	539.41	536.62	509.61	509.16	497.08	29.8	30.25	42.33
MW-11	02/21/18	539.41	536.62	506.45	509.85	497.08	32.96	29.56	42.33
	04/25/18	539.41	536.62	505.48	506.40	497.08	33.93	33.01	42.33
	08/01/18	539.41	536.62	505.53	505.54	497.08	33.88	33.87	42.33
	10/17/18	539.41	536.62	506.63	506.51	497.08	32.78	32.90	42.33
	02/04/19	539.41	536.62	506.19	506.19	497.08	33.22	33.22	42.33
	05/06/19	539.41	536.62	510.58	509.98	497.08	28.83	29.43	42.33
	08/06/19	539.41	536.62	505.66	505.66	497.08	33.75	33.75	42.33
	11/06/19	539.41	536.62	508.26	505.66	497.08	31.15	33.75	42.33
	02/12/20	539.41	536.62	505.88	505.81	497.08	33.53	33.60	42.33
	05/20/20	539.41	536.62	512.83	512.81	497.08	26.58	26.60	42.33
	07/30/20	539.41	536.62	505.53	505.48	497.08	33.88	33.93	42.33
	10/21/20	539.41	536.62	505.39	505.39	497.08	34.02	34.02	42.33
	02/11/21	539.41	536.62	505.46	505.39	497.08	33.95	34.02	42.33
	05/17/21	539.41	536.62	506.09	506.05	497.08	33.32	33.36	42.33

Note: Values for Depth to Bottom of Well are from prior to the installation of the dedicated pumps.
NM - Not Measured

Table 9-3. Hydraulic Gradient, Direction and Seepage Velocity - Midwest Generation, LLC, Joliet #29 Generating Station, Joliet, IL.

DATE	Groundwater Flow Direction	Kavg (ft/sec)*	Average Hydraulic Gradient (ft/ft)	Porosity (unitless)**	Estimated Seepage Velocity (ft/day)
10/28/2015	Southerly (SSW-SSE)	1.970E-03	0.0003	0.35	0.13
2/10/2016	Southerly (SSW-SSE)	1.970E-03	0.0007	0.35	0.32
5/12/2016	Southerly (SSW-SSE)	1.970E-03	0.0004	0.35	0.17
8/31/2016	Southerly (SSW-SSE)	1.970E-03	0.0004	0.35	0.17
11/2/2016	Southerly (SSW-SSE)	1.970E-03	0.0007	0.35	0.32
2/6/2017	Southerly (SSW-SSE)	1.970E-03	0.0005	0.35	0.22
4/26/2017	Southerly (SSW-SSE)	1.970E-03	0.0006	0.35	0.29
6/14/2017	Southerly (SSW-SSE)	1.970E-03	0.0006	0.35	0.29
8/2/2017	Southerly (SSW-SSE)	1.970E-03	0.0008	0.35	0.39
10/18/2017	Southerly (SSW-SSE)	1.970E-03	0.0004	0.35	0.19
4/24/2018	Southerly (SSW-SSE)	1.970E-03	0.0008	0.35	0.39
10/16/2018	Southerly (SSW)	1.970E-03	0.00053	0.35	0.26
5/6/2019	Southerly (SSW-SSE)	1.970E-03	0.0010	0.35	0.46
11/6/2019	Southerly (SSW-SSE)	1.970E-03	0.00200	0.35	0.97
5/20/2020	Southerly (SSW-SSE)	1.970E-03	0.0043	0.35	2.11
10/21/2020	Southerly (SSW-SSE)	1.970E-03	0.00080	0.35	0.39
5/17/2021	Southerly (SSW-SSE)	1.970E-03	0.00140	0.35	0.68

* Kavg - See Section 9.1.2 discussion for average hydraulic conductivity (feet/second).
** - Porosity estimate from Applied Hydrogeology, Fetter, 1980.
SSW - South-southwest
SSE - South-southeast

Table 9-4. Groundwater Analytical Results - Midwest Generation, LLC, Joliet Station #29, Joliet, IL.

Well	Date	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Fluoride	Lead	Lithium	Mercury	Molybdenum	Radium 226 + 228	Selenium	Thallium
	10/28/2015	0.47	100	200	0.41	7.04	84	790	< 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	0.41	100	210	0.44	7.17	120	820	< 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	0.29	100	300	0.42	7.02	110	920	< 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	0.36	89	170	0.46	6.95	100	760	< 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	0.48	100	130	0.45	6.99	95	720	< 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	0.44	120	190	0.36	6.99	88	820	< 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	0.35	120	200	0.35	7.27	87	760	< 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	0.29	91	160	0.43	7.48	75	690	< 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	0.45	97	170	0.38	7.23	110	750	< 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
MW-10 up-gradient	10/18/2017	0.61	120	140	0.41	7.11	130	820	< 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
	4/24/2018	0.4	110	260	0.39	7.28	120	910	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/17/2018	0.63	120	180	0.42	7.30	110	810	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/24/2018 R	0.44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/7/2019	0.56	130	410	0.39	7.17	95	1,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	7/3/2019 R	NA	NA	230	NA	NA	NA	830	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/7/2019	0.35	90	130	0.36	7.40	59	650	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/20/2020	0.85	120	250	0.41	6.90	100	960	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	6/11/2020 R	0.26	NA	NA	NA	NA	NA	770	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/22/2020	0.34	110	230	0.41	7.11	93	850	< 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	0.33	140	350	0.39	7.16	210	1,200	< 0.003	0.0014	0.06	< 0.001	< 0.0005	< 0.005	< 0.001	0.39	< 0.0005	0.015	< 0.0002	0.0055	< 0.4800	< 0.0025	< 0.002
	6/29/2021 R	NA	160	420	NA	NA	190	1,300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/28/2015	0.34	110	230	0.41	7.11	110	960	< 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	0.49	100	220	0.44	7.31	130	790	< 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	0.48	95	240	0.44	7.07	130	800	< 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	0.49	100	250	0.45	7.18	120	920	< 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	0.34	87	190	0.44	7.45	94	780	< 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	0.40	97	140	0.39	7.35	77	720	< 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	0.54	100	210	0.36	7.03	120	820	< 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	0.45	88	190	0.44	7.43	75	760	< 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	0.41	99	200	0.40	7.34	110	850	< 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
MW-03 down-gradient	10/18/2017	0.35	93	160	0.42	7.11	100	850	< 0.003	0.0015	0.088	< ^ 0.001	< 0.0005	< 0.005	< 0.001	0.42	< 0.0005	0.012	< 0.0002	0.0055	< 0.417	0.0026	^ < 0.002
	4/24/2018	0.52	100	220	0.42	7.2	150	930	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	7/31/2018 R	NA	NA	NA	NA	NA	110	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/17/2018	0.25	100	250	0.4	7.04	110	870	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/7/2019	0.43	120	280	0.4	7.27	140	880	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	7/3/2019 R	NA	NA	NA	NA	NA	65	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/7/2019	0.34	100	150	0.4	7.32	65	660	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/20/2020	0.38	100	230	0.42	7.56	78	960	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	6/11/2020 R	NA	NA	NA	NA	NA	NA	930	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/22/2020	0.32	110	180	0.43	7.23	90	770	< 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	0.28	130	290	0.4	7.13	190	1,200	< 0.003	0.0016	0.14	< 0.001	< 0.0005	< 0.005	0.0011	0.4	< 0.0005	0.014	< 0.0002	< 0.0050	1.1000	< 0.0025	< 0.002
	6/29/2021 R	NA	NA	NA	NA	NA	210	1,300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/28/2015	0.34	94	F1 200	0.45	7.07	83	740	< 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	0.32	97	210	0.47	7.22	140	810	< 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	0.47	100	260	0.46	6.71	150	900	< 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	0.42	100	210	0.45	7.07	120	890	< 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	0.32	98	160	0.43	7.25	83	750	< 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	0.40	110	200	0.37	7.19	98	790	< 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	0.33	100	220	0.37	7.46	89	770	< 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	0.37	92	190	0.47	7.45	80	770	< 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	0.35	93	180	0.43	7.41	100	770	< 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
MW-04 down-gradient	10/18/2017	0.54	97	140	0.45	7.2	120	790	< 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
	4/24/2018	0.4	110	240	0.43	7.21	160	940	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	7/31/2018 R	NA	NA	NA	NA	NA	120	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/17/2018	0.29	100	230	0.45	7.2	130	840	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/7/2019	0.76	120	340	0.42	7.27	120	1,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	7/3/2019 R	0.23	NA	250	NA	NA	NA	870	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/6/2019	0.3	77	140	0.41	7.33	53	670	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/20/2020	0.79	110	250	0.45	7.3	110	1,100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	6/11/2020 R	0.28	NA	NA	NA	NA	NA	850	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/22/2020	0.33	100	190	0.48	7.15	83	770	< 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	0.22	120	280	0.42	7.3	190	1,100	< 0.003	0.0019	0.12	< 0.001	< 0.0005	< 0.005	0.0037	0.42	< 0.0005	0.014	< 0.0002	< 0.005	< 0.4450	< 0.0025	< 0.002
	6/29/2021 R	NA	NA	NA	NA	NA	190	1,200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/28/2015	0.64	100	160	0.39	7.12	120	790	< 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	0.46	110	220	0.39	7.25	120	790	< 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	0.8	150	220	0.46	6.88	290	950	< 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	1.0	140	99	0.56	6.81	260	820	< 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	0.41	98	130	0.37	7.26	100	700	< 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	0.48	150	180	0.30	7.22	120	790	< 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	0.67	110	F1 190	0.37	7.28	170	770	< 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	0.44	75	150	0.46	7.47	110	670	< 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	0.28	83	170	0.35	7.30	99	770	< 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
MW-05 down-gradient	10/18/2017	0.42	110	110	0.38	7.16	95	720	< 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
	4/24/2018	0.31	110	300	0.34	7.33	130	1,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	7/31/2018 R	NA	NA	NA	NA	NA	NA	940	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/17/2018	0.31	110	210	0.36	7.29	93	810	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/6/2019	0.38	130	500	0.31	7.11	84	1,300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	7/3/2019 R	NA	NA	150	NA	NA	NA	890	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	11/7/2019	0.31	180	130	0.3	7.44	64	590	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	12/4/2019 R	NA	89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	5/20/2020	0.32	100	270	0.37	7.03	67	890	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/22/2020	0.52	92	180	0.38	7.16	85	720	< 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	0.37	130	410	0.3	7.00	160	1,300	< 0.003	0.0015	0.1	< 0.001	< 0.0005	< 0.0050	< 0.0010	0.3	< 0.0005	0.023	< 0.0002	< 0.005	< 0.5970	< 0.0025	< 0.002
	6/29/2021 R	NA	NA	430	NA	NA	150	1,300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: All units are in mg/l except pH is in standard units and radium is in pCi/L

DNYA - Data not yet available.

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

NA - Not analyzed. No confirmation resample required.

Table 9-5.Turbidity Measurement Data, Midwest Generation, LLC, Joliet #29 Generating Station

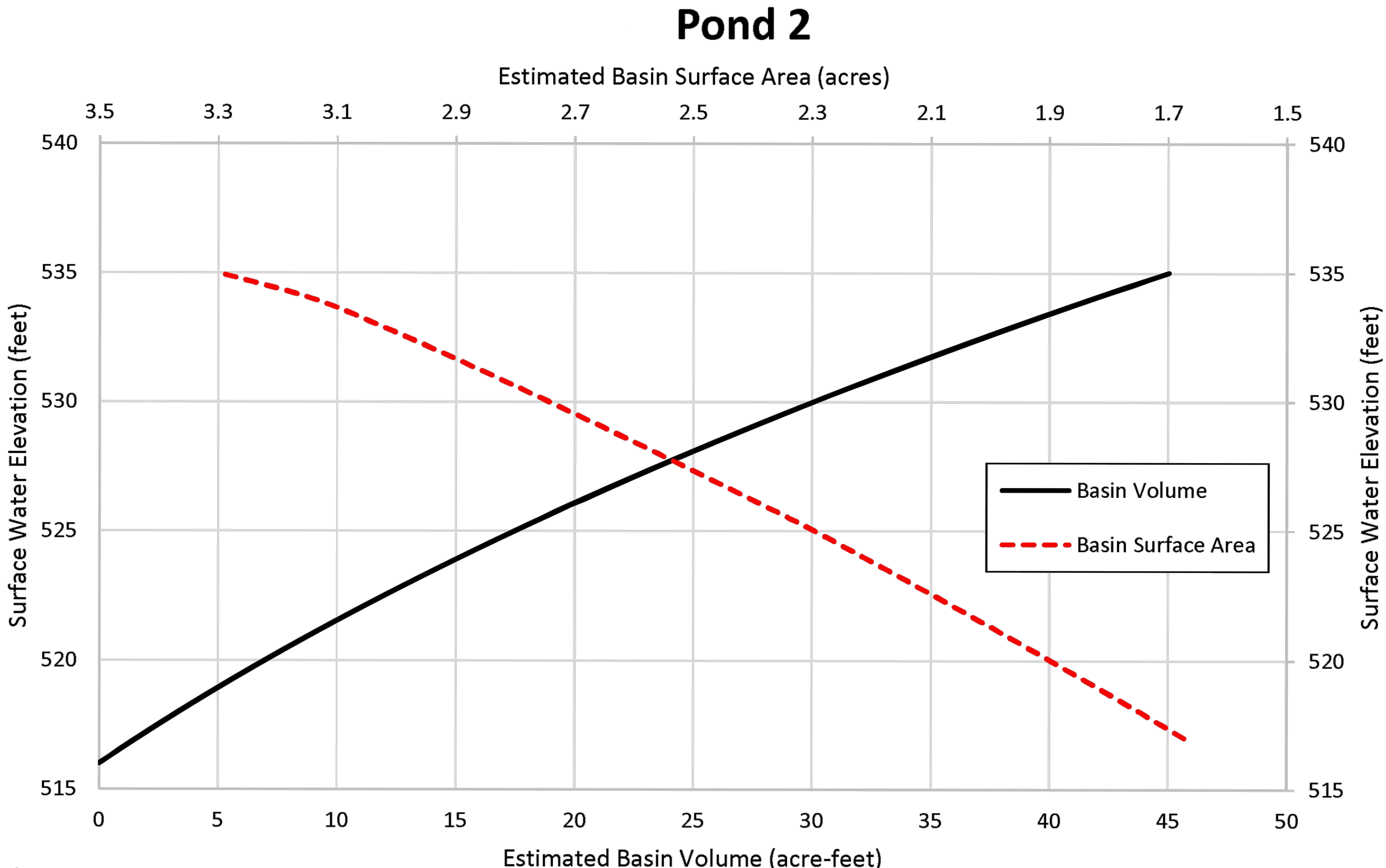
Well ID	Date	Turbidity (NTU)
MW-03	3/2/2021	0.45
	4/10/2021	22.9
	4/25/2021	2.40
	5/18/2021	2.53
	6/11/2021	2.34
	6/29/2021	2.86
	7/19/2021	37.40
	8/9/2021	2.71
	8/30/2021	5.70
	9/27/2021	10.27
MW-04	3/2/2021	81.89
	4/10/2021	5.96
	4/25/2021	3.02
	5/18/2021	2.52
	6/11/2021	2.8
	6/29/201	3.34
	7/19/2021	47.4
	8/9/2021	4.13
	8/30/2021	18.3
	9/27/2021	1.76
MW-05	2/25/2021	1.57
	4/10/2021	8.36
	4/25/2021	2.42
	5/17/2021	5.2
	6/11/2021	14.22
	6/29/2021	5.33
	7/19/2021	26.9
	8/9/2021	3.69
	8/27/2021	8.7
	9/27/2021	14.92
MW-10	3/2/2021	26.07
	4/10/2021	7.31
	4/25/2021	5.21
	5/18/2021	3.73
	6/11/2021	6.65
	6/29/2021	9.49
	7/19/2021	14.5
	8/9/2021	10.08
	8/30/2021	9.3
	9/27/2021	16.3

Table 9-7. Proposed Site-Specific Groundwater Protection Standards - Joliet #29

Upgradient Well(s)	Parameter	Section 845.600 Standards	Interwell Background Prediction Limit	**Proposed GWPS**
MW-10	Antimony	0.006	0.003	**0.006**
MW-10	Arsenic	0.01	0.002	**0.01**
MW-10	Barium	2.0	0.063	**2.0**
MW-10	Beryllium	0.004	0.001	**0.004**
MW-10	Boron	2.0	0.831	**2.0**
MW-10	Cadmium	0.005	0.005	**0.005**
MW-10*	Chloride*	200	368	**368**
MW-10	Chromium	0.1	0.005	**0.1**
MW-10	Cobalt	0.006	0.001	**0.006**
MW-10	Combined Radium 226 + 228 (pCi/L)	5.0	0.626	**5.0**
MW-10	Fluoride	4.0	0.486	**4.0**
MW-10	Lead	0.0075	0.0014	**0.0075**
MW-10	Lithium	0.04	0.019	**0.040**
MW-10	Mercury	0.002	0.0002	**0.002**
MW-10	Molybdenum	0.10	0.009	**0.10**
MW-10	pH (standard units)	6.5-9.0	6.733-7.569	**6.5-9.0**
MW-10	Selenium	0.05	0.003	**0.050**
MW-10	Sulfate	400	214.7	**400**
MW-10	Thallium	0.002	0.002	**0.002**
MW-10*	Total Dissolved Solids*	1200	1031	**1200**
MW-10*	Calcium*	NE	143.0	**143.0**
MW-10	Turbidity	NE	31.22	**31.22**

All values are in mg/L (ppm) unless otherwise noted.
* - Limited to original 8 background samples.
NE - Not Established
Bold - Proposed Site-specific Groundwater Protection Standard based on Section 845.600(a)(2)

OPERATING PERMIT FIGURES



NOTES:

1. SURFACE WATER ELEVATIONS ARE NAVD88.
2. BASIN VOLUMES ARE ESTIMATED BASED ON AS-BUILT INFORMATION AND 2008 SITE TOPOGRAPHY.
3. AREA-CAPACITY CURVE CREATED BY GEOSYNTEC AS PART OF COMPLETING THE HISTORY OF CONSTRUCTION IN ACCORDANCE WITH 40 CFR PART 257.

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG

KPRG and Associates, inc.

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414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

AREA-CAPACITY CURVE	
JOLIET 29 GENERATING STATION JOLIET, ILLINOIS	
Scale: NTS	Date: August 25, 2021
KPRG Project No. 19520	FIGURE 1

W:\projects\midwest generation\operating-constructing permits\joliet 29\area-capacity curve.dwg

LEGEND

- FACILITY BOUNDARY
- TYPICAL VEHICLE ACCESS TO POND 2
- LARGE VEHICLE ACCESS TO POND 2
- FACILITY FENCE

E N V I R O N M E N T A L C O N S U L T A T I O N & R E M E D I A T I O N

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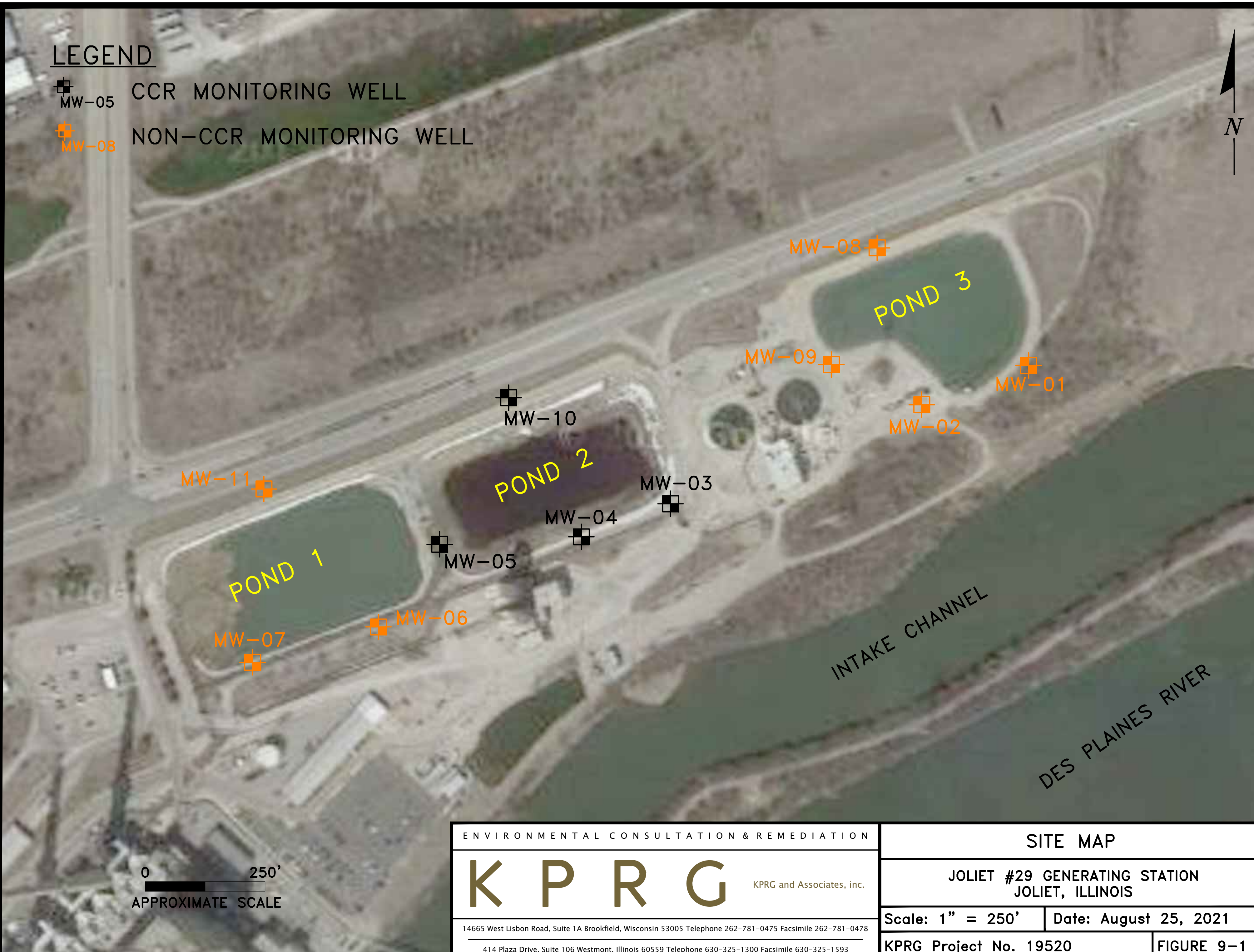
SITE LOCATION MAP	
JOLIET #29 GENERATING STATION JOLIET, ILLINOIS	
Scale: 1" = 250'	Date: January 4, 2022
KPRG Project No. 19620	FIGURE 2

W:\projects\midwest gen\operating and construct permits - various stations\joliet site location maps.dwg



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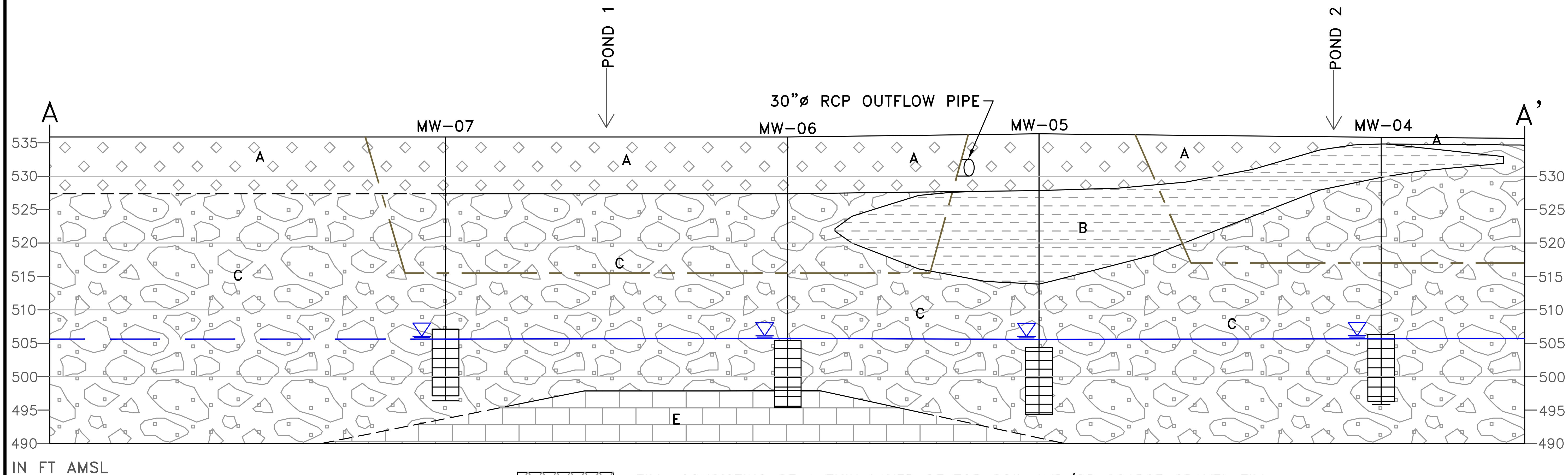
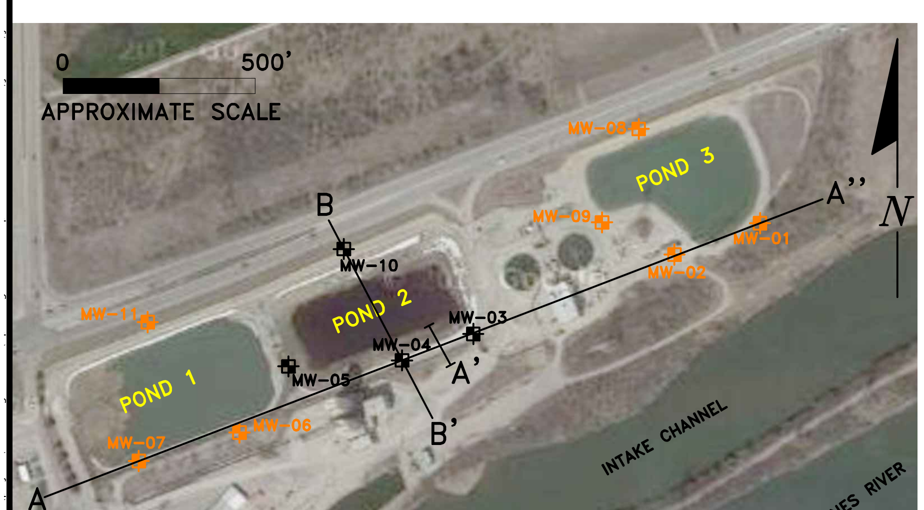
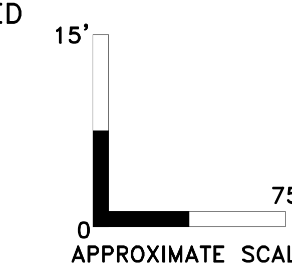
SITE MAP	
JOLIET #29 GENERATING STATION JOLIET, ILLINOIS	
Scale: 1" = 250'	Date: August 25, 2021
KPRG Project No. 19520	FIGURE 9-1

W:\projects\midwest gen\operating and construct permits - various stations\joliet 29\joliet 29 station.dwg



A	FILL: CONSISTING OF A THIN LAYER OF TOP SOIL AND/OR COARSE GRAVEL FILL.
B	SILTY CLAY TO CLAY: CONSISTING OF BLACK/BROWN SILTY CLAY TO CLAY WITH A TRACE OF COARSE GRAVEL.
C	SAND AND GRAVEL: 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.
D	SANDY SILT/SILTY CLAY: CONSISTING OF BLACK/GRAY SANDY SILT GRADING DOWNWARD TO A GRAY SILTY CLAY WITH COARSE SAND. NOT CONTINUOUS ACROSS SITE.
E	BEDROCK: CONSISTING OF SILURIAN DOLOMITE – TOP OF UNIT ENCOUNTERED 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.
▽	WATER LEVEL (5/21)
— — —	PROJECTED POND OUTLINE





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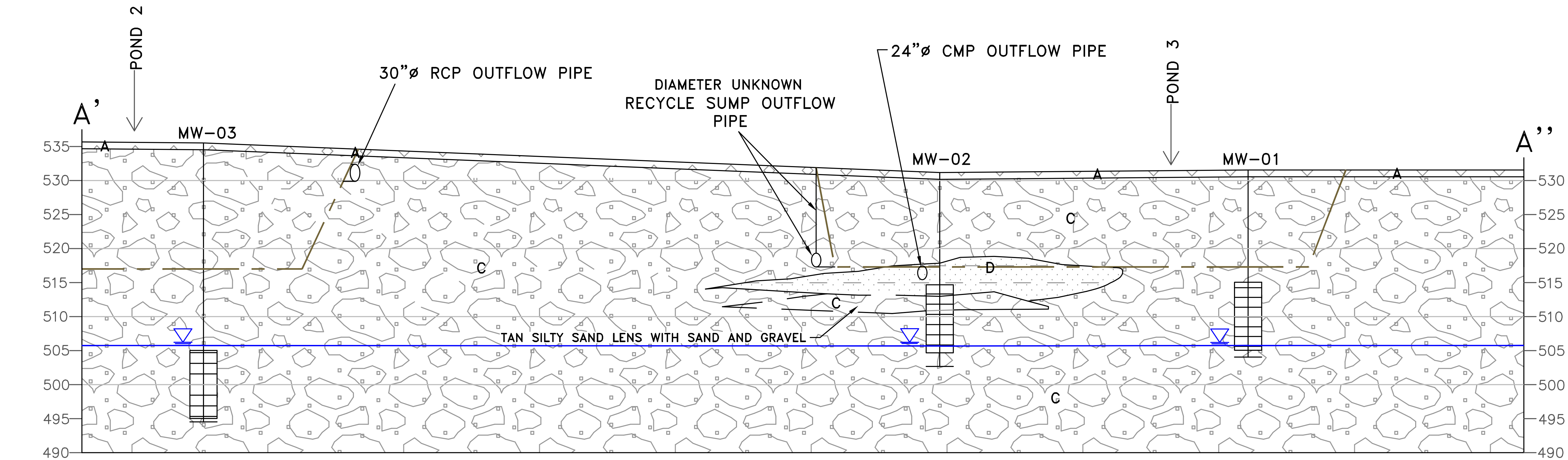
CROSS SECTION A – A'	
JOLIET #29 GENERATING STATION JOLIET, ILLINOIS	
SEE SCALE	Date: October 4, 2021
KPRG Project No. 19520	FIGURE 9-2



IN FT AMSL

A	FILL: CONSISTING OF A THIN LAYER OF TOP SOIL AND/OR COARSE GRAVEL FILL.
B	SILTY CLAY TO CLAY: CONSISTING OF BLACK/BROWN SILTY CLAY TO CLAY WITH A TRACE OF COARSE GRAVEL.
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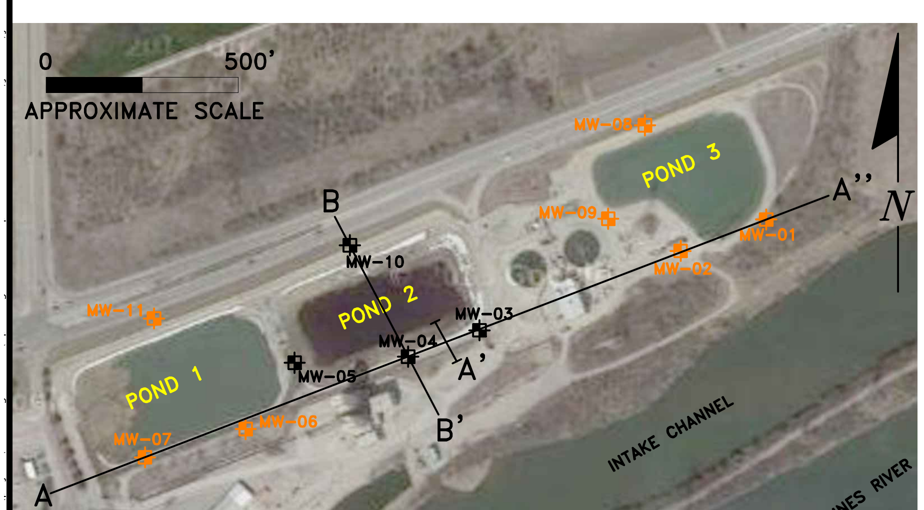
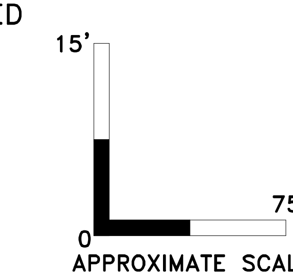
▽	WATER LEVEL (5/21)
—— — ——	PROJECTED POND OUTLINE





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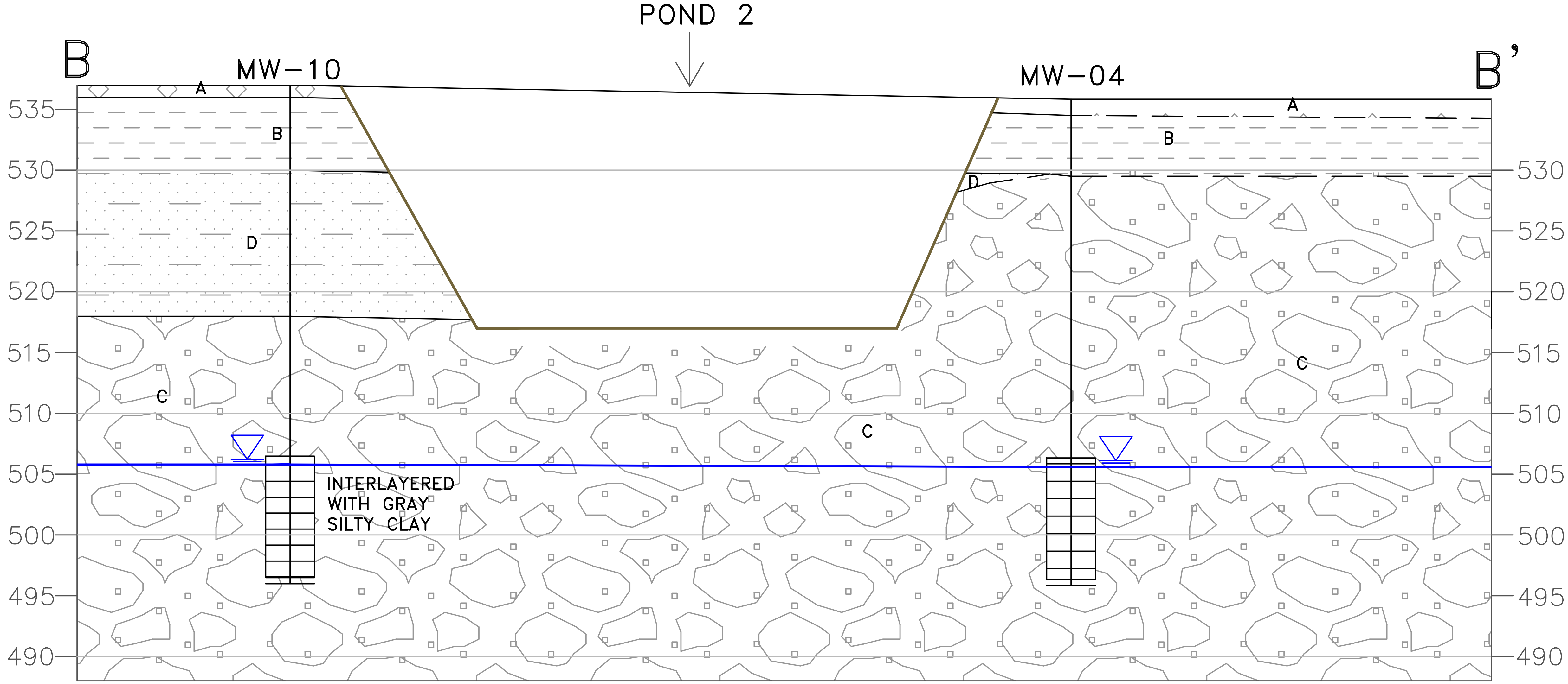
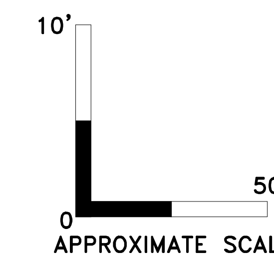
CROSS SECTION A' – A''

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

SEE SCALE	Date: October 4, 2021
KPRG Project No. 19520	FIGURE 9-3





IN FT AMSL

A — FILL: CONSISTING OF A THIN LAYER OF TOP SOIL AND/OR COARSE GRAVEL FILL.

B — SILTY CLAY TO CLAY: CONSISTING OF BLACK/BROWN SILTY CLAY TO CLAY WITH A TRACE OF COARSE GRAVEL.

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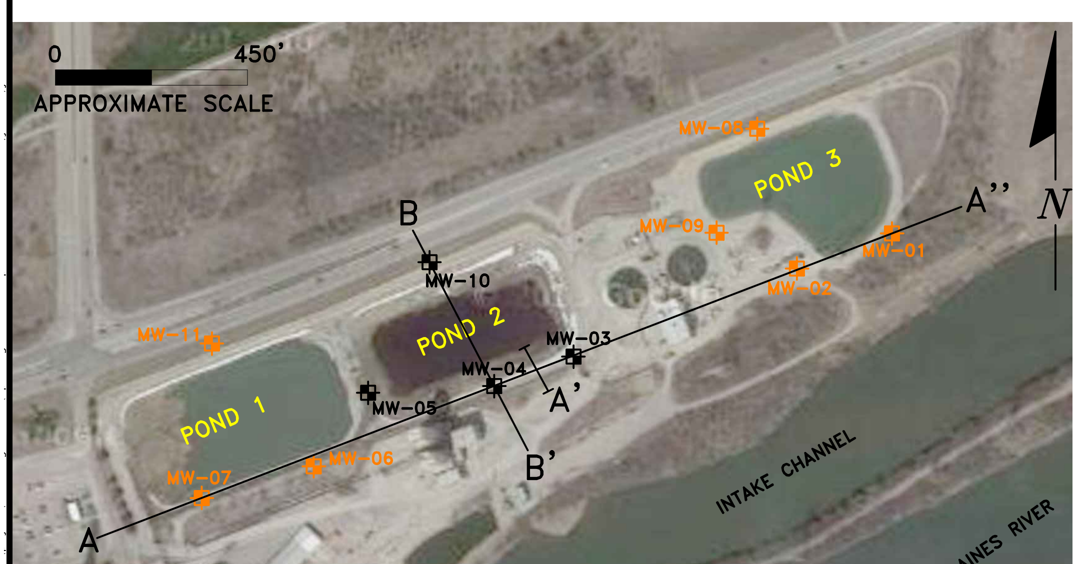
D — SANDY SILT/SILTY CLAY: CONSISTING OF BLACK/GRAY SANDY SILT GRADING DOWNWARD TO A GRAY SILTY CLAY WITH COARSE SAND. NOT CONTINUOUS ACROSS SITE.

E — BEDROCK: CONSISTING OF SILURIAN DOLOMITE – TOP OF UNIT ENCOUNTERED 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.

WATER LEVEL (5/21)

POND OUTLINE



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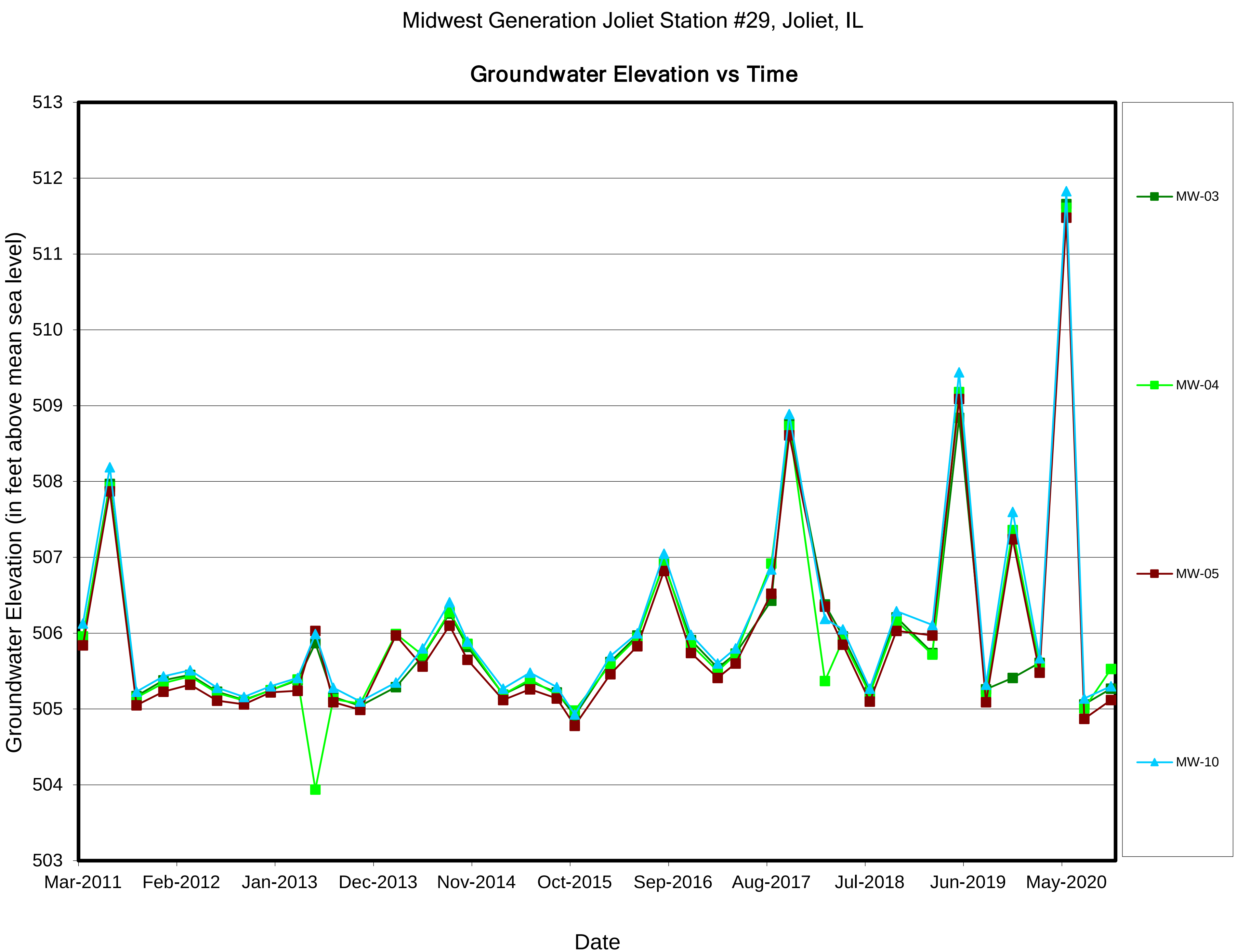
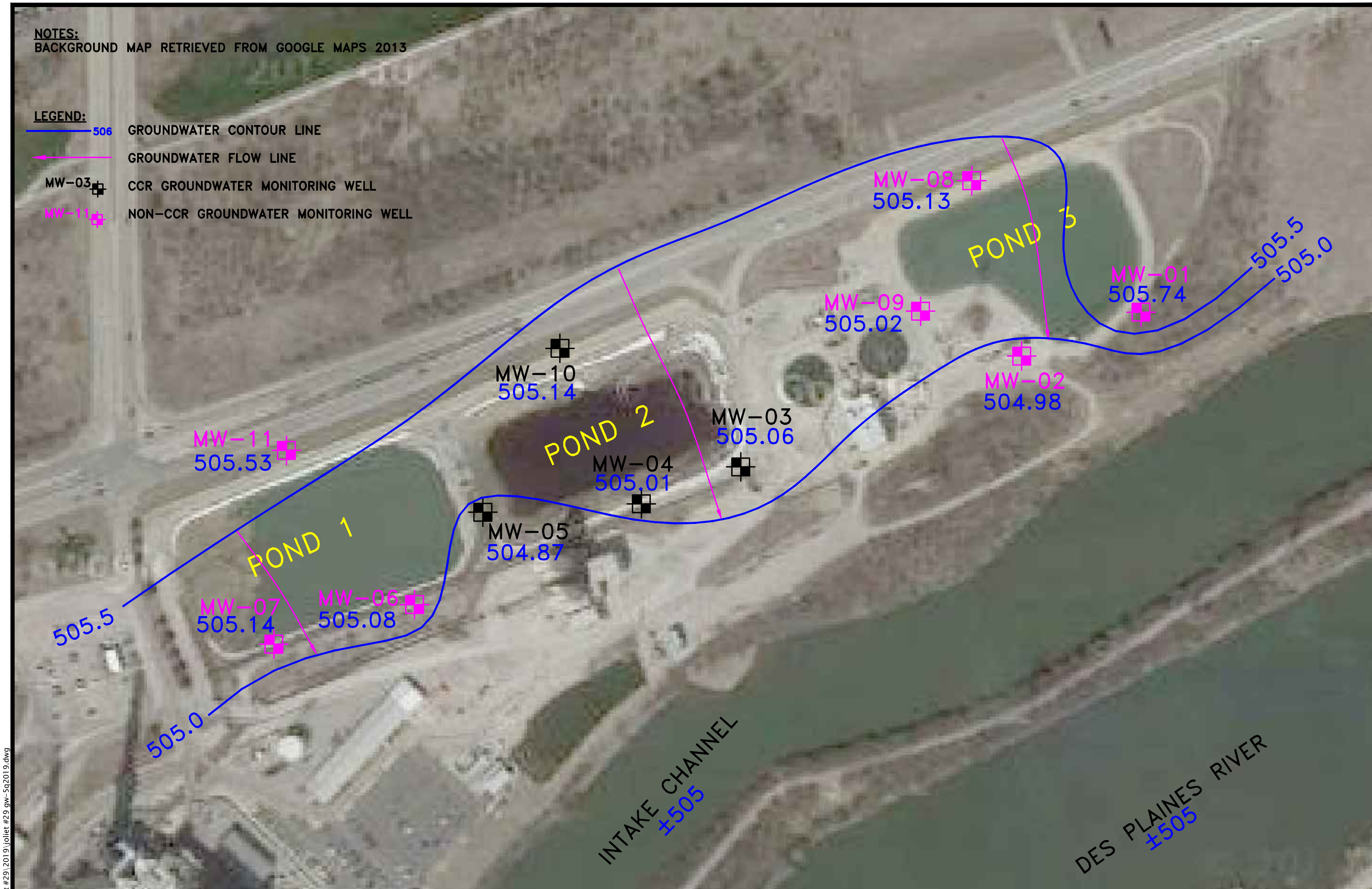
CROSS SECTION B-B'	
JOLIET #29 GENERATING STATION JOLIET, ILLINOIS	
SEE SCALE	Date: October 4, 2021
KPRG Project No. 19520	FIGURE 9-4

Figure 9-5. Hydrograph





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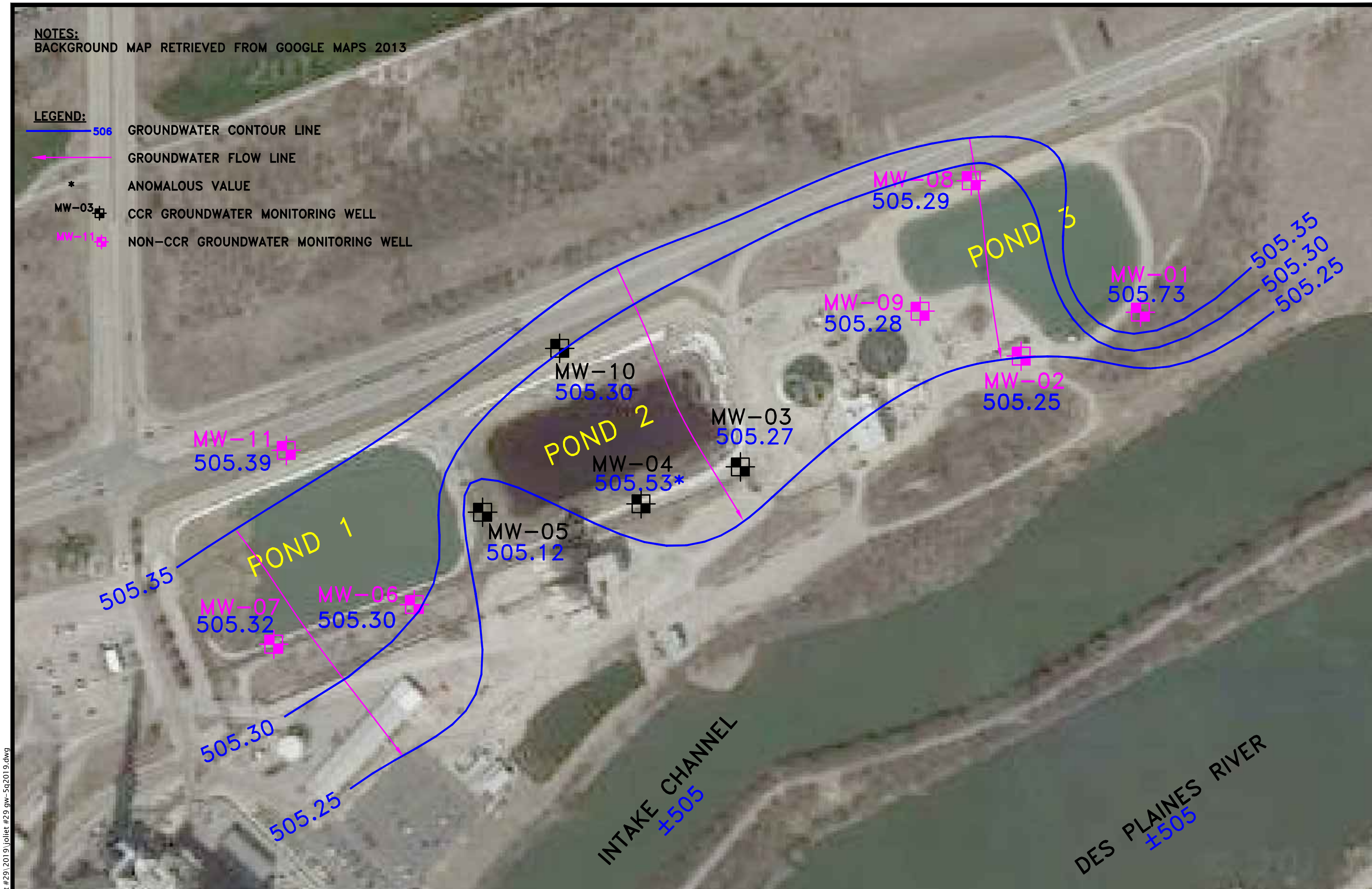
GROUNDWATER CONTOUR MAP 07/2020

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 250'	Date: September 04, 2020
KPRG Project No. 12313.0	FIGURE 9-6



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GROUNDWATER CONTOUR MAP 10/2020

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 250'	Date: January 4, 2021
KPRG Project No. 12313.0	FIGURE 9-7

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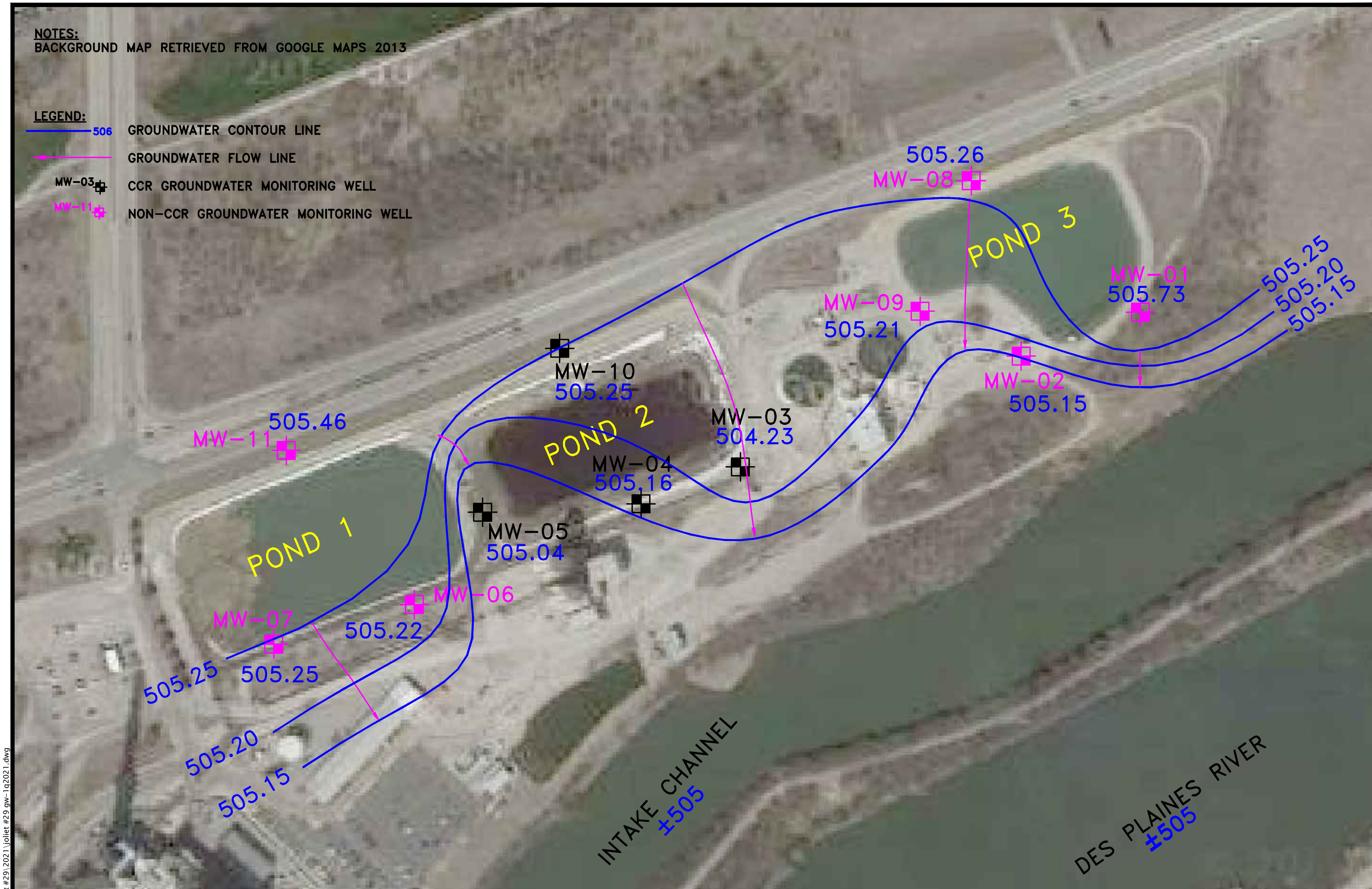

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0 250'

APPROXIMATE SCALE

N

E N V I R O N M E N T A L C O N S U L T A T I O N & R E M E D I A T I O N

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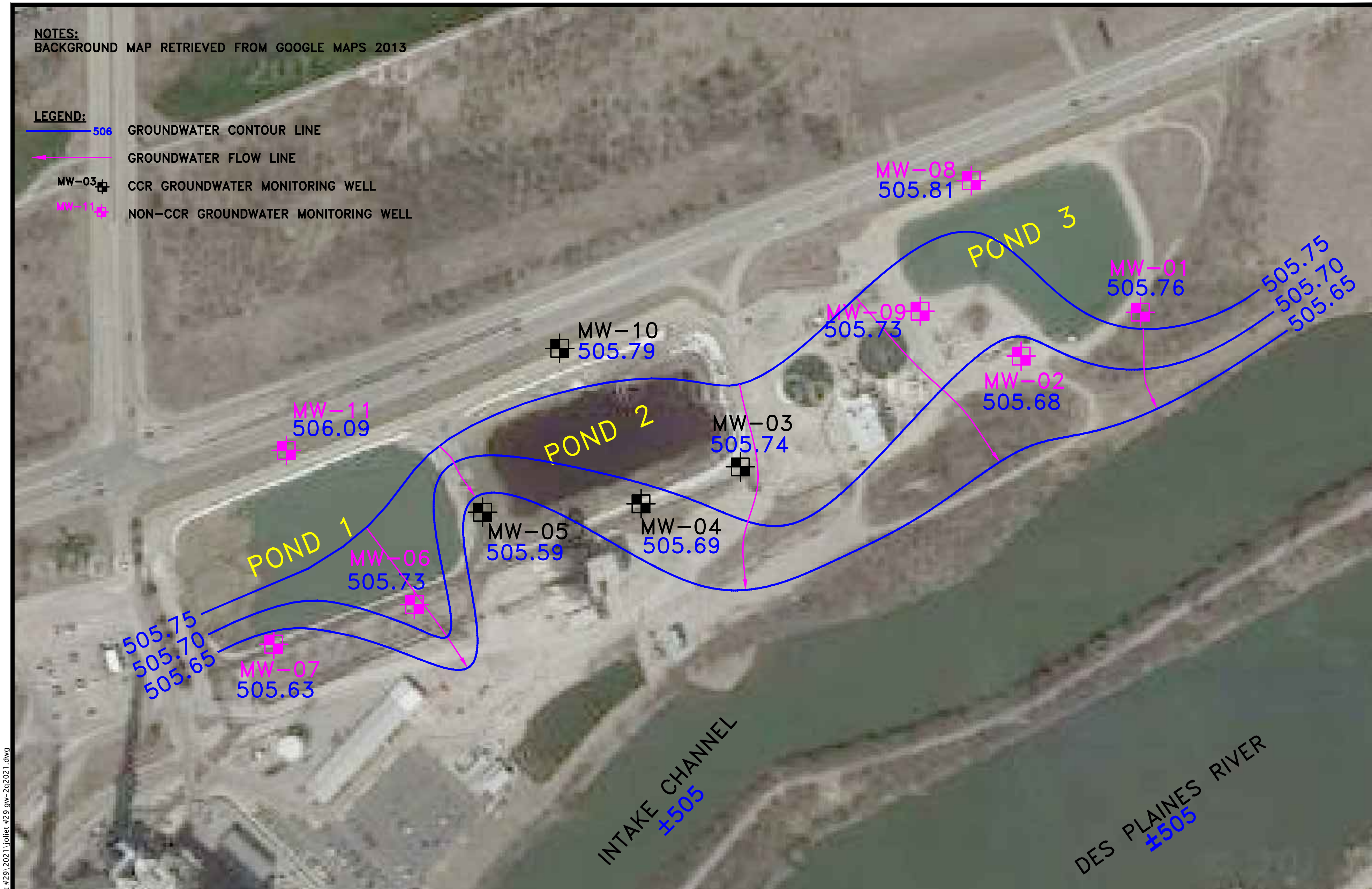
GROUNDWATER CONTOUR MAP 2/2021

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 250'	Date: April 2, 2021
KPRG Project No. 12313.0	FIGURE 9-8



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0 250'
APPROXIMATE SCALE
N

ENVIRONMENTAL CONSULTATION & REMEDIATION

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GROUNDWATER CONTOUR MAP 5/2021

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 250' | Date: July 12, 2021

KPRG Project No. 12313.0 | FIGURE 9-9

ENVIRONMENTAL CONSULTATION & REMEDIATION
KPRG
KPRG and Associates, inc.
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14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

GROUNDWATER MANAGEMENT ZONE

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 500' | Date: August 25, 2021

KPRG Project No. 19520 | FIGURE 9-10

W:\c-p&p\projects\midwest generation\ash pond issues\eluc & gmz\joliet #29 gmz.dwg(proposed gmz)

LEGEND

- —·— SITE BOUNDARY
- ● WATER WELL
- 02355 SHORT API WELL ID
- 1509 TOTAL WELL DEPTH

0 750'

APPROXIMATE SCALE

NOTES: * – THE TOTAL DEPTH NOT GIVEN

ENVIRONMENTAL CONSULTATION & REMEDIATION

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2500' RADIUS POTABLE WELL MAP

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 250'	Date: August 25, 2021
KPRG Project No. 19520	FIGURE 9-11

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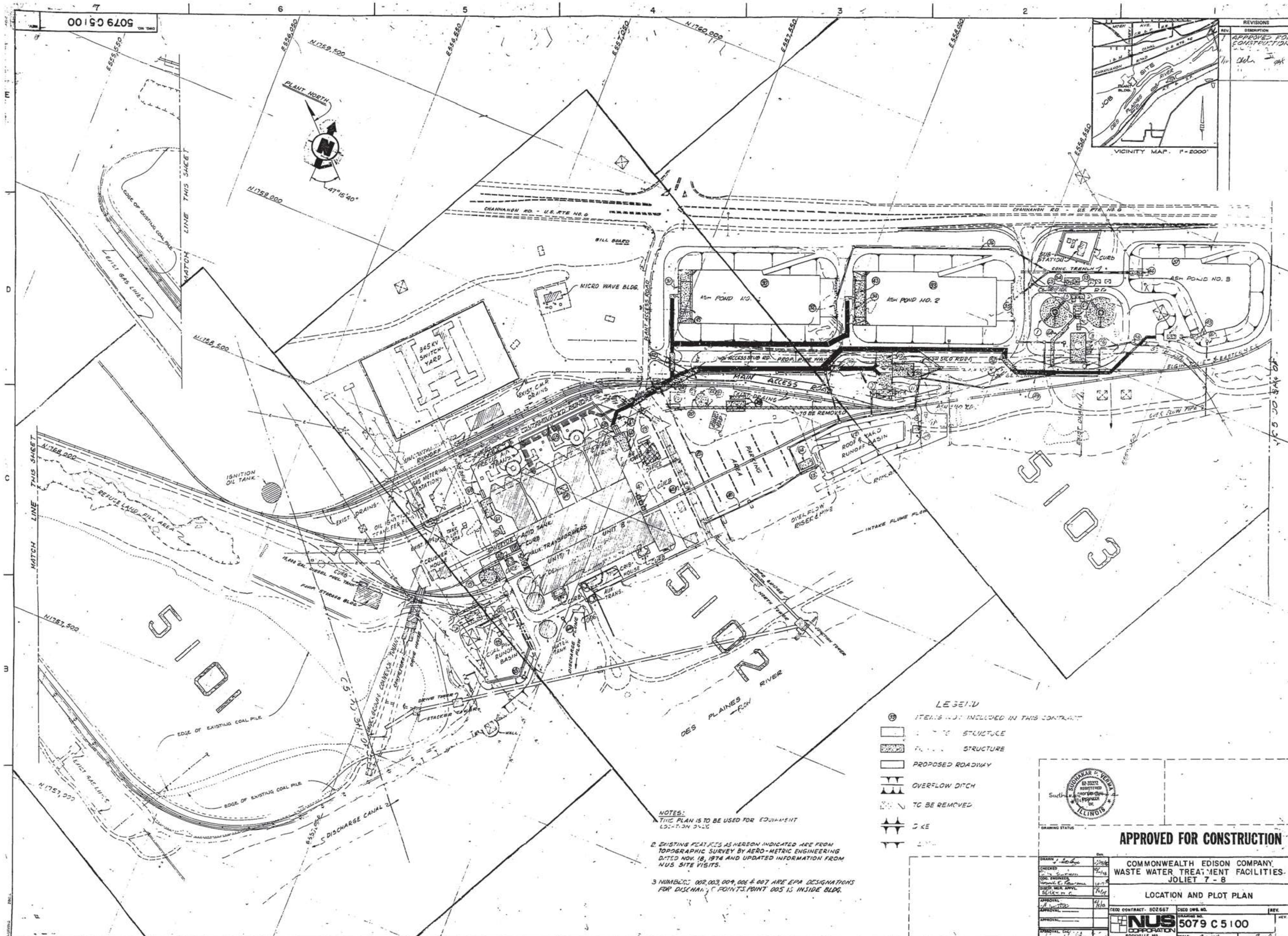
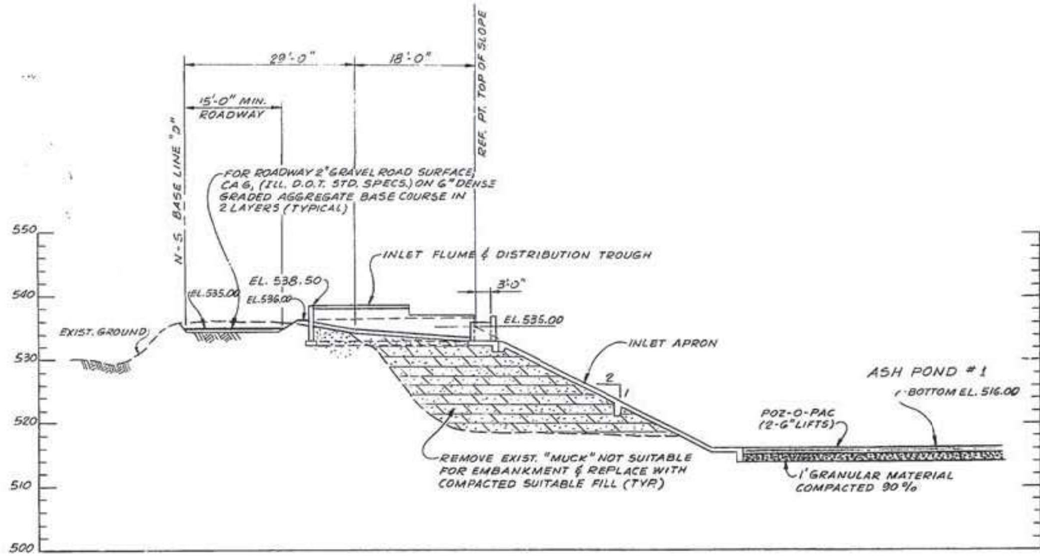
OPERATING PERMIT ATTACHMENTS

ATTACHMENT 1
HISTORY OF CONSTRUCTION

Attachment 1-1 – Construction Drawings


5079 C5100
PLANT NORTH
47°15'40"
VICINITY MAP 1" = 2000'
REVISIONS
APPROVED FOR CONSTRUCTION
CHANNAHON RD. - U.S. RTE NO. 6
BILL BOARD
MICRO WAVE BLDG.
345 KV SWITCH YARD
ASH POND NO. 1
ASH POND NO. 2
ASH POND NO. 3
SUB-STATION
MAIN ACCESS ROAD
PARKING AREA
ROOF & YARD RUNOFF BASIN
IGNITION OIL TANK
REFUSE LAND FILL AREA
MATCH LINE THIS SHEET
EDGE OF EXISTING COAL PILE
DISCHARGE CANAL
INTAKE FLUME FLOW
OVERFLOW RISER & PIPE
DES PLAINES RIVER
FLOW
5101
5102
5103
LEGEND
ITEMS NOT INCLUDED IN THIS CONTRACT
STRUCTURE
STRUCTURE
PROPOSED ROADWAY
OVERFLOW DITCH
TO BE REMOVED
NOTES:
1. THIS PLAN IS TO BE USED FOR EQUIPMENT LOCATION ONLY.
2. EXISTING FEATURES AS HEREON INDICATED ARE FROM TOPOGRAPHIC SURVEY BY AERO-METRIC ENGINEERING DATED NOV. 18, 1974 AND UPDATED INFORMATION FROM NUS SITE VISITS.
3 NUMBERS 002, 003, 004, 006 & 007 ARE EPA DESIGNATIONS FOR DISCHARGE POINTS. POINT 005 IS INSIDE BLDG.
SUDHAKAR P. VERMA
62-33272
REGISTERED PROFESSIONAL ENGINEER OF ILLINOIS
DRAWING STATUS
APPROVED FOR CONSTRUCTION
DRAWN
CHECKED
COG. ENGINEER
DISCIP. MGR. APPVL.
APPROVAL
COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
JOLIET 7 - 8
LOCATION AND PLOT PLAN
CECO CONTRACT - 802667
CECO DWG. NO.
REV.
NUS CORPORATION
ROCKVILLE, MD.
DRAWING NO.
5079 C 5100
SCALE: 1" = 100'
SHEET 2 OF 4

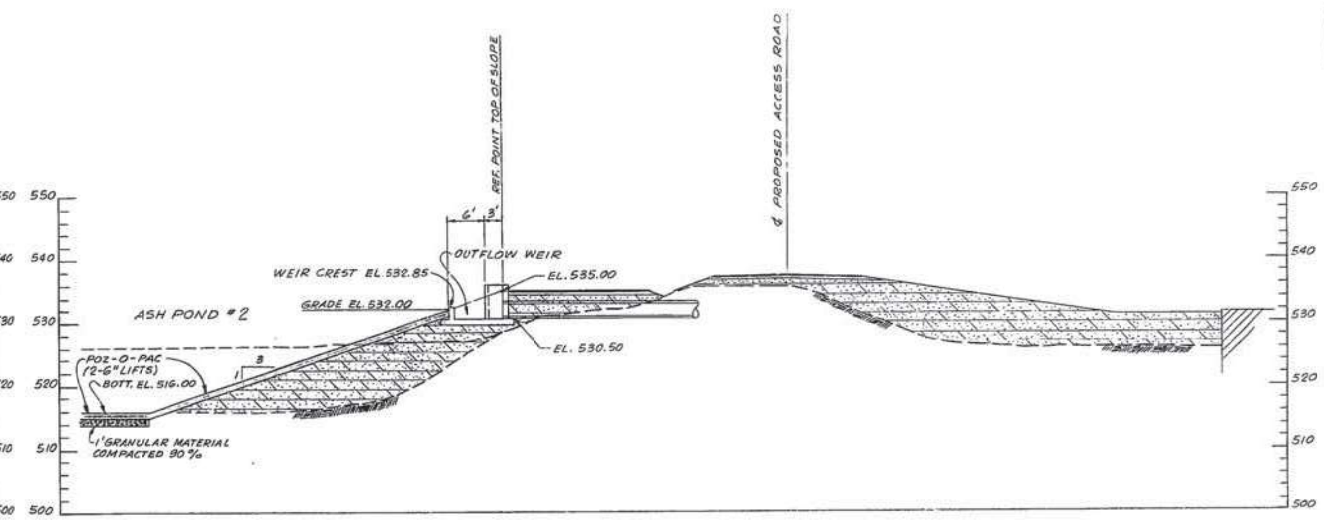
5079C5019 SH3



SECTION AT INLET FLUME & DISTRIBUTION THROUGH ASH POND NO. 1

SCALE: HORIZ. 1" = 10' VERT. 1" = 10'

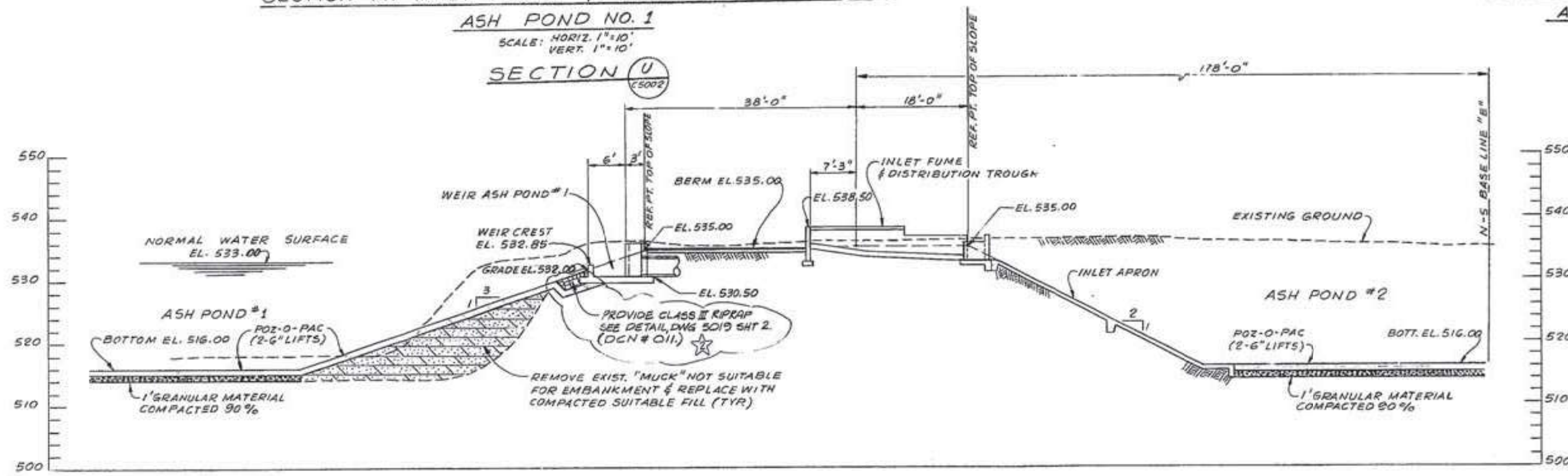
SECTION (U / C5002)



SECTION AT WEIR ASH POND NO. 2 AND ACCESS ROAD

SCALE: HORIZ. 1" = 10' VERT. 1" = 10'

SECTION (V / C5003)



SECTION AT WEIR ASH POND NO. 1 AND DISTRIBUTION THROUGH ASH POND NO. 2

SCALE: HORIZ. 1" = 10' VERT. 1" = 10'

SECTION (W / C5003)

FOR POZ-O-PAC NOTES SEE SHEET 2 OF 3

REV.	REVISIONS DESCRIPTION
1	APPROVED FOR CONSTRUCTION
2	REVISED SECTION (W) WEIR ASH POND #1 TO SHOW RIPRAP AS PER DCN # 011.

Sudhakar P. Verma 6/17/78

DRAWING STATUS: APPROVED FOR CONSTRUCTION 6/17/78

COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
JOLIET 7 - 8

PONDS & BASINS PROFILES SECTIONS & DETAILS

NUS CORPORATION ROCKVILLE, MD.

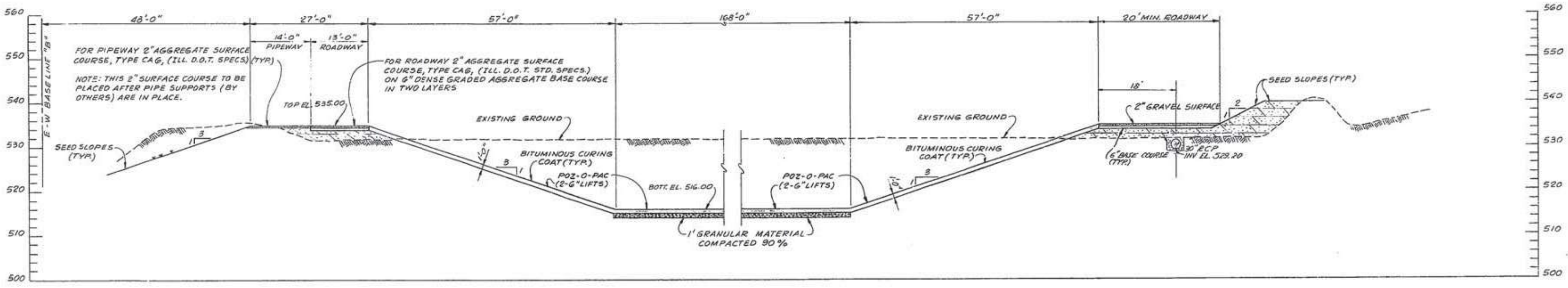
DRAWING NO. 5079C5019 REV. 2

SCALE: AS NOTED SHEET 3 OF 3

5079C5019 SH2

DWG. NO. 5079 C5019 REV. 2

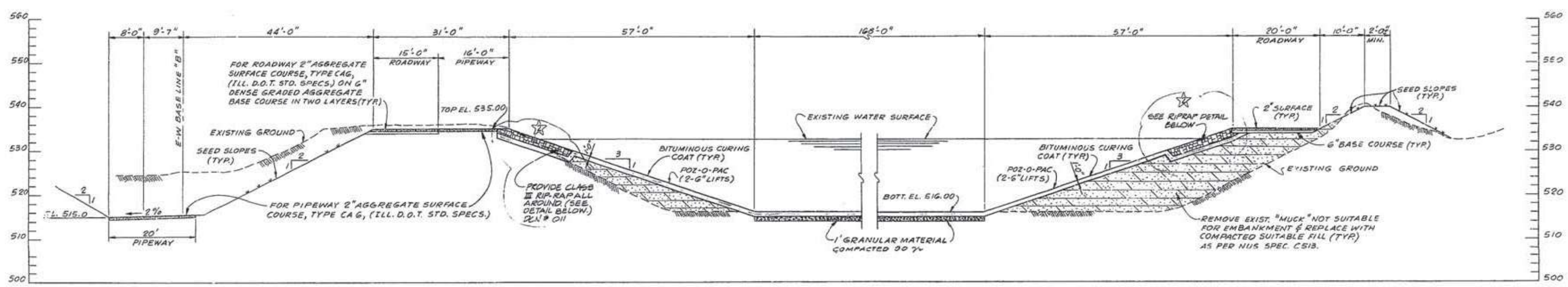
REVISIONS	
REV.	DESCRIPTION
1	APPROVED FOR CONSTRUCTION
2	REVISED POZ-O-PAC MIX IN NOTE 2 AS PER DCN # 002. ADDED RIPRAP DETAIL, ACCESS RAMP DETAIL, & ADDED RIPRAP TO THE SECTION THRU ASH POND #1 AS PER DCN # 011.



TYPICAL SECTION THROUGH ASH POND NO. 2

SCALE: HORIZ. 1" = 10' VERT. 1" = 10'

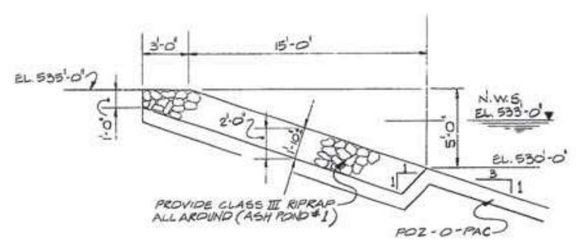
SECTION (5 / C5003)



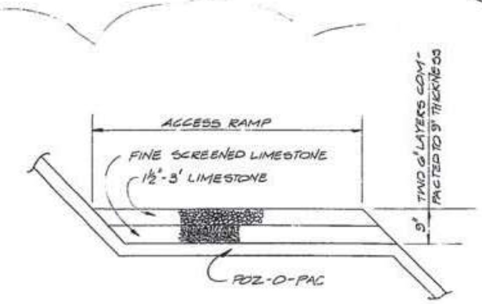
TYPICAL SECTION THROUGH ASH POND NO. 1

SCALE: HORIZ. 1" = 10' VERT. 1" = 10'

SECTION (T / C5003)



RIPRAP DETAIL (ASH POND #1 ONLY)



ACCESS RAMP DETAIL (ASH POND #1 ONLY)

POZ-O-PAC NOTES:

1. ALLOW A MINIMUM OF 7 DAYS CURING OF POZ-O-PAC PRIOR TO APPLICATION OF THE BITUMINOUS SEAL COAT.
2. THE POZ-O-PAC SHALL BE COMPOSED OF THE FOLLOWING MIX: 1.) HYDRATED LIME 3 %. 2) FLY ASH 20 %, 3) BOILER SLAG AGGREGATE 77 %. POZ-O-PAC DENSITY 136.9 # PER CUBIC FT. DCN 002
3. THE 1 FOOT LAYER OF POZ-O-PAC SHALL BE COMPACTED WITH 2-6" LIFTS UNTIL THE DESIRED DENSITY IS OBTAINED.
4. PRIOR TO THE INSTALLATION OF THE POZ-O-PAC, THE SUBBASE SHALL BE PREPARED BY UNDERCUTTING TO A MINIMUM OF 1 FOOT BELOW THE BOTTOM OF THE POZ-O-PAC FILLING WITH 2-6" LIFTS TO A COMPACTION OF 90 % PROCTOR WITH CONSOLIDATION.

Sudhakar P Verma 6/17/78

DRAWING STATUS: APPROVED FOR CONSTRUCTION 6/17/78

COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
JOLIET 7-8

PONDS & BASINS PROFILES
SECTIONS & DETAILS

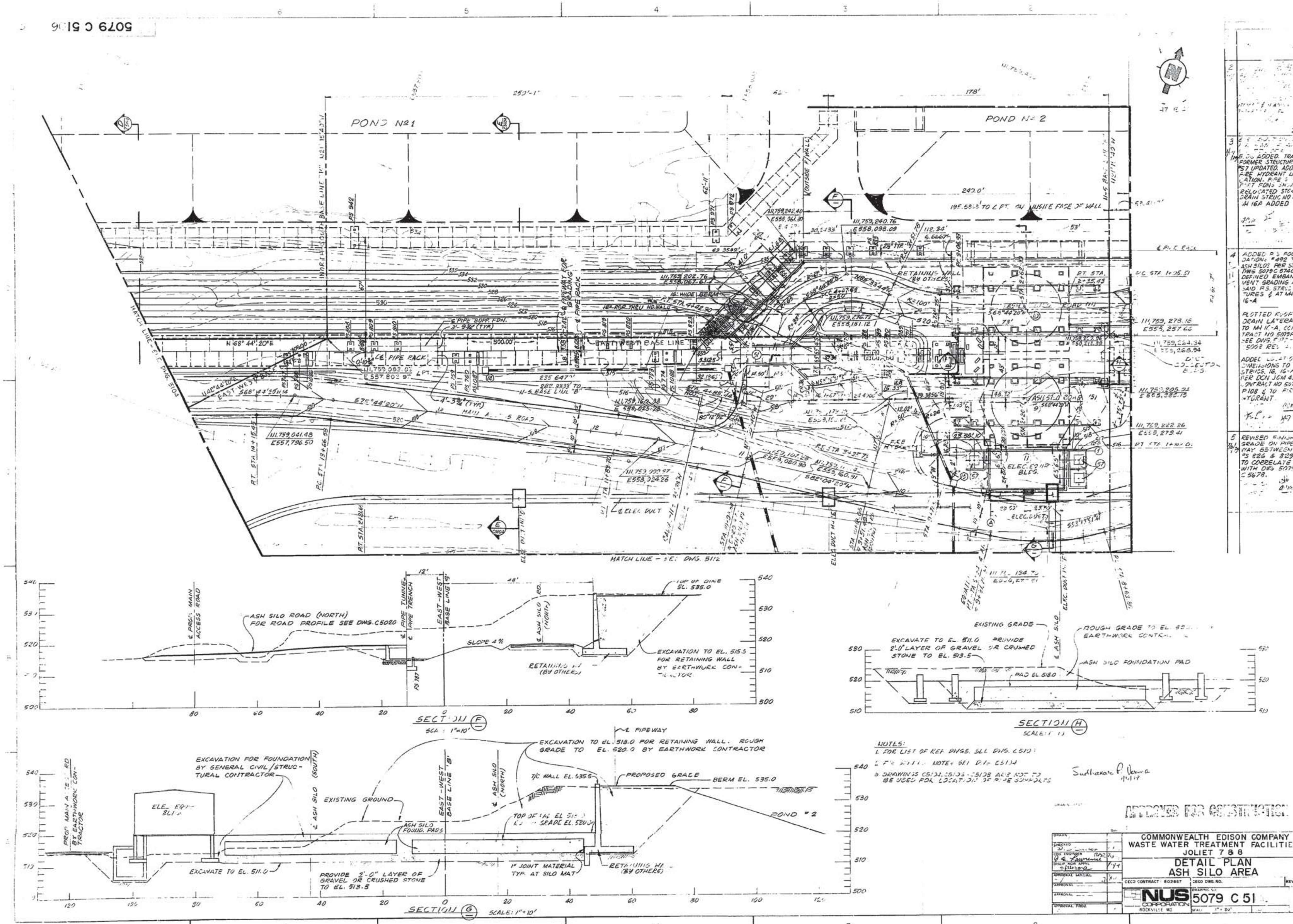
CECO CONTRACT 80267 | CECO DWG. NO. | REV.

NUS CORPORATION, ROCKVILLE, MD.

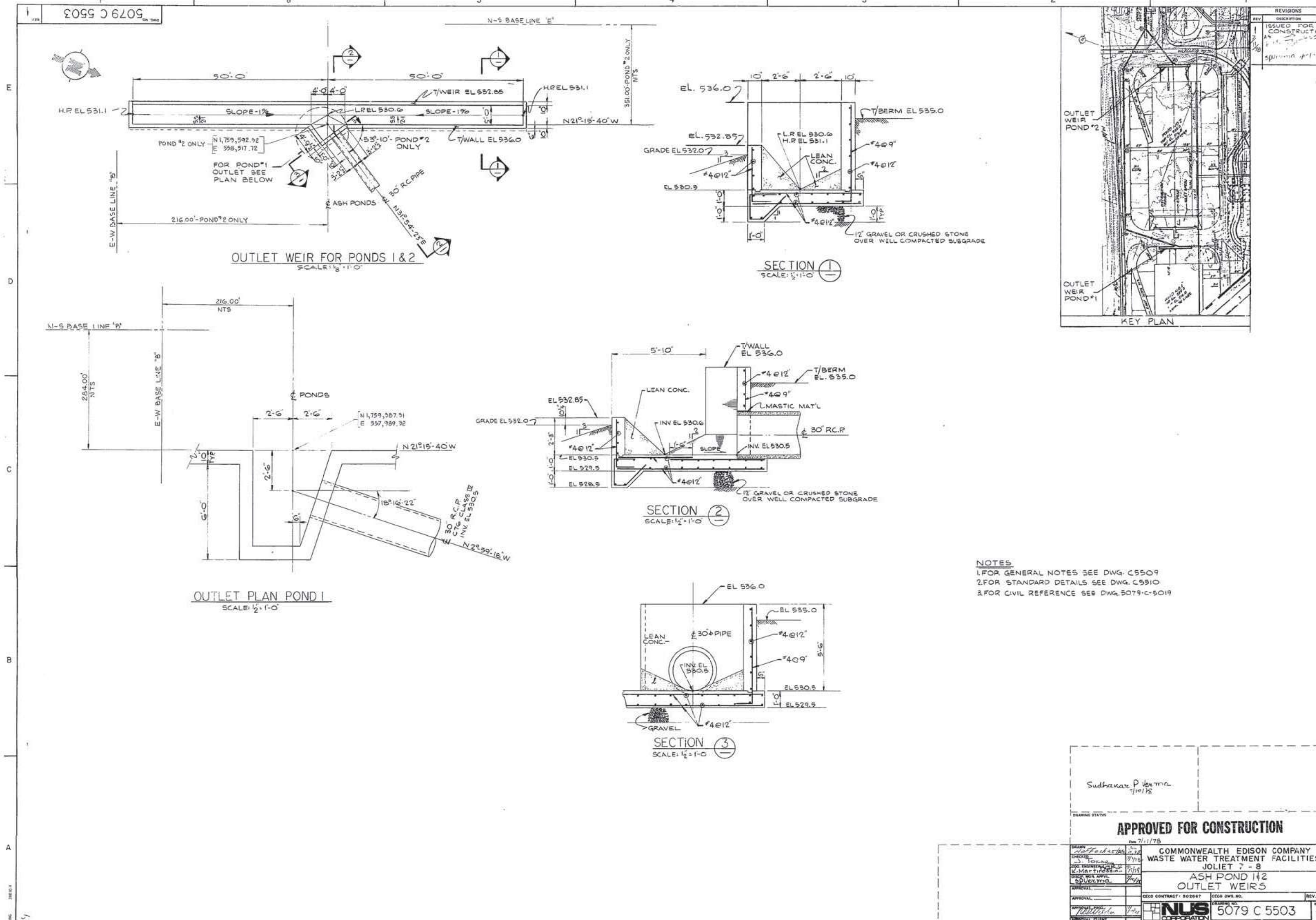
DRAWING NO. 5079C5019 | REV. 2

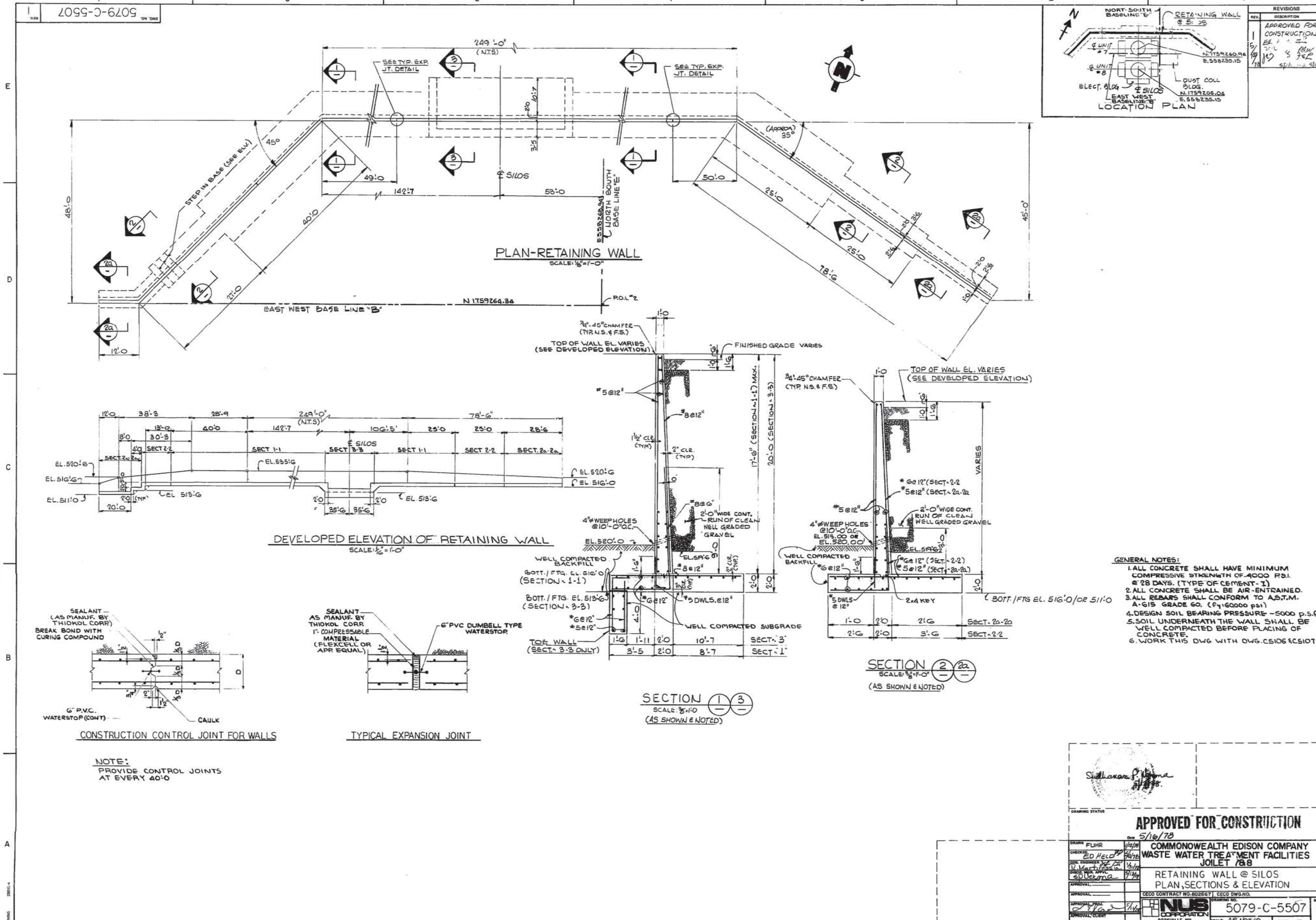
SCALE: AS NOTED | SHEET 2 OF 3

5079C5106



CONDITION OF ORIGINAL -FAIR- | REPRODUCTION CONSULTANTS, LTD.
30X42

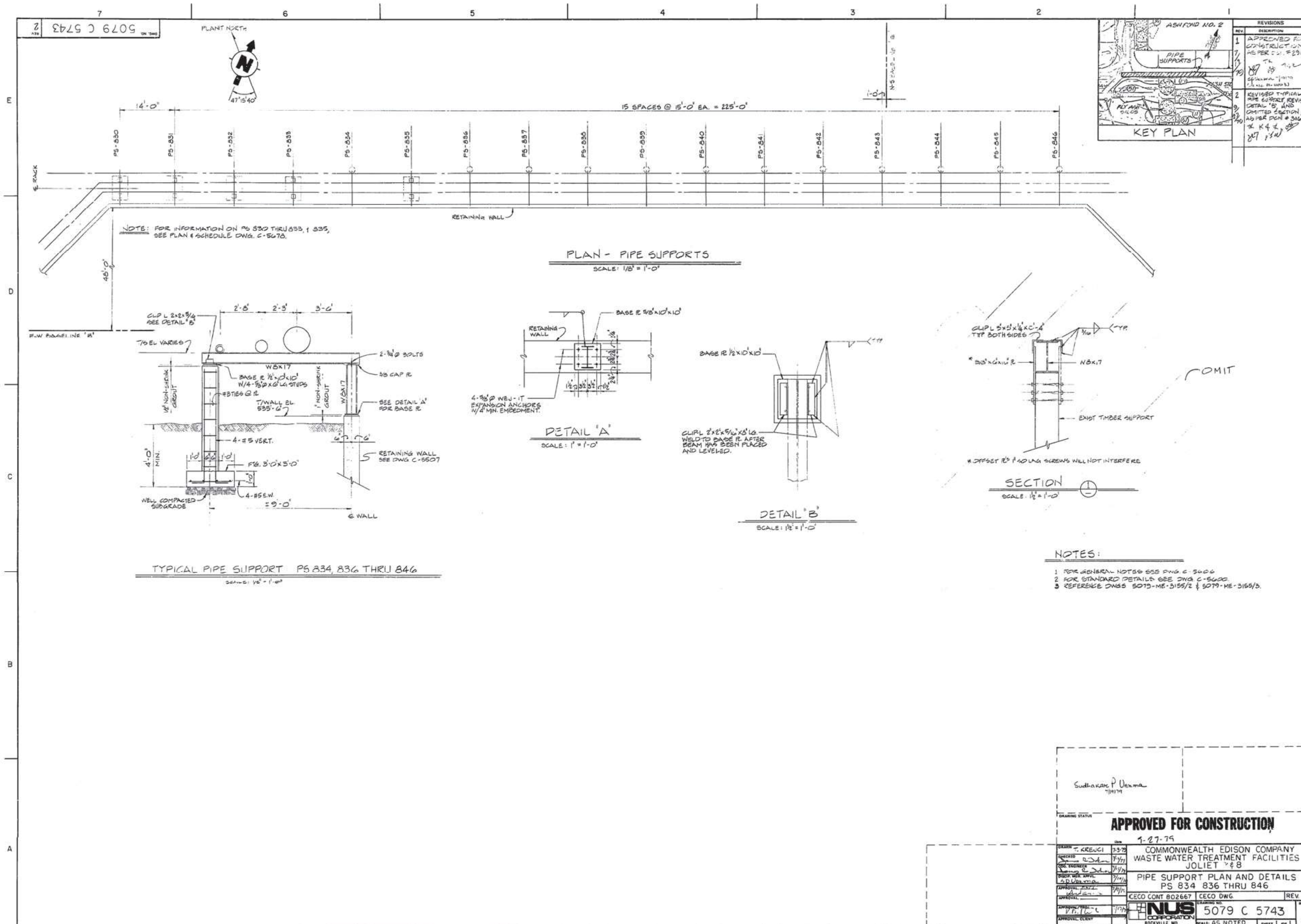

5079 C 5503
OUTLET WEIR FOR PONDS 1 & 2
SCALE: 1/8" = 1'-0"
N-S BASE LINE 'E'
E-W BASE LINE 'B'
H.P. EL 531.1
T/WEIR EL 532.85
L.P. EL 530.6
SLOPE-1%
T/WALL EL 536.0
N21°-15'-40"W
216.00'-POND #2 ONLY
FOR POND #1 OUTLET SEE PLAN BELOW
℄ ASH PONDS
30" R.C. PIPE
SECTION 1
SCALE: 1/2" = 1'-0"
EL. 536.0
T/BERM EL 535.0
EL. 532.85
GRADE EL 532.0
LEAN CONC.
12" GRAVEL OR CRUSHED STONE OVER WELL COMPACTED SUBGRADE
KEY PLAN
OUTLET WEIR POND #2
OUTLET WEIR POND #1
REVISIONS
ISSUED FOR CONSTRUCTION
OUTLET PLAN POND 1
SCALE: 1/2" = 1'-0"
N-S BASE LINE 'A'
℄ PONDS
N 1,759,387.31
E 557,989.32
N21°-15'-40"W
N2°-59'-18"W
SECTION 2
SCALE: 1/2" = 1'-0"
T/WALL EL 536.0
T/BERM EL. 535.0
MASTIC MAT'L
INV. EL 530.6
INV. EL 530.5
℄ 30" R.C.P.
SECTION 3
SCALE: 1/2" = 1'-0"
EL 536.0
EL 535.0
℄ 30" PIPE
INV. EL 530.5
EL 530.5
EL 529.5
GRAVEL
NOTES
1. FOR GENERAL NOTES SEE DWG. C5509
2. FOR STANDARD DETAILS SEE DWG. C5510
3. FOR CIVIL REFERENCE SEE DWG. 5079-C-5019
APPROVED FOR CONSTRUCTION
COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
JOLIET 7 - 8
ASH POND 1 & 2
OUTLET WEIRS
NUS CORPORATION
ROCKVILLE, MD.
5079 C 5503
SCALE: NOTED



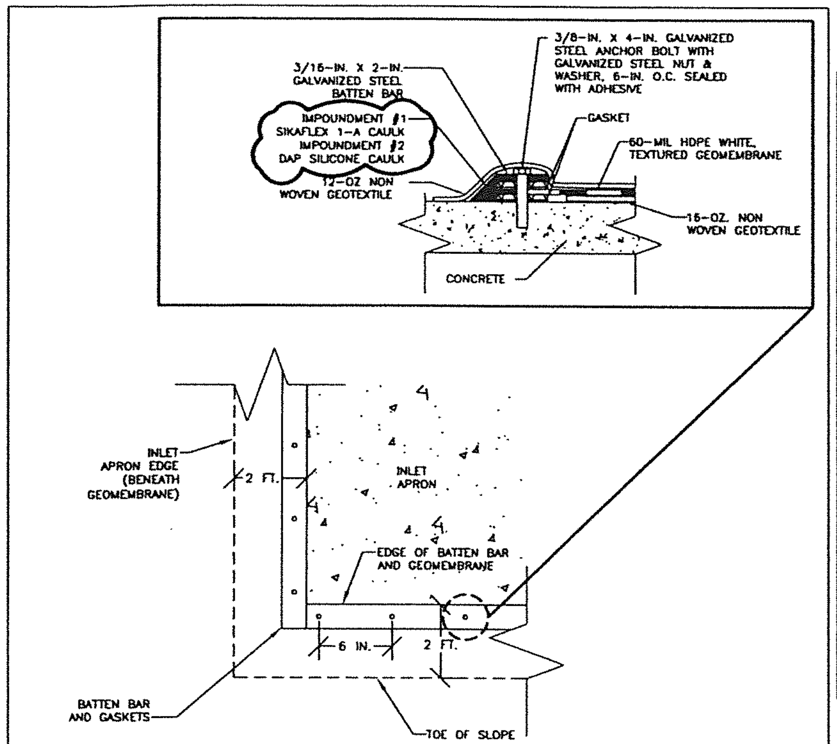
5079-C-5507
PLAN-RETAINING WALL
SCALE: 1/8"=1'-0"
249'-0" (N.T.S)
SEE TYP. EXP. JT. DETAIL
℄ SILOS
STEP IN BASE (SEE ELV.)
NORTH SOUTH BASE LINE "E"
EAST WEST BASE LINE "B"
N 1759264.34
LOCATION PLAN
NORTH-SOUTH BASELINE "E"
RETAINING WALL @ SILOS
DUST COLL. BLDG.
ELECT. BLDG.
EAST WEST BASELINE "B"
REVISIONS
APPROVED FOR CONSTRUCTION
DEVELOPED ELEVATION OF RETAINING WALL
SCALE: 1/16"=1'-0"
SECT 1-1
SECT 2-2
SECT 3-3
SECT. 2a-2a
EL. 520'-6
EL. 516'-6
EL. 511'-0
EL. 513'-6
EL. 535'-6
TOP OF WALL EL. VARIES (SEE DEVELOPED ELEVATION)
3/4"-45° CHAMFER (TYP. N.S. & F.S.)
FINISHED GRADE VARIES
4" ø WEEPHOLES @ 10'-0" O.C.
2'-0" WIDE CONT. RUN OF CLEAN WELL GRADED GRAVEL
WELL COMPACTED BACKFILL
WELL COMPACTED SUBGRADE
BOTT./FTG. EL. 516'-0 (SECTION-1-1)
BOTT./FTG. EL. 513'-6 (SECTION-3-3)
TOE WALL (SECT.-3-3 ONLY)
2x4 KEY
BOTT./FTG EL. 516'-0 OR 511'-0
SECTION 1 3
SCALE: 3/8"=1'-0"
(AS SHOWN & NOTED)
SECTION 2 2a
SCALE: 3/8"=1'-0"
(AS SHOWN & NOTED)
SEALANT (AS MANUF. BY THIOKOL CORP.)
BREAK BOND WITH CURING COMPOUND
6" P.V.C. WATERSTOP (CONT.)
CAULK
CONSTRUCTION CONTROL JOINT FOR WALLS
SEALANT AS MANUF. BY THIOKOL CORP.
1" COMPRESSABLE MATERIAL (FLEXCELL OR APP. EQUAL)
6" PVC DUMBELL TYPE WATERSTOP
TYPICAL EXPANSION JOINT
NOTE:
PROVIDE CONTROL JOINTS AT EVERY 40'-0
GENERAL NOTES:
1. ALL CONCRETE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 4000 P.S.I. @ 28 DAYS. (TYPE OF CEMENT - I)
2. ALL CONCRETE SHALL BE AIR-ENTRAINED.
3. ALL REBARS SHALL CONFORM TO A.S.T.M. A-615 GRADE 60. (Fy=60000 psi)
4. DESIGN SOIL BEARING PRESSURE - 5000 p.s.f.
5. SOIL UNDERNEATH THE WALL SHALL BE WELL COMPACTED BEFORE PLACING OF CONCRETE.
6. WORK THIS DWG WITH DWG. C5106 & C5107
APPROVED FOR CONSTRUCTION
5/16/78
COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
JOILET 7&8
RETAINING WALL @ SILOS
PLAN, SECTIONS & ELEVATION
NUS CORPORATION
ROCKVILLE, MD.
SCALE: AS NOTED
5079-C-5507
REV. 1

5079C5103

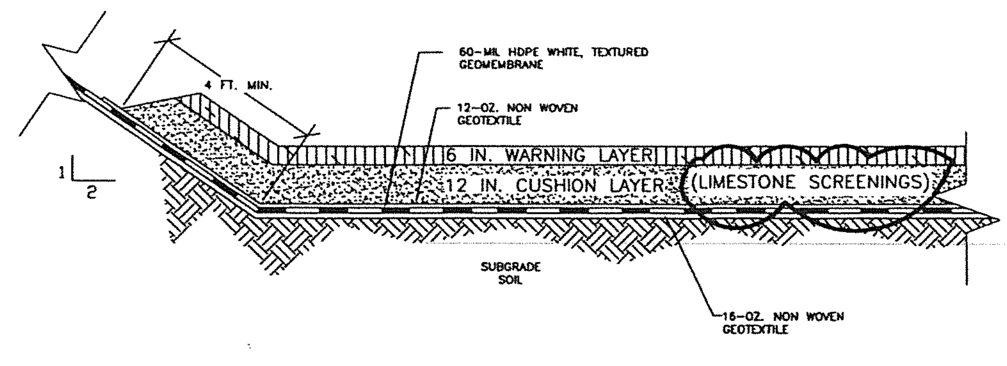

5079 C 5103
N-S BASE LINE
U.S. HIGHWAY #6
CHANNAHON ROAD
SECURITY FENCE
ASH POND # 3
TOP EL 535.0
BOT EL 516.0
N 21°15'40"W
OVERFLOW SPILLWAY
ASH POND #3 PUMP INLET W/TRASH RACK
CLARIFIER
CLARIFIER
MAIN WASTE TREATMENT BLDG
STUB ROAD
RIPRAP
EXISTING 24" C.S.P.
ASH POND #2
TOP EL 535.0
BOT EL 516.0
N-S BASE LINE "E"
N 21°15'40"W
SECURITY FENCE (BY OTHERS)
R/W
N-S BASE LINE "B"
N 21°15'40"W
ASH POND #1
TOP EL 535.0
BOT EL 516.0
OIL SEPARATOR FOUNDATION
MATCH LINE SEE DWG C5102
FOR GENERAL NOTES SEE DRAWING 5079 C 5101.
APPROVED FOR CONSTRUCTION
COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
JOLIET 7 - 8
SITE PLAN
EAST YARD AREA
NUS CORPORATION
ROCKVILLE, MD
5079 C 5103



5079 C 5743
PLANT NORTH
KEY PLAN
REVISIONS
1 APPROVED FOR CONSTRUCTION
2 REVISED TYPICAL PIPE SUPPORT, REVISED DETAIL 'B' AND OMITTED SECTION 1
15 SPACES @ 15'-0" EA. = 225'-0"
14'-0"
PS-830
PS-831
PS-832
PS-833
PS-834
PS-835
PS-836
PS-837
PS-838
PS-839
PS-840
PS-841
PS-842
PS-843
PS-844
PS-845
PS-846
RETAINING WALL
NOTE: FOR INFORMATION ON PS 830 THRU 833, & 835, SEE PLAN & SCHEDULE DWG. C-5678.
PLAN - PIPE SUPPORTS
SCALE: 1/8" = 1'-0"
TYPICAL PIPE SUPPORT PS 834, 836 THRU 846
DETAIL 'A'
SCALE: 1" = 1'-0"
DETAIL 'B'
SCALE: 1½" = 1'-0"
SECTION 1
SCALE: 1½" = 1'-0"
OMIT
EXIST TIMBER SUPPORT
NOTES:
1 FOR GENERAL NOTES SEE DWG. C-5606
2 FOR STANDARD DETAILS SEE DWG. C-5600.
3 REFERENCE DWGS 5079-ME-3155/2 & 5079-ME-3155/3.
APPROVED FOR CONSTRUCTION
DRAWN T. KREJCI
COMMONWEALTH EDISON COMPANY
WASTE WATER TREATMENT FACILITIES
JOLIET 7 & 8
PIPE SUPPORT PLAN AND DETAILS
PS 834 836 THRU 846
CECO CONT 802667
CECO DWG.
REV.
NUS CORPORATION
ROCKVILLE, MD.
DRAWING NO.
5079 C 5743
SCALE: AS NOTED
SHEET 1 OF 1
2

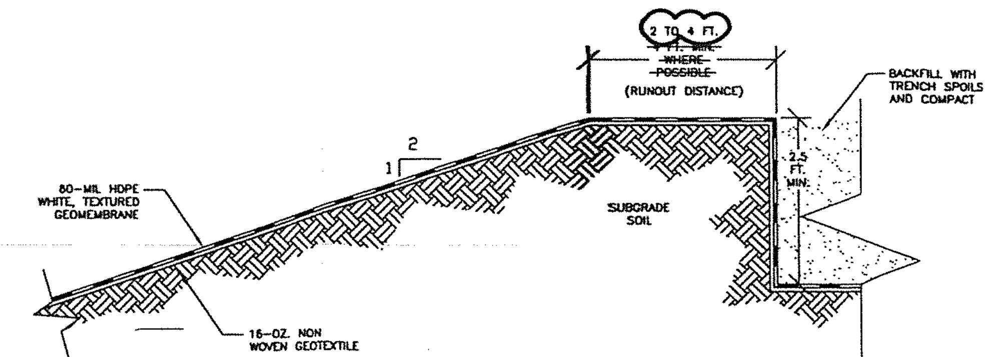


2 INLET APRON DETAIL PLAN
C030 NOT TO SCALE

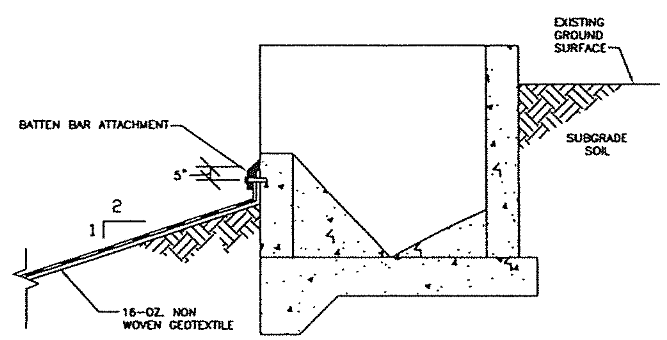


NOTE:
1. GEOMEMBRANE SEAMS SHALL BE PLACED 2 TO 5 FT. FROM TOE OF SLOPE AT A MINIMUM.

A SLOPE TRANSITION SECTION
C030 NOT TO SCALE

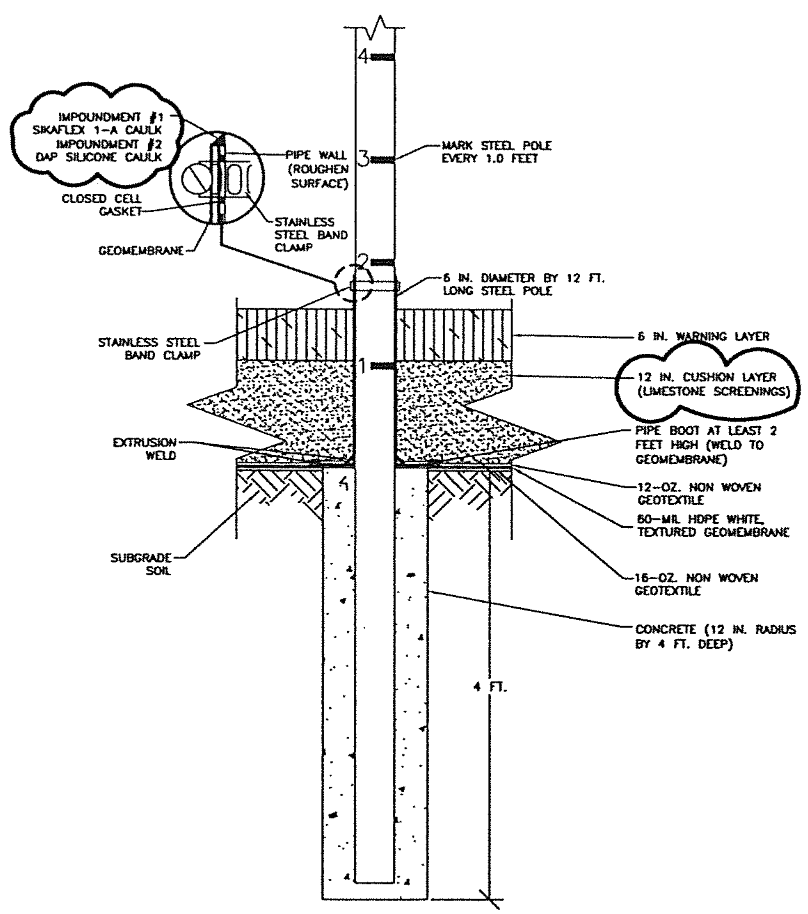


D ANCHOR TRENCH SECTION
C030 NOT TO SCALE

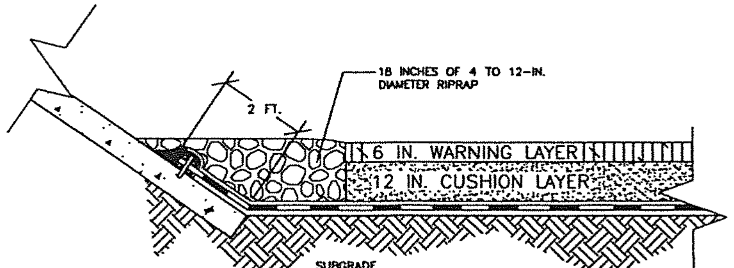


NOTE:
1. REFER TO DETAIL 2 FOR BATTEN BAR ATTACHMENT. EXCLUDE USE OF THE TOP LAYER OF 12-OZ. NON WOVEN GEOTEXTILE.

3 OUTLET WEIR DETAIL
C030 NOT TO SCALE

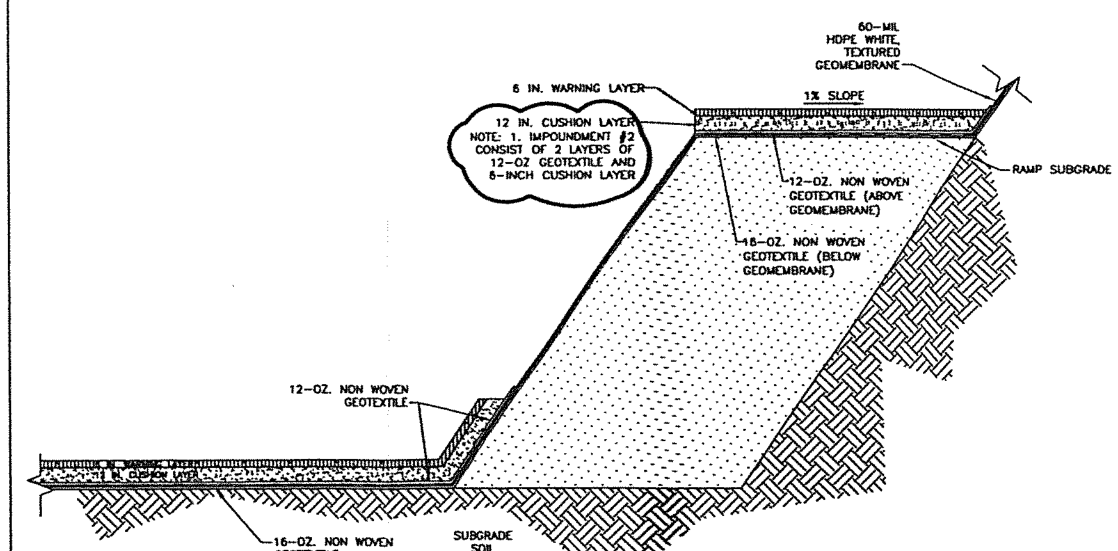


1 MARKER POST DETAIL
C020 NOT TO SCALE



NOTE:
1. REFER TO DETAIL 2 FOR BATTEN BAR ATTACHMENT.

C INLET APRON SECTION
-- NOT TO SCALE

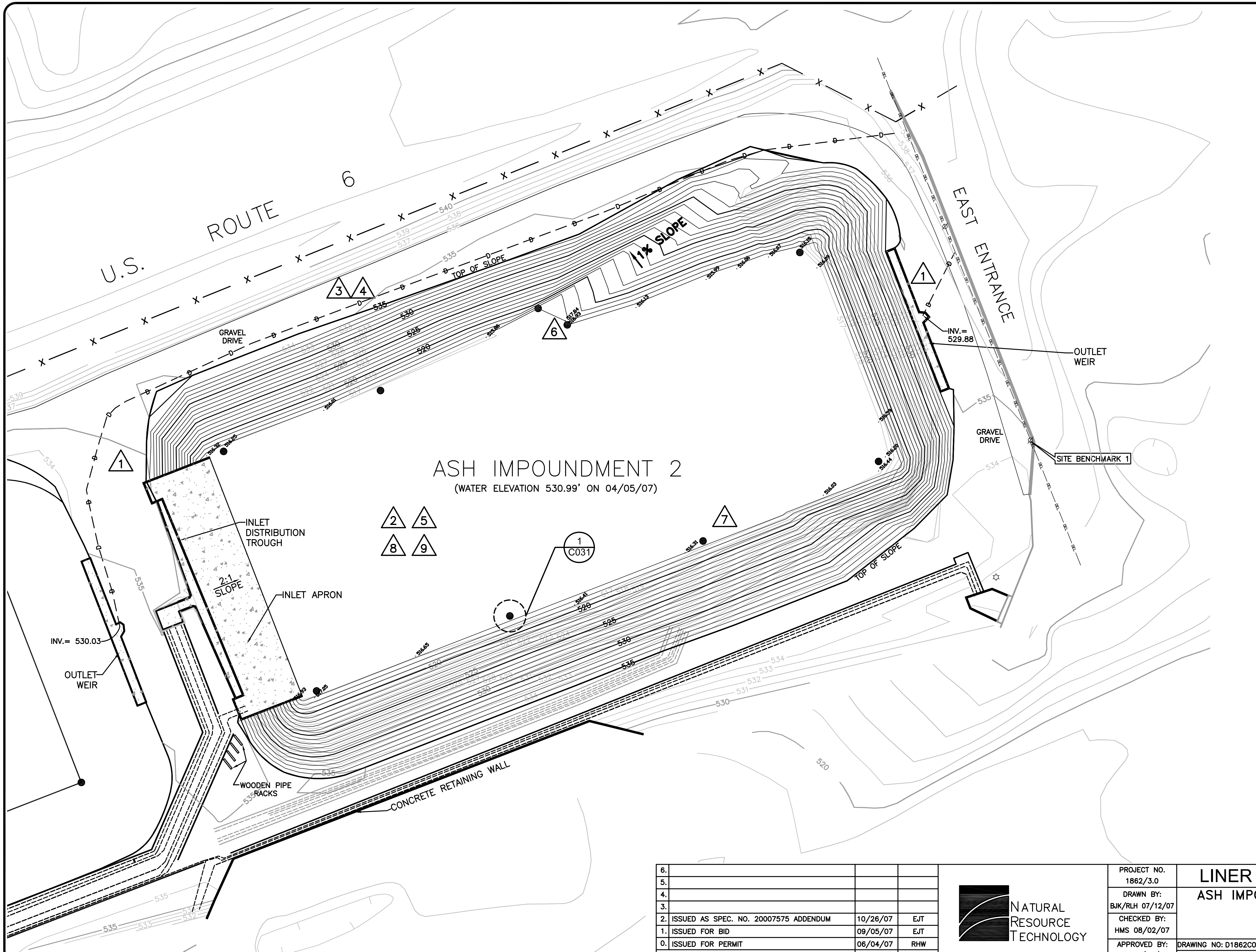


B RAMP SECTION
C030 NOT TO SCALE

6.			
5.			
4.			
3.			
2.			
1.			
0.	RECORD DRAWING	12/19/08	HMS
REVISION:		DATE:	APP'D BY:

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1862/5.2	DETAILS AND SECTIONS
DRAWN BY: KNW 12/19/08	ASH IMPOUNDMENT #1 AND #2 LINER REPLACEMENT MIDWEST GENERATION, LLC JOLIET STATION NO. 29 JOLIET, ILLINOIS
CHECKED BY: HMS 12/19/08	
APPROVED BY: HMS 12/19/08	DRAWING NO: 01862C031-00 REFERENCE: 1862/RECORD DWGS/
SHEET NO.	C031



LEGEND

- GROUND SURFACE CONTOURS
- PROPOSED SURFACE CONTOURS
- UNDERGROUND DISCHARGE PIPE
- FENCE
- EDGE OF PIPE RACK
- ABOVE GROUND PIPELINES
- OVERHEAD ELECTRIC LINE
- POWER POLE
- LIGHT POLE
- MARKER POST
- CONCRETE

CONTRACTOR NOTES: △

1. CONTRACTOR SHALL FIELD VERIFY LOCATION OF UNDERGROUND DISCHARGE PIPES WITH ASSISTANCE OF OWNER'S UTILITY LOCATOR.
2. PROTECT ALL CONCRETE AND UTILITY STRUCTURES THROUGHOUT PROJECT DURATION.
3. CONTRACTOR SHALL STORE ALL GEOSYNTHETICS AND SUBGRADE MATERIALS AT A LOCATION APPROVED BY OWNER AS DISCUSSED DURING PRE-BID MEETING.
4. CONTRACTOR SHALL STORE AND STAGE EQUIPMENT AT A LOCATION APPROVED BY THE OWNER.
5. CONTRACTOR SHALL REMOVE VEGETATION, ROCKS AND OTHER DEBRIS GREATER THAN 3 INCHES FROM IMPOUNDMENT SUBGRADE AND DISPOSE AT AN APPROVED FACILITY. SIDE SLOPES SHALL BE GRADED FLAT TO REMOVE EROSION RILLS.
6. CONTRACTOR SHALL REMOVE AT LEAST 18 INCHES OF EXISTING RAMP MATERIAL FOR PLACEMENT OF SUBGRADE LAYER AND FINAL LAYER OF RAMP. EXCAVATED RAMP MATERIAL SHALL BE REUSED AS FINAL LAYER OF RAMP AS APPROVED BY OWNER. RAMP SUBGRADE SHALL BE SLOPED AS INDICATED ON THIS SHEET.
7. CONTRACTOR SHALL INSTALL MARKER POSTS ALONG THE BASE OF THE IMPOUNDMENTS AS SHOWN AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND DETAIL 1 ON SHEET C031.
8. CONTRACTOR SHALL PLACE 16 OZ. NON WOVEN GEOTEXTILE OVER THE PREPARED SUBGRADE IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND AS APPROVED BY GEOMEMBRANE INSTALLER PRIOR TO INSTALLATION OF GEOMEMBRANE.
9. CONTRACTOR SHALL PROVIDE MEANS TO PROTECT 16-OZ. NON WOVEN GEOTEXTILE FROM POTENTIAL DAMAGE. DAMAGE TO GEOTEXTILE SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE.

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A SURVEY MAP BY RUETTIGER, TONELLI & ASSOCIATES, INC., JOLIET, ILLINOIS, PLAT OF PARTIAL TOPOGRAPHY OF MIDWEST GENERATION JOLIET 29 POWER PLANT ASH IMPOUNDMENTS, SHEET 1 OF 1, DATED APRIL 7, 2007, FILE NO: 06487.DWG. COORDINATE SYSTEM IS ILLINOIS STATE PLANE EAST ZONE, (NAD 83).
2. ASH IMPOUNDMENTS 1 AND 2 WERE DEVELOPED FROM DRAWINGS BY NUS CORPORATION, DRAWING NUMBERS: 5079C5102 AND 5079C5103, DATED JANUARY 23, 1979.
3. TOPOGRAPHY OUTSIDE OF ASH IMPOUNDMENTS 1 AND 2 WAS DEVELOPED FROM DIGITAL-ORTHO FILES, 030750.DWG, 040750.DWG, AND 040760.DWG ILLINOIS STATE PLANE EAST NAD 83 COORDINATE SYSTEM, DATED APRIL, 1997 DOWNLOADED FROM http://www.willcogis.org.
4. GROUND SURFACE CONTOURS WERE DEVELOPED FROM A SURVEY MAP BY RUETTIGER, TONELLI & ASSOCIATES, INC., JOLIET, ILLINOIS, PLAT OF PARTIAL TOPOGRAPHY OF MIDWEST GENERATION JOLIET 29 POWER PLANT ASH IMPOUNDMENTS, SHEET 1 OF 1, DATED OCTOBER 20, 2007, FILE NO: 06487.DWG.

NOT FOR CONSTRUCTION

	REVISION:	DATE:	APP'D BY:
6.			
5.			
4.			
3.			
2.	ISSUED AS SPEC. NO. 20007575 ADDENDUM	10/26/07	EJT
1.	ISSUED FOR BID	09/05/07	EJT
0.	ISSUED FOR PERMIT	06/04/07	RHW

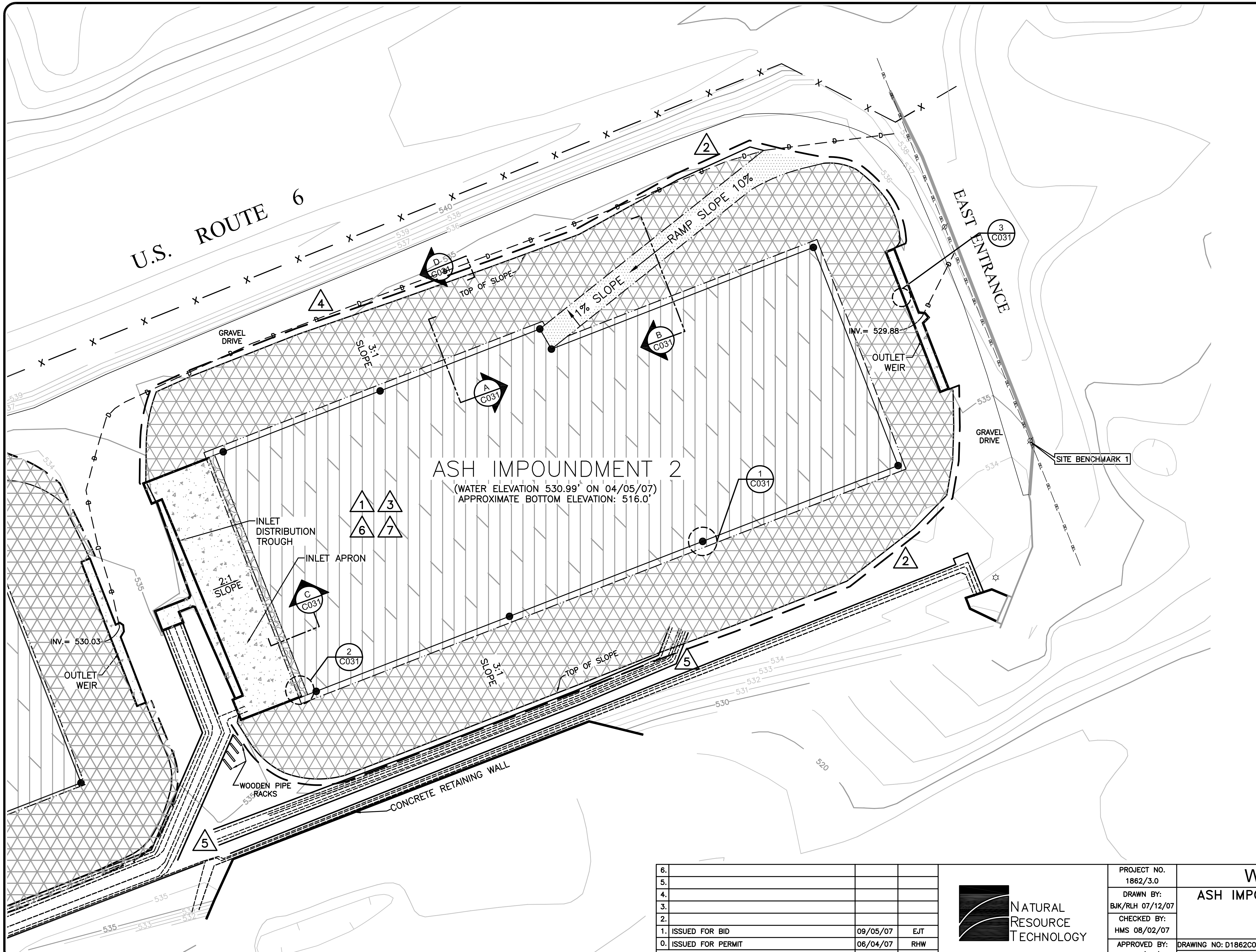
NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1862/3.0
DRAWN BY: BJK/RLH 07/12/07
CHECKED BY: HMS 08/02/07
APPROVED BY: EJT 09/05/07

LINER SUBGRADE PREPARATION

ASH IMPOUNDMENT #2 LINER REPLACEMENT
MIDWEST GENERATION
JOLIET STATION NO. 29
JOLIET, ILLINOIS

DRAWING NO: D1862C020-02
REFERENCE: 1862/3/BID-CON/
SHEET NO. C020



LEGEND

- GROUND SURFACE CONTOURS
- UNDERGROUND DISCHARGE PIPE
- FENCE
- EDGE OF PIPE RACK
- ABOVE GROUND PIPELINES
- OVERHEAD ELECTRIC LINE
- POWER POLE
- LIGHT POLE
- MARKER POST
- ANCHOR TRENCH
- 12 OZ. NON-WOVEN GEOTEXTILE
- CONCRETE
- EXCAVATED RAMP MATERIAL
- RIP RAP
- WARNING LAYER
- HDPE GEOMEMBRANE

CONTRACTOR NOTES: △

1. CONTRACTOR SHALL INSTALL 60 MIL HDPE, WHITE, TEXTURED GEOMEMBRANE IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION PRIOR TO PLACEMENT OF THE WARNING LAYER. CONTRACTOR SHALL PROVIDE AND FOLLOW AN APPROVED GEOMEMBRANE LAYOUT PLAN.
2. GEOMEMBRANE SHALL BE ANCHORED INTO 2.5 FEET DEEP TRENCHES ALONG TOP OF IMPOUNDMENT BANK, AS SHOWN IN SECTION D ON SHEET C031. CONTRACTOR SHALL ADVISE OWNER AND/OR ENGINEER IF PROPOSED LOCATION NOT POSSIBLE. DISCHARGE PIPE SHALL BE FIELD LOCATED AND CONTRACTOR SHALL NOTIFY OWNER IF ANCHOR TRENCH INTERFERES WITH PIPING.
3. CONTRACTOR SHALL PLACE 12-OZ. NON-WOVEN GEOTEXTILE OVER THE GEOMEMBRANE, SAND MATERIAL AND WARNING LAYER MATERIAL AT BASE AND 4 FEET ON SIDE SLOPES AFTER RECEIVING APPROVAL FROM ENGINEER AND PASSING QUALITY CONTROL RESULTS IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS. (SEE SHEET C031)
4. RESTORE AREAS DISTURBED BY EQUIPMENT AND MATERIAL LAYDOWN.
5. ABOVE GROUND PIPING TO BE INSTALLED BY OTHERS.
6. CONTRACTOR SHALL PROVIDE SURVEY DOCUMENTATION OF THE ITEMS LISTED IN THE TECHNICAL SPECIFICATIONS.
7. CONTRACTOR SHALL PERFORM A LEAK LOCATION SURVEY IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS.

SOURCE NOTES:

1. THIS DRAWING WAS DEVELOPED FROM A SURVEY MAP BY RUETTIGER, TONELLI & ASSOCIATES, INC., JOLIET, ILLINOIS, PLAT OF PARTIAL TOPOGRAPHY OF MIDWEST GENERATION JOLIET 29 POWER PLANT ASH IMPOUNDMENTS, SHEET 1 OF 1, DATED APRIL 7, 2007, FILE NO: 06457.DWG. COORDINATE SYSTEM IS ILLINOIS STATE PLANE EAST ZONE, (NAD 83).
2. ASH IMPOUNDMENTS 1 AND 2 WERE DEVELOPED FROM DRAWINGS BY NUS CORPORATION, DRAWING NUMBERS: 5079C5102 AND 5079C5103, DATED JANUARY 23, 1979.
3. TOPOGRAPHY OUTSIDE OF ASH IMPOUNDMENTS 1 AND 2 WAS DEVELOPED FROM DIGITAL-ORTHO FILES, 030750.DWG, 040750.DWG, AND 040760.DWG ILLINOIS STATE PLANE EAST NAD 83 COORDINATE SYSTEM, DATED APRIL, 1997 DOWNLOADED FROM http://www.willcogis.org.

NOT FOR CONSTRUCTION

REVISION:		DATE:	APP'D BY:
6.			
5.			
4.			
3.			
2.			
1.	ISSUED FOR BID	09/05/07	EJT
0.	ISSUED FOR PERMIT	06/04/07	RHW

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1862/3.0
DRAWN BY: BJK/RLH 07/12/07
CHECKED BY: HMS 08/02/07
APPROVED BY: EJT 09/05/07

WARNING LAYER PLAN

ASH IMPOUNDMENT #2 LINER REPLACEMENT
MIDWEST GENERATION
JOLIET STATION NO. 29
JOLIET, ILLINOIS

DRAWING NO: D1862C030-01
REFERENCE: 1862/3/BID-CON/
SHEET NO. C030

ASBUILT OF
MIDWEST GENERATION JOLIET 29 POWER PLANT
WEST-ASH IMPOUNDMENTS

LEGEND

- meas. — MEASURED
- rec. — RECORDED
- calc. — CALCULATED
- FOUND SURVEY MONUMENT
- SET 5/8" REBAR UNLESS OTHERWISE NOTED
- 6' HIGH CHAIN LINK FENCE
- UTILITY POLE
- LIGHT
- P — UNDERGROUND PIPELINE LOCATED BY OTHERS
- XXX — EXISTING CONTOUR
- XXX.XX — EXISTING ELEVATION
- OHU — OVERHEAD UTILITY LINES

SITE BENCHMARK 1:

SET CONCRETE NAIL IN WESTERLY FACE OF UTILITY POLE, WEST SIDE OF EAST ENTRANCE ROAD, 4TH UTILITY POLE SOUTH OF U.S. ROUTE 6.

ELEVATION: 536.39 (NGVD 29)

SITE BENCHMARK 2:

SET REBAR 2' S & 2.5' E OF 6' HIGH CHAIN LINK FENCE CORNER AT SOUTHEAST CORNER OF MAIN ENTRANCE ROAD & U.S. ROUTE 6.

ELEVATION: 536.71 (NGVD 29)

BENCHMARK:

WILL COUNTY CONTROL MONUMENT STATION 6274 CUT SQUARE ON CENTERLINE OF SOUTH HEADWALL IN THE SOUTHEAST CORNER OF THE INTERSECTION OF BRANDON ROAD AND MEADOW AVENUE.

ELEVATION: 550.33 (NGVD 29)

FIELD VERIFY BENCHMARKS WITH BENCHMARK LIST.

ASBUILT NOTE:

THE POND ASBUILT EXTENDS TO THE OUTSIDE OF THE NEW LINER, AS SHOWN HEREON. AREAS OUTSIDE THE NEW LINER AND SHOWN HEREON HAVE NOT BEEN REVERIFIED

STATE OF ILLINOIS)
)SS
COUNTY OF WILL)

RUETTIGER, TONELLI & ASSOCIATES, INC., ILLINOIS PROFESSIONAL DESIGN FIRM No. 184-001251, HEREBY CERTIFIES THAT IT HAS TOPOGRAPHICALLY SURVEYED THE POND AREA NOTED HEREON AND AS SHOWN ON THE ANNEXED PLAT, WHICH IS A TRUE AND CORRECT REPRESENTATION OF SAID TOPOGRAPHY.

SURVEY FIELD WORK COMPLETED 10/20/08

GIVEN UNDER MY HAND AND SEAL THIS 10th DAY OF MAY, 2008.

BY ______________________

ILLINOIS PROFESSIONAL LAND SURVEYOR (MY LICENSE EXPIRES 11-30-2008)

TO ENSURE AUTHENTICITY OF THIS DRAWING, IT MUST BEAR THE EMBOSSED SEAL OF THE DESIGN FIRM OR PROFESSIONAL LICENSEE WHO PREPARED THIS DRAWING.

ANY DISCREPANCY IN MEASUREMENT DISCOVERED UPON THE GROUND SHOULD BE PROMPTLY REPORTED TO THE SURVEYOR FOR EXPLANATION OR CORRECTION.

FOR BUILDING LINE AND OTHER RESTRICTIONS NOT SHOWN HEREON REFER TO YOUR ABSTRACT, DEED, CONTRACTS AND ZONING ORDINANCES.

REVISIONS

No.	DATE	DESCRIPTION	BY
1	12/2/08	ADDED NEW ASBUILT INFORMATION	MJ

RT&A
Ruettiger, Tonelli & Associates, Inc.
Surveyors • Engineers • Planners • Landscape Architects • G.I.S. Consultants
2174 ONEIDA STREET, JOLIET, ILLINOIS 60435, PH. (815) 744-6600 FAX (815) 744-0101
2603 S. WASHINGTON STREET - SUITE 170, NAPERVILLE, ILLINOIS 60565, PH. (630) 420-7740 FAX (630) 420-7741

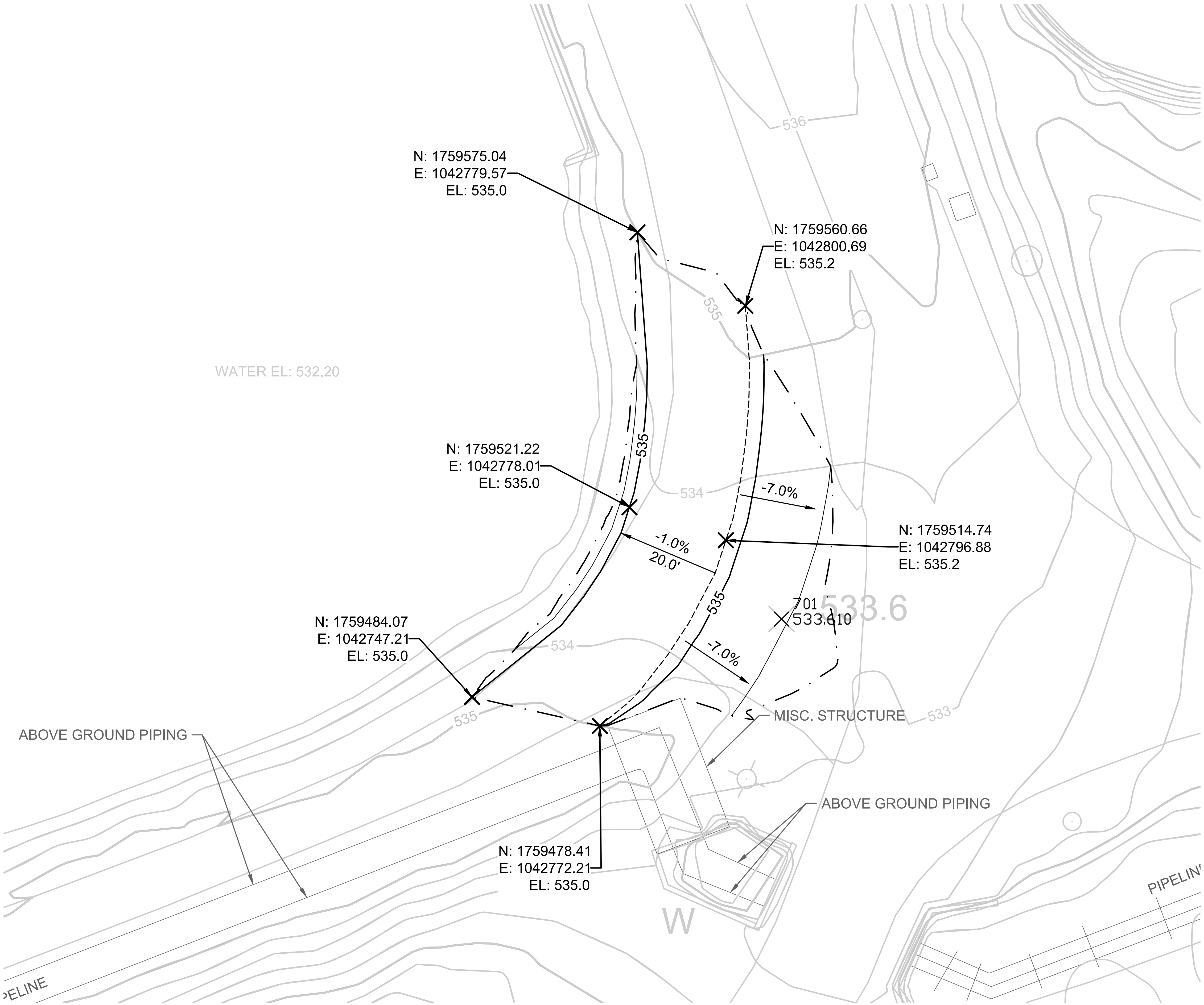
DATE: 6/9/08	SCALE: 1" = 40'	DRAWN BY: MJ	CHECKED BY: EC

PREPARED FOR: BREISER CONSTRUCTION COMPANY
24101 S. MUNICIPAL DRIVE
CHANNAHON, IL

FIELD BOOK: MIDWEST GEN.
PAGE: 11-13

DRAWING No.: 308-0363 ASBUILT WEST-ASH IMP.

DRAWING TITLE: ASBUILT



LEGEND

- 535 — EXISTING GROUND MAJOR CONTOUR (5')
- EXISTING GROUND MINOR CONTOUR (1')
- 535 — PROPOSED GRADING MAJOR CONTOUR (5')
- PROPOSED GRADING MINOR CONTOUR (1')
- PROPOSED LIMIT OF GRADING
- GRADE BREAK

NOTES:

1. SOURCE AERIAL TOPOGRAPHY: AERO-METRIC, INC. DATE OF PHOTOGRAPHY: 6/17/2008.
2. EARTHWORK VOLUME = 100 CY
3. FILL (CA-6 AGGREGATE) SHALL BE PLACED WITH A MAXIMUM LOOSE LIFT THICKNESS OF 10 INCHES WITH A MAXIMUM COMPACTED LIFT THICKNESS OF 6 INCHES. FILL SHALL BE COMPACTED BY A MINIMUM OF 3 PASSES WITH A CAT 34B OR EQUIVALENT SMOOTH DRUM ROLLER (MINIMUM OPERATING WEIGHT OF 8,000 lbs. AND MINIMUM CENTRIFUGAL FORCE PER DRUM OF 5,000 lbs.) AND SHALL BE FIRM AND UNYIELDING.

N

0 20' 40'

SCALE IN FEET

PROPOSED BERM GRADING
JOLIET 29 STATION
JOLIET, ILLINOIS

Geosyntec consultants

FIGURE 1

PROJECT NO: SW0251-05 | AUGUST 2016

Z:\CADD\FIGURES\JOLIET\SW0251-05 BERM GRADING

Attachment 1-2 – HDPE Liner Replacement Specifications

SECTION 02600
HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

PART 1 - GENERAL

1.01 WORK INCLUDES

A. Furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for installation of 60-mil High Density Polyethylene (HDPE) geomembrane, as specified herein, and as shown on Contract Drawings.

1.02 REFERENCE STANDARDS

A. ASTM D1004 – Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

B. ASTM D1238 – Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

C. ASTM D1505 – Test Method for Density of Plastics by the Density-Gradient Technique.

D. ASTM D1603 – Test Method for Carbon Black in Olefin Plastics.

E. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

F. ASTM D5199 – Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

G. ASTM D5397 – Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.

H. ASTM D5596 – Test Method for Microscopic Evaluation of Dispersion of Carbon Black in Polyolefin Geosynthetics.

I. ASTM D5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes.

J. ASTM D6392 –Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

K. ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

L. GRI Test Method, GM 13 - Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes

M. GRI Test Method, GM 14 – Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes.

N. GRI Test Method, GM 19 – Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes.

1.03 DEFINITIONS

A. Geomembrane Installer: hired by Contractor or Owner responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.

B. Geomembrane Manufacturer: hired by Geomembrane Installer to provide HDPE geomembrane.

C. Geosynthetic Quality Assurance Consultant: Consultant, independent from the Owner, Manufacturer, and Installer, responsible for field oversight of geosynthetics installation, and related testing, usually under the direction of the Owner.

D. Geosynthetic Quality Assurance Laboratory (Testing Laboratory): Party, independent from the Owner, Manufacturer and Installer, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the Owner.

D. Lot: A quantity of resin (usually the capacity of one rail car) used in the manufacture of geomembranes. Finished roll will be identified by a roll number traceable to the resin lot used.

E. Resin Supplier: selected by Geomembrane Manufacturer to provide resin used in manufacturing geomembrane.

F. Panel: Unit area of a geomembrane that will be seamed in the field that is larger than $100ft^2$.

G. Patch: Unit area of a geomembrane that will be seamed in the field that is less than $100ft^2$.

H. Subgrade Surface (Bedding Layer): Soil Layer surface which immediately underlies the geosynthetic material(s).

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Geomembrane Installer:

a. 5 years of continuous experience in installation of HDPE geomembrane.

b. Experience totaling a minimum of 5,000,000 square feet of installed HDPE geomembrane on some combination of at least 10 completed facilities.

c. Personnel performing seaming operations qualified by experience or by successfully passing seaming tests. Master seamer shall have experience seaming a minimum of 3,000,000 square feet of geomembrane using same type of seaming apparatus to be used on this project.

B. Quality Assurance Program:

1. Geomembrane Manufacturer/Installer shall conform with requirements of these Technical Specifications.

2. The Engineer will document geomembrane installation including panel placement, seaming, pre-qualification seam testing, non-destructive seam and repair testing, repair size and locations, weather conditions.

3. The Owner will engage and pay for the services of a Geosynthetic Quality Assurance Consultant and Laboratory to monitor geomembrane installation.

1.05 SUBMITTALS

A. Prior to project start, submit the following to Geosynthetic Quality Assurance Consultant in accordance with Section 01300, Submittals:

1. Raw Materials:

a. Name of Resin Supplier, location of supplier’s production plant(s), resin brand name and product number.

b. Source and nature of plasticizers, fillers, carbon black and any other additives along with their percent addition to geomembrane material.

c. Test results documenting conformance with the “index properties” of GRI Test Method, GM 13.

2. Geomembrane Manufacturer’s Certification:

a. Written certification that Geomembrane Manufacturer’s Quality Control Plan was fully implemented during production of geomembrane material supplied for this project. (Submittal shall be made within 5 working days of delivery to site).

3. Geomembrane Installer’s Seaming Personnel

a. Corporate background information indicating compliance with qualification requirements.

b. Training completed by personnel.

c. Seaming experience for each personnel.

4. Geomembrane Manufacturer Production Information:

a. Corporate background information indicating compliance with qualification requirements.

b. Quality control plan for manufacturing.

c. Copy of quality control certificates demonstrating compliance with the quality control plan for manufacturing and the test property requirements of GRI Test method, GM 13 (i.e. mill certificates).

5. Geomembrane Installer’s Information:

a. Corporate background information indicating compliance with qualification requirements.

b. List of completed facilities, totaling 5,000,000 square feet minimum for which Geomembrane Installer has completed installation of a HDPE geomembrane. Include name and purpose of facility, location, date of installation, and quantity installed.

c. Resumes of personnel performing field seaming operation, along with pertinent experience information. Include documentation regarding which seamers are qualified to use thermal fusion welding apparatus.

d. Installation quality control plan.

6. Installation panel layout diagram identifying placement of geomembrane panels, seams, and any variance or additional details which deviate from Contract Drawings or Technical Specifications. Layout shall be drawn to scale and shall be adequate for use as a construction plan. Layout shall include dimensions and pertinent seam and anchorage details.

7. Installation Sequence and Schedule shall be included as part of Construction Progress Schedule.

8. Description of seaming apparatus to be used indicating compliance with specified requirements.

B. During installation, submit the following to the Geosynthetic Quality Assurance Consultant:

1. Daily records/logs prepared by Geomembrane Installer documenting work performed, personnel involved, general working conditions, and any problems encountered or anticipated on project. Submit on a weekly basis.

2. Copy of subgrade acceptance signed by Geomembrane Installer for areas to be covered with geomembrane each day.

C. Within 10 days of geomembrane installation completion, submit the following to Geosynthetic Quality Assurance Consultant:

1. Geomembrane installation certification that Work was performed under Geomembrane Installer's approved quality control plan and in substantial compliance with Technical Specifications and Contract Drawings.

2. As-built panel diagram identifying placement of geomembrane panels, seams, repairs, and destructive seam sample locations.

3. Copy of warranty for material (including factory seams) and installation covering both for a period of 2 years from the date of substantial completion.

D. The Geosynthetic Quality Assurance Consultant will review and inspect HDPE geomembrane installation upon completion of all Work specified in this Section. Deficiencies noted shall be corrected at no additional cost to the Owner.

E. The Geosynthetic Quality Assurance Consultant will provide written final acceptance of the geomembrane installation after completion of material placement above geomembrane. Written conditional geomembrane installation acceptance can be provided to the Contractor prior to completion of material placement above geomembrane when the following conditions are satisfied, if necessary, and requested by the Contractor:

1. The entire geomembrane installation is completed or any pre-determined subsection if the project is phased.

2. All installation quality assurance/control documentation has been completed and submitted to the Geosynthetic Quality Assurance Consultant or Owner.

3. Verification of the adequacy of all field seams, repairs and associated testing is complete.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transportation:

1. Geomembrane rolls shall be transported, unloaded and handled at the job site in accordance with manufacturer recommendations. Damaged material may be rejected by the Geosynthetic Quality Assurance Consultant. Manufacturer packaging shall be labeled in accordance with Section 02700, 2.02G.

B. On-site Storage:

1. Geomembrane rolls which have been delivered to job site shall be unloaded and stored in original, unopened packaging in a secure location, determined by Owner and/or Geosynthetic Quality Assurance Consultant.

2. Store geomembrane rolls to ensure adequate protection against exposure to the following:

a. Equipment;

b. Strong oxidizing chemicals, acids, or bases;

c. Flames, including welding sparks;

d. Temperatures in excess of 160 deg. F;

e. Dust;

f. Ultraviolet radiation (i.e. sunlight); and

g. Inclement weather.

3. Whenever possible, provide a 6-inch minimum air space between rolls.

4. Containers/rolls shall not be stacked.

C. On-Site Handling:

1. Handle rolls per Geomembrane Manufacturer’s recommendations and as necessary to prevent damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. High Density Polyethylene (HDPE) White Textured Geomembrane.

1. HDPE geomembrane shall be white, textured, 60-mil product approved by the Engineer and/or Geosynthetic Quality Assurance Consultant.

2. The Contractor shall submit, with the bid, written certification from the proposed Geomembrane Manufacturer that geomembrane products proposed in the bid satisfy the following requirements:

a. The proposed Geomembrane Manufacturer shall have a minimum of 5 years of continuous experience manufacturing HDPE geomembrane totaling 1,000,000 square feet.

b. The proposed HDPE compound shall be comprised entirely of virgin materials. Compliance with this specification shall be documented in accordance with Geomembrane Manufacturer's quality control program and submitted to the Geosynthetic Quality Assurance Consultant with the written conformance certification.

c. The proposed Geomembrane Manufacturer shall certify that any plasticizers, fillers and additives incorporated into the manufacturing process for the proposed HDPE geomembrane have demonstrated acceptable performance on past projects.

d. The proposed geomembrane shall meet the requirements of Geosynthetic Research Institute’s test method GM 13.

e. The nominal thickness of proposed geomembrane shall be 60 mil., or as approved by the Engineer and/or Geosynthetic Quality Assurance Consultant.

3. Geomembrane sheets shall be visually consistent in appearance and shall contain no holes, blisters, undisbursed raw materials or other signs of contamination by foreign material. Geomembrane must have no striations, roughness or bubbles on the surface.

B. Seaming Apparatus

1. Thermal fusion welding machines used for joining geomembrane surfaces may be either extrusion or hot wedge. These machines shall include sufficient temperature and rate-of-travel monitoring devices to allow continuous monitoring of operating conditions.

2. One spare, operable thermal fusion seaming device shall be maintained on site at all times.

C. Field Test Equipment

1. Field Tensiometer: the field tensiometer shall be calibrated within three months prior to project start date over the range of field test values.

2. Air Channel Test Equipment: air channel test equipment shall consist of hoses, fittings, valves and pressure gauge(s) needed to deliver and monitor the pressure of compressed air through an approved pressure feed device.

3. Air Compressor: the air compressor utilized for field testing shall be capable of producing and maintaining an operating pressure of at least 50 psi.

4. Vacuum Box: the vacuum box shall consist of a vacuum gage, valve, and a gasket around the edge of the open bottom needed to apply vacuum to a surface.

2.02. CONFORMANCE TESTING REQUIREMENTS

A. Geomembrane shipped to site shall undergo conformance testing. Manufacturer's roll certificates may be used for conformance evaluation at the option of the Geosynthetic Assurance Consultant. Nonconforming material shall either be retested at the direction of the Geosynthetic Quality Assurance Consultant or removed from site and replaced at Contractor's expense.

B. Conformance Test Methods

1. Samples will be located and collected by the Geosynthetic Quality Assurance Consultant at a rate of one sample per 100,000 square feet of geomembrane delivered to site.

2. One sample will be obtained from each geomembrane production batch delivered to the site.

3 Samples shall be cut by Geomembrane Installer and be at least 45 square feet in size.

4. Samples shall be tested in accordance with Table 1 (Smooth) or Table 2 (Textured) specified in GRI Test Method GM13.

5. Geomembrane thickness shall be measured a minimum of three times per panel during deployment to verify conformance with GRI Test Method GM13.

C. Role of Testing Laboratories

1. The Geosynthetic Quality Assurance Consultant will be responsible for acquiring samples of the geomembrane for conformance testing. The Owner or Geosynthetic Quality Assurance Consultant will retain an independent, third party laboratory to perform conformance testing on samples of geomembrane.

2. Retesting of geomembrane panels by the Geomembrane Installer because of failure to meet any of the conformance specifications can only be authorized by the Geosynthetic Quality Assurance Consultant. Non-conforming panels may be retested in accordance with Subsection 2.03(B) and 2.03(D) under authorization of the Geosynthetic Quality Assurance Consultant only.

3. The Geomembrane Manufacturer and/or Geomembrane Installer may perform independent tests in accordance with methods and procedures specified in Subsection 2.03(B). Results shall not be substituted for quality assurance testing described herein.

D. Procedures for Determining Conformance Test Failures

1. If conformance test results fail to meet specifications, the roll and/or batch may be retested using specimens from either the original roll sample or from another sample collected by the Geosynthetic Quality Assurance Consultant. Two additional tests (retests) shall be performed for each failed test procedure. Each retest shall consist of multiple specimen tests if multiple specimens are specified in the test procedure. If the results of both retests meet specifications, the roll and batch will be considered to have passed conformance testing.

2. Failure of any retest shall be cause for rejection of the entire roll or batch depending on the type of failing test. The Geosynthetic Quality Assurance Consultant reserves the right to collect samples from other roll of a particular batch for further conformance testing. The Geosynthetic Quality Assurance Consultant may choose to accept only a portion of the batch on the basis of the results of conformance testing of samples collected from other rolls.

3. If retesting does not result in conformance with the specifications as defined in preceding paragraph, or if there are any other nonconformities with the material

specifications, the Contractor shall remove the rolls from use in project. The Contractor shall also be responsible for removal of rejected geomembrane from the site and replacement with acceptable geomembrane at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION MEETING

A. A Pre-Construction Meeting shall be held at the site in accordance with Section 01040, Project Administration, to discuss and plan the details of geomembrane installation. This meeting shall be attended by the Geomembrane Installer, Owner, Geosynthetic Quality Assurance Consultant and the General Contractor.

B. The following topics relating to geomembrane installation shall be addressed:

1. Responsibilities of each party.
2. Lines of authority and communication.
3. Methods for documenting, reporting and distributing documents and reports.
4. Procedures for packaging and storing archive samples.
5. Review of the schedule for all installation and quality assurance testing, including third-party testing turnaround times.
6. Review of panel layout, access and numbering systems for panels and seams including details for marking on the HDPE geomembrane.
7. Procedures and responsibilities for preparation and submittal of as-built drawings.
8. Temperature and weather limitations, installation procedures for adverse weather conditions and defining acceptable subgrade or ambient moisture and temperature conditions for working during liner installation.
9. Subgrade conditions, dewatering responsibilities and subgrade maintenance plan.
10. Deployment techniques including allowable subgrade for geomembrane.
11. Procedures for covering of the geomembrane to prevent damage.
12. Plan for minimizing wrinkles in the geomembrane.
13. Measurement and payment schedules.
14. Site health and safety procedures/protocols.

3.02 SUBGRADE PREPARATION

A. Contractor shall prepare a subgrade surface in accordance with Section 02243, Subgrade Layer Preparation, and excavate and backfill in accordance with Section 02222, Anchor Trenching, Backfilling and Compaction.

B. The Contractor shall not excavate more than the amount of anchor trench required for one day of geosynthetics deployment, unless otherwise specified by the Geosynthetic Quality Assurance Consultant. Rounded corners shall be provided in the trenches where the geosynthetics enter the trench to allow them to be uniformly supported by the subgrade and to avoid sharp bends. The geosynthetics shall not be supported by loose soils in anchor trenches.

C. The Geomembrane Installer shall visually inspect the subgrade immediately prior to geomembrane deployment. Inspection shall verify that there are no potentially harmful foreign objects present, such as sharp rocks and other deleterious debris. Any foreign objects encountered shall be removed by Geomembrane Installer or Contractor. All subgrade damaged by construction equipment and deemed unsuitable for geomembrane deployment shall be repaired prior to geomembrane deployment. All repairs shall be approved by the Geosynthetic Quality Assurance Consultant and Geomembrane Installer. The responsibility for preparation, repairs, and maintenance of the subgrade shall be defined in the preconstruction meeting. The Geomembrane Installer shall provide the Geosynthetic Quality Assurance Consultant with written acceptance of subgrade surface over which geomembrane is deployed (Part 1 .05B*)* for each day of deployment.

3.03 GEOMEMBRANE DEPLOYMENT

A. Geomembrane shall not be deployed until all applicable certifications/quality control certificates listed in subsection 1.05 of this section and conformance testing listed in subsection 2.03 of this section are submitted and approved by the Geosynthetic Quality Assurance Consultant. Any geomembrane deployed prior to approval by the Geosynthetic Quality Assurance Consultant shall be at the sole risk of the Geomembrane Installer and/or Contractor. If material installed prior to approval by the Geosynthetic Quality Assurance Consultant does not meet the requirements of this specification, it shall be removed from the site at no additional cost to the Owner.

B. Geomembrane will be deployed according to submitted panel layout drawing as approved by the Geosynthetic Quality Assurance Consultant. The Geosynthetic Quality Assurance Consultant is to be notified of and approve any revisions or modifications to the approved panel layout drawing prior to deploying geomembrane in the area of review.

C. Adequate temporary anchoring (sand bags, tires, etc.) that will not damage the geomembrane shall be placed on a deployed panel to prevent uplift by wind.

D. Geomembrane shall not be deployed if:

1. Ambient temperatures are below 41 degrees F (5 degrees C) or above 104 degrees F (40 degrees C) measured six inches above geomembrane surface unless approved by the Geosynthetic Quality Assurance Consultant.

2. Precipitation is expected or in the presence of excessive moisture or ponded water on the subgrade surface.

3. Winds are excessive as determined by Geomembrane Installer in agreement with the Geosynthetic Quality Assurance Consultant.

4. The Geosynthetic Quality Assurance Consultant will have the authority to suspend work during such conditions.

E. The Geomembrane Installer shall be responsible for conformance with the following requirements:

1. Equipment utilized for installation/quality assurance testing does not damage geomembrane. Such equipment shall have rubber tires and a ground pressure not exceeding 5 psi or total weight exceeding 750 lbs. Only equipment necessary for installation and quality assurance testing is allowed on the deployed geomembrane.

2. Personnel working on geomembrane do not damage geomembrane (activities such as smoking or wearing damaging clothing shall not be allowed).

3. Method of deployment does not damage geomembrane.

4. Method of deployment minimizes wrinkles.

5. Temporary loading or anchoring does not damage geomembrane.

6. Direct contact with geomembrane is minimized.

F. No vehicles shall be allowed on deployed geomembrane under any circumstances.

3.04 FIELD SEAMS

A. Seam Layout

1. In general, seams shall be oriented parallel to the line of the maximum slope. In corners and at other odd-shaped geometric intersections, number of seams should be minimized. If at all possible, seams shall not be located at low points in the subgrade unless geometry requires seaming to be done at these locations.

2. A seam numbering system compatible with the panel numbering system shall be agreed upon at the Pre-Construction Meeting.

B. Seaming Processes/Equipment

1. Approved processes for field seaming (panel to panel) are extrusion or hot wedge fusion-type seam methods. No other processes can be used without prior written authorization from the Geosynthetic Quality Assurance Consultant. Only equipment which has been specifically approved by make and model shall be used, if applicable.

2. The Geomembrane Installer will meet following requirements regarding use, availability, and cleaning of welding equipment at job site:

a. Intersecting hot wedge seams shall be patched using extrusion welding process.

b. Electric generator for equipment shall be placed on a smooth base such that no damage occurs to geomembrane. A smooth insulating plate or fabric shall be placed beneath hot equipment after usage.

3. The Geomembrane Installer shall keep records for performance and testing of all seams.

C. Seaming Requirements/Procedures

1. Weather Conditions - Range of weather conditions under which geomembrane seaming can be performed are as follows:

a. Unless otherwise authorized in writing by Geosynthetic Quality Assurance Consultant, no seaming shall be attempted or performed at an ambient temperature below 41 degrees F (5 degrees C) or above 104 degrees F (40 degrees C).

b. Between ambient temperatures of 32 degrees F (0 degrees C) and 41 degrees F (5 degrees C), seaming shall be performed only if geomembrane is preheated by either sun or a hot air device, provided there is no excessive ambient cooling resulting from high winds. Pre-qualification seams shall be produced under identical conditions.

c. Above 41 degrees F (5 degrees C), no preheating of geomembrane will be required.

d. Geomembrane shall be dry and protected from wind.

e. Seaming shall not be performed during any precipitation event.

f. Seaming shall not be performed in areas where ponded water has collected below surface of geomembrane.

2. If the Geomembrane Installer chooses to use methods which may allow seaming at ambient temperatures below 41 degrees F or above 104 degrees F, the Geomembrane Installer shall demonstrate and submit certification to Geosynthetic Quality Assurance Consultant that methods and techniques used to perform seaming produce seams that are equivalent to seams produced at temperatures above 41 degrees F and below 104 degrees F. The Geosynthetic Quality Assurance Consultant may deny approval for use of the proposed technique regardless of demonstration results.

3. Overlapping - Geomembrane panels shall have finished overlap as follows:

a. Minimum of 6 inches for thermal fusion welding.

b. Insufficient overlap will be considered a failed seam.

4. Pre-qualification tests for geomembrane fusion welding shall be conducted by a minimum of 2 pre-qualification seams conducted per day per welding machine by each seaming technician performing welding with that machine. At least one test shall be performed at the start of each work day, with tests at intervals of no greater than 5 hours and additional pre-qualification tests following work interruptions, weather changes, changes to machine settings, or as directed by the Geosynthetic Quality Assurance Consultant. Pre-qualification seams shall be made under the same conditions as the actual seams.

   a. Pre-qualification seam samples shall be 5 feet long by 1-foot wide (minimum) after seaming, with seam centered along its length. Each pre-qualification seam shall be labeled with the date, geomembrane temperature, seaming unit identifier, seam number or test location, technician performing the test seam and description of testing results.

   b. Seam overlap shall be in accordance with subsection 3.04(C)(3).

   c. Pre-qualification seams shall be inspected for proper squeeze-out, footprint pressure, and general appearance.

   d. Four specimens, each 1-inch in length, shall be cut from opposite ends of the pre-qualification seam sample by the Geomembrane Installer. The remainder of pre-qualification seam shall be retained by the Geosynthetic Quality Assurance Consultant and may be submitted for laboratory testing.

   e. The Geomembrane Installer shall complete two shear tests and two peel tests.

   f. Pre-qualification seams failed by inspection or testing may be retested at request of the Geomembrane Installer. If the second pre-qualification seam fails, then the seaming apparatus or seaming technique shall be disqualified from use until two consecutive, satisfactory pre-qualification seams are obtained.

5. Seam Preparation

   a. Prior to seaming, seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material.

   b. Seams shall be aligned so as to minimize number of wrinkles and fishmouths.

6. General Seaming Procedures

   a. Fishmouths or wrinkles at seam overlaps shall be cut along ridge of the wrinkle to achieve a flat overlap. Cut fishmouths or wrinkles shall be repaired, and/or patched in accordance with Part 3.07.

   b. Seaming shall extend to the outside edge of geomembrane panels including material placed in anchor trenches.

c. For cross seams, the intersecting thermal fusion seams shall be patched using the extrusion welding process.

3.05 NON-DESTRUCTIVE TESTING

A. Each field seam shall be non-destructively tested over its entire length by the Installer. Testing shall be conducted as field seaming progresses, not at completion of all seams, unless specifically agreed to by the Geosynthetic Quality Assurance Consultant in writing.

B. Vacuum Testing – shall be performed in accordance with ASTM D5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.

C. Air Pressure Testing – shall be performed in accordance with ASTM D5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes, and GRI GM 6, Pressurized Air Channel Test for Dual Seamed Geomembranes.

D. Each seam tested non-destructively shall be marked with the date of the test, name of the testing technician, length of the seam, test method and results. The same shall also be recorded by the Geosynthetic Quality Assurance Consultant on the appropriate CQA documentation.

E. Non-Destructive Seam Test Failures

1. Seams failing non-destructive testing shall be repaired by the Geomembrane Installer according to Part 3.07. Seams shall be non-destructively retested. If the seam defect cannot be located, the entire section of seams affected shall be repaired and retested.

3.06 DESTRUCTIVE TESTING

A. The Owner shall have the option to conduct destructive testing of geomembrane panel seams completed in the field. Destructive seam sampling and testing shall be performed by the Geomembrane Installer under the observation of the Geosynthetic Quality Assurance Consultant.

B. Sampling Procedure

1. For each sample location, the Geosynthetic Quality Assurance Consultant will:

a. Assign a sample number and mark the sample accordingly.

b. Record the sample location on the as-built layout drawing.

c. By sample number, record reason for collecting sample (e.g., as part of statistical testing program, suspicious seam, retest, etc.).

d. Record pertinent information, including date, time, seam number, number of seaming unit, and name of seamer, on both the seam sample and CQA documentation.

2. Each destructive sample shall be at least 12 inches wide (at least 6 inches on each side of seam) by 54 inches long. Samples will be cut by the Geomembrane Installer into three parts and distributed as follows:

   a. A 12-inch by 12-inch portion shall be cut and tested in accordance with subsection 3.06(C) by the Geomembrane Installer.

   b. A 12-inch by 12-inch portion shall be cut and retained by the Geomembrane Installer. The Geomembrane Installer may elect to omit this requirement.

   c. A 12-inch by 12-inch portion shall be cut and retained by the Geosynthetic Quality Assurance Consultant as an archive sample.

   d. A 12-inch by 18-inch portion shall be submitted by the Geosynthetic Quality Assurance Consultant for laboratory testing as described in Part 3.06(D).

3. Ten specimens, each 1 inch wide by 12 inches long with seam centered perpendicular to width, shall be collected and field tested by the Geomembrane Installer prior to shipping the sample to the laboratory. If all samples pass field tensiometer test described in Part 3.06(C), then the laboratory sample shall be collected according to procedure described in Part 3.06(B)(2)(d).

4. Holes cut into geomembrane resulting from destructive seam sampling shall be immediately repaired by Geomembrane Installer in accordance with repair procedures described in Part 3.07.

C. Field Test Methods

1. Ten 1-inch-wide samples described above under Part 3.06(B)(3) shall be field tested for peel (5 samples) and shear (5 samples).

2. One end of seam sample shall be field tested for peel and shear at end of each continuous field seam 100 feet long or greater.

3. Testing shall be performed in accordance to with ASTM D6392 using a field tensiometer or equivalent device to qualitatively and quantitatively determine mode of failure.

4. Seam shall be considered passing if failure in both peel and shear meet criteria listed in GRI GM 19, Table 2.

5. The procedures specified in Subsection 3.06(D) shall be implemented when sample passes field tensiometer test.

D. Laboratory Test Methods

1. Laboratory testing of seam samples shall be conducted by the Geosynthetic Quality Asssurance Laboratory under contract with the Geosynthetic Quality Assurance Consultant or Owner. Five specimens shall be tested in shear and five in peel.

2. Laboratory testing shall be conducted in accordance with ASTM D6392.

3. For both seam shear and peel tension tests, an indication will be given for each specimen tested which defines locus of failure.

4. For shear tests, the following values, along with the mean and standard deviation where appropriate, will be reported for each specimen tested:

   a. Maximum tension in pounds per square inch.

   b. Elongation at break (up to a tested maximum of 100 percent).

   c. Locus of failure using ASTM designations.

5. For peel tests, the following values, along with the mean and standard deviation where appropriate, will be reported for each specimen tested:

   a. Maximum tension in pounds per square inch.

   b. Seam separation (expressed as percent of original seam area).

   c. Locus of failure.

4. Retesting of seams due to nonconformance with specifications may be performed at the discretion of the Geosynthetic Quality Assurance Consultant.

E. Destructive Seam Test Failure

1. Shear and peel test results derived from testing described in Parts 3.06(C) and 3.06(D) shall comply with GRI GM 19, Table 2 for seam to be considered acceptable.

2. The Geomembrane Installer has two options in determining the repair boundary whenever a seam has failed destructive testing:

a. The seam can be reconstructed between the two previously tested and passed destructive sample locations; or,

b. The Geomembrane Installer can trace the welding path to an intermediate location at least ten feet from point of failed test in each direction and obtain destructive test samples collected from these locations. If destructive tests on these samples are acceptable, then the seam shall be reconstructed between the intermediate locations. If either sample fails, the process may be repeated until an acceptable seam test has been performed on both sides of the original failed sample. If a passing sample is not realized on one (or both) side of the original failed sample, then seam repair must extend to the end(s) of the seam. Retesting of seams according to this procedure shall utilize the sampling methodology described in Part 3.06(B). The Owner reserves the right to terminate this process, at the discretion of the Geosynthetic Quality Assurance Consultant, after the second retesting. An additional sample taken from the reconstructed zone must pass destructive seam testing, if destructive sample failure(s) causes reconstruction.

3. The Geosynthetic Quality Assurance Consultant shall be responsible for documenting all actions taken in repairing seams. The Geomembrane Installer will be responsible for keeping the Geosynthetic Quality Assurance Consultant informed of seaming progress.

3. Additional fees for destructive seam test failures shall be assessed to the Contractor and deducted from payment. This fee shall be assessed only if the failing sample is a laboratory sample.

3.07 DEFECTS AND REPAIRS

A. The geomembrane shall be examined by the Geomembrane Installer and the Engineer for defects, holes, blisters, undispersed raw materials, and any signs of contamination by foreign matter. The geomembrane surface shall be swept and/or washed by the Geomembrane Installer if the amount of dust or mud inhibits examination. The Contractor shall provide a water truck, an operator, clean water and hoses as reasonably necessary to assist the Geomembrane Installer in this activity.

B. Portions of geomembrane exhibiting flaws, or failing a non-destructive or destructive (if conducted) test, shall be repaired or replaced by the Geomembrane Installer. Repair procedures available include:

1. Patching - used to repair large holes, tears, undispersed raw materials, contamination by foreign matter, holes resulting from destructive sampling (if conducted), and locations where seam overlap is insufficient;

2. Capping - used to repair large lengths of failed seams; and

3. Additional Procedures - used upon recommendation of the Geomembrane Installer if agreed to by the Engineer.

C. Patches or caps.

1. Extend patch or cap 6 inches (minimum) beyond the edge of the defect.

2. Round corners of patch and/or cap (suggest 3-inch radius).

3. Repair procedures, equipment, materials, and techniques will be approved by the Geosynthetic Quality Assurance Consultant prior to repair.

4. Geomembrane below large caps shall be appropriately cut to avoid water or gas collection between two sheets.

D. The Geomembrane Installer shall mark on the geomembrane (using a non-puncturing writing utensil), repair date, time, and personnel involved.

E. Each repair shall be non-destructively tested in accordance with Part 3.05. Large caps may require destructive test sampling at the discretion of the Geosynthetic Quality Assurance Consultant (in accordance with Part 3.06).

F. Repairs which fail testing shall be redone and retested until a passing result is obtained. The Geomembrane Installer will perform non-destructive testing or repairs and will document retesting of repairs.

G. The Geosynthetic Quality Assurance Consultant will document repairs, repair testing, and retesting results.

H. The Geomembrane Installer shall cut and seam wrinkles which may adversely affect long-term integrity of the geomembrane, hinder subsequent construction of overlying layers, or impede drainage off of the geomembrane after it is covered by soil. Seaming shall be done in accordance with procedures described in Parts 3.04(B) and 3.04(C), and it shall be subject to test provisions of Parts 3.05 (non-destructive testing) and 3.06 (destructive testing – if conducted).

3.08 PROTRUSIONS AND CONNECTIONS TO GEOMEMBRANE

A. If required, the Geomembrane Installer shall install geomembrane around utility poles, guy wires, and other structures according to the Contract Drawings and the following requirements:

1. Use minimum 1-ft long membrane pipe boots and steel straps to seal the geomembrane around pole or structure.

2. Use standard welding procedures to seam the membrane boot to the geomembrane.

3. Seaming performed on and around penetrations, and other appurtenances shall be non-destructively tested using the vacuum testing method.

3.09 SURVEY DOCUMENTATION

A. The Geomembrane Installer shall survey the completed geomembrane prior to covering and provide the Geosynthetic Quality Assurance Consultant with 24-hour notification of survey. The Contractor shall document the location of all seams (panel corners acceptable), destructive test samples (if conducted) and repairs. The Contractor shall provide survey data to the Geosynthetic Quality Assurance Consultant within one working day of survey completion and in accordance with Section 01050.

3.10 DAILY FIELD INSTALLATION REPORTS

A. At the beginning of each day, the Geomembrane Installer shall provide the Geosynthetic Quality Assurance Consultant with a report for all work completed the previous day.

B. The Daily Field Installation Report shall include the following:

1. The total amount and location of geomembrane placed.

2. The total length and location of seams completed, technician name and welding unit numbers.

3. A drawing or sketch depicting the geomembrane installed the previous day including the panel number, seam number and locations of non-destructive and destructive testing (if conducted).

4. Results of pre-qualification test seams, if available.

5. Results of non-destructive testing.

C. Destructive test results (if conducted) shall be reported within 48 hours or prior to covering the geomembrane, whichever is practical.

3.10 MATERIAL ABOVE GEOMEMBRANE

A. The Geosynthetic Quality Assurance Consultant and Geomembrane Installer shall verify the area of geomembrane completion prior to placement of material over the geomembrane.

B. Soils - Requirements for placement of general fill are described in Sections 02221 and 02222. Apply following general criteria for covering of the geomembrane:

1. Do not place soils on the geomembrane at an ambient temperature below 32 degrees F, (0 degrees C) nor above 104 degrees F (40 degrees C), unless otherwise specified.

2. Do not drive equipment used for placing soil directly on the geomembrane.

3. A minimum thickness of 1 foot of soil is specified between a low ground pressure dozer (maximum contact pressure of 5 lb/sq. inch) and the geomembrane.

4. A minimum thickness of 2 feet of soil is required between rubber-tired vehicles and the geomembrane.

5. Do not compact soils placed directly on geomembrane.

6. Damage to the geomembrane resulting from placement of cover soils shall be repaired in accordance with Part 3.07 by the Geomembrane Installer at the Contractor's expense.

7. Do not push soil downslope. Soil shall be placed over the geomembrane starting from base of the slope, up to top of the slope.

END OF SECTION

f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test

6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:
   a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.
   b. The testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed. Allow two (2) minutes for the injected air to come to equilibrium in the channel, and sustain pressure for five (5) minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.
   c. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.
   d. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

B. Spark testing should be done in areas where both air pressure testing and vacuum testing are not possible.

   1. Equipment for spark testing shall be comprised of but not limited to a hand held holiday spark tester and conductive wand that generates a high voltage.

   2. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non-welded segment shall be subject to a calibration test to ensure that such a defect (nonwelded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.

   3. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.

   4. Care should be taken if flammable gases are present in the area to be tested.

Attachment 1-3 – Pond 2 Liner Repair Specifications

Final Cleaning of Joliet Pond 2
(CCR Clean Closure of Pond 2)
PHASE 2 Scope-of-Work Performance Testing Requirements
Attachment 1

The performance tests for the repairs of the liner in Pond 2 shall be conducted in accordance with Section 3.05 Field Quality Control located in the Guidelines for Installation of HDPE Geomembrane Installation created by the International Association of Geosynthetic Installers, revised November 1, 2015. The pertinent sections from that document for performance testing are provided below and shall be followed to verify the repair installations.

A. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner's Representative.

2. Testing should be done as the seaming work progresses, not at the completion of all field seaming, unless agreed to in advance by the Owner's Representative. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.

3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.

4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner's Representative all test methods to verify the test procedures are valid.

5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:
   a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.
   b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig). c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 0.3m (12 in) by 1.2m (48 in) (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately five (5) seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after five (5) seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.
   d. All areas where soap bubbles appear shall be marked, repaired and then retested.
   e. At locations where seams cannot be nondestructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in section B below) or equivalent should be substituted.

<u>ATTACHMENT 2</u>
<u>CCR LABORATORY DATA PACKAGE</u>

eurofins | Environment Testing America

ANALYTICAL REPORT

Eurofins TestAmerica, Chicago
2417 Bond Street
University Park, IL 60484
Tel: (708)534-5200

Laboratory Job ID: 500-204544-1
Client Project/Site: Joliet #29 Ash

For:
KPRG and Associates, Inc.
14665 West Lisbon Road,
Suite 1A
Brookfield, Wisconsin 53005

Attn: Richard Gnat

Authorized for release by:
9/15/2021 5:41:59 PM

Diana Mockler, Project Manager I
(219)252-7570
Diana.Mockler@Eurofinset.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

1 2 3 4 5 6 7 8 9 10 11 12

Table of Contents

Case Narrative

Job ID: 500-204544-1

Laboratory: Eurofins TestAmerica, Chicago

Narrative

Job Narrative
500-204544-1

Comments
No additional comments.

Receipt
The sample was received on 8/31/2021 1:00 PM. Unless otherwise noted below, the sample arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was 22.4º C.

Metals
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Method Summary

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-1

Method	Method Description	Protocol	Laboratory
6010B	Metals (ICP)	SW846	TAL CHI
7471A	Mercury (CVAA)	SW846	TAL CHI
9056A	Anions, Ion Chromatography	SW846	TAL CHI
Moisture	Percent Moisture	EPA	TAL CHI
SM 4500 Cl- E	Chloride, Total	SM	TAL CHI
SM 4500 F C	Fluoride	SM	TAL CHI
300_Prep	Anions, Ion Chromatography, 10% Wt/Vol	MCAWW	TAL CHI
3050B	Preparation, Metals	SW846	TAL CHI
7471A	Preparation, Mercury	SW846	TAL CHI

Protocol References:

EPA = US Environmental Protection Agency

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CHI = Eurofins TestAmerica, Chicago, 2417 Bond Street, University Park, IL 60484, TEL (708)534-5200

Sample Summary

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
500-204544-1	Jolet #29 Ash	Solid	08/31/21 10:00	08/31/21 13:00

Client Sample ID: Jolet #29 Ash

Lab Sample ID: 500-204544-1

Date Collected: 08/31/21 10:00

Matrix: Solid

Date Received: 08/31/21 13:00

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<1.8	F1	1.8		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Arsenic	**1.5**	**F1**	0.89		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Barium	**3000**		4.4		mg/Kg		09/10/21 08:41	09/13/21 21:10	5
Beryllium	**1.5**	**F1**	0.35		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Boron	**130**	**F1 V**	4.4		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Cadmium	<0.18		0.18		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Calcium	**100000**		89		mg/Kg		09/10/21 08:41	09/13/21 21:10	5
Chromium	**12**	**F1**	0.89		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Cobalt	**15**		11		mg/Kg		09/10/21 08:41	09/14/21 10:57	25
Lead	**5.6**		0.44		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Lithium	**20**	**V**	0.89		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Molybdenum	**1.1**	**F1**	0.89		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Selenium	<0.89	F1	0.89		mg/Kg		09/10/21 08:41	09/12/21 15:18	1
Thallium	**2.9**		0.89		mg/Kg		09/10/21 08:41	09/12/21 15:18	1

Method: 7471A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.016		0.016		mg/Kg		09/09/21 13:15	09/10/21 09:11	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**560**		19		mg/Kg		09/14/21 11:45	09/14/21 17:58	10
Chloride	<20		20		mg/Kg		09/15/21 09:49	09/15/21 15:04	1
Fluoride	<1.0		1.0		mg/Kg		09/15/21 09:49	09/15/21 12:47	1

1 2 3 4 5 6 7 8 9 10 11 12

Qualifiers

Metals

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.
F1	MS and/or MSD recovery exceeds control limits.
F3	Duplicate RPD exceeds the control limit
F5	Duplicate RPD exceeds limit, and one or both sample results are less than 5 times RL, and the absolute difference between results is < the upper reporting limits for both.
V	Serial Dilution exceeds the control limits

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Metals

Prep Batch: 617888

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	7471A	
MB 500-617888/12-A	Method Blank	Total/NA	Solid	7471A	
LCS 500-617888/13-A	Lab Control Sample	Total/NA	Solid	7471A	

Prep Batch: 618052

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	3050B	
MB 500-618052/1-A	Method Blank	Total/NA	Solid	3050B	
LCS 500-618052/2-A	Lab Control Sample	Total/NA	Solid	3050B	
500-204544-1 MS	Jolet #29 Ash	Total/NA	Solid	3050B	
500-204544-1 MSD	Jolet #29 Ash	Total/NA	Solid	3050B	
500-204544-1 DU	Jolet #29 Ash	Total/NA	Solid	3050B	

Analysis Batch: 618070

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	7471A	617888
MB 500-617888/12-A	Method Blank	Total/NA	Solid	7471A	617888
LCS 500-617888/13-A	Lab Control Sample	Total/NA	Solid	7471A	617888

Analysis Batch: 618247

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	6010B	618052
MB 500-618052/1-A	Method Blank	Total/NA	Solid	6010B	618052
LCS 500-618052/2-A	Lab Control Sample	Total/NA	Solid	6010B	618052
500-204544-1 MS	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 MSD	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 DU	Jolet #29 Ash	Total/NA	Solid	6010B	618052

Analysis Batch: 618479

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 MS	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 MSD	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 DU	Jolet #29 Ash	Total/NA	Solid	6010B	618052

Analysis Batch: 618576

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 MS	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 MSD	Jolet #29 Ash	Total/NA	Solid	6010B	618052
500-204544-1 DU	Jolet #29 Ash	Total/NA	Solid	6010B	618052

General Chemistry

Analysis Batch: 617356

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	Moisture	

Prep Batch: 618524

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	300_Prep	

General Chemistry (Continued)

Prep Batch: 618524 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 500-618524/1-A	Method Blank	Total/NA	Solid	300_Prep	
LCS 500-618524/2-A	Lab Control Sample	Total/NA	Solid	300_Prep	

Analysis Batch: 618534

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	9056A	618524
MB 500-618524/1-A	Method Blank	Total/NA	Solid	9056A	618524
LCS 500-618524/2-A	Lab Control Sample	Total/NA	Solid	9056A	618524

Prep Batch: 618692

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	300_Prep	
MB 500-618692/1-A	Method Blank	Total/NA	Solid	300_Prep	
LCS 500-618692/2-A	Lab Control Sample	Total/NA	Solid	300_Prep	

Analysis Batch: 618739

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	SM 4500 F C	618692
MB 500-618692/1-A	Method Blank	Total/NA	Solid	SM 4500 F C	618692
LCS 500-618692/2-A	Lab Control Sample	Total/NA	Solid	SM 4500 F C	618692

Analysis Batch: 618775

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	SM 4500 Cl- E	618692
MB 500-618692/1-A	Method Blank	Total/NA	Solid	SM 4500 Cl- E	618692
LCS 500-618692/2-A	Lab Control Sample	Total/NA	Solid	SM 4500 Cl- E	618692

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 500-618052/1-A **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618247 **Prep Batch: 618052**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<2.0		2.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Arsenic	<1.0		1.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Barium	<1.0		1.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Beryllium	<0.40		0.40		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Boron	<5.0		5.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Cadmium	<0.20		0.20		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Calcium	<20		20		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Chromium	<1.0		1.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Cobalt	<0.50		0.50		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Lead	<0.50		0.50		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Lithium	<1.0		1.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Molybdenum	<1.0		1.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Selenium	<1.0		1.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1
Thallium	<1.0		1.0		mg/Kg		09/10/21 08:41	09/12/21 15:12	1

Lab Sample ID: LCS 500-618052/2-A **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618247 **Prep Batch: 618052**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	50.0	49.5		mg/Kg		99	80 - 120
Arsenic	10.0	9.09		mg/Kg		91	80 - 120
Barium	200	196		mg/Kg		98	80 - 120
Beryllium	5.00	4.54		mg/Kg		91	80 - 120
Boron	100	83.6		mg/Kg		84	80 - 120
Cadmium	5.00	4.69		mg/Kg		94	80 - 120
Calcium	1000	912		mg/Kg		91	80 - 120
Chromium	20.0	18.3		mg/Kg		91	80 - 120
Cobalt	50.0	46.6		mg/Kg		93	80 - 120
Lead	10.0	9.03		mg/Kg		90	80 - 120
Lithium	50.0	53.2		mg/Kg		106	80 - 120
Molybdenum	100	99.6		mg/Kg		100	80 - 120
Selenium	10.0	8.61		mg/Kg		86	80 - 120
Thallium	10.0	8.77		mg/Kg		88	80 - 120

Lab Sample ID: 500-204544-1 MS **Client Sample ID: Jolet #29 Ash**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618247 **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	<1.8	F1	49.6	6.04	F1	mg/Kg		12	75 - 125
Arsenic	1.5	F1	9.92	9.59		mg/Kg		81	75 - 125
Beryllium	1.5	F1	4.96	5.09	F1	mg/Kg		72	75 - 125
Boron	130	F1 V	99.2	178	F1	mg/Kg		50	75 - 125
Cadmium	<0.18		4.96	3.82		mg/Kg		75	75 - 125
Chromium	12	F1	19.8	24.8	F1	mg/Kg		67	75 - 125
Lead	5.6		9.92	16.2		mg/Kg		107	75 - 125
Lithium	20	V	49.6	62.1		mg/Kg		85	75 - 125
Molybdenum	1.1	F1	99.2	68.4	F1	mg/Kg		68	75 - 125

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: 500-204544-1 MS | **Client Sample ID: Jolet #29 Ash**
Matrix: Solid | **Prep Type: Total/NA**
Analysis Batch: 618247 | **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Selenium	<0.89	F1	9.92	6.39	F1	mg/Kg		64	75 - 125
Thallium	2.9		9.92	10.9		mg/Kg		80	75 - 125

Lab Sample ID: 500-204544-1 MS | **Client Sample ID: Jolet #29 Ash**
Matrix: Solid | **Prep Type: Total/NA**
Analysis Batch: 618479 | **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Barium	3000		198	2980	4	mg/Kg		11	75 - 125
Calcium	100000		992	97600	4	mg/Kg		-533	75 - 125

Lab Sample ID: 500-204544-1 MS | **Client Sample ID: Jolet #29 Ash**
Matrix: Solid | **Prep Type: Total/NA**
Analysis Batch: 618576 | **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Cobalt	15		49.6	67.5		mg/Kg		105	75 - 125

Lab Sample ID: 500-204544-1 MSD | **Client Sample ID: Jolet #29 Ash**
Matrix: Solid | **Prep Type: Total/NA**
Analysis Batch: 618247 | **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	<1.8	F1	45.0	4.97	F1	mg/Kg		11	75 - 125	19	20
Arsenic	1.5	F1	9.01	8.21	F1	mg/Kg		74	75 - 125	16	20
Beryllium	1.5	F1	4.50	4.74	F1	mg/Kg		72	75 - 125	7	20
Boron	130	F1 V	90.1	183	F1	mg/Kg		61	75 - 125	3	20
Cadmium	<0.18		4.50	3.56		mg/Kg		77	75 - 125	7	20
Chromium	12	F1	18.0	23.7	F1	mg/Kg		67	75 - 125	4	20
Lead	5.6		9.01	14.4		mg/Kg		98	75 - 125	12	20
Lithium	20	V	45.0	57.0		mg/Kg		82	75 - 125	9	20
Molybdenum	1.1	F1	90.1	59.6	F1	mg/Kg		65	75 - 125	14	20
Selenium	<0.89	F1	9.01	5.78	F1	mg/Kg		64	75 - 125	10	20
Thallium	2.9		9.01	10.6		mg/Kg		85	75 - 125	3	20

Lab Sample ID: 500-204544-1 MSD | **Client Sample ID: Jolet #29 Ash**
Matrix: Solid | **Prep Type: Total/NA**
Analysis Batch: 618479 | **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Barium	3000		180	3090	4	mg/Kg		74	75 - 125	4	20
Calcium	100000		901	104000	4	mg/Kg		99	75 - 125	6	20

Lab Sample ID: 500-204544-1 MSD | **Client Sample ID: Jolet #29 Ash**
Matrix: Solid | **Prep Type: Total/NA**
Analysis Batch: 618576 | **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Cobalt	15		45.0	58.0		mg/Kg		95	75 - 125	15	20

Method: 6010B - Metals (ICP) (Continued)

Lab Sample ID: 500-204544-1 DU **Client Sample ID: Jolet #29 Ash**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618247 **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Antimony	<1.8	F1	<1.8		mg/Kg		NC	20
Arsenic	1.5	F1	2.20	F5	mg/Kg		36	20
Beryllium	1.5	F1	1.48		mg/Kg		2	20
Boron	130	F1 V	118		mg/Kg		9	20
Cadmium	<0.18		0.195		mg/Kg		NC	20
Chromium	12	F1	11.3		mg/Kg		2	20
Lead	5.6		5.71		mg/Kg		2	20
Lithium	20	V	19.9		mg/Kg		0	20
Molybdenum	1.1	F1	1.20		mg/Kg		8	20
Selenium	<0.89	F1	<0.90		mg/Kg		NC	20
Thallium	2.9		1.94	F3	mg/Kg		41	20

Lab Sample ID: 500-204544-1 DU **Client Sample ID: Jolet #29 Ash**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618479 **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Barium	3000		2840		mg/Kg		4	20
Calcium	100000		104000		mg/Kg		1	20

Lab Sample ID: 500-204544-1 DU **Client Sample ID: Jolet #29 Ash**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618576 **Prep Batch: 618052**

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Cobalt	15		13.9		mg/Kg		10	20

Method: 7471A - Mercury (CVAA)

Lab Sample ID: MB 500-617888/12-A **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618070 **Prep Batch: 617888**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.017		0.017		mg/Kg		09/09/21 13:15	09/10/21 08:27	1

Lab Sample ID: LCS 500-617888/13-A **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 618070 **Prep Batch: 617888**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.167	0.179		mg/Kg		107	80 - 120

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-1

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 500-618524/1-A
Matrix: Solid
Analysis Batch: 618534

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 618524

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	<2.0		2.0		mg/Kg		09/14/21 11:45	09/14/21 12:53	1

Lab Sample ID: LCS 500-618524/2-A
Matrix: Solid
Analysis Batch: 618534

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 618524

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Sulfate	50.0	53.9		mg/Kg		108	80 - 120

Method: SM 4500 Cl- E - Chloride, Total

Lab Sample ID: MB 500-618692/1-A
Matrix: Solid
Analysis Batch: 618775

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 618692

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<20		20		mg/Kg		09/15/21 09:49	09/15/21 15:03	1

Lab Sample ID: LCS 500-618692/2-A
Matrix: Solid
Analysis Batch: 618775

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 618692

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	200	202		mg/Kg		101	85 - 115

Method: SM 4500 F C - Fluoride

Lab Sample ID: MB 500-618692/1-A
Matrix: Solid
Analysis Batch: 618739

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 618692

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	<1.0		1.0		mg/Kg		09/15/21 09:49	09/15/21 12:27	1

Lab Sample ID: LCS 500-618692/2-A
Matrix: Solid
Analysis Batch: 618739

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 618692

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Fluoride	100	103		mg/Kg		103	80 - 120

Eurofins TestAmerica, Chicago
2417 Bond Street
University Park IL 60484
Phone 708 534-5200 Fax 708 534-5211

Chain of Custody Record

eurofins
244-ATLANTA

Client Information	Sampler Michael Ress	Lab PM Mockler Diana J	Carrier Tracking No(s)	COC No 500-94568-41920 1
Client Contact Richard Gnat	Phone 630-203-7240	E-Mail Diana Mockler@Eurofinset com	State of Origin	Page Page 1 of 1
Company KPRG and Associates Inc	PWSID	Analysis Requested		Job # 500-204544

Address 14665 West Lisbon Road Suite 1A	Due Date Requested	
City Brookfield	TAT Requested (days)	
State Zip WI 53005	Compliance Project Δ Yes Δ No	
Phone	PO # 4502042860	
Email richardg@kprginc com	WO #	
Project Name Joliet #9 Ash	Project # 50011504	
Site Illinois	SSOW#	

Analysis columns: Field Filtered Sample (Yes or No); Perform MS/MSD (Yes or No); 903.0 904.0; Ra226Ra228_GFPC Combined Rad 226/228; 4500_F_C 6010B, 7471A 9056A SM4500_Cl_E; Total Number of containers

500-204544 COC

Preservation Codes
A HCL, B NaOH, C Zn Acetate, D Nitric Acid, E NaHSO4, F MeOH, G Amchlor, H Ascorbic Acid, I Ice, J DI Water, K EDTA, L EDA
M Hexane, N None, O AsNaO2, P Na2O4S, Q Na2SO3, R Na2S2O3, S H2SO4, T TSP Dodecahydrate, U Acetone, V MCAA, W pH 4-5, Z other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample	Perform MS/MSD	903.0 904.0	Ra226Ra228_GFPC Combined Rad 226/228	4500_F_C 6010B, 7471A 9056A SM4500_Cl_E	Total Number of containers	Special Instructions/Note
			Preservation Code				N	N	N		
Joliet #9 Ash	8/31	9:30	C	Solid			X	X	X		
Joliet #29 Ash	8/31	10:00	C	Solid			X	X	X		
				Solid							

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested I II III IV Other (specify)

Special Instructions/QC Requirements

Empty Kit Relinquished by	Date	Time	Method of Shipment

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
Michael Ress	8/31 13:00	KPRG	Stephanie Hernandez	8/31/21 1300	ETA-CHI

Custody Seals Intact Δ Yes Δ No	Custody Seal No	Cooler Temperature(s) °C and Other Remarks 22 4

Ver 06/08/2021

Login Sample Receipt Checklist

Client: KPRG and Associates, Inc. Job Number: 500-204544-1

Login Number: 204544 **List Source: Eurofins TestAmerica, Chicago**
List Number: 1
Creator: Hernandez, Stephanie

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	Received same day of collection; chilling process has begun.
Cooler Temperature is recorded.	True	22.4
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Accreditation/Certification Summary

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-1

Laboratory: Eurofins TestAmerica, Chicago

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
Illinois	NELAP	IL00035	04-29-22

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
7471A	7471A	Solid	Mercury
Moisture		Solid	Percent Moisture
Moisture		Solid	Percent Solids

eurofins | Environment Testing America

ANALYTICAL REPORT

Eurofins TestAmerica, Chicago
2417 Bond Street
University Park, IL 60484
Tel: (708)534-5200

Laboratory Job ID: 500-204544-2
Client Project/Site: Joliet #29 Ash

For:
KPRG and Associates, Inc.
14665 West Lisbon Road,
Suite 1A
Brookfield, Wisconsin 53005

Attn: Richard Gnat

Authorized for release by:
10/26/2021 8:28:20 AM

Diana Mockler, Project Manager I
(219)252-7570
Diana.Mockler@Eurofinset.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

1 2 3 4 5 6 7 8 9 10 11 12 13

Table of Contents

Case Narrative

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-2

Job ID: 500-204544-2

Laboratory: Eurofins TestAmerica, Chicago

Narrative

Job Narrative
500-204544-2

Comments
No additional comments.

Receipt
The sample was received on 8/31/2021 1:00 PM. Unless otherwise noted below, the sample arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was 22.4º C.

RAD
Methods 903.0, 9315: Radium 226 prep batch 160-527617
Any minimum detectable concentration (MDC), critical value (DLC), or Safe Drinking Water Act detection limit (SDWA DL) is sample-specific unless otherwise stated elsewhere in this narrative. Radiochemistry sample results are reported with the count date/time applied as the Activity Reference Date.

Jolet #29 Ash (500-204544-1), (LCS 160-527617/2-A), (MB 160-527617/1-A), (500-204327-A-20-D) and (500-204327-A-20-E DU)

Method 904.0: Radium-228 prep batch 160-528400:

Any minimum detectable concentration (MDC), critical value (DLC), or Safe Drinking Water Act detection limit (SDWA DL) is sample-specific unless otherwise stated elsewhere in this narrative. Radiochemistry sample results are reported with the count date/time applied as the Activity Reference Date. Jolet #29 Ash (500-204544-1), (LCS 160-528400/2-A), (MB 160-528400/1-A), (500-204543-A-1-C) and (500-204543-A-1-D DU)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
Methods 6010B, NONE: The following sample was diluted to bring the concentration of target analytes within the calibration range: Jolet #29 Ash (500-204544-1). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Method	Method Description	Protocol	Laboratory
903.0	Radium-226 (GFPC)	EPA	TAL SL
904.0	Radium-228 (GFPC)	EPA	TAL SL
Ra226_Ra228	Combined Radium-226 and Radium-228	TAL-STL	TAL SL
DPS-0	Preparation, Digestion/ Precipitate	None	TAL SL
DPS-21	Preparation, Digestion/Precipitate Separation (21-Day In-Growth)	None	TAL SL

Protocol References:

EPA = US Environmental Protection Agency

None = None

TAL-STL = TestAmerica Laboratories, St. Louis, Facility Standard Operating Procedure.

Laboratory References:

TAL SL = Eurofins TestAmerica, St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Sample Summary

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
500-204544-1	Jolet #29 Ash	Solid	08/31/21 10:00	08/31/21 13:00

Client Sample ID: Jolet #29 Ash

Lab Sample ID: 500-204544-1

Date Collected: 08/31/21 10:00
Date Received: 08/31/21 13:00

Matrix: Solid

Method: 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	1.54		0.311	0.341	1.00	0.252	pCi/g	09/19/21 19:06	10/15/21 17:11	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*104*		*40 - 110*	*09/19/21 19:06*	*10/15/21 17:11*	*1*

Method: 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	1.63		0.377	0.406	1.00	0.443	pCi/g	09/22/21 16:04	10/06/21 12:36	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*91.3*		*40 - 110*	*09/22/21 16:04*	*10/06/21 12:36*	*1*
Y Carrier	*78.1*		*40 - 110*	*09/22/21 16:04*	*10/06/21 12:36*	*1*

Method: Ra226_Ra228 - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Combined Radium 226 + 228	3.17		0.489	0.530	5.00	0.443	pCi/g		10/25/21 17:38	1

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-2

Qualifiers

Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Rad

Prep Batch: 527617

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	DPS-21	
MB 160-527617/1-A	Method Blank	Total/NA	Solid	DPS-21	
LCS 160-527617/2-A	Lab Control Sample	Total/NA	Solid	DPS-21	

Prep Batch: 528400

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-204544-1	Jolet #29 Ash	Total/NA	Solid	DPS-0	
MB 160-528400/1-A	Method Blank	Total/NA	Solid	DPS-0	
LCS 160-528400/2-A	Lab Control Sample	Total/NA	Solid	DPS-0	

Method: 903.0 - Radium-226 (GFPC)

Lab Sample ID: MB 160-527617/1-A **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 531966 **Prep Batch: 527617**

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.1252	U	0.144	0.144	1.00	0.234	pCi/g	09/19/21 19:06	10/15/21 17:14	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*80.9*		*40 - 110*	*09/19/21 19:06*	*10/15/21 17:14*	*1*

Lab Sample ID: LCS 160-527617/2-A **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 531966 **Prep Batch: 527617**

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Radium-226	11.3	12.04		1.37	1.00	0.272	pCi/g	106	75 - 125

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*82.8*		*40 - 110*

Method: 904.0 - Radium-228 (GFPC)

Lab Sample ID: MB 160-528400/1-A **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 530453 **Prep Batch: 528400**

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.1697	U	0.277	0.278	1.00	0.467	pCi/g	09/22/21 16:04	10/06/21 12:35	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.5*		*40 - 110*	*09/22/21 16:04*	*10/06/21 12:35*	*1*
Y Carrier	*80.0*		*40 - 110*	*09/22/21 16:04*	*10/06/21 12:35*	*1*

Lab Sample ID: LCS 160-528400/2-A **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 530453 **Prep Batch: 528400**

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Radium-228	9.27	10.17		1.24	1.00	0.492	pCi/g	110	75 - 125

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*78.9*		*40 - 110*
Y Carrier	*77.4*		*40 - 110*

Eurofins TestAmerica, Chicago
2417 Bond Street
University Park IL 60484
Phone 708 534-5200 Fax 708 534-5211

Chain of Custody Record

eurofins
244-ATLANTA

Client Information	Sampler: Michael Ress	Lab PM: Mockler Diana J	Carrier Tracking No(s)	COC No: 500-94568-41920 1
Client Contact: Richard Gnat	Phone: 630-203-7240	E-Mail: Diana Mockler@Eurofinset com	State of Origin	Page: Page 1 of 1
Company: KPRG and Associates Inc	PWSID	Analysis Requested		Job #: 500-204544
Address: 14665 West Lisbon Road Suite 1A	Due Date Requested			Preservation Codes
City: Brookfield	TAT Requested (days)			
State Zip: WI 53005	Compliance Project ∆ Yes ∆ No			
Phone	PO #: 4502042860			
Email: richardg@kprginc com	WO #			
Project Name: Joliet #9 Ash	Project #: 50011504			
Site: Illinois	SSOW#			Other:

500-204544 COC

Preservation Codes:
A HCL, B NaOH, C Zn Acetate, D Nitric Acid, E NaHSO4, F MeOH, G Amchlor, H Ascorbic Acid, I Ice, J DI Water, K EDTA, L EDA
M Hexane, N None, O AsNaO2, P Na2O4S, Q Na2SO3, R Na2S2O3, S H2SO4, T TSP Dodecahydrate, U Acetone, V MCAA, W pH 4-5, Z other (specify)

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0 904.0	Ra226Ra228_GFPC Combined Rad 226/228	4500_F_C 6010B, 7471A 9056A SM4500_Cl_E	Total Number of containers	Special Instructions/Note
			Preservation Code				N	N	N		
Joliet #9 Ash	8/31	9:30	C	Solid			X	X	X		
Joliet #29 Ash	8/31	10:00	C	Solid			X	X	X		
				Solid							

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For ________ Months

Deliverable Requested I II III IV Other (specify)

Special Instructions/QC Requirements

Empty Kit Relinquished by	Date	Time	Method of Shipment

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
Michael Ress	8/31 13:00	KPRG	Stephanie Hernandez	8/31/21 1300	ETA-CHI

Custody Seals Intact ∆ Yes ∆ No	Custody Seal No	Cooler Temperature(s) °C and Other Remarks: 22 4

Ver 06/08/2021

Eurofins TestAmerica, Chicago
2417 Bond Street
University Park, IL 60484
Phone: 708-534-5200 Fax: 708-534-5211

Chain of Custody Record

eurofins Environment Testing America

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Mockler, Diana J	Carrier Tracking No(s):	COC No: 500-152056.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: Diana.Mockler@Eurofinset.com	State of Origin: Illinois	Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note): NELAP - Illinois		Job #: 500-204544-2
Address: 13715 Rider Trail North,	Due Date Requested: 10/3/2021			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: Joliet #29 Ash	Project #: 50005078			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Z - other (specify)

Other:

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0/DPS_21 Radium 226	904.0/DPS_0 Radium 228	Ra226Ra228_GFPC/ Combined Rad 226/228	Total Number of containers	Special Instructions/Note:
			Preservation Code:								
Jolet #29 Ash (500-204544-1)	8/31/21	10:00 Central		Solid			X	X	X	2	

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica places the ownership of method, analyte & accreditation compliance upon out subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins TestAmerica attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said complicance to Eurofins TestAmerica.

Possible Hazard Identification
Unconfirmed

Deliverable Requested: I, II, III, IV, Other (specify) Primary Deliverable Rank: 2

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ______ *Months*

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:		
Relinquished by: Shir Scott	Date/Time: 8/31/21 1445	Company: ETA CHI	Received by: Micha Kuinhing	Date/Time: 9/1/21 08:37	Company: ETA St
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

Ver: 06/08/2021

Login Sample Receipt Checklist

Client: KPRG and Associates, Inc. Job Number: 500-204544-2

Login Number: 204544 **List Source: Eurofins TestAmerica, Chicago**
List Number: 1
Creator: Hernandez, Stephanie

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	Received same day of collection; chilling process has begun.
Cooler Temperature is recorded.	True	22.4
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Login Sample Receipt Checklist

Client: KPRG and Associates, Inc.
Job Number: 500-204544-2

Login Number: 204544
List Number: 2
Creator: Korrinhizer, Micha L

List Source: Eurofins TestAmerica, St. Louis
List Creation: 09/01/21 05:40 PM

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Accreditation/Certification Summary

Client: KPRG and Associates, Inc. Job ID: 500-204544-2
Project/Site: Joliet #29 Ash

Laboratory: Eurofins TestAmerica, St. Louis

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Alaska (UST)	State	20-001	05-06-22
ANAB	Dept. of Defense ELAP	L2305	04-06-22
ANAB	Dept. of Energy	L2305.01	04-06-22
ANAB	ISO/IEC 17025	L2305	04-06-22
Arizona	State	AZ0813	12-08-21
California	Los Angeles County Sanitation Districts	10259	06-30-22
California	State	2886	06-30-21 *
Connecticut	State	PH-0241	03-31-23
Florida	NELAP	E87689	06-30-22
HI - RadChem Recognition	State	n/a	06-30-22
Illinois	NELAP	004553	11-30-21
Iowa	State	373	12-01-22
Kansas	NELAP	E-10236	10-31-21
Kentucky (DW)	State	KY90125	01-01-22
Kentucky (WW)	State	KY90125 (Permit KY0004049)	12-31-21
Louisiana	NELAP	04080	06-30-22
Louisiana (DW)	State	LA011	12-31-21
Maryland	State	310	09-30-22
MI - RadChem Recognition	State	9005	06-30-22
Missouri	State	780	06-30-22
Nevada	State	MO000542020-1	07-31-22
New Jersey	NELAP	MO002	06-30-22
New York	NELAP	11616	04-01-22
North Dakota	State	R-207	06-30-22
NRC	NRC	24-24817-01	12-31-22
Oklahoma	State	9997	08-31-22
Oregon	NELAP	4157	09-01-22
Pennsylvania	NELAP	68-00540	03-01-22
South Carolina	State	85002001	06-30-22
Texas	NELAP	T104704193	07-31-22
US Fish & Wildlife	US Federal Programs	058448	07-31-22
USDA	US Federal Programs	P330-17-00028	03-11-23
Utah	NELAP	MO000542021-14	08-01-22
Virginia	NELAP	10310	06-14-22
Washington	State	C592	08-30-22
West Virginia DEP	State	381	10-31-22

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Tracer/Carrier Summary

Client: KPRG and Associates, Inc.
Project/Site: Joliet #29 Ash

Job ID: 500-204544-2

Method: 903.0 - Radium-226 (GFPC)

Matrix: Solid

Prep Type: Total/NA

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Ba (40-110)
500-204544-1	Jolet #29 Ash	104
LCS 160-527617/2-A	Lab Control Sample	82.8
MB 160-527617/1-A	Method Blank	80.9

Tracer/Carrier Legend

Ba = Ba Carrier

Method: 904.0 - Radium-228 (GFPC)

Matrix: Solid

Prep Type: Total/NA

Percent Yield (Acceptance Limits)

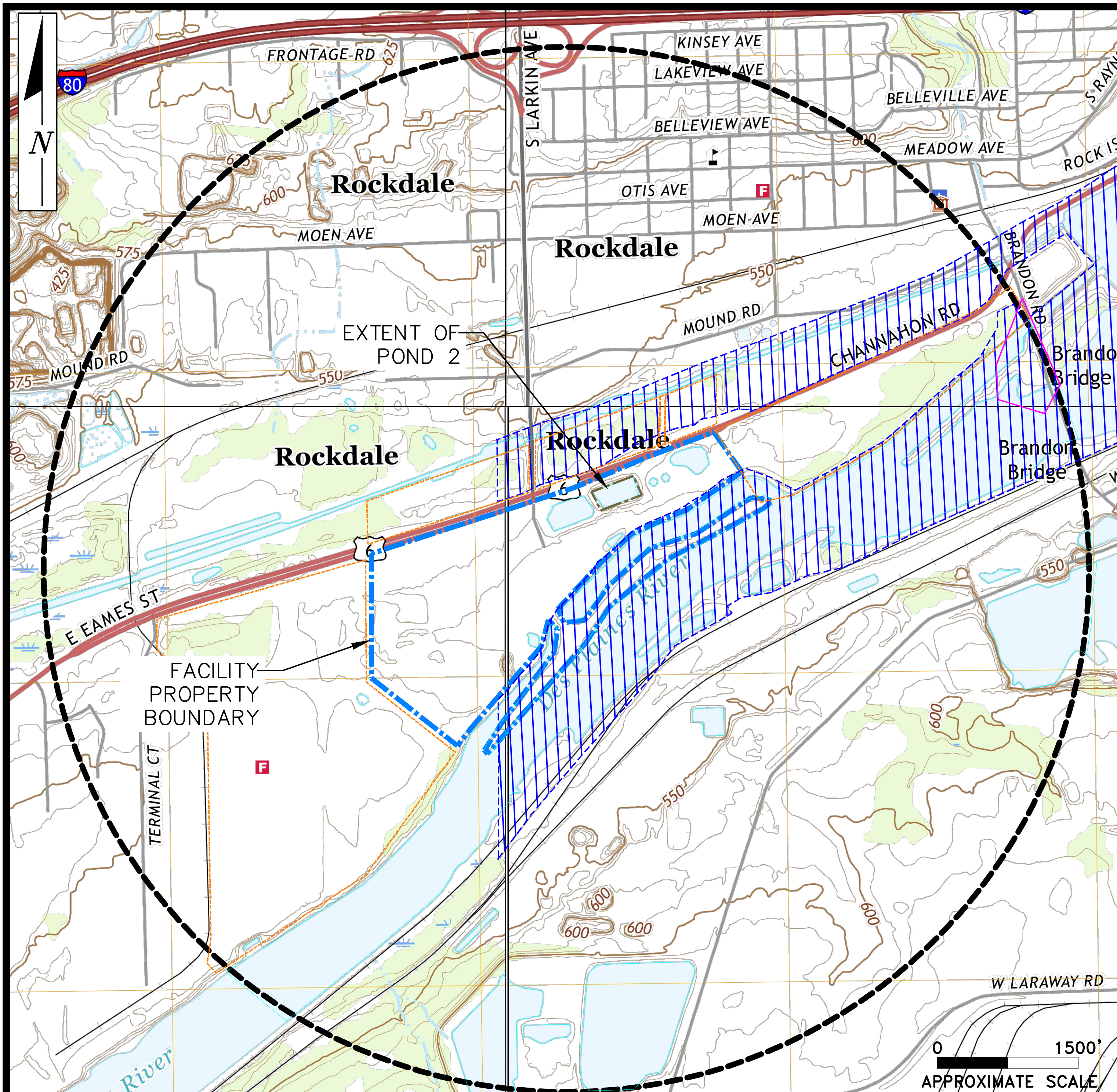
Lab Sample ID	Client Sample ID	Ba (40-110)	Y (40-110)
500-204544-1	Jolet #29 Ash	91.3	78.1
LCS 160-528400/2-A	Lab Control Sample	78.9	77.4
MB 160-528400/1-A	Method Blank	87.5	80.0

Tracer/Carrier Legend

Ba = Ba Carrier

Y = Y Carrier

<u>ATTACHMENT 3</u>
<u>SITE LOCATION MAP</u>



LEGEND

- FACILITY BOUNDARY
- SURFACE WATERS
- LIMITS OF ALL 100-YEAR FLOODPLAINS
- HISTORIC PLACES
- ADJACENT PROPERTY BOUNDARY
- RADIUS DEPICTING 3,280 FEET (1000 METERS) FROM FACILITY BOUNDARY

NOTES:

1. THE USGS BACKGROUND WAS OBTAINED FROM THE U.S.G.S ONLINE TOPOGRAPHY MAP RESOURCE
2. THERE ARE NO KNOWN HISTORIC, ARCHITECTURAL OR ARCHAEOLOGICAL SITES WITHIN THE EXTENT OF LINCOLN STONE QUARRY.
3. THERE ARE NO NATURE PRESERVES IN THE VICINITY OF LINCOLN STONE QUARRY.
4. THERE ARE NO KNOWN CRITICAL HABITATS AND ENDANGERED OR THREATENED SPECIES WITHIN THE EXTENT OF LINCOLN STONE QUARRY.

S
PREVAILING WIND DIRECTION

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG

KPRG and Associates, inc.

14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

SITE LOCATION MAP

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 1500'	Date: January 5, 2022
KPRG Project No. 19620	ATTACHMENT 3

W:\projects\midwest generation\operate & construct permits\joliet site location maps.dwg

ATTACHMENT 4
SITE PLAN MAPS

LEGEND

- FACILITY BOUNDARY
- MW-05 CCR MONITORING WELL
- MW-08 NON-CCR MONITORING WELL

ENVIRONMENTAL CONSULTATION & REMEDIATION

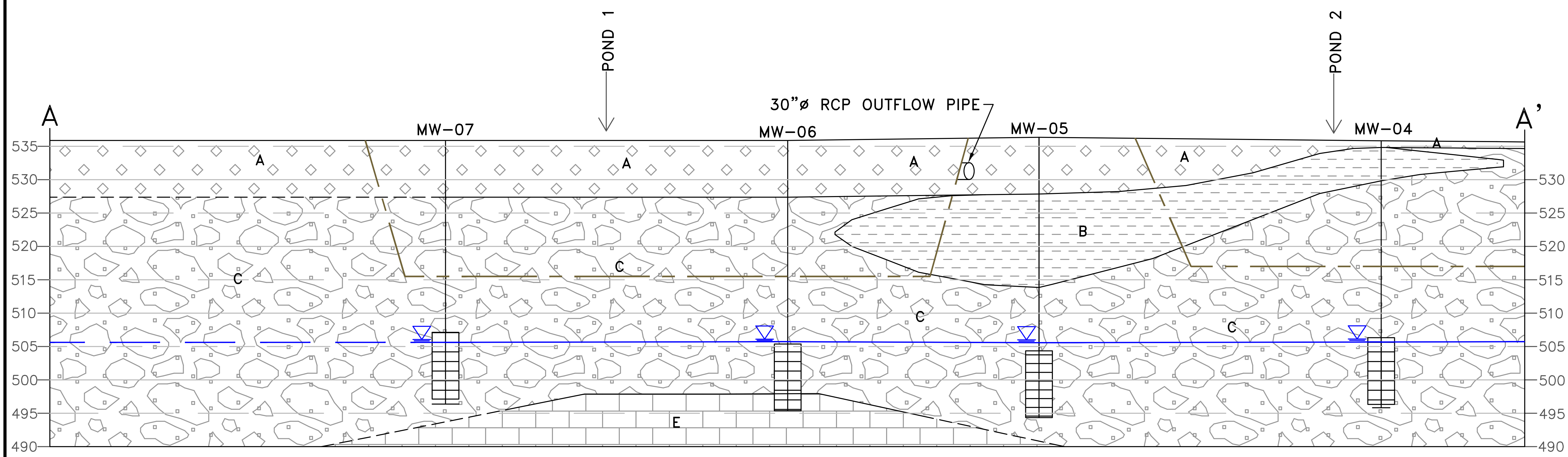
KPRG

KPRG and Associates, Inc.

14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

SITE PLAN MAP	
JOLIET #29 GENERATING STATION JOLIET, ILLINOIS	
Scale: 1" = 400'	Date: January 4, 2022
KPRG Project No. 19620	FIGURE 4-1



FILL: CONSISTING OF A THIN LAYER OF TOP SOIL AND/OR COARSE GRAVEL FILL. (A)

SILTY CLAY TO CLAY: CONSISTING OF BLACK/BROWN SILTY CLAY TO CLAY WITH A TRACE OF COARSE GRAVEL. (B)

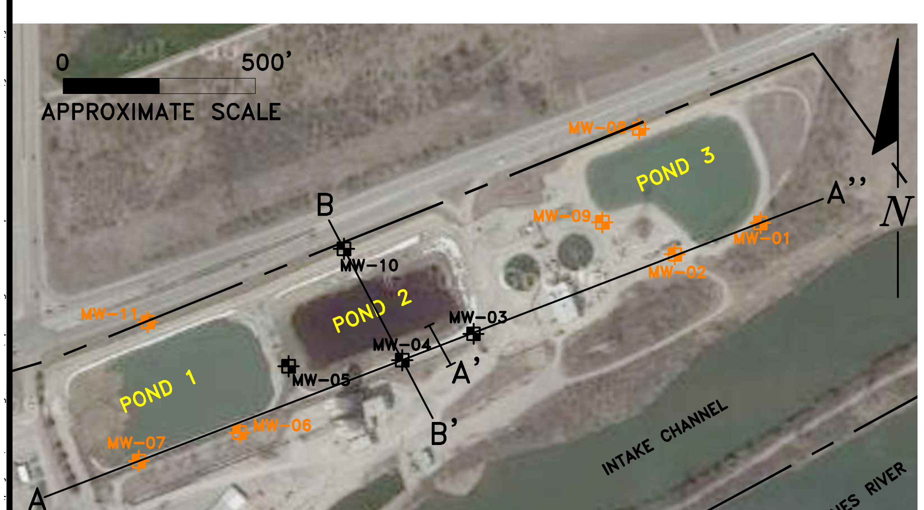
SAND AND GRAVEL: CONSISTING OF BLACK/BROWN FINE TO COARSE SAND AND GRAVEL WITH LIMESTONE FRAGMENTS NOTED THROUGHOUT. MAY LOCALLY INCLUDE SOME LENSES OR INTERLAYERING OF BLACK SILTY CLAY AND/OR TAN SILTY SAND. (C)

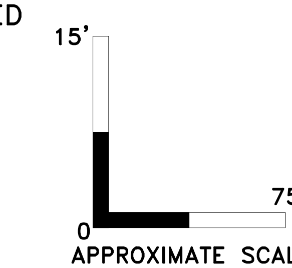
SANDY SILT/SILTY CLAY: CONSISTING OF BLACK/GRAY SANDY SILT GRADING DOWNWARD TO A GRAY SILTY CLAY WITH COARSE SAND. NOT CONTINUOUS ACROSS SITE. (D)

BEDROCK: CONSISTING OF SILURIAN DOLOMITE – TOP OF UNIT ENCOUNTERED 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. (E)

WATER LEVEL (5/21)

PROJECTED POND OUTLINE





ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG

KPRG and Associates, inc.

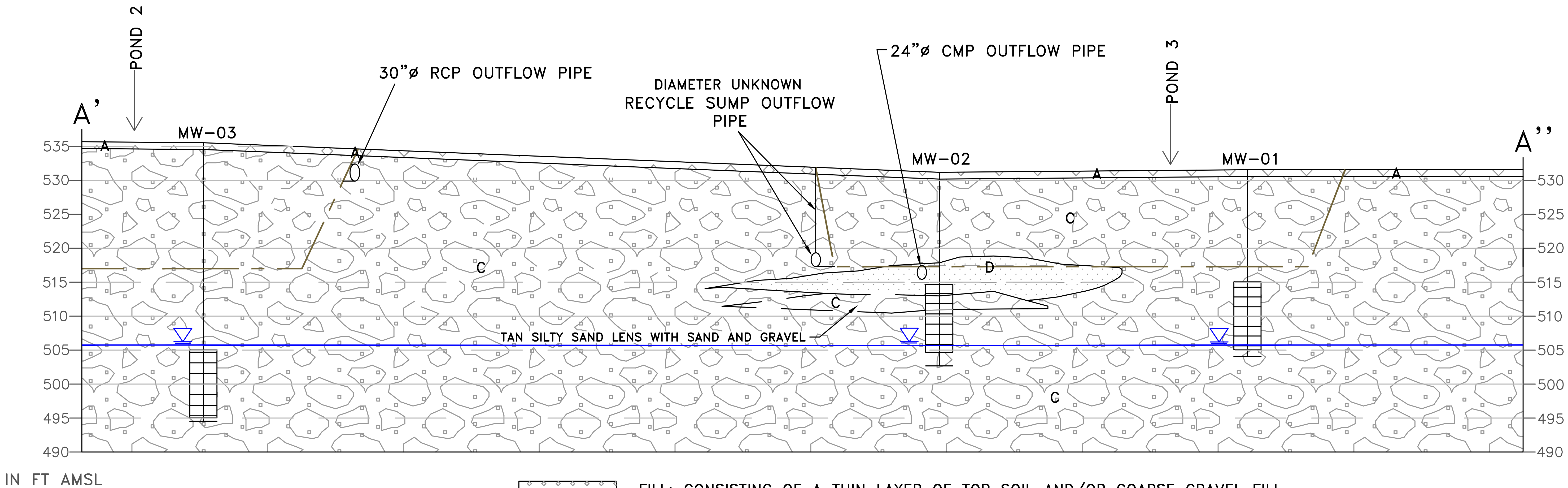
14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

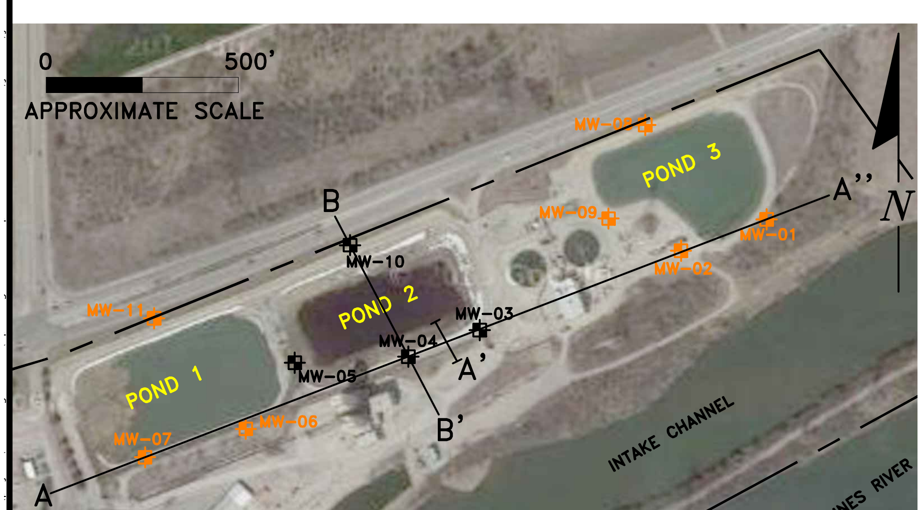
CROSS SECTION A – A'

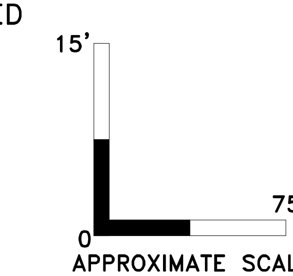
JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

SEE SCALE	Date: January 5, 2022
KPRG Project No. 19520	FIGURE 4-2



Unit	Description
A	FILL: CONSISTING OF A THIN LAYER OF TOP SOIL AND/OR COARSE GRAVEL FILL.
B	SILTY CLAY TO CLAY: CONSISTING OF BLACK/BROWN SILTY CLAY TO CLAY WITH A TRACE OF COARSE GRAVEL.
C	SAND AND GRAVEL: 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.
D	SANDY SILT/SILTY CLAY: CONSISTING OF BLACK/GRAY SANDY SILT GRADING DOWNWARD TO A GRAY SILTY CLAY WITH COARSE SAND. NOT CONTINUOUS ACROSS SITE.
E	BEDROCK: CONSISTING OF SILURIAN DOLOMITE – TOP OF UNIT ENCOUNTERED 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.
▽	WATER LEVEL (5/21)
— — —	PROJECTED POND OUTLINE





ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG

KPRG and Associates, inc.

14665 West Lisbon Road, Suite 1A Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

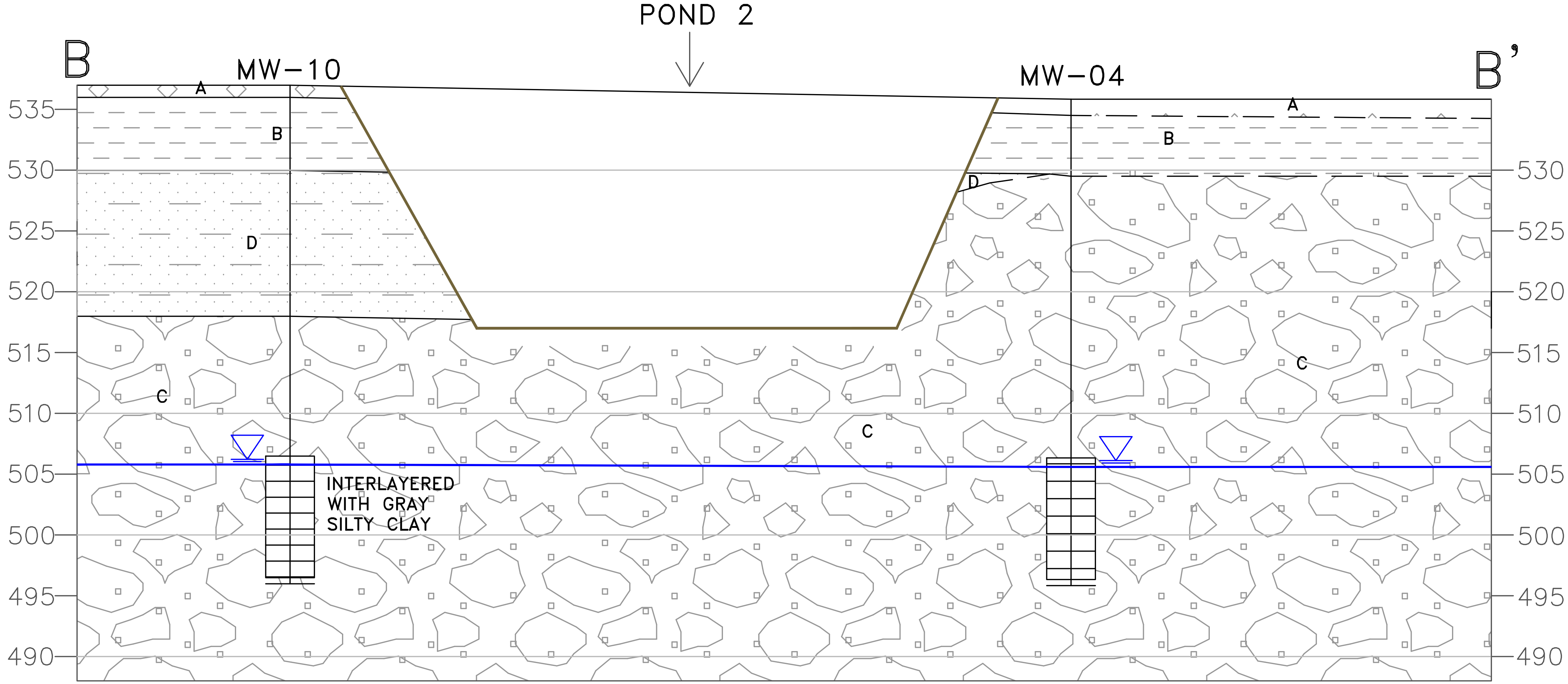
414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

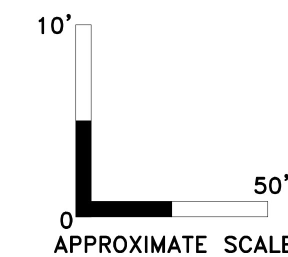
CROSS SECTION A' – A''

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

SEE SCALE | Date: January 5, 2022

KPRG Project No. 19520 | FIGURE 4-3





IN FT AMSL

A — FILL: CONSISTING OF A THIN LAYER OF TOP SOIL AND/OR COARSE GRAVEL FILL.

B — SILTY CLAY TO CLAY: CONSISTING OF BLACK/BROWN SILTY CLAY TO CLAY WITH A TRACE OF COARSE GRAVEL.

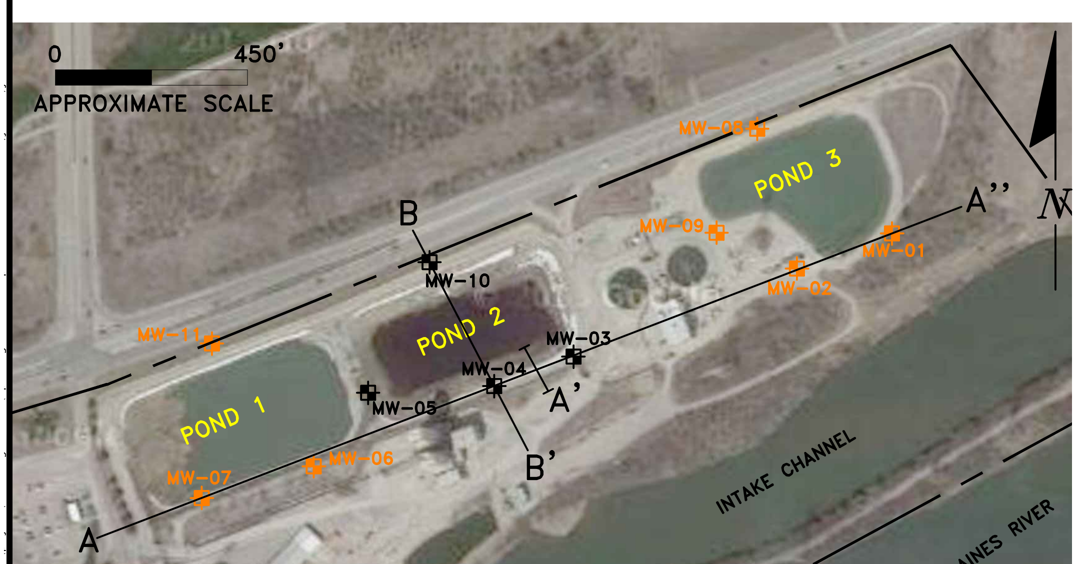
C — SAND AND GRAVEL: CONSISTING OF BLACK/BROWN FINE TO COARSE SAND AND GRAVEL WITH LIMESTONE FRAGMENTS NOTED THROUGHOUT. MAY LOCALLY INCLUDE SOME LENSES OR INTERLAYERING OF BLACK SILTY CLAY AND/OR TAN SILTY SAND.

D — SANDY SILT/SILTY CLAY: CONSISTING OF BLACK/GRAY SANDY SILT GRADING DOWNWARD TO A GRAY SILTY CLAY WITH COARSE SAND. NOT CONTINUOUS ACROSS SITE.

E — BEDROCK: CONSISTING OF SILURIAN DOLOMITE – TOP OF UNIT ENCOUNTERED 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.

WATER LEVEL (5/21)

POND OUTLINE



ENVIRONMENTAL CONSULTATION & REMEDIATION

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CROSS SECTION B-B'	
JOLIET #29 GENERATING STATION JOLIET, ILLINOIS	
SEE SCALE	Date: January 5, 2022
KPRG Project No. 19520	FIGURE 4-4

ATTACHMENT 5
DAVID E. NIELSON EXPERT OPINION

Expert Opinion of David E. Nielson In Support of Midwest Generation, LLC's Petitions for an Adjusted Standard to Reuse the Polyethylene Liners in the Coal Combustion Residual Surface Impoundments

My name is David E. Nielson I am a Sr. Consultant and Sr. Manager with Sargent & Lundy (S&L). S&L is an Illinois-based engineering firm with over 125 years of history focused on the design of electric power generation and transmission systems. I have over 30 years of professional experience as a geotechnical and civil engineer. I have been a licensed professional engineer (civil) in the state of Illinois in good standing since 1993. My professional career has included services associated with coal combustion residuals (CCR), industrial waste surface impoundments, industrial waste landfills, and municipal solid waste (MSW) landfills in numerous states and regulatory environments since 1990. My curriculum vitae is attached (Attachment G).

I have been retained by Midwest Generation, LLC ("MWG") to provide expert testimony on MWG's Petitions for Adjusted Standards from Section 845.740(a) of the Illinois Coal Combustion Residual rule, Part 845 of the Illinois Pollution Control Board's ("Board") rules. Specifically, I am providing testimony supporting the closure of a CCR surface impoundment, by removal of the CCR with decontamination of the geomembrane liner, so it may be reused as a low-volume wastewater pond liner.

In 2020, I was retained by MWG to review and comment on the Illinois Environmental Protection Agency's ("Illinois EPA") proposed Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments as the new Part 845 of the Illinois Pollution Control Board's Rules. *In the Matter of: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: Proposed New 35 Ill. Adm. Code 845*, PCB 20-19 ("Illinois CCR rule"). In that proceeding, I provided written testimony and oral testimony, including my opinion that a competent geomembrane liner may be reused as part of retrofitting a CCR surface impoundment. *Id.* My opinion here is similar to and consistent with my opinion that I provided *In the Matter of: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: Proposed New 35 Ill. Adm. Code 845*, PCB 20-19.

I. Background

- The Illinois CCR Rule - Section 845.120 states:
  “"Retrofit" means to remove all CCR and contaminated soils and sediments from the CCR surface impoundment, and to ensure the surface impoundment complies with the requirements in Section 845.410.”

  The Illinois CCR Rule - Section 845.410 details and references the requirements of a composite liner for new and laterally expanded CCR surface impoundments.

- Section 845.770(a)(4) of the Illinois CCR Rule states
  “An owner or operator may request the Agency to approve the use of an existing competent geomembrane liner as a supplemental liner by submitting visual inspection, and analytical testing results to demonstrate that the existing liner is not contaminated with CCR constituents.”

  Thus, the Illinois EPA and Board have established that existing liners can be considered supplemental liners provided that adequate visual and analytical test results demonstrate it is not contaminated with CCR constituents.

- Section 257.102 of the Federal Rule presents the requirements for closure of CCR impoundments by removal. 257.102(c) states “An owner or operator may elect to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to §257.95(h) for constituents listed in appendix IV to this part."

This Federal rule does not require the removal of any decontaminated liner systems.

- Section 845.740 of the Illinois Rule requires removal of liner systems for closure by removal as stated:
  "…containment system components such as the impoundment liner and contaminated subsoils, and CCR impoundment structures and ancillary equipment have been removed."

II. Geomembrane Liners in CCR Surface Impoundments Can be Decontaminated and Reused for Low-Volume Waste Ponds

In my opinion the reuse of geomembrane liners from CCR Surface impoundments that are properly decontaminated and undamaged can enhance the protection of health and the environment when they are repurposed for non-CCR impoundments, including low-volume waste ponds. My opinion is made to a reasonable degree of scientific certainty. This opinion is based on the following:

1. A low-volume waste pond is a pond that collects "low volume waste sources." "Low volume waste sources are defined in the Steam Electric Power Generating Effluent Guidelines and Standards as "wastewater from all sources except those for which specific limitations or standards are otherwise established in this part. Low volume waste sources include, but are not limited to, the following: Wastewaters from ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, recirculating house service water systems, and wet scrubber air pollution control systems whose primary purpose is particulate removal. Sanitary wastes, air conditioning wastes, and wastewater from carbon capture or sequestration systems are not included in this definition." 40 C.F.R. § 423.11(b).

2. A low volume waste pond has an unmeasurable amount of non-CCR material because it holds the water required for the station operations and also stormwater. A power generating station uses the low volume waste ponds for temporary storage of large volumes of non-CCR waste streams until the water can be treated and discharged pursuant to the station's NPDES permit. For example, stormwater at a station would be directed to a low volume waste pond to avoid flooding a station and to also avoid discharge of stormwater from the station before treatment.

3. Geomembrane liners are flexible membranes that are manufactured of resins such as polyethylene (HDPE, LLDPE, LDPE) and polyvinyl chloride (PVC), which are energy intensive to manufacture and very low permeability. ASTM International defines geomembrane as "an essentially impermeable geosynthetic composed of one or more synthetic sheets." (Attachment A, p. 3).

4. Geomembrane liners, including HDPE, are used worldwide, including hazardous waste landfills, municipal solid waste landfills, hazardous waste impoundments, non-hazardous waste impoundments, tailings ponds, dams, and stormwater management ponds.

5. My research has not found any evidence that geomembrane liners, such as HDPE become contaminated with waste products that are present in CCR. In fact, I am not aware of a study that shows that polymer liners become saturated with CCR constituents. Thus, there is no basis to conclude that a geomembrane liner would be saturated with CCR constituents such that it cannot be decontaminated for reuse.

6. To clean a CCR surface impoundment, first the CCR is carefully removed from the surface impoundment. Following removal, the sides and base of the CCR surface impoundment are methodically cleaned with a high pressure power-washer to remove the residual CCR from the geomembrane. Visual inspections for any damage would also occur, and any potential damage found would be repaired.

7. Performing analytical testing on wipe samples to verify suitable decontamination of the exposed surface of undamaged HDPE liner systems is considered a reasonable

path forward to allow existing liners to be repurposed for non-CCR impoundments. The wipe samples would be obtained for the metal and other constituents regulated by the Illinois CCR Rule (845.600(a)(1)).

I suggest the sampling and testing consist of:

- In accordance with ASTM D6966-18 (Attachment B) perform a systematic and repeatable wipe sampling,
- Analytical chemistry testing to quantify the concentrations of the regulated metals and other chemical constituents.

It is my opinion that performing 1 set of wipe samples and tests per acre is an appropriate testing frequency. This opinion is based on the USEPA guidance that one permeability test should be performed per acre per lift of compacted clay liner (Attachment C, Section 2.8.4.3).

8. Geomembrane liners have been successfully cleaned for reuse for an alternative purpose. In 2018, a geomembrane lined landfill leachate pond was cleaned so the pond could store clean water. The geomembrane liner had been in use for approximately 25 years. Because the geomembrane liner would be exposed, the owner conducted an analysis of the condition of geomembrane after over two decades of use. The analysis showed that the geomembrane was in good condition with little signs of degradation, and the owner continued using the impoundment for clean water. Attachment D.

9. When considering a 60 mil HDPE liner that is 10 acres in extent, it contains over 120,000 pounds or about 60,000 kg of HDPE resin. The energy demand for manufacturing of the resin requires over 76 MJ/kg or 72,000 BTU/kg. (Attachment E, p. 11). Therefore, it is estimated that to manufacture the resin for 10 acres of 60 mil HDPE liner requires over 4,300,000,000 BTU of energy. This includes the energy value of the oil and natural gas products used to make the resin. This does not include the energy required to extrude the resin into sheets,

transportation, deployment, or seaming. Thus, I conclude that the energy intensive requirements to replace decontaminated, undamaged HDPE liner are not warranted.

10. Pond 1 at MWG's Joliet 29 station has a HDPE liner that was repurposed for the existing non-CCR impoundment. Ongoing groundwater testing validates that CCR constituents have not adversely impacted the groundwater. Attachment F.

11. When HDPE liner is removed from an impoundment it is not typically rolled to reduce the volume of waste to be transported to a landfill. Instead it is often removed with an excavator and loaded into dump trucks. Because removal of the liner is a demolition project, there would be no need for the excavators to carefully remove the liner. Instead, when the liner is removed, the CCR material that remained in the CCR surface impoundment would likely mix with the underlying soil. To confirm that all sub-soils were removed of CCR, at least 6 inches of subsoil would have to be removed and disposed of as well as the liner.

12. It is recognized that the zero air void volume of a typical liner for a 10 acre pond only occupies about 80 cubic yards of volume. However, when the material is placed in a dump truck with an excavator along with the nominal 6 inches of subsoil, it would likely require approximately 500 dump truck loads of the waste liner and subsoil to be hauled to a landfill. Additionally, about 5 over the road tractor trailer loads would be required to transport the new liner material from the factory to the site. In my opinion it is not prudent to require about 500 truck trips per 10 acres of lined impoundment to remove and replace an undamaged decontaminated existing liner.

13. Additionally, removing the liner and the subsoil, and installing a virtually identical liner to hold low-volume wastewater will take a significant amount of time compared to removing the CCR and decontaminating the liner. In the Demonstrations for a Site-Specific Alternative Deadline to Initiate Closure of the basins at the MWG Stations that MWG submitted to the U.S. EPA pursuant to the federal CCR rule, MWG committed to providing alternative disposal of the CCR as soon as technically

feasible. *See* Demonstration for a Site-Specific Alternative Deadline to Initiate Closure, Powerton Station, p. 3-5; Demonstration for a Site-Specific Alternative Deadline to Initiate Closure, Waukegan Station, p. 3-5. Because it is technically feasible to decontaminate a geomembrane liner, by removing the CCR and decontaminating the liner, MWG would be fulfilling its commitment to provide the alternative capacity for CCR and non-CCR wastestreams as soon as technically feasible.

III. Conclusion

I recommend that MWG be granted an adjusted standard from the Illinois CCR Rule requirement to remove the geomembrane liner of a CCR surface impoundment for closure by removal of CCR. A competent geomembrane liner does not become saturated with CCR constituents, and can be cleaned and decontaminated for another purpose. Additionally, wipe samples will be taken to confirm that the decontamination cleaning was successful. As previously noted the adjusted standard as requested is in accordance with the USEPA CCR Rule.

Digitally signed by David E. Nielson
Date: 2021.05.09 18:40:37 -05'00'

David E. Nielson, P.E.

ATTACHMENTS

A. ASTM International, Standard Terminology for Geosynthetics, ASTM D4439 - 20, January 2020.

B. ASTM International, Standard Practice for Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Determination of Metals, ASTM D6966-18, November 2018.

C. https://geosyntheticsmagazine.com/2019/02/01/a-leachate-pond-geomembrane-after-25-years-of-service/

D. Daniel, D. E. and R. M. Koerner. Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities, EPA/600/R-93/182 (NTIS PB94-159100), 1993.

E. PlasticsEurope, Eco-profiles of the European Plastics Industry, High Density Polyethylene (HDPE), March 2005.

F. Midwest Generation, LLC, 2021; Annual and Quarterly Groundwater Monitoring Report, Joliet #29 Generating Station, January 21, 2021.

G. David E. Nielson, Curriculum Vitae

ATTACHMENT A

Standard Terminology for Geosynthetics
ASTM D4439 - 20

Designation: D4439 − 20

Standard Terminology for Geosynthetics[1]

This standard is issued under the fixed designation D4439; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Referenced Documents

1.1 *ASTM Standards:*[2]

C125 Terminology Relating to Concrete and Concrete Aggregates
D1987 Test Method for Biological Clogging of Geotextile or Soil/Geotextile Filters
D4354 Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing
D4491/D4491M Test Methods for Water Permeability of Geotextiles by Permittivity
D4533/D4533M Test Method for Trapezoid Tearing Strength of Geotextiles
D4594/D4594M Test Method for Effects of Temperature on Stability of Geotextiles
D4595 Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
D4632/D4632M Test Method for Grab Breaking Load and Elongation of Geotextiles
D4716/D4716M Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
D4751 Test Methods for Determining Apparent Opening Size of a Geotextile
D4759 Practice for Determining the Specification Conformance of Geosynthetics
D4833/D4833M Test Method for Index Puncture Resistance of Geomembranes and Related Products
D4873/D4873M Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
D4884/D4884M Test Method for Strength of Sewn or Bonded Seams of Geotextiles
D4885 Test Method for Determining Performance Strength of Geomembranes by the Wide Strip Tensile Method
D5101 Test Method for Measuring the Filtration Compatibility of Soil-Geotextile Systems
D5141 Test Method for Determining Filtering Efficiency and Flow Rate of the Filtration Component of a Sediment Retention Device
D5262 Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics
D5322 Practice for Laboratory Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids
D5323 Practice for Determination of 2 % Secant Modulus for Polyethylene Geomembranes
D5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
D5494 Test Method for the Determination of Pyramid Puncture Resistance of Unprotected and Protected Geomembranes
D5496 Practice for In Field Immersion Testing of Geosynthetics
D5514/D5514M Test Method for Large-Scale Hydrostatic Puncture Testing of Geosynthetics
D5567 Test Method for Hydraulic Conductivity Ratio (HCR) Testing of Soil/Geotextile Systems
D5594 Test Method for Determination of the Vinyl Acetate Content of Ethylene-Vinyl Acetate (EVA) Copolymers by Fourier Transform Infrared Spectroscopy (FT-IR)
D5617 Test Method for Multi-Axial Tension Test for Geosynthetics
D5641/D5641M Practice for Geomembrane Seam Evaluation by Vacuum Chamber
D5747/D5747M Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids
D5818 Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics
D5820 Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes
D5994/D5994M Test Method for Measuring Core Thickness of Textured Geomembranes

1.2 *Federal Standard:*[3]

Federal Standard 751a Stitches, Seams, and Stitchings

[1] This terminology is under the jurisdiction of D35 on Geosynthetics and is the direct responsibility of D35.93 on Editorial and Terminology.

Current edition approved Jan. 1, 2020. Published January 2020. Originally approved in 1984. Last previous edition approved in 2018 as D4439 – 18. DOI: 10.1520/D4439-20.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.

2. Terminology

absorption, *n*—the process by which a liquid is drawn into and tends to fill permeable pores in a porous solid body, also, the increase in mass of a porous solid body resulting from penetration of a liquid into its permeable pores. **C125**

aerobic, *n*—a condition in which a measurable volume of air is present in the incubation chamber or system. **D1987**

anaerobic, *n*—a condition in which no measurable volume of air is present in the incubation chamber or system. **D1987**

apparent opening size (AOS), O_{95}, *n—for a geotextile,* a property which indicates the approximate largest particle that would effectively pass through the geotextile. **D4751**

atmosphere for testing geosynthetics, *n*—air maintained at a relative humidity between 50 to 70 % and a temperature of 21 ± 2 °C (70 ± 4 °F). **D4439, D4751, D5494**

back flushing, *n*—a process by which liquid is forced in the reverse direction to the flow direction. **D1987**

basis weight—deprecated term (do not use in the sense of mass per unit area). **D4439**

bend, *vt—in mechanics*, to force an object from its natural or manufactured shape into a curve or into increased curvature. **D4439**

biocide, *n*—a chemical used to kill bacteria and other microorganisms. **D1987**

bituminous geosynthetic barrier (GBR-B), *n*—factory-produced structure of geosynthetic materials in the form of a sheet in which the barrier function is fulfilled by bitumen.

blinding, *n—for geotextiles*, the condition where soil particles block the surface openings of the fabric, thereby reducing the hydraulic conductivity of the system. **D4439**

breaking force, *(F), J*, *n*—the force at failure. **D4885**

breaking load, *n*—the maximum force applied to a specimen in a tensile test carried to rupture. **D4632/D4632M**

breaking toughness, *T*, (FL^{-1}), Jm^{-2}, *n—for geotextiles*, the actual work-to-break per unit surface area of material. **D4595, D4885**

chemical resistance, *n*—the ability to resist chemical attack. **D5322**

clogging, *n—for geotextiles,* the condition where soil particles move into and are retained in the openings of the fabric, thereby reducing the hydraulic conductivity. **D4439**

clogging potential, *n—in geotextiles*, the tendency for a given geotextile to decrease permeability due to soil particles that have either lodged in the geotextile openings or have built up a restrictive layer on the surface of the geotextile. **D5101**

compressed thickness (t, (L), mm), *n*—thickness under a specified stress applied normal to the material. **D4439**

constant-rate-of-load tensile testing machine (CRL), *n*—a testing machine in which the rate of increase of the load being applied to the specimen is uniform with time after the first 3 s. **D4439**

corresponding force, *n*—synonym for force at specified elongation. **D4885**

coupon, *n*—a portion of a material or laboratory sample from which multiple specimens can be taken for testing. **D5747/D5747M**

creep, *n*—the time-dependent increase in accumulative strain in a material resulting from an applied constant force. **D5262**

critical height *(ch)*, *n*—the maximum exposed height of a cone or pyramid that will not cause a puncture failure of a geosynthetic at a specified hydrostatic pressure for a given period of time. **D5514/D5514M**

cross-machine direction, *n*—the direction in the plane of the fabric perpendicular to the direction of manufacture. **D4632/D4632M**

density (ρ, (ML^{-3}), kg/m^3), *n*—mass per unit volume. **D4439**

design load—the load at which the geosynthetic is required to operate in order to perform its intended function. **D5262**

elastic limit, *n—in mechanics*, the stress intensity at which stress and deformation of a material subjected to an increasing force cease to be proportional; the limit of stress within which a material will return to its original size and shape when the force is removed, and hence, not a permanent set. **D4885**

elongation at break, *n*—the elongation corresponding to the breaking load, that is, the maximum load. **D4632/D4632M**

failure, *n*—an arbitrary point beyond which a material ceases to be functionally capable of its intended use. **D4885, D5262**

failure, *n—in testing geosynthetics*, water or air pressure in the test vessel at failure of the geosynthetic. **D5514/D5514M**

field testing, *n*—testing performed in the field under actual conditions of temperature and exposure to the fluids for which the immersion testing is being performed. **D5496**

fill—deprecated term, see **filling**.

filling, *n*—yarn running from selvage to selvage at right angles to the warp in a woven fabric. **D4439**

flexible polypropylene, *n*—a material having a 2 % secant modulus of less than 300 MPa (40 000 psi) as determined by Practice D5323, produced by polymerization of propylene with or without other alpha olefin monomers.

force at specific elongation, FASE, *n*—the force associated with a specific elongation on the force-elongation curve. **D4439**

force-elongation curve, *n—in a tensile test*, a graphical representation of the relationship between the magnitude of an externally applied force and the change in length of the specimen in the direction of the applied force. (*Synonym* for stress-strain curve.) **D4885**

geocomposite, *n*—a product composed of two or more materials, at least one of which is a geosynthetic.

geofoam, *n*—block or planar rigid cellular foamed polymeric material used in geotechnical engineering applications.

geogrid, *n*—a geosynthetic formed by a regular network of integrally connected elements with apertures greater than 6.35 mm (¼ in.) to allow interlocking with surrounding soil, rock, earth, and other surrounding materials to function primarily as reinforcement. **D5262**

geomembrane, *n*—an essentially impermeable geosynthetic composed of one or more synthetic sheets. **D4439, D4873/D4873M, D4885, D5994/D5994M, D5820**

geonet, *n*—a geosynthetic consisting of integrally connected parallel sets of ribs overlying similar sets at various angles for planar drainage of liquids or gases. **D4439**

geostrip—polymeric material in the form of a strip of width not more than 200 mm (7.87 in.), used in contact with soil or other materials in geotechnical and civil engineering applications, or both.

geosynthetic, *n*—a planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure, or system. **D4354, D4759, D4873/D4873M, D5617, D5818**

geosynthetic barrier—low-permeability geosynthetic material, used in geotechnical and civil engineering applications with the purpose of reducing or preventing the flow of fluid through the construction.

geosynthetic barrier clay (GBR-C), *n*—factory-produced structure of geosynthetic materials in the form of a sheet, in which the barrier function is fulfilled by clay.

geosynthetic barrier polymeric (GBR-P), *n*—factory-produced structure of geosynthetic materials in the form of a sheet, in which the barrier function is fulfilled by polymers.

geosynthetic cementitious composite mat (GCCM), *n*—a factory-assembled geosynthetic composite consisting of a cementitious material contained within layer or layers of geosynthetic materials that becomes hardened when hydrated.

geosynthetic clay liner, *n*—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetic materials.

geotechnical engineering, *n*—the engineering application of geotechnics. **D4439, D4595**

geotechnics, *n*—the application of scientific methods and engineering principles to the acquisition, interpretation, and use of knowledge of materials of the earth's crust to the solution of engineering problems. **D4439, D4491/D4491M, D4595, D4716/D4716M, D4751**

geotextile, *n*—a permeable geosynthetic comprised solely of textiles.

Discussion—Geotextiles perform several functions in geotechnical engineering applications, including: separation, filtration, drainage, reinforcement, and protection. **D1987, D4439, D5594**

grab test, *n*—*in fabric testing*, a tension test in which only a part of the width of the specimen is gripped in the clamps. **D4632/D4632M**

gradient ratio, *n*—*in geotextiles*, the ratio of the hydraulic gradient through a soil-geotextile system to the hydraulic gradient through the soil alone. **D5101**

gravity flow, *n*—flow in a direction parallel to the plane of a geotextile or related product driven predominately by a difference in elevation between the inlet and outflow points of a specimen. **D4716/D4716M**

head, *n*—pressure at a point in a liquid, expressed in terms of the vertical distance of the point below the surface of the liquid. **D4716/D4716M**

hydraulic conductivity *(k)*, *n*—the rate of discharge of water under laminar flow conditions through a unit cross-sectional area of a porous medium under a unit hydraulic gradient and standard temperature conditions (20 °C). **D5567**

hydraulic conductivity ratio (HCR), *n*—the ratio of the hydraulic conductivty of the soil/geotextile system, k_{sg}, at any time during the test, to the initial hydraulic conductivity, k_{sgo}, measured at the beginning of the test (NEW).

hydraulic gradient, *i, s (D)*—the loss of hydraulic head per unit distance of flow, dH/dL. **D5101**

hydraulic transmissivity, θ (L^2 T^{-1}), *n*—*for a geotextile or related product*, the volumetric flow rate of water per unit width of specimen per unit gradient in a direction parallel to the plane of the specimen. **D4716/D4716M**

hydrostatic pressure, *n*—a state of stress in which all the principal stresses are equal (and there is no shear stress), as in a liquid at rest; induced artificially by means of a gaged pressure system; the product of the unit weight of the liquid and the difference in elevation between the given point and the free water elevation. **D5514/D5514M**

index test, *n*—a test procedure which may contain a known bias but which may be used to establish an order for a set of specimens with respect to the property of interest. **D4833/D4833M, D4885**

inflection point, *n*—the first point of the force-elongation curve at which the second derivative equals zero. **D4885**

initial tensile modulus, J_p (FL^{-1}), Nm^{-1}, *n*—*for geosynthetics*, the ratio of the change in force per unit width to the change in elongation of the initial portion of a force-elongation curve. **D4885**

in-plane flow, *n*—fluid flow confined to a direction parallel to the plane of a geotextile or related product. **D4716/D4716M**

integral, *adj—in geosynthetics*, forming a necessary part of the whole; constituent. **D4439**

laboratory sample, *n*—a portion of material taken to represent the lot sample, or the original material, and used in the laboratory as a source of test specimens. **D4354**

laminar flow, *n*—flow in which the head loss is proportional to the first power of the velocity. **D4716/D4716M**

linear density, *n*—mass per unit length; the quotient obtained by dividing the mass of a fiber or yarn by its length.

lot, *n*—a unit of production, or a group of other units or packages, taken for sampling or statistical examination, having one or more common properties and being readily separable from other similar units. **D4354**

lot sample, *n*—one or more shipping units taken at random to represent an acceptance sampling lot and used as a source of laboratory samples. **D4354**

machine direction, *n*—the direction in the plane of the fabric parallel to the direction of manufacture. **D4632/D4632M**

minimum average roll value (MARV), *n*—for geosynthetics, a manufacturing quality control tool used to allow manufacturers to establish published values such that the user/purchaser will have a 97.7 % confidence that the property in question will meet published values. For normally distributed data, "MARV" is calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.

Discussion—MARV is applicable to a geosynthetic's intrinsic physical properties such as weight, thickness, and strength. MARV may not be appropriate for some hydraulic, performance, or durability properties.

minimum test value, *n—for geosynthetics*, the lowest sample value from documented manufacturing quality control test results for a defined population from one test method associated with one specific property.

modulus of elasticity, *MPa* (FL^{-2}), *n*—the ratio of stress (nominal) to corresponding strain below the proportional limit of a material, expressed in force per unit area, such as megapascals (pounds-force per square inch). **D5323**

multi-axial tension, *n*—stress in more than one direction. **D5617**

multi-linear drainage geocomposite, *n*—a manufactured product composed of a series of parallel single drainage conduits regularly spaced across its width sandwiched between two or more geosynthetics.

nominal, *n*—representative value of a measurable property determined under a set of conditions, by which a product may be described.

nominal value, *n*—representative value of a measurable property by which a product may be described **D4439**

normal direction, *n—for geotextiles*, the direction perpendicular to the plane of a geotextile. **D4439**

normal stress, (FL^{-2}), *n*—the component of applied stress that is perpendicular to the surface on which the force acts. **D4439**

offset modulus, J_o, (FL^{-1}), Nm^{-1}, *n—for geosynthetics*, the ratio of the change in force per unit width to the change in elongation below an arbitrary offset point at which there is a proportional relationship between force and elongation, and above the inflection point on the force-elongation curve. **D4885**

performance property, *n*—a result obtained by conducting a performance test. **D5141**

performance test, *n*—a test which simulates in the laboratory as closely as practicable selected conditions experienced in the field and which can be used in design. (Synonym for **design test**.) **D4885**

performance test, *n—in geosynthetics*, a laboratory procedure which simulates selected field conditions which can be used in design. **D5141**

permeability, *n*—the rate of flow of a liquid under a differential pressure through a material. **D1987, D4491/D4491M**

permeability, *n—of geotextiles,* hydraulic conductivity. **D4491/D4491M**

permeation, *n*—the transmissioin of a fluid through a porous medium (NEW).

permittivity, **(Ψ)**, (T^{-1}), *n—of geotextiles*, the volumetric flow rate of water per unit cross-sectional area per unit head under laminar flow conditions, in the normal direction through a geotextile. **D1987, D4491/D4491M**

pore volume of flow (V_{pq}), *n*—the cumulative volume of flow through a test specimen divided by the volume of voids within the specimen. **D5567**

pre-fabricated vertical drain (PVD), *n*—a geocomposite consisting of geotextile cover and drainage core installed vertically into soil to provide drainage for accelerating consolidation of soils.

Discussion—Also known as band or wick drain.

pressure flow, *n*—flow in a direction parallel to the plane of a geotextile or related product driven predominately by a differential fluid pressure. **D4716/D4716M**

primary sampling unit, *n*—the sampling unit containing all the sources of variability which should be considered in acceptance testing; the sampling unit taken in first stage of selection in any procedure for sampling a lot or shipment. **D4354**

production unit—*as referred to in this practice*, is a quantity of geotextile agreed upon by the purchaser and seller for the purpose of sampling. **D4354**

proportional limit, *n*—the greatest stress which a material is capable of sustaining without any deviation from proportionality of stress to strain (Hooke's law). **D4595**

puncture resistance, (F), *n*—the inherent resisting mechanism of the test specimen to the failure by a penetrating or puncturing object. **D4833/D4833M**

quality assurance, *n*—all those planned or systematic actions necessary to provide adequate confidence that a material, product, system, or service will satisfy given needs. **D4354**

quality control, *n*—the operational techniques and the activities which sustain a quality of material, product, system, or service that will satisfy given needs; also the use of such techniques and activities. **D4354**

rate of creep, *n*—the slope of the creep-time curve at a given time. **D5262**

residual shear strength, *n*—value of shear stress at sufficiently large displacement where the stress remains constant with continued shearing

rib, *n*—for geogrids, the continuous elements of a geogrid which are interconnected to a node or junction.

sample, *n*—(*1*) a portion of material which is taken for testing or for record purposes. (*2*) a group of specimens used, or of observations made, which provide information that can be used for making statistical inferences about the population(s) from which the specimens are drawn. (See also **laboratory sample, lot sample,** and **specimen**.) **D4354, D5818**

sample, laboratory—See **laboratory sample**.

sample, lot—See **lot sample**.

sampling unit, *n*—an identifiable, discrete unit or subunit of material that could be taken as part of a sample. (See also **primary sampling unit, laboratory sample,** and **specimen**.) **D4354**

sampling unit, primary—See **primary sampling unit**.

seam, *n*—a permanent joining of two or more materials. **D5820**

seam, *n*—the connection of two or more pieces of material by mechanical, chemical, or fusion methods to provide the integrity of a single piece of the material. **D5641/D5641M**

seam allowance, *n*—the width of fabric used in making a seam assembly, bounded by the edge of the fabric and the furthest stitch line. **D4884/D4884M**

seam assembly, *n*—the unit obtained by joining fabrics with a seam, including details such as fabric direction(s), seam allowance, sewing threads used, and number of stitches per unit length; and sometimes additional details of fabrication such as sewing-machine type and speed, needle type and size, etc. **D4884/D4884M**

seam design engineering, *n*—the procedures used to select a specific thread, a specific stitch type, and a specific seam type to achieve the required seam strength. **D4884/D4884M**

seam efficiency, sewn, *n*—*in sewn fabrics*, the ratio expressed as a percentage of seam strength to fabric strength.

seam interaction, *n*—the result of combining a specific textile, a specific stitch type, and a specific seam type. **D4884/D4884M**

seam type, *n*—*in sewn fabrics,* an alphanumeric designation relating to the essential characteristics of fabric positioning and rows of stitching in a specific sewn fabric seam (see Federal Standard 751). **D4884/D4884M**

secant modulus, *n*—the ratio of stress (nominal) to corresponding strain at any specified point on the stress-strain curve. **D5323**

secant modulus, J_{sec}, (FL^{-1}), Nm^{-1}, *n*—*for geosynthetics*, the ratio of change in force per unit width to the change in elongation between two points on a force-elongation curve. **D4885**

selvage, *n*—the woven edge portion of a fabric parallel to the warp. **D4884/D4884M**

sewing thread, *n*—a flexible, small-diameter yarn or strand, usually treated with a surface coating, lubricant, or both, intended to be used to stitch one or more pieces of material or an object to a material. **D4884/D4884M**

sewn seam, *n*—*in sewn fabrics*, a series of stitches joining two or more separate plies of a material or materials of planar structure such as textile fabric. **D4884/D4884M**

sewn seam strength, *n*—*for geotextiles*, the maximum resistance, measured in kilonewtons per metre, of the junction formed by stitching together two or more planar structures. **D4884/D4884M**

specification, *n*—a precise statement of a set of requirements to be satisfied by a material, product, system or service that indicates the procedures for determining whether each of the requirements is satisfied. **D4759**

specific gravity, *n*—the ratio of the density of the substance in question to the density of a reference substance at specified conditions of temperature and pressure. **D4439**

specimen, *n*—a specific portion of a material or laboratory sample upon which a test is performed or which is taken for that purpose. (*Syn.* test specimen) **D4354**

standard geosynthetic laboratory environment—a general purposes geosynthetic laboratory should control, monitor, and record the temperature range to 22 ± 3 °C and the relative humidity to 45 to 75 %. In cases of dispute, one should use the "atmosphere for testing" suggested in the appropriate standard test method.

stiffness, *n*—resistance to bending. **D4439**

stitch, *n*—the repeated unit formed by the sewing thread in the production of seams in a sewn fabric (see Federal Standard 751a). **D4884/D4884M**

strain, *n*—the change in length per unit of length in a given direction. **D4439**

stress crack, *n*—an external or internal crack in a plastic caused by tensile stresses less than its short-time mechanical strength. **D5397**

tangent point, *n*—*for geotextiles*, the first point of the force-elongation curve at which a major decrease in slope occurs. **D4595**

tearing strength, (F, (F), kN), *n*—the force required either (*1*) to start or (*2*) to continue or propagate a tear in a fabric under specified conditions. **D4439, D4533/D4533M**

temperature stability, *n—for a geotextile*, the percent change in tensile strength or in percent elongation as measured at a specified temperature and compared to values obtained at the standard conditions for testing geotextiles. **D4594/D4594M**

tensile creep rupture strength, $[FL^{-1}]$, *n—for geosynthetics*, the force per unit width that will produce failure by rupture in a creep test in a given time, at a specified constant environment **D5262**

tensile creep strain, *n*—the total strain at any given time. **D5262**

tensile modulus, *J*, (FL^{-1}), Nm^{-1}, *n—for geotextiles*, the ratio of the change in tensile force per unit width to a corresponding change in strain (slope). **D4595**

tensile strength, *n—for geotextiles*, the maximum resistance to deformation developed for a specific material when subjected to tension by an external force. **D4595**

tensile test, *n—in textiles*, a test in which a textile material is stretched in one direction to determine the force-elongation characteristics, the breaking force, or the breaking elongation. **D4595**

test result, *n*—a value obtained by applying a given test method, expressed either as a single observation or a specified combination of a number of observations. **D4354**

test section, *n*—a distinct area of construction. **D5818**

thickness, compressed—See **compressed thickness**.

turbulent flow, *n*—that type of flow in which any water particle may move in any direction with respect to any other particle, and in which the head loss is approximately proportional to the second power of the velocity. **D4716/D4716M**

turf reinforcement mat (TRM), *n—in erosion control*, a non-degradable geosynthetic or geocomposite processed into a matrix sufficient to increase the stability threshold of otherwise unreinforced established vegetation.

Discussion—Products in this category may incorporate ancillary degradable components to enhance the germination and establishment of vegetation.

typical value, *n—for geosynthetics*, the mean value calculated from documented manufacturing quality control test results for a defined population obtained from one test method associated with on specific property. **D4439**

vacuum chamber, *n*—a device that allows a vacuum to be applied to a surface. **D5641/D5641M**

vertical strip drain, *n*—a geocomposite consisting of a geotextile cover and drainage core installed vertically into soil to provide drainage for accelerating consolidation of soils.

Discussion—Also known as band drain, wick drain, or prefabricated vertical drain (PVD).

void ratio (e, (D)), *n*—the ratio of the volume of void space to the volume of solids. **D4439**

warp, *n*—the yarn running lengthwise in a woven fabric. **D4884/D4884M**

weft, *n*—see **filling**.

wide strip tensile test, *n—for geosynthetics*, a tensile test in which the entire width of a 200 mm (8.0 in.) wide specimen is gripped in the clamps and the gage length is 100 mm (4.0 in.). **D4885**

wide-width strip tensile test, *n—for geotextiles*, a uniaxial tensile test in which the entire width of a 200-mm (8.0-in.) wide specimen is gripped in the clamps and the gage length is 100 mm (4.0 in.). **D4595**

work-to-break (W, (LF)), *n—in tensile testing*, the total energy required to rupture a specimen. **D4439, D4595, D4885**

yield point, *n—in geosynthetics*, the point on the force-elongation curve at which the first derivative equals zero (the first maximum). **D4885**

ATTACHMENT B

Standard Practice for Collection of Settled Dust Samples
Using Wipe Sampling Methods for Subsequent Determination of Metals
ASTM D6966-18

Designation: D6966 – 18

Standard Practice for Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Determination of Metals[1]

This standard is issued under the fixed designation D6966; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the collection of settled dust on surfaces using the wipe sampling method. These samples are collected in a manner that will permit subsequent extraction and determination of target metals in the wipes using laboratory analysis techniques such as atomic spectrometry.

1.2 This practice does not address the sampling design criteria (that is, sampling plan which includes the number and location of samples) that are used for clearance, hazard evaluation, risk assessment, and other purposes. To provide for valid conclusions, sufficient numbers of samples should be obtained as directed by a sampling plan, for example, in accordance with Guide D7659.

1.3 This practice contains notes that are explanatory and are not part of the mandatory requirements of this practice.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1356 Terminology Relating to Sampling and Analysis of Atmospheres
D4840 Guide for Sample Chain-of-Custody Procedures
D7144 Practice for Collection of Surface Dust by Micro-vacuum Sampling for Subsequent Metals Determination
D7659 Guide for Strategies for Surface Sampling of Metals and Metalloids for Worker Protection
D7707 Specification for Wipe Sampling Materials for Beryllium in Surface Dust
E1792 Specification for Wipe Sampling Materials for Lead in Surface Dust

3. Terminology

3.1 For definitions of terms not listed here, see Terminology D1356.

3.2 *Definitions:*

3.2.1 *batch, n*—a group of field or quality control (QC) samples that are collected or processed together at the same time using the same reagents and equipment.

3.2.2 *wipe, n*—a disposable towellette that is moistened with a wetting agent. **E1792**

3.2.2.1 *Discussion*—These towellettes are used to collect samples of settled dust on surfaces for subsequent determination of metals content in the collected dust.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *field blank, n*—a wipe (see 3.2.2) that is exposed to the same handling as field samples except that no sample is collected (no surface is actually wiped).

3.3.1.1 *Discussion*—Analysis results from field blanks provide information on the analyte background level in the wipe, combined with the potential contamination experienced by samples collected within the batch (see 3.2.1) resulting from handling.

4. Summary of Practice

4.1 Wipe samples of settled dust are collected on surfaces from areas of known dimensions with wipes satisfying certain requirements, using a specified pattern of wiping.

4.2 The collected wipes are then ready for subsequent sample preparation and analysis for the measurement of metals of interest.

[1] This practice is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.04 on Workplace Air Quality.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

5. Significance and Use

5.1 This practice is intended for the collection of settled dust samples for the subsequent measurement of target metals. The practice is meant for use in the collection of settled dust samples that are of interest in clearance, hazard evaluation, risk assessment, and other purposes.

5.2 This practice is recommended for the collection of settled dust samples from hard, relatively smooth nonporous surfaces. This practice is less effective for collecting settled dust samples from surfaces with substantial texture such as rough concrete, brickwork, textured ceilings, and soft fibrous surfaces such as upholstery and carpeting. Micro-vacuum sampling using Practice D7144 may be more suitable for these surfaces. Collection efficiency for metals such as lead from smooth, hard surfaces has been found to exceed 75 % (Specification E1792).

6. Apparatus and Materials

6.1 *Sampling Templates*—One or more of the following: 10 cm by 10 cm (minimum dimensions) reusable or disposable aluminum or plastic template(s), or disposable cardboard templates, (full-square, rectangular, square "U-shaped," rectangular "U-shaped," or "L-shaped," or both); or templates of alternative areas having accurately known dimensions (see Note 1). Templates shall be capable of lying flat on a surface.

NOTE 1—For most surfaces, it is recommended to collect settled dust from a minimum surface area of 100 cm^2 to provide sufficient material for subsequent laboratory analysis. However, larger areas (for example, 30 cm by 30 cm) may be appropriate for surfaces having little or no visible settled dust, while a smaller sampling area (for example, 10 cm by 10 cm) may be appropriate for surfaces with high levels of visible settled dust. It is recommended to have a suite of templates with various sampling dimensions.

6.2 *Wipes,* for collection of settled dust samples from surfaces. Wipes shall be individually wrapped and fully wetted. The background metal(s) content of the wipes should be as low as possible. At a maximum, the background level of target metal(s) shall be no more than one-tenth the target concentration the metal(s) to be measured.

NOTE 2—Wipes meeting the requirements of Specifications E1792 or D7707, or both, may be suitable.

NOTE 3—Wipes made of cellulosic materials may produce fewer analysis problems than wipes made of synthetic polymeric materials.

6.3 *Sample containers,* sealable, rigid-walled, 30-mL minimum volume.

NOTE 4—Screw-top plastic centrifuge tubes are an example of a suitable rigid-walled sample container.

NOTE 5—Use of a sealable plastic bag for holding and transporting the settled dust wipe sample is not recommended due to the potential loss of collected dust within the plastic bag during transportation and laboratory handling. Quantitative removal and processing of the settled dust wipe sample by the laboratory is significantly improved through the use of sealable rigid-walled containers.

6.4 *Measuring tool,* tape or ruler, capable of measuring to the nearest ± 0.1 cm.

6.5 *Plastic gloves,* powderless.

6.6 *Cleaning cloths,* for cleaning of templates and other equipment.

NOTE 6—Wipes used for dust sampling (6.2) can be used for cleaning templates and other sampling equipment, but other cleaning cloths or wipes not meeting the requirements described in (6.2) may be suitable for this purpose.

6.7 *Adhesive tape,* suitable for securing the template(s) to the surface(s) to be sampled, and for demarcating sampling areas if templates are not used.

NOTE 7—Masking tape, for example, functions well for these purposes.

6.8 *Disposable shoe covers,* optional.

7. Procedure

7.1 Use one of the following two options when collecting settled dust samples from each sampling location. For wide, flat locations, it is recommended to use the template-assisted sampling procedure (see 7.1.1.2 (*1*)). For small locations (for example, window sill, section of a piece of equipment, or portion of a vehicle interior), it will ordinarily be necessary to use the confined-area sampling procedure (see 7.1.1.2 (*2*)).

NOTE 8—Metal contamination problems during field sampling can be severe and may affect subsequent wipe sample analysis results. Contamination can be minimized through frequent changing of gloves, use of shoe covers (see 6.8), and regular cleaning of sampling equipment with cleaning cloths (see 6.6). Use of disposable shoe covers between different locations, and removal of them prior to leaving the sampling site or entering vehicles, can be helpful in minimizing inadvertent transfer of contaminated dust from one location to another.

7.1.1 *Sampling Procedure:*

7.1.1.1 Don a pair of clean, powderless, plastic gloves (see 6.5 and Note 8).

7.1.1.2 Use either a template-assisted sampling procedure (*1*) or tape-defined sampling procedure (*2*):

(*1*) Carefully place a clean template on the surface to be sampled in a manner that minimizes disturbance of settled dust at the sampling location. Tape the outside edge of the template to prevent the template from moving during sample collection.

(*2*) Alternatively, mark the defined area to be sampled with adhesive tape (6.7) being careful not to disturb the settled dust, and measure the area to be sampled using the measuring tool (6.4).

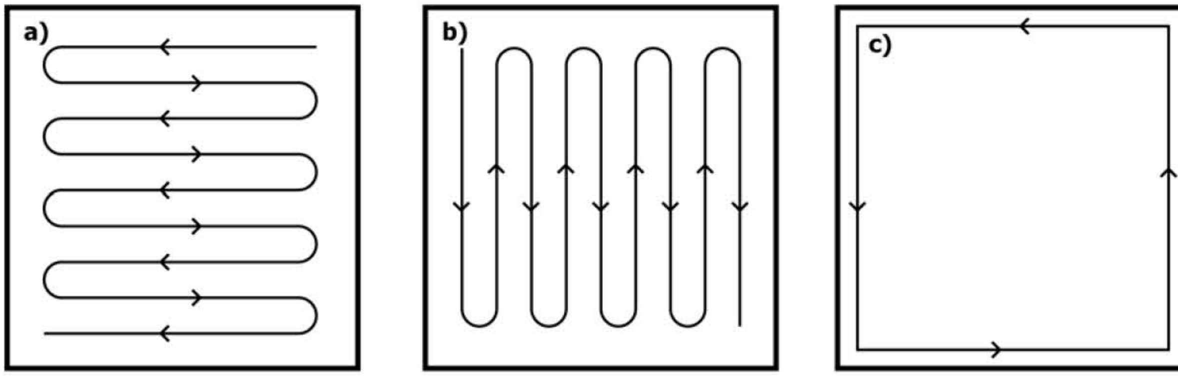
7.1.1.3 Obtain a wipe (6.2) and, if there is a possibility for the package containing the wipe to be contaminated with dust, clean the outside of the package with a cleaning cloth (6.6).

7.1.1.4 Remove the wipe from its package, and inspect the wipe to ensure that it is fully wetted and not contaminated with dust or other material. Discard the wipe if it is found to be too dry or contaminated, or both.

7.1.1.5 Using an open flat hand with the fingers together, place the wipe on the surface to be sampled. Wipe the selected surface area, side to side, in an overlapping "S" or "Z" pattern while applying pressure to the fingertips (refer to Figs. 1 and 2). Wipe the surface so that the entire selected surface area is covered. Perform the wiping procedure using the fingers and not the palm of the hand.

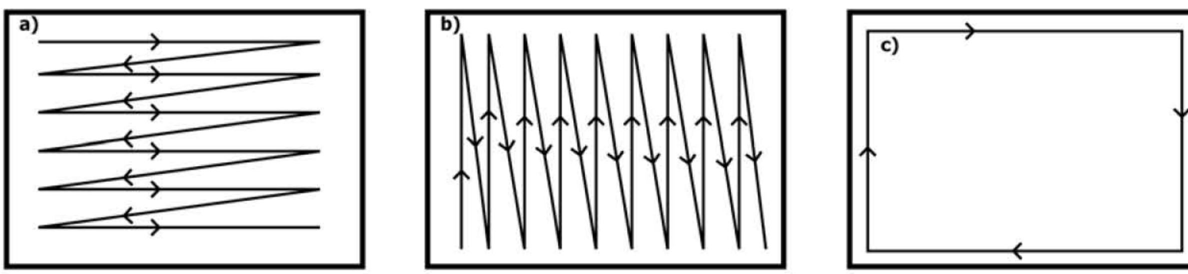
7.1.1.6 Repeat 7.1.1.5 using a different brand of wipe (after selecting a different sampling location) if the wipe originally used significantly changes shape (for example, rolls up by curling) or tears during the wiping process.

NOTE 9—Some surfaces (for example, rough surfaces) may cause certain wipes to curl up or otherwise significantly change shape during the wiping process. A type of wipe that maintains its integrity should be selected for each surface sampled.



NOTE 1—Only the center of the wiping path is shown, not the entire wiping width. Fig. 1a) shows the first "S" wiping pattern over the surface area to be sampled; Fig. 1b) demonstrates the second "S" wiping course over the surface; and Fig. 1c) shows the final wiping which is targeted toward edges and corners.

FIG. 1 Schematic of a Side-to-Side Overlapping "S" Wiping Pattern



NOTE 1—Only the center of the wiping path is shown, not the entire wiping width. Fig. 2a) shows the first "Z" wiping pattern over the surface area to be sampled; Fig. 2b) demonstrates the second "Z" wiping course over the surface; and Fig. 2c) shows the final wiping which is targeted toward edges and corners.

FIG. 2 Schematic of a Side-to-Side Overlapping "Z" Wiping Pattern

7.1.1.7 Fold the wipe in half with the collected dust side folded inward and repeat the preceding wiping procedure (7.1.1.5) within the selected sampling area using an up and down overlapping "S" or "Z" pattern at right angles to the first wiping (see Fig. 1, Fig. 2, and Note 10).

NOTE 10—Wipes are folded to envelop the collected dust within the wipe, to avoid loss of the collected dust, and to expose a clean wipe surface for further dust collection from the sampling location. For sample areas containing large amounts of settled dust, carefully wipe the area to ensure as much dust as possible within the wipe is captured.

7.1.1.8 Fold the wipe in half again with the collected dust side folded inward and repeat the wiping procedure one more time, concentrating on collecting settled dust from edges and corners within the selected surface area (see Fig. 1, Fig. 2, and Note 10).

7.1.1.9 Fold the wipe again with the collected dust side folded inward and insert the wipe into a sample container (6.3).

7.1.1.10 Label the sample container with sufficient information to uniquely and indelibly identify the sample.

7.1.1.11 Record the dimensions (in square centimetres) of the selected sampling area (that is, the internal dimensions defined by the template or the taped area) or that the sample is a blank.

7.1.1.12 Discard the gloves.

7.2 Collect field blanks at a minimum frequency of 5 % (at least one field blank for every 20 wipe samples collected). The minimum number of field blanks to collect for each batch of wipe samples used should be three. Place field blanks in sample containers and label these samples in the same fashion as the collected surface dust samples (see 7.1.1.10).

7.3 Follow sampling chain of custody procedures to ensure sample traceability. Ensure that the documentation which accompanies the samples is suitable for a chain of custody to be established in accordance with Guide D4840.

8. Records

8.1 Field data related to sample collection shall be documented in a sample log form or field notebook (see Note 11). If field notebooks are used, then they shall be bound with pre-numbered pages. All entries on sample data forms and field notebooks shall be made using ink, with the signature and date of entry. Any entry errors shall be corrected by using only a single line through the incorrect entry (no scratch outs), accompanied by the initials of the person making the correction, and the date of the correction (see Note 12).

8.1.1 *Electronic Laboratory Notebooks*—If electronic laboratory notebooks, or ELNs, are used in lieu of a field notebook or sample log, procedures shall be implemented to assure the integrity of the data recorded, including prevention of falsification or other unauthorized changes, and regular backup of data.

NOTE 11—Field notebooks are useful for recording field data even when preprinted sample data forms are used.

NOTE 12—These procedures are important to properly document and trace field data.

8.2 At a minimum, the following information shall be documented:

8.2.1 Project or client name, address, and city/state/country location.

8.2.2 General sampling site description.

8.2.3 Information as to the specific collection protocol used (for example, template-assisted; "Z"-wiping pattern, etc.).

8.2.4 Information as to the specific type or brand of wipes used, including manufacturer and lot number.

8.2.5 Information on quality control (QC) samples: which samples are associated with what group of field blanks.

8.2.6 For each sample collected (including field blanks): an individual and unique sample identifier and date of collection. This information shall be recorded on the sample container in addition to the field documentation.

8.2.7 For field samples (not including field blanks), record in field documentation (field notebook or sample log form) the dimensions of each area sampled (in square centimetres).

8.2.8 For each sample collected: name of person collecting the sample, and specific sampling location information from which the sample was removed.

9. Keywords

9.1 metals measurement; sample collection; settled dust; surfaces; wipe

ATTACHMENT C

A Leachate Pond Geomembrane After 25 years of Service

Industrial Fabrics Association International

A leachate pond geomembrane after 25 years of service

February 1st, 2019 / By: Richard Thiel / Feature

FIGURE 1 Aerial view of operational leachate and rainwater ponds built 25 years ago

This article reports on the evaluation of an exposed geomembrane liner in a landfill leachate pond after being in service for 25 years. The evaluation was performed in two campaigns: in August 2014 and in May 2018. The purpose of the evaluation was to determine the condition of the geomembrane and to provide a recommendation to the owner on whether or not it was in need of imminent replacement. The results of the evaluation indicate that the geomembrane appears to be in decent condition and is expected to last some number of additional years, but the definitive number is not possible to estimate. Based on the work performed in 2014, it seems that the material is still readily repairable, if need be. Recommendations for future periodic inspection and testing are provided herein.

The leachate pond is a 5-million-gallon (19-million-L) double-lined leachate storage pond that was constructed

Materials
Geocells
Geogrids
Geomembranes
Geosynthetic Clay Liners
Geotextiles
Member News
News
Company News
COVID-19
Events
GMA News
GSI News
IGS-NA (NAGS)
Industry News
Industry News
Panorama
People
Updates
Premier Product Preview
Press Release
Press Release
Products
ShowStoppers
Projects
Resources
Designer's Forum
Technical
Specifications
Testing & Codes
White Papers

for the Headquarters Landfill in Cowlitz County, Wash., in 1993. The pond is designed with a dividing berm that partitions the pond into two equal, symmetric halves. The dividing berm is lined over its top so that the liner system is continuous between the two pond halves. The southern half of the pond has historically contained various levels of clean rainwater, with only occasional containment of leachate toward the end of a few wet winters. The northern half of the pond has historically been the primary management basin for leachate storage, and its sump is used for leachate transfer via an outlet pipe. **Figure 1** shows an aerial view of the ponds.

The pond was operated for 21 years by Weyerhaeuser for its forest products landfill, the leachate of which derived from pulp and paper industrial waste, ash, and related industrial and construction waste. In 2014 the county purchased the landfill, and since that time the landfill has been operated as a mixed municipal solid waste (MSW)/industrial waste landfill.

TABLE 1 Summary of test results for headquarters landfill facility leachate pond primary geomembrane

The 80-mil (2-mm) primary exposed geomembrane that was installed in 1993 was manufactured by GSE Environmental (then Gundle) as a custom order with three co-extruded layers. The top layer is textured high-density polyethylene (HDPE) with a white pigment. The middle layer is very low density polyethylene (VLDPE). The bottom layer is smooth HDPE containing extra carbon black to make it electrically conductive for spark testing. The original project specifications and conformance testing results for the primary pond geomembrane are included in **Table 1**.

Sampling strategy and field observations

In 2014 two above-water samples were taken and tested. Sample #1 was taken from the anchor trench. Sample #2 was taken from the middle of the berm slope on the southern pond (which is south facing) near the crest of the slope. The sample was 12-inches wide × 48-inches long (30-cm × 122-cm) (parallel to the slope crest). The hole was easily repaired with HDPE geomembrane that was on-site for construction of a new landfill cell.

In May 2018 two “below-water” samples were taken from rub sheets in the bottoms of both the southern and northern halves of the pond that had been largely submerged for the past 25 years. Sample #3 was taken from the southern pond that typically contained clean rainwater, and Sample #4 was taken from the northern pond that had continuously contained landfill leachate. Due to sediment and sludge buildup around the outlet in the sump of the northern pond, that pond was cleaned in April 2018. The southern pond also had to be completely emptied and cleaned at this time, because it had been used temporarily for leachate management in the past winter and needed to be prepared to store clean water again. The cleaning activities in both ponds at this time allowed access to the pond bottoms where samples could be cut from existing loose rub sheets. It should be noted that the conditions of the rub sheets would be conservative in the sense that both sides of the rub sheets had been exposed to the contained fluids, whereas for the primary geomembrane, only the upper side would have been exposed to the contained fluids.

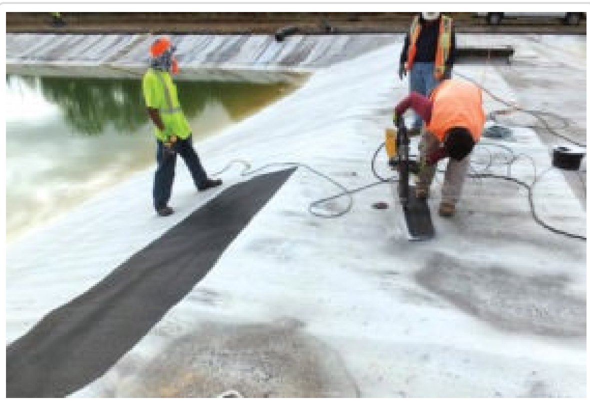


FIGURE 2 Patching a hole in pond liner where a sample was taken for testing in May 2014. The photograph shows trial weld being performed

Visual inspection of the exposed and cleaned geomembrane in both halves of the pond indicated the geomembrane to be in good condition with no signs of degradation or cracks. While *where new HDPE is being welded to old pond liner.*

no repair welds were required in 2018, the repair welds performed in 2014 appeared to be successful with excellent trial-weld field test observations. **Figure 2** shows a patch being installed on the sampling location, **Figure 3** shows the beginning of removing sludge from the northern half of the pond in 2018, and **Figure 4** shows the empty northern pond after cleaning.

Results

The samples that were taken in 2014 and 2018 were tested for a suite of index and performance parameters. A summary of the results for both the 2014 and 2018 testing campaigns is presented in **Table 1**. The anchor trench sample appears to meet or exceed the original project specifications. Where there are actual test results from 1993 (thickness, density, carbon black content, carbon black dispersion, tensile break strength and tensile break elongation), there appear to be no degradation in the anchor trench sample. We note there are still substantial oxidative induction time (OIT) and high-pressure oxidative induction time (HP-OIT) values in the anchor trench sample that would exceed current GRI-GM13 standards for new geomembranes. The stress crack results from the single point-notched constant tensile load test (SP-NCTL) are exceptional, which is undoubtedly due to the VLDPE core. Having this stress crack-resistant core was the original purpose of coextruding with VLDPE.

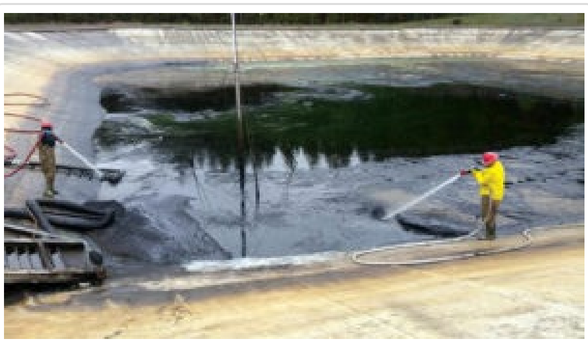


FIGURE 3 April 2018 cleaning sludge from northern half of pond

Comparing the test results between the 2014 above-water exposed sample, the 2018 below-water sample from the northern (leachate) side of the pond, and the 2018 below-water sample from the southern (rainwater) side of the pond indicates very interesting patterns of degradation. With the exception of HP-OIT, the least amount of degradation (as indicated by the test results) occurred in the below-water sample from the leachate (northern) side of the pond. This result was the opposite of what was expected. For HP-OIT, the least amount of degradation occurred in the above-water sample.

The greatest amount of degradation, across the board, occurred in the below-water sample from the rainwater (southern) side of the pond.

Degradation in the exposed above-water sample from 2014 was generally midway between the other two samples, with the exceptions of melt flow index (MFI) and HP-OIT, where it had the least amount of degradation. The small amounts of apparent degradation in tensile yield strength, puncture and tear (all < 10%) in the below-water samples is probably not substantial.

FIGURE 4 April 2018 northern half of pond after cleaning

The increase in MFI of 14% in both of the below-water samples is not excessive but is relatively substantial evidence that some level of polymer-chain breakdown is occurring in the primary geomembrane as a result of submergence. However, it is not known in which of the three coextruded layers of the primary geomembrane this might be occurring. That could be determined through more sophisticated testing.

The most significant test parameters of concern that indicate substantive degradation are the OIT test results that reveal a substantial amount of depletion of the antioxidant package. These results indicate that even though there was some significant degradation, especially in the rainwater side of the pond, there are still ample stabilizers present in the material to protect it for some time, but exactly how much time is not predictable.

The key performance test result is the SP-NCTL stress crack test data, in which all samples continue to perform well.

Discussion

Why was the below-water leachate sample the least degraded? Perhaps the leachate contains a soup of dissolved solids and compounds that was not aggressive in using up or dissolving the antioxidant package and also provided a low diffusion gradient potential for leaching and blooming of antioxidants from the interior of the geomembrane to its surface, and thus preserved the antioxidants within the geomembrane.

Conversely, the clean rainwater may create a high diffusion-gradient differential to pull antioxidants to the surface of the geomembrane. The “very clean” and aggressive pure rainwater may also react with the antioxidants or cause them to move out of the geomembrane and go into solution with the water. In the same manner, the aggressive and very clean water may have also attacked the polyethylene resin at a higher rate than either the leachate or the atmosphere, resulting in apparent degradation in tensile properties.

One interesting conclusion that could be derived from the testing is that if the geomembrane is going to experience failure, it will likely occur on the clean rainwater side of the pond before the leachate side of the pond. This is good news for the pond operator who is wondering when the liner should be replaced. If a failure would occur significantly in advance in the rainwater side of the pond compared to the leachate side, then that may allow adequate response time and not be of great consequence because the water is clean. The clean (southern) side of the pond could be immediately emptied and relined, followed by a transfer of leachate to the relined southern side, and a subsequent relining of the northern side, hopefully before the northern side fails.

While this study was very fortunate in being able to evaluate four samples from a range of exposure conditions (anchor trench, above-water exposed, below-water leachate and below-water rainwater), there could exist elevation zones in both halves of the pond, such as at the waterline, or various UV exposure locations that created a higher level of degradation than any of the samples that were retrieved.

FIGURE 5 Photograph from 2014 of original razor-blade slit that extended through the white surface into the VLDPE core. During the NCTL stress-crack test, the sharp notch eventually blunted and did not propagate, which is a testimony to the functionality of the VLDPE core to resist stress cracking. No photographs were taken in 2018, but the NCTL results indicated continued very strong performance for this test.

In 2014 the testing laboratory took some close-up photographs (e.g., **Figure 5**) of the razor-blade slit in the test specimen during the SP-NCTL test. It was clear, even in such photographs, that blunting of the sharp razor cut had occurred during the test due to the performance of the VLDPE core and that cracks will not easily expand through the VLDPE layer. This provides further confidence that a sudden failure may not be catastrophic, especially considering the presence of a complete secondary geomembrane and leakage collection layer between the primary and secondary geomembranes.

Conclusions, recommendations, qualifiers and other considerations

Field observations indicated that the exposed geomembrane is in decent shape after 25 years of service and shows no visible signs of degradation. There does not appear to be any leakage of leachate into the leakage detection layer in these double-lined ponds, which is again indicative of positive primary liner performance.

Laboratory test results of geomembrane samples taken from the northern and southern halves of the pond support the field observations and indicate that there are still ample stabilizers present to protect this material for some years to come, perhaps even on the order of five to ten years. We must add a caveat that these conclusions with the fact that a limited number of samples were taken, and there could be more critical areas that were not detected.

Based on these results, the team concluded that the leachate pond can continue in operation in the same manner it has been since put into service 26 years ago. The owner was advised to obtain additional samples from the southern pond in three years' time and that it be tested for the same parameters that were tested in this study. This will allow for a better estimate to be made of remaining lifetime. The sample would be of highest value if it could be taken in the summer when the water level is low and a trial weld be performed to continue to assess liner repairability. In addition, the leakage detection sumps should continue to be monitored. Some leakage can be allowed to the extent that it would not exceed 12 inches (30 cm) of head on the secondary liner system outside the sumps. Since there is a dual-basin system in the pond, one side of the pond could be taken out of service, if need be, while the pond was operated from the other side.

Richard Thiel, P.E., is the president of Thiel Engineering in Oregon House, Calif.

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CCR Clean Closure of Joliet Pond 2
Liner Repair Performance Testing Requirements
Attachment 1

The performance tests for the repairs of the liner in Pond 2 shall be conducted in accordance with Section 3.05 Field Quality Control located in the Guidelines for Installation of HDPE Geomembrane Installation created by the International Association of Geosynthetic Installers, revised November 1, 2015. The pertinent sections from that document for performance testing are provided below and shall be followed to verify the repair installations.

A. Field Seam Non-destructive Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Owner's Representative.

2. Testing should be done as the seaming work progresses, not at the completion of all field seaming, unless agreed to in advance by the Owner's Representative. All defects found during testing shall be numbered and marked immediately after detection. All defects found should be repaired, retested and remarked to indicate acceptable completion of the repair.

3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.

4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Owner's Representative all test methods to verify the test procedures are valid.

5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:
   a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.
   b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig). c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 0.3m (12 in) by 1.2m (48 in) (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately five (5) seconds. The geomembrane should be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after five (5) seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.
   d. All areas where soap bubbles appear shall be marked, repaired and then retested.
   e. At locations where seams cannot be nondestructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in section B below) or equivalent should be substituted.

f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test

6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D 5820 and ASTM D 4437 and the following equipment and procedures:
   a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.
   b. The testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed. Allow two (2) minutes for the injected air to come to equilibrium in the channel, and sustain pressure for five (5) minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.
   c. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.
   d. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

B. Spark testing should be done in areas where both air pressure testing and vacuum testing are not possible.

1. Equipment for spark testing shall be comprised of but not limited to a hand held holiday spark tester and conductive wand that generates a high voltage.

2. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non-welded segment shall be subject to a calibration test to ensure that such a defect (nonwelded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.

3. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.

4. Care should be taken if flammable gases are present in the area to be tested.

CCR Clean Closure of Joliet Pond 2
Scope-Of-Work

- **The vendor shall** remove all solids from Pond 2 and dispose at a licensed disposal facility. The vendor shall use 7,400 tons of material removal (not including liquids) as the estimate for this bid. The vendor shall be paid based on the actual tonnage of the material disposed at the licensed disposal facility. The actual tonnage will be obtained from the licensed disposal facility.
- **The vendor shall** supply all equipment needed for accomplishing this scope of work:
  - The vendor shall remove ALL material from Pond 2, including the entire extent of the warning layer material. (This is a project to clean Pond 2 of all CCR; this is not a simple dredging project in which room is being made for additional solids settling).
  - Vendor shall perform the following:
    - Wash down sides of Pond 2 to an initial clean condition (NRG shall determine cleanliness).
    - Dewater Pond 2 as needed to dredge. The water from this operation shall be placed into pond 1 after contractor filters the water through a filter made for this purpose (e.g., “geotube”, ”dirtbag”, ”dewatering bag”, etc.). THE WATER PLACED IN POND 1 SHALL BE VISIBLY CLEAR. Visibly clear shall be determined by collecting water in a clear container and allowing water to stand for two (2) minutes at which point it will be viewed by NRG.
      - Plans to be detailed by contractor in bid
    - All removed solids will be transported to a licensed disposal facility.
      - Plans to be detailed by contractor in bid and shall comply with 35 Ill. Adm. Code 845.740(c).
    - Repair any and all damage to the 60 mil pond liner which results from this scope-of-work. Liner Repairs to be made by sub-contracting the repairs to Clean Air and Water Systems LLC of Dousman, WI, 262-965-4369 or equivalent repair vendor approved by NRG. Repair material required for restoration of the liner integrity shall be the responsibility of the contractor.
      - The Contractor shall detail repair plans in their bid.
      - Attachment 1 contains the liner repair testing requirements.
- **The vendor shall** provide and manage pumping equipment and filtering equipment as needed to dewater Pond 2 such that there is no release of sediment laden water to the environment. The vendor shall dispose of water from dewatering by depositing same into the adjacent Pond 1. All water disposed of (deposited into) Pond 1 shall be visibly clear of suspended solids. Vendor may propose alternate water disposal method in bid proposal for NRG’s consideration.
- **The vendor shall** disposal of dewatering liquids such that there is no release of liquids to the public roadways or the environment.
- **The vendor shall** make any and all necessary repairs to Pond 2 access roads if damaged.
- **The vendor shall** minimize the occurrence of dust. We cannot have any dust complaints from neighbors - preventative actions need to be taken before trucking begins.
  - Plan to be detailed in bid.
- **The vendor shall** provide means to clean trucking equipment to avoid getting material on public roads/byways and Joliet Station roadways.
  - Plan to be detailed in bid.

- **The vendor shall** keep track of material removed in a logbook w/ three-way matching/comparison between truck tickets, gatehouse log and invoicing.
- **The vendor shall** provide weight capacity (tons) per truck prior to commencing work. Truck capacity should be w/in 10% of actual capacity.
- **The vendor shall** submit work-loaded schedule with bid proposal. Schedule shall include contingency plan for 10 days of weather-related delays.
- **The vendor shall** leave the area around Pond 2 in the same clean condition as it was in at the beginning of project.
- **The vendor shall** provide safety spotter at Pond 2 whenever heavy equipment is being used.
- **The vendor shall** provide all goods, materials, labor and supervision, tools and equipment, and technical expertise to accomplish this scope of work. This vendor supplied equipment shall include, but is not limited to, dewatering pumps and dewatering filters, high pressure washers, excavation and associated heavy equipment, transport trucks, street sweepers (as needed for public roadways), water wagons (for dust control as needed), and Vac Trucks.

ATTACHMENT 6
FACILITY/COMPONENT PLANS AND SPECIFICATIONS

Attachment 6 – No Attachment

ATTACHMENT 7
CLOSURE CONSTRUCTION

Attachment 7-1 – Final Closure Plan

FINAL CLOSURE PLAN
POND 2
JOLIET #29 STATION
JANUARY 25, 2022

1.0 Introduction [845.720(b)]

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). MWG removed all of the coal combustion residuals ("CCR") from Pond 1 and decontaminated the liner before October 2015, and repurposed the pond as a low volume wastewater pond.[1] Pond 3 is a *de minimis* pond and is not a CCR surface impoundment. 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 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.

As required by 845.700(b), Midwest Generation will be closing Pond 2. A preliminary closure plan was submitted as part of the Joliet 29 Pond 2 operating permit application and is finalized as part of submitting the construction permit application to execute the closure of Pond 2. This final closure plan has been executed in accordance with 845.720(b), which includes completing a closure alternatives analysis. Pursuant to 845.710, a closure alternatives analysis was completed prior to selecting the closure method that will be used for Pond 2 and described in this final closure plan. The closure alternatives analysis was performed to evaluate the closure methods involving closure by removal and closure in place and is included as part of this final closure plan in Attachment 1.

Midwest Generation has filed a Petition for an Adjusted Standard with the Illinois Pollution Control Board requesting that Midwest Generation may reuse the existing HDPE liner in Pond 2. *In the Matter of: Petition of Midwest Generation for an Adjusted Standard from 845.740(a) and Finding of Inapplicability of Part 845*, PCB AS21-02. With the petition, "Midwest Generation plans to keep the structure of the pond intact for use for non-CCR material". Approval of the petition would allow Midwest Generation to keep intact the existing inlet and outlet structures as well as the existing 60-mil HDPE geomembrane liner that was installed in 2008. The petition would seek to remove the existing warning layer and seek to decontaminate the existing geomembrane liner.

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

The closure alternatives analysis report evaluated three different closure methods. The three different methods evaluated consisted of the following:

- Closure by removal in accordance with Section 845.740;
- Closure by Removal based on Midwest Generation's Adjusted Standard Petition;
- Closure in place with a final cover system in accordance with Section 845.740.

The closure alternatives analysis identified that closure by removal based on Midwest Generation's Adjusted Standard Petition is as effective at protecting the environment when compared to the other two options and will cause the least disturbance to the surrounding neighborhood and is selected as the chosen closure alternative. This final closure plan identifies the steps necessary to execute the closure and the schedule to complete the closure for Pond 2.

2.0 Closure Narrative [845.720(a)(1)(A)]

The closure of Pond 2 will be by removal in accordance with Ill. Adm. Code 35 Part 845.740(a) and Midwest Generation's Adjusted Standard Petition. The CCR was previously removed from Pond 2 in 2019 and only the warning layer remains within the bottom of the pond. Executing the closure outlined in this plan would be to remove the remaining warning layer and decontaminate the geomembrane liner, inlet trough, and outlet structure.

Executing the closure by removal for Pond 2 is a multi-step process. First, the remaining CCR was removed from the sides of the liner using an excavator to pull down as much of the material as possible from the slopes onto the warning layer. Next the liner side slopes were pressure washed to remove the rest of the material on the slope. The previously described work was completed in 2019. The next steps would be to remove the warning layer from the base of Pond 2 using an excavator or front end loader and hauled off-site for disposal. The excavator or front end loader would also use a rubber surface on the edge of the bucket to protect the geomembrane as the material is scooped. Once the warning layer material is removed from the base, the entire slopes and base of Pond 2 would be pressure washed. The liner slopes and base would be visually inspected and any damages observed would be repaired. After the liner is clean and any necessary repairs are made, wipe samples would be collected and analyzed to confirm the geomembrane liner has been decontaminated. The wipe sampling would be performed in accordance with ASTM D6966-18 and laboratory testing would be performed for metals and other chemical constituents, as necessary. One wipe sample and test would be performed per acre of geomembrane liner in Pond 2. The above described closure process was included in Midwest Generation's petition for an adjusted standard as Exhibit 3.

Once the liner decontamination process is complete and verified, Pond 2 will be used to manage the Joliet 29 station's non-CCR waste streams. These non-CCR waste streams are the service-water/low volume wastewater from the RO sand filter backwash, the west area basin, the former coal pile runoff pump discharge, and the plant drains, including the Station floor drains, and roof drains and area drains.

3.0 CCR Removal and Decontamination [845.720(a)(1)(B)]

Closure of Pond 2 will be through removal in accordance with Midwest Generation's Adjusted Standard Petition and 845.740(a). The first step in the closure process is to remove any precipitation that has accumulated within Pond 2 because Pond 2 has not been in service since the spring of 2019 when the CCR was removed. The accumulated water will be mechanically pumped from Pond 2 and discharged into Pond 1 using filtration as necessary to remove any total suspended solids. Excavating sumps, excavating trenches and utilizing earth moving equipment to pile the warning layer may also occur to promote drainage and further dewater the pond, as needed.

The warning layer will be removed through mechanical excavation once the pond has been sufficiently dewatered. A mechanical excavator or other type of loading equipment will excavate the warning layer material and load it into dump trucks. Once the warning layer material has been mechanically loaded it will be hauled to a regulated disposal facility. The trucks hauling the warning layer material will transport the material in accordance with 84.740(c)(1), which includes carrying disposal manifests and moving the material in accordance with a transportation plan. As the warning layer material is being excavated and loaded, on-site fugitive dust control measures will be implemented as needed. Any warning layer remnants will be removed through washing/rinsing and/or vacuuming or another method as determined by the cleaning contractor. The warning layer remnants will be containerized and hauled offsite to a permitted disposal facility. In addition, any CCR remnants will be removed from the pond inlet and outlet structures through mechanical means and also by washing/rinsing. The CCR remnants will be containerized and hauled offsite to a permitted disposal facility.

CCR removal and decontamination will be considered complete when the warning layer has been removed from the pond and the inlet and outlet structures have been decontaminated. The decontamination process will be determined through wipe sampling conducted at a ratio of one wipe test every acre of liner and the wipes will be laboratory analyzed. In addition, groundwater monitoring in accordance with 845.740(b) will be conducted for three years after the completion of the warning layer removal and decontamination.

4.0 Closure with CCR Left in Place [845.720(a)(1)(C)]

Closure of Pond 2 will be through removal of CCR and decontamination of areas affected by CCR. Therefore, this requirement is not applicable.

5.0 Maximum Inventory of CCR [845.720(a)(1)(D)]

The estimated maximum inventory of CCR on-site contained in Pond 2 is approximately 45,000 cubic yards based upon the estimated quantity prior to the pond's cleaning in the spring of 2019.

6.0 Largest Area of CCR Requiring a Final Cover [845.720(a)(1)(E)]

Pond 2 will be closed by removing the CCR in accordance with 845.740 and the Adjusted Standard Petition; therefore, this section is not applicable to this closure plan.

7.0 Closure Schedule [845.720(a)(1)(F)]

Implementation of closure through removal of CCR is estimated to require 2 years. Closure is anticipated to begin in 2022 and estimated to be completed sometime in 2024. Prior to initiation of closure, a notice of intent to close will be prepared in accordance with §845.730(d) and an Illinois Environmental Protection Agency (IEPA) construction permit will be obtained. A preliminary schedule of anticipated closure activities is included below. Some of the activities noted in the table below can occur at the same time and the schedule time listed is the anticipated time to complete both activities.

Closure Schedule

Closure Activity	Estimated Duration
Complete Closure Construction Documents and Obtain IEPA Closure Construction Permit	15 months
Dewater	1 month
Excavate Warning Layer	1-2 weeks
Decontaminate Pond Liner	1 month
Decontaminate Pond Inlet & Outlet Structures	1 month
Closure Certification and Report	6 months

8.0 Initiation and Completion of Closure Activities [845.730 & 845.760]

Closure activities will commence when one or more of the following conditions have occurred:

- No later than 30 days after the date on which the CCR unit received the known final receipt of CCR or non-CCR waste;
- No later than 30 days after the removal of the known final volume of CCR for the purpose of beneficial use;
- Within two years of the last receipt of waste for a unit that has not received CCR or non-CCR waste; or
- Within two years of the last removal of CCR material for the purposes of beneficial use.

Upon completion of the IEPA approved closure activities, a closure report and closure certification will be submitted to IEPA in accordance with 845.760(e). The closure report will contain the following information, 1) engineering and hydrogeology reports, including monitoring well completion reports and boring logs, all CQA reports, certifications, and designations of CQA officers-in-absentia required by Section 845.290; 2) photographs, including time, date and location information of the photographs, of the final cover system and groundwater collection system, if applicable, and any other photographs relied upon to document construction activities; 3) a written summary of closure requirements and completed activities as stated in the closure plan and in Part 845; and 4) any other information relied upon by the qualified professional engineer in making the closure certification.

In accordance with 845.760(f), notification of closure of a CCR unit will be made within 30 days of IEPA's approval of the submitted closure report and closure certification. The notification will include certification from a qualified profesional engineer, as required by 845.760(e)(2) and will be placed in the facility's operating record.

9.0 Closure Plan Amendments [845.720(a)(3)]

This Closure Plan will be amended in accordance with 845.720(a)(3). If a change in the operation of Pond 2 would be substantially affect the content of this Closure Plan or if unanticipated events necessitate revision of the plan. If a change in operation requires amendment to the Closure Plan, the plan will be amended no later than 60 days prior to the change in operation being implemented. If an unexpected event occurs that requires amendment of the Closure Plan, the plan will be amended within 60 days of the unexpected event or within 30 days of the unexpected event if the event occurs after closure activities have commenced. Amendments to this Closure Plan will be certified by a professional engineer registered in the State of Illinois in accordance with 845.720(a)(4).

10.0 Professional Engineer's Certification [845.720(a)(4)]

This Closure Plan has been prepared to meet the requirements of Ill. Adm. Code Title 35 845.720(b).

1/25/22

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

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062-061945
LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

Attachment 7-2 – Closure Alternatives Analysis

KPRG

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG and Associates, Inc.

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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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 ponds (Ponds 1 and 2) and a service water basin (Pond 3). Ponds 1 and 3 are not 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 $1/16^{th}$ -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 make 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 monofill 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 for mechanical evacuation of 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.

1/26/22

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SEAL

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FIGURES

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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

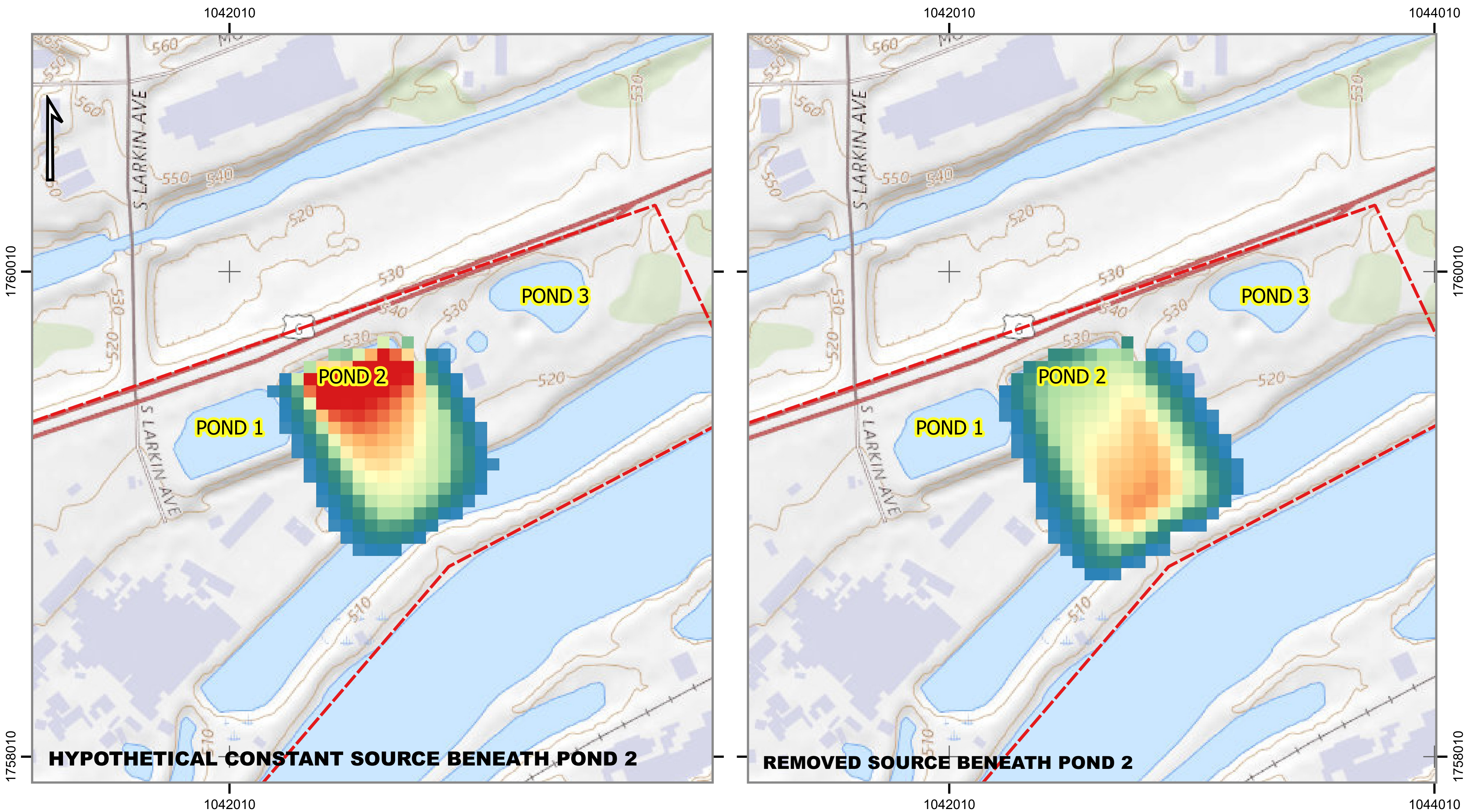
Closure Costs for Closure By Removal & Disposal at Lincoln Stone Quarry

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

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

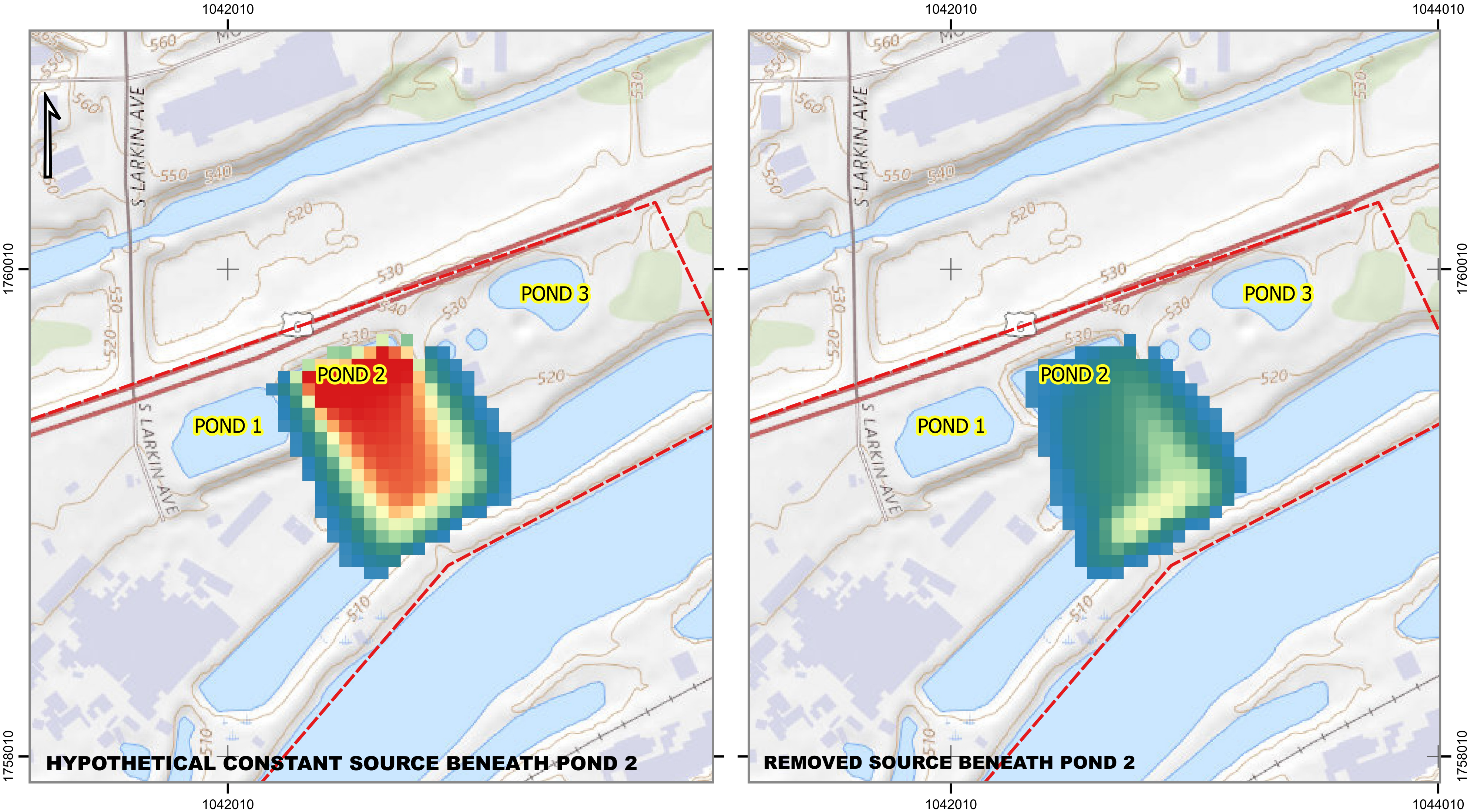
0 300 600 ft

FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure15_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	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **1**		



LEGEND

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

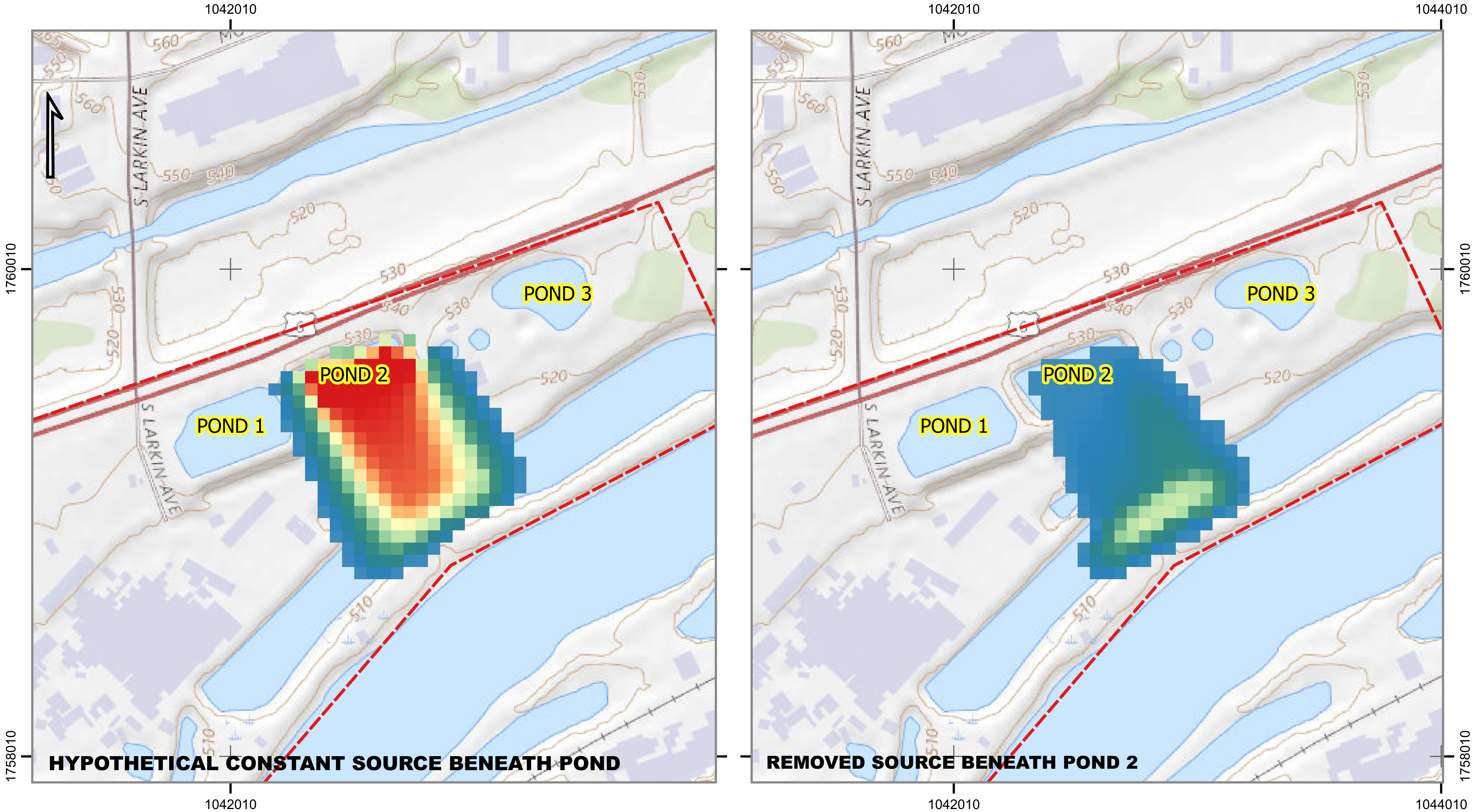
KPRG

0 300 600 ft

FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure16_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	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **2**		



LEGEND

APPROXIMATE SITE BOUNDARY

RELATIVE CONCENTRATION

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0.10000	0.80000
0.20000	0.90000
0.30000	1.00000

BAS GROUNDWATER CONSULTING

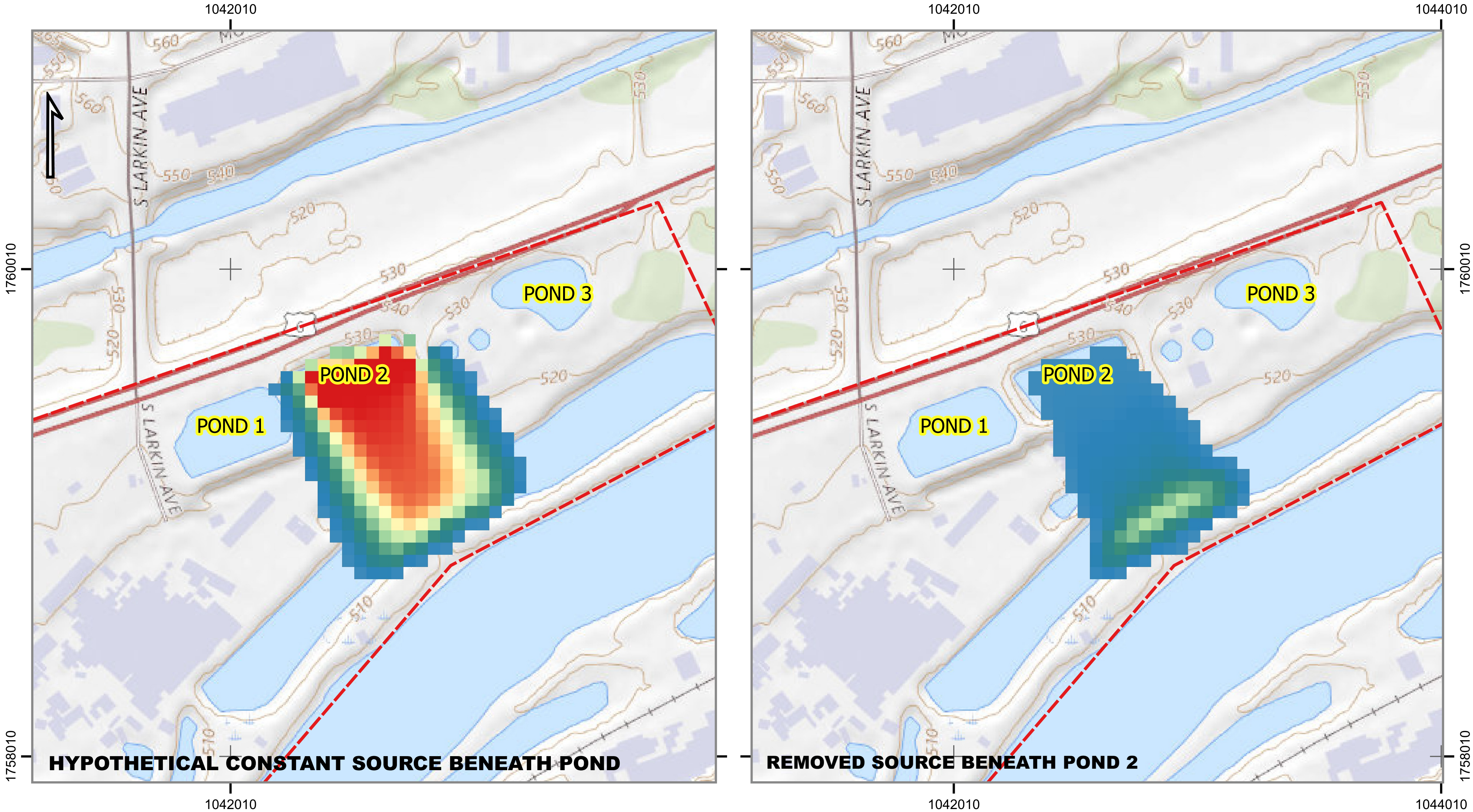
KPRG

0 300 600 ft

FEET

Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure17_50YearPlumeDistributions.qgz

CLIENT	MIDWEST GENERATION, LLC		
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL		
TITLE	**50-YEAR PLUME DISTRIBUTION**		
SCALE AT ANSI A 1:7,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: **3**	



LEGEND

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

K P R G

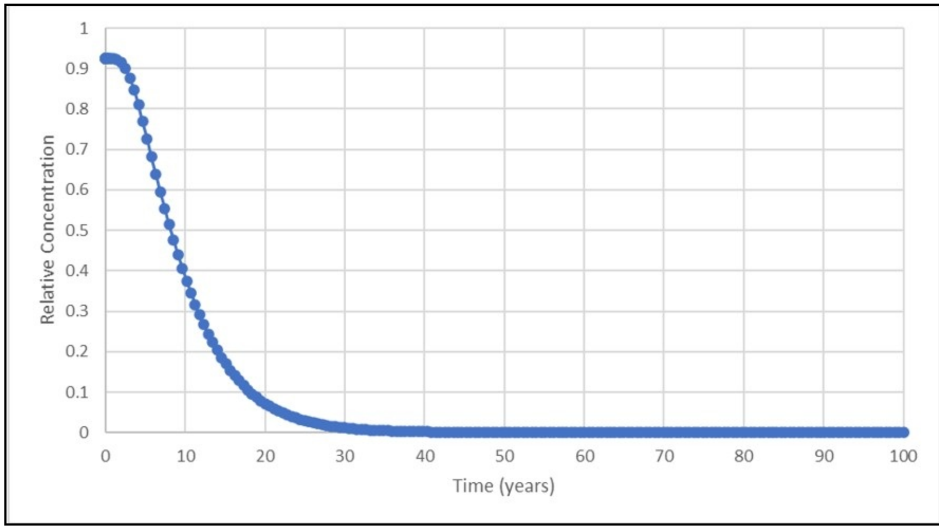
0 300 600 ft
FEET

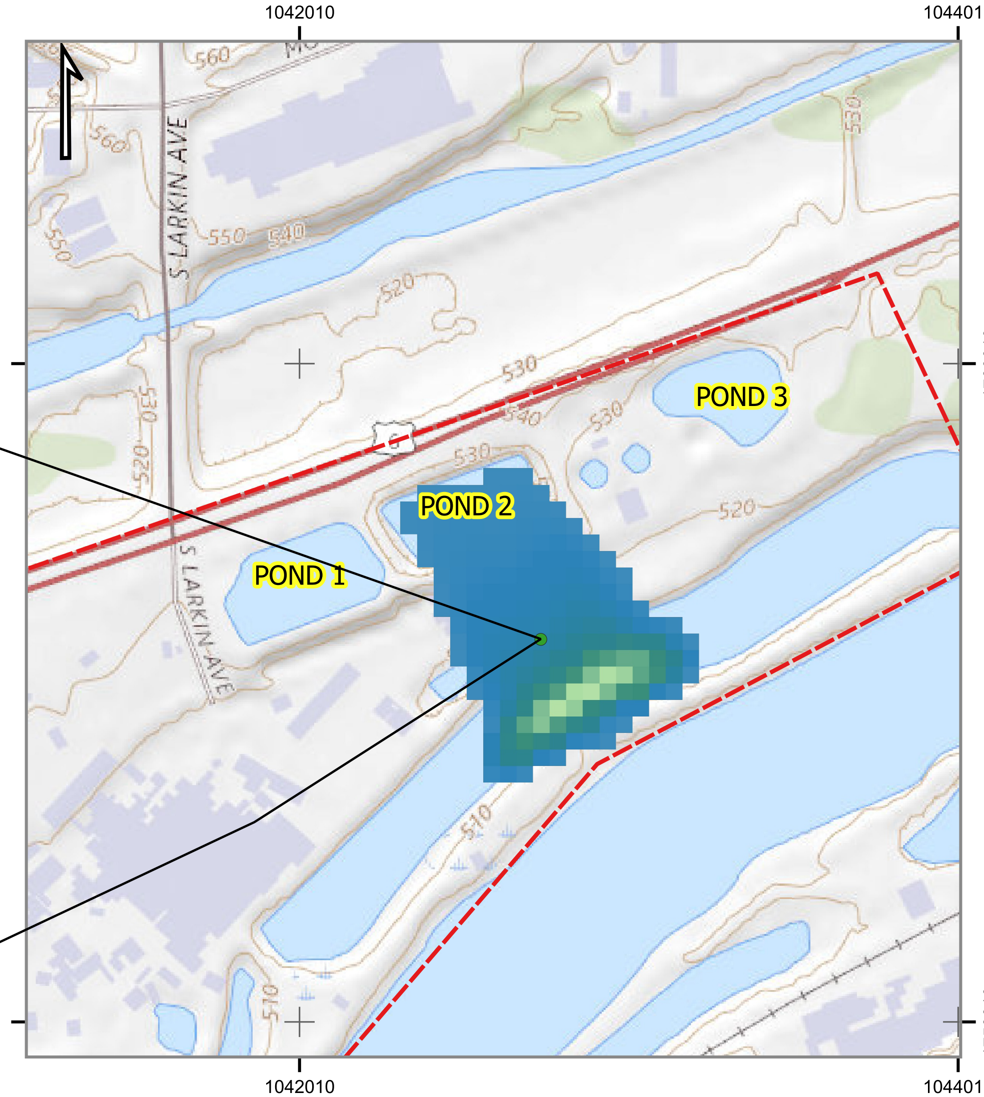
Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure18_100YearPlumeDistributions.qgz

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	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **4**		

100-YEAR PLUME DISTRIBUTION

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





LEGEND

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

K P R G

0 300 600 ft

FEET

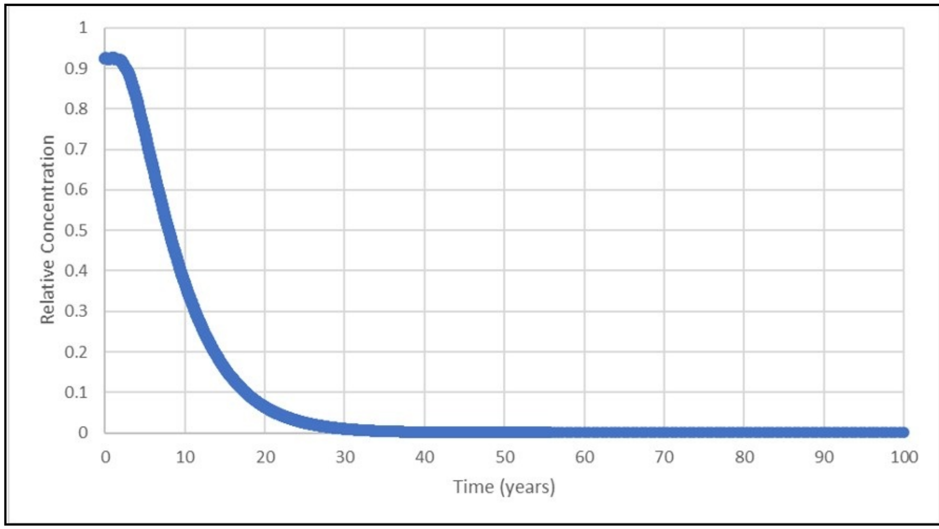
Coordinate System:

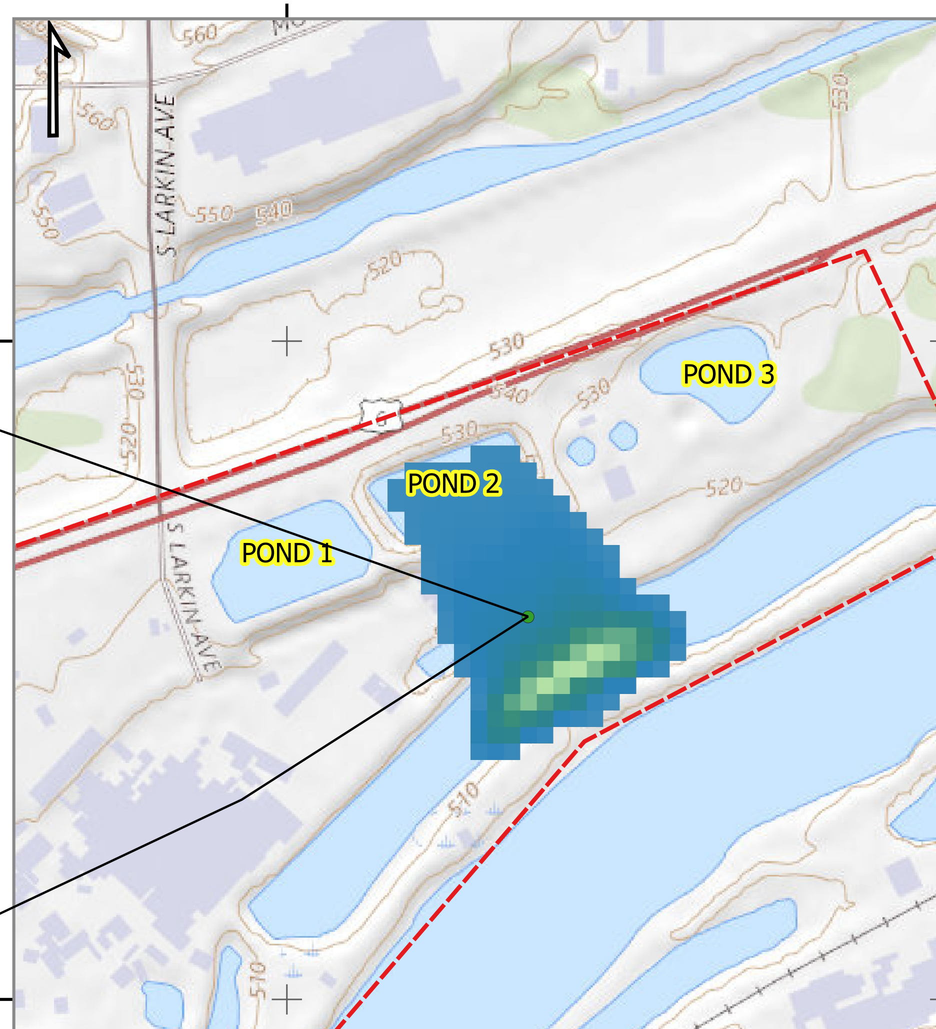
Project File: Figure19_ConcentrationsOverTime.qgz

CLIENT	MIDWEST GENERATION, LLC		
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL		
TITLE	**CONCENTRATIONS OVER TIME**		
SCALE AT ANSI A 1:7,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
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

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

K P R G

0 300 600 ft

FEET

Coordinate System:

Project File: Figure20_SeasonalSensitivityTest.qgz

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

SCALE AT ANSI A 1:7,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **6**		

ATTACHMENT 8
GROUNDWATER MODELING REPORT

REPORT

NUMERICAL GROUNDWATER FLOW MODEL

Groundwater Flow Modeling in Support of CCR Compliance and Permitting

Midwest Generation, LLC
Joliet Generating Station No. 29
Joliet, Illinois

Submitted to:

KPRG and Associates, Inc.
14665 W. Lisbon Road, Suite 1A
Brookfield, WI 53005

and:

Midwest Generation, LLC
Joliet Generating Station No. 29
1800 Channahon Road
Joliet, IL 60436

Prepared by:

BAS Groundwater Consulting Inc.
3649 Evergreen Parkway Ste 1510
Evergreen, Colorado 80437
+1 720 334-8249

January 28, 2022

NUMERICAL GROUNDWATER FLOW MODEL

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January 28, 2022

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Senior Hydrogeologist/*BAS Groundwater Consulting Inc.*

Distribution List

Midwest Generation, LLC

KPRG and Associates, Inc.

Executive Summary

This report documents the results of a numerical groundwater modeling analysis of groundwater flow in the vicinity of the on-site Pond 2 at the Midwest Generation, LLC (Midwest Generation) Joliet #29 Generating Station (Joliet #29 Station). The purpose of the numerical groundwater modeling was to create a tool capable of evaluating groundwater flow paths around Pond 2 and to provide a platform upon which proposed engineering scenarios for pond closures can be overlain and evaluated for their short and long-term effectiveness relative to improvements of groundwater quality. The results of the modeling are intended for input into the engineering considerations and evaluations of various closure alternatives being evaluated for the pond. This modeling is a requirement under Illinois Administrative Code Title 35 Part 845.220(d)(3).

The model has a uniform grid spacing of 50 feet and has seven layers. The groundwater flow model was run in the software MODFLOW-NWT and the transport model was run with the software MT3D-USGS. The model represents the regional flow direction to the Des Plaines River to the south with a constant head boundary on the north side of the model.

The model was calibrated to water levels measured in monitoring wells upgradient and downgradient of the site ponds. The model achieved a good calibration, with a scaled root mean squared error in the site wells of less than 10 percent. The model was the most sensitive to the modeled values of hydraulic conductivity and less sensitive to the regional recharge rate.

The existing groundwater quality data do not suggest that Pond 2 is leaking/discharging contaminants to the water table and all ash has been removed from the pond since 2019. Therefore, to meet the modeling requirements of Part 845.220(d)(3), a hypothetical initial situation was created in which a constant source of a surrogate mass (relative concentration of “1”) was modeled at Pond 2 and allowed to discharge freely to groundwater (i.e., assumed the pond was filled with ash and water with a fully compromised or no liner). The resulting hypothetical distribution of concentrations served as the initial concentrations to predictive scenarios of pond closure alternatives. The source removal scenario indicates that the hypothetically introduced mass into groundwater should be flushed through the shallow groundwater system within approximately 30 years.

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Tables

Figures

Table of Abbreviations

Abbreviation	Definition
A	Cross sectional area
ADAMP	Adaptive damping solution method
amsl	Above mean sea level
af/yr	Acre-feet per year
CCR	Coal Combustion Residuals
cfd	Cubic feet per day
cm/s	Centimeters per second
dh/dl	Hydraulic gradient
ft bgs	Feet below ground surface
ft/d	Feet per day
ft^2	Square feet
ft/ft	Feet per feet
GHB	General head boundary
GIS	Geographic information system
gpm	Gallons per minute
GWPS	Groundwater Protection Standard
HCLOSEXMD	Head change closure criterion
ISGS	Illinois State Geological Survey
ILWATER	Illinois Water Well Database
ISWS	Illinois State Water Survey
in/yr	Inches per year
LINMETH	XMD linear solution method
K	Hydraulic conductivity
MAP	Mean annual precipitation
mg/l	Milligrams per liter
PCGn	Preconditioned Conjugate Gradient
Q	Darcy Flux

Abbreviation	Definition
RMS	Root Mean Square
TDS	Total Dissolved Solids
%	Percent

1.0 INTRODUCTION

This report documents the results of a numerical groundwater modeling analysis of groundwater flow in the vicinity of Pond 2 at the Midwest Generation, LLC (Midwest Generation) Joliet Generating Station No 29 (Joliet 29 Station). The numerical groundwater flow and transport modeling was conducted as required under the Ill. Adm. Code Title 35, Part 845: Standards for the Disposal of Coal Combustion Residuals (CCR) in Surface Impoundments (State CCR Rule) Section 845.220(d)(3).

2.0 BACKGROUND

Joliet 29 Station is an active gas-fired generating station located on the northern bank of the Des Plaines River in Joliet, Illinois in Section 19, Township 35 North, Range 10 East. The station switched from coal to natural gas in 2016. The station operated two ash ponds (Ponds 1 and 2) and a service water basin (Pond 3) as part of the previous coal-fired operations. Ponds 1 and 3 are not CCR surface impoundments. Pond 1 was taken out of service before October 2015, all ash was removed, the liner was decontaminated, and the use of the pond was repurposed for low volume wastewater. Pond 3 was a service water basin and did not collect CCR. Pond 2 continued to be used for CCR management/storage until 2019 at which point the ash was removed. The warning layer currently remains in-place and all other portions of the exposed liner have been decontaminated (MWG, 2021). The locations of the facility, Pond 2, and Ponds 1 and 3, are shown on Figure 1. Joliet 29 Station is bordered by industrial properties to the north and the Des Plaines River to the south. There are 11 monitoring wells located on site (MW-1 through MW-11). The locations of the 11 monitor wells are shown on Figure 2. The CCR monitoring network around Pond 2 consists of four of the noted monitoring wells. These are MW-10 (upgradient) and MW-3 through MW-5, which are the downgradient monitoring points.

The purpose of the numerical groundwater modeling was to create a tool capable of evaluating groundwater flow paths near the ponds and to then use this model to overlay various pond closure scenarios to assist in evaluating short and long-term changes to associated downgradient groundwater quality.

3.0 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 4.0: Conceptual Model – This section provides information that was used to refine the conceptual model of groundwater flow at Joliet 29 Station. The conceptual model formed the basis for construction and calibration of the numerical model.
- Section 5.0: Numerical Groundwater Flow Model – This section provides a description of the numerical model construction, calibration, and sensitivity analysis. The calibrated groundwater flow model was used as the basis to conduct predictive analyses of engineering closure alternatives to assist in the engineering evaluations.

- Section 6.0: Predictive Model Simulations – This section provides results of predictive analyses that were used to evaluate changes to the water table, groundwater flow paths, and contaminant concentrations beneath and adjacent to the ponds.
- Section 7.0: Conclusions – This section provides a summary of the modeling and predictive analysis.
- Section 8.0: References – This section provides a list of references used in the analysis documented in this report.

Figures and tables follow the main text of the report.

4.0 CONCEPTUAL MODEL

Site data were compiled as part of this modeling study and used to update the conceptual model of groundwater flow at Joliet 29 Station. The numerical model was constructed to represent the updated conceptual model.

Components of the conceptual model of groundwater flow include:

- climate
- lithology and geologic framework
- aquifer properties
- nature of groundwater flow
- water budget

Each of these components of the conceptual model is presented below.

4.1 Climate

Joliet 29 Station is located within the humid continental climate zone with warm to hot and humid summers and cold and snowy winters. There are four weather stations located relatively near Joliet 29 Station that provide data to evaluate long-term trends in precipitation. These stations are shown on Figure 3 and are listed here:

- Elwood 8 NW
- Joliet Brandon Road Dam
- Joliet
- Joliet Regional Airport

Precipitation data from complete years from these stations were averaged for monthly and annual averages and are provided in Table 1. These stations provide data for years between 1944 and 2020. Long-term average monthly precipitation has ranged from just over 1 inch in January and February to over 3.5 inches in late Spring and Summer (April through August). The long-term mean annual precipitation (MAP) from these data is 34.4 inches.

4.2 Geology

The geology at Joliet 29 Station was summarized in the Application for Initial Operating Permit (MWG, 2021) as unconsolidated glacial deposits underlain by Silurian dolomite. The Silurian dolomite is underlain by the Maquoketa Group and includes the Scales Shale, which is considered a regional aquitard separating the overlying Silurian dolomite from the deeper Cambro-Ordovician sandstone and limestone aquifers. Geologic cross-sections are included with the above referenced Application for Operating Permit. The site lithology is summarized as:

- Fill (approximately 0 to 8.5 feet thick) – Consisting of a thin layer of topsoil followed by coarse gravel fill.
- Silty Clay (approximately 0 to 14 feet thick) – Consisting of black/brown silty clay with a trace of coarse gravel.
- Sand and Gravel (approximately 14 to 40 feet thick) – Consisting of black/brown fine to coarse sand and gravel with limestone fragments noted throughout. May locally include some lenses of interlayering of black silty clay and/or tan silty sand in the vicinity of wells MW-1 and MW-2.
- Silty Clay (approximately 5 to 15 feet thick) – Consisting of black/brown silty clay with a trace of coarse sand. Not continuous across the site along and east-west transect.
- Sandy Silt/Silty Clay (approximately 0 to 34 feet thick) – Consisting of black/gray sandy silt grading downward to a gray silty clay with coarse sand. Not continuous across the site. Appears to be limited to the vicinity of well locations MW-10 and MW-11 on northwest side of pond area.
- Bedrock – Consisting of Silurian dolomite – Top of unit encountered at approximately 38.5 feet below ground surface (ft bgs) at boring location MW-6. The borings were noted with increased limestone fragments at the bottom, which were interpreted to be at or near the top of the weathered bedrock surface.

Surficial geology was obtained from the Surficial Geology of the Chicago Region (Caron, 2017), (Willman & Lineback, 1970) and is shown on Figure 4. This figure provides some good information but is very generalized as it is part of a larger regional study. It suggests the presence of dolomite bedrock at the surface at the site in the vicinity of the ponds which is inconsistent with site-specific borehole data. The regional, surficial geology can be used to depict overall geologic trends as shown on Figure 4 but is superseded by site-specific geologic information. Borehole logs for the site wells were compiled along with logs for nearby wells from the Illinois State Geological Survey's (ISGS) Water and Related Wells Database (ILWATER) and are presented in Table 2 and on Figure 5. Lithology in the borehole logs is displayed in three dimensions on Figure 6 and includes the groups:

- Topsoil
- Fill
- Loam

- Silt and Clay
- Clay, Sand, and Gravel
- Sandy Clay
- Sand and Gravel
- Flagstone
- Carbonate and Shale
- Carbonate
- Shale

Near the site the lithology is dominated by silt, clay, sand, and gravel. The lithologic intervals provided guidance on initial model calibration through the definition of zones of hydraulic conductivity that were later modified as discussed further in Section 5.2.1.

4.3 Aquifer Properties

Aquifer properties of hydraulic conductivity (K) and storage are important controls on groundwater movement and behavior and are necessary parameters to define in a numerical model. Hydraulic conductivity values were initially estimated for monitor wells MW-4, -6, -9, and -11 from slug tests (Patrick Engineering Inc, 2011). The geometric mean of the test data for these wells was approximately 310 feet per day (ft/d), as calculated by (Patrick Engineering Inc, 2011). The slug test data were reviewed as part of this current modeling study and the data were reanalyzed using corrected input values for the well casing and borehole dimensions and effective porosity of the sand filter pack material. The revised hydraulic conductivity estimated values are summarized in Table 3 for comparison. The revised geometric mean of the test data for these wells decreased to approximately 170 ft/d.

4.4 Nature of Groundwater Flow

Shallow groundwater occurs under unconfined conditions with depth to water ranging from approximately 28 feet at monitor well MW-01 to approximately 34 feet at monitor wells MW-05 and MW-10 (monitoring data provided by KPRG). Figures 9-6 through 9-9 of the above referenced Application for Initial Operating Permit\ (MWG, 2021) illustrate that the groundwater flow direction is generally to the south beneath the ponds toward the Des Plaines River. Groundwater flow should be mainly controlled by the Des Plaines River, with shallow groundwater flow directions southward to the Des Plaines River during most periods of the year.

Groundwater level measurements from 11 site wells since June 2011 were provided by KPRG. Wells with available water level data are shown on Figure 7. A summary of these data is provided in Table 4 including minimum and maximum measured water level elevations and the average water level elevation from the 1st and 3rd quartiles to eliminate statistical outliers. These average water levels were used as the water level calibration targets. No recent, shallow water levels were found in the Illinois Domestic Wells Database or the Illinois Water and Related Wells (ILWATER) Database (Illinois State Geological Survey, 2021) to supplement these site data for the model calibration.

4.5 Impacted Groundwater

As noted above, the CCR groundwater monitoring network for Pond 2 has four wells: MW-3, MW-4, MW-5, and upgradient well MW-10. CCR sampling under the Federal Rule was initiated in 2015 for the identified Appendix III and Appendix IV parameters and quarterly detection monitoring under that program is ongoing for Appendix III parameters. Also, starting in second quarter 2021, sampling under the new State CCR Rule was initiated quarterly for all Federal CCR Rule Appendix III/IV parameters plus turbidity since the State Rule does not distinguish between detection and assessment monitoring parameter lists.

Relative to the most recent (August 2021) and more comprehensive sampling under the State CCR Rule, concentrations of all 22 monitored water quality parameters in the three downgradient monitoring wells were below the Proposed Groundwater Protection Standards (GWPSs) presented in the above referenced Application for Initial Operating Permit. In addition, all parameters were at concentrations below the Part 845.600(a) groundwater quality standards except for chloride in all four monitoring wells including upgradient well MW-10. The chloride detections have been determined to be associated with source(s) other than the subject pond (i.e., the pond is not the source of the noted chloride impacts).

4.6 Water Budget

A conceptual water budget was developed for Joliet 29 Station to provide context of the results of the calibrated model water budget (ASTM D5447-17, 2017). The identified and estimated components of the conceptual water budget included:

- recharge to groundwater
- inflow from the north
- discharge of groundwater to the Des Plaines River

The conceptualized estimate for each of these components of the water budget is discussed below. The conceptual water budget was used as an initial definition of the water budget in the numerical model, and components were adjusted during model calibration.

4.6.1 Recharge to Groundwater

Recharge from the infiltration of precipitation to the water table has been estimated in a regional, general context for northeastern Illinois:

- A groundwater/surface water model for the Upper Fox River Basin in Southeastern Wisconsin estimated recharge of approximately 4 to 4.4 inches/year (in/yr) (Feinstein, Fienen, Kennedy, Buchwald, & Greenwood, 2012).

- The Illinois State Water Survey (ISWS) estimated shallow groundwater recharge using a geographic information system (GIS) approach coupled with pattern recognition (Interagency Coordinating Committee on Groundwater, 2010). A generalized map of potential recharge at Illinois power plants shows Joliet 29 Station on the edge of the border between areas with "moderately low to low" to "very high" recharge potential.
- A model previously developed for the Midwest Generation Joliet 9 Generating Station (Lincoln Stone Quarry, located south across the river from the Joliet 29 Station) used a calibrated recharge rate of 1 in/yr (approximately 2.5 to 3 percent of MAP) for the area between the uplands and the river.

Recharge from precipitation was initially assumed in the groundwater model at 1 in/yr, which equates to approximately 3 percent of MAP. This rate over the model domain minus the river (Section 5.1) equates to approximately 55 acre-feet per year (af/yr) (6,548 cubic feet per day (cfd)).

4.6.2 Groundwater Inflow from the North

The boundaries to the groundwater model are discussed below in Section 5.1.3. Groundwater flow into the model domain from the north was estimated using Darcy's Law:

$$Q = KA\frac{dh}{dl}$$

where Q is the Darcy Flux, K is the hydraulic conductivity (ft/d), A is the cross-sectional area (square feet (ft^2)), and dh/dl is the hydraulic gradient (ft/ft). Using the length of the northern model boundary (10,438 feet), an assumed thickness of unconsolidated materials above the Silurian dolomite of 35 feet, plus 15 feet of weathered dolomite (50 feet total), hydraulic conductivity of 170 ft/d (the geometric mean of test data from site wells), and a hydraulic gradient of 0.0006 ft/ft estimated from the site water level contours on the above referenced groundwater flow maps (see Section 4.4) (MWG, 2021), a rough estimate of groundwater flow from the north above the intact Silurian dolomite was calculated as 446 af/yr (53,233 cfd).

4.6.3 Discharge to Des Plaines River

The boundaries to the groundwater model are discussed below in Section 5.1.3. Groundwater flow south to the Des Plaines River was also estimated using Darcy's Law. Using the same assumed parameter values as in Section 4.5.2, except with the length of the southern model boundary (10,815 feet), a rough estimate of groundwater flow to the Des Plaines River was calculated as 462 af/yr (55,155 cfd).

It is assumed that the upper portion of the Silurian dolomite is weathered and that groundwater flow through the weathered carbonate bedrock is sufficiently greater than flow through the underlying intact carbonate bedrock resulting in negligible flow in the deeper carbonate bedrock in this focused conceptual water budget.

This discussion of the conceptual water budget is an order-of-magnitude, first approximation to estimate the components of the water budget that will be represented in the numerical model. The conceptual water budget will be used to compare to the modeled water budget, and to provide initial estimates for defined boundary conditions.

5.0 NUMERICAL GROUNDWATER FLOW MODEL

A numerical groundwater flow model was constructed for Joliet 29 Station. This section describes the construction and calibration of the numerical model.

5.1 Model Construction

The numerical model was created to cover the vicinity of Pond 2 at Joliet 29 Station and Midwest Generation property (Figure 8). The model domain extends east and west of the pond one-half mile, north from Midwest Generation property approximately one-quarter mile, and south from Midwest Generation property to the Des Plaines River. The selection of lateral boundaries to the model is further described below. The overall, active model area is approximately 1.4 square miles.

5.1.1 Software Selection

The groundwater flow system was simulated with MODFLOW-NWT (Niswonger, 2011), an advanced version of the widely used MODFLOW software. Groundwater Vistas (Version 8.0) (Environmental Simulaitons Inc. (ESI), 2020), a graphical user interface, was used to parameterize the model input, write MODFLOW files, and visualize results. MODFLOW-NWT was considered over MODFLOW-2000, MODFLOW-2005, or MODFLOW-USG because it has enhanced solvers that employ upstream weighting for non-linear problems, it is a relatively recent, widely used, and non-proprietary release of MODFLOW, and it is coupled with the widely used and non-proprietary transport model MT3DMS (Zheng, 2012), which was used for the transport simulations.

5.1.2 Model Grid and Layering

The model has a uniform grid spacing of 50 feet and has 136 rows and 214 columns and seven layers, and a total of 105,728 active cells (Figure 9). The MODFLOW-NWT model was constructed with length and time units of feet and days, respectively. The coordinate system State Plane Illinois East, NAD 83, FIPS 1201 was used for all coordinates and for GIS data management. The model grid has an origin at coordinates 1,038,526, 1,753,446, rotated 30.2 degrees to the northwest to align the model grid with the overall groundwater flow direction toward the river.

Lithology data was compiled from site well logs and ISGS drill logs and organized into geological units as described in Section 4.2. Contacts were used to create surfaces of the top of the carbonate unit and of the top of the Maquoketa Shale using Seequent Leapfrog™ software (Seequent Limited, 2021), as well as to visualize the borehole lithology. Model layers one through five represent the unconsolidated materials, and model layers six and seven represent the carbonate unit. The top of model layer 6 was defined from the created carbonate surface and the bottom of the model was defined from the created surface of the Maquoketa Shale.

The top of the model was defined with surface topography from the 3D Elevation Program, 1-Meter Resolution Digital Elevation Model (U.S. Geological Survey, 2021). The volume of unconsolidated material above the carbonate unit was divided into five model layers to simulate groundwater flow through the unconsolidated sediments. Model layers one through fived, together, range in thickness from 10 to 50 feet across the model domain, and together are approximately 35 feet thick beneath the ponds. Model layer six represents weathered carbonate bedrock and was defined as 10 feet thick, consistent with the well log for monitor well MW-08. Representative sections through the model domain are provided on Figure 10 to show the layering in an east-west model row (row 70) and a north-south model column (column 135) through the site near Pond 3.

5.1.3 Model Boundaries

The outside edges of the model domain must be defined with model boundaries to describe how groundwater inside the model domain interacts with groundwater outside the model domain. Additionally, boundaries can be defined interior to the model domain to represent sources and sinks of groundwater such as pumping wells or infiltration through a pond. Exterior boundaries of the numerical model are shown on Figure 8 and include:

- River boundary along the southern edge of the model domain, aligned with the Des Plaines River.
- No-flow boundaries along the east and west edges of the model.
- Constant head boundaries along the north side of the model.

The river boundary along the model's southern side is defined with a stage set to 505 feet above mean sea level (ft, amsl), consistent with surface topography. The river was defined in model layer 1. The river was assumed to be 10 feet deep, and the conductance was set from the model cell dimensions and an assumed hydraulic conductivity of 50 ft/d and a thickness of 1 foot, to represent relative ease of exchanging water between the river and groundwater.

Constant head boundaries were defined along the north side of the model. The constant heads were defined at an elevation of 509.7 ft amsl from an old (1986) water level in regional well 121972919900. Although this water level is old, it gives an elevation for the constant head boundary. Lower elevations for this boundary were tested in the sensitivity analysis discussed below.

The eastern and western model boundaries were defined with no flow boundaries to represent streamlines (groundwater flow directions) as expected from the conceptualized direction of groundwater flow toward the Des Plaines River.

5.1.4 Model Stresses

In addition to the exterior model boundaries described in Section 5.1.3, MODFLOW's recharge package was used to simulate recharge from precipitation throughout the model domain. Recharge was simulated at approximately 1.03 in/yr (2.35E-04 ft/d) or approximately 3 percent MAP. This is consistent with the initial recharge rate assumed in the conceptual water budget (Section 4.5.1), and with recharge used in previous modelling at Lincoln Stone Quarry across the river (KPRG, 2013) and resulted in a good model calibration. No recharge from precipitation was assigned below the footprint of the ponds which are lined.

5.1.5 Numerical Parameters

The Preconditioned Conjugate Gradient (PCGn) package was used with MODFLOW-NWT to solve the system of equations within the model domain. The type of solver was tested in early model runs and the PCGn solver provided a stable solution in a fast computational time compared to other solvers available with MODFLOW. The solver was used with adaptive damping (ADAMP) and the XMD linear solution method (LINMETH), again to provide a stable and computationally quick solution.

Optimal settings for the PCGn with XMD were found during model calibration. Key numerical parameters were a head change closure criterion (HCLOSEXMD) of 1E-03 feet for inner iterations and 1E-05 feet for outer iterations, 2000 maximum outer iterations and 100 maximum inner iterations.

5.2 Model Calibration

The following sections describe the approach taken to calibrate the model and the results of the model calibration.

5.2.1 Approach

The groundwater flow model was first calibrated through a trial-and-error approach by adjusting hydraulic conductivity and recharge rates until the model reasonably matched field measurements. Model calibration then continued with parameter estimation techniques in PEST software (Doherty, 2010), used with pilot points within Groundwater Vistas.

The flow model calibration relied on the measured water level data provided by KPRG for the site wells. The period of measured water levels from the site wells since 2011 were averaged, having removed outliers determined from the interquartile range, and used as model calibration targets (Table 4). The data from the site wells were considered reliable and were given a target weight of 1.

In addition to calibrating to measured water levels in the wells, qualitative considerations of model calibration included:

- General groundwater flow directions south to the Des Plains River,
- General consistency in the modeled hydraulic conductivity and the field-measured hydraulic conductivity,
- General consistency in the modeled water budget with the conceptual water budget, and
- Eliminating flooding above the surface of the model.

The measure of model calibration, other than the qualitative considerations, was to minimize the calibration residual, measured as the difference between measured and modeled groundwater elevations in wells. A negative residual indicates that the modeled groundwater elevation is higher than the measured elevation, and a positive residual indicates that the modeled groundwater elevation is lower. The statistical measures of average residual, sum of squared residuals, and root mean square (RMS) error were used to objectively evaluate the calibration.

The RMS error was calculated as:

$$\mathrm{RMS} = \left[\frac{1}{\mathrm{n}}\sum_{\mathrm{i}=1}^{\mathrm{n}}(\mathrm{h_o} - \mathrm{h_s})^2\right]^{0.5}$$

where $h_o - h_s$ is the target residual and n is the number of observed groundwater elevation values. The RMS error is typically scaled against the range in observed groundwater elevations in the model area. A scaled RMS error of less than 10% is the standard calibration criteria that is generally considered acceptable throughout the industry (Anderson, 2015).

Initially, the lithologic intervals in borehole locations were intersected with the model grid and zones of hydraulic conductivity ("K zones") were drawn around these lithologic groups (i.e., grouped together areas of silty sand, areas of sand and gravel, etc). Hydraulic conductivity was defined for these K zones based on the site K values, literature values, and professional judgement for initial model calibration. After the basic model calibration was completed by varying the values of hydraulic conductivity and recharge, the model calibration was refined using pilot points and PEST software. Pilot points were defined throughout model layers 3 through 5, the layers that contain the site wells for calibration, to estimate the horizontal and vertical hydraulic conductivity values. Initial values of horizontal hydraulic conductivity in the unconsolidated sediments were 170 ft/d, the geometric mean of the site data, with a range between 50 and 500 ft/d, except at the locations of the wells with hydraulic conductivity data in which the upper range was increased to the original estimate of hydraulic conductivity from Patrick Engineering and the lower range was set approximately one-half magnitude lower than the revised estimates of hydraulic conductivity (Table 3). This range was deemed reasonable to account for the accuracy of field-measured hydraulic conductivity. Additionally, near Pond 2, the deeper unconsolidated sediments were allowed to vary as low as 1 ft/d to represent clay and clayey gravel, consistent with well logs.

5.2.2 Model Calibration Results

The calibrated distribution of horizontal hydraulic conductivity in the model is shown for model layers 3 through 5 on Figures 11a through 11c. The calibrated, model-calculated groundwater level contours are shown on Figure 12. The spatial distribution of the calibration residuals is shown on Figure 13 and a scatter plot of the residuals are shown on Figure 14. The calibrated model water budget is provided in Table 5, the model calibration residuals are provided in Table 6, and the calibrated model statistics are provided in Table 7. Recharge from precipitation was simulated at approximately 1.03 in/yr (2.35E-04 ft/d), consistent with the conceptual model and equal to approximately 3 percent of MAP (Section 4.5.1)

5.2.2.1 Calibrated Hydraulic Conductivity

The model calibrated distribution of horizontal hydraulic conductivity ranges from approximately 1 to 650 ft/d in the unconsolidated sediments in model layers 3 through 5. The horizontal hydraulic conductivity in model layers 1 and 2 were set equal to 170 ft/d, consistent with the geometric mean of the site data. The horizontal hydraulic conductivity of the weathered carbonate bedrock (model layer 6) was set equal to 1 ft/d, and was tested during model calibration between 0.1 and 10 ft/d. The horizontal hydraulic conductivity of the intact carbonate bedrock (model layer 7) was set equal to 0.1 ft/d to represent less permeable material.

Use of PEST software for the model calibration resulted in a krigged distribution of hydraulic conductivity rather than zones of hydraulic conductivity. A krigged surface is more appropriate for the unconsolidated sediments above the carbonates because the bounds of the hydraulic conductivity zones were based on available borehole logs, which include old drillers logs, thereby making the definition of zones uncertain. PEST was used to estimate horizontal and vertical hydraulic conductivity in model layers 3 through 5. The vertical hydraulic conductivity was allowed to be up to three orders of magnitude lower than the horizontal hydraulic conductivity in the unconsolidated sediments in model layers 3 through 5 to represent the presence of clay materials at depth. The vertical hydraulic conductivity was assumed equal to the horizontal hydraulic conductivity in the carbonate bedrock (model layers 6 and 7) and in model layers 1 and 2, in which no monitor wells fall to use for model calibration and to therefore constrain the values of hydraulic conductivity.

The resulting vertical hydraulic conductivity values (Kv) in the unconsolidated sediments (model layers 3 through 5) range from equal to horizontal to three orders of magnitude lower than the horizontal values (Kh), representing a vertical anisotropy ratio that ranges from 1:1 to 1:1000 Kh:Kv, appropriate for clays, and silty, clayey, sands and gravels. The anisotropy ratio is low (close to 1:1) throughout much of the model domain and is highest (lowest Kv values) beneath the ponds (Figures 11a through 11c).

The calibrated values of hydraulic conductivity at wells MW-04, -06, -09, and -11, were compared to the field data for these wells (Table 3). The modeled values of hydraulic conductivity for these four wells are generally consistent with the revised estimates of hydraulic conductivity (Table 3). Each of these wells is located in an area of steep gradient in the modeled distribution of hydraulic conductivity, with hydraulic conductivity varying substantially in a relatively short distance within the model domain. The calibrated model's values of horizontal hydraulic conductivity in the area of model cells containing these monitor wells are:

- MW-04: 488 ft/d,
- MW-06: 102 ft/d,
- MW-09: 130 ft/d, and
- MW-22: 161 ft/d,

These values are, overall, consistent with the new estimates of hydraulic conductivity for these wells (Table 3), except for well MW-04, which is more similar to the original estimates of hydraulic conductivity.

5.2.2.2 Calibrated Water Budget

The model calibrated water budget is provided in Table 5. Groundwater recharge equals 58 af/yr (6,871 cfd), consistent with the conceptual water budget estimate of 55 af/yr. The constant head boundary representing groundwater flow into the model domain from the north provided 16 af/yr (1,935 cfd), lower than the conceptual model estimate of 446 af/yr but representing the balanced water budget with spatially varying hydraulic conductivity.

Outflow from the groundwater model is through discharge to the Des Plaines River. Discharge to the river boundary on the south side of the site equalled 74 af/yr (8,806 cfd), lower than the conceptual water budget estimate but again represents the balanced water budget with spatially varying hydraulic conductivity. The total outflows from the groundwater system balance the inflows at 74 af/yr (8,806 cfd) (Table 5).

5.2.2.3 Statistics and Residuals

The calibration residuals and modeled water level for each well is provided in Table 6. Calibration residuals for the site wells range from -0.06 feet in wells MW -07 and -10 to 0.06 feet in well MW-11. The average residual is 0.0005 feet (Table 7). The RMS error is 0.044 feet, or 8.3 percent of the change in hydraulic head across the model domain. These results are below the recommended threshold of 10 percent for the scaled RMS error (Anderson, 2015).

The sum of squared residuals (phi) for the weighted calibration targets from the manual calibration was 11.8 square feet (ft^2), representing the starting point for the PEST calibration. The final, calibrated phi was 0.021 ft^2, representing a significant improvement of the calibration by the PEST software.

The modeled water level contours and water level elevation in each calibration target (well) is shown on Figure 12. The modeled water level contours match the overall southward groundwater flow direction shown on Figure 4 by KPRG (MWG, 2021). The calibration residuals for each calibration target (well) are shown on Figure 13. Generally, there is no trend toward over or under-estimating the water levels, indicating that the model is not biased toward high or low water level elevations. The overall model calibration to measured groundwater levels in site wells is very close, within one-tenth of a foot everywhere.

A scatter plot of the calibration residuals is provided for site wells on Figure 14. In a perfect model calibration, each point would fall on a 1:1 line. Ideally deviations from the line should be balanced between high and low representing a lack of bias in the model calibration toward over- or under-prediction of the groundwater system. The calibration residuals for all wells are generally close to the 1:1 line, with the points falling both above and below the line, representing a relatively balanced, on whole, calibration to the site wells.

These results demonstrate that the model reasonably matches the overall groundwater elevations across the model domain, and the water balance reasonably represents the conceptual model of groundwater flow. The calibrated model is appropriate to use for predictive simulations.

5.3 Model Sensitivity

A sensitivity analysis was conducted as part of the model calibration. Calibrating the numerical model was an effort of fine-tuning the heterogeneity and distribution of the horizontal and vertical hydraulic conductivity values and the recharge to match measured water levels in the wells. During the PEST and manual trial-and-error calibration model runs, the model was the most sensitive to the values of hydraulic conductivity. The model calibration was particularly sensitive to the hydraulic conductivity values near the ponds, and to the hydraulic conductivity of the underlying shallow bedrock unit. A moderately permeable value of hydraulic conductivity improved the model calibration to the site wells.

The model calibration is sensitive to the recharge rate, but to a lesser extent than it is to hydraulic conductivity. The model calibrated well without recharge (seepage) from Ponds 1, 2, or 3, consistent with the ponds being fully lined. Two sensitivity model runs were conducted with seepage through the ponds applied as recharge: one with the recharge rate two orders of magnitude lower than the background recharge rate, and one equal to the recharge rate. The model calibration was not sensitive to these two variations in the recharge.

A sensitivity model run was also conducted in which the thickness of the moderately permeable, underlying bedrock unit was 15 feet thick instead of 10 feet thick. The model calibration was not sensitive to this change. Another sensitivity model run was conducted in which the upgradient constant head boundary condition was lowered two feet (to 507.5 feet). The appropriate hydraulic head value to use to define the constant head in this area is not well known and this model tested the impact to calibration if the regional hydraulic gradient were lowered. This calibration test adversely affected model calibration. Initially the scaled RMS error was increased from 8.3 to 25 percent. The change to the upgradient constant head boundary was balanced with modifications to the hydraulic conductivity values and an increase to background recharge to 5 percent of MAP. Despite these adjustments, the scaled RMS remained worse than the calibrated model, at 10.8 percent. This test indicates that the upgradient constant head value used in the calibrated model is more appropriate to represent the regional and local groundwater flow systems.

6.0 PREDICTIVE MODEL SIMULATIONS

Both evaluated closure alternatives for Pond 2 include removal of the ash (completed in 2019). Two predictive, contaminant transport model runs were conducted to demonstrate the impact to potential impacted groundwater from pond closure. Both evaluated closure alternatives for Pond 2 include removal of the ash, which was already completed in 2019. Transport modeling was performed using the software MT3D-USGS, a widely used and accepted version of the MT3D software designed to be compatible with MODFLOW-NWT.

The calibrated, steady state groundwater flow model was used as the basis for a hypothetical 100-year transport simulation of a surrogate constituent from Pond 2. As previously stated, the current data do not indicate any releases associated with the pond. Furthermore, all ash was removed from this pond in 2019. Therefore, to provide a platform upon which to evaluate potential closure alternative, a hypothetical release from Pond 2 was established. The hypothetical (artificial) release assumes that the pond is full of ash and water and that the liner is fully compromised or non-existent. The surrogate constituent was simulated by hypothetically introducing a concentration in groundwater of "1" beneath Pond 2. The hypothetical mass was defined in groundwater beneath Pond 2 using a constant source boundary condition and forward tracked for 100 years. The resulting hypothetical plume is shown on Figures 15 through 18, at 5 years, 25 years, 50 years, and 100 years, respectively, on the *left-hand side* of these figures. The mass at Pond 2 is continuous in these model runs, therefore the mass is shown at the relative concentration of "1" beneath the pond in all figures.

6.1 Results

A model scenario was then conducted to represent removal of the hypothetical source of mass from Pond 2. In this scenario, the source boundary condition was removed from the water table and the 100-year distribution of dissolved surrogate mass (Figure 18, left-hand side) was used as the initial concentrations. With this model scenario, the distribution of dissolved contaminants that resulted from the hypothetical, continuous release of mass from Pond 2 was reduced over time after the removal of the source mass at the pond. These plumes are shown on the *right-hand side* of Figures 15 through 18 at 5 years, 25 years, 50 years, and 100 years, respectively. As these figures show, the dissolved mass reduced to approximately 50 percent at the river by 25 years and to approximately 10 percent by 100 years with the removal of the source mass. Figure 19 shows a graph of relative concentration of the surrogate mass over time at a hypothetical monitoring point between Pond 2 and the river. This graph illustrates the decay of the surrogate mass over time, and shows that at a point approaching the river, the hypothetical mass is reduced to a relative concentration of about 0 within 30 years, meaning the hypothetical mass has been flushed through the shallow groundwater system within about 30 years.

A second model scenario was conducted to test the impacts of seasonal variations of climate. The typical, annual precipitation pattern is for higher rainfall in the summer and less in the winter. A 100-year transient flow model was run with alternating stress periods of higher and lower recharge (5 months of higher recharge to represent April through August, and 7 months of lower recharge to represent September through March). The same initial distribution of concentrations used in Scenario 1 was used for Scenario 2. The source at Pond 2 was removed, and the initial distribution of concentrations was moved through the seasonally varying flow paths for 100 years. The results of this model scenario are shown on Figure 20. The 100-year distribution of dissolved contaminants is almost identical to the results from Scenario 1. As in Scenario 1, the decay of concentrations over time in a hypothetical location between Pond 2 and the river shows a decline to a relative concentration of approximately 0 within 30 years, meaning the hypothetical mass has been flushed through the shallow groundwater system within about 30 years.

7.0 CONCLUSIONS

A numerical groundwater flow model was created for the vicinity of Pond 2 at the Joliet #29 station. The model was calibrated to current water levels in site wells to replicate the groundwater flow patterns beneath the site. Groundwater flow paths from the pond are predicted to the south toward the Des Plaines River. Because the groundwater data do not indicate a release to groundwater from Pond 2, to meet the requirements of the regulation, the model was used predictively to simulate a hypothetical release scenario to the underlying water table based upon which the effectiveness of engineering closure options can be evaluated. A hypothetical surrogate constituent was simulated at Pond 2 in the groundwater. The hypothetical surrogate mass travelled with the groundwater flow paths toward the Des Plaines River. This hypothetical distribution of mass served as the initial concentrations to a predictive scenario of source removal alternatives at the pond. The hypothetical scenario assumes that Pond 2 is full of ash and water and the liner is fully compromised or non-existent allowing for impacts to freely discharge constituents to the water table. The predictive scenario of source removal (ash already has been removed) then illustrates the relative reduction in the mass concentrations in groundwater as a result. The model indicates that hypothetical downgradient dissolved contaminants would be flushed through the shallow groundwater system within about 30 years.

8.0 REFERENCES

Anderson, M. W. (2015). *Applied Groundwater Modeling, Simulation of Flow and Advective Transport.* San Diego, CA: Elsevier, Inc.

ASTM D5447-17. (2017). Standard Guide for Application of a Numerical Groundwater Flow Model to a Site-Specific Problem. *ASTM International, West Conshohocken, PA*.

Caron, O. (2017). Surficial Geology of Romeoville Quadrangle, Cook, DuPage, and Will Counties, Illinois. ILLINOIS STATE GEOLOGICAL SURVEY.

Doherty, J. a. (2010). Approaches to highly parameterized inversion - A guide to using PEST for groundwater-model calibration. In U. G. 2010-5169, *Scientific Investigations Report 2010-5169* (p. 59). United States Department of the Interior.

Environmental Simulations Inc. (ESI). (2020). Groundwater Vistas v.8.0.

Feinstein, D. T., Fienen, M. N., Kennedy, J. L., Buchwald, C. A., & Greenwood, M. M. (2012). *Development and Application of a Groundwater/Surface-Water Flow Model using MODFLOW-NWT for the Upper Fox River Basin, Southeastern Wisconsin.* Scientific Investigations Report 2012–5108, USGS.

Illinois State Geological Survey. (2021). *The Illinois Water and Related Wells Map, https://maps.isgs.illinois.edu/ilwater.*

Interagency Coordinating Committee on Groundwater. (2010). *Illinois Groundwater Protection Program - Biennial Comprehensive Status and Self-Assessment Report.* Illinois Environmental Protection Agency, Bureau of Water.

KPRG. (2013). *Revised Groundwater Impact Assessment, Lincoln Stone Quarry Landfill, Addendum to IEPA Application Logs 2004-052 and 2009-213, Volume 2, March 13, 2013.*

Meyer, S., Roadcap, G., Lin, Y.-F., & Walker, D. (2009). *Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois.* Champaign, Illinois: Illinois State Water Survey.

Midwest Generation (MWG) (2021). *Application for Initial Operating Permit, Joliet #29 Generating Station, Midwest Generation, LLC, Joliet, Illinois, October 29, 2021.*

Niswonger, R. P. (2011). MODFLOW-NWT, A Newton formulation for MODFLOW-2005. In U. G. Survey, *Techniques and Methods 6-A37* (p. 44). Reston, Virginia: U.S. Department of the Interior.

Patrick Engineering Inc. (2011). *Hydrogeologic Assessment Report, Joliet Generating Station No. 29, Joliet, Illinois.* Prepared for Midwest Generation, LLC and submitted to Illinois Environmental Protection Agency.

Seequent Limited. (2021, June 16). Leapfrog Works 2021.1.2. Brisbane, Australia.

U.S. Geological Survey. (2021). 3D Elevation Program 1-Meter Resolution Digital Elevation Model. Retrieved from https://www.usgs.gov/core-science-systems/ngp/3dep/data-tools

Willman, H. B., & Lineback, J. (1970). *Surficial Geology of the Chicago Region.* Urbana, Illinois: Illinois State Geological Survey.

Zheng, C. M. (2012). MT3DMS: Model Use, Calibration, and Validation. *Transactions of the ASABE, Volume 55*.

Signature Page

BAS Groundwater Consulting Inc.

Betsy Semmens, RG
President/BAS Groundwater Consulting

TABLES

Table 1: Precipitation Data near Joliet 29 Station

Month	Average Monthly Precipitation (inches)[1,2]
January	1.09
February	1.27
March	2.01
April	3.66
May	3.90
June	4.65
July	4.41
August	4.08
September	3.02
October	3.09
November	2.40
December	1.81
Average Annual Precipitation[1]	34.4

Notes:

[1]Data were averaged for the periods of complete records available for these stations: Elwood 8 NW, Joliet Brandon Rd Dam, Joliet, Joliet Regional Airport

[2]Periods of complete records were determined as months with 5 or less missing days and years without months with more than 5 missing days

Table 2: Compiled Borehole Lithology

Well Name/Identifier	From[1]	To[1]	Description	Lithology Group
	ft bgs	ft bgs		
121973265800	0	15	gravel	Sand and gravel
121973265800	15	185	limestone	Carbonate
121973265800	185	267	shale	shale
121973842900	0	8	fill	FILL
121973842900	8	170	lime	Carbonate
121973842900	170	220	shale	Shale
121973842800	0	10	black dirt and rocks	FILL
121973842800	10	135	yellow limestone	Carbonate
121973842800	150	175	limestone	Carbonate
121974206700	0	7	clay	Silt and Clay
121974206700	7	8	broken rock	Carbonate
121974206700	8	50	lime	Carbonate
121974206700	50	200	white & gray lime	Carbonate
121974206700	200	215	shale streaks lime	Carbonate and Shale
121974206700	215	225	shale	shale
121974045100	0	20	sand & gravel	Sand and gravel
121974045100	20	140	brown limestone	Carbonate
121974045100	140	200	gray limestone	Carbonate
121972880200	0	25	clay	Silt and Clay
121972880200	25	40	clay & boulders	Silt and Clay
121972880200	40	50	lime	Carbonate
121972880200	50	85	porous lime	Carbonate
121972880200	85	140	white lime	Carbonate
121972880200	140	205	grey lime	Carbonate
121972880200	205	235	white porous lime	Carbonate
121972880200	235	250	grey lime w/shale streaks	Carbonate and Shale
121972880200	250	255	shale	shale
121972738300	0	60	clay	Silt and Clay
121972738300	60	185	limestone	Carbonate
121974359800	0	11	Clay Fill	Silt and Clay
121974359800	11	24	sand & gravel	Sand and gravel
121974359800	24	30.5	Fill	FILL
121974359800	30.5	33	Organic Clay	Silt and Clay
121974359800	33	43	loam	Loam
121972919900	0	8	clay	Silt and Clay
121972919900	8	100	limestone	Carbonate
121973006000	0	60	clay	Silt and Clay
121973006000	60	69	sand & gravel	Sand and gravel
121973006000	69	91	limestone	Carbonate
121973006000	91	135	shale	Shale
121973006000	135	185	limestone	Carbonate
121972758800	0	3	top soil	Topsoil
121972758800	3	90	rock	Carbonate
121972758800	90	108	shale	Shale
121972758800	108	138	rock	Carbonate or shale
121972758800	138	200	rock & shale	Carbonate and Shale
121972760100	0	65	clay	Silt and Clay
121972760100	65	70	sand	Sand and gravel
121972760100	70	90	gravel	Sand and gravel
121972760100	90	205	limestone	Carbonate
121972773600	0	90	clay & gravel	clay, sand, gravel
121972773600	90	185	limestone	Carbonate
121973178000	0	10	brown clay	Silt and Clay
121973178000	10	73	shale	Shale
121973179200	0	1	top soil	Topsoil
121973179200	1	75	clay	Silt and Clay
121973179200	75	90	clay/sand/gravel	clay, sand, gravel
121973179200	90	200	limestone	Carbonate
121973179400	0	2	top soil	Topsoil
121973179400	2	3	clay	Silt and Clay
121973179400	3	18	flagstone	Flagstone
121973179400	18	185	limestone	Carbonate

Well Name/Identifier	From[1]	To[1]	Description	Lithology Group
	ft bgs	ft bgs		
121973179400	185	205	shale	Shale
121973179500	0	26	gravel	Sand and gravel
121973179500	26	120	limestone	Carbonate
121973179500	120	140	shale	Shale
121973179500	140	150	limestone	Carbonate
121973179500	150	170	shale	Shale
121973179500	170	205	limestone	Carbonate
121973179600	0	40	clay & gravel	clay, sand, gravel
121973179600	40	115	limestone	Carbonate
121973179700	0	10	clay	Silt and Clay
121973179700	10	84	gravel	Sand and gravel
121973179700	84	205	limestone	Carbonate
121973624000	0	10	clay	Silt and Clay
121973624000	10	20	gravel	Sand and gravel
121973624000	20	130	limestone	Carbonate
121973624000	130	150	black hard shale	Shale
121973628800	0	6	fill	FILL
121973628800	6	70	dolomite	Carbonate
121973524600	0	5	gravel	Sand and gravel
121973524600	5	200	limestone	Carbonate
121973686500	0	8	clay & gravel	clay, sand, gravel
121973686500	8	20	flagstone	Flagstone
121973686500	20	145	gray limestone	Carbonate
121970126200	0	5	FILL	Fill
121970126200	5	102	dolomite	Carbonate
121970126200	102	210	Maquoketa	Shale
121973388700	0	5	fill and black soil	Fill
121973388700	5	35	clay, yellow	Silt and Clay
121973388700	35	68	clay, blue	Silt and Clay
121973388700	68	82	sand & clay	Sandy Clay
121973388700	82	112	rock, hard, white	Carbonate
121973388700	112	170	red rock	Shale
121973889900	0	12	Large River Rock	Sand and Gravel
121973889900	12	15	Sand and Gravel	Sand and Gravel
121973889900	15	20	Clay	Silt and Clay
121973889900	20	35	Sand and Large Gravel	Sand and Gravel
121973889900	35	37	broken rock	Carbonate
121973889900	37	95	Lime	Carbonate
121973889900	95	105	Shallow and Lime	Carbonate
121973889900	105	140	Lime and Shale Streaks	Carbonate and Shale
121973889900	140	218	Shale	Shale
121973265900	0	7	black soil	Topsoil
121973265900	7	17	broken limestone	Carbonate
121973265900	17	103	limestone	Carbonate
121970027700	0	10	boulders	sand and gravel
121970027700	10	20	gravel boulders and sand	sand and gravel
121970027700	20	23	yellowish lime	Carbonate
121970027700	23	33	dark gray lime	Carbonate
121970027700	33	73	gray lime	Carbonate
121970027700	73	135	white lime	Carbonate
121970159300	0	1	drift	Topsoil
121970159300	1	133	Silurian dolomite	Carbonate
121970159300	133	143	dolomite withe shale	Carbonate
121970159300	143	145	shale	shale
121970350100	0	2	top soil	Topsoil
121970350100	2	55	clay	Silt and Clay
121970350100	55	83	sand	Sand and gravel
121970350100	83	225	limestone	Carbonate
121970119800	0	3	Drift	Topsoil
121970119800	3	65	Limestone	Carbonate
121970119800	65	201	Maquoketa	Shale
121970356800	0	1	topsoil	Topsoil
121970356800	1	58	clay & gravel	clay, sand, gravel
121970356800	58	180	limestone	Carbonate
121970356900	0	1	top soil	Topsoil

Well Name/Identifier	From[1]	To[1]	Description	Lithology Group
	ft bgs	ft bgs		
121970356900	1	76	clay & gravel	clay, sand, gravel
121970356900	76	185	limestone	Carbonate
121970124700	0	12	surface	Topsoil
121970124700	12	135	limestone, hard	Carbonate
121970124700	135	140	shale	Shale
121970124700	140	165	limestone, hard	Carbonate
121970124700	165	175	streaks of limestone, shale	Carbonate and Shale
121970124700	175	245	Maquoketa	Shale
121970124800	0	125	Dolomite	Carbonate
121970124800	125	240	Maquoketa	Shale
121970125000	10	148	Dolomite	Carbonate
121970125000	148	256	Maquoketa	Shale
121970296100	0	42	clay & gravel	clay, sand, gravel
121970296100	42	160	limestone	Carbonate
121972646300	0	40	clay & gravel	clay, sand, gravel
121972646300	40	115	limestone	Carbonate
121973925800	0	6	drift	Topsoil
121973925800	6	33	limestone	Carbonate
121973925800	33	37	shale	Shale
121970126100	0	98	Dolomite	Carbonate
121970126100	98	210	Maquoketa	shale
121973265600	0	4	black soil	Topsoil
121973265600	4	10	yellow clay and boulders	clay, sand, gravel
121973265600	10	35	yellow clay	Silt and Clay
121973265600	35	55	blue clay	Silt and Clay
121973265600	55	62	sand and gravel	Sand and Gravel
121973265600	62	200	limestone	Carbonate
121973265700	0	14	boulders	Sand and Gravel
121973265700	14	17	rock and gravel	Sand and Gravel
121973265700	17	94	lime	Carbonate
121973265700	94	103	shale and lime	Carbonate and Shale
121973265700	103	137	shale	Shale
MW-01	0	1	FILL: Topsoil with fine to coarse gravel	FILL
MW-01	1	6	FILL: 1' to 2' rounded coarse gravel at surface	FILL
MW-01	6	9	FILL: Fine to coarse sand and gravel, limestone fragments	FILL
MW-01	9	11	FILL: Limestone fragments	FILL
MW-01	11	19	Fine to coarse sand and gravel, some black clay, limestone fragments	clay, sand, gravel
MW-01	19	20	Limestone fragments	Sand and gravel
MW-01	20	27.5	Fine to coarse sand and gravel, with limestone fragments, weathered	Sand and gravel
MW-02	0	1	Fine to coarse grave (CA-6)	Sand and gravel
MW-02	1	4	Brown fine to coarse sand and gravel	Sand and gravel
MW-02	4	6	1" limestone fragments	Sand and gravel
MW-02	6	8	Brown fine to coarse sand and gravel	Sand and gravel
MW-02	8	12.5	1" limestone fragments	Sand and gravel
MW-02	12.5	13.5	Little Silty clay	Silt and Clay
MW-02	13.5	16	Coarse gravel with black silty clay, trace roots, trace coarse sand	clay, sand, gravel
MW-02	18.5	21	Brown silty fine to coarse sand, trace fine gravel	clay, sand, gravel
MW-02	21	24	Limestone fragments, trace light brown silty clay	clay, sand, gravel
MW-02	24	28.5	Limestone fragments	Sand and gravel
MW-03	0	4	Coarse gravel (CA-6)	Sand and gravel
MW-03	4	18.5	Fine to coarse sand and gravel	Sand and gravel
MW-03	18.5	41	Tan fine to coarse sand, with coarse gravel	Sand and gravel
MW-04	0	1	Coarse gravel (CA-6)	Sand and gravel
MW-04	1	6	Brown silty clay, trace coarse sand, stiff	clay, sand, gravel
MW-04	6	17	Brown fine to coarse sand and gravel, trace limestone fragments	Sand and gravel
MW-04	17	20	Limestone fragments	Sand and gravel
MW-04	20	23	Brown fine to coarse sand and gravel, trace limestone fragments	Sand and gravel
MW-04	23	33	Fine to coarse sand and gravel	Sand and gravel
MW-04	33	35.5	Fine to coarse sand	Sand and gravel
MW-04	35.5	40	Fine to coarse sand and gravel, with limestone fragments	Sand and gravel
MW-05	0	8.5	Fine to coarse gravel, topsoil	Topsoil
MW-05	8.5	19	Black silty clay, coarse sand	clay, sand, gravel
MW-05	19	23.5	Coarse gravel fragments	Sand and Gravel
MW-05	23.5	31	Tan to light brown fine to coarse sand, little coarse gravel	Sand and Gravel
MW-05	31	41	Fine to coarse sand and gravel	Sand and Gravel

Well Name/Identifier	From[1]	To[1]	Description	Lithology Group
	ft bgs	ft bgs		
MW-05	41	42	Tan to light brown fine to coarse sand, little coarse gravel	Sand and Gravel
MW-06	0	8.5	Gravel (CA-6) topsoil	Topsoil
MW-06	8.5	31	Brown to tan fine to coarse sand and gravel, trace limestone, gravel seams	Sand and Gravel
MW-06	31	38.5	Fine to coarse sand and gravel	Sand and Gravel
MW-06	38.5	40.5	Limestone Bedrock	Carbonate
MW-07	0	8.5	Gravel (CA-6) topsoil	Topsoil
MW-07	8.5	39.5	Tan to brown fine to coarse sand and gravel	Sand and Gravel
MW-08	0	1	Fine to coarse gravel fill	Sand and Gravel
MW-08	1	3.5	Dark brown silty clay, some fine to coarse sand, stiff	Sand and Gravel
MW-08	3.5	6	Black/brown fine to coarse sand and gravel	Sand and Gravel
MW-08	6	20	Limestone fragments	Sand and Gravel
MW-08	20	35.5	Black/brown fine to coarse sand and gravel	Sand and Gravel
MW-09	0	1	Coarse sand and gravel (CA-6)	Sand and Gravel
MW-09	1	3.5	Coarse gravel, with black silty clay, trace root seams	clay, sand, gravel
MW-09	3.5	11	Coarse gravel fragments, with fine to coarse sand	Sand and Gravel
MW-09	11	18.5	Limestone fragments, with light brown silty fine to coarse sand	Sand and Gravel
MW-09	18.5	23.5	Limestone fragments, with light brown to dark orange fine to coarse sand	Sand and Gravel
MW-09	23.5	28.5	Light brown/orange fine to coarse sand, with coarse gravel	Sand and Gravel
MW-09	28.5	35	Light brown coarse sand, some fine to coarse gravel, little fine sand	Sand and Gravel
MW-10	0	3	Coarse gravel	Sand and Gravel
MW-10	3	7	Brown clay	Silt and Clay
MW-10	7	19	Black/gray sandy silt	Silt and Clay
MW-10	19	41	Gray silty clay, trace coarse sand, soft	Sandy Clay
MW-11	0	9	Fine to coarse sand and gravel, fill	Sand and Gravel
MW-11	9	14	Grades to dark gray clayey silt	Silt and Clay
MW-11	14	24	Dark gray clayey silt, soft	Silt and Clay
MW-11	24	39.5	Light brown fine to coarse silt and gravel	clay, sand, gravel

Notes:

[1]Depth intervals in feet below ground surface (ft bgs).

Table 3: Hydraulic Conductivity Data for Site Wells

Well Name	Screened Depth	Screened Geology	Test Name	2011 Hydraulic Conductivity Estimate		2021 Hydraulic Conductivity Estimate	
	ft bgs			ft/s	ft/d	ft/s	ft/d
MW-4	29.5 - 39.5	Sandy Gravel	U2	6.95E-03	600	3.63E-03	310
			D1	4.27E-03	370	3.28E-03	280
MW-6	30.5 - 40.5	Sandy Gravel / Limestone Bedrock	U1	5.27E-03	460	1.48E-03	130
			D2	2.99E-03	260	1.61E-03	140
MW-9	24.75 - 34.75	Sandy Gravel	U2	1.95E-03	170	1.17E-03	100
			D1	1.93E-03	170	1.41E-03	120
MW-11	29.5 -39.5	Silty Gravel	U2	4.69E-03	400	2.38E-03	210
			D1	3.13E-03	270	1.95E-03	170

Notes:
ft bgs = feet below ground surface
ft/d = feet per day
ft/s = feet per second

Table 4: Groundwater Elevation Data

	MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07	MW-08	MW-09	MW-10	MW-11
Groundwater Elevation:											
Minimum (ft)	504.9	504.9	504.9	503.9	504.8	504.9	504.9	498.0	505.0	504.9	505.2
Maximum (ft)	511.6	512.3	511.7	511.6	511.5	511.5	511.5	511.8	511.1	511.8	512.8
1st Quartile (ft)	505.5	505.2	505.2	505.2	505.1	505.3	505.3	505.2	505.3	505.3	505.5
3rd Quartile (ft)	506.8	506.2	506.0	506.0	506.0	506.2	506.3	506.1	506.2	506.2	506.6
IQR (ft)	1.3	0.9	0.7	0.8	0.9	0.9	1.0	0.8	0.9	0.9	1.1
Lower Bound (ft)	503.6	503.8	504.1	504.0	503.8	503.9	503.8	504.0	503.9	503.9	503.8
Upper Bound (ft)	508.7	507.6	507.1	507.2	507.4	507.5	507.8	507.3	507.5	507.5	508.3
Average (ft)[1]	505.9	505.6	505.6	505.6	505.6	505.7	505.7	505.6	505.7	505.7	506.1

Notes:

ft = feet

IQR = Interquartile range

[1]The calculated average water level was used as the calibration head target in the numerical groundwater flow model

Table 5: Calibrated Water Budget

Component	Conceptual Flux	Modeled Flux	
	af/yr	af/yr	cfd
INFLOWS			
Recharge	55	58	6,871
Inflow from the North	446	16	1,935
Total Inflows	501	74	8,806
OUTFLOWS			
Discharge to Des Plaines River	462	74	8,806
Total Outflows		74	8,806

Notes:
af/yr = acre-feet per year
cfd = cubic feet per day

Table 6: Calibration Residuals

Well	Easting	Northing	Target Value[1]	Weight	Modeled Water Level	Residual
NAD83, State Plane, IL East, ft			ft		ft	ft
MW-01	1043517.49	1759791.00	505.9	1	505.87	0.03
MW-02	1043322.89	1759718.93	505.62	1	505.67	-0.05
MW-03	1042813.57	1759529.13	505.57	1	505.56	0.01
MW-04	1042623.77	1759421.02	505.57	1	505.54	0.03
MW-05	1042373.92	1759339.33	505.55	1	505.59	-0.04
MW-06	1042172.11	1759228.82	505.69	1	505.64	0.05
MW-07	1041898.22	1759127.91	505.73	1	505.79	-0.06
MW-08	1043219.58	1760040.85	505.63	1	505.65	-0.02
MW-09	1043044.21	1759795.81	505.67	1	505.63	0.04
MW-10	1042426.77	1759706.92	505.66	1	505.72	-0.06
MW-11	1041912.63	1759507.50	506.08	1	506.02	0.06

Notes:

ft = feet

[1]The target value for site-specific wells is the long-term average of measured water levels

Table 7: Calibration Statistics

Parameter	
Average Residual (ft)	0.0005
Minimum Residual (ft)	-0.061
Maximum Residual (ft)	0.062
Sum of Squared Residuals (ft^2)	0.021
RMS Error (ft)	0.044
%RMS[1]	8.3%

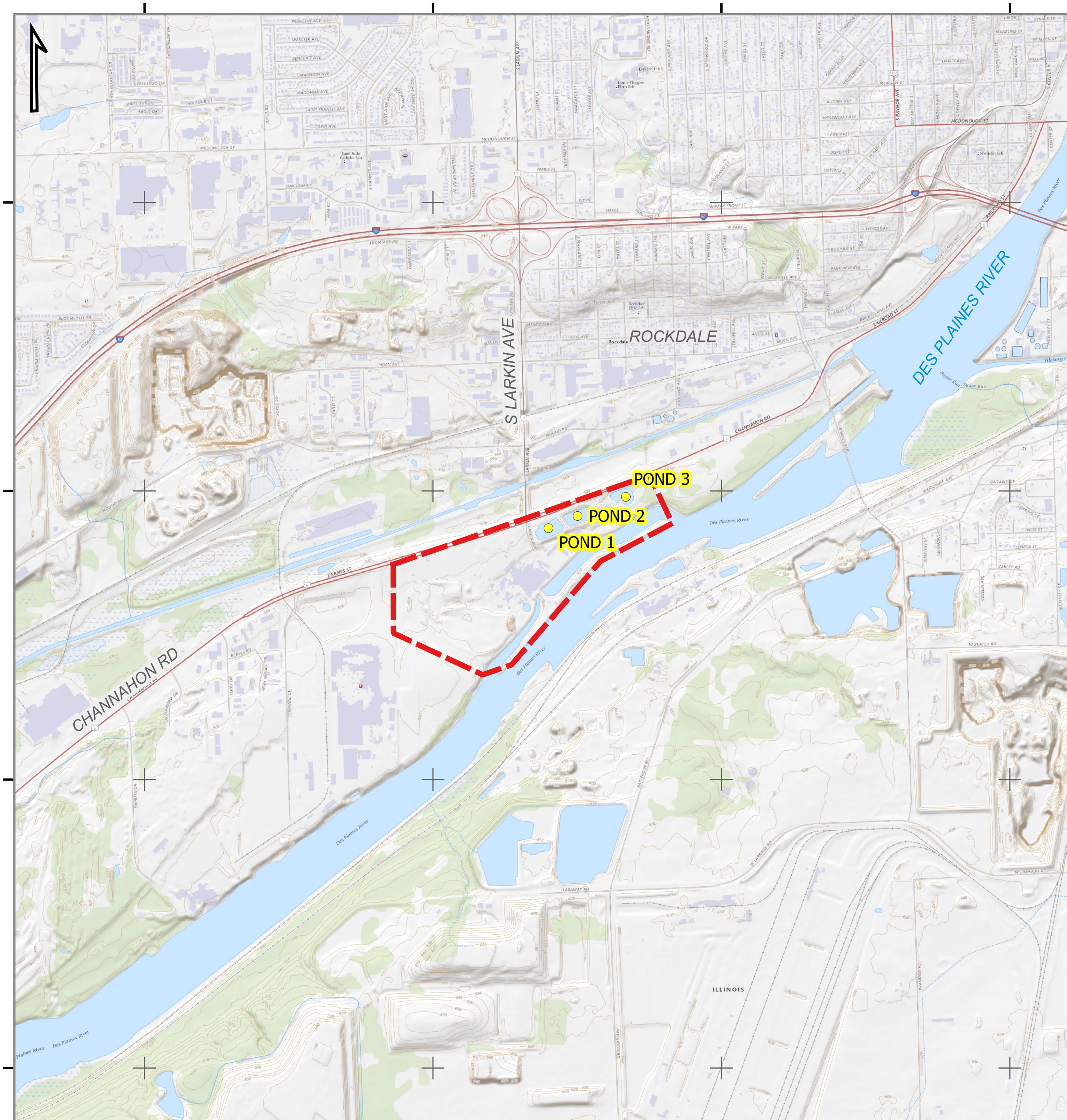
Notes:

ft = feet, ft^2 = square feet

RMS = root mean square

[1]Calculated by dividing the RMS error by the range in measured values

FIGURES



LEGEND

APPROXIMATE SITE BOUNDARY

0 0.5 mi

FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure1_LocationMap.qgz

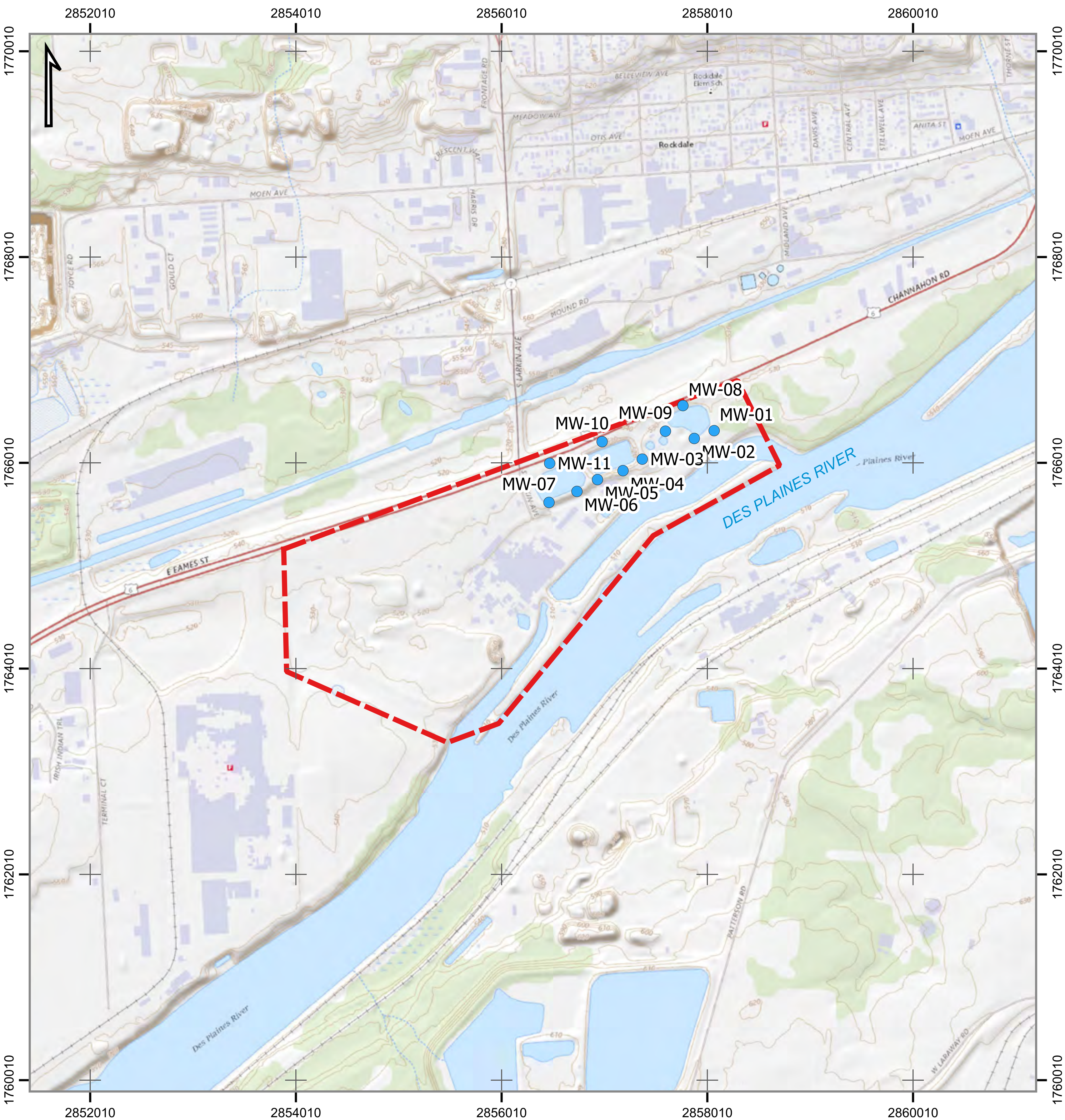
BAS GROUNDWATER CONSULTING

KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**LOCATION MAP**

SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:30,000	CHECKED	BAS	01/28/2022

BAS PROJECT No.	FIGURE:
21141501	1



LEGEND

SITE MONITORING WELL

APPROXIMATE SITE BOUNDARY

0 800 1,600 ft

FEET

Coordinate System: NAD_1983_StatePlane_Illinois_West_FIPS_1202_Feet

Project File: Figure2_SiteWells.qgz

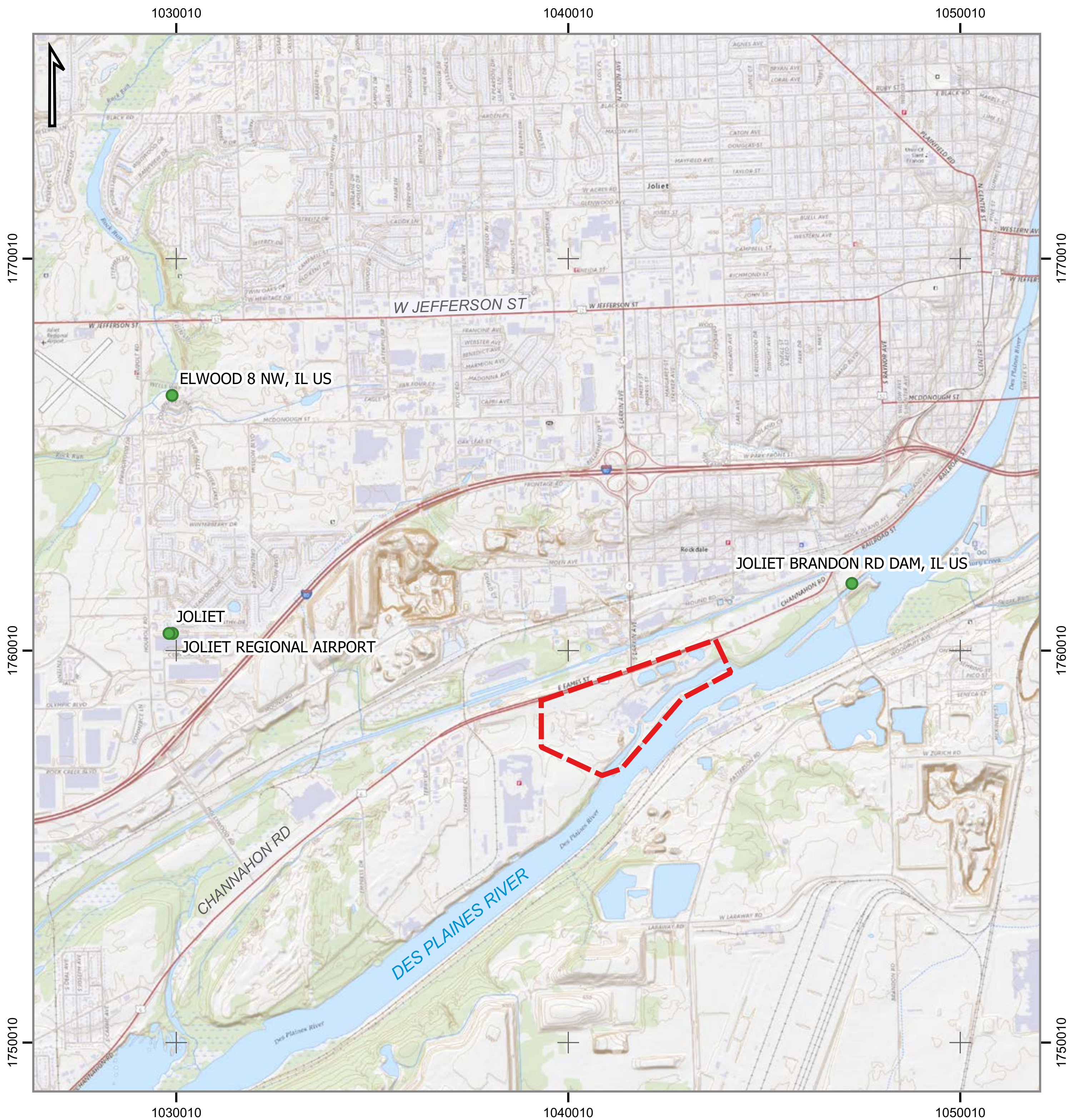
BAS GROUNDWATER CONSULTING

KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**SITE WELLS**

SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:16,000	CHECKED	BAS	01/28/2022

BAS PROJECT No.	FIGURE:
21141301	2



LEGEND

- CLIMATE STATION
- APPROXIMATE SITE BOUNDARY

0 2,000 4,000 ft

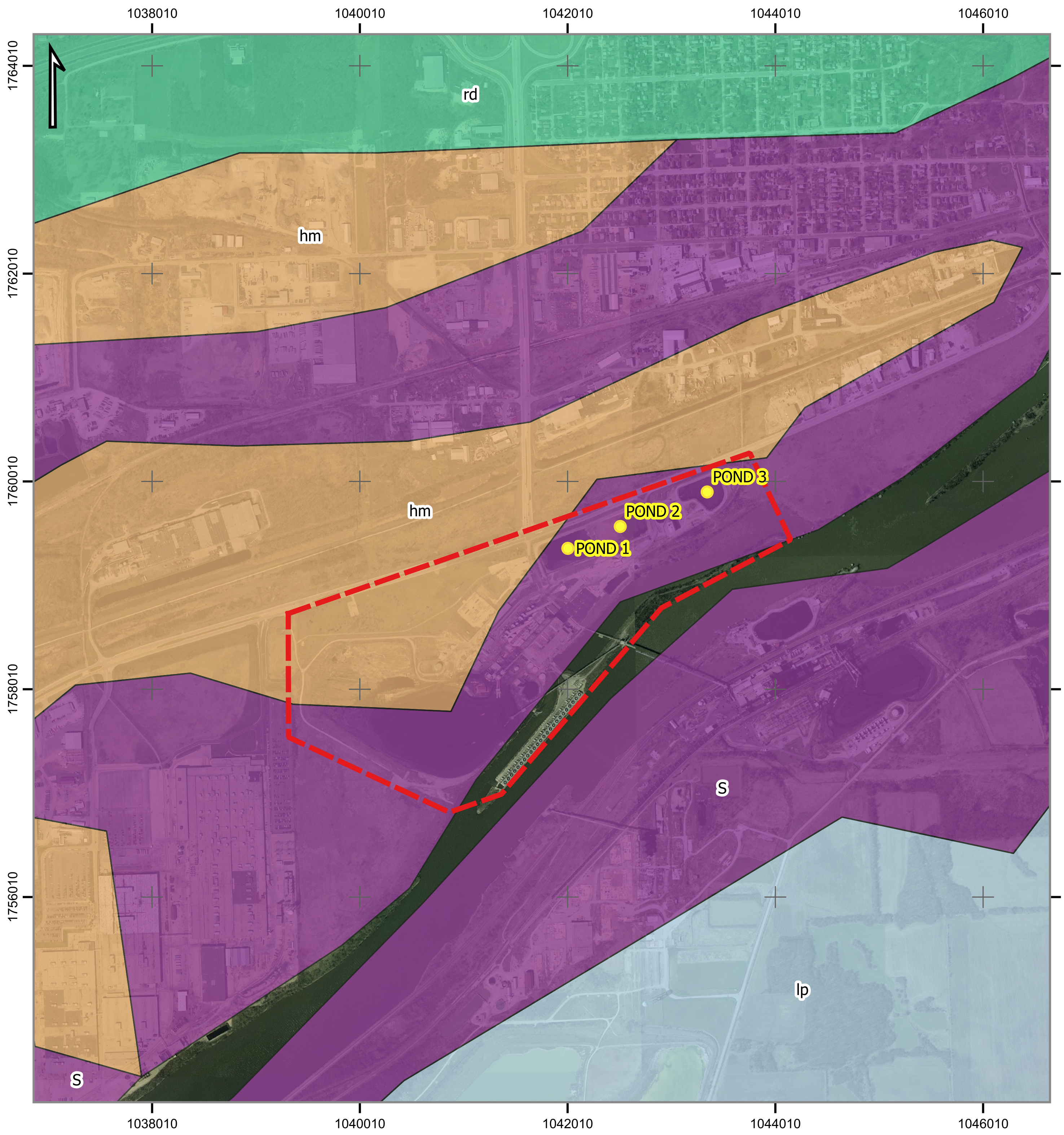
FEET

Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure3_ClimateStations.qgz

BAS GROUNDWATER CONSULTING | K P R G

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**CLIMATE STATIONS NEAR JOLIET 29 STATION**

SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:42,000	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: 3	



LEGEND

APPROXIMATE SITE BOUNDARY

SURFACE GEOLOGY

MACKINAW MEMBER OF THE HENRY FORMATION

LAKE PLAIN

ROCKDALE MORAINE

RACINE (TOP), WAUKESHA, JOLIET, KANKAKEE, AND EDGEWOOD FORMATIONS

0 800 1,600 ft

FEET

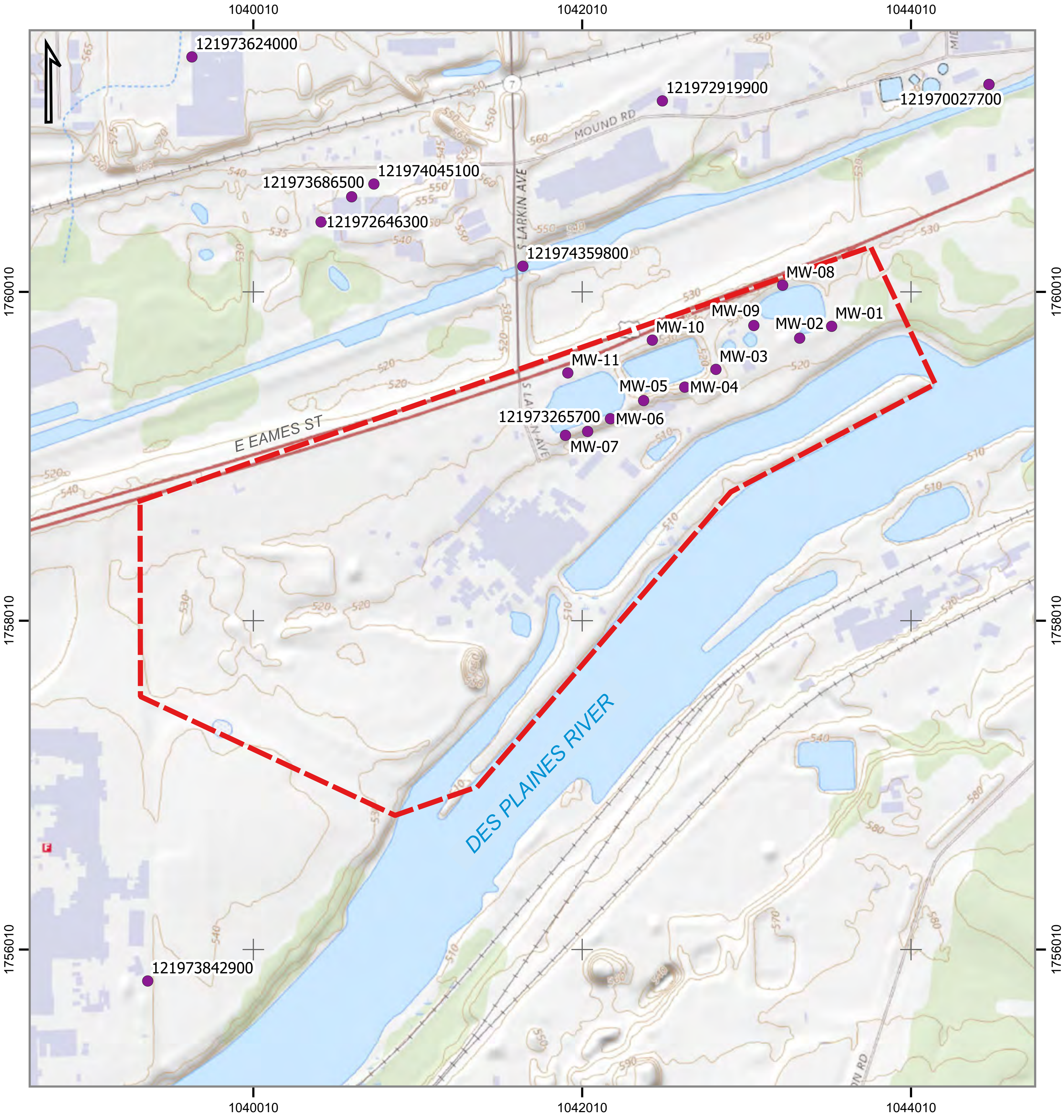
Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure4_Geology.qgz

BAS GROUNDWATER CONSULTING

K P R G

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**SURFACE GEOLOGY**

SCALE AT ANSI A: 1:16,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: 4		



LEGEND

- WELLS WITH BOREHOLE LITHOLOGY DATA
- APPROXIMATE SITE BOUNDARY

0 500 1,000 ft

FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure5_WellsWBoreholes2.qgz

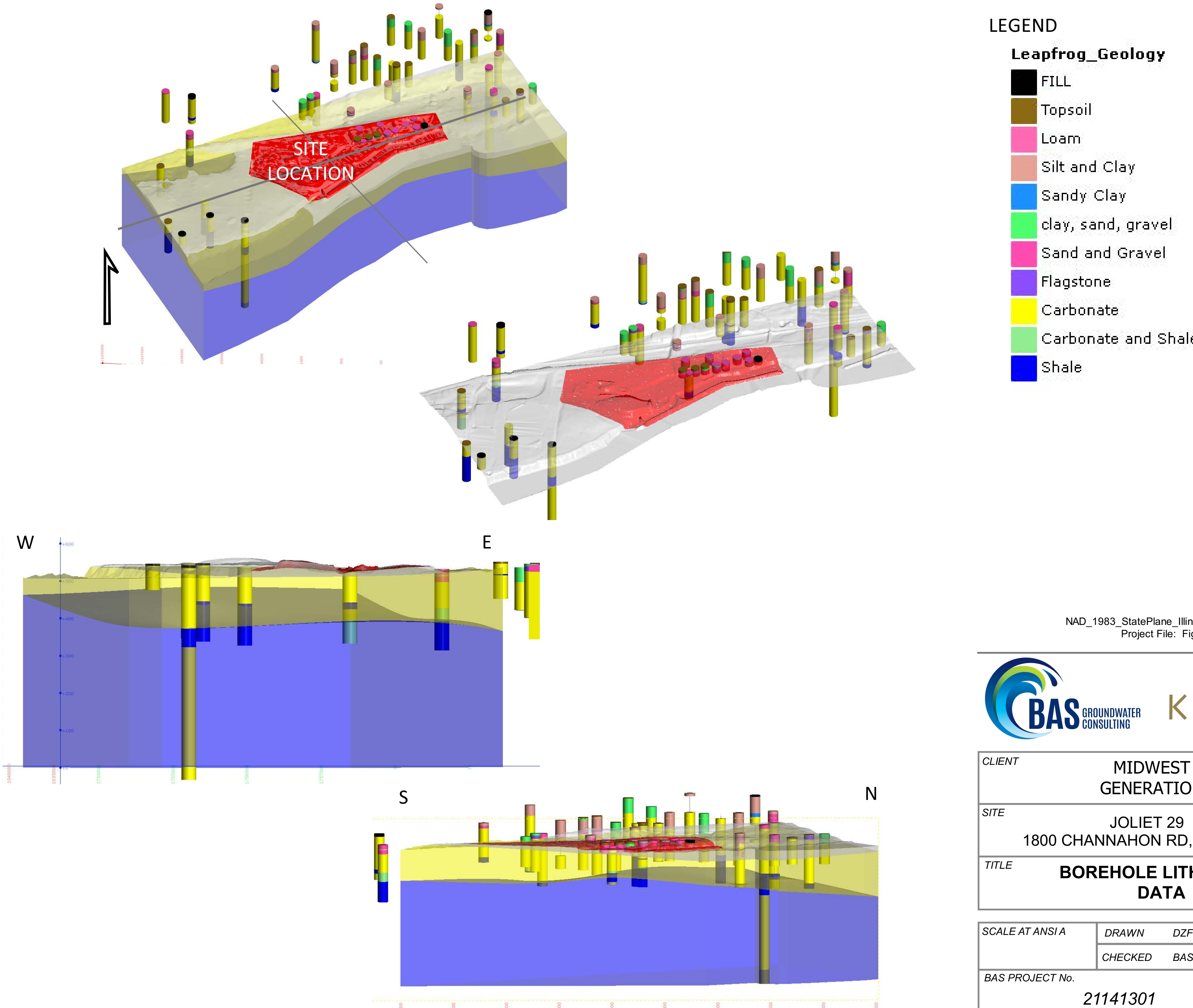
BAS GROUNDWATER CONSULTING

KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**WELLS WITH BOREHOLE LITHOLOGY DATA**

SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:10,000	CHECKED	BAS	01/28/2022

BAS PROJECT No.	FIGURE:
21141301	5

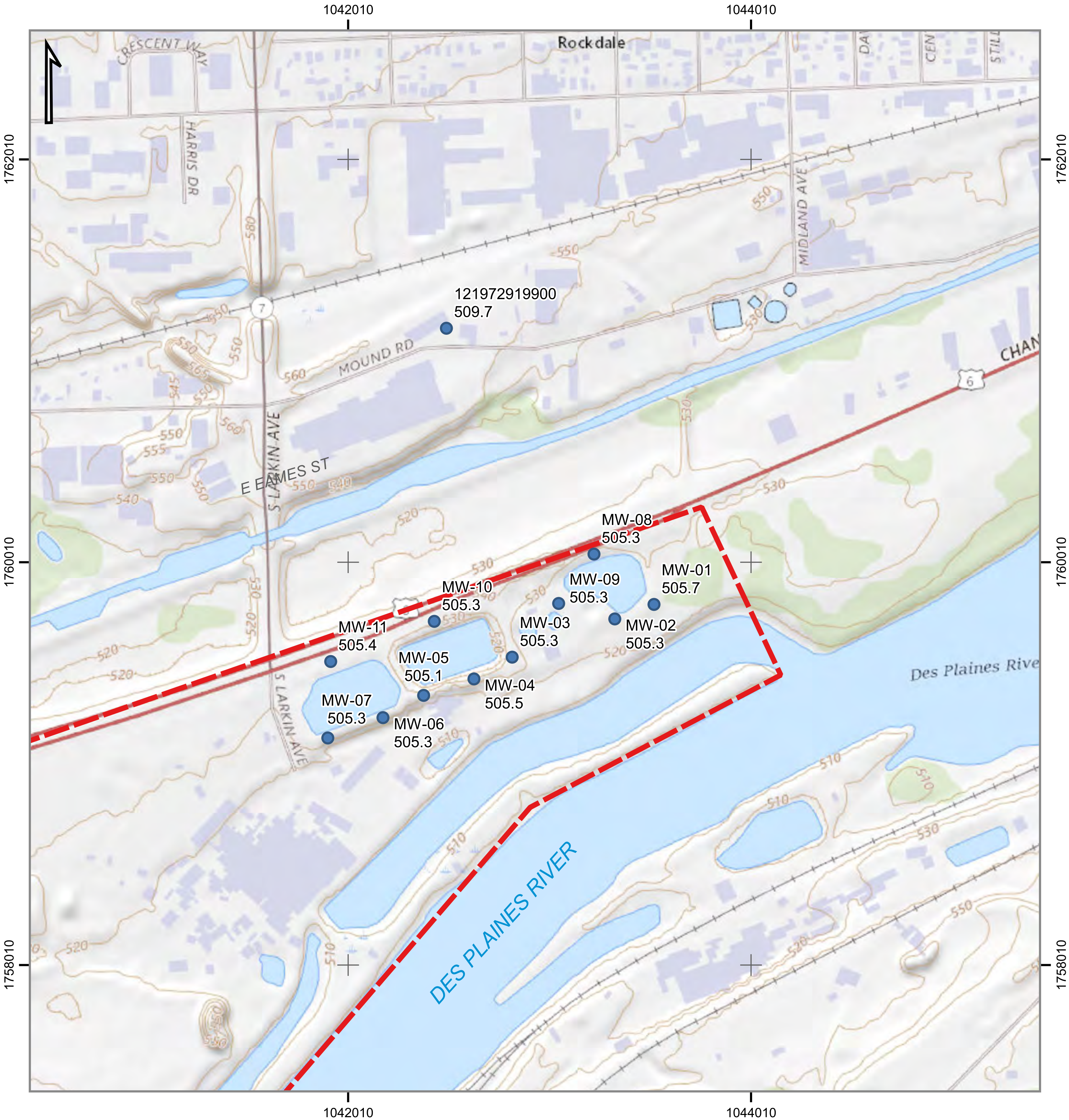


Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure6_LeapfrogGeology.qgz

BAS GROUNDWATER CONSULTING
KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**BOREHOLE LITHOLOGY DATA**

SCALE AT ANSI A	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: **6**	



LEGEND

- AVERAGE WATER LEVEL ELEVATION (FT, AMSL)
- APPROXIMATE SITE BOUNDARY

0 400 800 ft

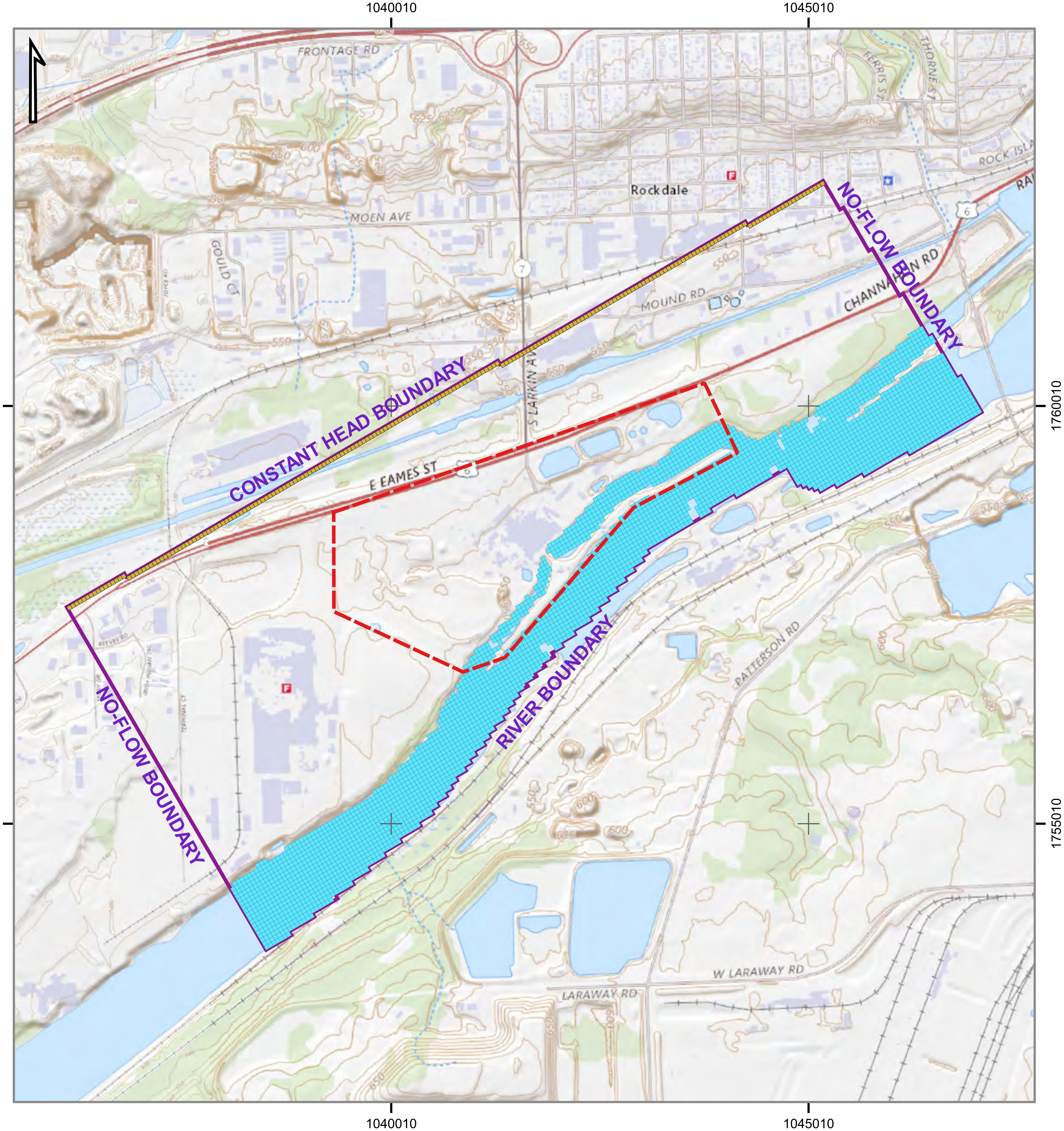
FEET

Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure7_WellsWWaterLevelData.qgz

BAS GROUNDWATER CONSULTING — KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**WELLS WITH WATER LEVEL DATA**

SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:8,200	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: 7	



LEGEND

- MODEL BOUNDARY
- RIVER BOUNDARY
- CONSTANT HEAD BOUNDARY
- APPROXIMATE SITE BOUNDARY

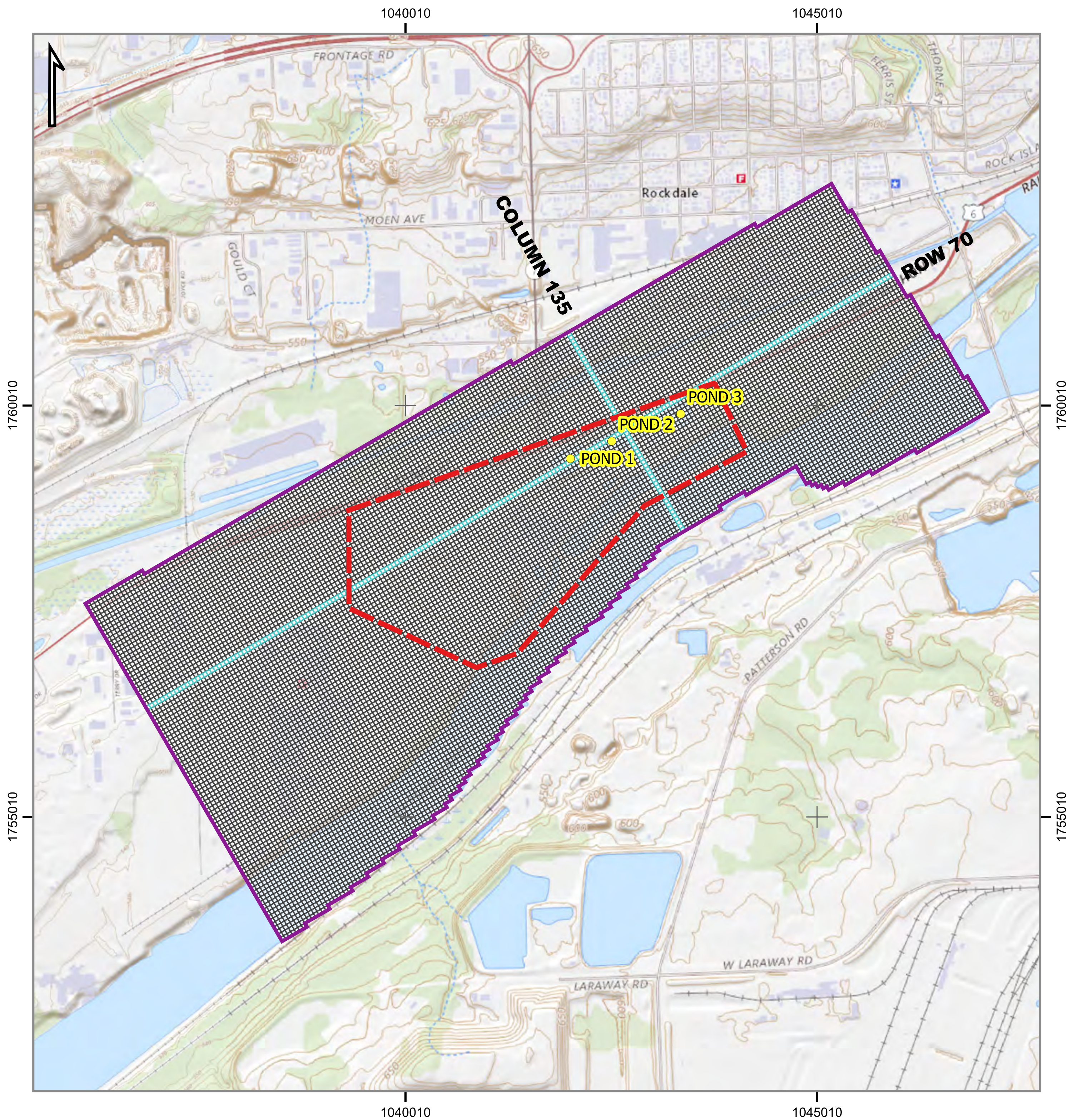
0 1,000 2,000 ft
FEET

Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure8_ModelBoundary.qgz

BAS GROUNDWATER CONSULTING   KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**MODEL BOUNDARY CONDITIONS**

SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:20,000	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: 8		



LEGEND

MODEL BOUNDARY

MODEL GRID

APPROXIMATE SITE BOUNDARY

HIGHLIGHTED SECTIONS SHOWN ON FIGURE 10

0 1,000 2,000 ft

FEET

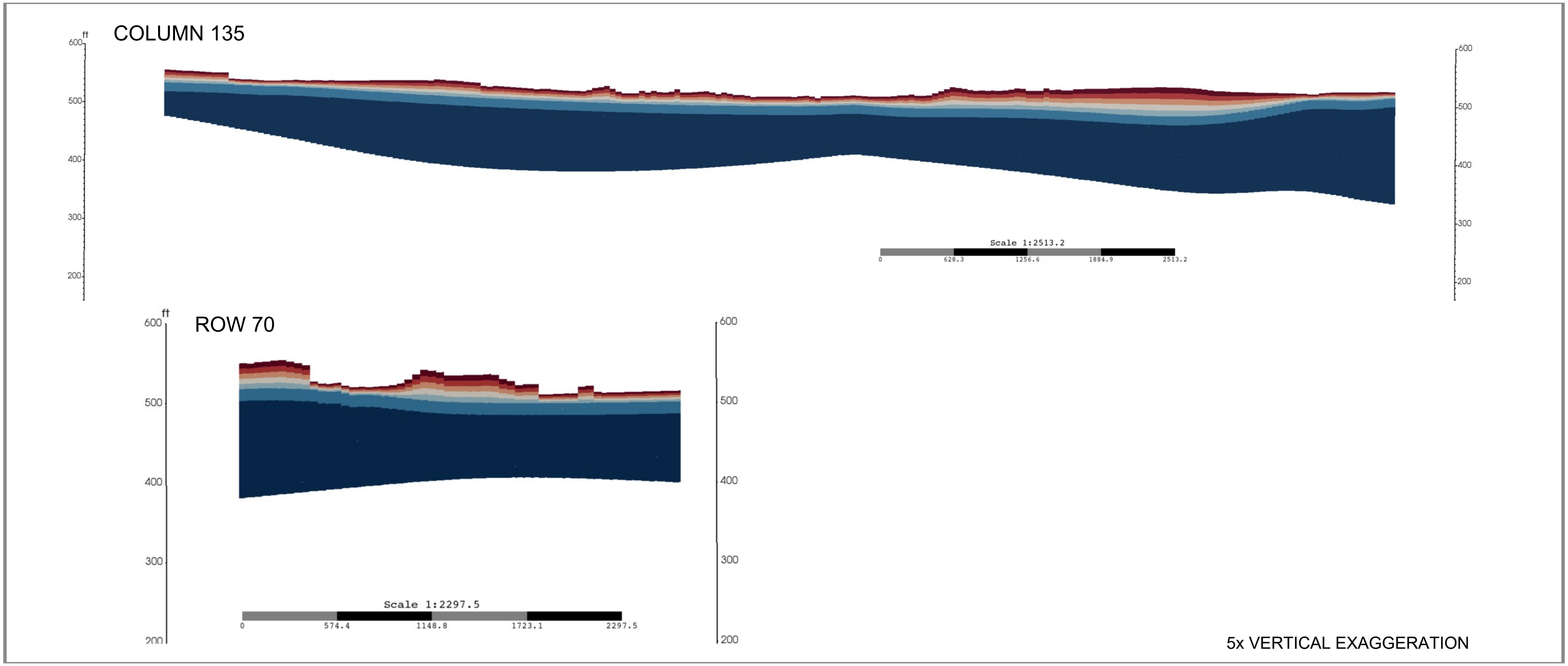
Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure9_ModelGrid.qgz

BAS GROUNDWATER CONSULTING KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**MODEL GRID**

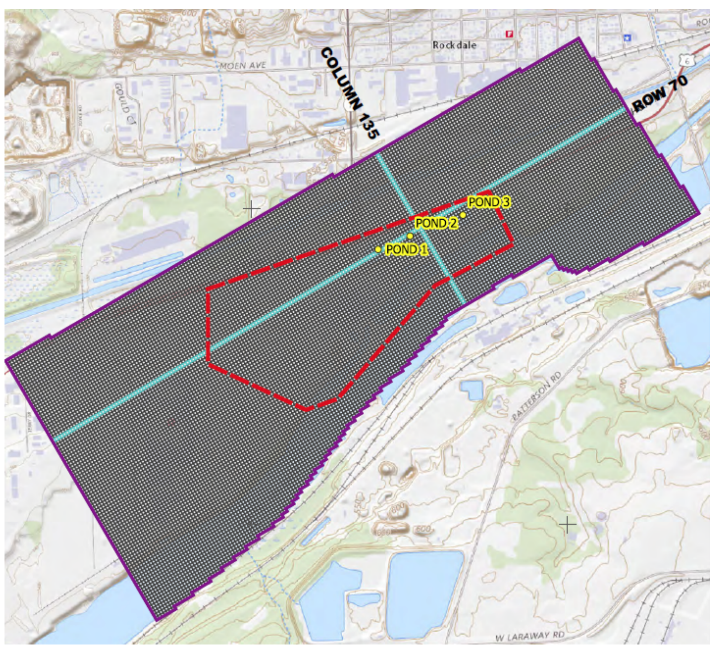
SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:20,000	CHECKED	BAS	01/28/2022

BAS PROJECT No.	FIGURE:
21141301	9



LEGEND

- LAYER 1
- LAYER 2
- LAYER 3
- LAYER 4
- LAYER 5
- LAYER 6

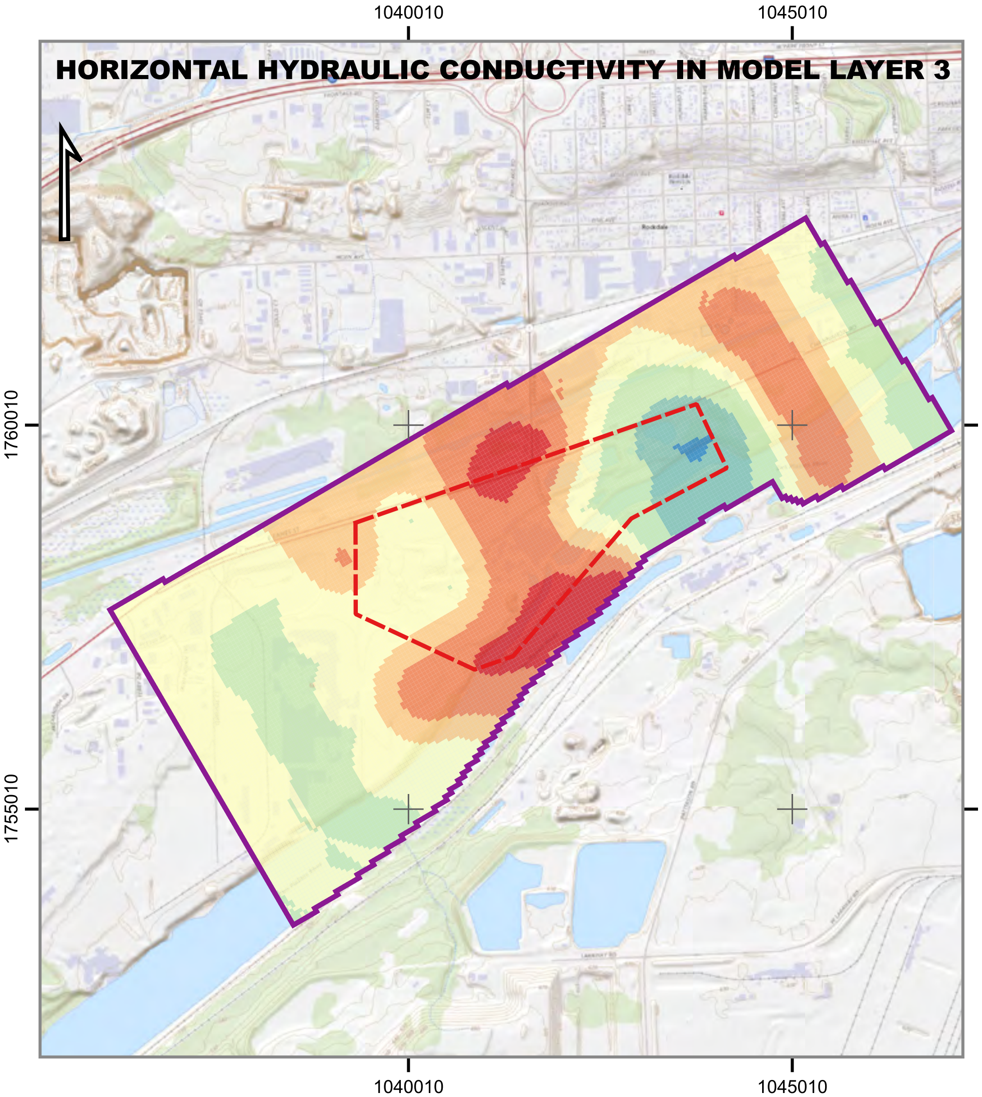


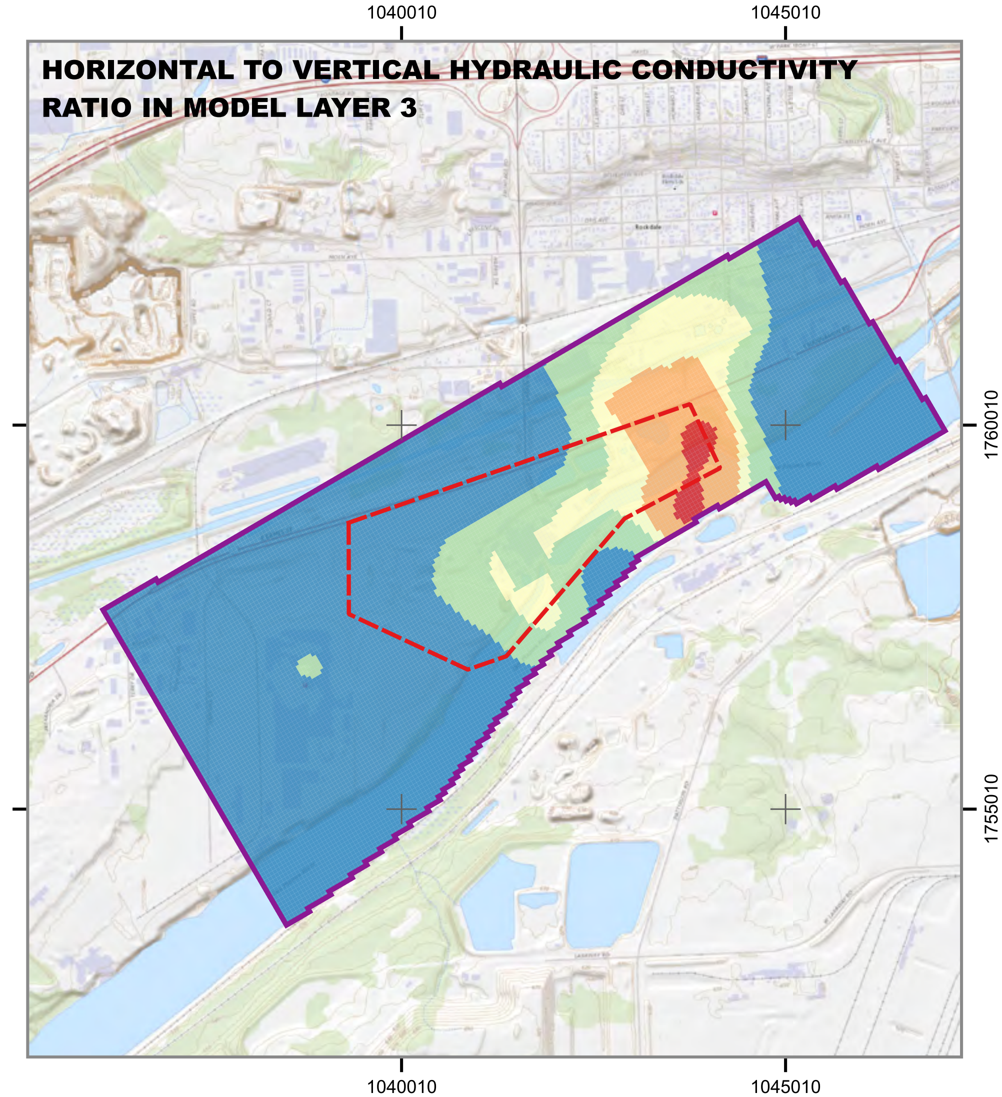
Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure10_ModelLayering.qgz

BAS GROUNDWATER CONSULTING
KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**MODEL LAYERING**

SCALE AT ANSI A	*DRAWN*	*DZF*	01/28/2022
	CHECKED	*BAS*	01/28/2022
BAS PROJECT No. 21141301		*FIGURE:* **10**	





LEGEND

MODEL BOUNDARY

APPROXIMATE SITE BOUNDARY

CALIBRATED HYDRAULIC CONDUCTIVITY VALUES, FT/D

- 0 - 1
- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 400
- 400 - 600

HORIZONTAL TO VERTICAL HYDRAULIC CONDUCTIVITY RATIO

- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 500
- 500 - 1000

BAS GROUNDWATER CONSULTING

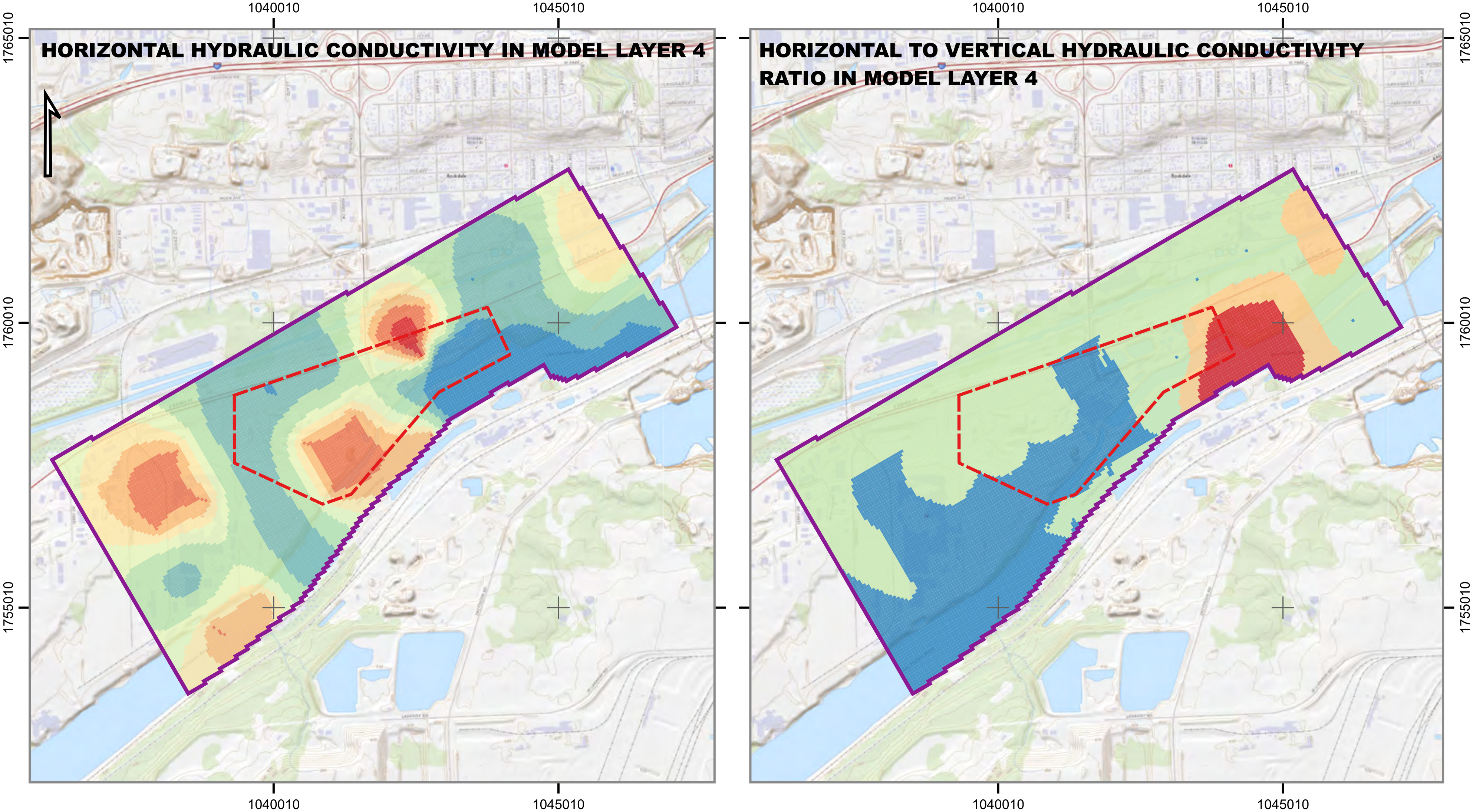
KPRG

0 1,000 2,000 ft

FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure11a_CalibratedKsLayers3.qgz

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	CALIBRATED HYDRAULIC CONDUCTIVITY DISTRIBUTION IN MODEL LAYER 3
SCALE AT ANSI A	1:30,000
DRAWN	DZF 01/28/2022
CHECKED	BAS 01/28/2022
BAS PROJECT No.	21141301
FIGURE:	11a



LEGEND

MODEL BOUNDARY

APPROXIMATE SITE BOUNDARY

CALIBRATED HYDRAULIC CONDUCTIVITY VALUES, FT/D

- 1 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700

HORIZONTAL TO VERTICAL HYDRAULIC CONDUCTIVITY RATIO

- 0 - 1
- 1 - 10
- 10 - 100
- 100 - 1000

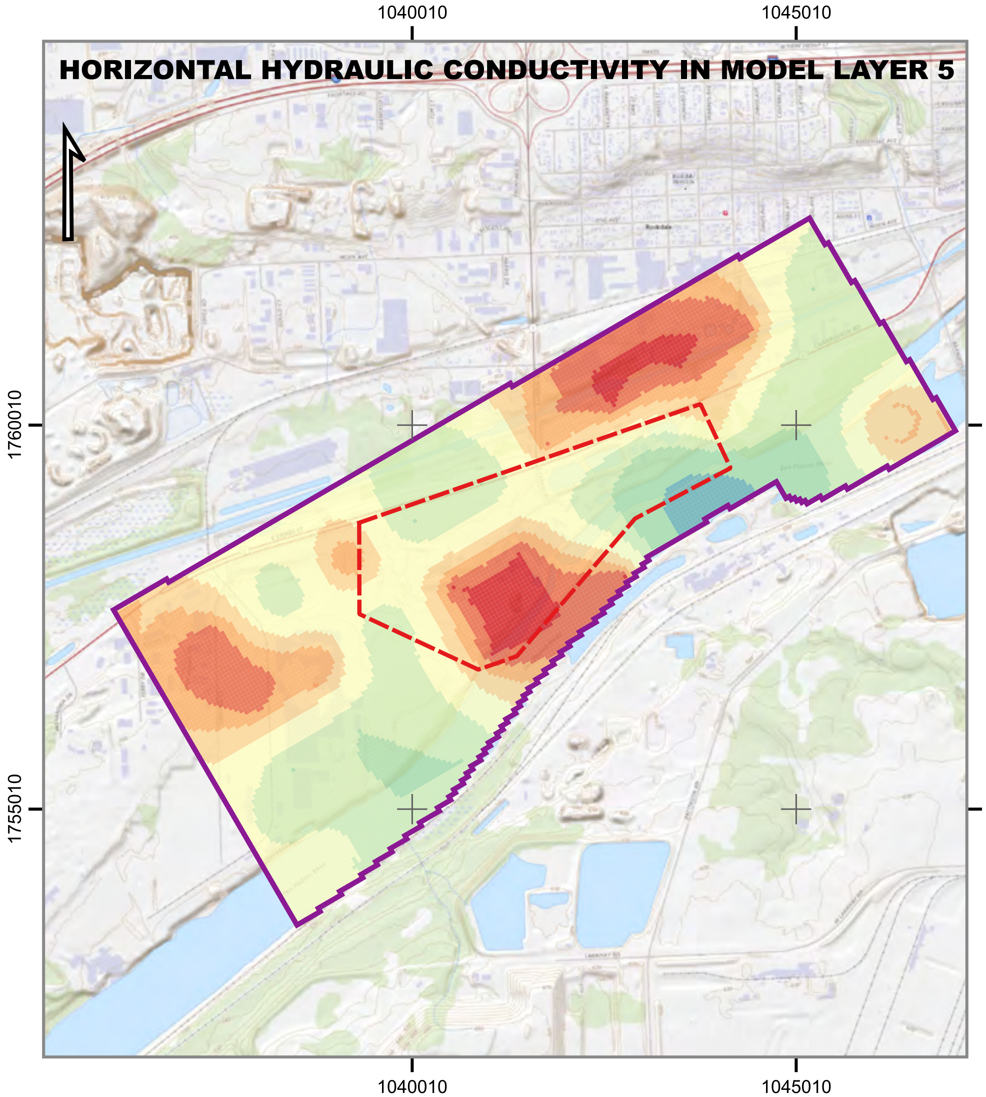
0 1,000 2,000 ft

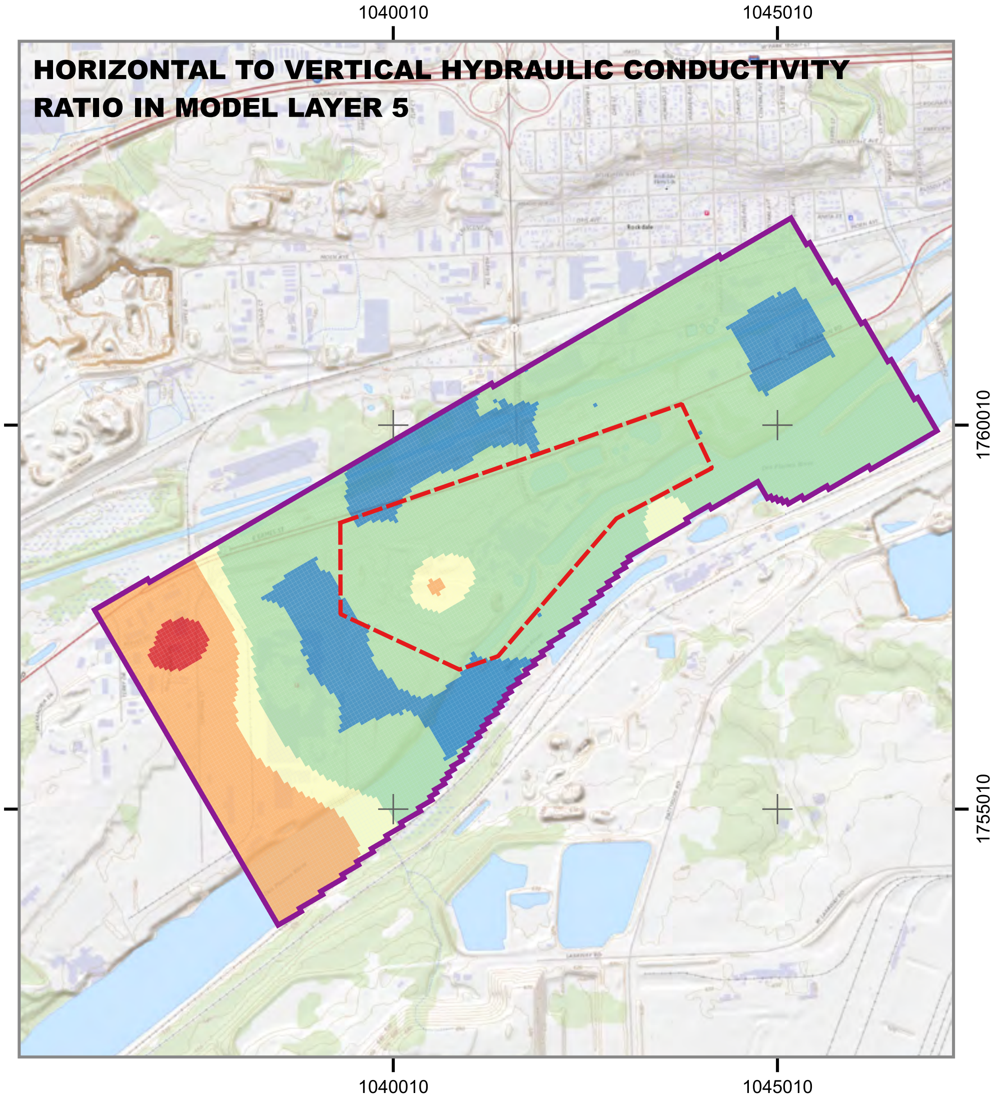
FEET

Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure11b_CalibratedKsLayers4.qgz

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	CALIBRATED HYDRAULIC CONDUCTIVITY DISTRIBUTION IN MODEL LAYER 4

SCALE AT ANSI A			
1:30,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: 11b	





LEGEND

MODEL BOUNDARY

APPROXIMATE SITE BOUNDARY

CALIBRATED HYDRAULIC CONDUCTIVITY VALUES, FT/D

- 0 - 1
- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600

HORIZONTAL TO VERTICAL HYDRAULIC CONDUCTIVITY RATIO

- 0 - 1
- 1 - 5
- 5 - 10
- 10 - 50
- 50 - 100

BAS GROUNDWATER CONSULTING

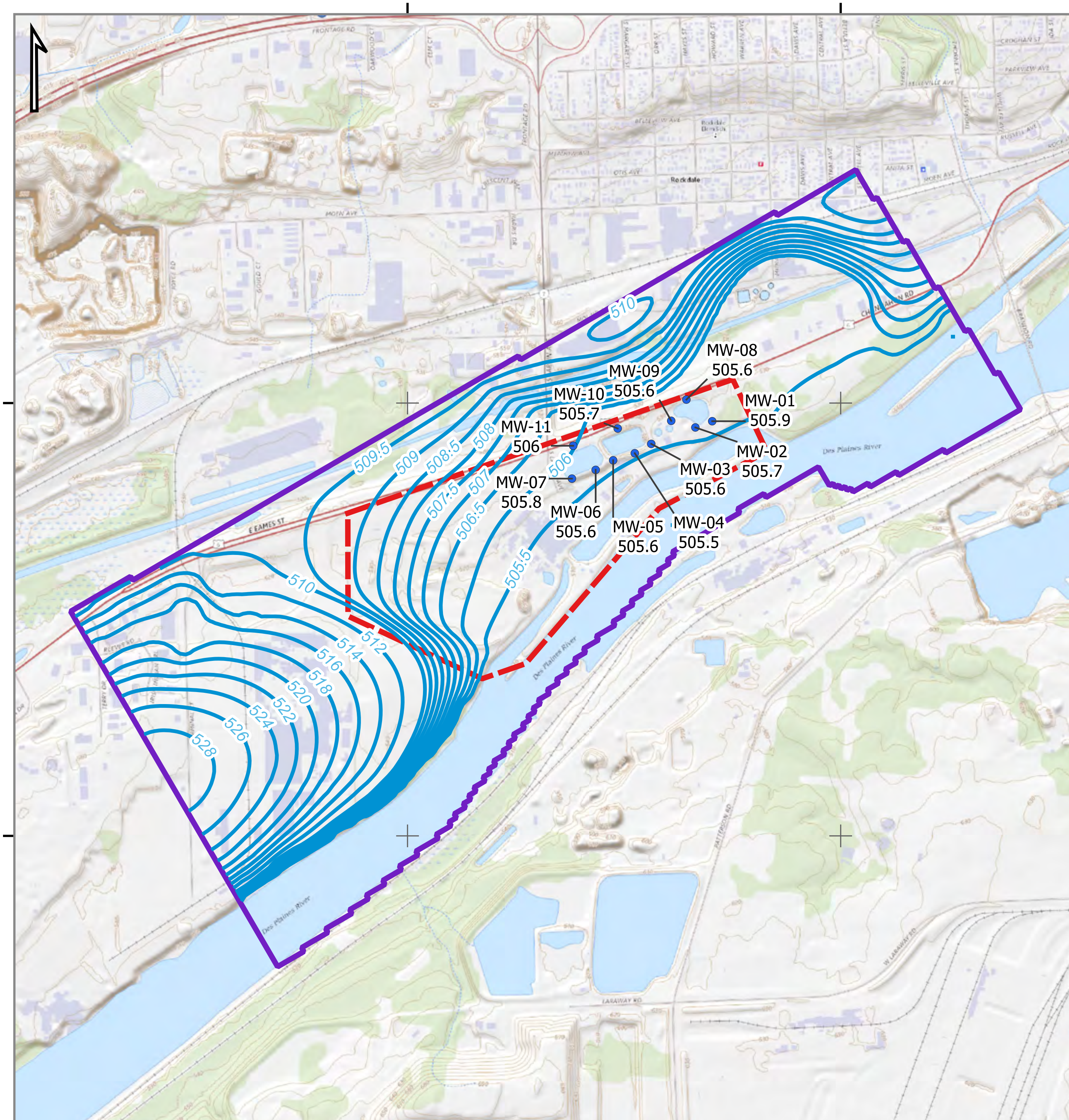
K P R G

0 1,000 2,000 ft

FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure11c_CalibratedKsLayers5.qgz

CLIENT	MIDWEST GENERATION		
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL		
TITLE	CALIBRATED HYDRAULIC CONDUCTIVITY DISTRIBUTION IN MODEL LAYER 5		
SCALE AT ANSI A 1:30,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: 11c		



LEGEND

- MODELED WATER LEVEL ELEVATION (FT, AMSL)
- MODELED WATER LEVEL ELEVATION CONTOUR (FT, AMSL)
  *NOTE THE VARYING CONTOUR INTERVAL TO SHOW TRENDS
- APPROXIMATE SITE BOUNDARY

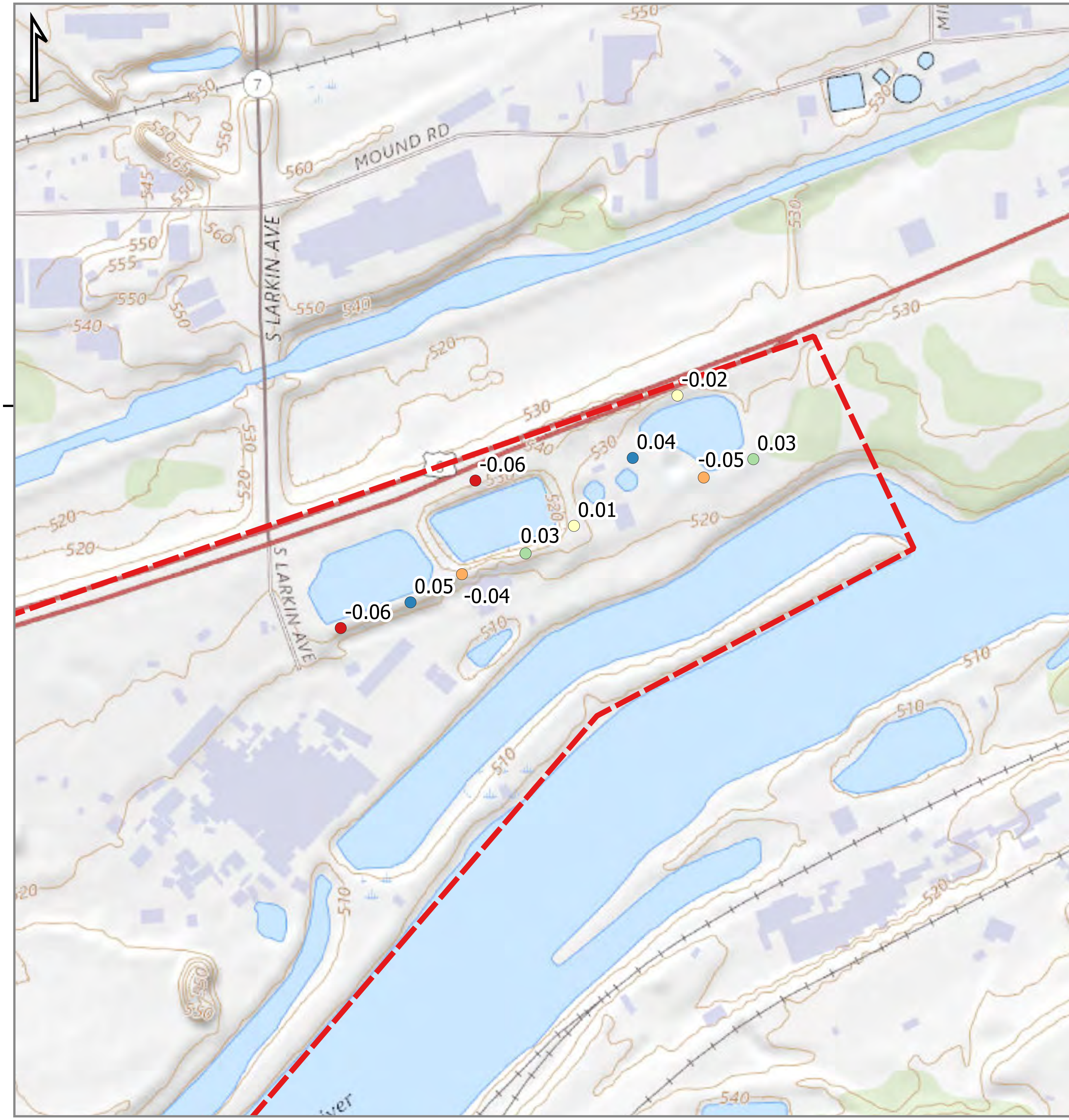
0 1,000 2,000 ft
FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure12_CalibratedWLs.qgz

BAS GROUNDWATER CONSULTING
KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**CALIBRATED WATER LEVEL ELEVATIONS**

SCALE AT ANSI A 1:20,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **12**		



LEGEND

APPROXIMATE SITE BOUNDARY

RESIDUALS (FT.)

- -0.06 - -0.06
- -0.06 - -0.03
- -0.03 - 0.02
- 0.02 - 0.03
- 0.03 - 0.06

0 300 600 ft

FEET

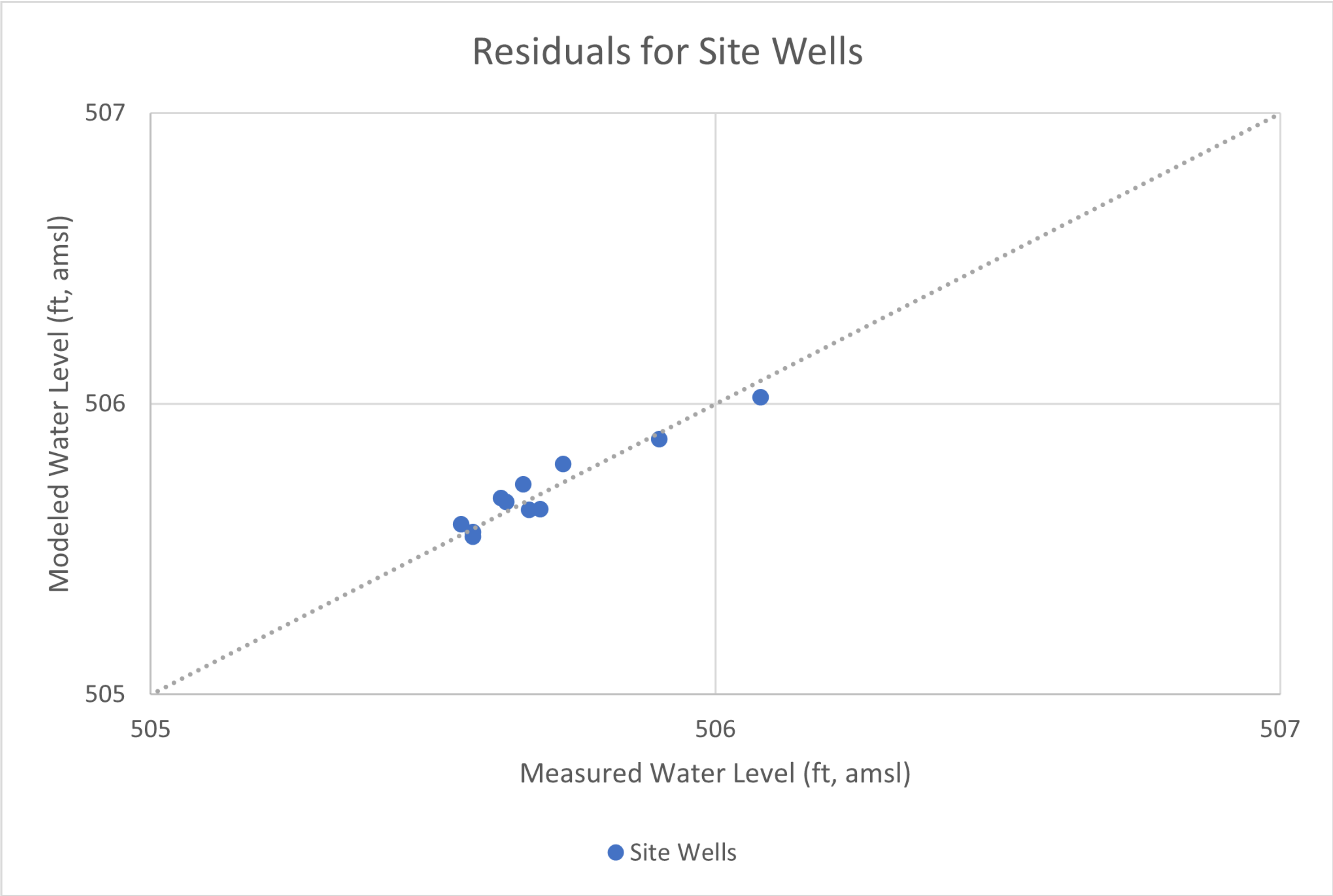
Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure13_CalibratedResiduals.qgz

BAS GROUNDWATER CONSULTING

KPRG

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**CALIBRATED WATER LEVEL RESIDUALS**

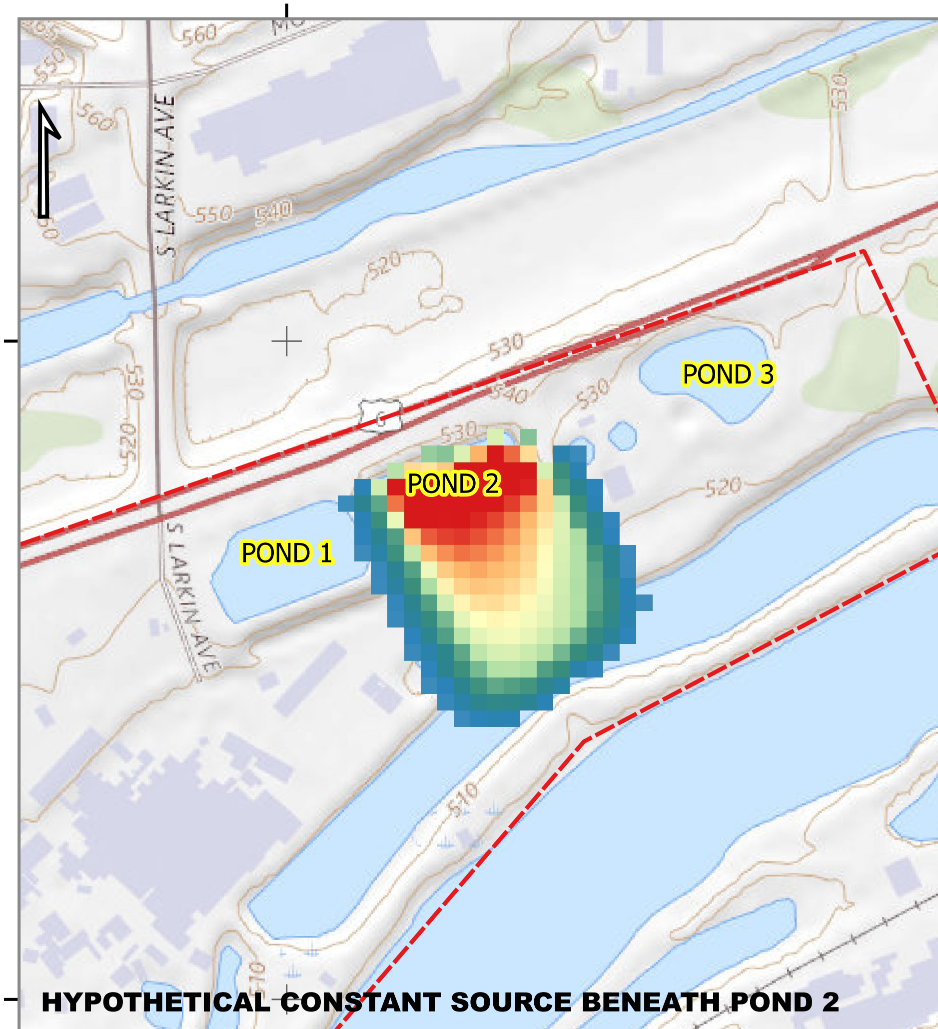
SCALE AT ANSI A	DRAWN	DZF	01/28/2022
1:6,800	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: **13**	

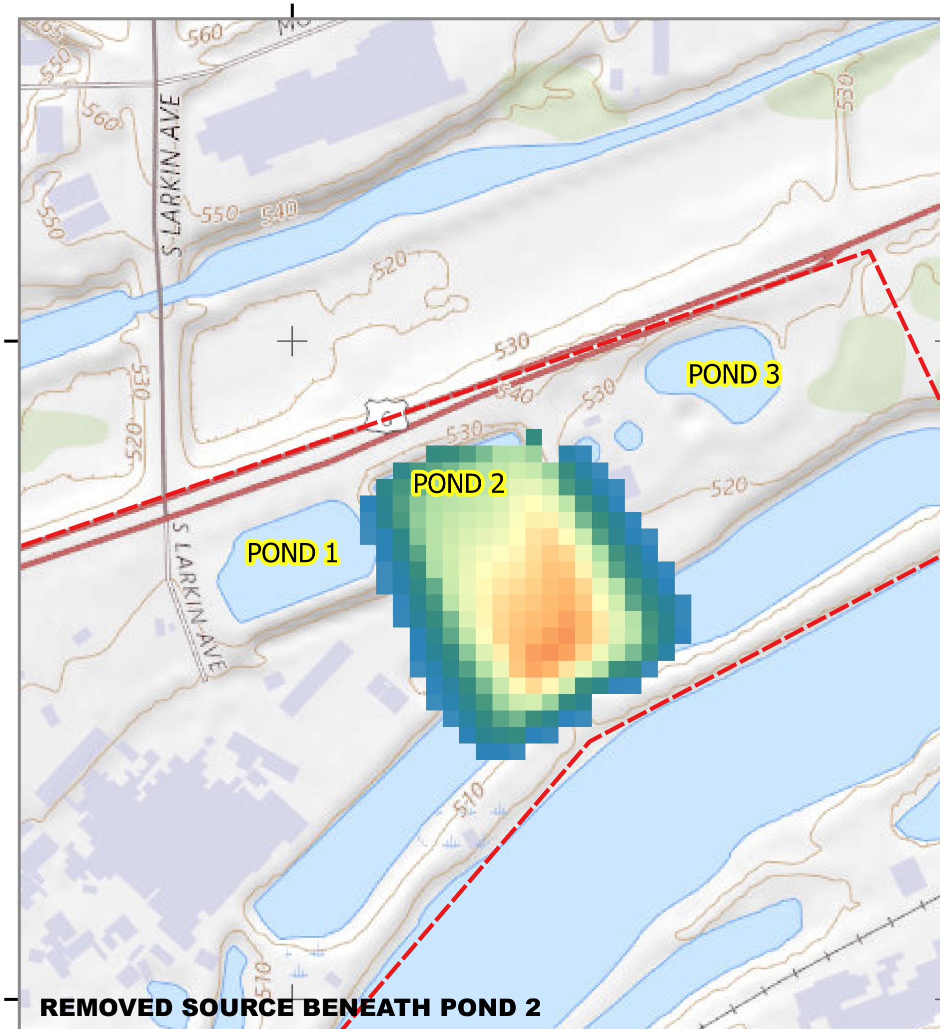


SCALE AT ANSI A	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: 14	

CLIENT	MIDWEST GENERATION
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**CALIBRATION SCATTER PLOT**

Project File: Figure14_CalibrationScatterPlot.qgz





LEGEND

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

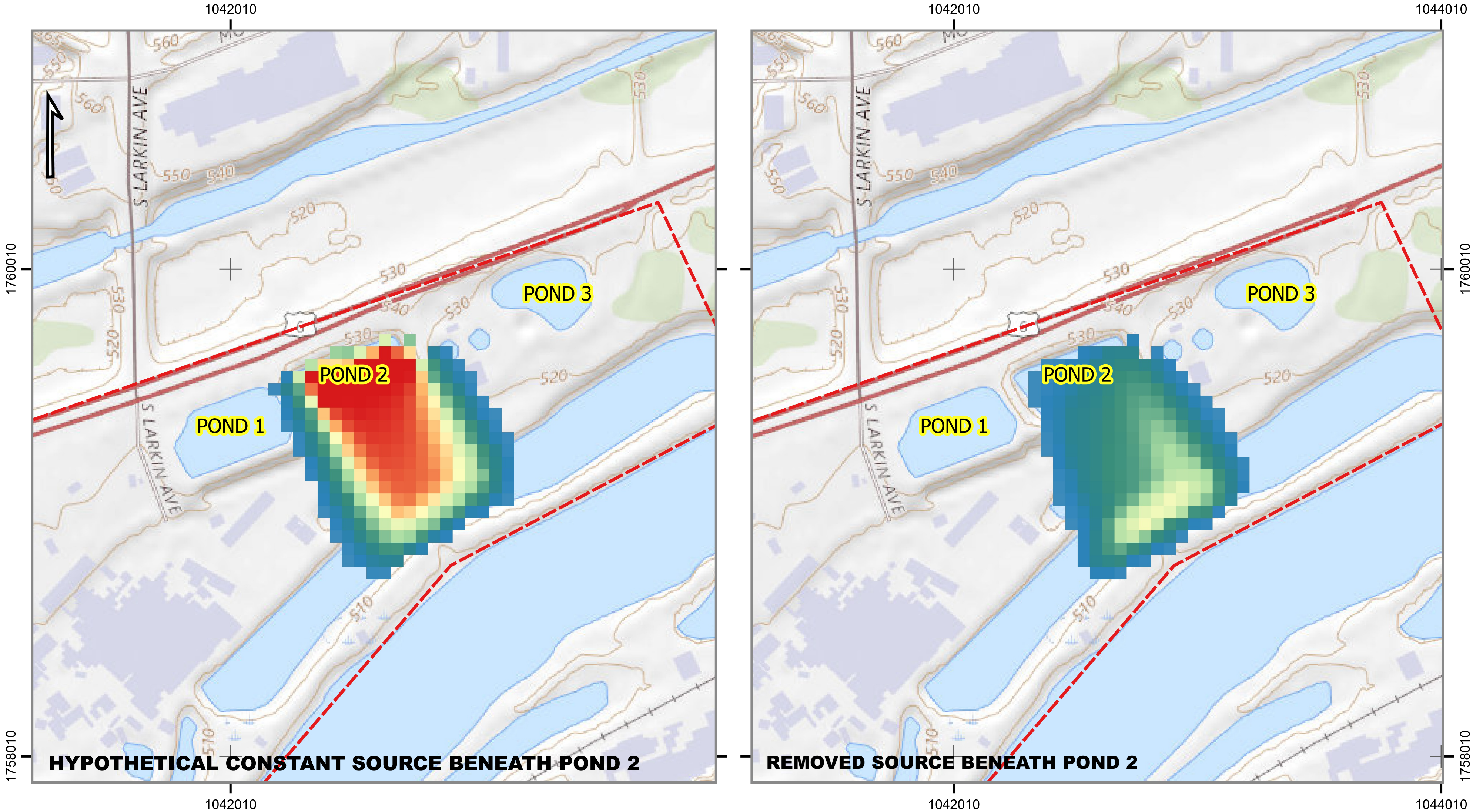
Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure15_5YearPlumeDistributions.qgz

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	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No.: 21141301		FIGURE: **15**	



LEGEND

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

K P R G

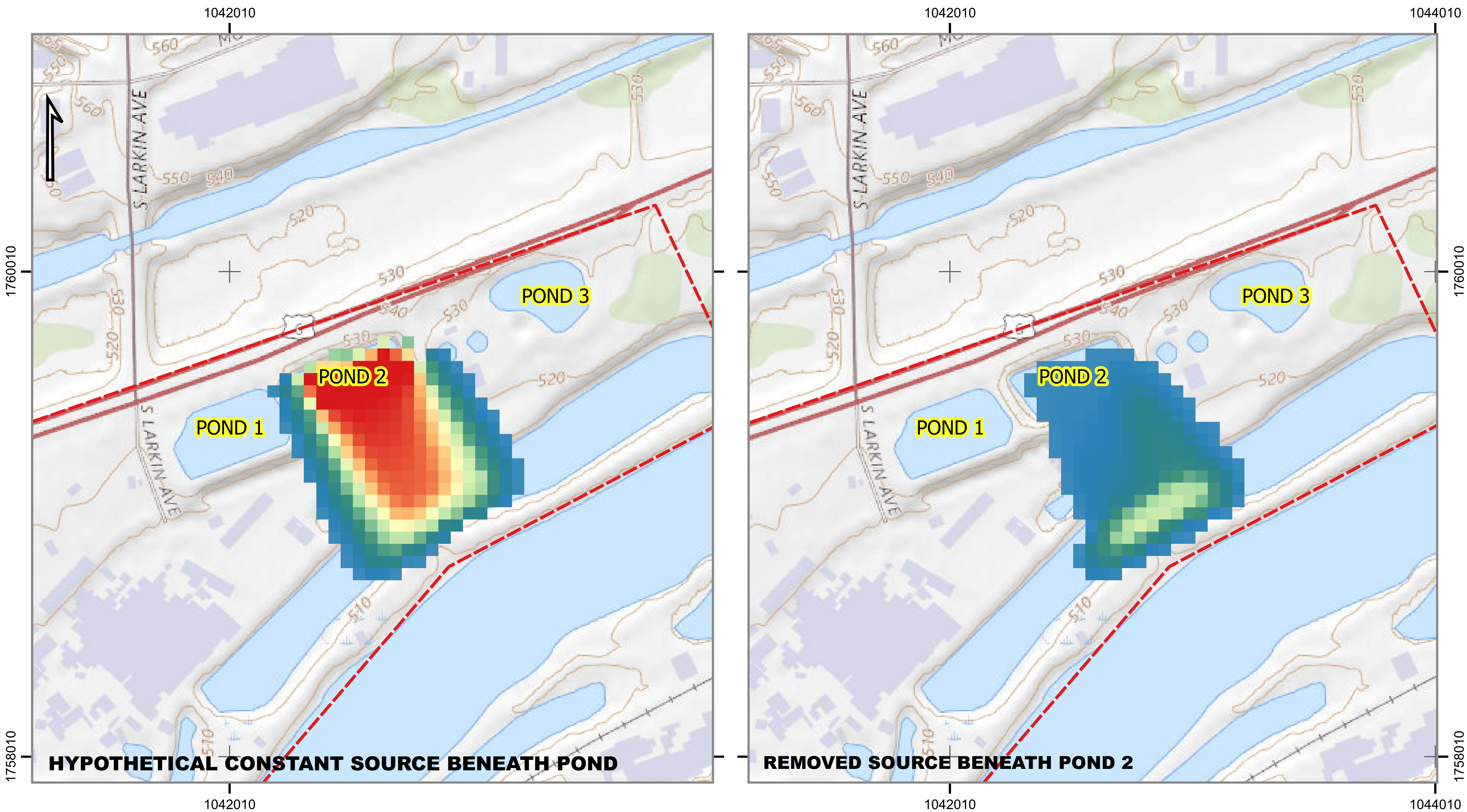
0 300 600 ft

FEET

Coordinate System: NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure16_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	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **16**		



LEGEND

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

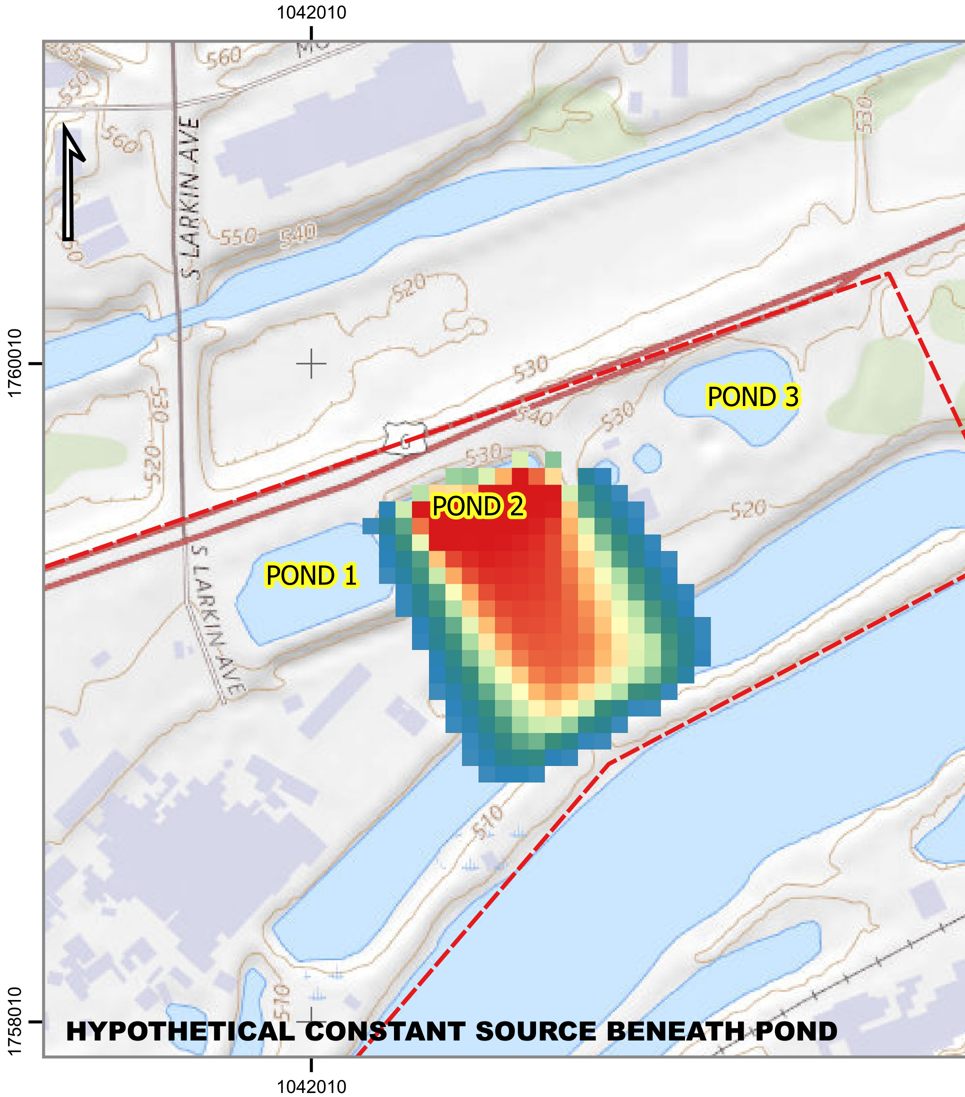
0 300 600 ft

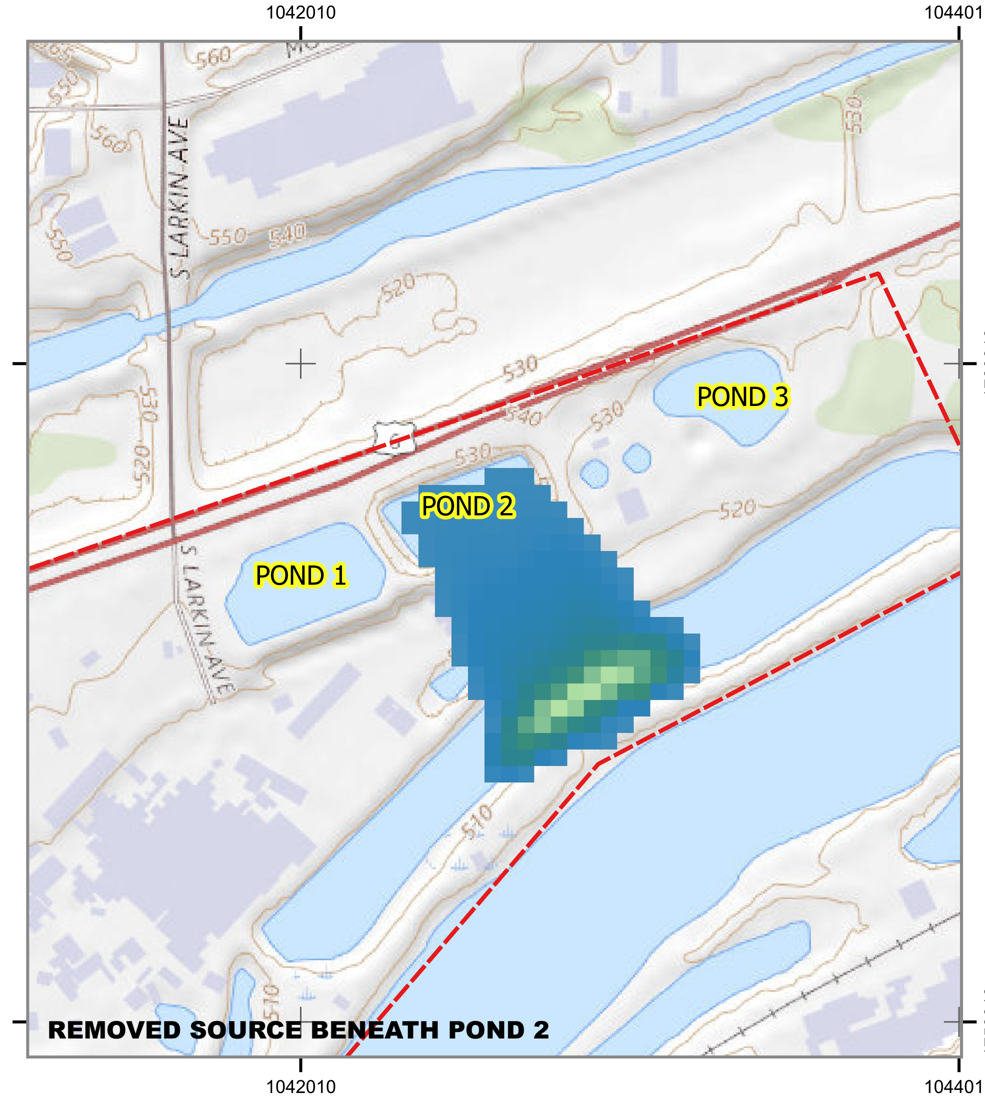
FEET

Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure17_50YearPlumeDistributions.qgz

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

SCALE AT ANSI A: 1:7,000	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No.: 21141301	FIGURE: **17**		





LEGEND

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

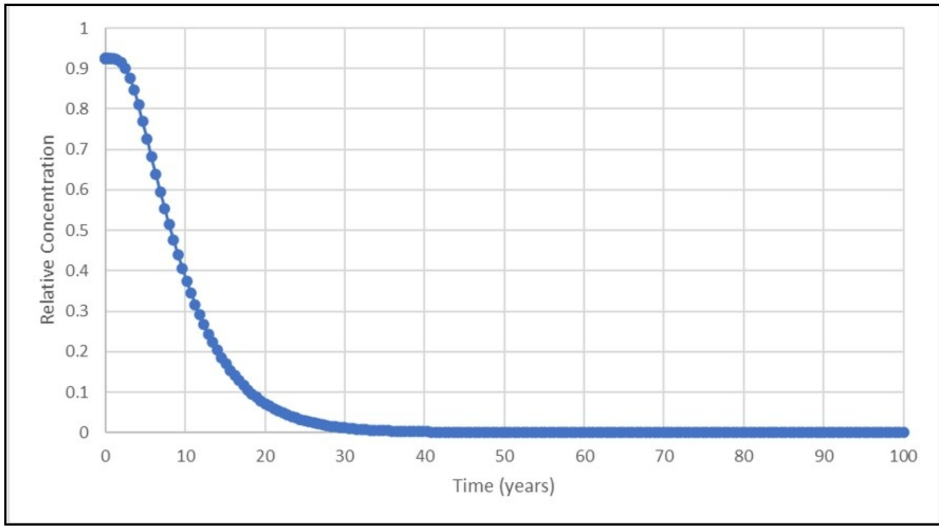
FEET

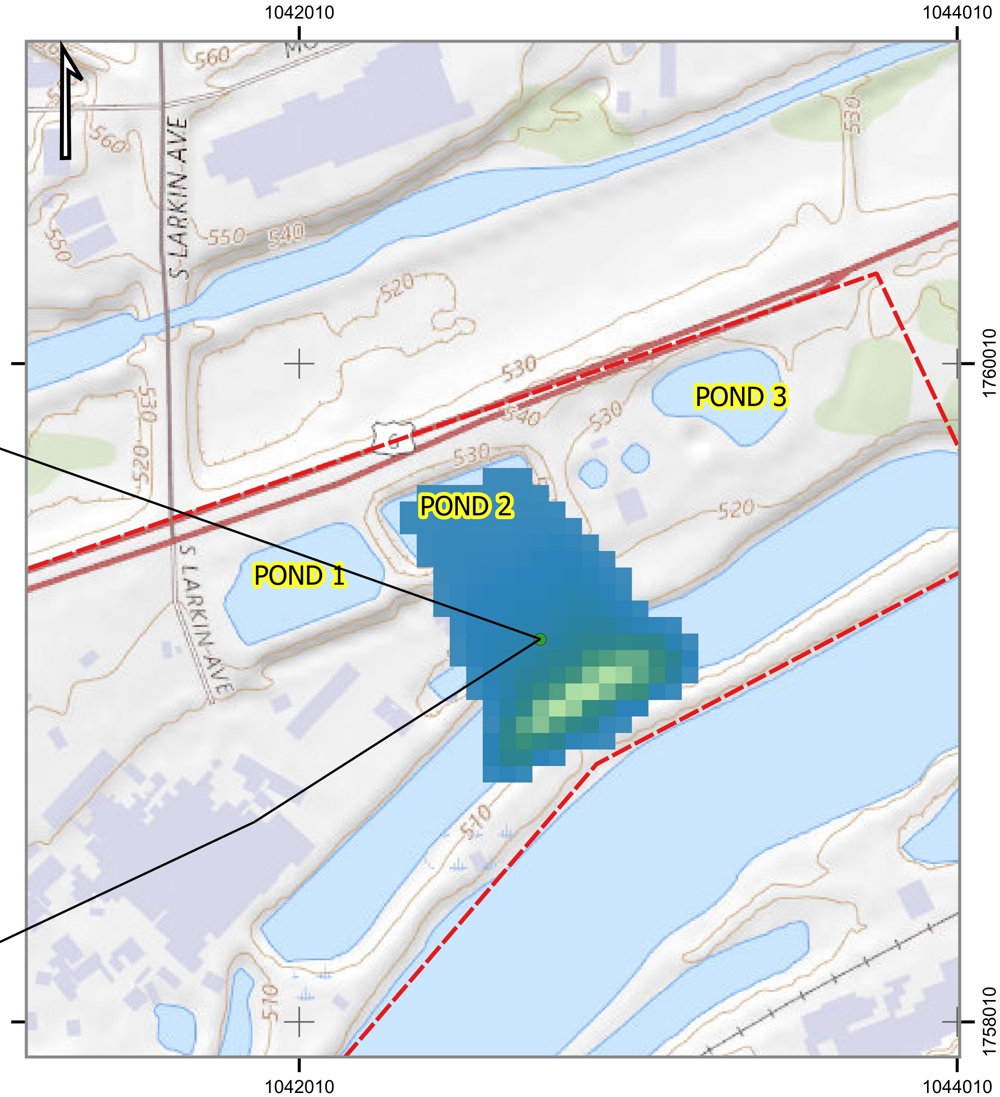
Coordinate System:
NAD_1983_StatePlane_Illinois_East_FIPS_1201_Feet
Project File: Figure18_100YearPlumeDistributions.qgz

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	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **18**		

100-YEAR PLUME DISTRIBUTION

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





LEGEND

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

K P R G

0 300 600 ft

FEET

Coordinate System:

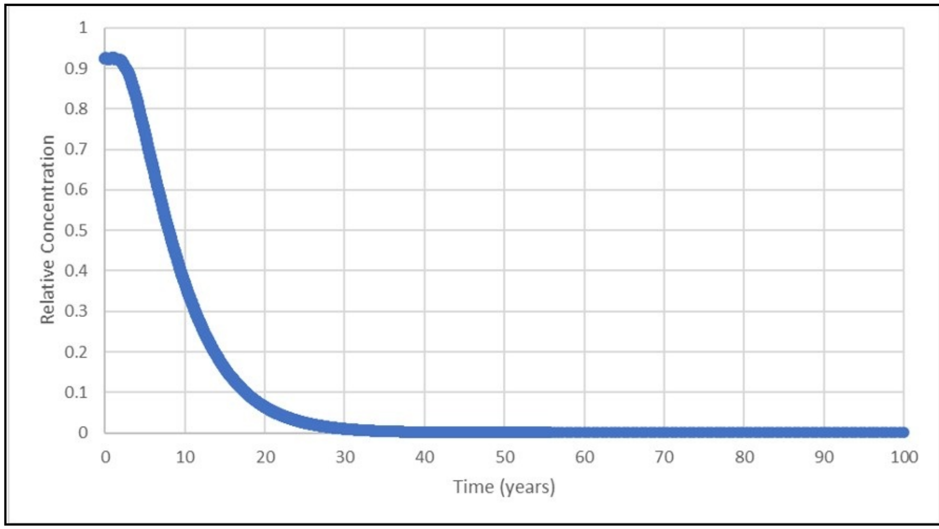
Project File: Figure19_ConcentrationsOverTime.qgz

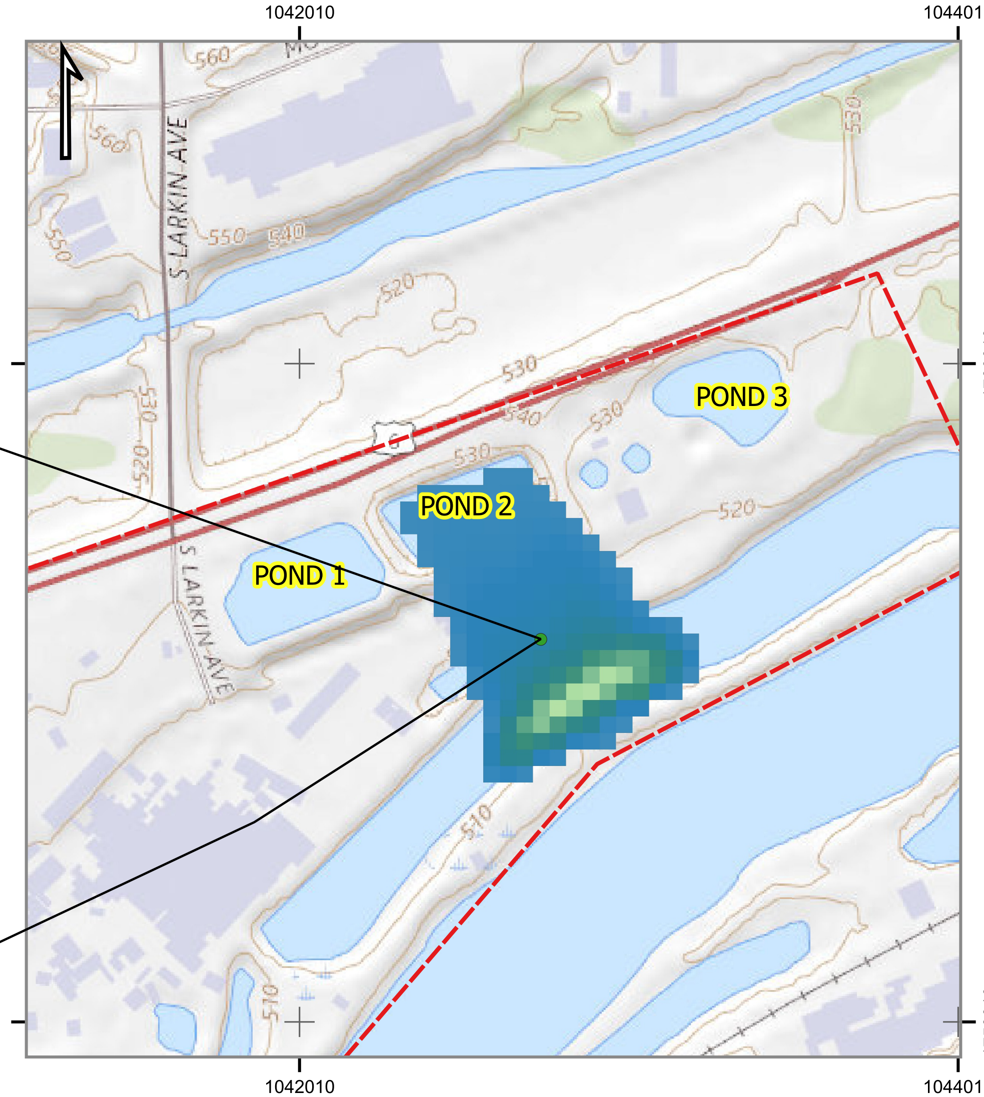
CLIENT	MIDWEST GENERATION, LLC
SITE	JOLIET 29 1800 CHANNAHON RD, JOLIET, IL
TITLE	**CONCENTRATIONS OVER TIME**

SCALE AT ANSI A 1:	DRAWN	DZF	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301		FIGURE: **19**	

100-YEAR PLUME DISTRIBUTION

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





LEGEND

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

Coordinate System:
Project File: Figure20_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	01/28/2022
	CHECKED	BAS	01/28/2022
BAS PROJECT No. 21141301	FIGURE: **20**		

basgroundwater.com

ATTACHMENT 9
GROUNDWATER MONITORING INFORMATION

Attachment 9-1 – Local Well Stratigraphy Information

Attachment 9-1.
Local Well Stratigraphy Information. Midwest Generation, LLC, Joliet #29 Generating Station, Joliet, IL.

ID	Well_Count	Well_ID	From	To	Original Logged Description
1	1	121973265800	0	15	gravel
2		121973265800	15	185	limestone
3		121973265800	185	267	shale
4		121973265800	267	605	limestone
5	2	121973842900	0	8	fill
6		121973842900	8	170	lime
7		121973842900	170	220	shale
8		121973842900	220	575	lime
9	3	121973842800	0	10	black dirt and rocks
10		121973842800	10	135	yellow limestone
11		121973842800	135	150	shale
12		121973842800	150	175	limestone
13	4	121974206700	0	7	clay
14		121974206700	7	8	broken rock
15		121974206700	8	50	lime
16		121974206700	50	200	white & gray lime
17		121974206700	200	215	shale streaks lime
18		121974206700	215	225	shale
19	5	121974045100	0	20	sand & gravel
20		121974045100	20	140	brown limestone
21		121974045100	140	200	gray limestone
22	6	121972880200	0	25	clay
23		121972880200	25	40	clay & boulders
24		121972880200	40	50	lime
25		121972880200	50	85	porous lime
26		121972880200	85	140	white lime
27		121972880200	140	205	grey lime
28		121972880200	205	235	white porous lime
29		121972880200	235	250	grey lime w/sh strks
30		121972880200	250	255	shale
31	7	121972738300	0	60	clay
32		121972738300	60	185	limestone
33	8	121974359800	0	11	Clay Fill
34		121974359800	11	24	sand & gravel
35		121974359800	24	30.5	Fill
36		121974359800	30.5	33	Organic Clay
37		121974359800	33	43	loam
38	9	121972919900	0	8	clay
39		121972919900	8	100	limestone
40	10	121973006000	0	60	clay
41		121973006000	60	69	sand & gravel
42		121973006000	69	91	limestone
43		121973006000	91	135	shale
44		121973006000	135	185	limestone
45	11	121972758800	0	3	top soil
46		121972758800	3	90	rock
47		121972758800	90	108	shale
48		121972758800	108	138	rock
49		121972758800	138	200	rock & shale
50	12	121972760100	0	65	clay
51		121972760100	65	70	sand
52		121972760100	70	90	gravel
53		121972760100	90	205	limestone
54	13	121972773600	0	90	clay & gravel
55		121972773600	90	185	limestone
56	14	121973178000	0	10	brown clay
57		121973178000	10	73	shale
58		121973178000	73	205	limestone
59	15	121973179200	0	1	top soil
60		121973179200	1	75	clay
61		121973179200	75	90	clay/sand/gravel
62		121973179200	90	200	limestone

63	16	121973179400	0	2	top soil
64		121973179400	2	3	clay
65		121973179400	3	18	flagstone
66		121973179400	18	185	limestone
67		121973179400	185	205	shale
68	17	121973179500	0	26	gravel
69		121973179500	26	120	limestone
70		121973179500	120	140	shale
71		121973179500	140	150	limestone
72		121973179500	150	170	shale
73		121973179500	170	205	limestone
74	18	121973179600	0	40	clay & gravel
75		121973179600	40	115	limestone
76	19	121973179700	0	10	clay
77		121973179700	10	84	gravel
78		121973179700	84	205	limestone
79	20	121973624000	0	10	clay
80		121973624000	10	20	gravel
81		121973624000	20	130	limestone
82		121973624000	130	150	black hard shale
83	21	121973628800	0	6	fill
84		121973628800	6	70	dolomite
85	22	121973524600	0	5	gravel
86		121973524600	5	200	limestone
87	23	121973686500	0	8	clay & gravel
88		121973686500	8	20	flagstone
89		121973686500	20	145	gray limestone
90	24	121970126200	0	5	FILL
91		121970126200	5	102	dolomite
92		121970126200	102	210	Maquoketa
93	25	121973388700	0	5	fill and black soil
94		121973388700	5	35	clay, yellow
95		121973388700	35	68	clay, blue
96		121973388700	68	82	sand & clay
97		121973388700	82	112	rock, hard, white
98		121973388700	112	170	red rock
99		121973388700	170	181	lime, dark gray
100	26	121973889900	0	12	Large River Rock
101		121973889900	12	15	Sand and Gravel
102		121973889900	15	20	Clay
103		121973889900	20	35	Sand and Large Gravel
104		121973889900	35	37	broken rock
105		121973889900	37	95	Lime
106		121973889900	95	105	Shallow and Lime
107		121973889900	105	140	Lime and Shale Streaks
108		121973889900	140	218	Shale
109	27	121973265900	0	7	black soil
110		121973265900	7	17	broken limestone
111		121973265900	17	103	limestone
112	28	121970027700	0	10	boulders
113		121970027700	10	20	gravel boulders and sand
114		121970027700	20	23	yellowish lime
115		121970027700	23	33	dark gray lime
116		121970027700	33	73	gray lime
117		121970027700	73	135	white lime
118	29	121970159300	0	1	drift
119		121970159300	1	133	Silurian dolomite
120		121970159300	133	143	dolomite withe shale
121		121970159300	143	145	shale
122	30	121970350100	0	2	top soil
123		121970350100	2	55	clay
124		121970350100	55	83	sand
125		121970350100	83	225	limestone

126	31	121970119800	0	3	Drift
127		121970119800	3	65	Limestone
128		121970119800	65	201	Maquoketa
129	32	121970356800	0	1	topsoil
130		121970356800	1	58	clay & gravel
131		121970356800	58	180	limestone
132	33	121970356900	0	1	top soil
133		121970356900	1	76	clay & gravel
134		121970356900	76	185	limestone
135	34	121970124700	0	12	surface
136		121970124700	12	135	limestone, hard
137		121970124700	135	140	shale
138		121970124700	140	165	limestone, hard
139		121970124700	165	175	streaks of limestone, shale
140		121970124700	175	245	Maquoketa
141	35	121970124800	0	125	Dolomite
142		121970124800	125	240	Maquoketa
143	36	121970125000	10	148	Dolomite
144		121970125000	148	256	Maquoketa
145	37	121970296100	0	42	clay & gravel
146		121970296100	42	160	limestone
147	38	121972646300	0	40	clay & gravel
148		121972646300	40	115	limestone
149	39	121973925800	0	6	drift
150		121973925800	6	33	limestone
151		121973925800	33	37	shale
152		121973925800	37	100	limestone
153	40	121970126100	0	98	Dolomite
154		121970126100	98	210	Maquoketa
155	41	121973265600	0	4	black soil
156		121973265600	4	10	yellow clay and boulders
157		121973265600	10	35	yellow clay
158		121973265600	35	55	blue clay
159		121973265600	55	62	sand and gravel
160		121973265600	62	200	limestone
161	42	121973265700	0	14	boulders
162		121973265700	14	17	rock and gravel
163		121973265700	17	94	lime
164		121973265700	94	103	shale and lime
165		121973265700	103	137	shale
166		121973265700	137	147	lime
167	43	MW-01	0	1	FILL: Topsoil with fine to coarse gravel
168		MW-01	1	6	FILL: 1' to 2' rounded coarse gravel at surface
169		MW-01	6	9	FILL: Fine to coarse sand and gravel, limestone fragments
170		MW-01	9	11	FILL: Limestone fragments
171		MW-01	11	19	Fine to coarse sand and gravel, some black clay, limestone fragments
172		MW-01	19	20	Limestone fragments
173		MW-01	20	27.5	Fine to coarse sand and gravel, with limestone fragments, weathered
174	44	MW-02	0	1	Fine to coarse grave (CA-6)
175		MW-02	1	4	Brown fine to coarse sand and gravel
176		MW-02	4	6	1" limestone fragments
177		MW-02	6	8	Brown fine to coarse sand and gravel
178		MW-02	8	12.5	1" limestone fragments
179		MW-02	12.5	13.5	Little Silty clay
180		MW-02	13.5	16	Coarse gravel with black silty clay, trace roots, trace coarse sand
181		MW-02	18.5	21	Brown silty fine to coarse sand, trace fine gravel
182		MW-02	21	24	Limestone fragments, trace light brown silty clay
183		MW-02	24	28.5	Limestone fragments
184	45	MW-03	0	4	Coarse gravel (CA-6)
185		MW-03	4	18.5	Fine to coarse sand and gravel
186		MW-03	18.5	41	Tan fine to coarse sand, with coarse gravel

187	46	MW-04	0	1	Coarse gravel (CA-6)
188		MW-04	1	6	Brown silty clay, trace coarse sand, stiff
189		MW-04	6	17	Brown fine to coarse sand and gravel, trace limestone fragments
190		MW-04	17	20	Limestone fragments
191		MW-04	20	23	Brown fien to coarse sand and gravel, trace limestone fragments
192		MW-04	23	33	Fine to coarse sand and gravel
193		MW-04	33	35.5	Fine to coarse sand
194		MW-04	35.5	40	Fine to coarse sand and gravel, with limestone fragments
195	47	MW-05	0	8.5	Fine to coarse gravel, topsoil
196		MW-05	8.5	19	Black silty clay, coarse sand
197		MW-05	19	23.5	Coarse gravel fragments
198		MW-05	23.5	31	Tan to light brown fine to coarse sand, little coarse gravel
199		MW-05	31	41	Fine to coarse sand and gravel
200		MW-05	41	42	Tan to light brown fine to coarse sand, little coarse gravel
201	48	MW-06	0	8.5	Gravel (CA-6) topsoil
202		MW-06	8.5	31	Brown to tan fine to coarse sand and gravel, trace limestone, gravel seams
203		MW-06	31	38.5	Fine to coarse sand and gravel
204		MW-06	38.5	40.5	Limestone Bedrock
205	49	MW-07	0	8.5	Gravel (CA-6) topsoil
206		MW-07	8.5	39.5	Tan to brown fine to coarse sand and gravel
207	50	MW-08	0	1	Fine to coarse gravel fill
208		MW-08	1	3.5	Dark brown silty clay, some fine to coarse sand, stiff
209		MW-08	3.5	6	Black/brown fine to coarse sand and gravel
210		MW-08	6	20	Limestone fragments
211		MW-08	20	35.5	Black/brown fine to coarse sand and gravel
212	51	MW-09	0	1	Coarse sand and gravel (CA-6)
213		MW-09	1	3.5	Coarse gravel, with black silty clay, trace root seams
214		MW-09	3.5	11	Coarse gravel fragments, with fine to coarse sand
215		MW-09	11	18.5	Limestone fragments, with light brown silty fine to coarse sand
216		MW-09	18.5	23.5	Limestone fragments, with light brown to dark orange fine to coarse sand
217		MW-09	23.5	28.5	Light brown/orange fine to coarse sand, with coarse gravel
218		MW-09	28.5	35	Light brown coarse sand, some fine to coarse gravel, little fine sand
219	52	MW-10	0	3	Coarse gravel
220		MW-10	3	7	Brown clay
221		MW-10	7	19	Black/gray sandy silt
222		MW-10	19	41	Gray silty clay, trace coarse sand, soft
223	53	MW-11	0	9	Fine to coarse sand and gravel, fill
224		MW-11	9	14	Grades to dark gray clayey silt
225		MW-11	14	24	Dark gray clayey silt, soft
226		MW-11	24	39.5	Light brown fine to coarse silt and gravel

Attachment 9-2 – Boring Logs

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-1** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **531.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content (PL □ ○ △ LL; 10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
531.5	0.0		Topsoil with fine to coarse gravel, moist				
			1' to 2' rounded coarse gravel at surface	SS-1 1.0-2.5 8"R	8 10 5		Bentonite seal 2.0'-14.0'. Stickup protective cover installed.
				SS-2 3.5-5.0 10"R	12 32 14		
			Fine to coarse sand and gravel, limestone fragments	SS-3 6.0-7.5 10"R	12 12 7		
			Limestone fragments, wet	SS-4 8.5-10.0 0.5"	8 4 4		
520.5	11.0		Fine to coarse sand and gravel, some black clay, limestone fragments, wet	SS-5 11.0-12.5 8"R	5 5 5		
				SS-6 13.5-15.0 6"R	45 6 10		Sand pack 14.0'-26.25'
514.5	17.0		∇ Saturated	SS-7 16.0-17.5 10"R	8 6 8		Set screen (slot 0.010) 16.25'-26.25'
			Limestone fragments, saturated	SS-8 18.5-20.0 6"R	14 10 11		
511.5	20.0						

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/27/10** ENDED **10/27/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
∇ **17.0**
▼ **15.0'**
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-1** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **531.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ — ○ — △ LL (10, 20, 30, 40, 50) / Unconfined Compressive Strength (TSF) ✳ (1, 2, 3, 4, 5)	NOTES & TEST RESULTS
511.5	20.0		Fine to coarse sand and gravel, with limestone fragments, weathered, saturated				
				SS-9 21.0-22.5 8"R	22 25 13		
			Wet to saturated	SS-10 23.5-25.0 8"R	15 11 10		
				SS-11 26.0-27.5 10"R	12 16 18		
504.0	27.5		Saturated				
			End of Boring at 27.5'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/27/10** ENDED **10/27/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **17.0**
▼ **15.0'**
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-2** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **531.2**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	PL □ Water Content ○ LL △ (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
531.2	0.0		Fine to coarse gravel (CA-6)				1" - 6" cobbles at surface
530.2	1.0		Brown fine to coarse sand and gravel, moist	SS-1 1.0-2.5 6"R	5 7 5		Bentonite seal 2.0'-14.0'. Stickup protective cover installed.
			1" limestone fragments	SS-2 3.5-5.0 0.5"R	8 12 6		
525.2	6.0		Brown fine to coarse sand and gravel, moist	SS-3 6.0-7.5 3"R	5 9 6		
			1" limestone fragments	SS-4 8.5-10.0 9"R	11 8 10		
			Little silty clay, moist to wet	SS-5 11.0-12.5 3"R	6 37 11		
517.7	13.5		Coarse gravel with black silty clay, trace roots, trace coarse sand, moist	SS-6 13.5-15.0 4"R	15 4 3		Sand pack 14.0'-26.5'
515.2	16.0		Black silty clay, with fine to coarse sand and gravel, moist	SS-7 16.0-17.5 8"R	12 6 12		Set screen 16.5'-26.5'
512.7	18.5	∇	Brown silty fine to coarse sand, trace fine gravel, saturated	SS-8 18.5-20.0 6"R	3 4 3		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/29/10** ENDED **10/29/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
∇ **18.5**
▼ **21.5'**
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-2** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **531.2**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ - - ○ - - △ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
511.2	20.0						
510.2	21.0						
			Limestone fragments, trace light brown silty clay, moist	SS-9 21.0-22.5 8"R	13 16 13		
			Limestone fragments, saturated	SS-10 23.5-25.0 4"R	14 13 13		
502.7	28.5						
			End of Boring at 28.5'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/29/10** ENDED **10/29/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **18.5**
▼ **21.5'**
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-3** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **535.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ 10 20 ○ 30 40 △ LL 50 / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
535.5	0.0		Coarse gravel (CA-6)				
				SS-1 1.0-2.5			Bentonite seal 2.0'-30.5'. Stickup protective cover installed.
			Fine to coarse sand and gravel, dry	SS-2 3.5-5.0	8 10 12		
				SS-3 6.0-7.5			
				SS-4 8.5-10.0	12 11 10		
				SS-5 11.0-12.5			
				SS-6 13.5-15.0	9 12 13		
				SS-7 16.0-17.5			
517.0	18.5		Tan fine to coarse sand, with coarse gravel, dry	SS-8 18.5-20.0	12 17 23		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/1/10** ENDED **11/1/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **31.0**
▽
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-3** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **535.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content: PL □ 10 20 ○ 30 40 △ LL 50; Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
514.5	21.0		Tan fine to coarse sand, with coarse gravel, dry	SS-9 21.0-22.5			
				SS-10 23.5-25.0	14 32 36		
				SS-11 26.0-27.5			
				SS-12 28.5-30.0	21 16 15		Sand pack 28.0'-40.5'
504.5	31.0		▽				Set screen (slat 0.010) 30.5'-40.5'
			Saturated	SS-13 31.0-32.5	15 11 12		
				SS-14 33.5-35.0			
				S-15 36.0-37.5			
				SS-16 38.5-40.0	50/0.5"		
494.5	41.0						
			End of Boring at 41.0'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/1/10** ENDED **11/1/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **31.0**
▽
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-4** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **535.8**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content: PL □ 10 20 ○ 30 40 △ LL 50 / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
535.8	0.0		Coarse gravel (CA-6), dry				
534.8	1.0		Brown silty clay, trace coarse sand, stiff, dry	SS-1 1.0-2.5 6"R	6 6 7		Bentonite seal 2.0'-27.5'. Stickup protective cover installed.
				SS-2 3.5-5.0 10"R	4 7 9		
529.8	6.0		Brown fine to coarse sand and gravel, trace limestone fragments	SS-3 6.0-7.5 6"R	20 22 12		
				SS-4 8.5-10.0 6"R	10 12 16		
				SS-5 11.0-12.5 8"R	11 20 23		
				SS-6 13.5-15.0 4"R	9 8 9		
			Limestone fragments, dry	SS-7 16.0-17.5 2"R	31 31		
				SS-8 18.5-20.0 4"R	24 40		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/1/10** ENDED **11/1/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
∇ **31.5**
∇
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-4** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **535.8**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ --- ○ --- △ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
515.8	20.0		Brown fine to coarse sand and gravel, trace limestone fragments				
				SS-9 21.0-22.5 4"R	60/6"		
			Fine to coarse sand and gravel, dry				
				SS-10 23.5-25.0 6"R	35 36		
				SS-11 26.0-27.5 10"R	28 21 10		
							Sand pack 27.5'-39.5'
				SS-12 28.5-30.0 6"R	12 8 8		
							Set screen (slot 0.010) 29.5'-39.5'
504.3	31.5	∇		SS-13 31.0-32.5 8"R	13 17 13		
			Saturated				
502.8	33.0		Fine to coarse sand, saturated				
				SS-14 33.5-35.0 18"R	13 24 24		
			Fine to coarse sand and gravel, with limestone fragments				
				SS-15 36.0-37.5			
				SS-16 38.5-40.0 10"R	21 50/3"		
495.8	40.0		End of Boring at 40.0'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/1/10** ENDED **11/1/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
∇ **31.5**
∇
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-5** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **536.4**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content (PL □ 10 20 ○ 30 40 △ 50 LL) / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
536.4	0.0		Fine to coarse gravel, topsoil, dry				
				SS-1 1.0-2.5			Bentonite seal 2.0'-32.0'. Stickup protective cover installed.
				SS-2 3.5-5.0			
				SS-3 6.0-7.5			
527.9	8.5		Black silty clay, coarse sand, moist to wet	SS-4 8.5-10.0 1"R	2 4 2		
				SS-5 13.5-15.0 8"R	2 4 3		
				SS-6 16.0-17.5			
			Coarse gravel fragments	SS-7 18.5-20.0 0.5"R	4 3 3		
				SS-8 21.0-22.5			

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/2/10** ENDED **11/2/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **31.0**
▽
▼

PATRICK ENGINEERING INC.

BORING NUMBER	**B-MW-5**
SHEET	**2** OF **2**
CLIENT	**Midwest Generation**
PROJECT & NO.	**21053.070**
LOCATION	**Joliet No. 29**
LOGGED BY	**AFG**
GROUND ELEVATION	**536.4**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ ○ △ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
513.9 / 513.4	22.5 / 23.0						
			Tan to light brown fine to coarse sand, little coarse gravel, dry	SS-9 23.5-25.0 12"R	27 35 38		
				SS-10 26.0-27.5	42 49		
				SS-11 28.5-30.0 8"R	7 8 9		Sand pack 30.0'-42.0'
505.4	31.0		∇ Fine to coarse sand and gravel, saturated	SS-12 31.0-32.5 4"R	7 10 27		Set screen (slot 0.010") 32.0'-42.0'
				SS-13 33.5-35.0			
				SS-14 36.0-37.5			
				SS-15 38.5-40.0	29 18		
			Tan to light brown fine to coarse sand, little coarse gravel, dry				
494.4	42.0						
			End of Boring at 42.0'				

DRILLING CONTRACTOR	**Groff Testing**
DRILLING METHOD	**4.25" I.D. HSA**
DRILLING EQUIPMENT	**CME**
DRILLING STARTED	**11/2/10**
ENDED	**11/2/10**

REMARKS

Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)

∇ 31.0

▼

▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-6** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **535.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content: PL □ – ○ – △ LL (10, 20, 30, 40, 50) / Unconfined Compressive Strength (TSF) ✳ (1, 2, 3, 4, 5)	NOTES & TEST RESULTS
535.9	0.0		Gravel (CA-6), topsoil, dry				
				SS-1 1.0-2.5			Bentonite seal 2.0'-30.5'. Stickup protective cover installed.
				SS-2 3.5-5.0			
				SS-3 6.0-7.5			
527.4	8.5		Brown to tan fine to coarse sand and gravel, trace limestone, gravel seams, dry	SS-4 8.5-10.0 12"R	12 12 12		
				SS-5 11.0-12.5			
				SS-6 13.5-15.0 14"R	23 30 27		
				SS-7 16.0-17.5			
				SS-8 18.5-20.0 12"R	18 28 24		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/3/10** ENDED **11/3/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **31.0**
▼
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-6** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **535.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content (PL □ 10 20 ○ 30 40 △ 50 LL) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
514.9	21.0		Brown to tan fine to coarse sand and gravel, trace limestone, gravel seams, dry	SS-9 21.0-22.5			
				SS-10 23.5-25.0 14"R	23 34 18/3"		
				SS-11 26.0-27.5			
				SS-12 28.5-30.0 12"R	33 21 27		Sand pack 28.0'-40.5'
504.9	31.0		⊽ Fine to coarse sand and gravel, saturated	SS-13 31.0-32.5 12"R			Set screen (slot 0.010) 30.5'-40.5'
				SS-14 33.5-35.0			
				SS-15 36.0-37.5			
497.4	38.5		Limestone bedrock	SS-16 38.5-40.0 0.5"R	50/0.5"		
495.4	40.5		End of Boring at 40.5'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/3/10** ENDED **11/3/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
⊽ 31.0
⊻
⊻

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-7** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **535.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	PL / Water Content / LL (10 20 30 40 50); Unconfined Compressive Strength (TSF) (1 2 3 4 5)	NOTES & TEST RESULTS
535.9	0.0		Gravel (CA-6), topsoil, dry				
				SS-1 1.0-2.5			Bentonite seal 2.0'-28.75'. Stickup protective cover installed.
				SS-2 3.5-5.0			
				SS-3 6.0-7.5			
527.4	8.5		Tan to brown fine to coarse sand and gravel, dry	SS-4 8.5-10.0 8"R	32 16 17		
				SS-5 11.0-12.5			
				SS-6 13.5-15.0	13 21		
				SS-7 16.0-17.5			
				SS-8 18.5-20.0	28 17		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/3/10** ENDED **11/3/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **31.0**
▼
▼

PATRICK ENGINEERING INC.	BORING NUMBER **B-MW-7**	SHEET **2** OF **2**
	CLIENT **Midwest Generation**	
	PROJECT & NO. **21053.070**	
	LOCATION **Joliet No. 29**	

LOGGED BY **AFG**

GROUND ELEVATION **535.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	PL □ Water Content ○ LL △ (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
515.9	20.0		Tan to brown fine to coarse sand and gravel, dry				
				SS-9 21.0-22.5			
				SS-10 23.5-25.0 8"R	21 28 1		
				SS-11 26.0-27.5			Sand pack 26.5'-38.75'
				SS-12 28.5-30.0 12"R	22 31 37		Set screen (slot 0.010) 28.75'-38.75'
504.9	31.0		⊻ Saturated	SS-13 31.0-32.5 10"R	12 8 5		
496.4	39.5						
			End of Boring at 39.5'				

DRILLING CONTRACTOR **Groff Testing**

DRILLING METHOD **4.25" I.D. HSA**

DRILLING EQUIPMENT **CME**

DRILLING STARTED **11/3/10** ENDED **11/3/10**

REMARKS

Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)

⊻ **31.0**

⊻

⊻

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-8** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **533.7**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ - - ○ - - △ LL (10, 20, 30, 40, 50) / Unconfined Compressive Strength (TSF) ✳ (1, 2, 3, 4, 5)	NOTES & TEST RESULTS
533.7	0.0		Fine to coarse gravel fill, dry				
532.7	1.0		Dark brown silty clay, some fine to coarse sand, stiff, moist	SS-1 1.0-2.5 6"R	2 5 9		Bentonite seal 2.0'-25.5'. Stickup protective cover installed.
530.2	3.5		Black/brown fine to coarse sand and gravel, moist	SS-2 3.5-5.0 6"R	5 5 10		
			Limestone fragments, dry	SS-3 6.0-7.5 8"R	13 16 14		
				SS-4 8.5-10.0 8"R	7 15 22		
				SS-5 11.0-12.5 8"R	15 13 13		
				SS-6 13.5-15.0 8"R	17 14 12		
				SS-7 16.0-17.5 8"R	5 12 8		
				SS-8 18.5-20.0 3"R	12 9 9		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/27/10** ENDED **10/27/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **27.0**
▽
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-8** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **533.7**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ - - ○ - - △ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
513.7	20.0		Black/brown fine to coarse sand and gravel, moist				
				SS-9 21.0-22.5 4"R	5 4 5		
			Moist to wet	SS-10 23.5-25.0 6"R	6 9 18		Sand pack 23.0'-35.5'
				SS-11 26.0-27.5 8"R	6 9 8		Screen set (slot 0.010) 25.5'-35.5'
506.7	27.0		▽ Saturated				
				SS-12 28.5-30.0 6"R	4 8 8		
				SS-13 33.5-35.0 2"R	50/1"		
498.2	35.5		End of Boring at 35.5'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/27/10** ENDED **10/27/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ 27.0
▼
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-9** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **531.1**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □---○---△ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
531.1	0.0		Coarse sand and gravel (CA-6), dry				
530.1	1.0		Coarse gravel, with black silty clay, trace root seams, moist	SS-1 1.0-2.5 6"R	15 14 13		Bentonite seal 2.0'-34.75'. Stickup protective cover installed.
527.6	3.5		Coarse gravel fragments, with fine to coarse sand, dry	SS-2 3.5-5.0 2"R	4 5 6		
				SS-3 6.0-7.5			
				SS-4 8.5-10.0			
520.1	11.0		Limestone fragments, with light brown silty fine to coarse sand, dry	SS-5 11.0-12.5 8"R	34 37		
				SS-6 13.5-15.0 10"R	20 16 16		
				SS-7 16.0-17.5 6"R	10 15 23		
512.6	18.5		Limestone fragments, with light brown to dark orange fine to coarse sand, moist	SS-8 18.5-20.0 10"R	15 24 28		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/29/10** ENDED **10/29/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **26.0**
▽
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-9** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **531.1**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	PL □- - -○- - -△ LL Water Content (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
511.1	20.0		Limestone fragments, with light brown to dark orange fine to coarse sand, moist				
				SS-9 21.0-22.5			
							Sand pack 22.5'-34.75'
507.6	23.5		Light brown/orange fine to coarse sand, with coarse gravel, moist	SS-10 23.5-25.0 12"R	15 29 36		
							Screen set (slot 0.010) 24.75'-34.75'
505.1	26.0		∇	SS-11 26.0-27.5 1"R	16 10 8		
502.6	28.5		Light brown coarse sand, some fine to coarse gravel, little fine sand, saturated	SS-12 28.5-30.0 10"R	6 10 13		
				SS-13 31.0-32.5			
				SS-14 33.5-35.0 6"R	18 50/4"		
496.1	35.0		End of Boring at 35.0'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **10/29/10** ENDED **10/29/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
∇ **26.0**
∇
∇

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-10** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **536.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 50 LL / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
536.9	0.0		Coarse gravel, dry				
				SS-1 1.0-2.5 10"R	5 4 5		Bentonite seal 2.0'-28.0'. Stickup protective cover installed.
			Brown clay				
				SS-2 3.5-5.0 10"R	3 2 2		
				SS-3 6.0-7.5 16"R	2 1 1		
529.9	7.0		Black/gray sandy silt, moist				
				SS-4 8.5-10.0 12"R	1 3 1		
				SS-5 11.0-12.5 18"R	1 1 1		
				SS-6 13.5-15.0 18"R	1 2 2		
				SS-7 16.0-17.5 18"R	1 3 2		
				SS-8 18.5-20.0 18"R	2 3 4		
517.9	19.0		Gray silty clay, trace coarse sand, soft, wet				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/2/10** ENDED **11/2/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **31.0**

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-10** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **536.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ — ○ — △ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
515.9	21.0		Gray silty clay, trace coarse sand, soft, wet	SS-9 21.0-22.5 8"R	12 28 31		
				SS-10 23.5-25.0 10"R	11 24 21		
				SS-11 26.0-27.5 12"R	6 13 17		
				SS-12 28.5-30.0 18"R	13 19 24		Sand pack 28.0'-40.5'
505.9	31.0		∇	SS-13 31.0-32.5 10"R	28 24 14		Screen set (slot 0.010) 30.5'-40.5'
				SS-14 33.5-35.0 18"R	16 63 12		
				SS-15 36.0-37.5			
				SS-16 38.5-40.0 18"R	9 14		
495.9	41.0		End of Boring at 41.0'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/2/10** ENDED **11/2/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
∇ **31.0**
∇
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-11** SHEET **1** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **536.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL (10 20 30 40 50) LL / Unconfined Compressive Strength (TSF) (1 2 3 4 5)	NOTES & TEST RESULTS
536.5	0.0		Fine to coarse sand and gravel, fill, dry				
				SS-1 1.0-2.5			Bentonite seal 2.0'-27.0'. Stickup protective cover installed.
				SS-2 3.5-5.0	3 2 2		
				SS-3 6.0-7.5			
			Grades to dark gray clayey silt	SS-4 8.5-10.0	3 2 2		
				SS-5 11.0-12.5			
522.5	14.0		Dark gray clayey silt, soft, moist	SS-6 13.5-15.0	1 2 2		
				SS-7 16.0-17.5			
				SS-8 18.5-20.0	1 3 5		

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/4/10** ENDED **11/4/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
▽ **31.0**
▼
▼

PATRICK ENGINEERING INC.

BORING NUMBER **B-MW-11** SHEET **2** OF **2**
CLIENT **Midwest Generation**
PROJECT & NO. **21053.070**
LOCATION **Joliet No. 29**

LOGGED BY **AFG**
GROUND ELEVATION **536.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ – – ○ – – △ LL (10 20 30 40 50); Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
516.5	20.0		Dark gray clayey silt, soft, moist				
				SS-9 21.0-22.5			
			Light brown fine to coarse silt and gravel, moist	SS-10 23.5-25.0	9 11 12		
				SS-11 26.0-27.5			Sand pack 27.0'-39.5'
				SS-12 28.5-30.0	1 3 13		Screen set (slot 0.010) 29.5'-39.5'
505.5	31.0		∇				
				SS-13 31.0-32.5	8 7 8		
				SS-14 33.5-35.0			
				SS-15 36.0-37.5			
				SS-16 38.5-40.0	36 50/2"		
497.0	39.5		End of Boring at 39.5'				

DRILLING CONTRACTOR **Groff Testing**
DRILLING METHOD **4.25" I.D. HSA**
DRILLING EQUIPMENT **CME**
DRILLING STARTED **11/4/10** ENDED **11/4/10**

REMARKS
Installed 2" diameter PVC monitoring well.

WATER LEVEL (ft.)
∇ **31.0**
∇
▼

Attachment 9-3 – Historical CCA Groundwater Data

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-01	Date	12/6/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012		3/5/2013	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	0.0043	NS	NS	0.0030	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0030	ND	NS	NS	NS	NS
Arsenic	0.010	0.0010	0.0011	NS	NS	0.0010	0.0014	NS	NS	NS	NS	NS	NS	NS	NS	0.0010	0.0012	NS	NS	NS	NS
Barium	2.0	0.0025	0.13	NS	NS	0.0025	0.14	NS	NS	NS	NS	NS	NS	NS	NS	0.0025	0.16	NS	NS	NS	NS
Beryllium	0.004	0.0010	ND	NS	NS	0.0010	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0010	ND	NS	NS	NS	NS
Boron	2.0	0.050	0.31	NS	NS	0.050	0.29	NS	NS	NS	NS	NS	NS	NS	NS	0.050	0.38^	NS	NS	NS	NS
Cadmium	0.005	0.00050	ND	NS	NS	0.00050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.00050	ND	NS	NS	NS	NS
Chloride	200.0	10	140	NS	NS	10	170	NS	NS	NS	NS	NS	NS	NS	NS	10	120	NS	NS	NS	NS
Chromium	0.1	0.0050	ND	NS	NS	0.0050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0050	ND	NS	NS	NS	NS
Cobalt	1.0	0.0010	ND	NS	NS	0.0010	0.0010	NS	NS	NS	NS	NS	NS	NS	NS	0.0010	ND	NS	NS	NS	NS
Copper	0.65	0.0020	0.0032	NS	NS	0.0020	0.0025	NS	NS	NS	NS	NS	NS	NS	NS	0.0020	0.0021	NS	NS	NS	NS
Cyanide	0.2	0.010	ND	NS	NS	0.010	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.010	ND	NS	NS	NS	NS
Fluoride	4.0	0.10	0.45	NS	NS	0.10	0.43	NS	NS	NS	NS	NS	NS	NS	NS	0.10	0.59	NS	NS	NS	NS
Iron	5.0	0.10	ND	NS	NS	0.10	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.10	ND	NS	NS	NS	NS
Lead	0.0075	0.00050	ND	NS	NS	0.00050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.00050	ND	NS	NS	NS	NS
Manganese	0.15	0.0025	ND	NS	NS	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0025	ND	NS	NS	NS	NS
Mercury	0.002	0.00020	ND	NS	NS	0.00020	ND^	NS	NS	NS	NS	NS	NS	NS	NS	0.00020	ND	NS	NS	NS	NS
Nickel	0.1	0.0020	0.0034	NS	NS	0.0020	0.0029	NS	NS	NS	NS	NS	NS	NS	NS	0.0020	0.0029	NS	NS	NS	NS
Nitrogen/Nitrate	10.0	0.10	1.9	NS	NS	0.10	2.9	NS	NS	NS	NS	NS	NS	NS	NS	0.10	4.2	NS	NS	NS	NS
Nitrogen/Nitrate, Nitri	NA	0.20	1.9	NS	NS	0.20	2.9	NS	NS	NS	NS	NS	NS	NS	NS	0.50	4.2	NS	NS	NS	NS
Nitrogen/Nitrite	NA	0.020	ND	NS	NS	0.020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.020	ND	NS	NS	NS	NS
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NS	NS	NS	NS	NS	NS	NS	NS	NR	NR	NS	NS	NS	NS
Selenium	0.05	0.0025	ND	NS	NS	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0025	ND	NS	NS	NS	NS
Silver	0.05	0.00050	ND	NS	NS	0.00050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.00050	ND	NS	NS	NS	NS
Sulfate	400.0	50	180	NS	NS	25	81	NS	NS	NS	NS	NS	NS	NS	NS	50	240	NS	NS	NS	NS
Thallium	0.002	0.0020	ND	NS	NS	0.0020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0020	ND	NS	NS	NS	NS
Total Dissolved Solids	1,200	10	590	NS	NS	10	670	NS	NS	NS	NS	NS	NS	NS	NS	10	630	NS	NS	NS	NS
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NS	NS	NS	NS	NS	NS	NS	NS	NR	NR	NS	NS	NS	NS
Zinc	5.0	0.020	ND	NS	NS	0.020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.020	ND	NS	NS	NS	NS
Benzene	0.005	NR	NR	NR	NR	NR	NR	NS	NS	NS	NS	NS	NS	NS	NS	NR	NR	NS	NS	NS	NS
BETX	11.705	NR	NR	NR	NR	NR	NR	NS	NS	NS	NS	NS	NS	NS	NS	NR	NR	NS	NS	NS	NS
pH	6.5 - 9.0	NA	7.82	NS	NS	NA	7.25	NS	NS	NS	NS	NS	NS	NS	NS	NA	7.46	NS	NS	NS	NS
Temperature	NA	NA	7.52	NA	NS	NA	13.92	NS	NS	NS	NS	NS	NS	NS	NS	NA	22.01	NS	NS	NS	NS
Conductivity	NA	NA	1.04	NA	NS	NA	1.28	NS	NS	NS	NS	NS	NS	NS	NS	NA	0.97	NS	NS	NS	NS
Dissolved Oxygen	NA	NA	NM	NA	NS	NA	4.19	NS	NS	NS	NS	NS	NS	NS	NS	NA	7.68	NS	NS	NS	NS
ORP	NA	NA	NM	NA	NS	NA	210.6	NS	NS	NS	NS	NS	NS	NS	NS	NA	155.0	NS	NS	NS	NS

Sample: MW-01	5/23/2013		7/22/2013		10/15/2013		2/21/2014		5/1/2014		8/18/2014		10/23/2014		2/10/2015		5/27/2015		8/4/2015	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	0.0052	NS	NS	NS	NS	NS	NS	NS	NS	0.0030	ND	0.0030	ND	NS	NS	NS	NS	NS	NS
Arsenic	0.0010	0.0011	NS	NS	NS	NS	NS	NS	NS	NS	0.0010	ND	0.0010	ND^	NS	NS	NS	NS	NS	NS
Barium	0.0025	0.15	NS	NS	NS	NS	NS	NS	NS	NS	0.0025	0.15	0.0025	0.17	NS	NS	NS	NS	NS	NS
Beryllium	0.0010	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0010	ND	0.0010	ND	NS	NS	NS	NS	NS	NS
Boron	0.050	0.33	NS	NS	NS	NS	NS	NS	NS	NS	0.050	0.22	0.050	0.21	NS	NS	NS	NS	NS	NS
Cadmium	0.00050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.00050	ND	0.00050	ND	NS	NS	NS	NS	NS	NS
Chloride	10	210	NS	NS	NS	NS	NS	NS	NS	NS	10	120	10	79	NS	NS	NS	NS	NS	NS
Chromium	0.0050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0050	ND	0.0050	ND	NS	NS	NS	NS	NS	NS
Cobalt	0.0010	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0010	ND	0.0010	ND	NS	NS	NS	NS	NS	NS
Copper	0.0020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0020	ND	0.0020	ND	NS	NS	NS	NS	NS	NS
Cyanide	0.010	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.010	ND	0.010	ND	NS	NS	NS	NS	NS	NS
Fluoride	0.10	0.42	NS	NS	NS	NS	NS	NS	NS	NS	0.10	0.47	0.10	0.39	NS	NS	NS	NS	NS	NS
Iron	0.10	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.10	ND	0.10	ND	NS	NS	NS	NS	NS	NS
Lead	0.00050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.00050	ND	0.00050	ND	NS	NS	NS	NS	NS	NS
Manganese	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0025	0.012	0.0025	0.015	NS	NS	NS	NS	NS	NS
Mercury	0.00020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.00020	ND	0.00020	ND	NS	NS	NS	NS	NS	NS
Nickel	0.0020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0020	0.0024	0.0020	0.0020	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrate	0.10	3.7	NS	NS	NS	NS	NS	NS	NS	NS	0.10	0.44	0.10	0.71	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrate, Nitri	0.50	3.7	NS	NS	NS	NS	NS	NS	NS	NS	0.10	0.44	0.10	0.71	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrite	0.020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.020	ND	0.020	ND	NS	NS	NS	NS	NS	NS
Perchlorate	0.0040	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0040	ND	0.0040	ND	NS	NS	NS	NS	NS	NS
Selenium	0.0025	0.0040	NS	NS	NS	NS	NS	NS	NS	NS	0.0025	ND	0.0025	ND	NS	NS	NS	NS	NS	NS
Silver	0.00050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.00050	ND	0.00050	ND	NS	NS	NS	NS	NS	NS
Sulfate	25	140	NS	NS	NS	NS	NS	NS	NS	NS	20	59	20	65	NS	NS	NS	NS	NS	NS
Thallium	0.0020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0020	ND	0.0020	ND	NS	NS	NS	NS	NS	NS
Total Dissolved Solids	10	700	NS	NS	NS	NS	NS	NS	NS	NS	10	550	10	570	NS	NS	NS	NS	NS	NS
Vanadium	0.0050	0.0081	NS	NS	NS	NS	NS	NS	NS	NS	0.0050	0.0066	0.0050	0.0068	NS	NS	NS	NS	NS	NS
Zinc	0.020	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.020	ND	0.020	ND	NS	NS	NS	NS	NS	NS
Benzene	0.00050	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.0005	ND	0.0005	ND	NS	NS	NS	NS	NS	NS
BETX	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS	0.002	ND	0.002	0.00056	NS	NS	NS	NS	NS	NS
pH	NM	NM	NS	NS	NS	NS	NS	NS	NS	NS	NA	6.54	NA	7.08	NS	NS	NS	NS	NS	NS
Temperature	NA	NM	NS	NS	NS	NS	NS	NS	NS	NS	NA	14.06	NA	12.25	NS	NS	NS	NS	NS	NS
Conductivity	NA	NM	NS	NS	NS	NS	NS	NS	NS	NS	NA	0.857	NA	0.90	NS	NS	NS	NS	NS	NS
Dissolved Oxygen	NA	NM	NS	NS	NS	NS	NS	NS	NS	NS	NA	3.38	NA	1.36	NS	NS	NS	NS	NS	NS
ORP	NA	NM	NS	NS	NS	NS	NS	NS	NS	NS	NA	150.8	NA	66.2	NS	NS	NS	NS	NS	NS

Sample: MW-01	10/28/2015		2/9/2016		5/11/2016		8/30/2016		11/3/2016		2/6/2017		4/25/2017		2/21/2018		8/1/2018		10/17/2018	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result			DL	Result	DL	Result
Antimony	NS	NS	NS	NS	0.0030	ND	0.0030	ND	0.0030	ND	NS	NS	NS	NS	0.0030	ND	NS	NS	0.003	ND
Arsenic	NS	NS	NS	NS	0.0010	ND ^	0.0010	ND	0.0010	ND	NS	NS	NS	NS	0.0010	ND	NS	NS	0.001	ND
Barium	NS	NS	NS	NS	0.0025	0.15	0.0025	0.071	0.0025	0.12	NS	NS	NS	NS	0.0025	0.079	NS	NS	0.0025	0.12
Beryllium	NS	NS	NS	NS	0.0010	ND	0.0010	ND ^	0.0010	ND	NS	NS	NS	NS	0.0010	ND	NS	NS	0.001	ND^
Boron	NS	NS	NS	NS	0.050	0.18	0.050	0.24	0.050	0.25	NS	NS	NS	NS	0.050	0.19	NS	NS	0.05	0.23
Cadmium	NS	NS	NS	NS	0.00050	ND	0.00050	ND	0.00050	ND	NS	NS	NS	NS	0.00050	ND	NS	NS	0.0005	ND
Chloride	NS	NS	NS	NS	50	400	10	93	10	73	NS	NS	NS	NS	10	280	NS	NS	10	130
Chromium	NS	NS	NS	NS	0.0050	ND	0.0050	ND	0.0050	ND	NS	NS	NS	NS	0.0050	ND	NS	NS	0.005	ND
Cobalt	NS	NS	NS	NS	0.0010	ND	0.0010	ND	0.0010	ND	NS	NS	NS	NS	0.0010	ND	NS	NS	0.001	ND
Copper	NS	NS	NS	NS	0.0020	ND	0.0020	ND	0.0020	ND	NS	NS	NS	NS	0.0020	ND	NS	NS	0.002	ND
Cyanide	NS	NS	NS	NS	0.010	ND	0.010	ND	0.010	ND	NS	NS	NS	NS	0.010	ND	NS	NS	0.01	ND
Fluoride	NS	NS	NS	NS	0.10	0.42	0.10	0.37	0.10	0.35	NS	NS	NS	NS	0.10	0.43	NS	NS	0.1	0.36
Iron	NS	NS	NS	NS	0.10	ND ^	0.10	ND	0.10	ND	NS	NS	NS	NS	0.10	0.17	NS	NS	0.1	ND
Lead	NS	NS	NS	NS	0.00050	ND	0.00050	ND	0.00050	ND	NS	NS	NS	NS	0.00050	ND	NS	NS	0.0005	ND
Manganese	NS	NS	NS	NS	0.0025	0.0065	0.0025	ND	0.0025	0.0032	NS	NS	NS	NS	0.0025	ND	NS	NS	0.0025	ND
Mercury	NS	NS	NS	NS	0.00020	ND	0.00020	ND	0.00020	ND	NS	NS	NS	NS	0.00020	ND	NS	NS	0.0002	ND
Nickel	NS	NS	NS	NS	0.0020	0.0041	0.0020	0.0022	0.0020	0.0022	NS	NS	NS	NS	0.0020	ND	NS	NS	0.002	ND
Nitrogen/Nitrate	NS	NS	NS	NS	0.10	1.2	0.10	1.9	0.10	1.0	NS	NS	NS	NS	0.10	2.6	NS	NS	0.1	1.8
Nitrogen/Nitrate, Nitri	NS	NS	NS	NS	0.10	1.2	0.10	1.9	0.10	1.0	NS	NS	NS	NS	0.20	2.6	NS	NS	0.1	1.8
Nitrogen/Nitrite	NS	NS	NS	NS	0.020	ND	0.020	ND	0.020	ND	NS	NS	NS	NS	0.020	0.029	NS	NS	0.02	ND
Perchlorate	NS	NS	NS	NS	0.0040	ND	0.0040	ND	0.0040	ND	NS	NS	NS	NS	0.0040	ND	NS	NS	0.004	ND
Selenium	NS	NS	NS	NS	0.013	0.021 ^	0.0025	0.0072	0.0025	0.0037	NS	NS	NS	NS	0.0025	0.0071	NS	NS	0.0025	0.0071
Silver	NS	NS	NS	NS	0.00050	ND	0.00050	ND	0.00050	ND	NS	NS	NS	NS	0.00050	ND	NS	NS	0.0005	ND
Sulfate	NS	NS	NS	NS	50	170	25	74	20	62	NS	NS	NS	NS	50	230 F1	NS	NS	20	56
Thallium	NS	NS	NS	NS	0.0020	ND	0.0020	ND	0.0020	ND	NS	NS	NS	NS	0.0020	ND	NS	NS	0.002	ND
Total Dissolved Solids	NS	NS	NS	NS	10	1100	10	670	10	600	NS	NS	NS	NS	10	990	NS	NS	10	720
Vanadium	NS	NS	NS	NS	0.0050	ND	0.0050	ND	0.0050	0.0071	NS	NS	NS	NS	0.0050	ND	NS	NS	0.005	ND^
Zinc	NS	NS	NS	NS	0.020	ND	0.020	ND	0.020	ND	NS	NS	NS	NS	0.020	ND	NS	NS	0.02	ND
Benzene	NS	NS	NS	NS	0.0005	ND	0.0005	ND	0.0005	ND	NS	NS	NS	NS	0.0005	ND	NS	NS	0.0005	ND
BETX	NS	NS	NS	NS	0.002	0.0024	0.002	ND	0.002	0.00743	NS	NS	NS	NS	0.0025	ND	NS	NS	0.0025	ND
pH	NS	NS	NS	NS	NA	7.02	NA	6.50	NA	7.08	NS	NS	NS	NS	NA	7.00	NS	NS	NA	7.20
Temperature	NS	NS	NS	NS	NA	14.78	NA	17.29	NA	14.78	NS	NS	NS	NS	NA	9.08	NS	NS	NA	13.12
Conductivity	NS	NS	NS	NS	NA	1.83	NA	1.05	NA	0.91	NS	NS	NS	NS	NA	0.91	NS	NS	NA	0.91
Dissolved Oxygen	NS	NS	NS	NS	NA	2.64	NA	5.40	NA	3.90	NS	NS	NS	NS	NA	8.08	NS	NS	NA	9.88
ORP	NS	NS	NS	NS	NA	26.4	NA	-62.3	NA	-25.4	NS	NS	NS	NS	NA	-13.2	NS	NS	NA	30.4

Sample: MW-01	2/4/2019		5/7/2019		8/6/2019		11/7/2019		2/13/2020		5/21/2020		7/30/2020		10/22/2020		3/2/2021		5/18/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	NS	0.003	ND	0.003	NS	0.003	ND	NS	NS	0.003	0.0066	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic	0.001	NS	0.001	ND	0.001	NS	0.001	ND	NS	NS	0.001	0.0012	NS	NS	NS	NS	NS	NS	NS	NS
Barium	0.0025	NS	0.0025	0.054	0.0025	NS	0.0025	0.051	NS	NS	0.0025	0.076	NS	NS	NS	NS	NS	NS	NS	NS
Beryllium	0.001	NS	0.001	ND ^	0.001	NS	0.001	ND	NS	NS	0.001	ND ^	NS	NS	NS	NS	NS	NS	NS	NS
Boron	0.05	NS	0.05	0.22	0.05	NS	0.05	0.22	NS	NS	0.05	0.35	NS	NS	NS	NS	NS	NS	NS	NS
Cadmium	0.0005	NS	0.0005	ND	0.0005	NS	0.0005	ND	NS	NS	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	10	NS	10	280	10	NS	10	60	NS	NS	10	140	NS	NS	NS	NS	NS	NS	NS	NS
Chromium	0.005	NS	0.005	ND	0.005	NS	0.005	ND	NS	NS	0.005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Cobalt	0.001	NS	0.001	ND	0.001	NS	0.001	ND	NS	NS	0.001	0.0011	NS	NS	NS	NS	NS	NS	NS	NS
Copper	0.002	NS	0.002	ND	0.002	NS	0.002	ND	NS	NS	0.002	ND	NS	NS	NS	NS	NS	NS	NS	NS
Cyanide	0.01	NS	0.01	ND	0.01	NS	0.01	ND	NS	NS	0.01	ND	NS	NS	NS	NS	NS	NS	NS	NS
Fluoride	0.1	NS	0.1	0.42	0.1	NS	0.1	0.34	NS	NS	0.1	0.4	NS	NS	NS	NS	NS	NS	NS	NS
Iron	0.1	NS	0.1	0.1	0.1	NS	0.1	ND	NS	NS	0.1	ND	NS	NS	NS	NS	NS	NS	NS	NS
Lead	0.0005	NS	0.0005	ND	0.0005	NS	0.0005	ND	NS	NS	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	0.0025	NS	0.0025	ND	0.0025	NS	0.0025	ND	NS	NS	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS
Mercury	0.0002	NS	0.0002	ND	0.0002	NS	0.0002	ND	NS	NS	0.0002	ND	NS	NS	NS	NS	NS	NS	NS	NS
Nickel	0.002	NS	0.002	ND	0.002	NS	0.002	ND	NS	NS	0.002	0.0023	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrate	0.1	NS	0.1	2.9	0.1	NS	0.1	1.6	NS	NS	0.1	2.1	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrate, Nitri	0.1	NS	0.1	2.9	0.1	NS	0.1	1.6	NS	NS	0.1	2.1	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrite	0.02	NS	0.02	ND	0.02	NS	0.02	ND	NS	NS	0.02	ND	NS	NS	NS	NS	NS	NS	NS	NS
Perchlorate	0.004	NS	0.004	ND	0.004	NS	0.004	ND	NS	NS	0.004	ND	NS	NS	NS	NS	NS	NS	NS	NS
Selenium	0.0025	NS	0.0025	0.016	0.0025	NS	0.0025	ND	NS	NS	0.0025	0.0075	NS	NS	NS	NS	NS	NS	NS	NS
Silver	0.0005	NS	0.0005	ND	0.0005	NS	0.0005	ND	NS	NS	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Sulfate	20	NS	20	84	20	NS	20	42	NS	NS	20	120	NS	NS	NS	NS	NS	NS	NS	NS
Thallium	0.002	NS	0.002	ND	0.002	NS	0.002	ND	NS	NS	0.002	ND	NS	NS	NS	NS	NS	NS	NS	NS
Total Dissolved Solids	10	NS	10	940	10	NS	10	510	NS	NS	10	730	NS	NS	NS	NS	NS	NS	NS	NS
Vanadium	0.005	NS	0.005	ND	0.005	NS	0.005	ND	NS	NS	0.005	0.005	NS	NS	NS	NS	NS	NS	NS	NS
Zinc	0.02	NS	0.02	ND ^	0.02	NS	0.02	ND	NS	NS	0.02	ND	NS	NS	NS	NS	NS	NS	NS	NS
Benzene	0.0005	NS	0.0005	ND	0.0005	NS	0.0005	ND	NS	NS	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
BETX	0.0025	NS	0.0025	ND	0.0025	NS	0.0025	ND	NS	NS	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS
pH	NA	NS	NA	7.42	NA	NS	NA	7.9	NS	NS	NA	7.01	NS	NS	NS	NS	NS	NS	NS	NS
Temperature	NA	NS	NA	14.8	NA	NS	NA	11.25	NS	NS	NA	12.7	NS	NS	NS	NS	NS	NS	NS	NS
Conductivity	NA	NS	NA	2.25	NA	NS	NA	90.6	NS	NS	NA	1.226	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved Oxygen	NA	NS	NA	8.62	NA	NS	NA	12.51	NS	NS	NA	8.61	NS	NS	NS	NS	NS	NS	NS	NS
ORP	NA	NS	NA	-246.5	NA	NS	NA	-29.4	NS	NS	NA	87.6	NS	NS	NS	NS	NS	NS	NS	NS

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm^c millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-02	Date	12/6/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	0.012	NS	NS	0.0030	0.0042	0.0030	0.0032	0.0030	ND	0.0030	ND	NS	NS
Arsenic	0.010	0.0010	ND	NS	NS	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	NS	NS
Barium	2.0	0.0025	0.082	NS	NS	0.0025	0.081	0.0025	0.10	0.0025	0.12	0.0025	0.12	NS	NS
Beryllium	0.004	0.0010	ND	NS	NS	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	NS	NS
Boron	2.0	0.050	0.31	NS	NS	0.050	0.35	0.050	0.44	0.050	0.74	0.050	0.22	NS	NS
Cadmium	0.005	0.00050	ND	NS	NS	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	NS	NS
Chloride	200.0	10	140	NS	NS	10	230	10	140	10	140	2.0	280	NS	NS
Chromium	0.1	0.0050	ND	NS	NS	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	NS	NS
Cobalt	1.0	0.0010	ND	NS	NS	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	NS	NS
Copper	0.65	0.0020	0.0032	NS	NS	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	NS	NS
Cyanide	0.2	0.010	ND	NS	NS	0.010	ND	0.010	ND	0.010	ND	0.010	ND	NS	NS
Fluoride	4.0	0.10	0.62	NS	NS	0.10	0.58	0.10	0.54	0.10	0.51	0.10	0.53	NS	NS
Iron	5.0	0.10	ND	NS	NS	0.50	ND	0.10	ND	0.10	ND	0.10	ND	NS	NS
Lead	0.0075	0.00050	ND	NS	NS	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	NS	NS
Manganese	0.15	0.0025	ND	NS	NS	0.013	ND	0.0025	0.0025	0.0025	ND	0.0025	ND^	NS	NS
Mercury	0.002	0.00020	ND	NS	NS	0.00020	ND^	0.00020	ND	0.00020	ND	0.00020	ND	NS	NS
Nickel	0.1	0.0020	0.0033	NS	NS	0.010	ND	0.0020	0.0027	0.0020	0.0023	0.0020	ND	NS	NS
Nitrogen/Nitrate	10.0	0.10	3.1	NS	NS	0.10	1.8	0.10	2.2	0.10	2.9	0.10	6.4	NS	NS
Nitrogen/Nitrate, Nitri	NA	0.20	3.1	NS	NS	0.10	1.8	0.20	2.2	0.10	2.9	0.50	6.4	NS	NS
Nitrogen/Nitrite	NA	0.020	ND	NS	NS	0.020	ND	0.020	ND	0.020	ND	0.020	ND	NS	NS
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NS	NS
Selenium	0.05	0.0025	ND	NS	NS	0.013	ND	0.0025	0.0038	0.0025	0.0055	0.0025	0.0048	NS	NS
Silver	0.05	0.00050	ND	NS	NS	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	NS	NS
Sulfate	400.0	50	190	NS	NS	25	67	25	110	50	150	50	110	NS	NS
Thallium	0.002	0.0020	ND	NS	NS	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	NS	NS
Total Dissolved Solids	1,200	10	600	NS	NS	10	720	10	690	10	750	10	800	NS	NS
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NS	NS
Zinc	5.0	0.020	ND	NS	NS	0.10	ND	0.020	ND	0.020	ND	0.020	ND	NS	NS
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NS	NS
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NS	NS
pH	6.5 - 9.0	NA	7.85	NS	NS	NA	7.30	NA	7.37	NA	7.37	NA	NM	NS	NS
Temperature	NA	NA	9.3	NA	NS	NA	15.57	NA	18.72	NA	13.04	NA	NM	NS	NS
Conductivity	NA	NA	1.1	NA	NS	NA	1.30	NA	0.98	NA	0.90	NA	NM	NS	NS
Dissolved Oxygen	NA	NA	NM	NA	NS	NA	6.45	NA	5.21	NA	5.91	NA	NM	NS	NS
ORP	NA	NA	NM	NA	NS	NA	227.3	NA	-36.0	NA	81.0	NA	NM	NS	NS

Sample: MW-02	9/19/2012		12/20/2012		3/5/2013		5/23/2013		7/22/2013		10/15/2013		2/21/2014	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	0.0015	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.12	0.0025	0.13	0.0025	0.12	0.0025	0.11	0.0025	0.12	0.0025	0.093	0.0025	0.13
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^
Boron	0.050	0.35^	0.050	0.42	0.050	0.41	0.050	0.35	0.050	0.29	0.050	0.41	0.050	0.34
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	120	10	150	10	260	10	250	10	310	10	180	10	240
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.64	0.10	0.59	0.10	0.59^	0.10	0.54	0.10	0.51	0.10	0.56	0.10	0.46
Iron	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0036	0.0025	ND	0.0025	ND
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	0.0024	0.0020	0.0029	0.0020	0.0027	0.0020	0.0022	0.0020	0.0061	0.0020	0.0039	0.0020	ND
Nitrogen/Nitrate	0.10	4.7	0.10	7.5	0.10	4.4	0.10	3.7	0.10	1.8	0.10	1.6	0.10	3.4
Nitrogen/Nitrate, Nitri	0.50	4.7	0.50	7.5	0.50	4.4	0.50	3.7	0.10	1.8	0.10	1.6	0.50	3.4
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	NR	NR	0.004	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	0.0034	0.0025	0.0027	0.0025	ND	0.0025	ND	0.0025	0.0077
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	50	190	50	140	50	130	25	150	50	140	25	130	25	61
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	580	10	720	10	840	10	860	10	980	10	660	10	830
Vanadium	NR	NR	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	NR	NR	0.0005	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
BETX	NR	NR	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	7.39	NA	7.39	NA	7.52	NA	7.44	NA	7.08	NA	7.20	NA	9.24
Temperature	NA	22.02	NA	14.4	NA	9.5	NA	12.82	NA	16.25	NA	15.37	NA	11.97
Conductivity	NA	0.90	NA	0.91	NA	1.02	NA	1.008	NA	1.785	NA	1.02	NA	1.00
Dissolved Oxygen	NA	6.02	NA	9.91	NA	7.79	NA	7.65	NA	14.83	NA	5.81	NA	6.17
ORP	NA	158.0	NA	41.0	NA	58.1	NA	178.0	NA	138.5	NA	-40.3	NA	-66.1

Sample: MW-02	5/2/2014		8/18/2014		10/23/2014		2/10/2015		5/27/2015		8/4/2015		10/28/2015	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND	0.0010	ND	0.0010	ND^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.11	0.0025	0.087	0.0025	0.089	0.0025	0.088	0.0025	0.092	0.0025	0.090	0.0025	0.084
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	0.050	0.25	0.050	0.22	0.050	0.22	0.050	0.23	0.050	0.35	0.050	0.25	0.050	0.21
Cadmium	0.00050	0.00057	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.00069	0.00050	ND	0.00050	ND
Chloride	50	350	10	280	10	240	10	190	50	410	10	290	10	130
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.0017	0.0010	0.010	0.0010	0.0027	0.0010	0.0017
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0059	0.0020	ND	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.40	0.10	0.49	0.10	0.45	0.10	0.40	0.10	0.40	0.10	0.41	0.10	0.39
Iron	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0031	0.0025	ND	0.0025	ND
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND *	0.00020	ND
Nickel	0.0020	0.0023	0.0020	0.0049	0.0020	0.0069	0.0020	0.0053	0.0020	0.013	0.0020	0.0073	0.0020	0.0031
Nitrogen/Nitrate	0.10	2.9	0.10	1.1	0.10	1.3	0.10	1.3	0.10	0.43	0.10	1.2	0.10	1.0
Nitrogen/Nitrate, Nitri	0.50	2.9	0.10	1.1	0.10	1.3	0.10	1.3	0.10	0.43	0.10	1.2	0.10	1.0
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	25	68	25	85	25	92	20	67	25	100	25	85	20	60
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	1100	10	850	10	810	10	730	10	1200	10	890	10	610
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	ND	0.002	0.00076	0.002	0.00076	0.002	0.00076	0.002	ND	0.002	ND
pH	NA	7.22	NA	7.07	NA	7.31	NA	7.46	NA	6.83	NA	7.61	NA	7.05
Temperature	NA	11.55	NA	16.92	NA	14.3	NA	9.28	NA	14.63	NA	16.75	NA	15.07
Conductivity	NA	1.35	NA	1.299	NA	1.30	NA	0.94	NA	1.75	NA	1.38	NA	1.10
Dissolved Oxygen	NA	8.48	NA	5.14	NA	4.07	NA	5.58	NA	1.96	NA	3.66	NA	4.47
ORP	NA	152.4	NA	115.8	NA	57.1	NA	73.2	NA	33.9	NA	-51.3	NA	110.4

Sample: MW-02	2/9/2016		5/11/2016		8/31/2016		11/1/2016		2/8/2017		4/25/2017		2/21/2018	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND ^	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.098	0.0025	0.11	0.0025	0.087	0.0025	0.071	0.0025	0.085	0.0025	0.10	0.0025	0.12
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND
Boron	0.050	0.20	0.050	0.18	0.050	0.18	0.050	0.18	0.050	0.17	0.050	0.15	0.050	0.19
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	180	10	340	10	170	10	97	10	140	10	330	10	240
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	0.0011	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND ^	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND F1,2	0.010	ND	0.010	ND
Fluoride	0.10	0.38	0.10	0.40	0.10	0.44	0.10	0.40	0.10	0.35	0.10	0.32	0.10	0.35
Iron	0.10	ND	0.10	ND ^	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	0.0039	0.0020	0.0071	0.0020	0.0062	0.0020	0.0044	0.0020	0.0030	0.0020	0.0050	0.0020	0.0054
Nitrogen/Nitrate	0.10	1.5	0.10	1.4	0.10	1.5	0.10	0.79	0.10	1.0	0.10	1.8	0.10	1.6
Nitrogen/Nitrate, Nitri	0.10	1.5	0.10	1.4	0.10	1.5	0.10	0.79	0.10	1.0	0.10	1.8	0.10	1.6
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND F1	0.0025	ND ^	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	20	88	25	100	25	62	10	41	20	50	25	140	50	160
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	750	10	960	10	700	10	570	10	630	10	890	10	970
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	0.002	0.002	ND	0.002	0.0068	0.002	ND	0.002	ND	0.0025	0.00052
pH	NA	7.12	NA	7.13	NA	6.70	NA	7.26	NA	6.97	NA	7.15	NA	7.28
Temperature	NA	11.10	NA	13.52	NA	18.75	NA	17.85	NA	11.92	NA	14.74	NA	7.75
Conductivity	NA	0.92	NA	1.38	NA	1.11	NA	0.84	NA	0.78	NA	1.22	NA	0.916
Dissolved Oxygen	NA	5.38	NA	4.25	NA	4.84	NA	3.87	NA	4.90	NA	6.60	NA	5.82
ORP	NA	80.7	NA	38.4	NA	47.8	NA	91.2	NA	15.3	NA	10.1	NA	13.1

Sample: MW-02	8/1/2018		10/16/2018		2/4/2019		5/7/2019		8/6/2019		11/7/2019		2/13/2020	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	NS	0.003	ND	0.003	NS
Arsenic	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	NS	0.001	ND	0.001	NS
Barium	0.0025	0.071	0.0025	0.063	0.0025	0.071	0.0025	0.11	0.0025	NS	0.0025	0.065	0.0025	NS
Beryllium	0.001	ND	0.001	ND^	0.001	ND	0.001	ND	0.001	NS	0.001	ND	0.001	NS
Boron	0.05	0.14	0.05	0.15	0.05	0.14	0.05	0.15	0.05	NS	0.05	0.18	0.05	NS
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	NS	0.0005	ND	0.0005	NS
Chloride	10	200	10	120	10	150	10	500	10	NS	10	100	10	NS
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	NS	0.005	ND	0.005	NS
Cobalt	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	NS	0.001	ND	0.001	NS
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	NS	0.002	ND	0.002	NS
Cyanide	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	NS	0.01	ND	0.01	NS
Fluoride	0.1	0.4	0.1	0.43	0.1	0.39	0.1	0.41	0.1	NS	0.1	0.38	0.1	NS
Iron	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	NS	0.1	ND	0.1	NS
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	NS	0.0005	ND	0.0005	NS
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	NS	0.0025	ND	0.0025	NS
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	NS	0.0002	ND	0.0002	NS
Nickel	0.002	0.003	0.002	ND	0.002	0.0027	0.002	0.0034	0.002	NS	0.002	0.0021	0.002	NS
Nitrogen/Nitrate	0.1	0.81	0.1	0.68	0.1	1.0	0.1	1.8	0.1	NS	0.1	1.2	0.1	NS
Nitrogen/Nitrate, Nitri	0.1	0.81	0.1	0.68	0.1	1.0	0.1	1.8	0.1	NS	0.1	1.2	0.1	NS
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	NS	0.02	ND	0.02	NS
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	NS	0.004	ND	0.004	NS
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	NS	0.0025	ND	0.0025	NS
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	NS	0.0005	ND	0.0005	NS
Sulfate	20	76	20	45	20	71	20	73	20	NS	20	34	20	NS
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	NS	0.002	ND	0.002	NS
Total Dissolved Solids	10	760	10	520	10	690	10	1,100	10	NS	10	580	10	NS
Vanadium	0.005	ND	0.005	ND^	0.005	ND	0.005	ND	0.005	NS	0.005	ND	0.005	NS
Zinc	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	NS	0.02	ND	0.02	NS
Benzene	0.0005	0.001	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	NS	0.0005	ND	0.0005	NS
BETX	0.0025	0.0142	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	NS	0.0025	ND	0.0025	NS
pH	NA	7.36	NA	7.70	NA	7.32	NA	7.3	NA	NS	NA	7.16	NA	NS
Temperature	NA	17.40	NA	14.68	NA	13.4	NA	19.3	NA	NS	NA	12.61	NA	NS
Conductivity	NA	0.961	NA	0.735	NA	1.1	NA	3.0	NA	NS	NA	9.67	NA	NS
Dissolved Oxygen	NA	5.36	NA	6.25	NA	6.20	NA	6.98	NA	NS	NA	9.1	NA	NS
ORP	NA	85.9	NA	36.6	NA	125.6	NA	NA	NA	NS	NA	-10.5	NA	NS

Sample: MW-02	5/21/2020		7/30/2020		10/22/2020		3/2/2021		5/18/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	NS	NS	NS	NS	NS	NS	NS	NS
Arsenic	0.001	ND	NS	NS	NS	NS	NS	NS	NS	NS
Barium	0.0025	0.089	NS	NS	NS	NS	NS	NS	NS	NS
Beryllium	0.001	ND ^	NS	NS	NS	NS	NS	NS	NS	NS
Boron	0.05	0.24	NS	NS	NS	NS	NS	NS	NS	NS
Cadmium	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Chloride	10	260	NS	NS	NS	NS	NS	NS	NS	NS
Chromium	0.005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Cobalt	0.001	ND	NS	NS	NS	NS	NS	NS	NS	NS
Copper	0.002	ND	NS	NS	NS	NS	NS	NS	NS	NS
Cyanide	0.01	ND	NS	NS	NS	NS	NS	NS	NS	NS
Fluoride	0.1	0.41	NS	NS	NS	NS	NS	NS	NS	NS
Iron	0.1	ND	NS	NS	NS	NS	NS	NS	NS	NS
Lead	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Manganese	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS
Mercury	0.0002	ND	NS	NS	NS	NS	NS	NS	NS	NS
Nickel	0.002	0.0046	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrate	0.1	2.9	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrate, Nitri	0.1	2.9	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen/Nitrite	0.02	ND	NS	NS	NS	NS	NS	NS	NS	NS
Perchlorate	0.004	ND	NS	NS	NS	NS	NS	NS	NS	NS
Selenium	0.0025	0.0045	NS	NS	NS	NS	NS	NS	NS	NS
Silver	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Sulfate	20	160	NS	NS	NS	NS	NS	NS	NS	NS
Thallium	0.002	ND	NS	NS	NS	NS	NS	NS	NS	NS
Total Dissolved Solids	10	910	NS	NS	NS	NS	NS	NS	NS	NS
Vanadium	0.005	ND	NS	NS	NS	NS	NS	NS	NS	NS
Zinc	0.02	ND	NS	NS	NS	NS	NS	NS	NS	NS
Benzene	0.0005	ND	NS	NS	NS	NS	NS	NS	NS	NS
BETX	0.0025	ND	NS	NS	NS	NS	NS	NS	NS	NS
pH	NA	6.99	NS	NS	NS	NS	NS	NS	NS	NS
Temperature	NA	14.5	NS	NS	NS	NS	NS	NS	NS	NS
Conductivity	NA	1.577	NS	NS	NS	NS	NS	NS	NS	NS
Dissolved Oxygen	NA	7.77	NS	NS	NS	NS	NS	NS	NS	NS
ORP	NA	82.1	NS	NS	NS	NS	NS	NS	NS	NS

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm^c millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-03	Date	12/7/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	0.0040	0.0030	ND	0.0030	ND	0.0030	0.0065	0.0030	0.016	0.0030	0.013	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	0.0011	0.0050	ND	0.0010	0.0012	0.0010	0.0016	0.0010	0.0014	0.0010	0.0011	0.0010	0.0012	0.0010	0.0012
Barium	2.0	0.0025	0.089	0.0025	0.085	0.0025	0.092	0.0025	0.081	0.0025	0.084	0.0025	0.081	0.0025	0.088	0.0025	0.097	0.0025	0.09
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.24	0.050	0.36	0.050	0.46	0.050	0.24	0.050	0.23	0.050	0.26	0.050	0.31	0.050	0.22^	0.050	0.28
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	0.00074	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	10	260	10	240	10	300	50	160	10	260	2.0	250	10	260	10	330	10	290
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	0.0013	0.0010	0.0013	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND*	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.43	0.10	0.40	0.10	0.41	0.10	0.31	0.10	0.40	0.10	0.39	0.10	0.43	0.10	0.43	0.10	0.38
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	0.10	0.0025	0.048	0.013	ND	0.0025	0.0076	0.0025	0.0080	0.0025	0.0095^	0.0025	0.014	0.0025	0.011	0.0025	0.0076
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND^	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.011	0.0020	0.0065	0.010	ND	0.0020	0.0041	0.0020	0.0060	0.0020	0.0046	0.0020	0.0044	0.0020	0.0059	0.0020	0.0063
Nitrogen/Nitrate	10.0	0.10	ND	0.10	1.0	0.10	2.1	0.10	1.1	0.10	0.79	0.10	ND	0.10	1.3	0.10	0.88	0.10	0.77
Nitrogen/Nitrate, Nitri	NA	0.10	ND	0.10	1.0	0.20	2.1	0.10	1.1	0.10	0.79	0.10	ND	0.10	1.3	0.10	0.88	0.10	0.77
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.004	ND
Selenium	0.05	0.0025	ND	0.0025	0.0050	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0043	0.0025	ND	0.0025	ND
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	0.00091	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	120	50	160	50	120	25	120	50	160	50	190	25	160	50	150	50	110
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	930	10	1100	10	1000	10	930	10	1100	10	1000	10	1100	10	1000	10	1100
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0005	ND
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0025	NS
pH	6.5 - 9.0	NA	7.84	NA	7.26	NA	7.41	NA	7.37	NA	7.48	NA	7.34	NA	7.21	NA	7.40	NA	7.42
Temperature	NA	NA	10.91	NA	12.73	NA	13.04	NA	11.90	NA	10.94	NA	13.73	NA	14.01	NA	13.35	NA	12.40
Conductivity	NA	NA	1.83	NA	1.76	NA	1.74	NA	1.15	NA	1.19	NA	1.21	NA	1.33	NA	1.41	NA	1.28
Dissolved Oxygen	NA	NA	NM	NA	4.73	NA	7.78	NA	6.03	NA	6.07	NA	6.07	NA	6.47	NA	6.35	NA	6.30
ORP	NA	NA	NM	NA	179.1	NA	223.5	NA	-51.0	NA	145.0	NA	193.0	NA	114.0	NA	134.0	NA	130.0

Sample: MW-03	3/5/2013		5/22/2013		7/22/2013		10/15/2013		2/17/2014		5/2/2014		8/18/2014		10/23/2014		2/10/2015	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	0.0014	0.0010	0.0013	0.0010	0.0012	0.0010	0.0014	0.0010	0.0014	0.0010	0.0015	0.0010	ND	0.0010	ND^	0.0010	0.0015
Barium	0.0025	0.089	0.0025	0.13	0.0025	0.10	0.0025	0.099	0.0025	0.098	0.0025	0.10	0.0025	0.075	0.0025	0.089	0.0025	0.093
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	0.050	0.29	0.050	0.74 V	0.050	0.67	0.050	0.27	0.050	0.45	0.050	0.27	0.050	0.37	0.050	0.45	0.050	0.52
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	260	50	380	10	210	10	250	10	200	10	300	10	220	10	180	10	160
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.42^	0.10	0.44	0.10	0.45	0.10	0.47	0.10	0.51	0.10	0.40	0.10	0.52	0.10	0.49	0.10	0.46
Iron	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	0.0068	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	0.0051	0.0020	0.0042	0.0020	0.0043	0.0020	0.0046	0.0020	0.0033	0.0020	0.0040	0.0020	0.0021	0.0020	0.0023	0.0020	ND
Nitrogen/Nitrate	0.10	0.86	0.10	3.6	0.10	3.1	0.10	1.9	0.10	1.5	0.10	2.3	0.10	1.9	0.10	1.8	0.10	2.5
Nitrogen/Nitrate, Nitri	0.10	0.86	0.50	3.6	0.50	3.1	0.10	1.9	0.10	1.5	0.50	2.3	0.10	1.9	0.10	1.8	0.20	2.5
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	0.0031	0.0025	0.022	0.0025	0.012	0.0025	ND	0.0025	0.0051	0.0025	ND	0.0025	0.0029	0.0025	0.0036	0.0025	0.0054
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	50	140	50	250	50	260	50	210	25	89	25	110	40	84	50	130	25	58
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	950	10	1300	10	1000	10	910	10	890	10	1100	10	810	10	760	10	700
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
pH	NA	7.66	NA	7.00	NA	7.26	NA	7.22	NA	8.57	NA	7.09	NA	6.70	NA	7.16	NA	7.55
Temperature	NA	11.20	NA	13.45	NA	17.29	NA	13.91	NA	9.27	NA	11.38	NA	18.40	NA	13.97	NA	9.02
Conductivity	NA	1.18	NA	1.55	NA	1.33	NA	0.99	NA	0.75	NA	1.31	NA	1.22	NA	1.22	NA	0.90
Dissolved Oxygen	NA	7.03	NA	5.31	NA	3.47	NA	2.78	NA	3.32	NA	5.23	NA	6.68	NA	5.41	NA	4.84
ORP	NA	196.6	NA	-20.4	NA	32.2	NA	-79.8	NA	-7.3	NA	141.8	NA	94.8	NA	69.5	NA	71.9

Sample: MW-03	5/27/2015		8/4/2015		10/28/2015		2/10/2016		5/10/2016		8/31/2016		11/2/2016		2/6/2017		4/26/2017		2/20/2018		7/31/2018	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.003	ND
Arsenic	0.0010	0.0015	0.0010	0.0015	0.0010	ND	0.0010	0.0015	0.0010	ND ^	0.0010	0.0011	0.0010	0.0013	0.0010	0.0013	0.0010	0.0011	0.0010	0.0012	0.001	0.0012
Barium	0.0025	0.094	0.0025	0.092	0.0025	0.10	0.0025	0.098	0.0025	0.093	0.0025	0.093	0.0025	0.089	0.0025	0.096	0.0025	0.096	0.0025	0.094	0.0025	0.099
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND ^	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.001	ND
Boron	0.050	0.54	0.050	0.48	0.050	0.29	0.050	0.49	0.050	0.44	0.050	0.37	0.050	0.38	0.050	0.39	0.050	0.45	0.050	0.51	0.05	0.33
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Chloride	10	220	10	230	10	230	10	200	10	240	10	240	10	170	10	140	10	210	10	170 F1	10	260
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.001	ND
Copper	0.0020	ND	0.0020	0.0021	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND	0.002	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.01	ND
Fluoride	0.10	0.43	0.10	0.47	0.10	0.41	0.10	0.48	0.10	0.49	0.10	0.45	0.10	0.57	0.10	0.39	0.10	0.35	0.10	0.42	0.1	0.42
Iron	0.10	ND	0.10	ND	0.10	ND	0.10	0.22	0.10	ND ^	0.10	ND	0.10	ND	0.10	ND	0.10	0.10	0.10	0.10	0.1	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0040	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0028	0.0025	ND
Mercury	0.00020	ND	0.00020	ND *	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.0002	ND
Nickel	0.0020	0.0026	0.0020	ND	0.0020	0.0023	0.0020	0.0025	0.0020	ND	0.0020	0.0020	0.0020	ND	0.0020	0.0025	0.0020	ND	0.0020	0.0024	0.002	0.0025
Nitrogen/Nitrate	0.10	2.1	0.10	1.9	0.10	1.6	0.10	1.9	0.10	1.5	0.10	3.4	0.10	1.9	0.10	1.4	0.10	2.6	0.10	1.7	0.1	1.4
Nitrogen/Nitrate, Nitri	0.20	2.1	0.10	1.9	0.10	1.6	0.10	1.9	0.20	1.5	0.50	3.4	0.10	1.9	0.10	1.4	0.20	2.6	0.10	1.7	0.1	1.4
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.004	ND
Selenium	0.0025	0.0063	0.0025	0.0066	0.0025	ND	0.0025	0.0048	0.013	ND ^	0.0025	0.0032	0.0025	0.0031	0.0025	0.0033	0.0025	0.0050	0.0025	ND	0.0025	0.0038
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Sulfate	25	84	25	91	40	180	50	150	25	130	25	96	20	87	25	75	25	110	50	110	25	110
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND
Total Dissolved Solids	10	830	10	860	10	820	10	780	10	850	10	920	10	800	10	740	10	890	10	840	10	920
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.00094	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	0.0015	0.002	ND	0.002	0.0065	0.002	ND	0.002	0.0027	0.002	ND	0.002	0.02984	0.002	ND	0.002	ND	0.0025	0.0015	0.0025	0.001
pH	NA	7.37	NA	7.29	NA	7.11	NA	7.31	NA	7.07	NA	7.18	NA	7.45	NA	7.35	NA	7.03	NA	7.11	NA	7.22
Temperature	NA	16.14	NA	17.45	NA	13.85	NA	6.78	NA	13.77	NA	18.94	NA	16.53	NA	12.81	NA	15.34	NA	13.37	NA	20.13
Conductivity	NA	1.23	NA	1.26	NA	1.50	NA	0.86	NA	1.18	NA	1.35	NA	1.14	NA	0.95	NA	1.05	NA	0.925	NA	1.206
Dissolved Oxygen	NA	5.49	NA	6.03	NA	5.48	NA	5.93	NA	5.65	NA	6.91	NA	5.30	NA	5.69	NA	7.22	NA	5.84	NA	6.75
ORP	NA	64.1	NA	7.6	NA	106.6	NA	94.8	NA	93.8	NA	66.4	NA	66.0	NA	5.1	NA	59.8	NA	111.7	NA	142.0

Sample: MW-03	10/17/2018		2/4/2019		5/7/2019		8/7/2019		11/7/2019		2/17/2020		5/20/2020		7/30/2020		10/22/2020		3/2/2021		5/18/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.001	0.001	0.001	0.0011	0.001	0.001	0.001	ND	0.001	0.0012	0.001	0.0015	0.001	0.0015	0.001	0.001	0.001	ND	0.001	0.001	0.001	ND
Barium	0.0025	0.1	0.0025	0.089	0.0025	0.11	0.0025	0.088	0.0025	0.081	0.0025	0.09	0.0025	0.11	0.0025	0.093	0.0025	0.1	0.0025	0.11	0.0025	0.14
Beryllium	0.001	ND^	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Boron	0.05	0.22	0.05	0.36	0.05	0.41	0.05	0.36	0.05	0.32	0.05	0.33	0.05	0.36	0.05	0.28	0.05	0.29	0.05	0.35	0.05	0.25
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	250	10	160	10	270 F1	10	220	10	150	10	130	10	230	10	170	10	180	10	200	40	290
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	0.001
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	0.0062	0.01	ND	0.005	ND	0.005	ND
Fluoride	0.1	0.4	0.1	0.43	0.1	0.41	0.1	0.39	0.1	0.41	0.1	0.46	0.1	0.42	0.1	0.45	0.1	0.44	0.1	0.44	0.1	0.4
Iron	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0035	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.002	0.0049	0.002	0.0033	0.002	0.0035	0.002	ND	0.002	0.0028	0.002	ND	0.002	ND	0.002	ND	0.002	0.0031	0.002	0.0048	0.002	0.0072
Nitrogen/Nitrate	0.1	0.94	0.1	1.0	0.1	2.1	0.1	2.7	0.1	1.8	0.1	1.7	0.1	2.1	0.1	3	0.1	2.8	0.1	2.8	0.1	1.9
Nitrogen/Nitrate, Nitri	0.1	0.94	0.1	1.0	0.1	2.1	0.1	2.7	0.1	1.8	0.1	1.7	0.1	2.1	0.5	3	0.5	2.8	0.5	2.8	0.5	1.9
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	0.0032	0.0025	0.0056	0.0025	0.0037	0.0025	0.0025	0.0025	0.0025	0.0025	0.0039	0.0025	0.0028	0.0025	ND	0.0025	0.0047	0.0025	ND
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	25	84	25	100	25	160	25	71	25	73	25	65	25	100	25	77	15	91	25	140	25	190
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	860	10	770	10	900	10	760	10	740	10	610	10	910	30	680	30	760	10	900	10	1100
Vanadium	0.005	ND^	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	7.04	NA	7.44	NA	7.27	NA	7.34	NA	7.32	NA	7.31	NA	7.56	NA	7.1	NA	7.23	NA	7.27	NA	7.13
Temperature	NA	11.69	NA	11.00	NA	12.00	NA	13.00	NA	11.86	NA	12.00	NA	11.50	NA	12.50	NA	12.60	NA	12.40	NA	12.80
Conductivity	NA	1.070	NA	123.700	NA	2.35	NA	1.37	NA	11.87	NA	9.37	NA	9.92	NA	1.36	NA	1.35	NA	1.561	NA	1.802
Dissolved Oxygen	NA	9.38	NA	7.10	NA	6.48	NA	6.09	NA	8.23	NA	5.7	NA	3.98	NA	7.65	NA	4.22	NA	4.96	NA	5.34
ORP	NA	101.7	NA	194.7	NA	-237.9	NA	157.7	NA	-9.8	NA	154.4	NA	160.7	NA	157.4	NA	180.0	NA	20.0	NA	88.3

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm[c] millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-04	Date	12/7/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012		3/5/2013		5/22/2013		7/22/2013		10/16/2013		2/21/2014		5/1/2014		8/18/2014		10/23/2014		2/10/2015		5/27/2015	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	0.0067	0.0030	0.0057	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	0.012	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	0.0011	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.0013	0.0010	0.0014	0.0010	0.0013	0.0010	0.0012	0.0010	0.0013	0.0010	ND	0.0010	0.0012	0.0010	ND	0.0010	ND	0.0010	0.0013
Barium	2.0	0.0025	0.065	0.0025	0.067	0.0025	0.059	0.0025	0.060	0.0025	0.069	0.0025	0.070	0.0025	0.068	0.0025	0.092	0.0025	0.87	0.0025	0.080	0.0025	0.084	0.0025	0.078	0.0025	0.089	0.0025	0.088	0.0025	0.072	0.0025	0.071	0.0025	0.078	0.0025	0.079	0.0025	0.090
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.46	0.050	0.37	0.050	0.38	0.050	0.25	0.050	0.34	0.050	0.29	0.050	0.48	0.050	0.34^	0.050	0.38	0.050	0.40	0.050	0.40	0.050	0.50	0.050	0.45	0.050	0.35	0.050	0.32	0.050	0.35	0.050	0.41	0.050	0.44	0.050	0.36
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	10	270	10	270	10	250	10	150	10	200	2.0	210	10	270	10	260	10	250	10	230	10	270	10	200	10	210	10	220	10	270	10	210	10	160	10	180	10	290
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	0.0018	0.0010	0.0028	0.0010	0.0026	0.0010	0.0042	0.0010	0.0059	0.0010	0.0049	0.0010	0.0057	0.0010	0.0012	0.0010	0.014	0.0010	0.0048	0.0010	0.0022	0.0010	ND	0.0010	0.0060	0.0010	0.011	0.0010	0.0076	0.0010	0.0062
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0041	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND*	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.49	0.10	0.38	0.10	0.44	0.10	0.37	0.10	0.44	0.10	0.41	0.10	0.46	0.10	0.47	0.10	0.41	0.10	0.47^	0.10	0.49	0.10	0.50	0.10	0.53	0.10	0.45	0.10	0.44	0.10	0.51	0.10	0.49	0.10	0.44	0.10	0.43
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	0.22	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.46	0.10	0.17	0.10	ND	0.10	ND	0.10	ND	0.10	0.18	0.10	ND	0.10	ND	0.10	0.14	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.00077	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	0.33	0.0025	0.048	0.013	0.018	0.0025	0.066	0.0025	0.029	0.0025	0.038^	0.0025	0.082	0.0025	0.043	0.0025	0.029	0.0025	0.067	0.0025	0.0081	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0044	0.0025	ND
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0067	0.0020	0.0037	0.010	ND	0.0020	0.0029	0.0020	0.0038	0.0020	0.0037	0.0020	0.0036	0.0020	0.0043	0.0020	0.0042	0.0020	0.0051	0.0020	0.0034	0.0020	0.0037	0.0020	0.0033	0.0020	0.0022	0.0020	0.0022	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0023
Nitrogen/Nitrate	10.0	0.10	0.81	0.10	1.6	0.10	2.7	0.10	1.6	0.10	1.4	0.10	0.62	0.10	1.4	0.10	1.3	0.10	0.91	0.10	1.3	0.10	2.9	0.10	2.4	0.10	2.5	0.10	2.0	0.10	2.0	0.10	1.9	0.10	1.6	0.10	2.2	0.10	2.5
Nitrogen/Nitrate, Nitri	NA	0.10	0.81	0.10	1.6	0.20	2.7	0.10	1.6	0.10	1.4	0.10	0.62	0.10	1.4	0.10	1.3	0.10	0.91	0.10	1.3	0.20	2.9	0.50	2.4	0.20	2.5	0.10	2.0	0.50	2.0	0.10	1.9	0.10	1.6	0.20	2.2	0.20	2.5
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.004	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.05	0.0025	0.0025	0.0025	ND	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0047	0.0025	0.0033	0.0025	ND	0.0025	0.0025	0.0025	ND	0.0025	0.0037	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	300	25	140	25	84	25	74	50	170	50	210	25	110	50	180	50	130	50	110	25	120	50	170	50	230	25	110	20	140	25	89	50	160	25	65	20	88
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	1100	10	1000	10	890	10	770	10	970	10	930	10	1100	10	980	10	1000	10	880	10	900	10	840	10	860	10	870	10	860	10	760	10	720	10	730	10	980
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0005	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0025	NS	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
pH	6.5 - 9.0	NA	7.71	NA	7.15	NA	7.48	NA	7.42	NA	7.56	NA	7.40	NA	7.31	NA	7.37	NA	7.38	NA	7.44	NA	7.18	NA	7.25	NA	7.24	NA	9.11	NA	7.15	NA	6.89	NA	7.11	NA	7.53	NA	7.31
Temperature	NA	NA	10.69	NA	12.13	NA	12.59	NA	11.78	NA	9.67	NA	12.52	NA	13.59	NA	14.52	NA	12.98	NA	9.90	NA	14.25	NA	14.76	NA	13.91	NA	9.25	NA	10.92	NA	18.13	NA	14.52	NA	8.49	NA	15.49
Conductivity	NA	NA	1.84	NA	1.76	NA	1.50	NA	0.94	NA	1.04	NA	1.06	NA	1.28	NA	1.33	NA	1.24	NA	1.05	NA	1.106	NA	1.07	NA	1.19	NA	0.93	NA	1.13	NA	1.18	NA	1.18	NA	0.90	NA	1.34
Dissolved Oxygen	NA	NA	NM	NA	6.80	NA	8.20	NA	7.17	NA	6.95	NA	6.95	NA	6.51	NA	6.26	NA	8.19	NA	7.6	NA	6.47	NA	4.4	NA	3.13	NA	5.94	NA	4.23	NA	5.82	NA	5.54	NA	4.57	NA	6.54
ORP	NA	NA	NM	NA	196.1	NA	217.5	NA	-43.0	NA	135.0	NA	177.0	NA	86.0	NA	155.0	NA	132.0	NA	140.9	NA	-6.4	NA	27.6	NA	-80.9	NA	-34.2	NA	101.1	NA	77.4	NA	57.6	NA	41.7	NA	36.7

Sample: MW-04	8/4/2015		10/28/2015		2/10/2016		5/10/2016		8/31/2016		11/2/2016		2/6/2017		4/26/2017		2/20/2018		7/31/2018		10/17/2018		2/4/2019		5/7/2019		8/6/2019		11/6/2019		2/17/2020		5/20/2020		7/31/2020		10/22/2020		3/2/2021		5/18/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.0010	0.0015	0.0010	ND	0.0010	0.0013	0.0010	ND ^	0.0010	0.0013	0.0010	0.0012	0.0010	0.0013	0.0010	0.0011	0.0010	0.0015	0.001	0.0011	0.001	0.001	0.001	0.0012	0.001	0.001	0.001	ND	0.001	0.001	0.001	0.0014	0.001	0.0014	0.001	ND	0.001	ND	0.001	0.0012	0.001	ND
Barium	0.0025	0.067	0.0025	0.083	0.0025	0.085	0.0025	0.10	0.0025	0.089	0.0025	0.079	0.0025	0.10	0.0025	0.084	0.0025	0.083	0.0025	0.089	0.0025	0.093	0.0025	0.085	0.0025	0.091	0.0025	0.08	0.0025	0.082	0.0025	0.085	0.0025	0.085	0.0025	0.082	0.0025	0.09	0.0025	0.099	0.0025	0.12
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND ^	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.001	ND	0.001	ND^	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Boron	0.050	0.33	0.050	0.30	0.050	0.35	0.050	0.51	0.050	0.43	0.050	0.32	0.050	0.38	0.050	0.29	0.050	0.46	0.05	0.35	0.05	0.29	0.05	0.44	0.05	0.77	0.05	0.26	0.05	0.28	0.05	0.25	0.05	0.25	0.05	0.23	0.05	0.29	0.05	0.33	0.05	0.2
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	200	10	200	10	200	10	260	10	200	10	140	10	200	10	220	10	150	10	250	10	210	10	190	10	310	10	220	10	140	10	160	10	160	10	170	10	190	10	230	40	290
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.0010	0.0047	0.0010	0.0041	0.0010	0.0075	0.0010	0.0046	0.0010	0.0072	0.0010	0.0029	0.0010	0.0082	0.0010	0.0052	0.0010	0.0083	0.001	0.008	0.001	ND	0.001	0.0046	0.001	ND	0.001	0.0057	0.001	0.0016	0.001	0.0071	0.001	0.0071	0.001	0.0031	0.001	0.0041	0.001	0.0059	0.001	0.0025
Copper	0.0020	0.0072	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	0.0057	0.01	ND	0.005	ND	0.005	ND
Fluoride	0.10	0.49	0.10	0.45	0.10	0.51	0.10	0.50	0.10	0.44	0.10	0.46	0.10	0.38	0.10	0.37	0.10	0.46	0.1	0.43	0.1	0.46	0.1	0.46	0.1	0.43	0.1	0.39	0.1	0.42	0.1	0.46	0.1	0.46	0.1	0.47	0.1	0.49	0.1	0.46	0.1	0.42
Iron	0.10	ND	0.10	ND	0.10	0.31	0.10	ND ^	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.16	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	0.14	0.1	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	0.0054	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0026	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0033	0.0025	ND
Mercury	0.00020	ND *	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.0020	ND	0.0020	ND	0.0020	0.0021	0.0020	0.0021	0.0020	0.0020	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0020	0.002	ND	0.002	0.0021	0.002	0.0022	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.003
Nitrogen/Nitrate	0.10	1.3	0.10	1.7	0.10	1.8	0.10	2.1	0.10	1.8	0.10	1.9	0.10	1.8	0.10	2.4	0.10	1.5	0.1	1.7	0.1	1.4	0.1	1.4	0.1	2.5	0.1	2.5	0.1	1.8	0.1	1.6	0.1	1.6	0.1	2.7	0.1	3.4	0.1	1.5	0.1	2.4
Nitrogen/Nitrate, Nitri	0.10	1.3	0.10	1.7	0.10	1.8	0.20	2.1	0.10	1.8	0.10	1.9	0.10	1.8	0.20	2.4	0.10	1.5	0.1	1.7	0.1	1.4	0.1	1.4	0.1	2.5	0.1	2.5	0.1	1.8	0.1	1.6	0.1	1.6	0.5	2.7	0.5	3.4	0.1	1.5	0.5	ND F1
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	0.02
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND ^	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0076	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.003	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	25	92	20	100	25	100	50	130	50	100	25	67	25	76	25	80	50	110	50	110	25	91	25	130	25	150	25	74	25	53	25	94	25	94	25	75	25	82	25	150	25	190
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	770	10	780	10	760	10	860	10	800	10	700	10	870	10	750	10	800	10	1000	10	790	10	840	10	980	10	770	10	690	10	710	10	710	30	700	30	760	10	920	10	950
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.0010	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.0024	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	ND	0.002	ND	0.002	0.0017	0.002	ND	0.002	0.01675	0.002	ND	0.002	ND	0.0025	ND	0.0025	0.0082	0.0025	ND^	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	6.80	NA	7.07	NA	7.22	NA	6.71	NA	7.07	NA	7.25	NA	7.19	NA	7.46	NA	7.46	NA	7.58	NA	7.20	NA	7.41	NA	7.27	NA	7.31	NA	7.33	NA	7.26	NA	7.26	NA	7.23	NA	7.15	NA	7.36	NA	7.30
Temperature	NA	18.49	NA	13.44	NA	4.24	NA	12.83	NA	19.61	NA	15.48	NA	11.95	NA	15.52	NA	12.63	NA	16.54	NA	12.53	NA	11.30	NA	11.60	NA	12.70	NA	11.72	NA	11.20	NA	11.20	NA	14.20	NA	14.40	NA	11.30	NA	17.50
Conductivity	NA	1.20	NA	1.34	NA	0.80	NA	1.21	NA	1.33	NA	1.10	NA	1.01	NA	1.08	NA	0.858	NA	1.125	NA	1.086	NA	1.336	NA	2.520	NA	1.440	NA	1.080	NA	1.016	NA	1.016	NA	1.428	NA	0.292	NA	1.605	NA	1.739
Dissolved Oxygen	NA	5.60	NA	5.76	NA	6.44	NA	7.00	NA	7.06	NA	3.56	NA	5.06	NA	8.90	NA	7.19	NA	7.54	NA	8.36	NA	6.32	NA	7.10	NA	52.40	NA	6.65	NA	6.23	NA	6.23	NA	7.32	NA	5.33	NA	6.65	NA	7.47
ORP	NA	25.8	NA	104.2	NA	99.2	NA	150.9	NA	72.1	NA	71.2	NA	-14.7	NA	-15.3	NA	70.7	NA	96.5	NA	58.0	NA	163.9	NA	-233.6	NA	182.3	NA	192.0	NA	167.2	NA	167.2	NA	128.4	NA	178.4	NA	-5.8	NA	121.7

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm² millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-05	Date	12/7/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	0.0040	0.0030	0.0035	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	0.0011	0.0010	0.0011	0.0010	ND	0.0010	ND	0.0010	0.0011	0.0010	ND
Barium	2.0	0.0025	0.061	0.0025	0.092	0.0025	0.053	0.0025	0.053	0.0025	0.062	0.0025	0.069	0.0025	0.056	0.0025	0.071	0.0025	0.078
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.42	0.050	0.52	0.050	0.47	0.050	0.57	0.050	0.49	0.050	0.54	0.050	0.44	0.050	0.55^	0.050	0.65
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	0.0016	0.00050	ND	0.00050	0.00091	0.00050	0.00076
Chloride	200.0	10	150	10	240	10	220	10	120	10	190	2.0	210	10	220	10	240	10	210
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.0040	0.0010	0.006
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.019	0.0020	0.017
Cyanide	0.2	0.010	ND	0.010	ND*	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.40	0.10	0.34	0.10	0.39	0.10	0.28	0.10	0.34	0.10	0.32	0.10	0.38	0.10	0.39	0.10	0.35
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.00062	0.00050	ND
Manganese	0.15	0.0025	0.0065	0.0025	ND	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0040	0.0025	0.081	0.0025	ND
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	ND	0.0020	ND	0.010	ND	0.0020	0.0021	0.0020	ND	0.0020	ND	0.0020	0.0025	0.0020	0.0080	0.0020	0.02
Nitrogen/Nitrate	10.0	0.10	ND	0.10	1.2	0.10	1.3	0.10	1.1	0.10	1.5	0.10	0.33	0.10	1.0	0.10	ND	0.10	0.21
Nitrogen/Nitrate, Nitri	NA	0.10	ND	0.10	1.2	0.10	1.3	0.10	1.1	0.10	1.5	0.10	0.33	0.10	1.0	0.10	ND	0.10	0.21
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.004	ND
Selenium	0.05	0.0025	ND	0.0025	0.0072	0.013	ND	0.0025	ND	0.0025	0.0050	0.0025	ND	0.0025	0.0057	0.0025	ND	0.0025	0.0034
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	25	110	50	160	25	100	50	140	50	140	50	190	25	130	50	210	50	210
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	750	10	990	10	850	10	800	10	900	10	930	10	1000	10	990	10	1000
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0005	ND
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0025	NS
pH	6.5 - 9.0	NA	7.82	NA	7.19	NA	7.44	NA	7.25	NA	7.44	NA	7.30	NA	7.18	NA	7.32	NA	7.36
Temperature	NA	NA	8.86	NA	13.41	NA	13.37	NA	12.15	NA	11.23	NA	13.52	NA	16.19	NA	14.23	NA	13.64
Conductivity	NA	NA	1.36	NA	1.65	NA	1.38	NA	0.92	NA	1.02	NA	1.19	NA	1.56	NA	1.29	NA	1.25
Dissolved Oxygen	NA	NA	NM	NA	6.96	NA	7.16	NA	6.43	NA	6.07	NA	6.24	NA	6.56	NA	3.68	NA	4.27
ORP	NA	NA	NM	NA	197.8	NA	210.0	NA	-26.0	NA	125.0	NA	228.0	NA	176.0	NA	155.0	NA	112.0

Sample: MW-05	Date	3/5/2013		6/5/2013		7/23/2013		10/15/2013		2/21/2014		5/1/2014		8/19/2014		10/23/2014		2/11/2015		5/27/2015	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.0010	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND^	0.0010	ND	0.0010	ND
Barium	2.0	0.0025	0.076	0.0025	0.060	0.0025	0.050	0.0025	0.056	0.0025	0.091	0.0025	0.078	0.0025	0.054	0.0025	0.057	0.0025	0.078	0.0025	0.053
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.59	0.050	0.69	0.050	0.81	0.050	0.55	0.050	0.34	0.050	0.36	0.050	0.95	0.050	0.57	0.050	0.69	0.050	1.0
Cadmium	0.005	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.00060	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	10	230	10	180	10	110	10	140	10	240	10	370	10	120	10	120	10	220	10	250
Chromium	0.1	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	0.0019	0.0010	ND	0.0010	ND	0.0010	0.0014	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.0035	0.0010	ND
Copper	0.65	0.0020	0.0065	0.0020	ND	0.0020	0.0020	0.0020	ND	0.0020	ND	0.0020	0.0057	0.0020	ND	0.0020	ND	0.0020	0.013	0.0020	0.0026
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.35^	0.10	0.39	0.10	0.38	0.10	0.41	0.10	0.34	0.10	0.32	0.10	0.42	0.10	0.44	0.10	0.42	0.10	0.54
Iron	5.0	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	0.0037	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.035	0.0025	0.0062	0.0025	ND	0.0025	0.0076	0.0025	ND
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0072	0.0020	0.0029	0.0020	0.0058	0.0020	0.0030	0.0020	ND	0.0020	0.0033	0.0020	0.0078	0.0020	0.0035	0.0020	0.0092	0.0020	0.0055
Nitrogen/Nitrate	10.0	0.10	0.16	0.10	1.7	0.10	1.0	0.10	1.0	0.10	1.2	0.10	1.6	0.10	0.53	0.10	1.2	0.10	1.7	0.10	1.5
Nitrogen/Nitrate, Nitri	NA	0.10	0.16	0.10	1.7	0.10	1.0	0.10	1.0	0.10	1.2	0.10	1.7	0.10	0.53	0.10	1.2	0.10	1.7	0.10	1.5
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	0.056	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.05	0.0025	ND	0.0025	0.025	0.0025	0.016	0.0025	0.0026	0.0025	0.0030	0.0025	ND	0.0025	0.017	0.0025	0.0097	0.0025	0.014	0.0025	0.025
Silver	0.05	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	150	50	200	50	290	50	180	25	130	25	160	100	360	50	240	50	230	50	290
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	960	10	1,100	10	910	10	680	10	840	10	1100	10	1000	10	730	10	1000	10	1000
Vanadium	0.049	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	11.705	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
pH	6.5 - 9.0	NA	7.34	NA	6.92	NA	6.71	NA	7.21	NA	9.09	NA	7.06	NA	6.40	NA	6.94	NA	7.49	NA	7.25
Temperature	NA	NA	10.90	NA	14.95	NA	14.65	NA	14.16	NA	11.17	NA	11.87	NA	16.11	NA	16.69	NA	8.18	NA	18.15
Conductivity	NA	NA	1.08	NA	1.067	NA	1.01	NA	0.93	NA	0.96	NA	1.46	NA	1.18	NA	1.17	NA	1.15	NA	1.49
Dissolved Oxygen	NA	NA	4.49	NA	4.01	NA	3.5	NA	1.17	NA	4.61	NA	1.10	NA	1.65	NA	4.70	NA	4.99	NA	6.73
ORP	NA	NA	160.5	NA	-1.7	NA	82.5	NA	-98.4	NA	-54.7	NA	91.1	NA	88.6	NA	62.0	NA	85.8	NA	92.2

Sample: MW-05	Date	8/4/2015		10/28/2015		2/10/2016		5/10/2016		8/31/2016		11/2/2016		2/6/2017		4/26/2017		2/20/2018		7/31/2018	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.003	ND
Arsenic	0.010	0.0010	ND	0.0010	ND	0.0010	0.0011	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.0012	0.001	ND
Barium	2.0	0.0025	0.060	0.0025	0.057	0.0025	0.063	0.0025	0.065	0.0025	0.066	0.0025	0.054	0.0025	0.077	0.0025	0.059	0.0025	0.098	0.0025	0.061
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND ^	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.001	ND
Boron	2.0	0.050	1.1	0.050	0.57	0.050	0.45	0.050	0.69	0.050	0.98	0.050	0.40	0.050	0.47	0.050	0.62	0.050	0.25	0.05	0.58
Cadmium	0.005	0.00050	0.0014	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Chloride	200.0	10	180	10	170	10	210	10	230	10	92	10	120	10	180	10	190	10	180	10	120
Chromium	0.1	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND
Cobalt	1.0	0.0010	0.0052	0.0010	0.0014	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.001	ND
Copper	0.65	0.0020	0.015	0.0020	0.0032	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND	0.002	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.01	ND
Fluoride	4.0	0.10	0.52	0.10	0.38	0.10	0.42	0.10	0.51	0.10	0.56	0.10	0.36	0.10	0.29	0.10	0.38	0.10	0.33	0.1	0.38
Iron	5.0	0.10	ND	0.10	ND	0.10	0.28	0.10	ND ^	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.15	0.1	ND
Lead	0.0075	0.00050	0.00074	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Manganese	0.15	0.0025	0.012	0.0025	0.0046	0.0025	0.0050	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0062	0.0025	ND
Mercury	0.002	0.00020	ND *	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.0002	ND
Nickel	0.1	0.0020	0.011	0.0020	0.0037	0.0020	0.0027	0.0020	0.0033	0.0020	0.0044	0.0020	ND	0.0020	0.0022	0.0020	0.0025	0.0020	0.0024	0.002	0.0034
Nitrogen/Nitrate	10.0	0.10	0.18	0.10	1.0	0.10	1.1	0.10	1.7	0.10	0.86	0.10	1.1	0.10	1.3	0.10	1.6	0.10	2.7	0.1	1.7
Nitrogen/Nitrate, Nitri	NA	0.10	0.18	0.10	1.0	0.10	1.1	0.10	1.7	0.10	0.86	0.10	1.1	0.10	1.3	0.10	1.6	0.20	2.7	0.1	1.7
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND
Perchlorate	0.0049	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.004	ND
Selenium	0.05	0.0025	0.013	0.0025	0.0030	0.0025	ND	0.013	0.018 ^	0.0025	0.019	0.0025	ND	0.0025	ND	0.0025	0.014	0.0025	ND	0.0025	0.023
Silver	0.05	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Sulfate	400.0	50	260	50	140	25	110	50	270	50	270	25	95	50	130	50	170	50	150	50	190
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND
Total Dissolved Solids	1,200	10	930	10	760	10	770	10	910	10	850	10	630	10	840	10	760	10	860	10	1000
Vanadium	0.049	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	0.011	0.0050	ND	0.0050	ND	0.0050	0.0087	0.0050	ND	0.005	0.0077
Zinc	5.0	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND
Benzene	0.005	0.0005	ND	0.0005	0.0008	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.00096
BETX	11.705	0.002	ND	0.002	0.0031	0.002	ND	0.002	0.0009	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.0025	0.0012	0.0025	0.00396
pH	6.5 - 9.0	NA	7.31	NA	7.12	NA	7.25	NA	6.88	NA	6.81	NA	7.26	NA	7.22	NA	7.28	NA	7.51	NA	7.61
Temperature	NA	NA	21.19	NA	14.30	NA	8.60	NA	14.22	NA	21.67	NA	17.16	NA	12.75	NA	17.02	NA	13.35	NA	18.49
Conductivity	NA	NA	1.47	NA	1.31	NA	0.84	NA	1.24	NA	1.27	NA	0.99	NA	0.93	NA	1.06	NA	0.835	NA	1.122
Dissolved Oxygen	NA	NA	2.77	NA	2.29	NA	4.11	NA	5.76	NA	4.62	NA	4.45	NA	6.15	NA	6.18	NA	6.74	NA	5.67
ORP	NA	NA	-27.6	NA	107.2	NA	123.3	NA	78.3	NA	61.6	NA	73.3	NA	11.9	NA	34.0	NA	59.1	NA	77.8

Sample: MW-05	Date	10/17/2018		2/5/2019		5/6/2019		8/6/2019		11/7/2019		2/13/2020		5/20/2020		7/31/2020		10/22/2020		2/25/2021		5/17/2021	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.010	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	0.0033	0.001	ND	0.001	0.0011	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Barium	2.0	0.0025	0.067	0.0025	0.076	0.0025	0.094	0.0025	0.062	0.0025	0.062	0.0025	0.072	0.0025	0.074	0.0025	0.054	0.0025	0.07	0.0025	0.091	0.0025	0.098
Beryllium	0.004	0.001	ND^	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND
Boron	2.0	0.05	0.31	0.05	0.28	0.05	0.34	0.05	0.5	0.05	0.32	0.05	0.43	0.05	0.29	0.05	0.47	0.05	0.47	0.05	0.29	0.05	0.32
Cadmium	0.005	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	200.0	10	200	10	180	10	470	10	120	10	130	10	170	10	280	10	180	10	180	10	220	40	410
Chromium	0.1	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	0.0053	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	1.0	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	0.0015	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.65	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.0063	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.2	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	ND	0.01	ND	0.005	ND	0.005	ND
Fluoride	4.0	0.1	0.33	0.1	0.33	0.1	0.31	0.1	0.31	0.1	0.31	0.1	0.36	0.1	0.37	0.1	0.38	0.1	0.38	0.1	0.34	0.1	0.31
Iron	5.0	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	4.1	0.1	ND	0.1	0.11	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Lead	0.0075	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.0033	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.15	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.14	0.0025	ND	0.0025	0.0025	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.002	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.1	0.002	ND	0.002	ND	0.002	ND	0.002	0.0024	0.002	0.0072	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Nitrogen/Nitrate	10.0	0.1	1.3	0.1	0.92	0.1	1.8	0.1	1.3	0.1	1.2	0.1	1.2	0.1	1.4	0.1	1.3	0.1	0.99	0.1	0.99	0.1	1.7
Nitrogen/Nitrate, Nitri	NA	0.1	1.3	0.1	0.92	0.1	1.8	0.1	1.3	0.1	1.2	0.1	1.2	0.1	1.4	0.1	1.3	0.1	0.99	0.1	0.99	0.1	1.7
Nitrogen/Nitrite	NA	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.0049	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.05	0.0025	0.0028	0.0025	ND	0.0025	ND	0.0025	0.011	0.0025	ND	0.0025	0.0025	0.0025	0.0048	0.0025	0.0029	0.0025	0.0032	0.0025	ND	0.0025	ND
Silver	0.05	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	400.0	25	110	25	110	25	90	25	180	25	68	25	ND	25	190	25	79	15	84	25	140	25	160
Thallium	0.002	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	1,200	10	800	10	720	10	1,400	10	770	10	630	10	700	10	920	30	680	30	690	10	880	10	1200
Vanadium	0.049	0.005	ND^	0.005	ND	0.005	ND	0.005	ND	0.005	0.012	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	5.0	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	0.027	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.005	0.0005	ND	0.0005	ND	0.0005	0.0007	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	11.705	0.0025	ND	0.0025	ND	0.0025	0.0007	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	6.5 - 9.0	NA	7.29	NA	7.40	NA	7.11	NA	7.03	NA	7.44	NA	7.02	NA	7.03	NA	7.28	NA	7.16	NA	7.31	NA	7
Temperature	NA	NA	14.72	NA	10.70	NA	13	NA	14.2	NA	10.34	NA	13.2	NA	12.8	NA	13.7	NA	14.5	NA	12.1	NA	13.2
Conductivity	NA	NA	1.050	NA	1.116	NA	2.95	NA	1.28	NA	10.56	NA	1.058	NA	1.534	NA	1.381	NA	0.278	NA	1.505	NA	2.084
Dissolved Oxygen	NA	NA	7.68	NA	5.97	NA	4.48	NA	3.53	NA	7.84	NA	6.2	NA	6.85	NA	5.7	NA	4.34	NA	4.63	NA	3.93
ORP	NA	NA	42.1	NA	150.3	NA	-281.1	NA	170.6	NA	-11.9	NA	136.4	NA	142.8	NA	119.9	NA	161.3	NA	11.4	NA	161.6

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm^c millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-06	Date	12/7/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012		3/5/2013		5/22/2013		7/23/2013		10/16/2013		2/21/2014	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	0.0045	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	0.0015	0.0050	ND	0.0010	ND	0.0010	0.0018	0.0010	0.0016	0.0010	0.0014	0.0010	0.0015	0.0010	0.0014	0.0010	0.0018	0.0010	0.0018	0.0010	0.0017	0.0010	0.0016	0.0010	0.0015
Barium	2.0	0.0025	0.075	0.0025	0.12	0.0025	0.082	0.0025	0.094	0.0025	0.11	0.0025	0.13	0.0025	0.11	0.0025	0.14	0.0025	0.12	0.0025	0.12	0.0025	0.097	0.0025	0.096	0.0025	0.11	0.0025	0.17
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^
Boron	2.0	0.050	0.32	0.050	0.44	0.050	0.32	0.050	0.27	0.050	0.30	0.050	0.25	0.050	0.26	0.050	0.25^	0.050	0.31	0.050	0.33	0.050	0.23	0.050	0.23	0.050	0.22	0.050	0.26
Cadmium	0.005	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	10	130	10	270	10	140	10	140	10	130	2.0	240	10	210	10	190	10	150	10	160	10	170	10	120	10	120	10	370
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	0.0019	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0025	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.40	0.10	0.36	0.10	0.44	0.10	0.29	0.10	0.44	0.10	0.36	0.10	0.36	0.10	0.36	0.10	0.38	0.10	0.40^	0.10	0.43	0.10	0.37	0.10	0.35	0.10	0.34
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	0.14	0.0025	0.033	0.013	ND	0.0025	0.036	0.0025	0.024	0.0025	0.015	0.0025	0.0080	0.0025	0.0087	0.0025	0.0076	0.0025	0.0047	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0056	0.0020	0.0025	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0021	0.0020	ND	0.0020	ND
Nitrogen/Nitrate	10.0	0.10	ND	0.10	1.3	0.10	0.91	0.10	0.31	0.10	0.36	0.10	ND	0.10	0.65	0.10	0.55	0.10	0.47	0.10	1.0	0.10	1.7	0.10	0.46	0.10	0.49	0.10	1.7
Nitrogen/Nitrate, Nitri	NA	0.10	ND^	0.10	1.3	0.10	0.91	0.10	0.31	0.10	0.36	0.10	ND	0.10	0.65	0.10	0.55	0.10	0.47	0.10	1.0	0.10	1.7	0.10	0.46	0.10	0.49	0.10	1.7
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.004	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.05	0.0025	0.0029	0.0025	0.0034	0.013	ND	0.0025	ND	0.0025	0.0054	0.0025	0.0051	0.0025	0.0069	0.0025	0.0073	0.0025	0.0059	0.0025	0.013	0.0025	0.0032	0.0025	0.0027	0.0025	0.0035	0.0025	0.0034
Silver	0.05	0.00050	ND	0.00050	0.00077	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	140	50	140	25	87	25	100	50	130	50	110	25	91	25	85	25	120	25	120	25	96	25	110	25	150	25	100
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	650	10	1000	10	650	10	620	10	710	10	800	10	860	10	760	10	710	10	690	10	690	10	350	10	570	10	930
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0050	0.0052	0.0050	0.0050	0.0050	0.0056	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0005	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0025	NS	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	6.5 - 9.0	NA	8.04	NA	7.51	NA	7.71	NA	7.53	NA	7.71	NA	7.57	NA	7.42	NA	7.46	NA	7.66	NA	8.05	NA	7.35	NA	7.42	NA	7.31	NA	9.52
Temperature	NA	NA	8.53	NA	12.90	NA	14.26	NA	12.73	NA	13.70	NA	14.45	NA	19.31	NA	14.51	NA	13.45	NA	12.20	NA	14.48	NA	15.22	NA	13.50	NA	7.33
Conductivity	NA	NA	1.20	NA	1.65	NA	1.05	NA	0.77	NA	0.87	NA	1.06	NA	1.23	NA	1.02	NA	0.93	NA	0.94	NA	0.855	NA	0.76	NA	0.80	NA	0.96
Dissolved Oxygen	NA	NA	NM	NA	7.44	NA	6.82	NA	6.74	NA	7.05	NA	7.47	NA	7.21	NA	6.27	NA	7.20	NA	8.70	NA	4.77	NA	2.44	NA	3.73	NA	4.78
ORP	NA	NA	NM	NA	183.7	NA	203.8	NA	-65.0	NA	113.0	NA	210.0	NA	153.0	NA	162.0	NA	125.0	NA	186.4	NA	18.1	NA	22.7	NA	-86.3	NA	-81.0

Sample: MW-06	5/2/2014		8/19/2014		10/23/2014		2/10/2015		5/28/2015		8/5/2015		10/27/2015		2/11/2016		5/12/2016		9/1/2016		11/3/2016		2/7/2017		4/27/2017		2/21/2018	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	0.0019	0.0010	0.0013	0.0010	0.0010	0.0010	0.0016	0.0010	0.0017	0.0010	0.0016	0.0010	ND	0.0010	0.0016	0.0050	ND ^	0.0010	0.0012	0.0010	0.0012	0.0010	0.0014	0.0010	0.0012	0.0010	0.0012
Barium	0.0025	0.15	0.0025	0.098	0.0025	0.12	0.0025	0.14	0.0025	0.14	0.0025	0.11	0.0025	0.12	0.0025	0.14	0.0025	0.14	0.0025	0.096	0.0025	0.12	0.0025	0.16	0.0025	0.10	0.0025	0.16
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND
Boron	0.050	0.17	0.050	0.26	0.050	0.19	0.050	0.22	0.050	0.19	0.050	0.21	0.050	0.22	0.050	0.17	0.050	0.19	0.050	0.28	0.050	0.25	0.050	0.22	0.050	0.15	0.050	0.20
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	50	340	10	120	10	100	10	150	10	270	10	140	10	130	10	230	10	250	10	79	10	85	10	200	10	150	50	500
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	0.0017	0.0010	ND	0.0010	0.0010	0.0010	0.0015	0.0010	0.0011	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	0.0056	0.0020	0.0021	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	0.054	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.33	0.10	0.38	0.10	0.34	0.10	0.36	0.10	0.35	0.10	0.39	0.10	0.32	0.10	0.34	0.10	0.38	0.10	0.34	0.10	0.32	0.10	0.27	0.10	0.28	0.10	0.32
Iron	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.50	ND	0.10	ND	0.10	ND	0.10	0.15	0.10	ND	0.10	0.27
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0068	0.0025	ND	0.0025	0.0048
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND *	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	ND	0.0020	0.0021	0.0020	0.0022	0.0020	0.0027	0.0020	0.0034	0.0020	0.0023	0.0020	0.0026	0.0020	ND	0.0020	0.0032	0.0020	0.0027	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0020
Nitrogen/Nitrate	0.10	1.3	0.10	0.51	0.10	0.64	0.10	1.3	0.10	1.2	0.10	0.35	0.10	0.47	0.10	1.6	0.10	1.5	0.10	0.43	0.10	0.31	0.10	0.99	0.10	1.1	0.10	7.2
Nitrogen/Nitrate, Nitri	0.10	1.3	0.10	0.51	0.10	0.64	0.10	1.3	0.10	1.2	0.10	0.35	0.10	0.47	0.10	1.6	0.10	1.5	0.10	0.43	0.10	0.31	0.10	0.99	0.10	1.1	0.50	7.2
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	0.0034	0.0025	0.0031	0.0025	0.0039	0.0025	0.0045	0.0025	0.0036	0.0025	ND	0.0025	0.0035	0.0025	0.0027	0.0025	0.0030 ^	0.0025	0.0037	0.0025	ND	0.0025	0.0042	0.0025	0.0026	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND F1	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	20	120	25	91	25	140	50	140	25	94	50	110	25	120	50	140	50	160	50	97	25	97	50	130	25	83	50	160
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	990	10	600	10	530	10	710	10	870	10	680	10	650	10	820	10	880	10	530	10	590	10	840	10	590	10	1400
Vanadium	0.0050	0.0059	0.0050	ND	0.0050	0.0057	0.0050	0.0063	0.0050	0.0060	0.0050	0.0063	0.0050	ND	0.0050	0.0065	0.0050	ND	0.0050	0.0054	0.0050	0.0066	0.0050	0.0060	0.0050	0.0054	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.00073	0.002	ND	0.002	ND	0.002	ND	0.002	0.0029	0.002	ND	0.002	0.0027	0.002	ND	0.002	ND	0.0025	0.0015
pH	NA	7.42	NA	7.29	NA	7.29	NA	7.78	NA	7.60	NA	7.79	NA	7.02	NA	7.30	NA	7.31	NA	7.36	NA	7.36	NA	6.84	NA	7.65	NA	7.65
Temperature	NA	11.12	NA	18.67	NA	13.92	NA	9.51	NA	16.30	NA	18.55	NA	14.11	NA	9.02	NA	13.65	NA	18.41	NA	15.80	NA	11.16	NA	11.48	NA	7.63
Conductivity	NA	1.37	NA	0.94	NA	0.88	NA	0.86	NA	1.19	NA	1.11	NA	1.12	NA	0.89	NA	1.16	NA	0.94	NA	0.78	NA	0.92	NA	0.83	NA	0.891
Dissolved Oxygen	NA	6.82	NA	3.99	NA	4.44	NA	7.08	NA	6.80	NA	5.23	NA	5.42	NA	6.28	NA	5.88	NA	5.35	NA	4.09	NA	6.71	NA	8.59	NA	8.85
ORP	NA	137.8	NA	60.1	NA	60.8	NA	88.5	NA	120.7	NA	-16.5	NA	164.8	NA	114.3	NA	50.1	NA	53.4	NA	22.7	NA	201.6	NA	-16.1	NA	38.6

Sample: MW-06	7/31/2018		10/18/2018		2/5/2019		5/6/2019		8/7/2019		11/7/2019		2/13/2020		5/21/2020		7/31/2020		10/22/2020		2/25/2021		5/17/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.001	0.0012	0.001	0.001	0.001	0.0011	0.001	0.0014	0.001	ND	0.001	0.0011	0.001	0.0014	0.001	0.0017	0.001	0.001	0.001	ND	0.001	0.001	0.001	ND
Barium	0.0025	0.1	0.0025	0.13	0.0025	0.12	0.0025	0.15	0.0025	0.11	0.0025	0.13	0.0025	0.14	0.0025	0.14	0.0025	0.13	0.0025	0.13	0.0025	0.16	0.0025	0.2
Beryllium	0.001	ND	0.001	ND^	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND
Boron	0.05	0.21	0.05	0.22	0.05	0.24	0.05	0.3	0.05	0.21	0.05	0.24	0.05	0.2	0.05	0.49	0.05	0.18	0.05	0.23	0.05	0.26	0.05	0.17
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	140	10	150	10	170 F1	10	420	10	130	10	99	10	150	10	180	10	160	10	160	10	240	40	410
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	0.0051	0.01	ND	0.005	ND	0.005	ND
Fluoride	0.1	0.31	0.1	0.34	0.1	0.33	0.1	0.34	0.1	0.26	0.1	0.3	0.1	0.37	0.1	0.37	0.1	0.32	0.1	0.31	0.1	0.36	0.1	0.3
Iron	0.1	ND	0.1	ND	0.1	ND	0.1	0.26	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.017	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.002	ND	0.002	ND	0.002	ND	0.002	0.0024	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Nitrogen/Nitrate	0.1	0.43	0.1	0.34	0.1	2.2	0.1	1.7	0.1	0.47	0.1	0.61	0.1	0.75	0.1	1.9	0.1	0.66	0.1	0.56	0.1	1.5	0.1	1.7
Nitrogen/Nitrate, Nitri	0.1	0.43	0.1	0.34	0.1	2.2	0.1	1.7	0.1	0.47	0.1	0.61	0.1	0.75	0.1	1.9	0.1	0.66	0.1	0.56	0.1	1.5	0.1	1.7
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	0.0034	0.0025	0.0026	0.0025	0.026	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.053	0.0025	ND	0.0025	ND	0.0025	0.0025	0.0025	0.0036
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND F1	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	25	76	20	89	20	130	20	110	20	7.8	20	78	20	130	20	160	25	110	15	83	25	160	25	130
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	620	10	640	10	720	10	1,200	10	620	10	620	10	710	10	830	30	650	30	640	10	930	10	1200
Vanadium	0.005	ND	0.005	ND^	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	0.0056	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	0.0023	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	7.54	NA	7.63	NA	7.62	NA	7.42	NA	7.39	NA	7.27	NA	7.42	NA	7.06	NA	7.44	NA	6.95	NA	7.52	NA	7.35
Temperature	NA	19.68	NA	12.51	NA	13.1	NA	11.7	NA	12.8	NA	13.84	NA	13.2	NA	12.5	NA	13.2	NA	17.1	NA	12.7	NA	12.2
Conductivity	NA	1.265	NA	0.825	NA	1159	NA	2.83	NA	1.06	NA	9.34	NA	0.983	NA	1.141	NA	1.306	NA	1.2	NA	1.539	NA	2.003
Dissolved Oxygen	NA	7.19	NA	10.56	NA	5.93	NA	5.82	NA	51.00	NA	9.01	NA	7.71	NA	7.98	NA	7.06	NA	3.67	NA	6.47	NA	6.93
ORP	NA	71.6	NA	2.2	NA	112.0	NA	-265.1	NA	187.4	NA	-11.6	NA	157.2	NA	224.6	NA	152.0	NA	157.4	NA	3.0	NA	161.0

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm^c millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-07	Date	12/7/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	0.0010	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	0.0014	0.0010	0.0010	0.0010	ND	0.0010	0.0013
Barium	2.0	0.0025	0.13	0.0025	0.11	0.0025	0.072	0.0025	0.092	0.0025	0.11	0.0025	0.13	0.0025	0.092	0.0025	0.12
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.51	0.050	0.39	0.050	0.25	0.050	0.29	0.050	0.35	0.050	0.30	0.050	0.25	0.050	0.31^
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	50	430	10	320	10	140	10	99	10	140	2.0	300	10	170	10	170
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	0.011	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	0.0025	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.36	0.10	0.31	0.10	0.35	0.10	0.27	0.10	0.35	0.10	0.31	0.10	0.37	0.10	0.32
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	3.8	0.10	ND	0.10	ND	0.10	0.13	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	0.29	0.0025	0.014	0.013	ND	0.0025	0.080	0.0025	0.0073	0.0025	0.015	0.0025	0.069	0.0025	0.0041
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0045	0.0020	ND	0.010	ND	0.0020	0.014	0.0020	ND	0.0020	ND	0.0020	0.0032	0.0020	ND
Nitrogen/Nitrate	10.0	0.10	ND	0.10	1.2	0.10	0.76	0.10	0.27	0.10	0.60	0.10	ND	0.10	0.65	0.10	0.61
Nitrogen/Nitrate, Nitri	NA	0.10	ND^	0.10	1.2	0.10	0.76	0.10	0.27	0.10	0.60	0.10	ND	0.10	0.65	0.10	0.61
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Selenium	0.05	0.0025	ND	0.0025	ND	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	250	50	120	25	85	25	110	50	160	50	140	50	190	50	130
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	1200	10	970	10	580	10	650	10	780	10	870	10	760	10	760
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
pH	6.5 - 9.0	NA	8.08	NA	7.50	NA	7.61	NA	7.65	NA	7.63	NA	7.53	NA	7.59	NA	7.45
Temperature	NA	NA	9.72	NA	13.58	NA	12.92	NA	12.50	NA	13.07	NA	15.40	NA	16.33	NA	13.97
Conductivity	NA	NA	2.12	NA	1.78	NA	1.02	NA	0.78	NA	0.89	NA	1.18	NA	0.99	NA	1.00
Dissolved Oxygen	NA	NA	NM	NA	7.02	NA	8.10	NA	7.70	NA	6.74	NA	7.23	NA	7.29	NA	7.16
ORP	NA	NA	NM	NA	183.2	NA	202.8	NA	-82.0	NA	113.0	NA	175.0	NA	148.0	NA	199.0

Sample: MW-07	12/20/2012		3/5/2013		5/22/2013		7/23/2013		10/16/2013		2/21/2014		5/2/2014		8/19/2014	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND	0.0010	0.0011	0.0010	0.0015	0.0010	0.0011	0.0010	0.0013	0.0010	ND	0.0010	0.0014	0.0010	ND
Barium	0.0025	0.11	0.0025	0.12	0.0025	0.11	0.0025	0.082	0.0025	0.13	0.0025	0.15	0.0025	0.12	0.0025	0.091
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND
Boron	0.050	0.41	0.050	0.39	0.050	0.21	0.050	0.21	0.050	0.24	0.050	0.30	0.050	0.15	0.050	0.22
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	140	10	190	10	170	10	95	10	130	50	470	10	350	10	110
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0047
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.31	0.10	0.30^	0.10	0.38	0.10	0.37	0.10	0.32	0.10	0.31	0.10	0.32	0.10	0.35
Iron	0.10	ND	0.10	ND	0.10	0.41	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	0.0063	0.0025	0.0044	0.0025	0.012	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0033
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	0.0024	0.0020	0.0024	0.0020	0.0020	0.0020	ND	0.0020	0.0021	0.0020	ND	0.0020	ND	0.0020	0.0022
Nitrogen/Nitrate	0.10	0.73	0.10	1.4	0.10	1.7	0.10	0.34	0.10	0.65	0.10	ND	0.10	1.3	0.10	0.46
Nitrogen/Nitrate, Nitri	0.10	0.73	0.10	1.4	0.10	1.7	0.10	0.34	0.10	0.65	0.50	ND	0.10	1.3	0.10	0.46
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.004	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	0.0031	0.0025	0.0041	0.0025	0.0026	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0026	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	25	90	25	150	50	150	25	74	50	190	25	170	20	110	25	82
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	760	10	720	10	740	10	540	10	650	10	1200	10	860	10	570
Vanadium	0.0050	0.0051	0.0050	ND	0.0050	0.0053	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	0.0051	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.0005	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND
BETX	0.0025	NS	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.002	ND	0.002	ND
pH	NA	7.52	NA	7.99	NA	7.34	NA	7.42	NA	7.33	NA	9.34	NA	7.35	NA	6.99
Temperature	NA	12.88	NA	12.30	NA	14.15	NA	15.44	NA	13.06	NA	8.38	NA	11.45	NA	17.46
Conductivity	NA	0.91	NA	0.99	NA	0.818	NA	0.72	NA	0.89	NA	1.21	NA	1.30	NA	0.90
Dissolved Oxygen	NA	8.51	NA	8.38	NA	4.29	NA	3.52	NA	2.52	NA	6.39	NA	5.51	NA	3.47
ORP	NA	152.0	NA	154.3	NA	17.0	NA	23.7	NA	-81.7	NA	-99.0	NA	141.5	NA	55.0

Sample: MW-07	10/23/2014		2/10/2015		5/28/2015		8/5/2015		10/27/2015		2/11/2016		5/12/2016	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND^	0.0010	ND	0.0010	0.0013	0.0010	0.0013	0.0010	ND	0.0010	0.0017	0.0050	ND ^
Barium	0.0025	0.11	0.0025	0.18	0.0025	0.12	0.0025	0.10	0.0025	0.11	0.0025	0.15	0.0025	0.12
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND
Boron	0.050	0.17	0.050	0.21	0.050	0.16	0.050	0.20	0.050	0.19	0.050	0.16	0.050	0.20
Cadmium	0.00050	ND	0.00050	0.0041	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	98	10	210	10	260	10	130	10	110	10	240	10	240
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	0.0090	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	0.0020	0.0020	0.096	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.36	0.10	0.30	0.10	0.32	0.10	0.35	0.10	0.32	0.10	0.33	0.10	0.35
Iron	0.10	0.13	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.85	0.50	ND
Lead	0.00050	ND	0.00050	0.0072	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.00057	0.00050	ND
Manganese	0.0025	0.0091	0.0025	0.0048	0.0025	0.0026	0.0025	ND	0.0025	0.0041	0.0025	0.018	0.0025	0.010
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND *	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	0.0027	0.0020	0.016	0.0020	0.0034	0.0020	ND	0.0020	0.0020	0.0020	0.0030	0.0020	0.0036
Nitrogen/Nitrate	0.10	0.56	0.10	0.19	0.10	1.1	0.10	0.37	0.10	0.51	0.10	1.7	0.10	1.4
Nitrogen/Nitrate, Nitri	0.10	0.56	0.10	0.33	0.10	1.1	0.10	0.37	0.10	0.51	0.10	1.7	0.10	1.4
Nitrogen/Nitrite	0.020	ND	0.020	0.14	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND ^
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	25	120	50	260	25	80	25	99	50	110	50	140	50	180
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	520	10	1000	10	860	10	640	10	620	10	860	10	860
Vanadium	0.0050	ND	0.0050	0.0052	0.0050	ND	0.0050	0.0051	0.0050	ND	0.0050	0.0077	0.0050	ND
Zinc	0.020	ND	0.020	0.036	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.0039
pH	NA	7.28	NA	7.52	NA	7.52	NA	7.75	NA	7.21	NA	7.35	NA	7.27
Temperature	NA	16.49	NA	10.95	NA	17.16	NA	21.99	NA	14.87	NA	5.97	NA	13.22
Conductivity	NA	0.91	NA	1.18	NA	1.30	NA	1.06	NA	1.04	NA	0.86	NA	1.12
Dissolved Oxygen	NA	3.32	NA	1.15	NA	4.82	NA	1.80	NA	3.74	NA	6.33	NA	5.75
ORP	NA	61.8	NA	78.4	NA	128.5	NA	-41.0	NA	147.0	NA	129.1	NA	74.0

Sample: MW-07	9/1/2016		11/3/2016		2/7/2017		4/27/2017		2/21/2018		8/1/2018		10/18/2018		2/5/2019	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.0010	ND	0.0010	0.0011	0.0010	0.0010	0.0010	ND	0.0010	0.0014	0.001	ND	0.001	ND	0.001	ND
Barium	0.0025	0.084	0.0025	0.11	0.0025	0.15	0.0025	0.096	0.0025	0.17	0.0025	0.093	0.0025	0.12	0.0025	0.13
Beryllium	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.001	ND	0.001	ND^	0.001	ND
Boron	0.050	0.23	0.050	0.23	0.050	0.19	0.050	0.13	0.050	0.24	0.05	0.18	0.05	0.25	0.05	0.19
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	77	10	84	10	240	10	160	10	350	10	130	10	140	10	180
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.01	ND	0.01	ND	0.01	ND
Fluoride	0.10	0.32	0.10	0.31	0.10	0.25	0.10	0.28	0.10	0.28	0.1	0.29	0.1	0.26	0.1	0.26
Iron	0.10	ND	0.10	0.25	0.10	0.15	0.10	0.40	0.10	0.63	0.1	ND	0.1	0.58	0.1	0.45
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	0.0005
Manganese	0.0025	0.0025	0.0025	0.0093	0.0025	0.0075	0.0025	0.011	0.0025	0.014	0.0025	0.0026	0.0025	0.015	0.0025	0.017
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.0020	ND	0.0020	0.0022	0.0020	ND	0.0020	ND	0.0020	0.0033	0.002	ND	0.002	0.0021	0.002	0.0022
Nitrogen/Nitrate	0.10	0.36	0.10	0.33	0.10	1.2	0.10	1.0	0.10	7.3	0.1	0.29	0.1	0.29	0.1	0.85
Nitrogen/Nitrate, Nitri	0.10	0.36	0.10	0.33	0.10	1.2	0.10	1.0	0.50	7.3	0.1	0.29	0.1	0.29	0.1	0.85
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND ^	0.0040	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0031	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	25	75	25	100	25	85	25	74	50	280	20	64	20	90	20	87
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	510	10	570	10	840	10	590	10	1300	10	580	10	680	10	670
Vanadium	0.0050	ND	0.0050	0.0051	0.0050	ND	0.0050	0.0050	0.0050	0.0066	0.005	ND	0.005	ND^	0.005	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	0.0018	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	0.0575	0.002	ND	0.002	ND	0.0025	0.00097	0.0025	0.0018	0.0025	ND	0.0025	ND
pH	NA	6.96	NA	7.55	NA	7.31	NA	7.70	NA	7.62	NA	7.47	NA	7.51	NA	7.48
Temperature	NA	18.40	NA	17.87	NA	12.53	NA	11.28	NA	7.25	NA	21.38	NA	12.69	NA	12.70
Conductivity	NA	0.86	NA	0.78	NA	0.98	NA	0.79	NA	0.929	NA	1.143	NA	0.784	NA	1.129
Dissolved Oxygen	NA	4.17	NA	4.97	NA	5.01	NA	6.40	NA	8.16	NA	3.97	NA	9.73	NA	2.96
ORP	NA	102.1	NA	24.2	NA	153.9	NA	-10.4	NA	48.5	NA	92.9	NA	6.0	NA	113.5

Sample: MW-07	5/6/2019		8/6/2019		11/7/2019		2/13/2020		5/21/2020		7/31/2020		10/22/2020		2/25/2021		5/17/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.001	ND	0.001	ND	0.001	ND	0.001	0.0011	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Barium	0.0025	0.1	0.0025	0.11	0.0025	0.11	0.0025	0.14	0.0025	0.095	0.0025	0.11	0.0025	0.13	0.0025	0.17	0.0025	0.17
Beryllium	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND
Boron	0.05	0.24	0.05	0.23	0.05	0.19	0.05	0.23	0.05	0.38	0.05	0.19	0.05	0.34	0.05	0.22	0.05	0.16
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	400 F1	10	130	10	87	10	190	10	190	10	210	10	150	40	310	40	440
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	ND	0.01	ND	0.005	ND	0.005	ND
Fluoride	0.1	0.3	0.1	0.24	0.1	0.26	0.1	0.3	0.1	0.33	0.1	0.29	0.1	0.28	0.1	0.25	0.1	0.26
Iron	0.1	0.2	0.1	0.16	0.1	ND	0.1	0.13	0.1	ND	0.1	ND	0.1	ND	0.1	0.15	0.1	ND
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	0.0068	0.0025	0.0063	0.0025	ND	0.0025	0.004	0.0025	ND	0.0025	0.0041	0.0025	ND	0.0025	0.0061	0.0025	ND
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.002	0.0022	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Nitrogen/Nitrate	0.1	1.6	0.1	0.23	0.1	0.68	0.1	0.88	0.1	1.4	0.1	0.54	0.1	0.93	0.1	1.1	0.1	1.6
Nitrogen/Nitrate, Nitri	0.1	1.6	0.1	0.23	0.1	0.68	0.1	0.88	0.1	1.4	0.1	0.54	0.1	0.93	0.1	1.1	0.1	1.6
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	0.0048	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0038	0.0025	ND	0.0025	0.0025	0.0025	ND	0.0025	ND
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	20	97	20	48	20	83	20	96	20	140	25	85	15	97	25	130	25	120
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	1,300	10	590	10	540	10	710	10	750	30	630	30	680	10	1000	10	1300
Vanadium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	7.36	NA	7.31	NA	7.55	NA	7.27	NA	7.09	NA	7.23	NA	7.06	NA	7.25	NA	7.18
Temperature	NA	12.10	NA	12.40	NA	13.75	NA	12.80	NA	12.00	NA	13.10	NA	14.50	NA	12.00	NA	12.30
Conductivity	NA	2.720	NA	1.020	NA	8.950	NA	1.052	NA	1.100	NA	1.327	NA	1.230	NA	1.692	NA	2.101
Dissolved Oxygen	NA	6.71	NA	27.40	NA	5.54	NA	7.22	NA	6.48	NA	4.62	NA	3.98	NA	3.76	NA	4.93
ORP	NA	-281.3	NA	189.6	NA	-22.6	NA	158.8	NA	282.5	NA	187.6	NA	150.9	NA	8.2	NA	163.9

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celsius
Conductivity ms/cm² milliSiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-08	Date	12/6/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Barium	2.0	0.0025	0.054	0.0025	0.055	0.0025	0.026	0.0025	0.048	0.0025	0.057	0.0025	0.049	0.0025	0.029
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.29	0.050	0.16	0.050	0.12	0.050	0.20	0.050	0.16	0.050	0.13	0.050	0.20
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	10	130	10	350	10	150	10	79	10	120	50	410	10	190
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.51	0.10	0.36	0.10	0.45	0.10	0.25	0.10	0.31	0.10	0.38	0.10	0.41
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	0.0051	0.0025	0.0026	0.013	0.017	0.0025	ND	0.0025	ND	0.0025	0.0042	0.0025	0.016
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0025	0.0020	ND	0.010	ND	0.0020	0.012	0.0020	ND	0.0020	ND	0.0020	ND
Nitrogen/Nitrate	10.0	0.10	0.33	0.10	2.2	0.10	1.9	0.10	0.95	0.10	0.86	0.10	ND	0.10	0.44
Nitrogen/Nitrate, Nitri	NA	0.10	0.33	0.20	2.2	0.10	1.9	0.10	0.95	0.10	0.86	0.10	ND	0.10	0.44
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Selenium	0.05	0.0025	ND	0.0025	ND	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	210	25	87	10	52	50	120	50	170	25	130	20	110
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	670	10	990	10	580	10	690	10	800	10	1000	10	740
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
pH	6.5 - 9.0	NA	7.75	NA	7.29	NA	7.70	NA	7.32	NA	7.38	NA	7.49	NA	7.64
Temperature	NA	NA	12.70	NA	13.06	NA	13.15	NA	12.20	NA	12.71	NA	14.64	NA	16.68
Conductivity	NA	NA	1.17	NA	1.80	NA	0.99	NA	0.80	NA	0.88	NA	1.40	NA	1.05
Dissolved Oxygen	NA	NA	NM	NA	7.82	NA	8.00	NA	6.06	NA	6.57	NA	7.68	NA	7.22
ORP	NA	NA	NM	NA	192.6	NA	196.0	NA	-47.0	NA	119.0	NA	130.0	NA	132.0

Sample: MW-08	9/19/2012		12/20/2012		3/5/2013		5/23/2013		7/22/2013		10/15/2013		2/21/2014	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.059	0.0025	0.058	0.0025	0.069	0.0025	0.057	0.0025	0.046	0.0025	0.045	0.0025	0.066
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^
Boron	0.050	0.46^	0.050	0.33	0.050	0.25	0.050	0.16	0.050	0.18	0.050	0.19	0.050	0.16
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	130	10	130	10	200	10	300	10	210	10	110	10	270
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.40	0.10	0.33	0.10	0.29^	0.10	0.34	0.10	0.34	0.10	0.36	0.10	0.29
Iron	0.10	0.24	0.10	ND	0.10	ND	0.10	0.23	0.10	ND	0.10	ND	0.10	0.11
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	0.023	0.0025	0.0044	0.0025	ND	0.0025	0.0065	0.0025	ND	0.0025	ND	0.0025	0.0039
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	0.0021	0.0020	ND	0.0020	ND	0.0020	0.0034	0.0020	0.0040	0.0020	ND	0.0020	ND
Nitrogen/Nitrate	0.10	4.0	0.10	2.0	0.10	2.2	0.10	2.8	0.10	1.2	0.10	1.2	0.10	1.6
Nitrogen/Nitrate, Nitri	0.50	4.0	0.50	2.0	0.20	2.2	0.20	2.8	0.10	1.2	0.10	1.2	0.10	1.6
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	NR	NR	0.004	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	0.0079	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	50	180	50	130	50	150	25	99	25	72	20	74	20	54
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	710	10	730	10	830	10	860	10	740	10	560	10	740
Vanadium	NR	NR	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	NR	NR	0.0005	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
BETX	NR	NR	0.0025	NS	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	6.80	NA	7.40	NA	7.46	NA	7.17	NA	7.28	NA	7.22	NA	9.17
Temperature	NA	15.09	NA	12.82	NA	11.10	NA	11.95	NA	13.86	NA	13.43	NA	10.89
Conductivity	NA	0.95	NA	0.91	NA	1.05	NA	1.031	NA	0.97	NA	0.83	NA	0.91
Dissolved Oxygen	NA	8.19	NA	9.83	NA	7.73	NA	5.33	NA	4.75	NA	3.69	NA	4.94
ORP	NA	211.0	NA	101.0	NA	136.1	NA	6.2	NA	30.5	NA	-49.3	NA	-64.9

Sample: MW-08	5/1/2014		8/18/2014		10/23/2014		2/10/2015		5/27/2015		8/4/2015		10/27/2015	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND	0.0010	ND	0.0010	ND^	0.0010	0.0089	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.12	0.0025	0.044	0.0025	0.051	0.0025	0.22	0.0025	0.057	0.0025	0.044	0.0025	0.048
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	0.050	0.15	0.050	0.19	0.050	0.16	0.050	0.64	0.050	0.11	0.050	0.15	0.050	0.15
Cadmium	0.00050	0.0019	0.00050	ND	0.00050	ND	0.00050	0.00053	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	50	780	10	170	10	140	50	470	10	270	10	130	2.0	70
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.13	0.0010	0.0018	0.0010	ND	0.0010	ND
Copper	0.0020	0.012	0.0020	ND	0.0020	ND	0.0020	0.0060	0.0020	0.0039	0.0020	ND	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	0.012	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.34	0.10	0.36	0.10	0.36	0.10	0.51	0.10	0.44	0.10	0.39	0.10	0.32
Iron	0.10	ND	0.10	ND	0.10	ND	0.10	10	0.10	ND	0.10	ND	0.10	ND
Lead	0.00050	0.0036	0.00050	ND	0.00050	ND	0.00050	0.0034	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	ND	0.0025	0.017	0.0025	0.0069	0.0025	1.1	0.0025	0.0044	0.0025	0.0029	0.0025	ND
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND *	0.00020	ND
Nickel	0.0020	0.0020	0.0020	0.0029	0.0020	0.0036	0.0020	0.19	0.0020	0.0033	0.0020	0.0020	0.0020	ND
Nitrogen/Nitrate	0.10	5.9	0.10	0.54	0.10	1.3	0.10	ND	0.10	1.7	0.10	0.72	0.10	1.0
Nitrogen/Nitrate, Nitri	0.50	6.2	0.10	0.54	0.10	1.3	0.10	ND	0.10	1.7	0.10	0.72	0.10	1.0
Nitrogen/Nitrite	0.040	0.33	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.020	ND	0.0040	ND	0.0040	ND	0.040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0034	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND^	0.00050	ND	0.00050	ND
Sulfate	100	460	10	59	20	73	100	600	5.0	25	10	31	10	41
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	13	2100	10	610	10	560	10	2000	10	760	10	540	10	470
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	0.080	0.020	ND	0.020	ND	0.020	0.026	0.020	ND	0.020	ND	0.020	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.002	0.0005	0.002	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	ND	0.002	ND	0.002	0.002	0.002	0.002	0.002	ND	0.002	ND
pH	NA	7.17	NA	7.28	NA	7.19	NA	7.58	NA	7.26	NA	7.47	NA	6.95
Temperature	NA	11.71	NA	20.49	NA	15.79	NA	9.48	NA	17.90	NA	22.19	NA	14.00
Conductivity	NA	2.71	NA	1.08	NA	1.01	NA	2.80	NA	1.57	NA	0.98	NA	0.86
Dissolved Oxygen	NA	4.72	NA	5.91	NA	3.52	NA	1.00	NA	3.82	NA	3.84	NA	3.86
ORP	NA	85.2	NA	76.5	NA	28.8	NA	-114.1	NA	-9.9	NA	-19.0	NA	146.3

Sample: MW-08	2/9/2016		5/11/2016		8/30/2016		11/1/2016		2/7/2017		4/25/2017		2/20/2018	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.055	0.0025	0.059	0.0025	0.044	0.0025	0.042	0.0025	0.069	0.0025	0.056	0.0025	0.063
Beryllium	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND
Boron	0.050	0.11	0.050	0.12	0.050	0.18	0.050	0.13	0.050	0.12	0.050	0.10	0.050	0.15
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	190	10	300	2.0	69	2.0	67	10	270	10	280	10	180
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.36	0.10	0.42	0.10	0.33	0.10	0.32	0.10	0.30	0.10	0.31	0.10	0.31
Iron	0.10	ND	0.10	ND ^	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.14
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	0.0034	0.0025	0.023	0.0025	0.0043	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0039
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.0020	ND	0.0020	0.0039	0.0020	ND	0.0020	ND	0.0020	0.0027	0.0020	0.0035	0.0020	0.0054
Nitrogen/Nitrate	0.10	0.82	0.10	1.2	0.10	1.3	0.10	0.46	0.10	1.3	0.10	1.4	0.10	0.74
Nitrogen/Nitrate, Nitri	0.10	0.82	0.10	1.2	0.10	1.3	0.10	0.46	0.10	1.3	0.10	1.4	0.10	0.74
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND	0.0025	ND ^	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	10	48	20	70	10	23	10	50	10	43	20	57	20	110
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	740	10	810	10	450	10	450	10	810	10	800	10	780
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.00059	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	0.0016	0.002	ND	0.002	0.02269	0.002	ND	0.002	ND	0.0025	ND
pH	NA	7.08	NA	7.05	NA	6.88	NA	7.04	NA	6.95	NA	7.37	NA	7.56
Temperature	NA	7.88	NA	14.82	NA	21.32	NA	19.47	NA	11.98	NA	17.31	NA	11.55
Conductivity	NA	0.81	NA	1.28	NA	1.16	NA	0.69	NA	0.98	NA	1.14	NA	0.804
Dissolved Oxygen	NA	5.38	NA	5.09	NA	4.83	NA	3.68	NA	5.62	NA	7.88	NA	5.69
ORP	NA	41.1	NA	-15.4	NA	22.7	NA	65.0	NA	100.1	NA	9.2	NA	33.5

Sample: MW-08	8/1/2018		10/16/2018		2/5/2019		5/6/2019		8/6/2019		11/7/2019		2/12/2020	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Barium	0.0025	0.037	0.0025	0.044	0.0025	0.046	0.0025	0.031	0.0025	0.027	0.0025	0.034	0.0025	0.054
Beryllium	0.001	ND	0.001	ND^	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Boron	0.05	0.15	0.05	0.15	0.05	0.089	0.05	0.09	0.05	0.12	0.05	0.14	0.05	0.11
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	120	10	85	10	200	10	310	10	270	10	70	10	230
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND
Fluoride	0.1	0.31	0.1	0.3	0.1	0.34	0.1	0.4	0.1	0.28	0.1	0.26	0.1	0.33
Iron	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	0.0027	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.0055
Nitrogen/Nitrate	0.1	0.49	0.1	0.63	0.1	0.89	0.1	2.3	0.1	0.76	0.1	0.94	0.1	1
Nitrogen/Nitrate, Nitri	0.1	0.49	0.1	0.63	0.1	0.89	0.1	2.3	0.1	0.76	0.1	0.94	0.1	1
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	20	43	20	31	20	26	20	39	20	16	20	29	20	63
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	520	10	480	10	560	10	930	10	420	10	470	10	750
Vanadium	0.005	ND	0.005	ND^	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	0.0022	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	0.0249	0.0025	0.0016	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	7.41	NA	7.47	NA	7.45	NA	7.38	NA	7.41	NA	7.01	NA	7.25
Temperature	NA	18.27	NA	14.62	NA	14.20	NA	13.80	NA	12.40	NA	11.31	NA	13.30
Conductivity	NA	0.854	NA	0.691	NA	1.062	NA	2.200	NA	0.850	NA	8.020	NA	1.112
Dissolved Oxygen	NA	5.48	NA	5.97	NA	5.22	NA	6.50	NA	48.30	NA	6.97	NA	7.14
ORP	NA	85.3	NA	83.5	NA	112.6	NA	-291.4	NA	190.0	NA	-24.4	NA	177.6

Sample: MW-08	5/20/2020		7/30/2020		10/22/2020		2/11/2021		5/17/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Barium	0.0025	0.041	0.0025	0.047	0.0025	0.062	0.0025	0.081	0.0025	0.086
Beryllium	0.001	ND ^	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Boron	0.05	0.14	0.05	0.11	0.05	0.18	0.05	0.16	0.05	0.091
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	370	10	160	10	180	10	230	40	450
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.01	ND	0.005	0.0062	0.01	ND	0.005	ND	0.005	0.0072
Fluoride	0.1	0.34	0.1	0.3	0.1	0.27	0.1	0.26	0.1	0.27
Iron	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.006	0.0025	ND
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.002	0.0024	0.002	ND	0.002	0.002	0.002	0.0023	0.002	ND
Nitrogen/Nitrate	0.1	3.6	0.1	1.4	0.1	1.4	0.1	1.5	0.1	1.3
Nitrogen/Nitrate, Nitri	0.1	3.6	0.1	1.4	0.1	1.4	0.1	1.5	0.1	1.3
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	0.0043	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	20	89	25	83	15	140	100	260	25	190
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	1100	30	650	30	800	10	990	10	1300
Vanadium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	7.10	NA	6.97	NA	7.14	NA	7.10	NA	7.14
Temperature	NA	12.80	NA	13.20	NA	12.90	NA	11.70	NA	12.90
Conductivity	NA	1.860	NA	1.297	NA	1.880	NA	1.570	NA	2.151
Dissolved Oxygen	NA	9.68	NA	6.97	NA	3.88	NA	5.92	NA	7.60
ORP	NA	139.8	NA	185.2	NA	189.0	NA	70.4	NA	186.3

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature	°C	degrees Celcius
Conductivity	ms/cm[c]	millisiemens/centimeters
Dissolved Oxygen	mg/L	milligrams/liter
Oxygen Reduction Potential (ORP)	mV	millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-09	Date	12/6/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012		3/5/2013	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.0010	0.0010	ND	0.0010	ND	0.0010	ND
Barium	2.0	0.0025	0.031	0.0025	0.029	0.0025	0.032	0.0025	0.029	0.0025	0.030	0.0025	0.021	0.0025	0.021	0.0025	0.022	0.0025	0.021	0.0025	0.016
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.36	0.050	0.32	0.050	0.29	0.050	0.35	0.050	0.31	0.050	0.38	0.050	0.34	0.050	0.59^	0.050	0.44	0.050	0.36
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	0.00059	0.00050	ND	0.00050	0.00065	0.00050	ND	0.00050	ND
Chloride	200.0	10	140	10	230	10	290	10	190	10	190	10	170	10	250	10	160	10	150	10	190
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	0.0047	0.0010	0.0034	0.0050	0.0062	0.0010	0.011	0.0010	0.0075	0.0010	0.0021	0.0010	0.0021	0.0010	0.0022	0.0010	0.002	0.0010	0.0024
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	0.0026	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.61	0.10	0.52	0.10	0.47	0.10	0.39	0.10	0.50	0.10	0.45	0.10	0.48	0.10	0.48	0.10	0.45	0.10	0.46^
Iron	5.0	0.10	ND	0.10	0.18	0.50	7.3	0.10	3.8	0.10	1.5	0.10	5.5	0.10	8.0	0.10	4.7	0.10	13	0.10	15
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	1.1	0.0025	1.6	0.013	0.95	0.0025	0.82	0.0025	0.66	0.0025	1.3	0.0025	1.2	0.0025	0.68	0.0025	0.44	0.0025	0.43
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0094	0.0020	0.0072	0.010	0.013	0.0020	0.014	0.0020	0.011	0.0020	0.0054	0.0020	0.0070	0.0020	0.010	0.0020	0.0059	0.0020	0.0065
Nitrogen/Nitrate	10.0	0.10	ND	0.10	ND	0.10	0.97	0.10	0.36	0.10	0.22	0.10	ND	0.10	ND	0.10	0.22	0.10	0.22	0.10	0.75
Nitrogen/Nitrate, Nitri	NA	0.10	ND^	0.10	ND	0.10	0.97	0.10	0.36	0.10	0.22	0.10	ND	0.10	ND	0.10	0.22	0.10	0.22	0.10	0.75
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.004	ND	0.020	ND
Selenium	0.05	0.0025	ND	0.0025	ND	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	250	1600	250	1100	100	580	130	750	50	130	500	1600	500	1500	250	1600	250	1100	250	700
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	2600	10	2400	10	1500	10	1700	10	2400	10	2600	10	2800	10	2900	10	2000	10	1700
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0050	ND	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	0.023
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0005	ND	0.00050	ND
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0025	NS	0.0025	ND
pH	6.5 - 9.0	NA	7.03	NA	7.19	NA	7.01	NA	6.90	NA	7.19	NA	6.86	NA	6.85	NA	6.82	NA	6.80	NA	7.05
Temperature	NA	NA	11.94	NA	12.78	NA	15.68	NA	15.90	NA	11.94	NA	14.29	NA	15.10	NA	16.23	NA	15.41	NA	12.20
Conductivity	NA	NA	2.97	NA	3.30	NA	2.25	NA	1.88	NA	1.54	NA	2.31	NA	2.50	NA	2.56	NA	1.93	NA	1.59
Dissolved Oxygen	NA	NA	NM	NA	7.49	NA	0.49	NA	0.33	NA	0.43	NA	2.22	NA	1.71	NA	6.15	NA	4.26	NA	4.86
ORP	NA	NA	NM	NA	102.2	NA	-43.5	NA	-114.0	NA	-40.0	NA	2.0	NA	-32.0	NA	-22.0	NA	-39.0	NA	-30.3

Sample: MW-09	5/23/2013		7/22/2013		10/15/2013		2/17/2014		5/1/2014		8/18/2014		10/23/2014		2/10/2015		5/27/2015		8/4/2015		10/27/2015	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.017	0.0025	0.017	0.0025	0.019	0.0025	0.022	0.0025	0.021	0.0025	0.018	0.0025	0.017	0.0025	0.029	0.0025	0.018	0.0025	0.013	0.0025	0.014
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	0.050	0.30	0.050	0.29	0.050	0.29	0.050	0.30	0.050	0.27	0.050	0.29	0.050	0.24	0.050	0.30	0.050	0.37	0.050	0.38	0.050	0.33
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.0019	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	290	10	280	10	280	10	270	10	340	10	270	10	230	50	390	10	340	10	230	10	220
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	0.0076	0.0010	0.0063	0.0010	0.0056	0.0010	0.0044	0.0010	0.0035	0.0010	0.0063	0.0010	0.0045	0.0010	0.047	0.0010	0.017	0.0010	0.013	0.0010	0.016
Copper	0.0020	ND	0.0020	0.0025	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.011	0.0020	0.0023	0.0020	ND	0.0020	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.40	0.10	0.47	0.10	0.53	0.10	0.56	0.10	0.50	0.10	0.56	0.10	0.55	0.10	0.51	0.10	0.44	0.10	0.27	0.10	0.35
Iron	0.10	160	0.10	50	0.10	25	0.10	12	0.10	8.4	0.10	130	0.10	45	0.10	23	0.10	140	0.10	ND	0.10	170
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.0010	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	1.6	0.0025	0.81	0.0025	0.52	0.0025	0.34	0.0025	0.30	0.0025	0.72	0.0025	0.38	0.0025	0.54	0.0025	0.66	0.0025	1.4	0.0025	0.79
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND ^	0.00020	ND
Nickel	0.0020	0.014	0.0020	0.012	0.0020	0.0090	0.0020	0.0057	0.0020	0.0057	0.0020	0.013	0.0020	0.0079	0.0020	0.039	0.0020	0.026	0.0020	0.021	0.0020	0.025
Nitrogen/Nitrate	0.10	ND	0.10	0.24	0.10	0.11	0.10	0.34	0.10	0.12	0.10	0.11	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Nitrogen/Nitrate, Nitri	0.10	ND	0.10	0.24	0.10	0.11	0.10	0.34	0.10	0.12	0.10	0.11	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	0.020	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND^	0.00050	ND	0.00050	ND
Sulfate	500	1300	250	1000	130	680	100	560	130	560	250	880	250	960	250	820	500	1100	500	1900	500	1100
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	13	3000	10	2300	10	1700	10	1600	10	1700	10	2100	10	1700	10	2400	17	3100	10	3900	10	2600
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	0.049	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	0.021	0.020	ND	0.020	0.072	0.020	0.028	0.020	0.17	0.020	0.050
Benzene	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.002	ND	0.002	ND	0.002	0.0006	0.002	0.0006	0.002	0.0006	0.002	ND	0.002	0.00093
pH	NA	6.34	NA	6.6	NA	6.69	NA	8.83	NA	6.71	NA	6.62	NA	6.93	NA	6.92	NA	6.59	NA	6.52	NA	6.37
Temperature	NA	12.19	NA	14.92	NA	15.21	NA	8.4	NA	9.84	NA	21.87	NA	15.35	NA	10.12	NA	19.34	NA	22.72	NA	13.47
Conductivity	NA	2.522	NA	2.17	NA	1.81	NA	1.02	NA	1.89	NA	2.91	NA	2.51	NA	2.50	NA	3.51	NA	4.04	NA	3.53
Dissolved Oxygen	NA	0.40	NA	1.22	NA	1.81	NA	1.24	NA	1.49	NA	0.41	NA	0.76	NA	1.26	NA	0.81	NA	1.00	NA	0.95
ORP	NA	-85.9	NA	-61.5	NA	-78.4	NA	-125.7	NA	25.7	NA	-108.7	NA	-85.1	NA	-82.0	NA	-96.9	NA	-108.0	NA	-24.9

Sample: MW-09	2/9/2016		5/11/2016		8/30/2016		11/1/2016		2/8/2017		4/25/2017		2/20/2018		8/1/2018		10/16/2018		2/5/2019	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND ^	0.0030	ND	0.0030	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.0010	0.0014	0.0050	ND ^	0.0010	0.0021	0.0010	0.0013	0.0010	0.0011 F1	0.0050	ND	0.0010	0.0025	0.001	0.0013	0.001	0.0013	0.001	0.0023
Barium	0.0025	0.013	0.0025	0.017	0.0025	0.015	0.0025	0.014	0.0025	0.012	0.013	0.014	0.0025	0.017	0.0025	0.0083	0.0025	0.011	0.0025	0.011
Beryllium	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.001	ND	0.001	ND^	0.001	ND
Boron	0.050	0.36	0.050	0.40	0.050	0.72	0.050	0.47	0.050	0.34	0.050	0.30	0.050	0.65	0.05	0.29	0.05	0.27	0.05	0.35
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	170	2.0	23	2.0	19	10	110	10	150	10	180	2.0	16	10	210	10	210	10	140
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND	0.005	ND	0.005	0.005
Cobalt	0.0010	0.034	0.0010	0.050	0.0010	0.034	0.0010	0.016	0.0010	0.0089	0.0010	0.023	0.0010	0.057	0.001	0.021	0.001	0.022	0.001	0.033
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND ^	0.0020	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.01	ND	0.01	ND	0.01	ND
Fluoride	0.10	0.45	0.10	0.31	0.10	0.26	0.10	0.30	0.10	0.36	0.10	0.31	0.10	0.54	0.1	0.38	0.1	0.43	0.1	0.46
Iron	0.10	ND	2.0	3400	0.10	ND	1.0	900	1.0	250	0.50	1000	2.0	3700	1	750	1	530	1	1200
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	2.3	0.050	6.0	0.0025	3.7	0.0025	1.6	0.0025	0.61	0.0025	1.9	0.050	5.8	0.0025	1.3	0.0025	0.96	0.0025	2.1
Mercury	0.00020	ND	0.00020	0.00032	0.00020	0.00096	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	0.00021	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.0020	0.071	0.0020	0.17	0.0020	0.14	0.0020	0.045	0.0020	0.015	0.0020	0.060	0.0020	0.22	0.002	0.046	0.002	0.03	0.002	0.077
Nitrogen/Nitrate	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.1	ND	0.1	ND	0.1	ND
Nitrogen/Nitrate, Nitri	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.1	ND	0.1	ND	0.1	ND
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.080	ND	0.040	ND	0.0040	ND F1	0.0040	ND	0.0040	ND	0.0040	ND ^	0.020	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	ND ^	0.0025	ND	0.0025	ND	0.0025	ND	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	1000	3600	2500	12000	2500	8100	500	3600	500	1200	1000	4700	2500	16000	500	2500	500	1900	500	3400
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	13	4700	50	19000	100	15000	17	6100	10	2800	25	6500	50	20000	13	4900	10	3700	10	5900
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND	0.005	ND^	0.005	ND
Zinc	0.020	0.70	0.020	2.3	0.020	1.8	0.020	0.45	0.020	0.092	0.10	0.73	0.020	3.0	0.02	0.56	0.02	0.3	0.02	0.74
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.0039	0.0005	ND	0.0005	ND
BETX	0.002	ND	0.002	0.00062	0.002	ND	0.002	0.00823	0.002	ND	0.002	ND	0.0025	0.00066	0.0025	0.0252	0.0025	0.0011	0.0025	ND
pH	NA	6.03	NA	5.73	NA	3.36	NA	6.19	NA	5.74	NA	6.13	NA	6.19	NA	7.30	NA	6.47	NA	6.16
Temperature	NA	7.31	NA	13.73	NA	22.44	NA	18.36	NA	9.03	NA	15.44	NA	11.22	NA	22.20	NA	14.34	NA	12.60
Conductivity	NA	3.29	NA	9.49	NA	8.79	NA	4.93	NA	2.14	NA	4.95	NA	7.519	NA	3.619	NA	2.920	NA	4.982
Dissolved Oxygen	NA	0.60	NA	1.90	NA	1.55	NA	0.52	NA	3.13	NA	4.22	NA	1.35	NA	1.32	NA	2.45	NA	1.58
ORP	NA	-19.6	NA	-12.9	NA	332.9	NA	-94.2	NA	34.9	NA	-51.1	NA	50.1	NA	35.8	NA	39.2	NA	-41.8

Sample: MW-09	5/7/2019		8/7/2019		11/7/2019		2/12/2020		5/20/2020		8/5/2020		10/22/2020		3/2/2021		5/17/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.001	0.0042	0.001	0.0016	0.001	0.0047	0.001	0.0038	0.001	0.0062	0.001	0.001	0.001	0.034	0.001	0.0043	0.001	0.0025
Barium	0.0025	0.012	0.0025	0.0084	0.0025	0.012	0.0025	0.01	0.0025	0.013	0.0025	0.01	0.0025	0.086	0.0025	0.015	0.0025	0.012
Beryllium	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND
Boron	0.05	0.45	0.05	0.33	0.05	0.73	0.05	0.33	0.05	0.3	0.05	0.29	0.05	0.37	0.05	0.47	0.05	0.29
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.0021	0.0005	ND	0.0005	ND
Chloride	10	57	10	180	10	23	10	75	10	6.1 F1	10	140	10	190	2	7	10	180
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	0.028	0.005	ND	0.005	ND
Cobalt	0.001	0.059	0.001	0.031	0.001	0.065	0.001	0.032	0.001	0.04	0.001	0.016	0.001	0.046	0.001	0.044	0.001	0.024
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.041	0.002	ND	0.002	ND
Cyanide	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	0.0053	0.01	ND	0.005	ND	0.005	ND
Fluoride	0.1	0.57	0.1	0.41	0.1	0.63	0.1	0.52	0.1	0.71	0.1	0.66	0.1	0.66	0.1	0.62	0.1	0.46
Iron	1	2,700	1	630	1	1800	1	960	1	1900	10	400	0.5	970	10	2000 ^	10	620
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.036	0.0005	ND	0.0005	ND
Manganese	0.0025	4.2	0.0025	1.4	0.0025	4.4	0.0025	2.2	0.0025	3	0.0025	0.96	0.0025	2.3	0.0025	3.5	0.0025	1.4
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.002	0.2	0.002	0.051	0.002	0.22	0.002	0.084	0.002	0.13	0.002	0.036	0.002	0.1	0.002	0.15	0.002	0.051
Nitrogen/Nitrate	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Nitrogen/Nitrate, Nitri	0.1	ND	0.1	ND	0.1	ND	0.1	ND F1	0.1	ND	5	ND	0.1	ND	0.1	ND	0.1	ND
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.02	ND	0.04	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0027	0.0025	ND	0.0025	ND
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	500	8900	500	2800	500	7100	500	ND	500	6800	250	2000	250	1500	1000	7400	1000	3300
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	15000	10	5000	10	11000	10	6600	10	11000	150	2900	150	3000	50	12000	25	5600 H
Vanadium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	0.026	0.005	ND	0.005	ND
Zinc	0.02	4.1	0.02	0.6	0.02	2.6	0.02	1	0.02	2.4	0.02	0.42	0.02	1.2	0.02	1.8	0.02	0.47
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	5.70	NA	6.07	NA	5.53	NA	5.74	NA	5.41	NA	6.26	NA	5.73	NA	5.92	NA	6.03
Temperature	NA	12.40	NA	13.10	NA	12.17	NA	12.60	NA	12.10	NA	13.90	NA	17.70	NA	12.50	NA	12.80
Conductivity	NA	13.650	NA	4.050	NA	7.426	NA	4.789	NA	7.209	NA	3.080	NA	4.030	NA	8.104	NA	4.881
Dissolved Oxygen	NA	0.48	NA	0.36	NA	1.18	NA	5.13	NA	1.17	NA	NS	NA	0.47	NA	0.12	NA	0.09
ORP	NA	-402.4	NA	-25.1	NA	35.2	NA	24.8	NA	25.9	NA	-44.5	NA	-91.4	NA	-28.2	NA	-34.6

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm^c millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-10	Date	12/6/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	0.0012	0.0010	ND	0.0010	ND	0.0010	0.0012	0.0010	0.001
Barium	2.0	0.0025	0.050	0.0025	0.051	0.0025	0.039	0.0025	0.039	0.0025	0.036	0.0025	0.040	0.0025	0.043	0.0025	0.040	0.0025	0.041
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.50	0.050	0.54	0.050	0.54	0.050	0.41	0.050	0.52	0.25	0.52	0.050	0.53	0.050	0.43^	0.050	0.49
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	10	200	10	300	2.0	7.1	10	170	10	180	10	180	10	290	10	230	10	200
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.43	0.10	0.39	0.10	0.42	0.10	0.41	0.10	0.45	0.10	0.41	0.10	0.46	0.10	0.50	0.10	0.47
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.15	0.0025	0.12	0.0025	0.0076	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0052	0.0020	0.0029	0.010	ND	0.0020	0.0087	0.0020	0.0024	0.0020	ND	0.0020	ND	0.0020	0.0021	0.0020	0.0024
Nitrogen/Nitrate	10.0	0.10	0.39	0.10	2.3	0.10	2.7	0.10	2.6	0.10	1.4	0.10	ND	0.10	1.8	0.10	1.5	0.10	1.5
Nitrogen/Nitrate, Nitri	NA	0.10	0.39	0.20	2.3	0.20	2.7	0.20	2.6	0.10	1.4	0.10	ND	0.10	1.8	0.10	1.5	0.10	1.5
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.004	ND
Selenium	0.05	0.0025	ND	0.0025	ND	0.013	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	130	50	130	25	89	25	100	50	190	50	250	50	170	50	110	25	120
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	860	10	1100	10	980	10	730	10	890	10	890	10	1100	10	870	10	860
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0005	ND
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0025	NS
pH	6.5 - 9.0	NA	7.65	NA	7.20	NA	7.40	NA	7.34	NA	7.51	NA	7.35	NA	7.20	NA	7.38	NA	7.38
Temperature	NA	NA	9.26	NA	12.40	NA	12.05	NA	11.23	NA	11.26	NA	13.08	NA	14.44	NA	13.53	NA	12.60
Conductivity	NA	NA	1.51	NA	1.88	NA	1.58	NA	0.98	NA	0.99	NA	1.04	NA	1.35	NA	1.13	NA	1.07
Dissolved Oxygen	NA	NA	NM	NA	7.18	NA	8.70	NA	7.42	NA	7.12	NA	7.08	NA	7.13	NA	6.93	NA	8.74
ORP	NA	NA	NM	NA	191.6	NA	210.0	NA	-37.0	NA	143.0	NA	210.0	NA	147.0	NA	146.0	NA	112.0

Sample: MW-10	3/5/2013		5/22/2013		7/23/2013		10/15/2013		2/17/2014		5/1/2014		8/18/2014		10/23/2014		2/11/2015		5/28/2015		8/4/2015	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.0010	0.0012	0.0010	0.0011	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND^	0.0010	ND	0.0010	ND	0.0010	ND
Barium	0.0025	0.040	0.0025	0.041	0.0025	0.042	0.0025	0.044	0.0025	0.047	0.0025	0.043	0.0025	0.038	0.0025	0.044	0.0025	0.050	0.0025	0.046	0.0025	0.035
Beryllium	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	0.050	0.49	0.050	0.25	0.050	0.30	0.050	0.42	0.050	0.40	0.050	0.39	0.050	0.48	0.050	0.56	0.050	0.52	0.050	0.35	0.050	0.32
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	10	210	10	240	10	210	10	220	10	240	10	300	10	200	10	170	10	210	10	320	10	180
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0027
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	0.10	0.49^	0.10	0.50	0.10	0.48	0.10	0.50	0.10	0.47	0.10	0.43	0.10	0.49	0.10	0.46	0.10	0.41	0.10	0.43	0.10	0.46
Iron	0.10	ND	0.10	0.32	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Manganese	0.0025	ND	0.0025	0.010	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0049	0.0025	ND	0.0025	ND
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND *
Nickel	0.0020	0.0022	0.0020	ND	0.0020	0.0027	0.0020	0.0024	0.0020	0.0020	0.0020	0.0023	0.0020	ND	0.0020	0.0020	0.0020	0.0037	0.0020	0.0023	0.0020	ND
Nitrogen/Nitrate	0.10	1.6	0.10	2.8	0.10	3.0	0.10	2.3	0.10	2.2	0.10	2.8	0.10	0.72	0.10	1.7	0.10	2.4	0.10	2.9	0.10	1.5
Nitrogen/Nitrate, Nitri	0.10	1.6	0.20	2.8	0.50	3.0	0.50	2.3	0.50	2.2	0.50	2.8	0.10	0.72	0.10	1.7	0.20	2.4	0.20	2.9	0.10	1.5
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0025	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND^	0.00050	ND
Sulfate	25	84	25	120	50	130	50	140	25	55	20	120	20	73	50	110	25	93	20	50	25	97
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	10	830	10	850	10	910	10	880	10	870	10	890	10	910	10	740	10	810	10	1100	10	710
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
pH	NA	7.55	NA	7.11	NA	7.26	NA	7.11	NA	4.39	NA	7.07	NA	6.74	NA	7.12	NA	7.26	NA	7.27	NA	6.92
Temperature	NA	10.40	NA	12.70	NA	14.21	NA	13.04	NA	11.47	NA	11.23	NA	16.85	NA	13.74	NA	6.83	NA	15.02	NA	17.42
Conductivity	NA	1.04	NA	0.964	NA	1.1	NA	1.09	NA	0.84	NA	1.18	NA	1.14	NA	1.18	NA	0.92	NA	1.37	NA	1.19
Dissolved Oxygen	NA	9.16	NA	6.14	NA	4.59	NA	4.27	NA	4.82	NA	6.31	NA	6.99	NA	6.16	NA	6.50	NA	7.41	NA	5.39
ORP	NA	129.5	NA	35.6	NA	30.2	NA	-48.9	NA	201.1	NA	109.8	NA	87.8	NA	77.3	NA	135.3	NA	134.8	NA	15.3

Sample: MW-10	10/28/2015		2/10/2016		5/12/2016		8/31/2016		11/2/2016		2/7/2017		4/26/2017		2/21/2018		8/1/2018		10/17/2018	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.003	ND	0.003	ND
Arsenic	0.0010	ND	0.0010	ND	0.0050	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.001	ND	0.001	ND
Barium	0.0025	0.041	0.0025	0.042	0.0025	0.055	0.0025	0.037	0.0025	0.034	0.0025	0.046	0.0025	0.038	0.0025	0.042	0.0025	0.042	0.0025	0.04
Beryllium	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.001	ND	0.001	ND^
Boron	0.050	0.44	0.050	0.43	0.050	0.32	0.050	0.34	0.050	0.49	0.050	0.39	0.050	0.29	0.050	0.31	0.05	0.27	0.05	0.6
Cadmium	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND
Chloride	10	210	10	200	10	290	10	150	10	120	10	200	10	210	10	170	10	240	10	170
Chromium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND	0.005	ND
Cobalt	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.001	ND	0.001	ND
Copper	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND	0.002	ND	0.002	ND
Cyanide	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.01	ND	0.01	ND
Fluoride	0.10	0.41	0.10	0.45	0.10	0.46	0.10	0.44	0.10	0.43	0.10	0.36	0.10	0.35	0.10	0.38	0.1	0.39	0.1	0.4
Iron	0.10	ND	0.10	0.13	0.10	ND ^	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.24	0.1	ND	0.1	ND
Lead	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	0.0037	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0057	0.0025	ND	0.0025	0.0028
Mercury	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.0002	ND	0.0002	ND
Nickel	0.0020	ND	0.0020	ND	0.0020	0.0032	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND	0.002	0.0021
Nitrogen/Nitrate	0.10	2.4	0.10	2.2	0.10	2.6	0.10	1.4	0.10	2.3	0.10	1.9	0.10	2.3	0.10	1.4	0.1	1.7	0.1	0.96
Nitrogen/Nitrate, Nitri	0.20	2.4	0.20	2.2	0.20	2.6	0.10	1.4	0.50	2.3	0.10	1.9	0.20	2.3	0.10	1.4	0.1	1.7	0.1	0.96
Nitrogen/Nitrite	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND	0.02	ND
Perchlorate	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	ND	0.0025	ND ^	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND
Sulfate	25	86	25	110	25	120	25	80	20	92	25	88	25	89	50	100	25	110	25	120
Thallium	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	810	10	800	10	920	10	670	10	690	10	810	10	750	10	820	10	1000	10	750
Vanadium	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND	0.005	ND^
Zinc	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.00076	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.002	0.00075	0.002	ND	0.002	0.00069	0.002	ND	0.002	0.02226	0.002	ND	0.002	ND	0.0025	0.0012	0.0025	0.0024	0.0025	ND
pH	NA	7.04	NA	7.17	NA	7.02	NA	6.95	NA	6.99	NA	6.99	NA	7.27	NA	7.62	NA	7.35	NA	7.30
Temperature	NA	12.90	NA	7.17	NA	13.60	NA	19.33	NA	15.66	NA	11.40	NA	16.65	NA	8.03	NA	17.55	NA	14.62
Conductivity	NA	1.40	NA	0.85	NA	1.29	NA	1.25	NA	0.95	NA	0.98	NA	1.09	NA	0.760	NA	1.147	NA	1.113
Dissolved Oxygen	NA	6.49	NA	7.45	NA	6.76	NA	7.13	NA	5.97	NA	6.48	NA	8.46	NA	8.84	NA	7.00	NA	8.75
ORP	NA	113.8	NA	121.8	NA	54.2	NA	90.4	NA	86.8	NA	127.9	NA	28.7	NA	47.9	NA	89.1	NA	34.6

Sample: MW-10	2/5/2019		5/7/2019		8/6/2019		11/7/2019		2/12/2020		5/20/2020		7/30/2020		10/22/2020		3/2/2021		5/18/2021	
Parameter	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Barium	0.0025	0.044	0.0025	0.05	0.0025	0.037	0.0025	0.033	0.0025	0.044	0.0025	0.045	0.0025	0.036	0.0025	0.04	0.0025	0.053	0.0025	0.064
Beryllium	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Boron	0.05	0.25	0.05	0.49	0.05	0.35	0.05	0.29	0.05	0.29	0.05	0.7	0.05	0.24	0.05	0.29	0.05	0.36	0.05	0.36
Cadmium	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	10	210	10	410	10	200	10	130	10	180	10	250	2	170	10	230	40	290	40	350
Chromium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.002	ND	0.002	ND	0.002	ND	0.002	0.0029	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	ND	0.01	ND	0.005	ND	0.005	ND
Fluoride	0.1	0.41	0.1	0.4	0.1	0.35	0.1	0.37	0.1	0.44	0.1	0.42	0.1	0.42	0.1	0.41	0.1	0.41	0.1	0.39
Iron	0.1	ND	0.1	0.44	0.1	ND	0.1	0.25	0.1	ND	0.1	1.8	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Lead	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0029	0.0025	ND	0.0025	0.0034	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.0023	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.0027
Nitrogen/Nitrate	0.1	1.3	0.1	2.4	0.1	ND	0.1	1.8	0.1	1.7	0.1	1.4	0.1	2.8	0.1	3.8	0.1	2.2	0.1	2.7
Nitrogen/Nitrate, Nitri	0.1	1.3	0.1	2.4	0.1	2.3	0.1	1.8	0.1	1.7	0.1	1.4	0.5	2.8	0.5	3.8	0.5	2.2	0.5	2.7
Nitrogen/Nitrite	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.0025	ND	0.0025	0.0041	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0035	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Silver	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	25	85	25	100	25	95	25	ND	25	110	25	170	25	88	15	94	25	150	25	210
Thallium	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	10	910	10	1000	10	810	10	660	10	810	10	1000	30	720	30	850	10	1100	10	1100
Vanadium	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	NA	7.31	NA	7.17	NA	7.4	NA	7.4	NA	7.28	NA	6.9	NA	6.95	NA	7.11	NA	7.19	NA	7.16
Temperature	NA	12.5	NA	11.8	NA	12.3	NA	11.89	NA	12.9	NA	12.5	NA	12.3	NA	12.7	NA	12.2	NA	14
Conductivity	NA	1.39	NA	2.74	NA	1.45	NA	1.085	NA	1.133	NA	1.61	NA	1.405	NA	1.51	NA	1.747	NA	1.95
Dissolved Oxygen	NA	5.60	NA	7.18	NA	5.45	NA	9.30	NA	7.73	NA	8.65	NA	7.68	NA	4.79	NA	4.70	NA	6.87
ORP	NA	127.7	NA	-231.3	NA	167.5	NA	-12.2	NA	166.3	NA	133.9	NA	138.6	NA	172.5	NA	41.8	NA	147.7

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celcius
Conductivity ms/cm[c] millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-3. CCA Groundwater Analytical Results - Midwest Generation LLC, Joliet Station #29, Joliet IL

Sample: MW-11	Date	12/6/2010		3/23/2011		6/14/2011		9/14/2011		12/7/2011		3/15/2012		6/19/2012		9/19/2012		12/20/2012	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.015	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	0.0013	0.0010	0.0016	0.0050	ND	0.0010	0.0016	0.0010	0.0019	0.0010	0.0017	0.0010	0.0017	0.0010	0.0018	0.0010	0.0018
Barium	2.0	0.0025	0.064	0.0025	0.076	0.013	0.051	0.0025	0.054	0.0025	0.057	0.0025	0.067	0.0025	0.046	0.0025	0.060	0.0025	0.063
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.050	0.47	0.050	2.6	0.050	2.2	0.050	1.1	0.050	1.2	0.25	1.4	0.050	0.85	0.050	0.68^	0.050	0.57
Cadmium	0.005	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Chloride	200.0	10	160	10	270	10	280	10	86	10	140	10	240	10	150	10	150	10	140
Chromium	0.1	0.0050	ND	0.0050	ND	0.025	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	ND	0.0050	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Copper	0.65	0.0020	ND	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.34	0.10	0.31	0.10	0.36	0.10	0.32	0.10	0.31	0.10	0.30	0.10	0.37	0.10	0.32	0.10	0.34
Iron	5.0	0.10	ND	0.10	ND	0.50	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.23	0.10	ND	0.10	0.42
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.0008
Manganese	0.15	0.0025	0.052	0.0025	0.0047	0.013	ND	0.0025	0.0053	0.0025	0.0047	0.0025	ND	0.0025	0.014	0.0025	ND	0.0025	0.042
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0022	0.0020	ND	0.010	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0025
Nitrogen/Nitrate	10.0	0.10	0.39	0.10	1.1	0.10	0.92	0.10	0.31	0.10	0.60	0.10	0.30	0.10	ND	0.10	0.36	0.10	0.46
Nitrogen/Nitrate, Nitri	NA	0.10	0.39	0.10	1.1	0.10	0.92	0.10	0.31	0.10	0.60	0.10	0.30	0.10	ND	0.10	0.36	0.10	0.46
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0040	ND
Selenium	0.05	0.0025	ND	0.0025	0.0054	0.013	ND	0.0025	0.0026	0.0025	0.0033	0.0025	0.0043	0.0025	0.0028	0.0025	ND	0.0025	ND
Silver	0.05	0.00050	ND	0.00050	ND	0.0025	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND
Sulfate	400.0	50	140	50	150	25	110	25	110	50	160	25	140	50	150	50	100	50	150
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	770	10	1000	10	710	10	590	10	790	10	850	10	760	10	740	10	730
Vanadium	0.049	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0050	0.0050
Zinc	5.0	0.020	ND	0.020	ND	0.10	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Benzene	0.005	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0005	ND
BETX	11.705	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.0025	NS
pH	6.5 - 9.0	NA	7.72	NA	7.23	NA	7.60	NA	7.38	NA	7.46	NA	7.38	NA	7.37	NA	7.36	NA	7.36
Temperature	NA	NA	11.97	NA	13.49	NA	11.69	NA	12.18	NA	13.15	NA	14.22	NA	15.30	NA	13.23	NA	12.83
Conductivity	NA	NA	1.32	NA	1.69	NA	1.14	NA	0.79	NA	0.92	NA	1.12	NA	0.97	NA	0.97	NA	0.89
Dissolved Oxygen	NA	NA	NM	NA	7.23	NA	8.65	NA	6.28	NA	6.74	NA	7.37	NA	7.09	NA	6.71	NA	8.66
ORP	NA	NA	NM	NA	194.3	NA	200.8	NA	-31.0	NA	136.0	NA	208.0	NA	172.0	NA	172.0	NA	113.0

Sample: MW-11	Date	3/5/2013		5/23/2013		7/23/2013		10/15/2013		2/21/2014		5/1/2014		8/19/2014		10/23/2014		2/11/2015		5/28/2015	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND
Arsenic	0.010	0.0010	0.0018	0.0010	0.0017	0.0010	0.0014	0.0010	0.0015	0.0010	ND	0.0010	0.0017	0.0010	0.0016	0.0010	0.0012	0.0010	ND	0.0010	0.0015
Barium	2.0	0.0025	0.060	0.0025	0.045	0.0025	0.040	0.0025	0.060	0.0050	0.090	0.0025	0.053	0.0025	0.048	0.0025	0.059	0.0025	0.10	0.0025	0.059
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND
Boron	2.0	0.50	1.1	0.050	0.34	0.050	0.88	0.050	0.49	0.10	1.2	0.050	1.3	0.25	1.6	0.050	2.0	0.050	1.1	0.050	1.0
Cadmium	0.005	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.0077	0.00050	ND
Chloride	200.0	10	190	10	160	10	91	10	140	50	430	10	340	10	120	10	84	10	270	10	290
Chromium	0.1	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Cobalt	1.0	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	0.033	0.0010	0.0016
Copper	0.65	0.0020	ND	0.0020	ND	0.0020	0.017	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.16	0.0020	0.0073
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND
Fluoride	4.0	0.10	0.29^	0.10	0.38	0.10	0.37	0.10	0.31	0.10	0.29	0.10	0.32	0.10	0.37	0.10	0.38	0.10	0.33	0.10	0.35
Iron	5.0	0.10	0.15	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	0.17	0.10	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	0.023	0.00050	ND
Manganese	0.15	0.0025	0.016	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.27	0.0025	ND
Mercury	0.002	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND
Nickel	0.1	0.0020	0.0020	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	0.0020	0.0020	0.16	0.0020	0.0097
Nitrogen/Nitrate	10.0	0.10	1.1	0.10	1.4	0.10	0.28	0.10	0.79	0.10	1.4	0.10	1.3	0.10	0.25	0.10	0.59	0.10	ND	0.10	1.1
Nitrogen/Nitrate, Nitri	NA	0.10	1.1	0.10	1.4	0.10	0.28	0.10	0.79	0.10	1.4	0.10	1.3	0.10	0.25	0.10	0.59	0.10	ND	0.10	1.1
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND
Perchlorate	0.0049	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	0.027	0.0040	ND
Selenium	0.05	0.0025	0.0043	0.0025	0.0034	0.0025	ND	0.0025	ND	0.0025	0.0041	0.0025	0.0043	0.0025	0.0069	0.0025	0.0040	0.0025	ND	0.0025	0.0035
Silver	0.05	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND^
Sulfate	400.0	50	110	25	100	25	100	25	110	25	130	25	100	25	91	50	120	100	290	25	84
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND
Total Dissolved Solids	1,200	10	770	10	670	10	570	10	690	10	1100	10	850	10	720	10	580	10	1300	10	860
Vanadium	0.049	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND
Zinc	5.0	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	0.056	0.020	ND
Benzene	0.005	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	11.705	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
pH	6.5 - 9.0	NA	7.60	NA	7.11	NA	7.33	NA	7.16	NA	9.25	NA	7.17	NA	6.78	NA	7.29	NA	7.16	NA	7.42
Temperature	NA	NA	10.60	NA	12.10	NA	14.41	NA	15.41	NA	10.38	NA	10.97	NA	16.58	NA	15.17	NA	8.04	NA	17.77
Conductivity	NA	NA	0.96	NA	0.774	NA	0.60	NA	0.95	NA	1.20	NA	1.25	NA	0.90	NA	0.95	NA	1.32	NA	1.45
Dissolved Oxygen	NA	NA	7.99	NA	5.38	NA	5.69	NA	3.26	NA	4.81	NA	6.31	NA	5.14	NA	3.80	NA	2.98	NA	5.44
ORP	NA	NA	167.1	NA	2.4	NA	26.5	NA	-58.4	NA	-51.0	NA	106.7	NA	87.8	NA	69.4	NA	108.2	NA	121.5

Sample: MW-11	Date	8/4/2015		10/29/2015		2/11/2016		5/11/2016		9/1/2016		11/2/2016		2/7/2017		4/26/2017		2/21/2018		8/1/2018	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND	0.0030	ND ^	0.0030	ND	0.0030	ND	0.003	ND
Arsenic	0.010	0.0010	0.0026	0.0010	ND	0.0010	0.0018	0.0010	0.0015	0.0010	0.0017	0.0010	0.0016	0.0010	0.0014	0.0010	0.0014	0.0010	0.0020	0.001	0.0012
Barium	2.0	0.0025	0.062	0.0025	0.069	0.0025	0.074	0.0025	0.066	0.0025	0.056	0.0025	0.062	0.0025	0.078	0.0025	0.051	0.0025	0.084	0.0025	0.046
Beryllium	0.004	0.0010	ND	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND ^	0.0010	ND	0.0010	ND	0.001	ND
Boron	2.0	0.050	1.4	0.050	0.78	0.050	1.4	0.050	1.5	0.050	1.6	0.050	1.6	0.050	1.3	0.050	1.1	0.050	2.4	0.05	1.2 V
Cadmium	0.005	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Chloride	200.0	10	150	10	120	10	230	10	240	10	110	10	93	10	240	10	150	10	260	10	120
Chromium	0.1	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.005	ND
Cobalt	1.0	0.0010	0.0015	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.0010	ND	0.001	ND
Copper	0.65	0.0020	0.0022	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND ^	0.0020	ND ^	0.0020	ND	0.002	ND
Cyanide	0.2	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.010	ND	0.01	ND
Fluoride	4.0	0.10	0.38	0.10	0.30	0.10	0.34	0.10	0.39	0.10	0.34	0.10	0.31	0.10	0.30	0.10	0.28	0.10	0.29	0.1	0.29
Iron	5.0	0.10	ND	0.10	ND	0.10	0.12	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.10	ND	0.1	ND
Lead	0.0075	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Manganese	0.15	0.0025	0.49	0.0025	0.040	0.0025	0.0034	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.002	0.00020	ND *	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.00020	ND	0.0002	ND
Nickel	0.1	0.0020	0.0099	0.0020	0.0028	0.0020	0.0028	0.0020	0.0031	0.0020	0.0020	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND
Nitrogen/Nitrate	10.0	0.10	0.15	0.10	0.48	0.10	1.8	0.10	1.4	0.10	0.69	0.10	0.58	0.10	1.2	0.10	1.1	0.10	1.5	0.1	0.41
Nitrogen/Nitrate, Nitri	NA	0.10	0.15	0.10	0.48	0.10	1.8	0.10	1.4	0.10	0.69	0.10	0.58	0.10	1.2	0.10	1.1	0.10	1.5	0.1	0.41
Nitrogen/Nitrite	NA	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND
Perchlorate	0.0049	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.20	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.0040	ND	0.004	ND
Selenium	0.05	0.0025	0.0050	0.0025	ND	0.0025	0.0040	0.0025	0.0033	0.0025	0.0046	0.0025	ND	0.0025	0.0025	0.0025	0.0034	0.0025	0.0077	0.0025	0.0032 F1
Silver	0.05	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.00050	ND	0.0005	ND
Sulfate	400.0	50	110	50	170	50	140	50	150	50	120	25	130	25	90	25	100	50	190	25	84
Thallium	0.002	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.0020	ND	0.002	ND
Total Dissolved Solids	1,200	10	700	10	740	10	880	10	920	10	660	10	640	10	830	10	620	10	1100	10	720
Vanadium	0.049	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	ND	0.0050	0.0053	0.005	ND
Zinc	5.0	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.020	ND	0.02	ND
Benzene	0.005	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.0016	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	0.0029
BETX	11.705	0.002	ND	0.002	0.00094	0.002	ND	0.002	0.0023	0.002	ND	0.002	0.0394	0.002	ND	0.002	ND	0.0025	0.0018	0.0025	0.0106
pH	6.5 - 9.0	NA	7.40	NA	7.26	NA	7.15	NA	7.24	NA	7.20	NA	7.18	NA	7.21	NA	7.47	NA	7.55	NA	7.39
Temperature	NA	NA	17.05	NA	12.34	NA	6.49	NA	14.15	NA	18.10	NA	16.36	NA	12.91	NA	17.52	NA	9.05	NA	18.04
Conductivity	NA	NA	1.08	NA	1.13	NA	0.87	NA	1.19	NA	1.03	NA	0.88	NA	1.04	NA	0.98	NA	0.953	NA	0.965
Dissolved Oxygen	NA	NA	1.52	NA	8.45	NA	8.32	NA	8.21	NA	6.22	NA	4.89	NA	4.91	NA	6.50	NA	7.72	NA	5.84
ORP	NA	NA	-25.7	NA	86.5	NA	139.1	NA	48.6	NA	53.3	NA	73.7	NA	133.0	NA	25.2	NA	47.6	NA	88.9

Sample: MW-11	Date	10/17/2018		2/5/2019		5/7/2019		8/6/2019		11/7/2019		2/13/2020		5/20/2020		7/30/2020		10/22/2020		3/2/2021		5/18/2021	
Parameter	Standards	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result	DL	Result
Antimony	0.006	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND	0.003	ND
Arsenic	0.010	0.001	0.0015	0.001	0.0013	0.001	0.0019	0.001	0.0011	0.001	ND	0.001	0.0014	0.001	0.0023	0.001	0.0011	0.001	ND	0.001	0.0013	0.001	ND
Barium	2.0	0.0025	0.064	0.0025	0.063	0.0025	0.058	0.0025	0.051	0.0025	0.033	0.0025	0.065	0.0025	0.085	0.0025	0.051	0.0025	0.055	0.0025	0.089	0.0025	0.078
Beryllium	0.004	0.001	ND^	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND ^	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Boron	2.0	0.05	1.2	0.05	2.7	0.05	0.98	0.05	1.1	0.05	0.29	0.05	1.4	0.05	0.51	0.05	0.86	0.05	0.44	0.05	1.2	0.05	0.67
Cadmium	0.005	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Chloride	200.0	10	160	10	170	10	290	10	130	10	130	10	200	10	520	10	170	10	170	40	320	40	420
Chromium	0.1	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Cobalt	1.0	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND	0.001	ND
Copper	0.65	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	0.0029	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Cyanide	0.2	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.01	ND	0.005	ND	0.01	ND	0.005	ND	0.005	0.0051
Fluoride	4.0	0.1	0.27	0.1	0.27	0.1	0.34	0.1	0.24	0.1	0.37	0.1	0.3	0.1	0.34	0.1	0.3	0.1	0.28	0.1	0.28	0.1	0.28
Iron	5.0	0.1	ND	0.1	ND	0.1	ND	0.1	ND	0.1	0.25	0.1	ND	0.1	0.23	0.1	ND	0.1	ND	0.1	ND	0.1	ND
Lead	0.0075	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Manganese	0.15	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	0.0029	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
Mercury	0.002	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND	0.0002	ND
Nickel	0.1	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Nitrogen/Nitrate	10.0	0.1	0.66	0.1	0.92	0.1	1.4	0.1	0.34	0.1	1.8	0.1	0.79	0.1	2	0.1	0.85	0.1	0.59	0.1	1.1	0.1	1.4
Nitrogen/Nitrate, Nitri	NA	0.1	0.66	0.1	0.92	0.1	1.4	0.1	0.34	0.1	1.8	0.1	0.79	0.1	2	0.1	0.85	0.1	0.59	0.1	1.1	0.1	1.4
Nitrogen/Nitrite	NA	0.02	ND	0.02	ND	0.02	ND	0.02	ND F1	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Perchlorate	0.0049	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND	0.004	ND
Selenium	0.05	0.0025	0.0029	0.0025	0.0056	0.0025	0.0056	0.0025	0.003	0.0025	ND	0.0025	0.0029	0.0025	0.0039	0.0025	ND	0.0025	ND	0.0025	0.0035	0.0025	0.0025
Silver	0.05	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
Sulfate	400.0	50	93	50	91	50	81	50	78	50	ND	50	110	50	82	25	100	15	89	25	160	25	140
Thallium	0.002	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND	0.002	ND
Total Dissolved Solids	1,200	10	740	10	780	10	810	10	590	10	660	10	710	10	1400	30	670	30	710	10	1000	10	1200
Vanadium	0.049	0.005	ND^	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND
Zinc	5.0	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND
Benzene	0.005	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND	0.0005	ND
BETX	11.705	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND	0.0025	ND
pH	6.5 - 9.0	NA	7.37	NA	7.33	NA	7.45	NA	7.42	NA	7.4	NA	7.3	NA	7.12	NA	7.13	NA	7.11	NA	7.33	NA	7.22
Temperature	NA	NA	14.41	NA	13.1	NA	10.9	NA	12.3	NA	11.89	NA	13.7	NA	12.2	NA	12.1	NA	12.7	NA	12.5	NA	13.2
Conductivity	NA	NA	0.866	NA	1.212	NA	2.24	NA	1.05	NA	1.085	NA	1.138	NA	2.323	NA	1.332	NA	1.51	NA	1.702	NA	2.022
Dissolved Oxygen	NA	NA	8.17	NA	7.00	NA	10.94	NA	7.00	NA	9.30	NA	8.76	NA	11.05	NA	9.19	NA	4.79	NA	9.97	NA	10.34
ORP	NA	NA	30.5	NA	122.0	NA	-234.2	NA	163.4	NA	-12.2	NA	156.1	NA	139.8	NA	140.8	NA	172.5	NA	27.7	NA	152.2

Notes: Standards obtained from IAC, Title 35, Chapter I, Part 620, Subpart D, Section 620.410 - Groundwater Quality Standards for Class I: Potable Resource Groundwater.
All values are in mg/L (ppm) unless otherwise noted.

DL - Detection limit
NA - Not Applicable
ND - Not Detected
NM - Not Measured

NR - Not Required
NS - Not Sampled
* ^ - Denotes instrument related QC exceeds the control limits

Temperature °C degrees Celsius
Conductivity ms/cm millisiemens/centimeters
Dissolved Oxygen mg/L milligrams/liter
Oxygen Reduction Potential (ORP) mV millivolts

Attachment 9-4 – IL PE Stamp

CERTIFICATION
35 Ill. Adm. Code 845.630

In accordance with Section 35 Ill. Adm. Code 845.630(g), I hereby certify based on review of the information contained within the Initial Operating Permit Application for Joliet #29 Station dated October 29, 2021, the groundwater monitoring system has been designed and constructed to satisfy the requirements of 35 Ill. Adm. Code 845.630. For this site the minimum number of wells required is deemed sufficient based on the following: 1) The number of wells, placement and screened intervals are based on a hydrogeologic assessment performed for the site; 2) hydrogeologic considerations included aquifer characteristics affecting flow velocity and physical transport processes; 3) available historical groundwater flow data indicate consistent flow conditions over time; 4) Illinois Environmental Protection Agency (IEPA) approved the overall hydrogeologic assessment as part of a larger study.

Certified by: [signature]

Date: 10/29/21

Joshua Davenport, P.E.
Professional Engineer Registration No.: 062-061945
KPRG and Associates, Inc.

JOSHUA D. DAVENPORT
062-061945
LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

Attachment 9-5 – CCR Compliance Statistical Approach

K P R G

E N V I R O N M E N T A L   C O N S U L T A T I O N   &   R E M E D I A T I O N

KPRG and Associates, Inc.

ILLINOIS STATE CCR RULE COMPLIANCE STATISTICAL APPROACH FOR GROUNDWATER DATA EVALUATION

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

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ILLINOIS ▪ WISCONSIN ▪ INDIANA

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1.0 INTRODUCTION

On April 21, 2021, the Illinois Pollution Control Board (IPCB) and Illinois Environmental Protection Agency (Illinois EPA) enacted a final rule regulating coal combustion residuals (CCR) as part of Ill. Adm. Code Title 35, Part 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (State CCR Rule). The State CCR Rule specifically requires that the owner or operator of a CCR unit must develop an Operating Permit that will specify a sampling and analysis program that includes procedures and techniques for sample collection, sample preservation and shipment, analytical procedures, chain of custody (COC) control, and quality assurance and quality control. As a result, each regulated facility must develop a program that meets the State CCR Rule. At the Joliet #29 facility, Ash Pond 2 requires monitoring under the State CCR Rule. The monitoring well network around this pond consists of four monitoring wells (MW-3, MW-4, MW-5 and MW-10 [upgradient]) as shown on Figure 1.

Section 845.640(f) of the State CCR Rule requires the development of the statistical approach that will be used for assessing the data and determining whether a statistically significant increase over background concentrations in groundwater has occurred at identified downgradient monitoring points. Potential statistical methods that can be applied to the data are listed in Section 845.640(f) and performance standards are provided in 845.640(g).

This narrative of the statistical approach that will be used for the Joliet #29 facility's groundwater monitoring data is intended to fulfill certification requirements under Section 845.640(f)(2). The professional engineer's certification of this statistical approach is provided in Section 4.0 of this document.

2.0 STATISTICAL METHOD SELECTION and BACKGROUND DATA EVALUATION

Section 845.640(f)(1) identifies five statistical data evaluation methods that can be used for assessing site groundwater data. Relative to the subject site, the prediction interval procedure identified in 845.640(f)(1)(C) will be used. This approach is robust and conforms to varying data distributions and facilitates various non-detect frequencies. U.S. EPA identifies this method as preferred over establishment of tolerance intervals (Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance, March 2009 [Unified Guidance]).

Total recoverable metals groundwater data has been collected for this site since 2015 as part of Federal CCR Rule requirements. Under the Federal CCR Rule, the initial eight rounds of quarterly data generated were used to develop a representative background concentration with which to develop applicable prediction limits for subsequent statistical downgradient monitoring well data comparisons. Since additional data has been generated since the initial eight rounds of groundwater monitoring under the Federal CCR Rule, the full, currently available data set through the second quarter 2021 will be evaluated for potential use in developing a representative background dataset. If appending this additional data to the original eight rounds of background sampling is determined to be not statistically appropriate, then the background calculations will be reverted to using the initial eight rounds of background data for subsequent calculations. The established, representative background concentration for the upgradient well location (in this case well MW-10) will be used to develop prediction limits for the regulated unit for each constituent listed in Section 845.600(a) and (b) as provided in Table 1.

Statistical evaluations will be performed with the assistance of the Sanitas™ software package.

2.1 Outlier Testing

The background dataset will be first checked for potential outliers for each constituent. Potential causes of outliers can be, but are not limited to:

- Changes in sampling technique;
- Changes in analytical methods;
- Data transcription errors;
- Unnatural localized event such as a spill; or
- Natural but extreme variations in constituent concentration.

The Unified Guidance does not recommend removing an outlier from the data set unless it can be shown that the outlier is not caused by extreme natural variation. If the outlier can be traced to other than natural causes, the data set will be adjusted appropriately.

2.2 Spatial Variability

If more than one background well is being used for the monitored unit, an evaluation of spatial variability will be performed to determine whether the mean concentration of a constituent varies statistically between the background points. This is generally accomplished by performing an Analysis of Variance (ANOVA). If statistically significant spatial variation is determined to be present, the background points will not be combined between the wells. If the spatial variability is determined to be natural, an intrawell data evaluation approach may be considered for both upgradient and downgradient wells.

2.3 Temporal Variability

Temporal variability in groundwater data from a specific monitoring point occurs when a consistent fluctuation of constituent concentrations occurs over time. The most common example is seasonal variation. If such a variation is noted in the data, the dataset should be corrected to account for the trend; however, any such corrections must be applied judiciously and would be completed in accordance with the Unified Guidance recommended procedures.

2.4 Trend Testing

As discussed above, it is intended to expand the initial background dataset collected under the Federal CCR Rule which consisted of eight rounds of quarterly sampling, with any additional data collected for a specific well since that time to facilitate a larger background data set upon which to develop subsequent interwell, and if necessary intrawell, prediction limits. The expanded background dataset for each upgradient well, for each constituent listed in Table 1, will undergo trend analysis to determine if there may be a potential statistically significant trend in the data. Linear regression will be the primary trend analysis tool, however, other methods such Sen's Slope Estimator may also be used. If a statistically significant trend is identified in the larger combined background dataset, the new data cannot be added to the initial background dataset, and only the original eight rounds of data can be used for that well in background development and associated subsequent calculations.

2.5 Test of Normality

The main underlying assumption in parametric data evaluations, such as establishing prediction limits, is that the underlying data distribution is normal. A quick approximation can be made by calculating the Coefficient of Variance (CV) which is the quotient of the standard deviation divided by the sample mean. In general, if this quotient is greater than 1, the underlying data distribution is probably not normal. The new Unified Guidance is more conservative and suggests that if this quotient is greater than 0.5, the dataset may not be normal and a more robust distribution evaluation should be performed. Therefore, for any CV value greater than 0.5 for a specific dataset, normality will be evaluated using the Shapiro-Wilk Test with an alpha (α) value of 0.05 (or 95%).

If the dataset does not pass this initial test, the data will undergo a log transformation and the test will be repeated for the natural log values of the dataset. If it is determined that this dataset is log-normal, statistical evaluations will be completed on those values and the result converted back to the standard value. If the underlying distribution is also determined not to be log-normal, the Unified Guidance provides for a number of other data transformations that can be performed to evaluate whether those underlying distributions may be normal at which point the entire dataset would be transformed for subsequent calculations.

If a normal underlying distribution can not be determined, non-parametric statistical evaluations will need to be considered which do not rely on a specific underlying distribution.

2.6 Non-Detects

It is not uncommon in environmental datasets to have parameters being detected at low concentrations during one sampling event and being not detected in other sampling events. Having a consistent approach to the handling of non-detect values is an important part of the statistical evaluation process. The handling of non-detect values will be accomplished as follows:

- 100 Percent Non-Detects – Assumed that the constituent is not present and no statistical evaluations will be performed. The upper prediction limit will be set at the Reporting Limit (RL) established by the analytical laboratory.

- 50 Percent or Greater Non-Detects – A non-parametric evaluation will be performed where the confidence interval will be constructed using the highest detected concentration as the upper prediction limit.

- 15 to 50 Percent Non-Detects – Aitchison's Adjustment will be used with subsequent parametric or non-parametric evaluations, as appropriate, based on underlying distributions.

- 0 to 15 Percent Non-Detects - The non-detect values will be replaced with RL/2 and the dataset will be evaluated for distribution normality with subsequent parametric or non-parametric evaluations, as appropriate, based on underlying distributions.

2.7 Prediction Limit Calculation for Normally Distributed Data

For datasets where the distribution or underlying transformed distribution is normal, a parametric statistical approach will be used for establishing the prediction limit at the required 95% statistical confidence. In accordance with Unified Guidance, the following equation will be used:

$$95\%\ Prediction\ Limit\ = \bar{x} + t_{1-0.05/m,n-1} s \sqrt{1 + \frac{1}{n}}$$

Where:

$\bar{x}$ = the sample mean of the detected or adjusted results
S = sample standard deviation of the detected or adjusted results
$t_{1-0.05\,/m,n-1}$ = the students t-coefficient for degrees of freedom (n-1) and confidence level (1-0.05/m)
n = the number of samples
m = the number of future samples

The number of future sampling events (*m*) will be set at 2 which will account for one sampling event and a confirmation resampling. This will assist in limiting the potential number of false positives. An acceptable site-wide false positive (SWFP) rate of 10% or less is acceptable under the Unified Guidance.

2.8 Prediction Limit Calculation for Non-Normally Distributed Data

If the dataset distribution or underlying distribution is determined not to be normal, a non-parametric approach will need to be used for the establishment of the prediction limit. The non-parametric evaluation will use the highest detected concentration as the upper prediction limit for the specific constituent.

3.0 GROUNDWATER MONITORING

The State CCR Rule does not distinguish between detection monitoring or assessment monitoring as was defined under the Federal CCR Rule. To meet the requirements set forth in Section 845.650(b), a minimum of eight rounds of groundwater data need to be collected for establishing background. As noted above, if more than eight rounds of data are available, then the larger dataset will be evaluated to determine whether the background dataset can be expanded to provide a more robust statistical assessment. At that point, statistical evaluation of the background dataset will be performed to establish the upper prediction limits for each Section 845.600(a) and (b) constituent. It is noted that in the case of pH, a lower prediction limit will also be established since this parameter has an established upper and lower value range for compliance.

Site specific Groundwater Protection Standards (GWPSs) will be developed in accordance with Section 845.600(a)(2) as follows:

- If the constituent has an established State standard listed in Section 845.600(a)(1) and the standard is greater than the calculated background upper prediction limit, then the standard will serve as the GWPS. If the background upper prediction limit is greater than the standard, the upper prediction limit will serve as the GWPS.

- If the constituent does not have an established standard (i.e., calcium and turbidity) then the calculated upper prediction limit will serve as the GWPS.

Once the proposed GWPSs are determined and approved by Illinois EPA, subsequent downgradient well concentrations will be compared against the upper prediction limit (and lower prediction limit in the case of pH), and the GWPSs. If an exceedance of the GWPS is identified during a quarterly sampling event, an immediate resampling of the specific well(s) will be completed for those specific parameters. If the exceedance is confirmed by the resampling, the Illinois EPA will be notified of the exceedance(s) and the notification will be placed in the facilities operating record in accordance with 845.800(d)(16). It is noted that there are some constituents that historically may have had no detections (i.e., 100% non-detects). In this case, in accordance with the Unified Guidance, if there is a detection of such a constituent, then the Double Quantification Rule will be applied. Under this rule, a confirmed exceedance is registered if any well-constituent pair in the 100% non-detect group exhibits quantified measurements (i.e., at or above the Reporting Limit in two consecutive sample and resample events.

If an exceedance of the GWPS is recorded and reported to Illinois EPA, an Alternate Source Demonstration (ASD) may be completed within 60-days of the confirmed exceedance in accordance with Section 845.650(e) and submitted to the Illinois EPA as well as placing the ASD on the facility's publically accessible CCR website. Illinois EPA will review and approve or disapprove the ASD.

If it is decided not to complete an ASD or if Illinois EPA does not concur with and approve the ASD, a characterization of the nature and extent of the potential release must be completed in accordance with Section 845.650(d)(1) as well as meeting the requirements of Sections 845.660, 845.670 and 845.680.

4.0 CERTIFICATION

In accordance with Section 845.640(f)(2) of the State CCR Rule, I hereby certify based on a review of the information contained within this Illinois State CCR Rule Compliance Statistical Approach for Groundwater Data Evaluation dated August 19, 2021, the statistical procedures developed and selected for evaluation of groundwater data associated with the Midwest Generation Joliet #29 Station CCR Unit are adequate and appropriate for evaluating the groundwater data.

Certified by: ______________________

Date: 8/19/21

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FIGURE

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APPROXIMATE SCALE

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ENVIRONMENTAL CONSULTATION & REMEDIATION

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CCR MONITORING WELLS SITE MAP

JOLIET #29 GENERATING STATION
JOLIET, ILLINOIS

Scale: 1" = 100'	Date: December 27, 2017
KPRG Project No. 12313.0	FIGURE 1

W:\projects\midwest generation\attorney-client privilege\gw evaluations\joliet #29 map.dwg

TABLE

Table 1. Section 845.600 Groundwater Monitoring Parameter List

Parameter	Section 845.600 Standards
Antimony	0.006
Arsenic	0.01
Barium	2
Beryllium	0.004
Boron	2.0
Cadmium	0.005
Chloride	200
Chromium	0.1
Cobalt	0.006
Combined Radium 226 + 228 (pCi/L)	5.0
Fluoride	4.0
Lead	0.0075
Lithium	0.04
Mercury	0.002
Molybdenum	0.10
pH (standard units)	6.5-9.0
Selenium	0.05
Sulfate	400
Thallium	0.002
Total Dissolved Solids	1200
Calcium	NE
Turbidity	NE

All vaues in mg/l unless otherwise specified.
NE- Not Established

Attachment 9-6 – Statistical Evaluation Summary

ATTACHMENT 9-6

BACKGROUND STATISTICAL EVALUATION SUMMARY
STATE RULE CCR GROUNDWATER MONITORING
JOLIET #29 GENERATING STATION

The newly enacted Ill. Adm. Code Title 35, Part 845: Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (State CCR Rule) requires development of proposed Groundwater Protection Standards (GWPSs) for inclusion within the Operating Permit for the regulated surface impoundments at the facility. Upon Illinois Environmental Protection Agency (EPA) review, concurrence and approval of these site-specific proposed GWPSs, subsequent quarterly downgradient groundwater monitoring data will be compared against these standards to determine whether standard quarterly monitoring is to continue or whether additional evaluations need to occur to in accordance with Section 845.650(d), 845.650(e), 845.660 and 845.670. The overall statistical approach to be used for the development of the proposed GWPSs is provided in Attachment 9-5 of the Operating Permit.

The proposed site-specific GWPSs for the Joliet #29 Generating Station are summarized in Table 9-7 in Section 9 of this Operating Permit. The background Prediction Limit values presented in that table were developed, where possible, by combining or "pooling" as many background data points as possible. This includes evaluating whether the initial eight rounds of data generated as part of Federal CCR Rule compliance that was completed between 2015 and 2017 can be combined with subsequent available data from ongoing groundwater monitoring since that time at the upgradient monitoring well location (MW-10). If the combined dataset (original eight rounds of data plus any subsequent data generated since the initial background sampling) at a specific well location (intrawell evaluation) for a specific parameter does not show a statistically significant trend, the data for that specific parameter at that well location can be pooled. If a statistically significant trend in the data is noted to exist, only the original eight rounds of background sampling can be used for subsequent calculations. Ten rounds of turbidity measurements were collected this calendar year (2021) since this was a new state requirement that was not part of the Federal CCR Rule.

Outlier Testing

Outlier tests were performed for all monitoring wells (upgradient and downgradient) in the proposed State CCR monitoring well network for all data available since the start of Federal CCR monitoring. Well MW-10 is the upgradient well. Wells MW-03 through MW-05 are the downgradient monitoring wells. The following statistically significant outliers (dates in parentheses) were noted:

- Barium – MW-03 (5/18/21) and MW-04 (5/18/21)
- Combined Radium – MW-04 (10/28/2015 and 2/10/16)
- Lead – MW-04 (11/2/16)
- Lithium – MW-03 (11/2/16) and MW-10 (4/26/17)

- Molybdenum – MW-04 (5/18/21)
- pH – MW-04 (5/10/16)

Since the outliers cannot be attributed to either lab error, transcription error or field sampling error, the outlier values were not removed from the datasets at this time but may be considered during subsequent data evaluations.

A statistical run summary which includes the specific statistical method used for each parameter for each well is provided at the end of this discussion.

Seasonality/Temporal Variability Testing

Seasonality/temporal variability tests were performed for all monitoring wells (upgradient and downgradient) in the proposed State CCR monitoring well network for all data available since the start of Federal CCR monitoring. No statistically significant seasonal/temporal variations were noted in any of the wells for any of the parameters. A statistical run summary which includes the specific statistical method used for each parameter for each well is provided at the end of this discussion. The turbidity database to date is insufficient to evaluate potential seasonal/temporal variability at this time.

Trend Analysis

To determine whether data generated since the initial eight rounds of background groundwater sampling since the enactment of the Federal Rule can potentially be pooled at the upgradient monitoring well location (MW-10), trend analysis for each constituent at each upgradient well location was performed. The results are summarized as flows:

- MW-10 – Statistically significant trends were noted for calcium, chloride and total dissolved solids (TDS).

A statistical run summary which includes the specific statistical method used for each parameter for each well is provided at the end of this discussion.

Spatial Variability Testing

Since only one upgradient monitoring well is being used for establishing a statistical background, spatial variability testing for the purposes of background calculations is not applicable at this time.

Test of Normality

The Shapiro-Wilk Normality Test with an alpha (α) value of 0.05 (or 95%) was used to evaluate the distribution of the full background dataset for each constituent, which includes all available data through the second quarter 2021, at upgradient well location MW-10. A Test of Ladders was also run to evaluate other potential underlying transformational distributions in the case that the non-transformed dataset was found not to be normally distributed. For all constituents the data distribution or underlying transformed data distribution, were found to be normal with the exception of antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, mercury, selenium and thallium. The various distributions or underlying transformed distributions for these parameters were found not to be normal due to the large number of non-detect values and will need to be handled through non-parametric analysis methods. The statistical run summary is at the end of this discussion.

Prediction Limits

Based on the various statistical evaluations discussed above, the following background data sets were used for background prediction limit calculations:

- Upgradient well MW-10 all parameter values pooled for all constituents through the second quarter 2021 except calcium, chloride and TDS. These datasets did not show any statistically significant trends or temporal variation in the expanded datasets.
- Upgradient well MW-10 original eight background values were used for calcium, chloride and TDS since there were noted statistically significant trends in the expanded datasets.
- Upgradient well MW-10 all ten turbidity measurements were used since no statistically significant trend was noted in the data.

The calculated prediction limits (PLs) under the above background dataset selection scenarios are summarized in Table 9-7 in Section 9 of this permit application. A prediction limit statistical run summary which includes the specific statistical method used for each parameter is provided at the end of this discussion.

Outlier Analysis - Joliet #29 - All CCR Wells

Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29   Printed 8/8/2021, 9:59 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.003	0	unknown	ShapiroWilk
Antimony (mg/L)	MW-04	n/a	n/a	n/a	NP (nrm)	NaN	12	0.003	0	unknown	ShapiroWilk
Antimony (mg/L)	MW-05	n/a	n/a	n/a	NP (nrm)	NaN	12	0.003	0	unknown	ShapiroWilk
Antimony (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.003	0	unknown	ShapiroWilk
Arsenic (mg/L)	MW-03	No	n/a	n/a	EPA 1989	0.05	12	0.0016	0.0003015	normal	ShapiroWilk
Arsenic (mg/L)	MW-04	No	n/a	n/a	EPA 1989	0.05	12	0.001658	0.0003825	ln(x)	ShapiroWilk
Arsenic (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	12	0.001608	0.0005869	normal	ShapiroWilk
Arsenic (mg/L)	MW-10 (bg)	No	n/a	n/a	NP (nrm)	NaN	12	0.001175	0.0002598	unknown	ShapiroWilk
Barium (mg/L)	**MW-03**	**Yes**	**0.14**	**5/18/2021**	**Dixon`s**	**0.05**	**12**	**0.09942**	**0.01466**	**normal**	**ShapiroWilk**
Barium (mg/L)	**MW-04**	**Yes**	**0.12**	**5/18/2021**	**Dixon`s**	**0.05**	**12**	**0.08867**	**0.01203**	**normal**	**ShapiroWilk**
Barium (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	12	0.06733	0.01459	normal	ShapiroWilk
Barium (mg/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	12	0.04258	0.00709	normal	ShapiroWilk
Beryllium (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.001	0	unknown	ShapiroWilk
Beryllium (mg/L)	MW-04	n/a	n/a	n/a	NP (nrm)	NaN	12	0.001	0	unknown	ShapiroWilk
Beryllium (mg/L)	MW-05	n/a	n/a	n/a	NP (nrm)	NaN	12	0.001	0	unknown	ShapiroWilk
Beryllium (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.001	0	unknown	ShapiroWilk
Boron (mg/L)	MW-03	No	n/a	n/a	EPA 1989	0.05	17	0.4006	0.08555	normal	ShapiroWilk
Boron (mg/L)	MW-04	No	n/a	n/a	EPA 1989	0.05	19	0.3926	0.1551	ln(x)	ShapiroWilk
Boron (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	17	0.4776	0.197	ln(x)	ShapiroWilk
Boron (mg/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	19	0.4374	0.1443	ln(x)	ShapiroWilk
Cadmium (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0005	0	unknown	ShapiroWilk
Cadmium (mg/L)	MW-04	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0005	0	unknown	ShapiroWilk
Cadmium (mg/L)	MW-05	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0005	0	unknown	ShapiroWilk
Cadmium (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0005	0	unknown	ShapiroWilk
Calcium (mg/L)	MW-03	No	n/a	n/a	NP (nrm)	NaN	17	101.7	10.75	unknown	ShapiroWilk
Calcium (mg/L)	MW-04	No	n/a	n/a	NP (nrm)	NaN	17	101.1	10.55	unknown	ShapiroWilk
Calcium (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	18	114.8	27.05	normal	ShapiroWilk
Calcium (mg/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	18	112.1	18.78	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-03	No	n/a	n/a	EPA 1989	0.05	17	213.5	42.56	normal	ShapiroWilk
Chloride (mg/L)	MW-04	No	n/a	n/a	EPA 1989	0.05	18	216.1	49.96	normal	ShapiroWilk
Chloride (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	19	221.5	113.2	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	19	227.9	86.77	ln(x)	ShapiroWilk
Chromium (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.005008	0.0000...	unknown	ShapiroWilk
Chromium (mg/L)	MW-04	n/a	n/a	n/a	NP (nrm)	NaN	12	0.007917	0.0101	unknown	ShapiroWilk
Chromium (mg/L)	MW-05	n/a	n/a	n/a	NP (nrm)	NaN	12	0.005108	0.000345	unknown	ShapiroWilk
Chromium (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.005	0	unknown	ShapiroWilk
Cobalt (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.001008	0.0000...	unknown	ShapiroWilk
Cobalt (mg/L)	MW-04	No	n/a	n/a	EPA 1989	0.05	12	0.0076	0.003815	normal	ShapiroWilk
Cobalt (mg/L)	MW-05	n/a	n/a	n/a	NP (nrm)	NaN	12	0.00105	0.0001168	unknown	ShapiroWilk
Cobalt (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.001	0	unknown	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	MW-03	No	n/a	n/a	NP (nrm)	NaN	11	0.6191	0.4393	unknown	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	**MW-04**	**Yes**	**0.741,1.52**	**10/28/201...**	**Dixon`s**	**0.05**	**11**	**0.5169**	**0.3544**	**normal**	**ShapiroWilk**
Combined Radium 226 + 228 (pCi/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	11	0.5354	0.2161	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	11	0.4169	0.08566	normal	ShapiroWilk
Fluoride (mg/L)	MW-03	No	n/a	n/a	EPA 1989	0.05	17	0.4153	0.02348	normal	ShapiroWilk
Fluoride (mg/L)	MW-04	No	n/a	n/a	NP (nrm)	NaN	17	0.4359	0.03144	unknown	ShapiroWilk
Fluoride (mg/L)	MW-05	No	n/a	n/a	NP (nrm)	NaN	17	0.3759	0.06727	unknown	ShapiroWilk
Fluoride (mg/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	17	0.4047	0.03145	normal	ShapiroWilk
Lead (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0005	0	unknown	ShapiroWilk
Lead (mg/L)	**MW-04**	**Yes**	**0.0012**	**11/2/2016**	**NP (nrm)**	**NaN**	**12**	**0.000595**	**0.000207**	**unknown**	**ShapiroWilk**

Outlier Analysis - Joliet #29 - All CCR Wells

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29 Printed 8/8/2021, 9:59 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Lead (mg/L)	MW-05	No	n/a	n/a	NP (nrm)	NaN	12	0.00115	0.0007799	unknown	ShapiroWilk
Lead (mg/L)	MW-10 (bg)	No	n/a	n/a	NP (nrm)	NaN	12	0.000...	0.0003144	unknown	ShapiroWilk
Lithium (mg/L)	**MW-03**	**Yes**	**0.005**	**11/2/2016**	**Dixon`s**	**0.05**	**12**	**0.01117**	**0.00225**	**normal**	**ShapiroWilk**
Lithium (mg/L)	MW-04	No	n/a	n/a	EPA 1989	0.05	12	0.01258	0.001165	normal	ShapiroWilk
Lithium (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	12	0.01408	0.005583	normal	ShapiroWilk
Lithium (mg/L)	**MW-10 (bg)**	**Yes**	**0.005**	**4/26/2017**	**Dixon`s**	**0.05**	**12**	**0.0115**	**0.002505**	**normal**	**ShapiroWilk**
Mercury (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0002	0	unknown	ShapiroWilk
Mercury (mg/L)	MW-04	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0002	0	unknown	ShapiroWilk
Mercury (mg/L)	MW-05	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0002	0	unknown	ShapiroWilk
Mercury (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0002	0	unknown	ShapiroWilk
Molybdenum (mg/L)	MW-03	No	n/a	n/a	NP (nrm)	NaN	12	0.005733	0.002192	unknown	ShapiroWilk
Molybdenum (mg/L)	**MW-04**	**Yes**	**0.0025**	**5/18/2021**	**Dixon`s**	**0.05**	**12**	**0.007017**	**0.001743**	**normal**	**ShapiroWilk**
Molybdenum (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	12	0.00605	0.002842	normal	ShapiroWilk
Molybdenum (mg/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	12	0.006342	0.0008898	normal	ShapiroWilk
pH (n/a)	MW-03	No	n/a	n/a	EPA 1989	0.05	17	7.243	0.1543	normal	ShapiroWilk
pH (n/a)	**MW-04**	**Yes**	**6.71**	**5/10/2016**	**Dixon`s**	**0.05**	**17**	**7.223**	**0.1744**	**normal**	**ShapiroWilk**
pH (n/a)	MW-05	No	n/a	n/a	EPA 1989	0.05	17	7.183	0.1793	normal	ShapiroWilk
pH (n/a)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	17	7.151	0.1617	normal	ShapiroWilk
Selenium (mg/L)	MW-03	No	n/a	n/a	NP (nrm)	NaN	12	0.00355	0.001102	unknown	ShapiroWilk
Selenium (mg/L)	MW-04	n/a	n/a	n/a	NP (nrm)	NaN	12	0.002575	0.0001765	unknown	ShapiroWilk
Selenium (mg/L)	MW-05	No	n/a	n/a	NP (nrm)	NaN	12	0.0064	0.006791	unknown	ShapiroWilk
Selenium (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.0025	0	unknown	ShapiroWilk
Sulfate (mg/L)	MW-03	No	n/a	n/a	EPA 1989	0.05	20	113.7	38.23	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-04	No	n/a	n/a	EPA 1989	0.05	19	116.8	37.08	normal	ShapiroWilk
Sulfate (mg/L)	MW-05	No	n/a	n/a	EPA 1989	0.05	18	128.7	60.87	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	18	109.8	37.14	ln(x)	ShapiroWilk
Thallium (mg/L)	MW-03	n/a	n/a	n/a	NP (nrm)	NaN	12	0.002	0	unknown	ShapiroWilk
Thallium (mg/L)	MW-04	n/a	n/a	n/a	NP (nrm)	NaN	12	0.002	0	unknown	ShapiroWilk
Thallium (mg/L)	MW-05	n/a	n/a	n/a	NP (nrm)	NaN	12	0.002	0	unknown	ShapiroWilk
Thallium (mg/L)	MW-10 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	12	0.002	0	unknown	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-03	No	n/a	n/a	EPA 1989	0.05	19	879.5	153.5	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-04	No	n/a	n/a	EPA 1989	0.05	20	866	138.9	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-05	No	n/a	n/a	NP (nrm)	NaN	20	875.5	207.8	unknown	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-10 (bg)	No	n/a	n/a	NP (nrm)	NaN	20	856.5	160.7	unknown	ShapiroWilk

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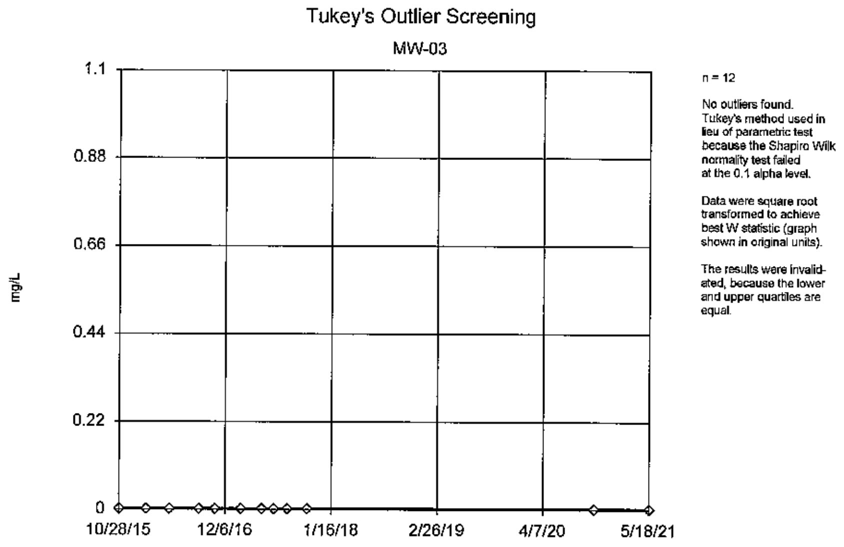

Constituent: Antimony Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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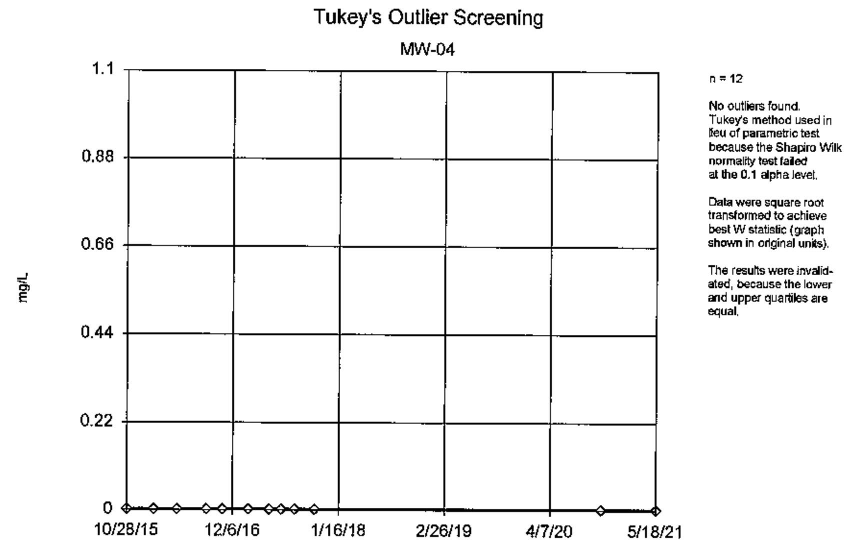

Constituent: Antimony Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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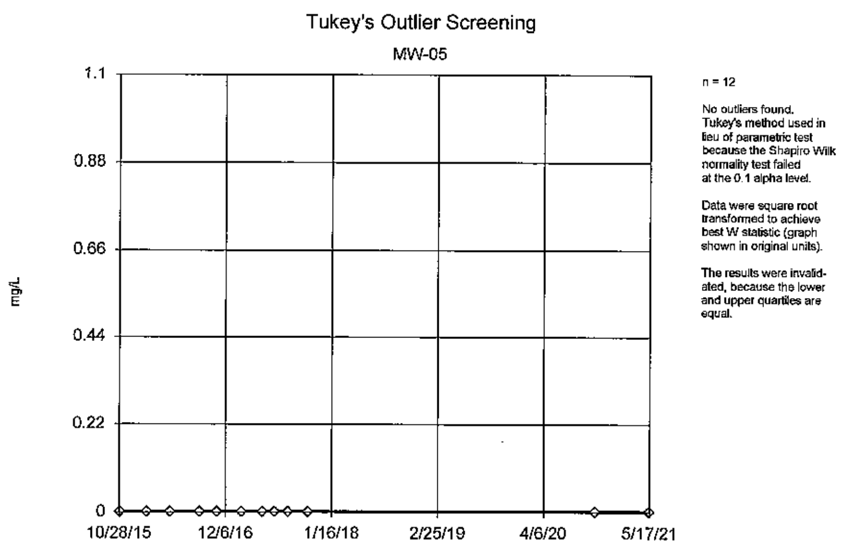

Constituent: Antimony Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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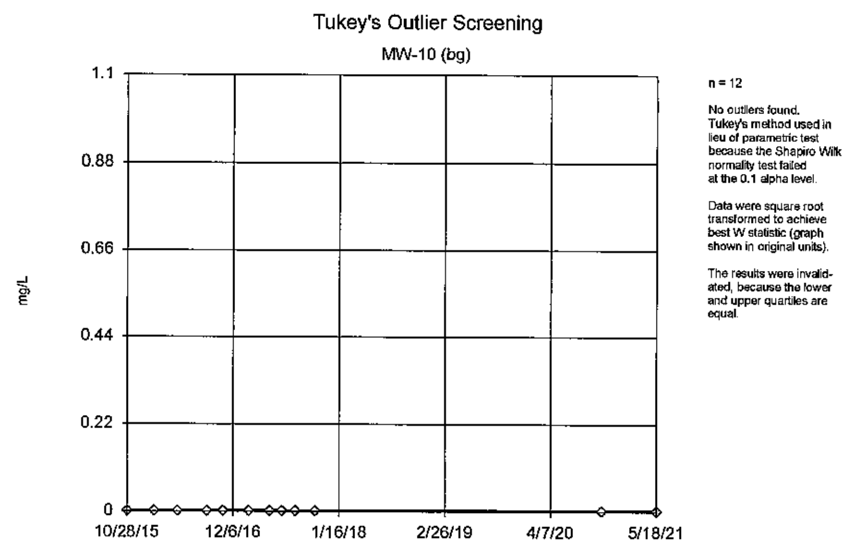
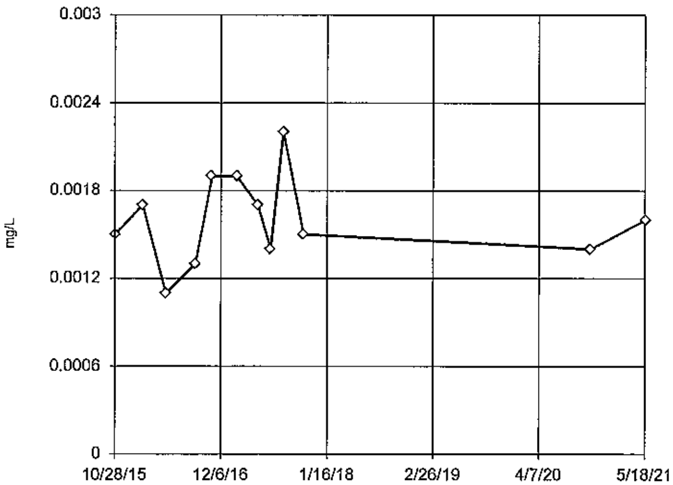


Constituent: Antimony Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 12

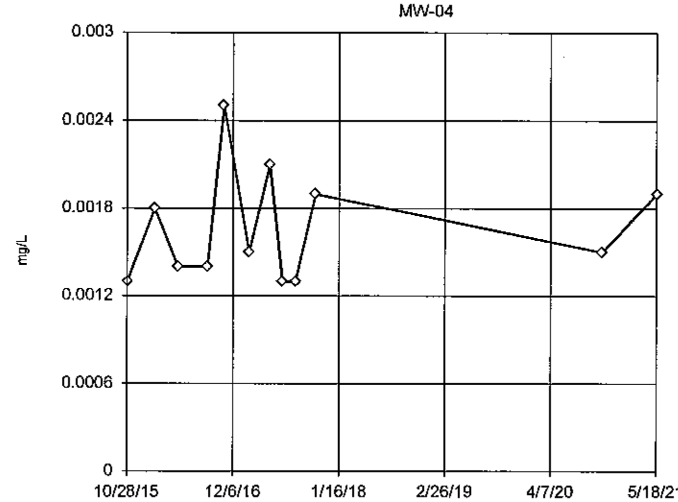
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.0016, std. dev. 0.0003015, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9764
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Arsenic Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-04



n = 12

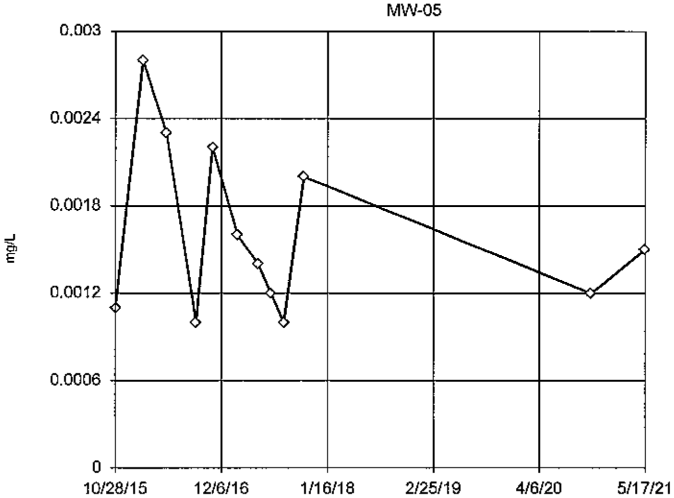
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.001658, std. dev. 0.0003825, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8891
Critical = 0.883 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Arsenic Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 12

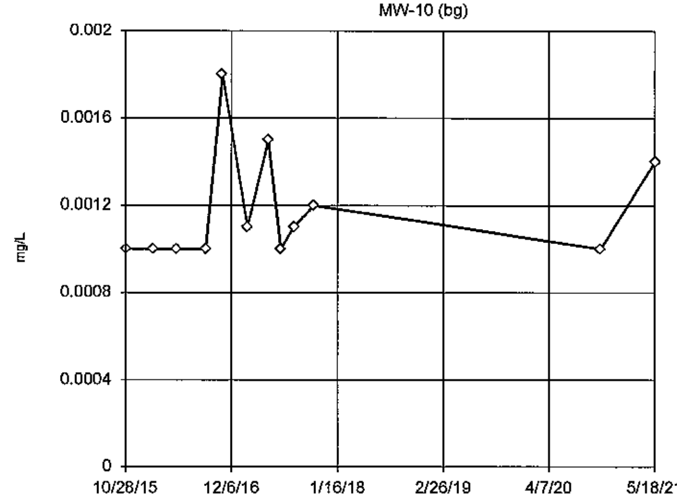
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.001608, std. dev. 0.0005869, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8961
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Arsenic Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Tukey's Outlier Screening

MW-10 (bg)



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.002822, low cutoff = 0.0004592, based on IQR multiplier of 3.

Constituent: Arsenic Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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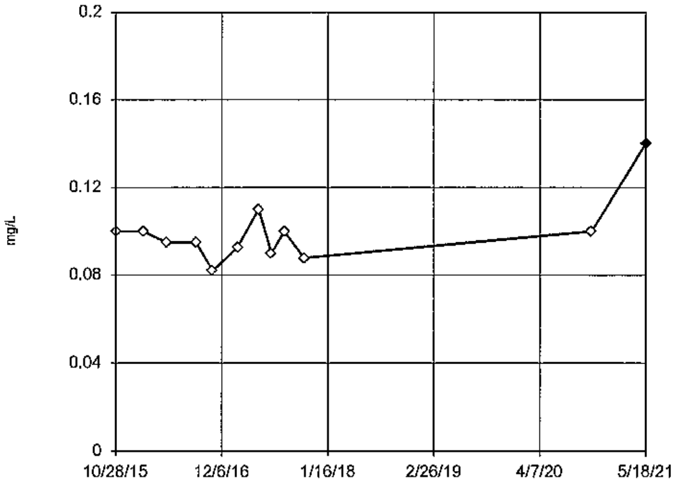
Dixon's Outlier Test

MW-03



n = 12

Statistical outlier is drawn as solid.
Testing for 1 high outlier.
Mean = 0.09942.
Std. Dev. = 0.01466.
0.14: c = 0.7692
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9563
Critical = 0.876
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Barium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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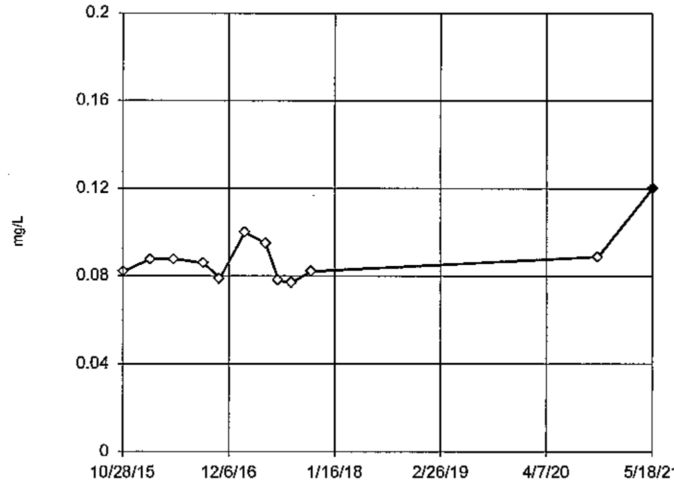
Dixon's Outlier Test

MW-04



n = 12

Statistical outlier is drawn as solid.
Testing for 1 high outlier.
Mean = 0.08867.
Std. Dev. = 0.01203.
0.12: c = 0.5952
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9358
Critical = 0.876
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Barium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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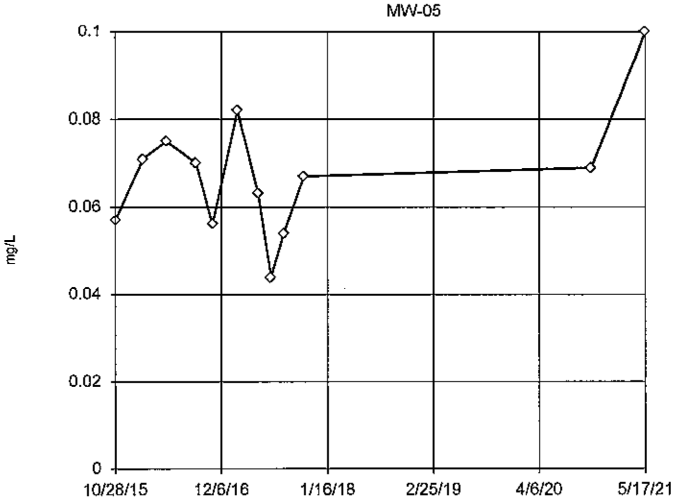
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.06733, std. dev. 0.01459, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9581
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Barium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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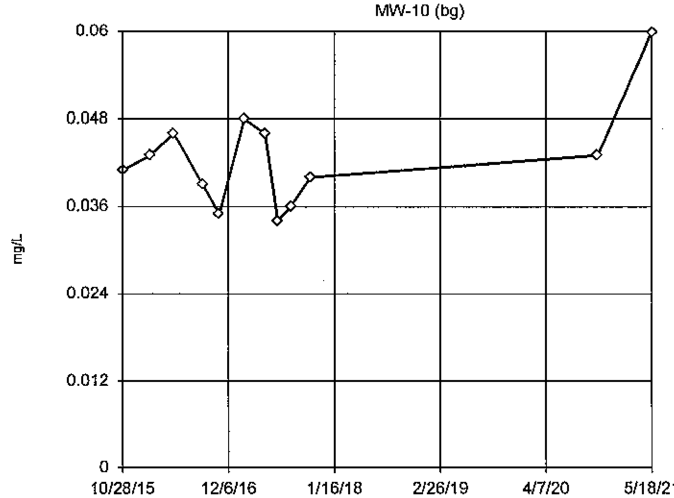
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)

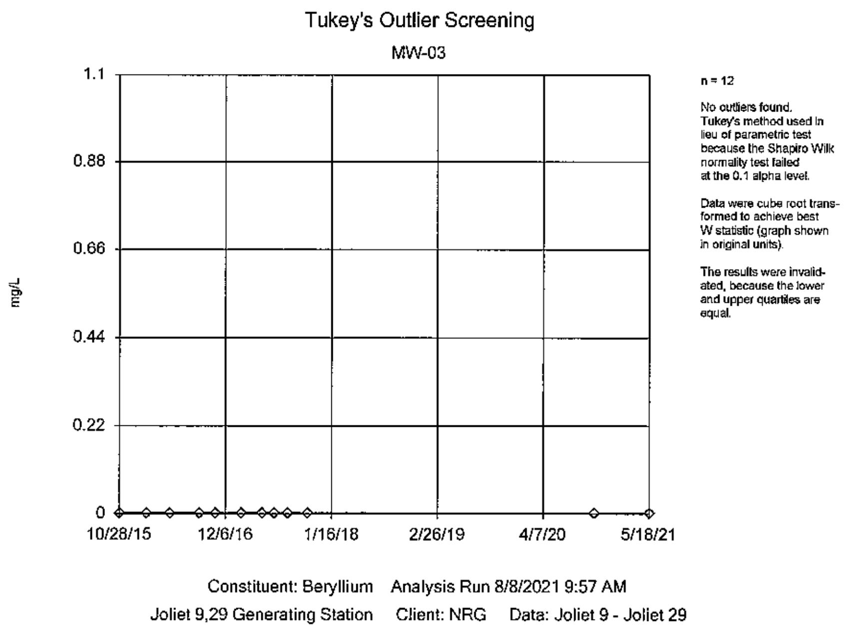


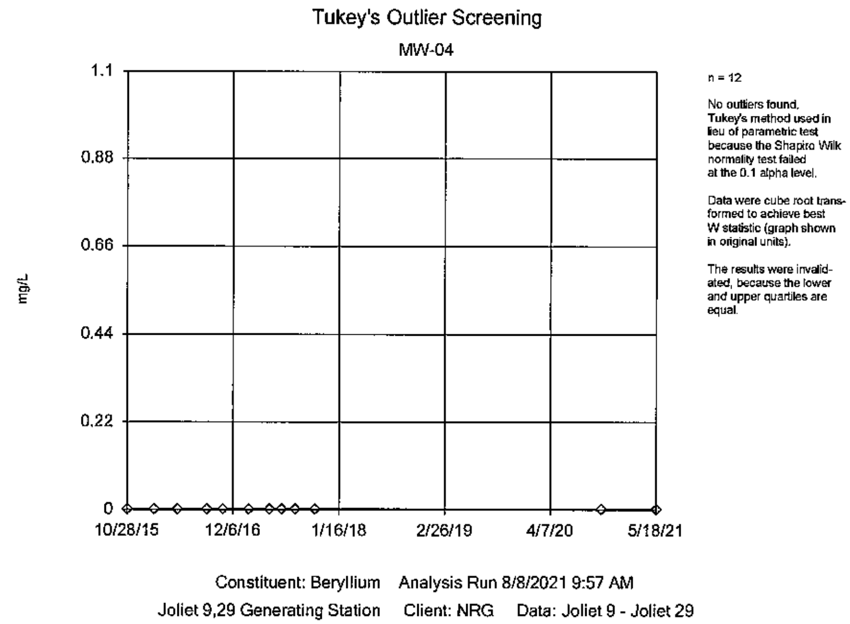
n = 12

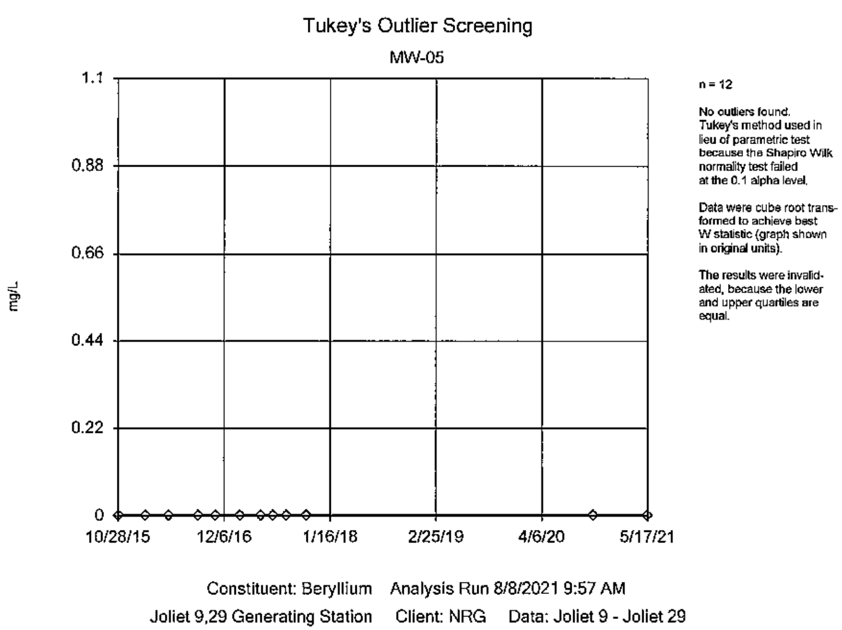
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.04258, std. dev. 0.00709, critical Tn 2.285

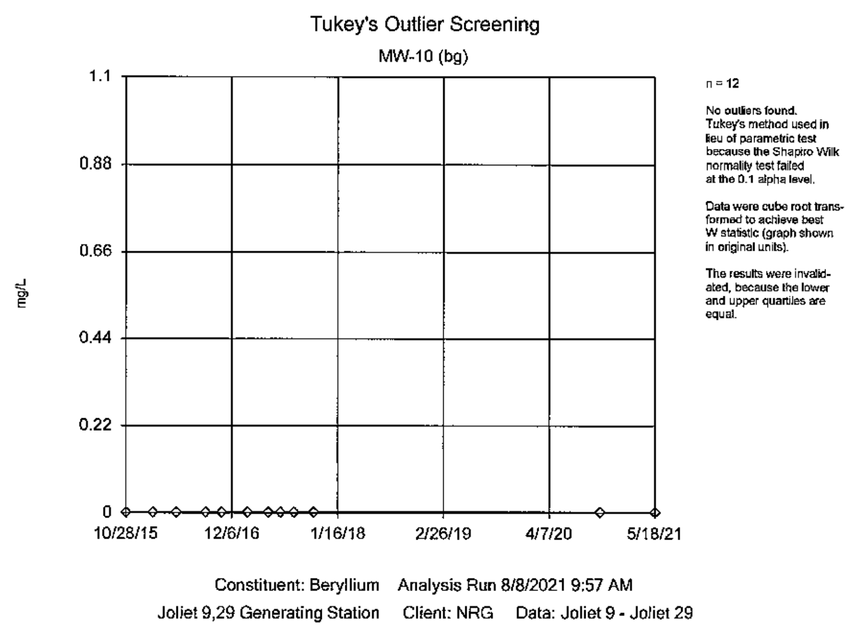
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9036
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Barium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Tukey's Outlier Screening
MW-03
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Beryllium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Tukey's Outlier Screening
MW-04
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Beryllium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Tukey's Outlier Screening
MW-05
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/25/19
4/6/20
5/17/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Beryllium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Tukey's Outlier Screening
MW-10 (bg)
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Beryllium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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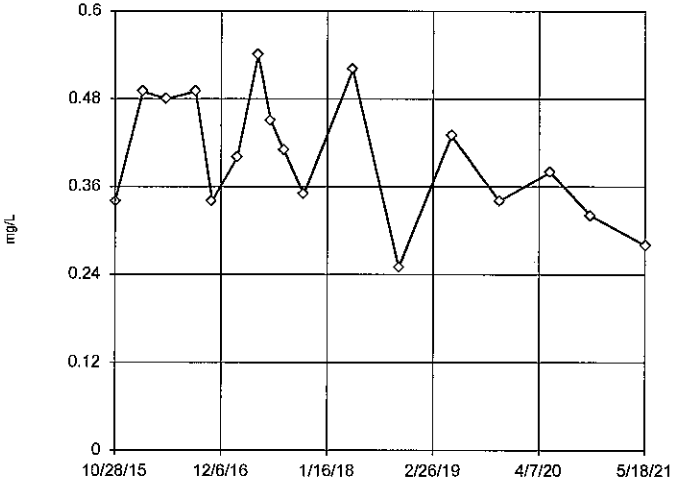
EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.4006, std. dev. 0.08555, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9644
Critical = 0.91
The distribution was found to be normally distributed.

Constituent: Boron Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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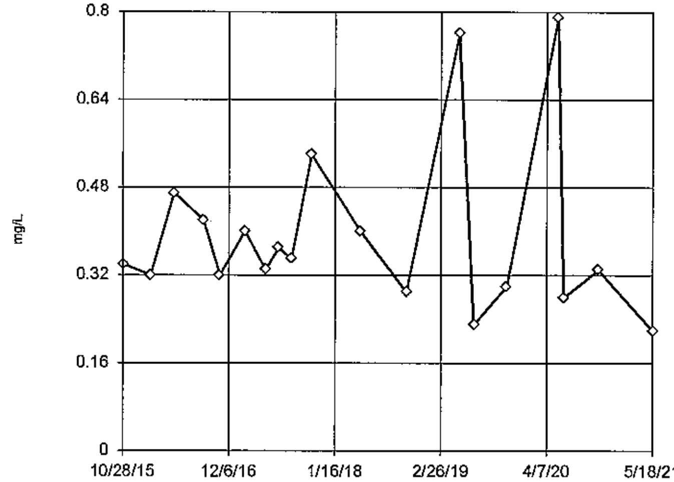
EPA Screening (suspected outliers for Dixon's Test)

MW-04



n = 19

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.3926, std. dev. 0.1551, critical Tn 2.532

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9189
Critical = 0.917 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Boron Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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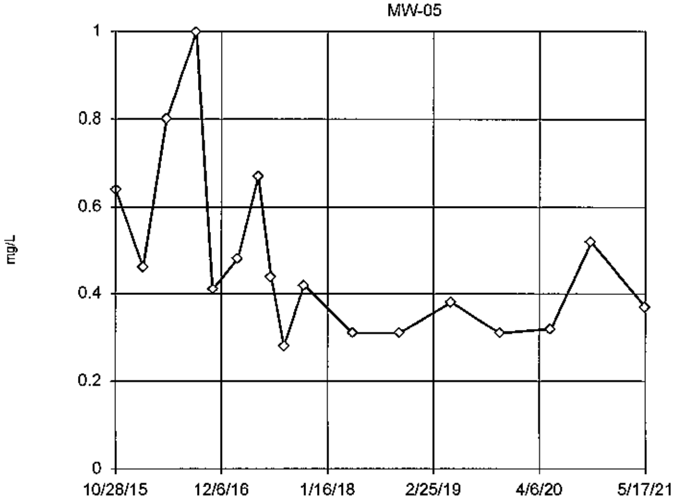
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.4776, std. dev. 0.197, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9293
Critical = 0.91 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Boron Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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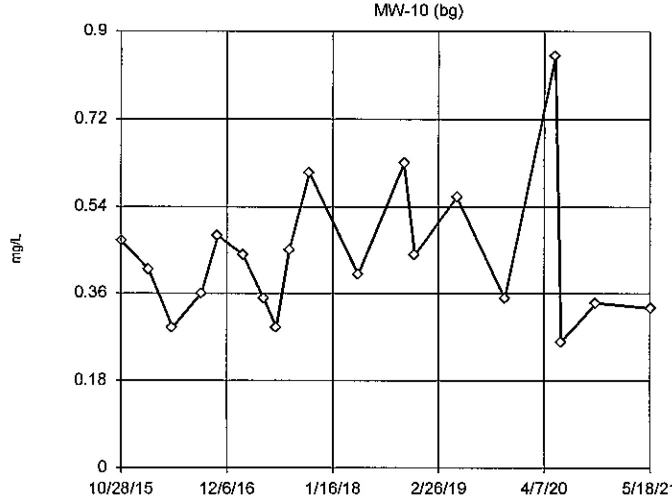
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



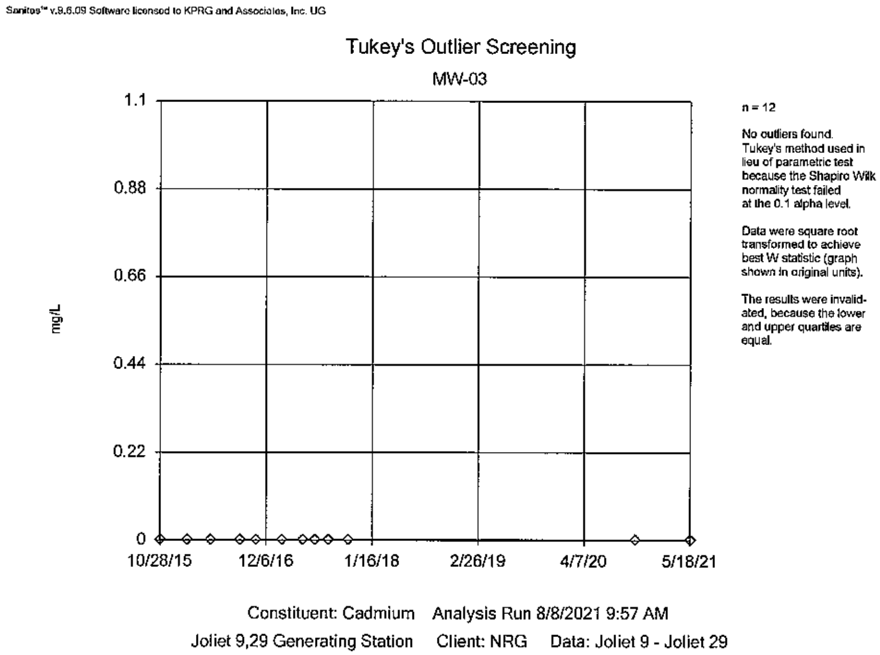
n = 19

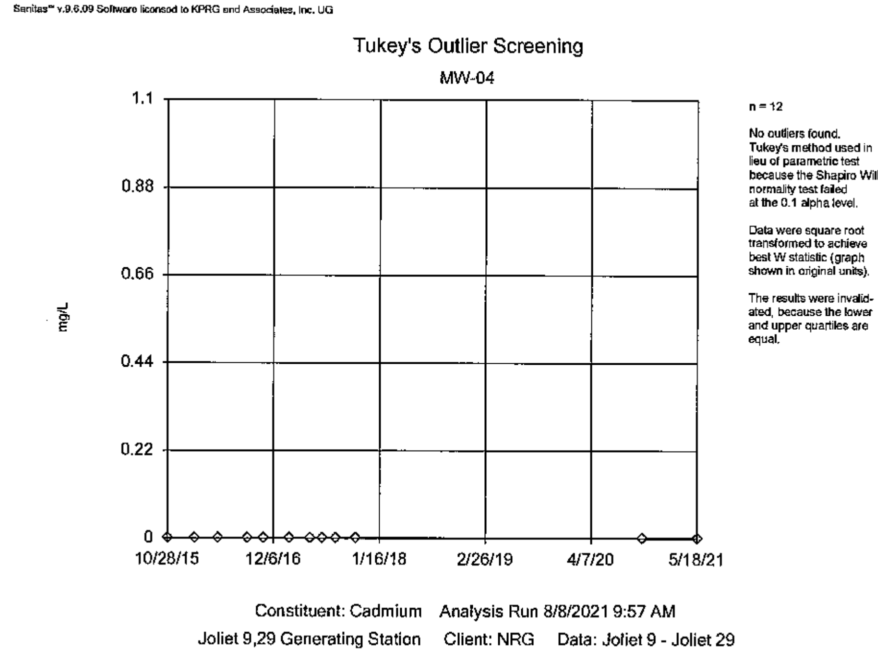
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.4374, std. dev. 0.1443, critical Tn 2.532

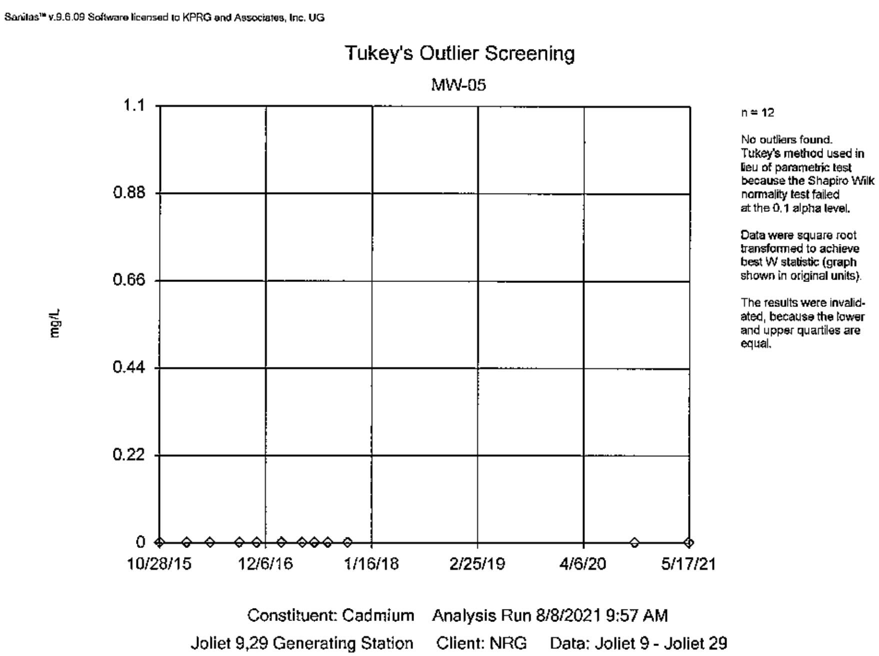
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9662
Critical = 0.917 (after natural log transformation)
The distribution was found to be log-normal.

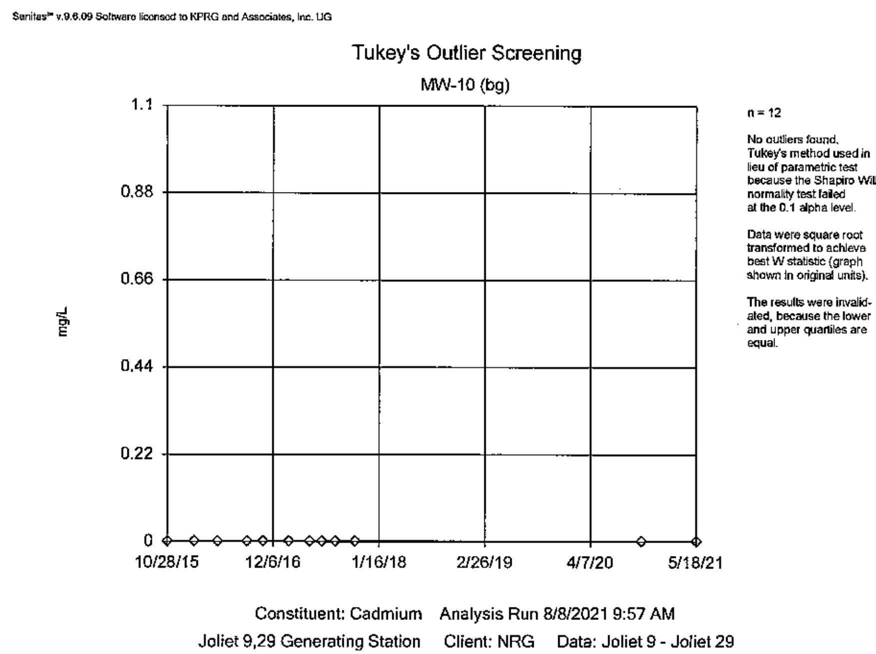
Constituent: Boron Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Tukey's Outlier Screening
MW-03
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Cadmium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

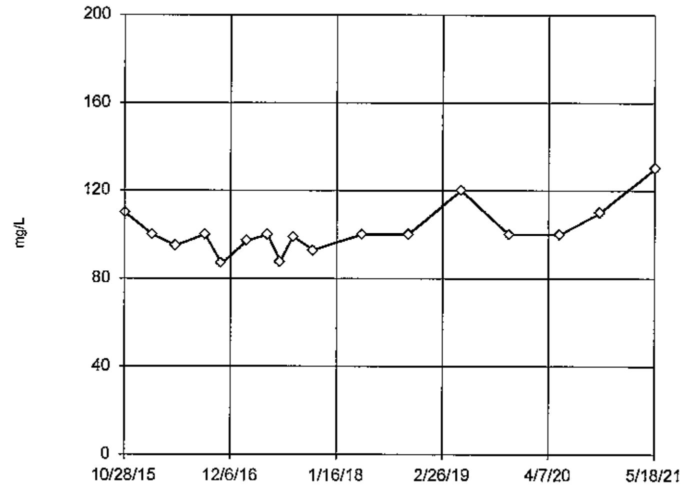

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Tukey's Outlier Screening
MW-04
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Cadmium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Tukey's Outlier Screening
MW-05
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/25/19
4/6/20
5/17/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Cadmium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Tukey's Outlier Screening
MW-10 (bg)
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Cadmium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Tukey's Outlier Screening

MW-03



n = 17

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

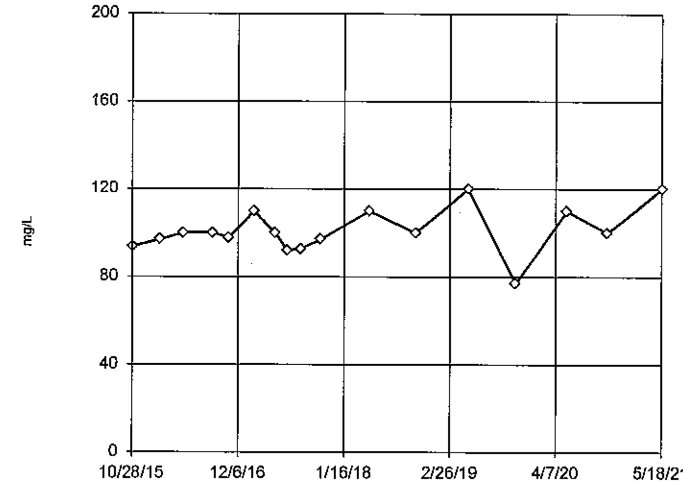
High cutoff = 136.8, low cutoff = 73.6, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Tukey's Outlier Screening

MW-04



n = 17

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

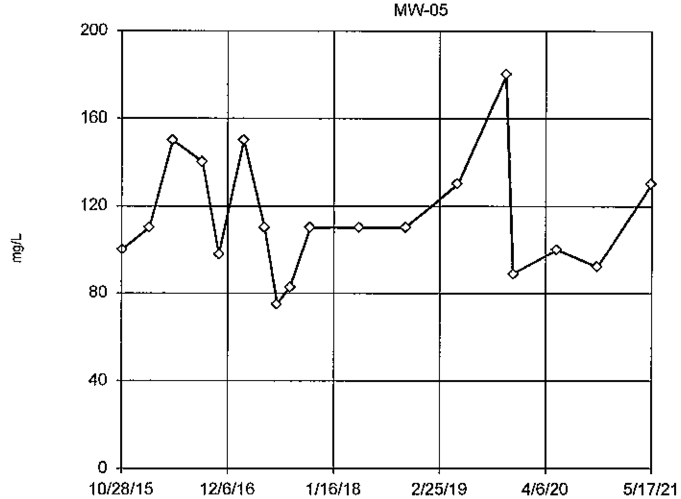
High cutoff = 153.5, low cutoff = 52, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 18

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 114.8, std. dev. 27.05, critical Tn 2.504

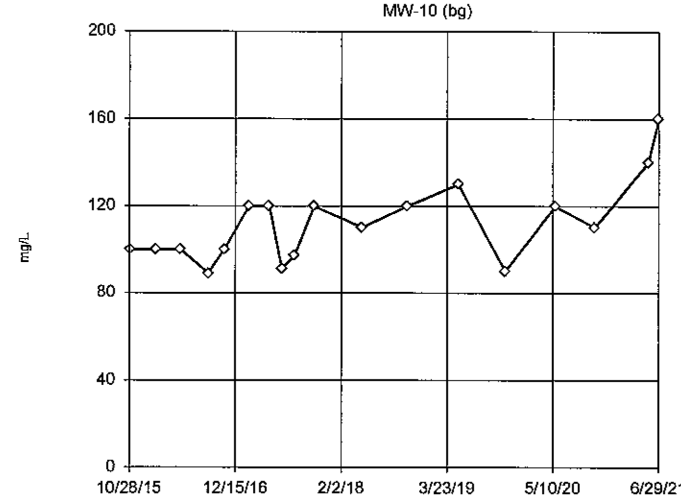
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9358
Critical = 0.914
The distribution was found to be normally distributed.

Constituent: Calcium Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



n = 18

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 112.1, std. dev. 18.78, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9362
Critical = 0.914 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Calcium Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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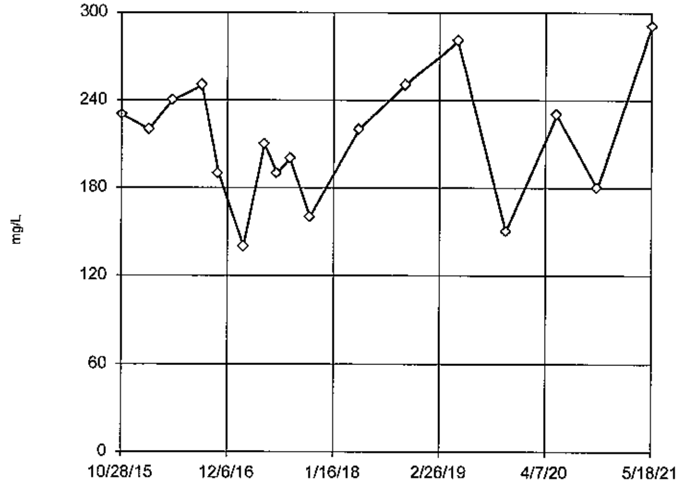
EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 213.5, std. dev. 42.56, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9787
Critical = 0.91
The distribution was found to be normally distributed.

Constituent: Chloride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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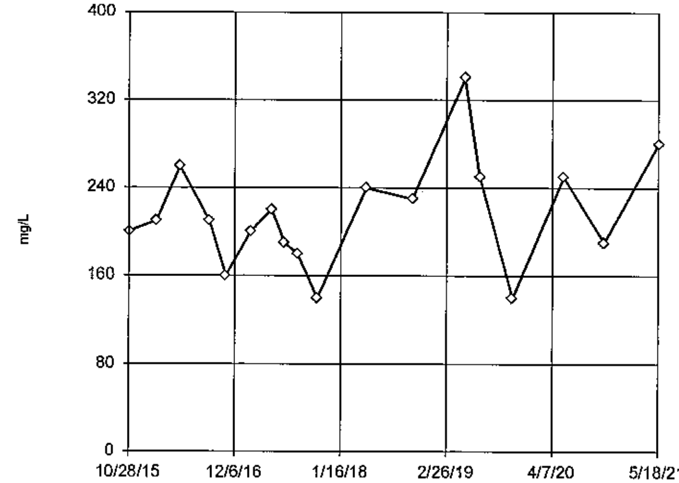
EPA Screening (suspected outliers for Dixon's Test)

MW-04



n = 18

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 216.1, std. dev. 49.96, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9616
Critical = 0.914
The distribution was found to be normally distributed.

Constituent: Chloride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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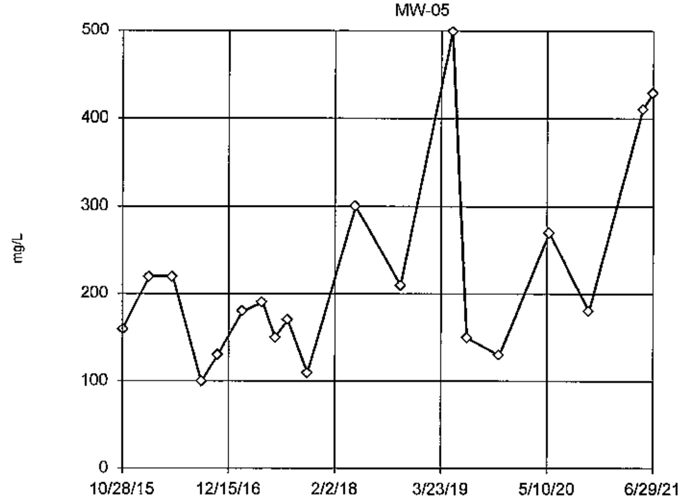
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 19

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 221.5, std. dev. 113.2, critical Tn 2.532

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9488
Critical = 0.917 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Chloride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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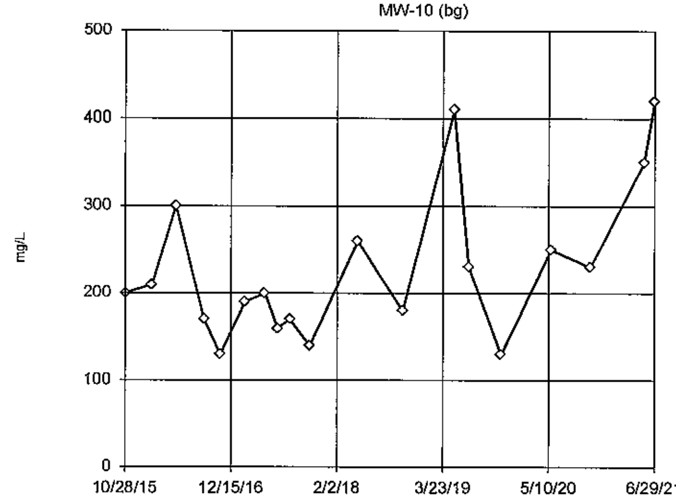
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



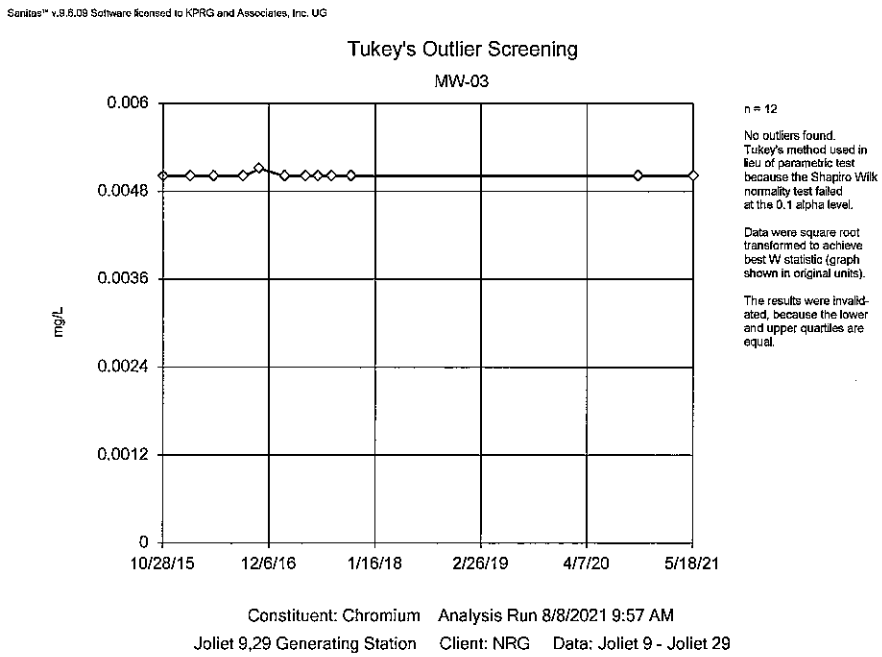
n = 19

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 227.9, std. dev. 86.77, critical Tn 2.532

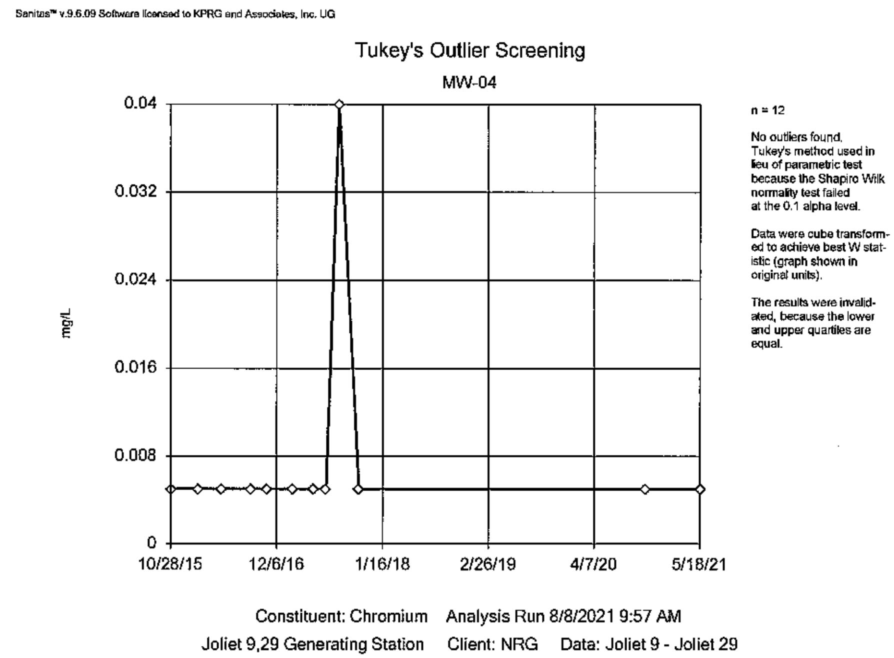
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9492
Critical = 0.917 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Chloride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29



Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Tukey's Outlier Screening
MW-03
0.006
0.0048
0.0036
0.0024
0.0012
0
mg/L
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Chromium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29



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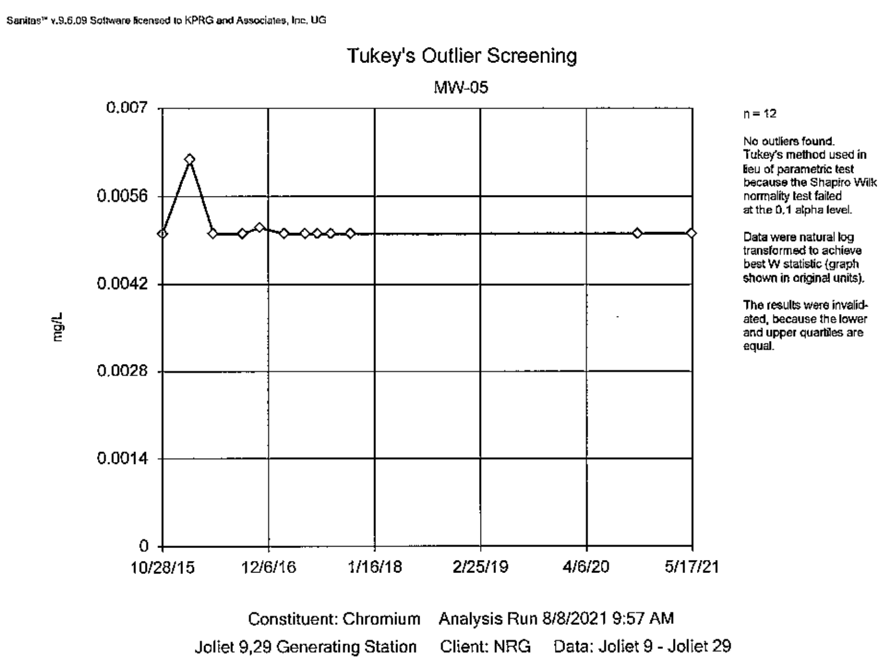
Tukey's Outlier Screening
MW-04
0.04
0.032
0.024
0.016
0.008
0
mg/L
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were cube transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Chromium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29



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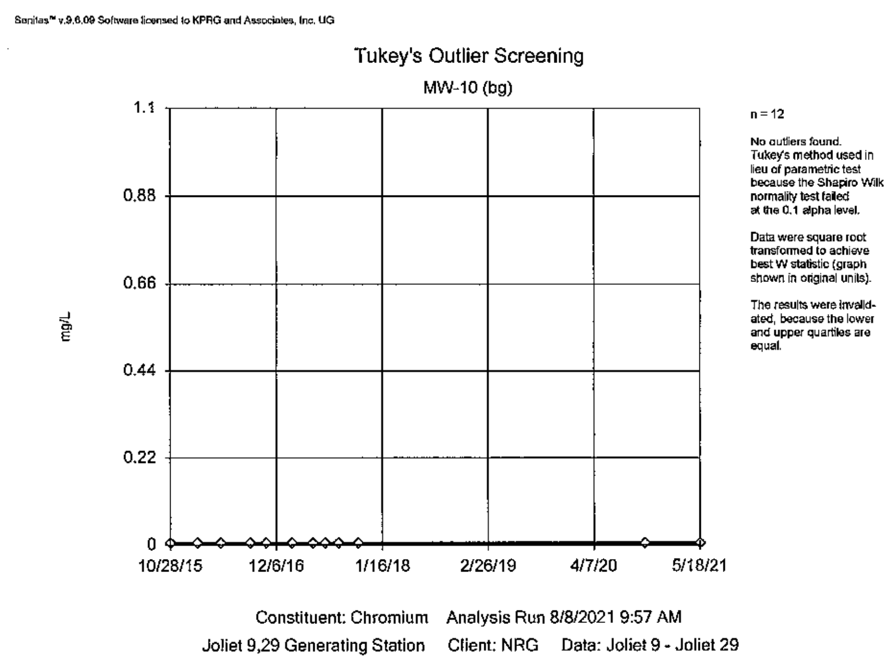
Tukey's Outlier Screening
MW-05
0.007
0.0056
0.0042
0.0028
0.0014
0
mg/L
10/28/15
12/6/16
1/16/18
2/25/19
4/6/20
5/17/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Chromium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29



Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Tukey's Outlier Screening
MW-10 (bg)
1.1
0.88
0.66
0.44
0.22
0
mg/L
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Chromium Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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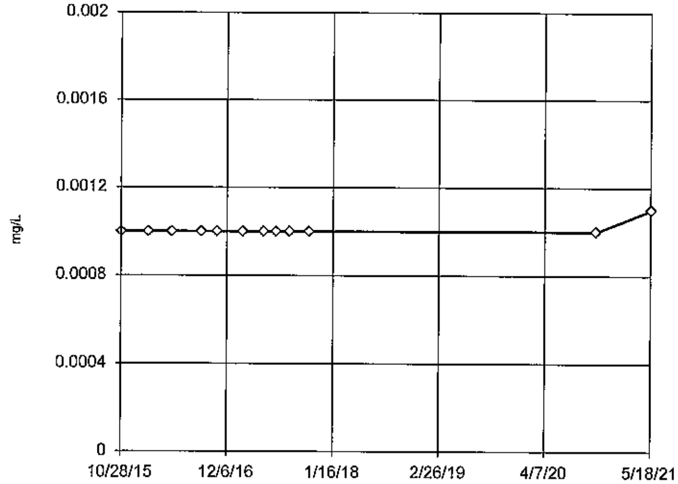
Tukey's Outlier Screening

MW-03



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cobalt Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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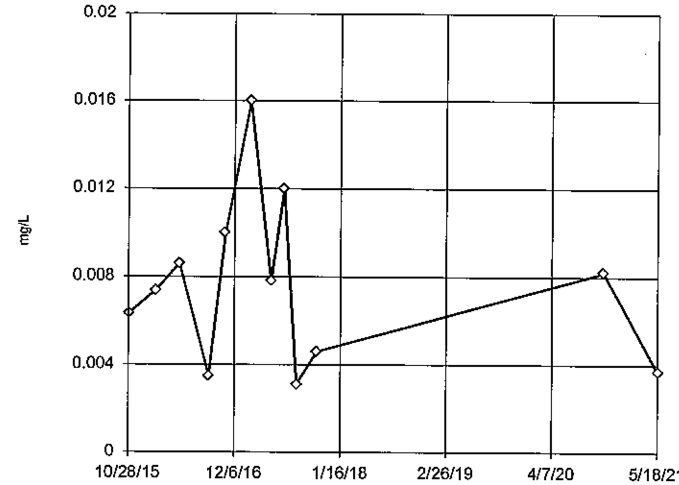
EPA Screening (suspected outliers for Dixon's Test)

MW-04



n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.0076, std. dev. 0.003815, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9282
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Cobalt Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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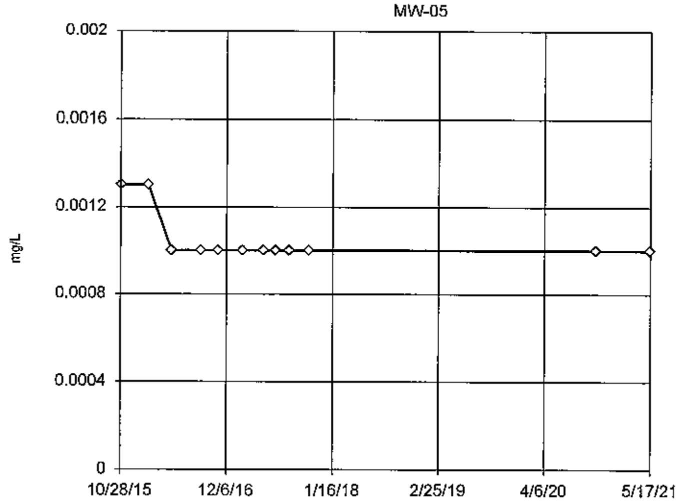
Tukey's Outlier Screening

MW-05



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cobalt Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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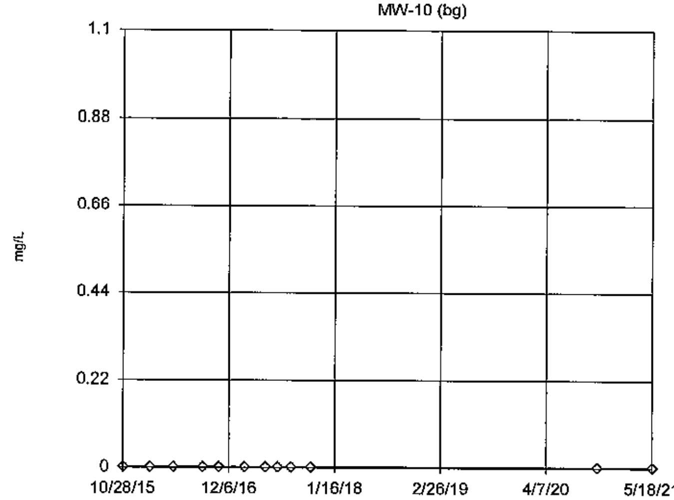
Tukey's Outlier Screening

MW-10 (bg)



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cobalt Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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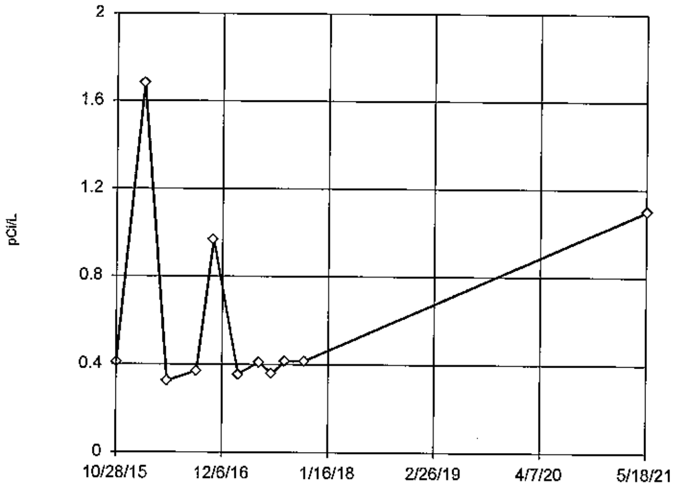
Tukey's Outlier Screening

MW-03



n = 11

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 18.9, low cutoff = 0.01828, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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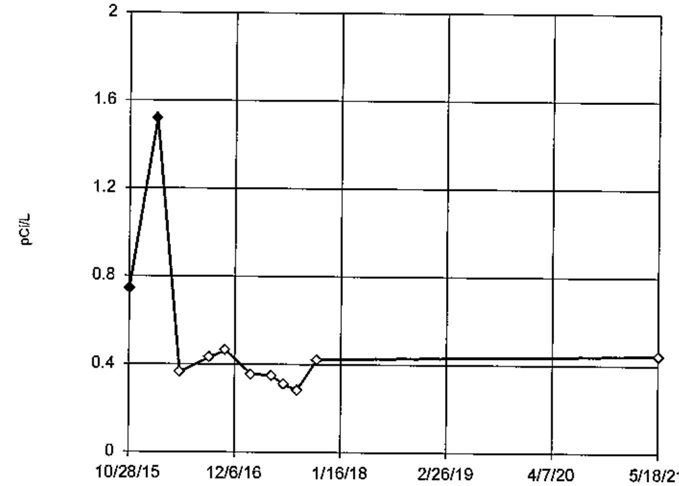
Dixon's Outlier Test

MW-04



n = 11

Statistical outliers are drawn as solid.
Testing for 2 high outliers.
Mean = 0.5169.
Std. Dev. = 0.3544.
0.741: c = 0.6852
tabl = 0.576.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9376
Critical = 0.859
The distribution, after removal of suspect values, was found to be normally distributed.

Constituent: Combined Radium 226 + 228 Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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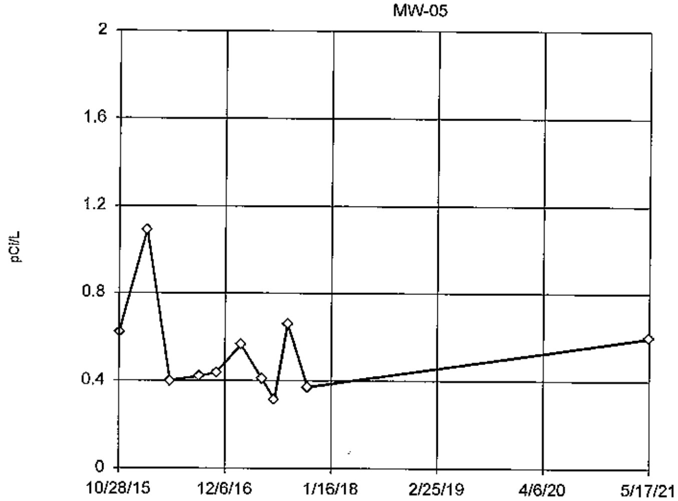
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 11

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.5354, std. dev. 0.2161, critical Tn 2.234

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9228
Critical = 0.876 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Combined Radium 226 + 228 Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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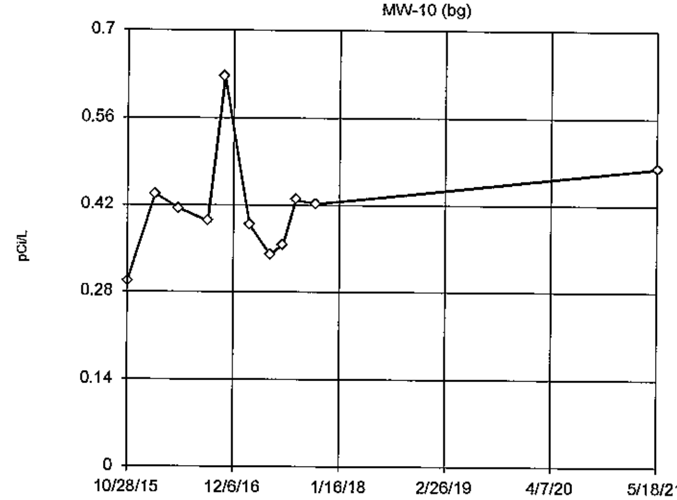
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



n = 11

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.4169, std. dev. 0.08566, critical Tn 2.234

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8951
Critical = 0.876
The distribution was found to be normally distributed.

Constituent: Combined Radium 226 + 228 Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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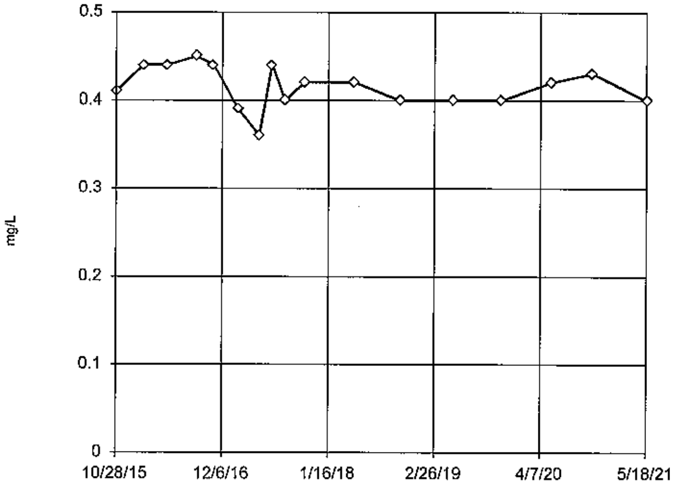
EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.4153, std. dev. 0.02348, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9266
Critical = 0.91
The distribution was found to be normally distributed.

Constituent: Fluoride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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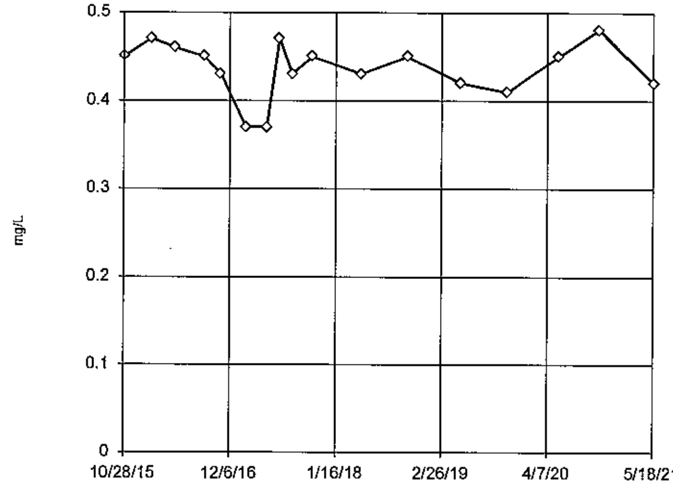
Tukey's Outlier Screening

MW-04



n = 17

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.517, low cutoff = -0.4094, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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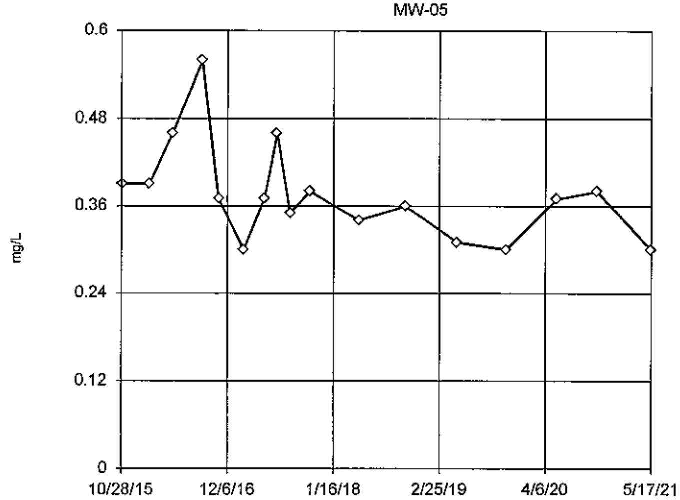
Tukey's Outlier Screening

MW-05



n = 17

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.6761, low cutoff = 0.1873, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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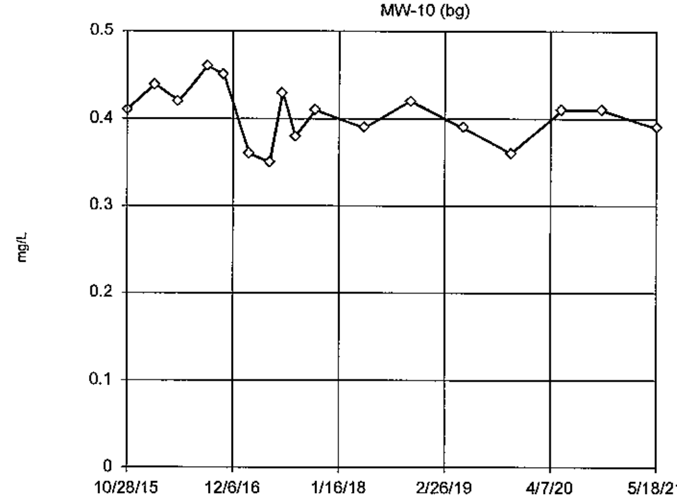
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.4047, std. dev. 0.03145, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9672
Critical = 0.91
The distribution was found to be normally distributed.

Constituent: Fluoride Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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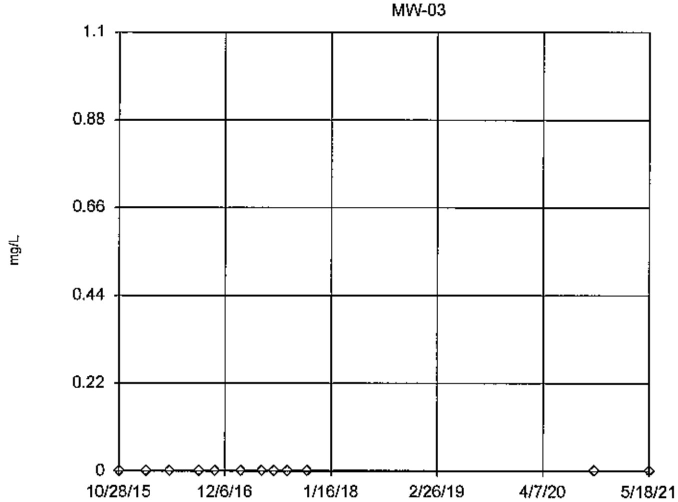
Tukey's Outlier Screening

MW-03



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Lead Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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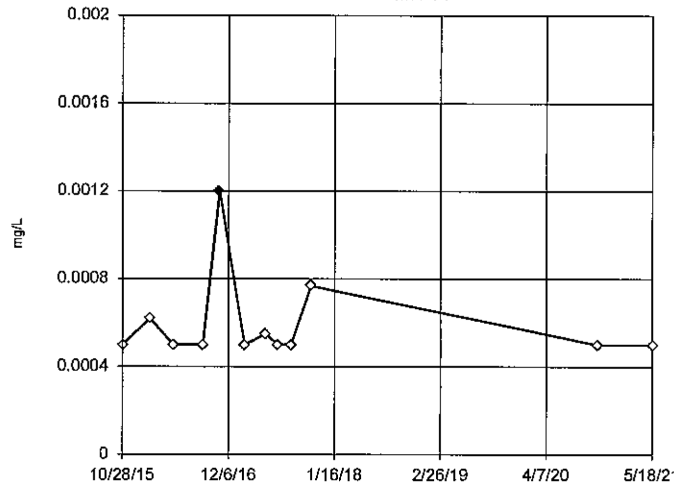
Tukey's Outlier Screening

MW-04



n = 12

Outlier is drawn as solid.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0009302, low cutoff = 0.0003139, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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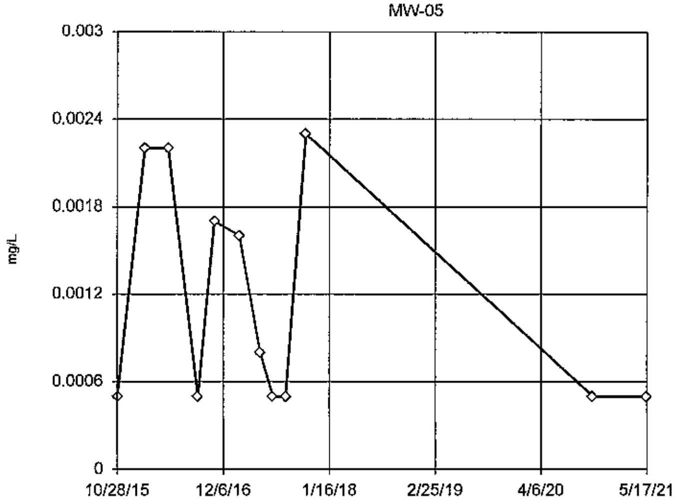
Tukey's Outlier Screening

MW-05



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.0063, low cutoff = -0.00385, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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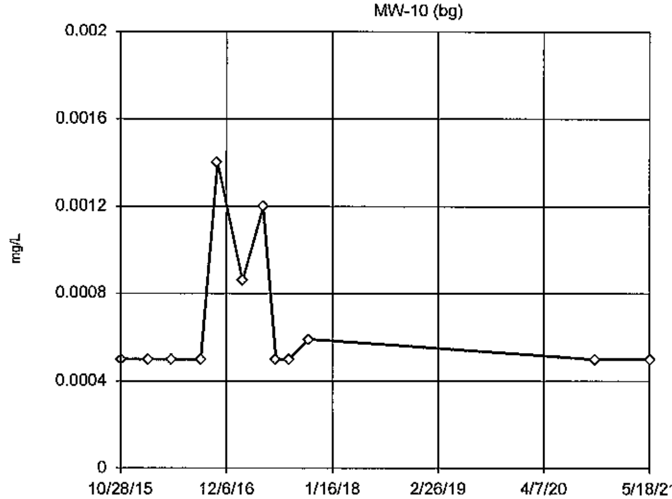
Tukey's Outlier Screening

MW-10 (bg)



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.00206, low cutoff = 0.0001729, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 8/8/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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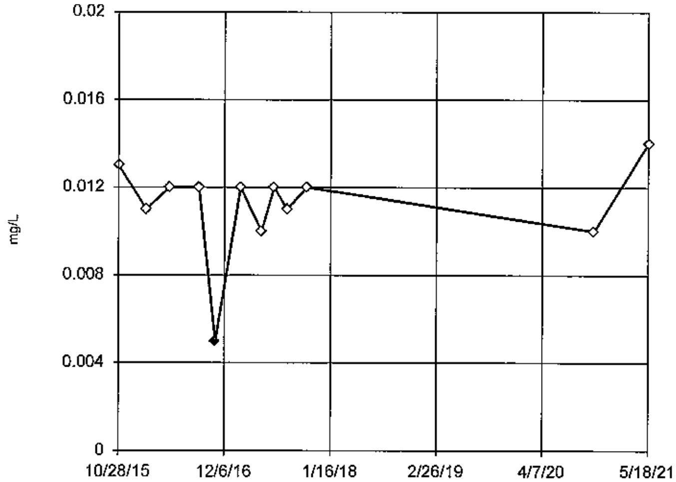
Dixon's Outlier Test

MW-03



n = 12

Statistical outlier is drawn as solid.
Testing for 1 low outlier.
Mean = 0.01117.
Std. Dev. = 0.00225.
<0.01: c = 0.625
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9158
Critical = 0.876
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Lithium Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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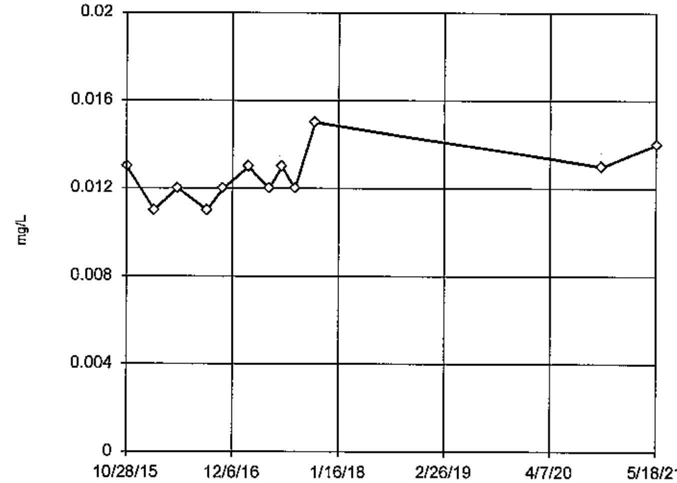
EPA Screening (suspected outliers for Dixon's Test)

MW-04



n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.01258, std. dev. 0.001165, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9194
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Lithium Analysis Run 8/8/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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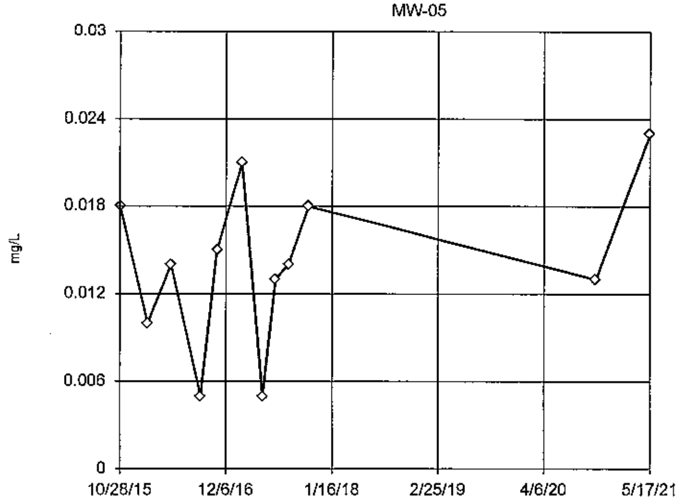
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.01408, std. dev. 0.005583, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.948
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Lithium Analysis Run 8/8/2021 9:58 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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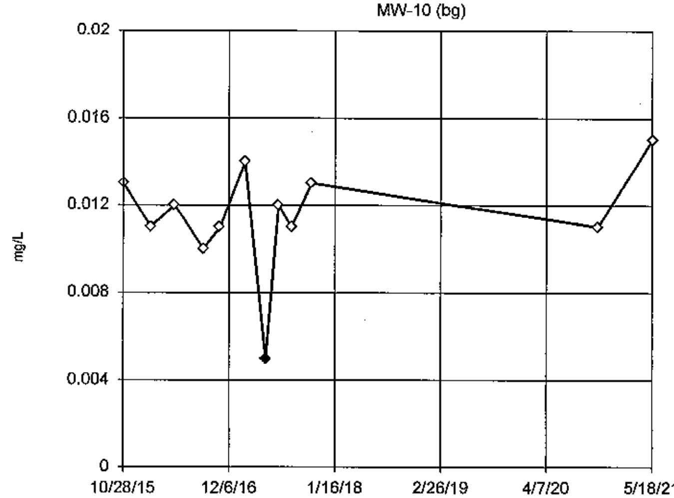
Dixon's Outlier Test

MW-10 (bg)



n = 12

Statistical outlier is drawn as solid.
Testing for 1 low outlier.
Mean = 0.0115.
Std. Dev. = 0.002505.
<0.01: c = 0.6667
tabl = 0.546.
Alpha = 0.05.

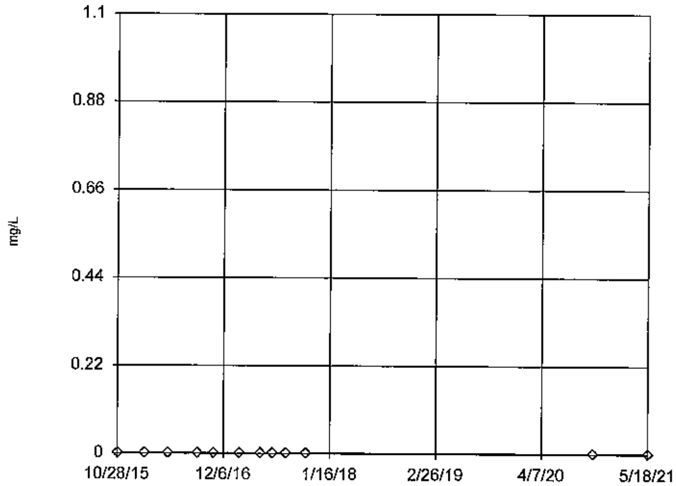
Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9246
Critical = 0.876
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Lithium Analysis Run 8/8/2021 9:58 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Tukey's Outlier Screening

MW-03



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

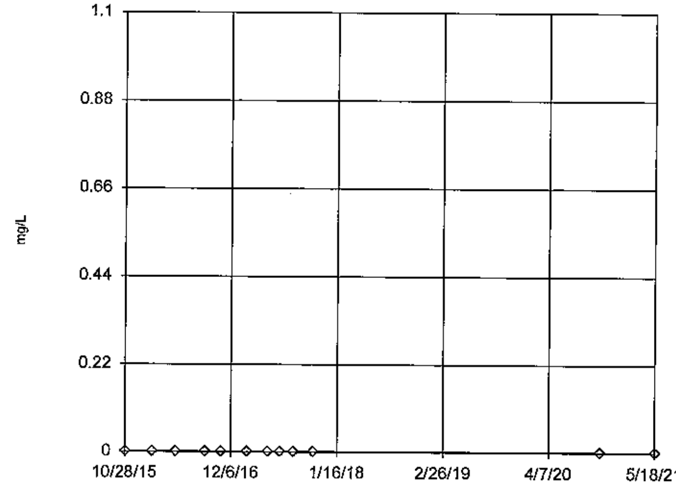
Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Tukey's Outlier Screening

MW-04



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

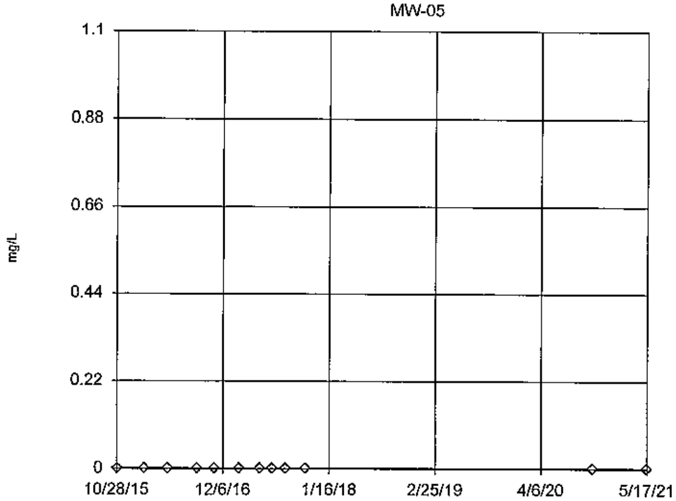
Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Tukey's Outlier Screening

MW-05



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

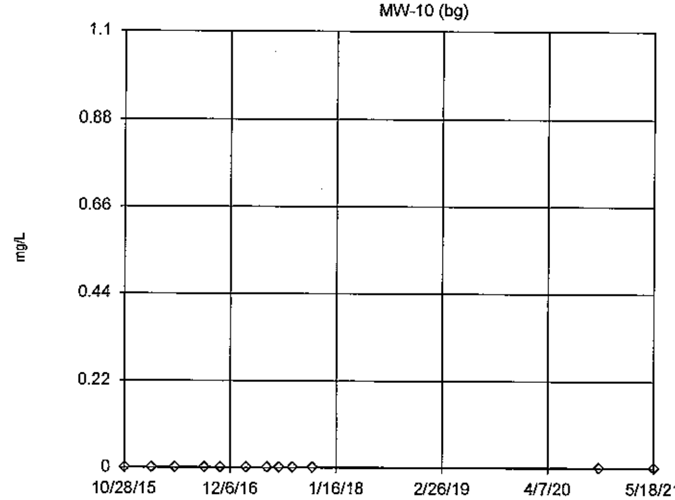
Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Tukey's Outlier Screening

MW-10 (bg)



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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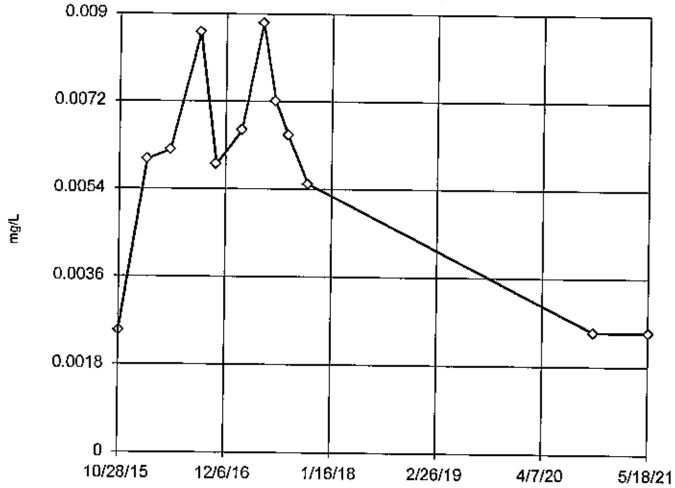
Tukey's Outlier Screening

MW-03



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.01166, low cutoff = -0.008373, based on IQR multiplier of 3.

Constituent: Molybdenum Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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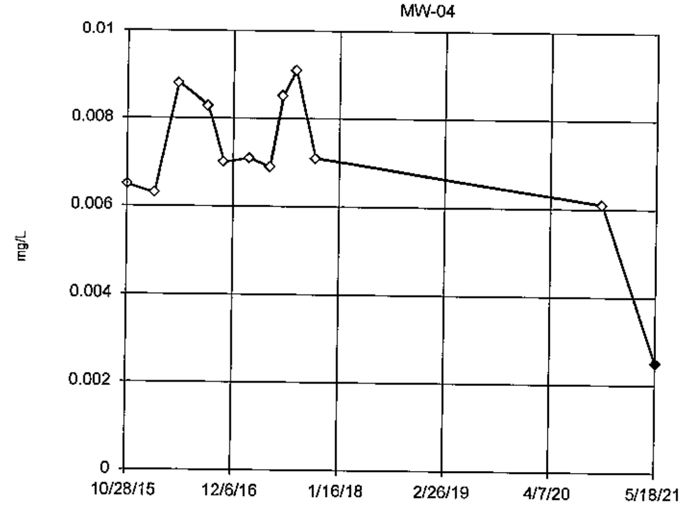
Dixon's Outlier Test

MW-04



n = 12

Statistical outlier is drawn as solid.
Testing for 1 low outlier.
Mean = 0.007017.
Std. Dev. = 0.001743.
<0.005: c = 0.6032
tabl = 0.546.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8992
Critical = 0.876
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Molybdenum Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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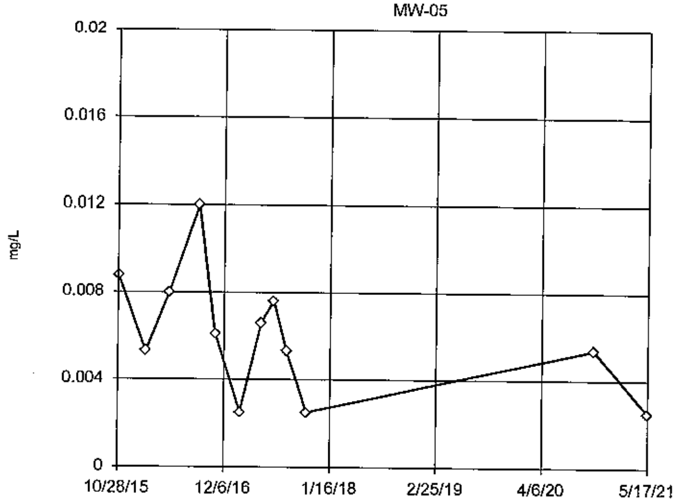
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.00605, std. dev. 0.002842, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9307
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Molybdenum Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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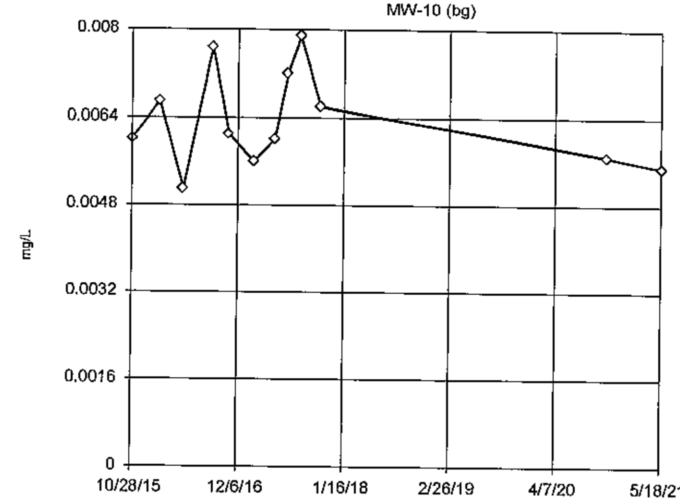
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



n = 12

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 0.006342, std. dev. 0.0008898, critical Tn 2.285

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9372
Critical = 0.883
The distribution was found to be normally distributed.

Constituent: Molybdenum Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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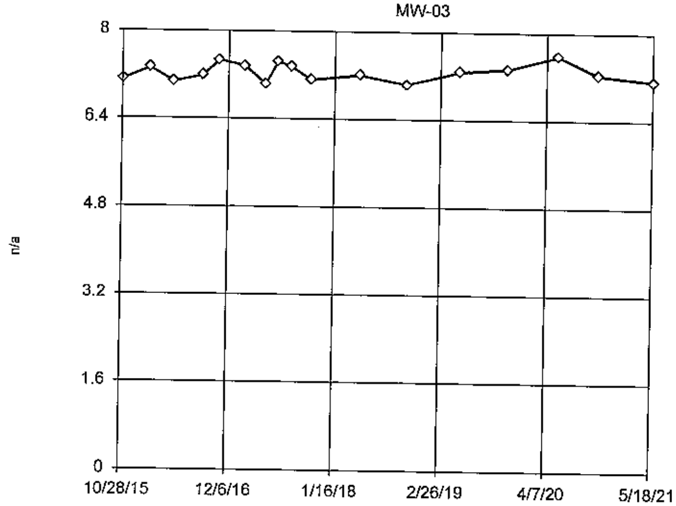
EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 7.243, std. dev. 0.1543, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9599
Critical = 0.91
The distribution was found to be normally distributed.

Constituent: pH Analysis Run 8/8/2021 9:58 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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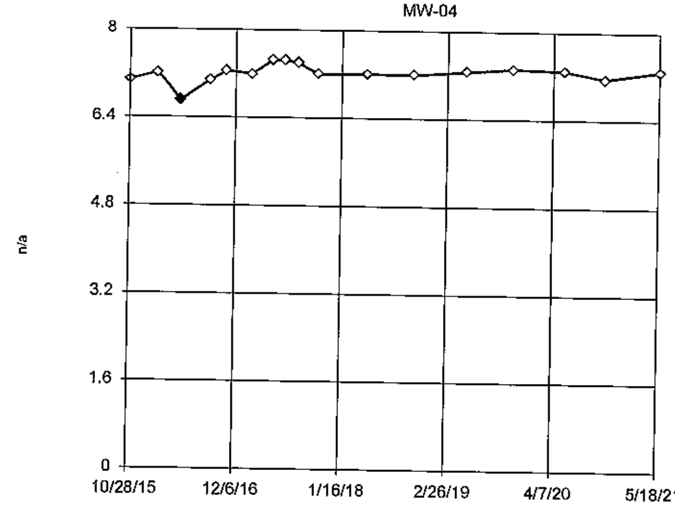
Dixon's Outlier Test

MW-04



n = 17

Statistical outlier is drawn as solid.
Testing for 1 low outlier.
Mean = 7.223.
Std. Dev. = 0.1744.
6.71: c = 0.5143
tabl = 0.49.
Alpha = 0.05.

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9505
Critical = 0.906
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: pH Analysis Run 8/8/2021 9:58 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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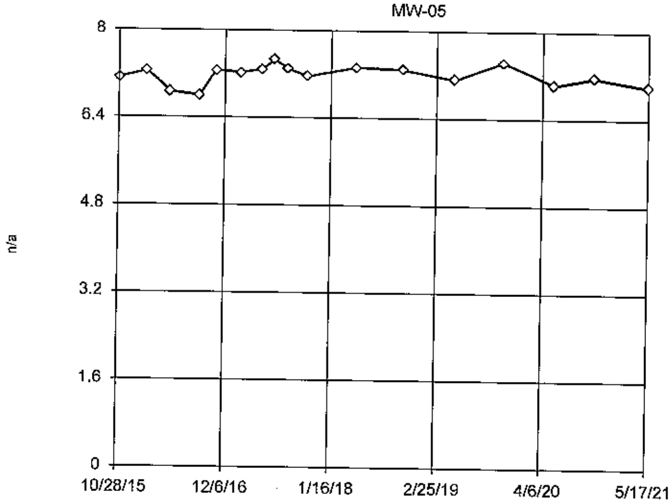
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 7.183, std. dev. 0.1793, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9641
Critical = 0.91
The distribution was found to be normally distributed.

Constituent: pH Analysis Run 8/8/2021 9:58 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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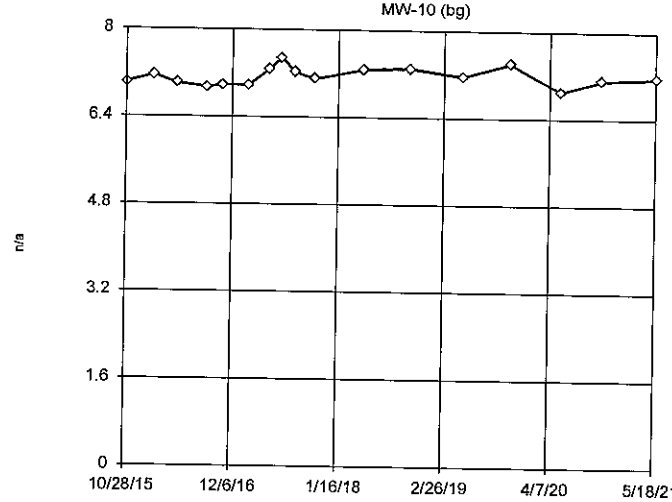
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



n = 17

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 7.151, std. dev. 0.1617, critical Tn 2.475

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9714
Critical = 0.91
The distribution was found to be normally distributed.

Constituent: pH Analysis Run 8/8/2021 9:58 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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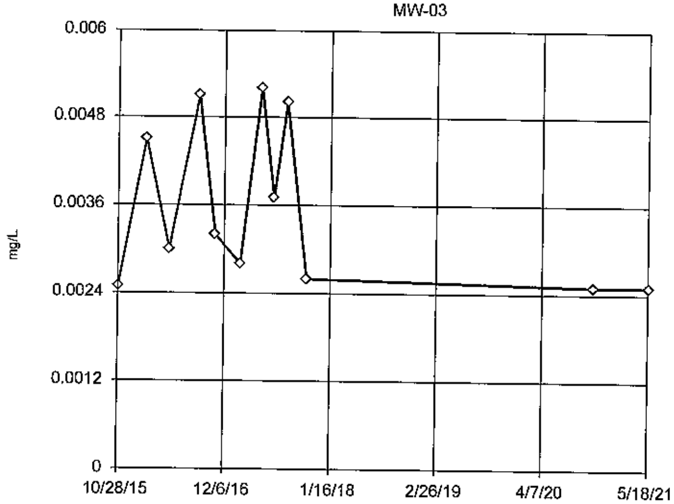
Tukey's Outlier Screening

MW-03



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.03055, low cutoff = 0.0003959, based on IQR multiplier of 3.

Constituent: Selenium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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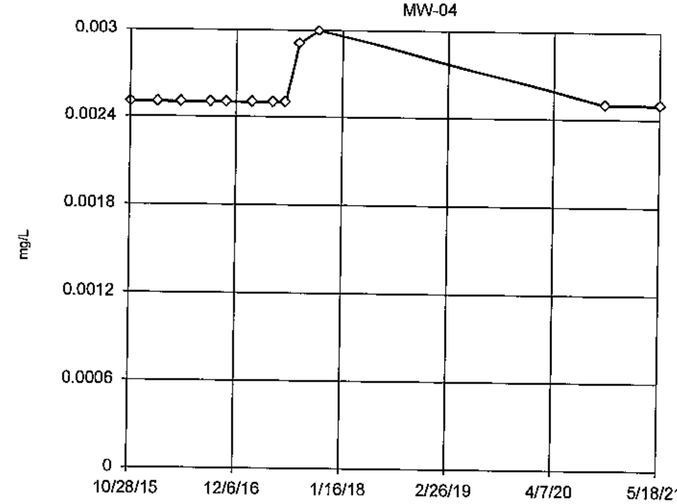
Tukey's Outlier Screening

MW-04



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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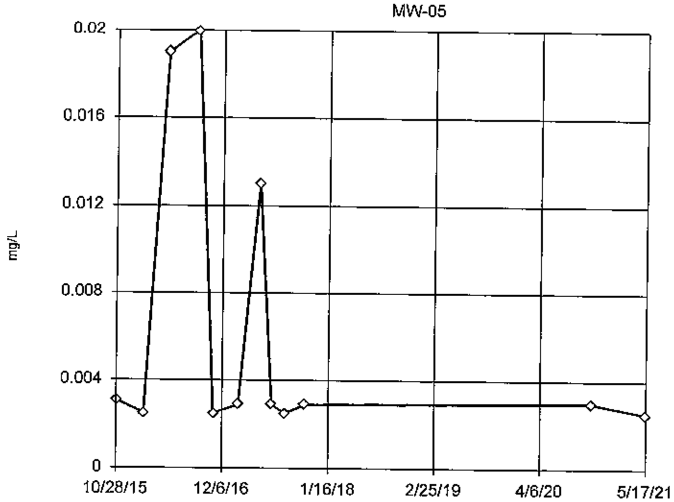
Tukey's Outlier Screening

MW-05



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1039, low cutoff = 0.0001527, based on IQR multiplier of 3.

Constituent: Selenium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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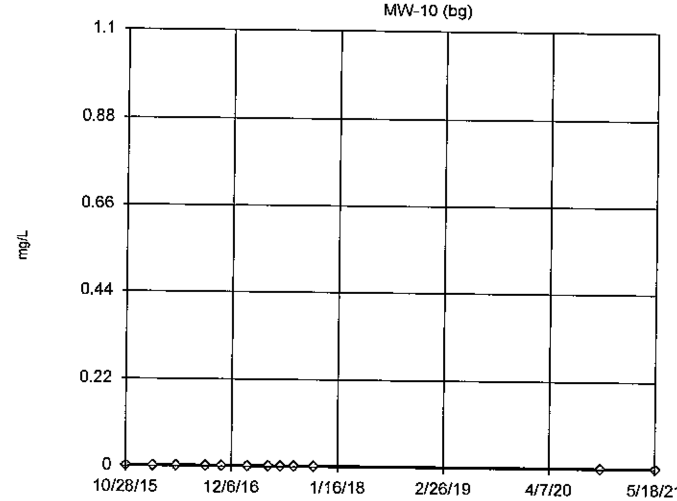
Tukey's Outlier Screening

MW-10 (bg)



n = 12

No outliers found.
Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

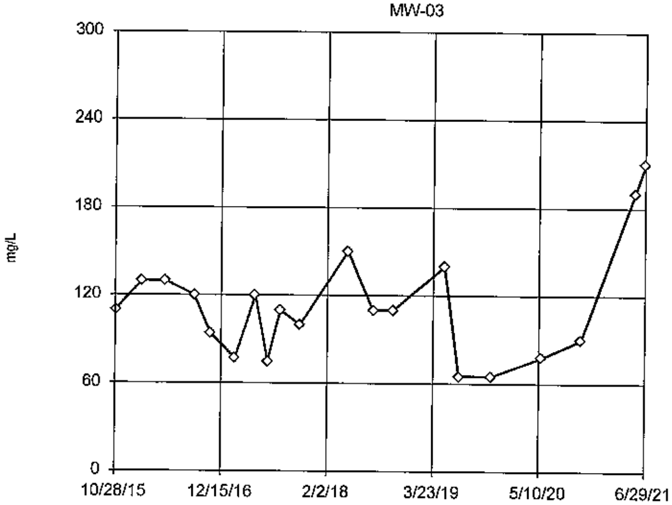
Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 20

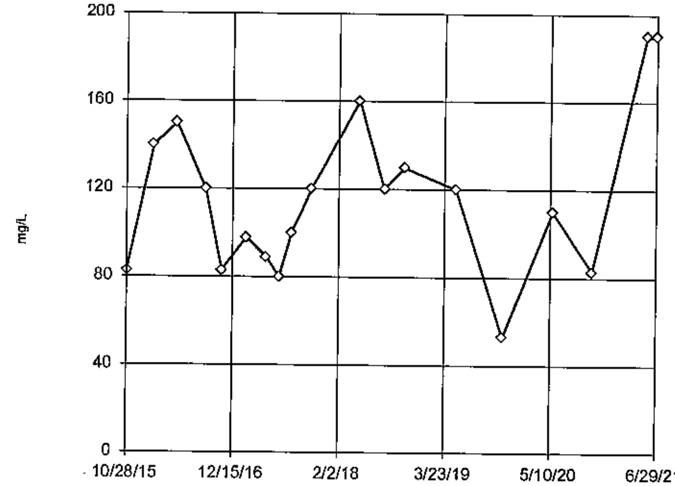
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 113.7, std. dev. 38.23, critical Tn 2.557

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9664
Critical = 0.92 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Sulfate Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-04



n = 19

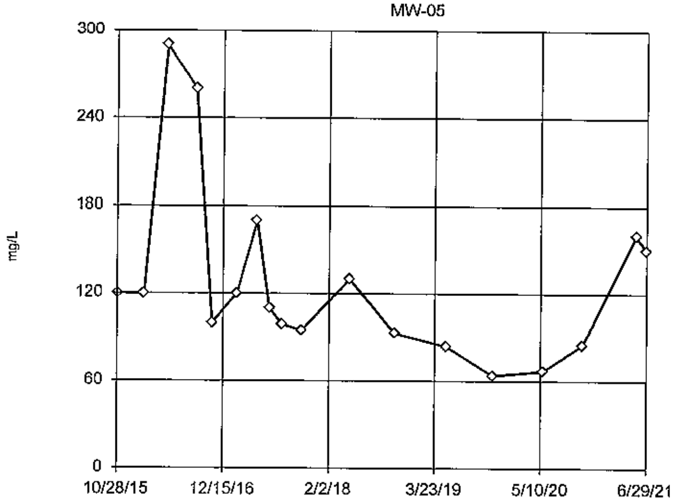
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 116.8, std. dev. 37.08, critical Tn 2.532

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.947
Critical = 0.917
The distribution was found to be normally distributed.

Constituent: Sulfate Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 18

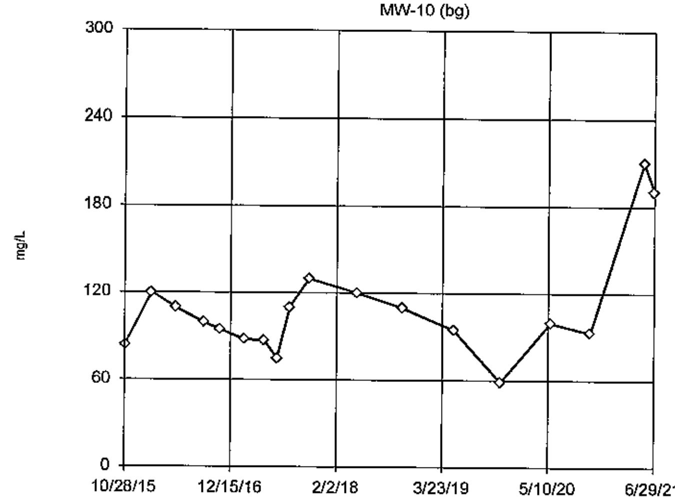
Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 128.7, std. dev. 60.87, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9423
Critical = 0.914 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Sulfate Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



n = 18

Dixon's will not be run.
No suspect values identified or unable to establish suspect values.
Mean 109.8, std. dev. 37.14, critical Tn 2.504

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9281
Critical = 0.914 (after natural log transformation)
The distribution was found to be log-normal.

Constituent: Sulfate Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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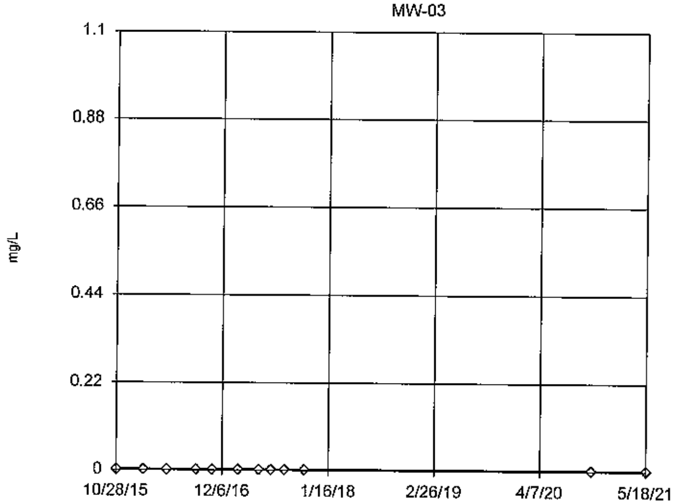
Tukey's Outlier Screening

MW-03



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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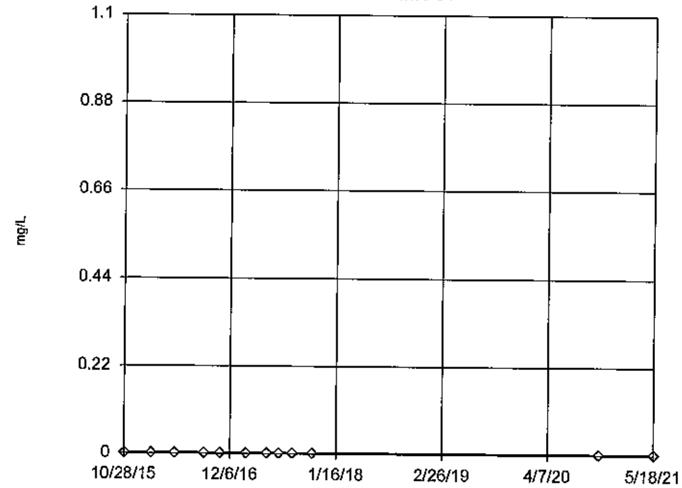
Tukey's Outlier Screening

MW-04



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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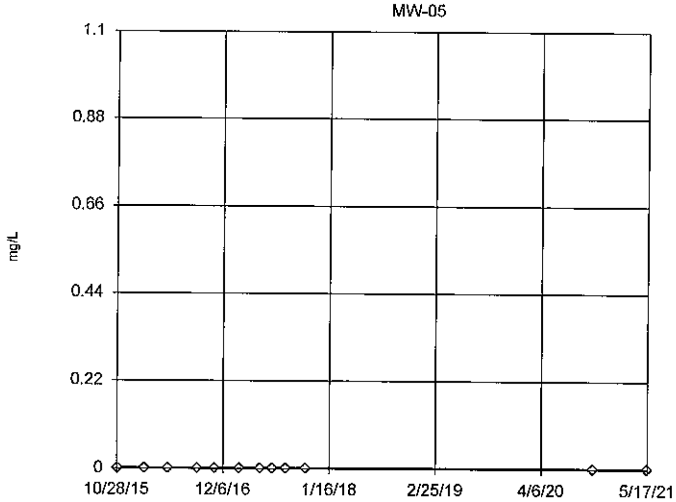
Tukey's Outlier Screening

MW-05



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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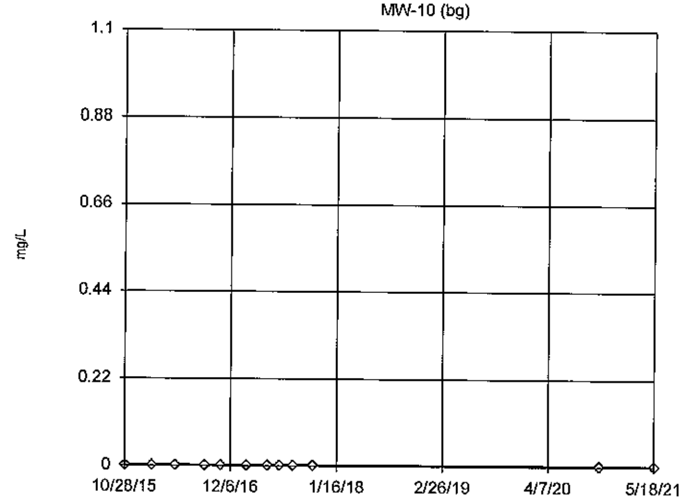
Tukey's Outlier Screening

MW-10 (bg)



n = 12

No outliers found. Tukey's method used in lieu of parametric test because the Shapiro Wilk normality test failed at the 0.1 alpha level.

Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Thallium Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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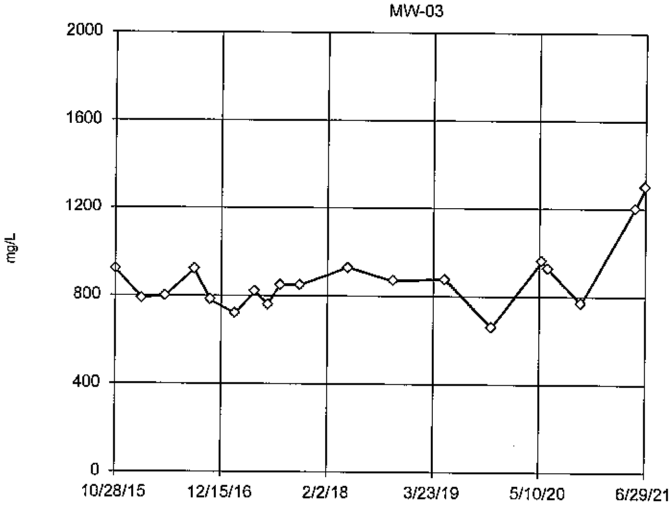
EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 19

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 879.5, std. dev.
153.5, critical Tn 2.532

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.92
Critical = 0.917 (after
natural log transforma-
tion)
The distribution was found
to be log-normal.

Constituent: Total Dissolved Solids Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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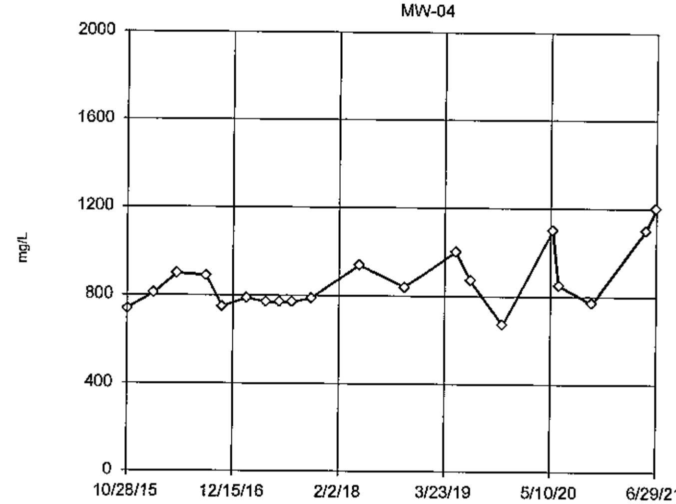
EPA Screening (suspected outliers for Dixon's Test)

MW-04



n = 20

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 866, std. dev. 138.9,
critical Tn 2.557

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9241
Critical = 0.92 (after
natural log transforma-
tion)
The distribution was found
to be log-normal.

Constituent: Total Dissolved Solids Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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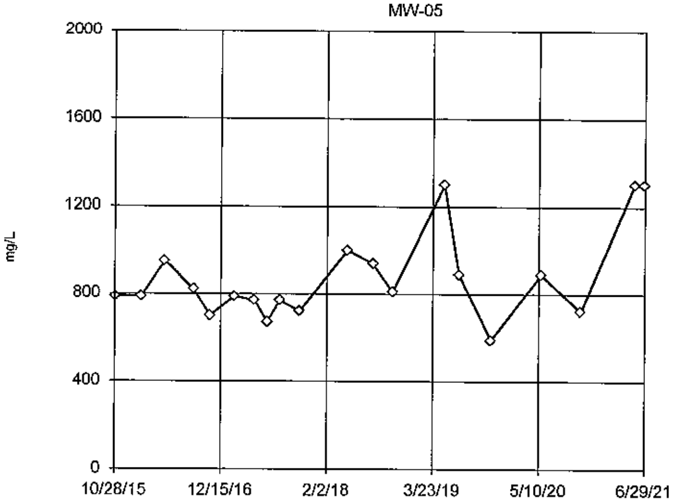
Tukey's Outlier Screening

MW-05



n = 20

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 1932, low
cutoff = 364.2, based
on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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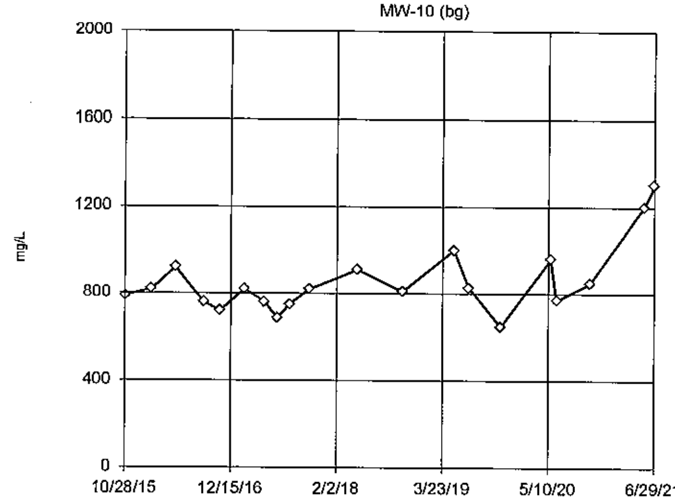
Tukey's Outlier Screening

MW-10 (bg)



n = 20

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 1597, low
cutoff = 435.5, based
on IQR multiplier of 3.

Constituent: Total Dissolved Solids Analysis Run 8/8/2021 9:58 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Outlier Analysis - Joliet 29 - All Wells All Values

Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29   Printed 10/7/2021, 2:37 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Turbidity (NTU)	MW-03	No	n/a	n/a	EPA 1989	0.05	10	8.956	11.98	ln(x)	ShapiroWilk
Turbidity (NTU)	MW-04	No	n/a	n/a	NP (nrm)	NaN	10	17.11	26.77	unknown	ShapiroWilk
Turbidity (NTU)	MW-05	No	n/a	n/a	EPA 1989	0.05	10	9.131	7.729	ln(x)	ShapiroWilk
Turbidity (NTU)	MW-10 (bg)	No	n/a	n/a	EPA 1989	0.05	10	10.86	6.601	normal	ShapiroWilk

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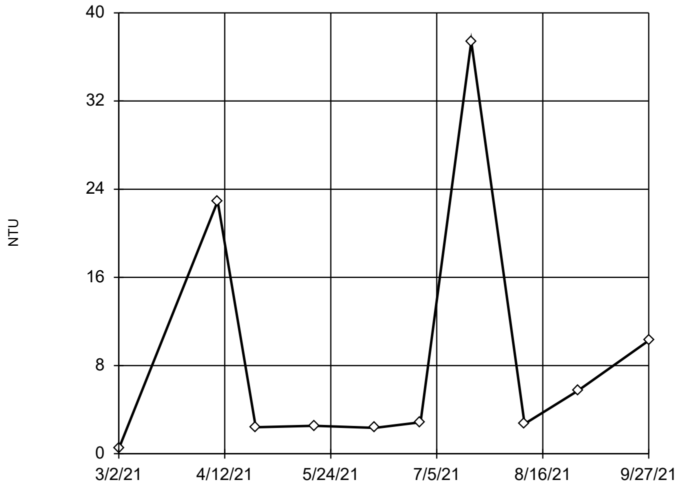
EPA Screening (suspected outliers for Dixon's Test)

MW-03



n = 10

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 8.956, std. dev.
11.98, critical Tn 2.176

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9265
Critical = 0.869 (after
natural log transforma-
tion)
The distribution was found
to be log-normal.

Constituent: Turbidity Analysis Run 10/7/2021 2:36 PM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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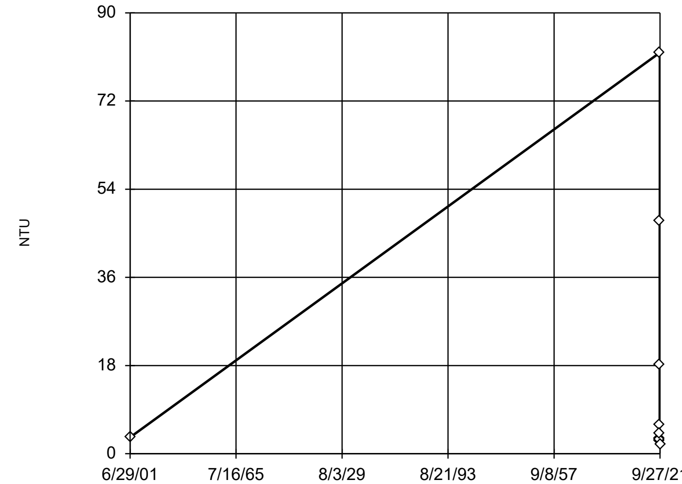
Tukey's Outlier Screening

MW-04



n = 10

No outliers found.
Tukey's method used in
lieu of parametric test
because the Shapiro Wilk
normality test failed
at the 0.1 alpha level.

Data were natural log
transformed to achieve
best W statistic (graph
shown in original units).

High cutoff = 40144, low
cutoff = 0.001949, based
on IQR multiplier of 3.

Constituent: Turbidity Analysis Run 10/7/2021 2:36 PM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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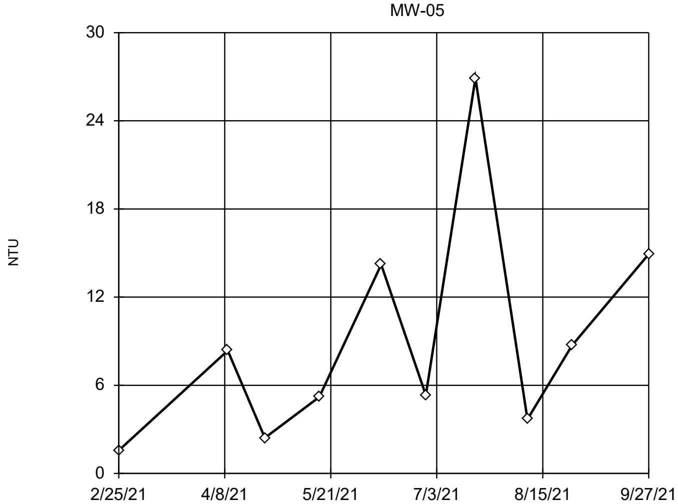
EPA Screening (suspected outliers for Dixon's Test)

MW-05



n = 10

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 9.131, std. dev.
7.729, critical Tn 2.176

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.9831
Critical = 0.869 (after
natural log transforma-
tion)
The distribution was found
to be log-normal.

Constituent: Turbidity Analysis Run 10/7/2021 2:36 PM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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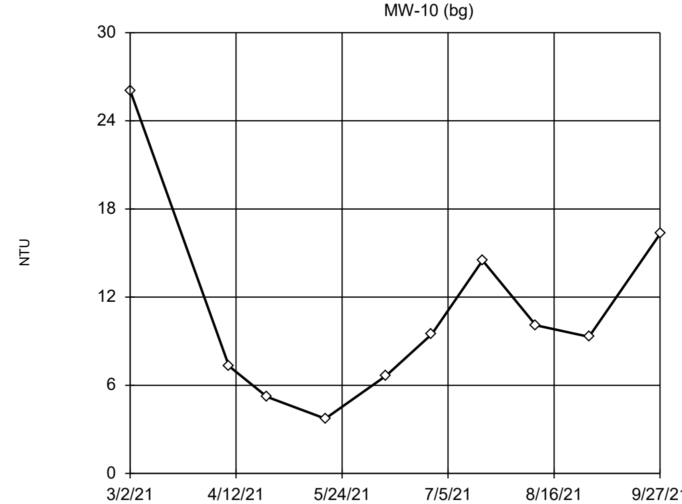
EPA Screening (suspected outliers for Dixon's Test)

MW-10 (bg)



n = 10

Dixon's will not be run.
No suspect values identified
or unable to establish
suspect values.
Mean 10.86, std. dev.
6.601, critical Tn 2.176

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8725
Critical = 0.869
The distribution was found
to be normally distrib-
uted.

Constituent: Turbidity Analysis Run 10/7/2021 2:36 PM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Seasonality - Joliet #29 - All CCR Wells

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29 Printed 8/8/2021, 10:19 AM

Constituent	Well	Sig.	K.-W.	Chi-Sq.	df	N	Alpha
Boron (mg/L)	MW-03	No	0	0	0	17	0.05
Boron (mg/L)	MW-04	No	0	0	0	19	0.05
Boron (mg/L)	MW-05	No	0	0	0	17	0.05
Boron (mg/L)	MW-10 (bg)	No	2.541	7.815	3	19	0.05
Calcium (mg/L)	MW-03	No	2.541	7.815	3	17	0.05
Calcium (mg/L)	MW-04	No	2.541	7.815	3	17	0.05
Calcium (mg/L)	MW-05	No	1.353	7.815	3	18	0.05
Calcium (mg/L)	MW-10 (bg)	No	1.353	7.815	3	18	0.05
Chloride (mg/L)	MW-03	No	1.353	7.815	3	17	0.05
Chloride (mg/L)	MW-04	No	1.353	7.815	3	18	0.05
Chloride (mg/L)	MW-05	No	1.353	7.815	3	19	0.05
Chloride (mg/L)	MW-10 (bg)	No	1.353	7.815	3	19	0.05
Fluoride (mg/L)	MW-03	No	1.353	7.815	3	17	0.05
Fluoride (mg/L)	MW-04	No	1.353	7.815	3	17	0.05
Fluoride (mg/L)	MW-05	No	1.353	7.815	3	17	0.05
Fluoride (mg/L)	MW-10 (bg)	No	1.353	7.815	3	17	0.05
pH (n/a)	MW-03	No	1.353	7.815	3	17	0.05
pH (n/a)	MW-04	No	1.353	7.815	3	17	0.05
pH (n/a)	MW-05	No	1.353	7.815	3	17	0.05
pH (n/a)	MW-10 (bg)	No	1.353	7.815	3	17	0.05
Sulfate (mg/L)	MW-03	No	1.353	7.815	3	20	0.05
Sulfate (mg/L)	MW-04	No	1.353	7.815	3	19	0.05
Sulfate (mg/L)	MW-05	No	1.353	7.815	3	18	0.05
Sulfate (mg/L)	MW-10 (bg)	No	1.353	7.815	3	18	0.05
Total Dissolved Solids (mg/L)	MW-03	No	1.353	7.815	3	19	0.05
Total Dissolved Solids (mg/L)	MW-04	No	1.353	7.815	3	20	0.05
Total Dissolved Solids (mg/L)	MW-05	No	1.353	7.815	3	20	0.05
Total Dissolved Solids (mg/L)	MW-10 (bg)	No	1.353	7.815	3	20	0.05

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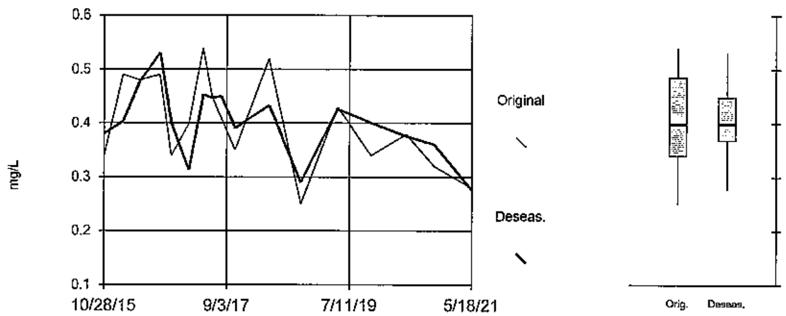
Seasonality: MW-03

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Boron Analysis Run 8/8/2021 10:17 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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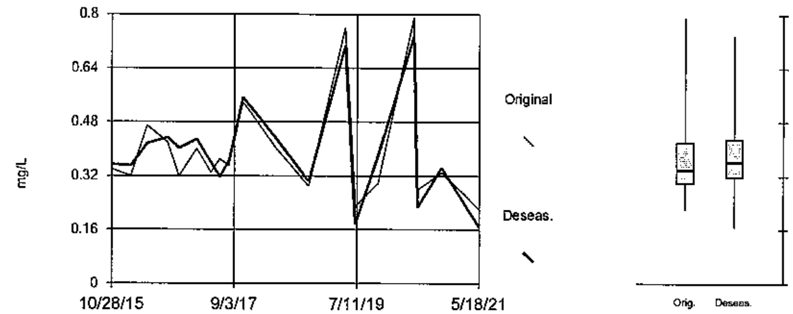
Seasonality: MW-04

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Boron Analysis Run 8/8/2021 10:17 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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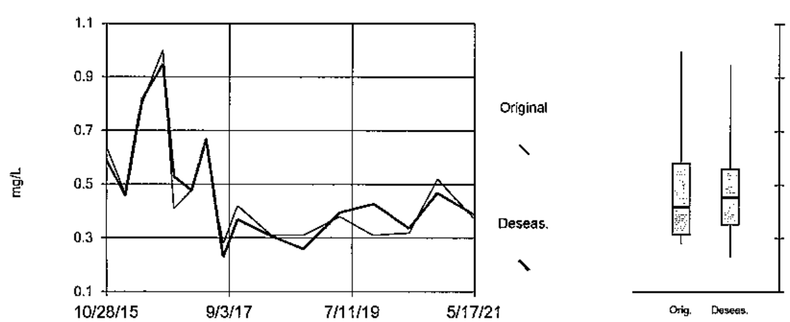
Seasonality: MW-05

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Boron Analysis Run 8/8/2021 10:17 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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Seasonality: MW-10 (bg)

For the selected data, the Kruskal-Wallis test indicates NO SEASONALITYat the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no season has a significantly different median concentration of this constituent than any other season.

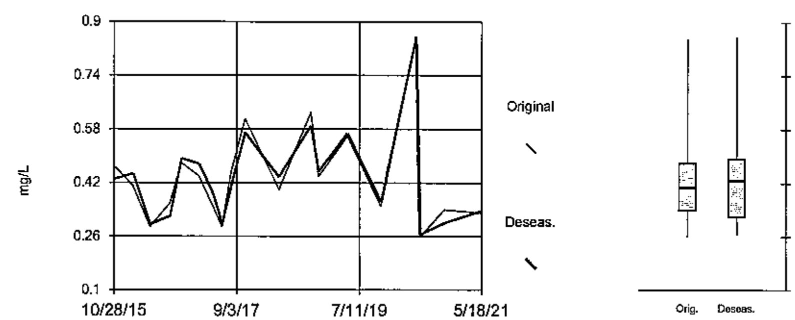
Calculated Kruskal-Wallis statistic = 2.541

Tabulated Chi-Squared value = 7.815 with 3 degrees of freedom at the 5% significance level.

There were 3 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.

Kruskal-Wallis statistic (H) = 2.534

Adjusted Kruskal-Wallis statistic (H') = 2.541



Constituent: Boron Analysis Run 8/8/2021 10:17 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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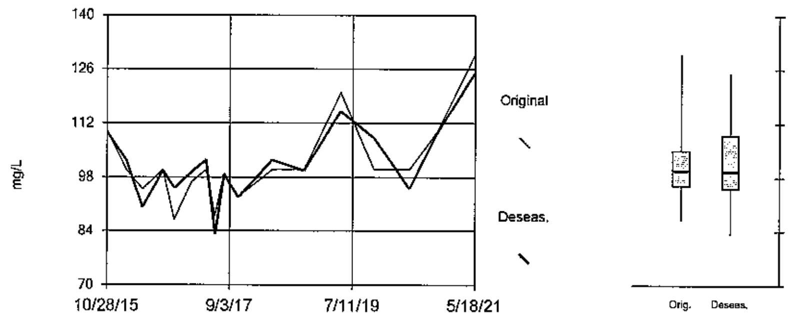
Seasonality: MW-03

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Calcium Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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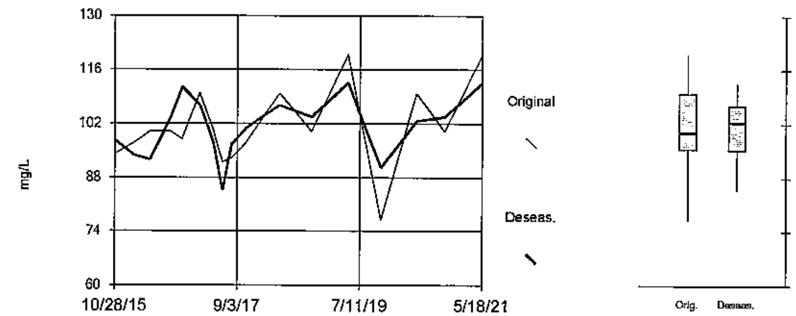
Seasonality: MW-04

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Calcium Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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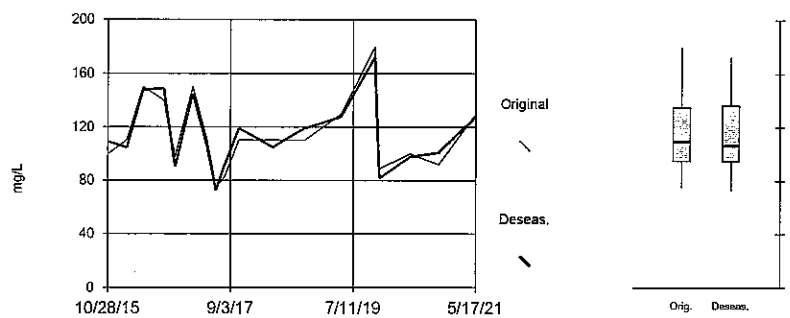
Seasonality: MW-05

For the selected data, the Kruskal-Wallis test indicates NO SEASONALITYat the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no season has a significantly different median concentration of this constituent than any other season.
Calculated Kruskal-Wallis statistic = 1.353
Tabulated Chi-Squared value = 7.815 with 3 degrees of freedom at the 5% significance level.
There were 4 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 1.321
Adjusted Kruskal-Wallis statistic (H') = 1.353



Constituent: Calcium Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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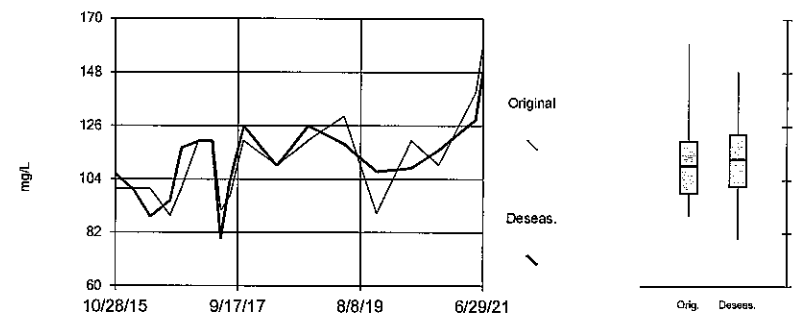
Seasonality: MW-10 (bg)

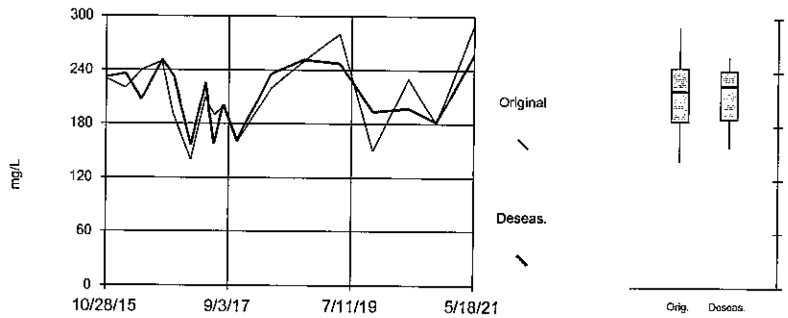
Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Calcium Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Seasonality: MW-03

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Chloride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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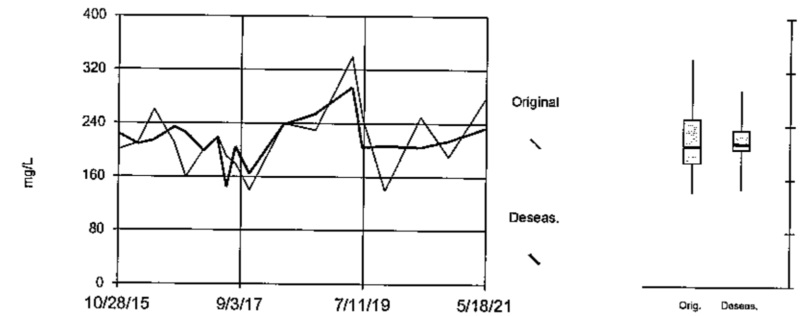
Seasonality: MW-04

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Chloride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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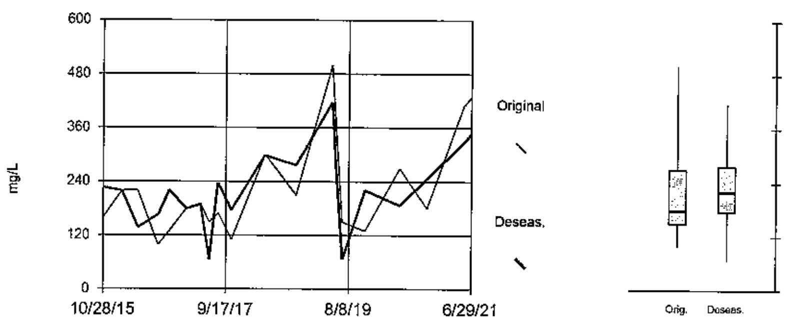
Seasonality: MW-05

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Chloride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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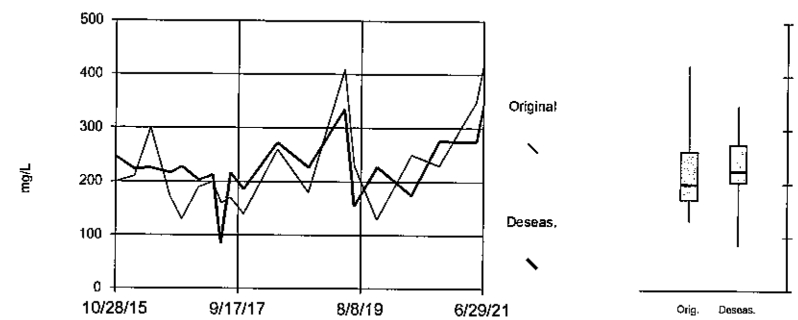
Seasonality: MW-10 (bg)

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Chloride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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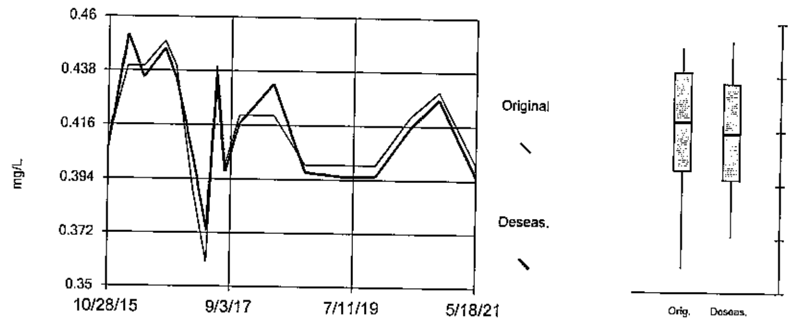
Seasonality: MW-03

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Fluoride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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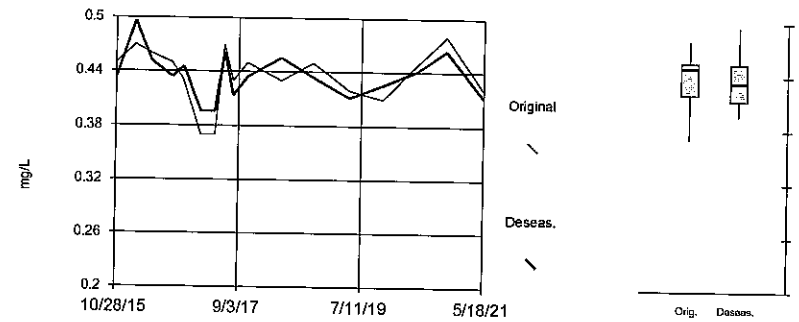
Seasonality: MW-04

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).

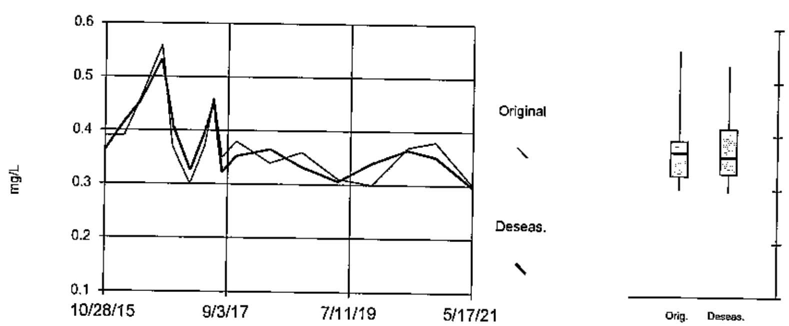


Constituent: Fluoride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG

Seasonality: MW-05

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Fluoride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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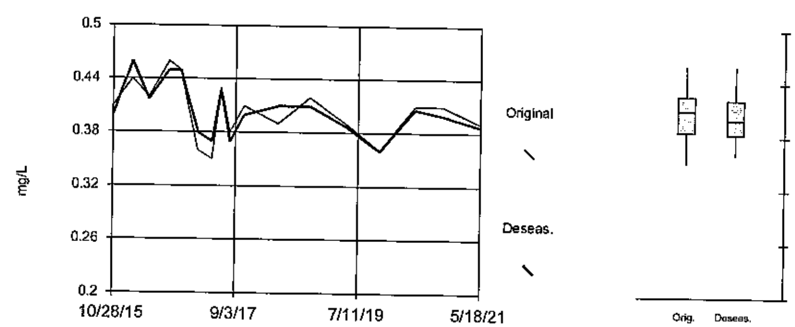
Seasonality: MW-10 (bg)

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).

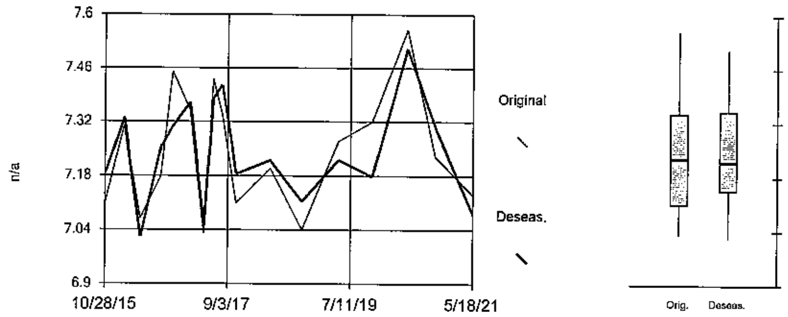


Constituent: Fluoride Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG

Seasonality: MW-03

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



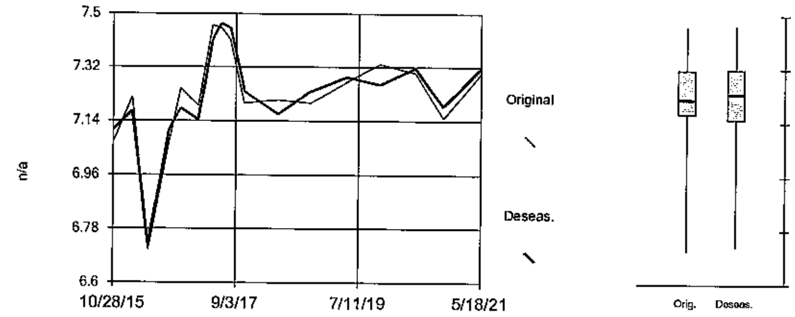
Constituent: pH Analysis Run 8/8/2021 10:18 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG

Seasonality: MW-04

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



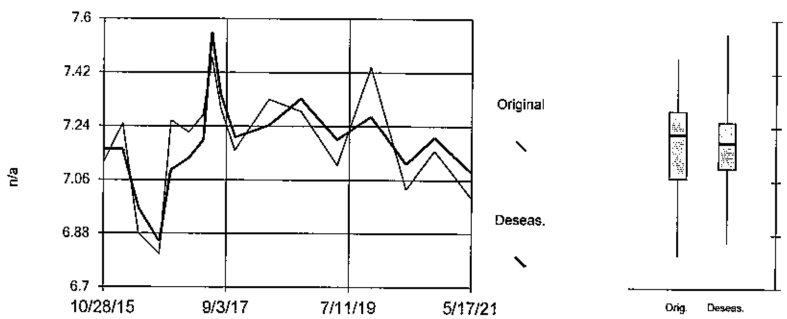
Constituent: pH Analysis Run 8/8/2021 10:18 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG

Seasonality: MW-05

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: pH Analysis Run 8/8/2021 10:18 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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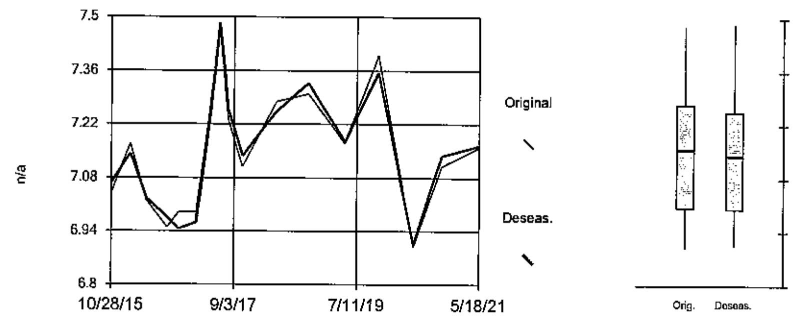
Seasonality: MW-10 (bg)

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).

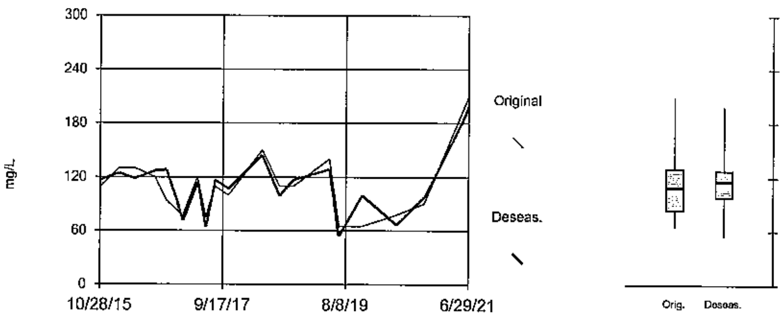


Constituent: pH Analysis Run 8/8/2021 10:18 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Seasonality: MW-03

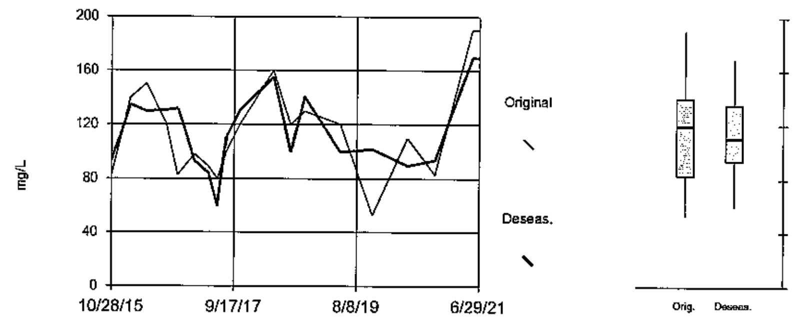
Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Sulfate Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Seasonality: MW-04

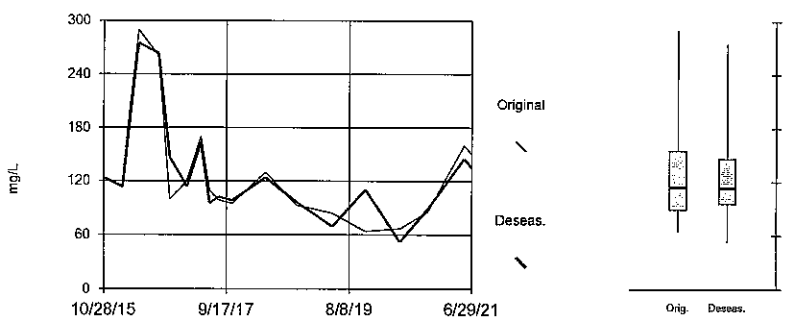
Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Sulfate Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Seasonality: MW-05

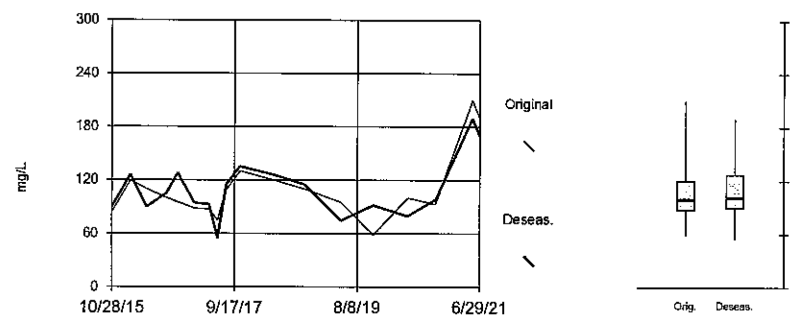
Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Sulfate Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Seasonality: MW-10 (bg)

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).



Constituent: Sulfate Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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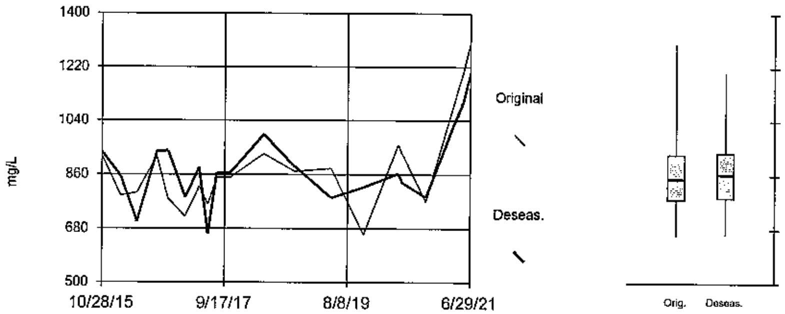
Seasonality: MW-03

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).

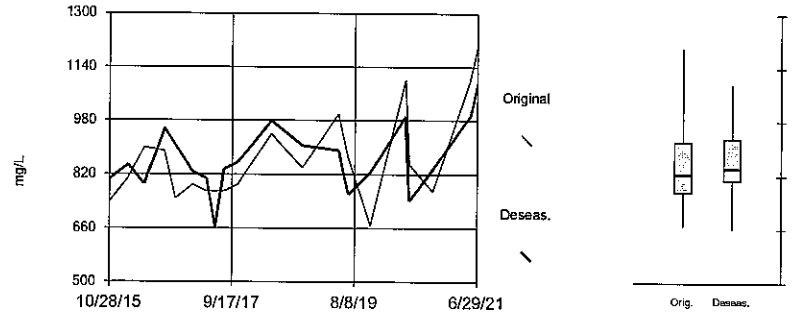


Constituent: Total Dissolved Solids Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG

Seasonality: MW-04

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).

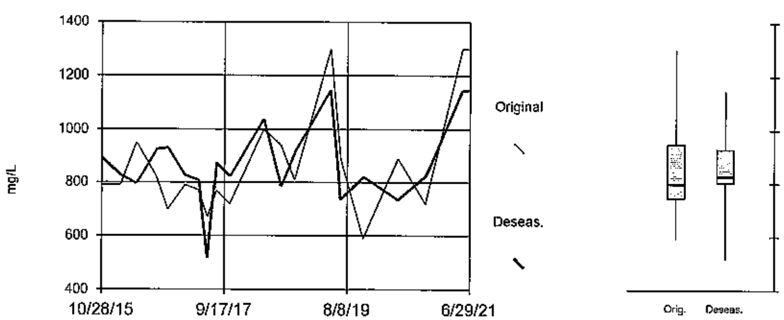


Constituent: Total Dissolved Solids Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG

Seasonality: MW-05

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).

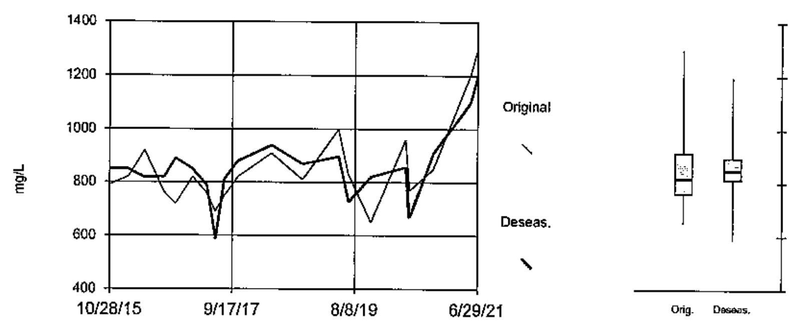


Constituent: Total Dissolved Solids Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG

Seasonality: MW-10 (bg)

Data set is of insufficient size to test for seasonality (non-parametric ANOVA requires a minimum of three observations per group, i.e. season).

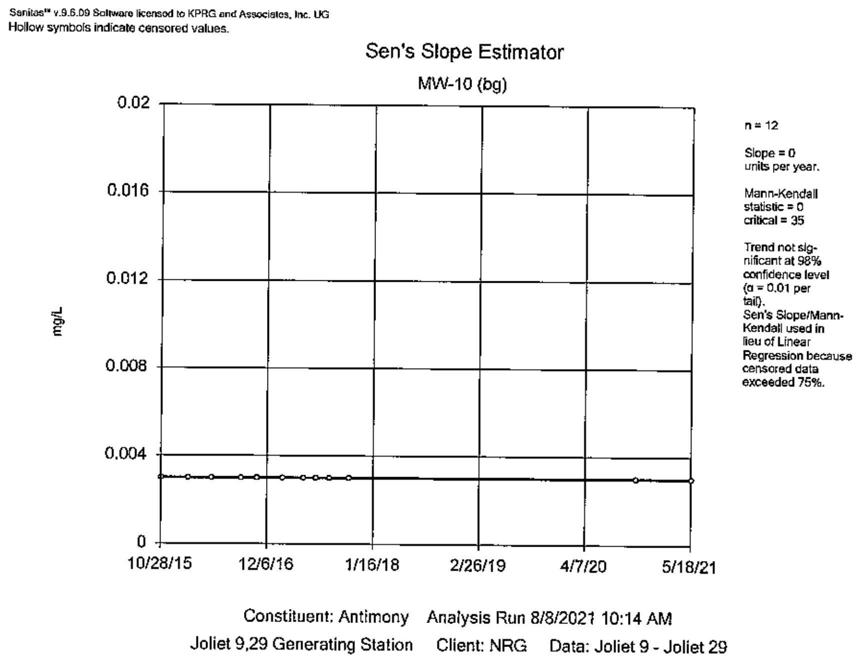


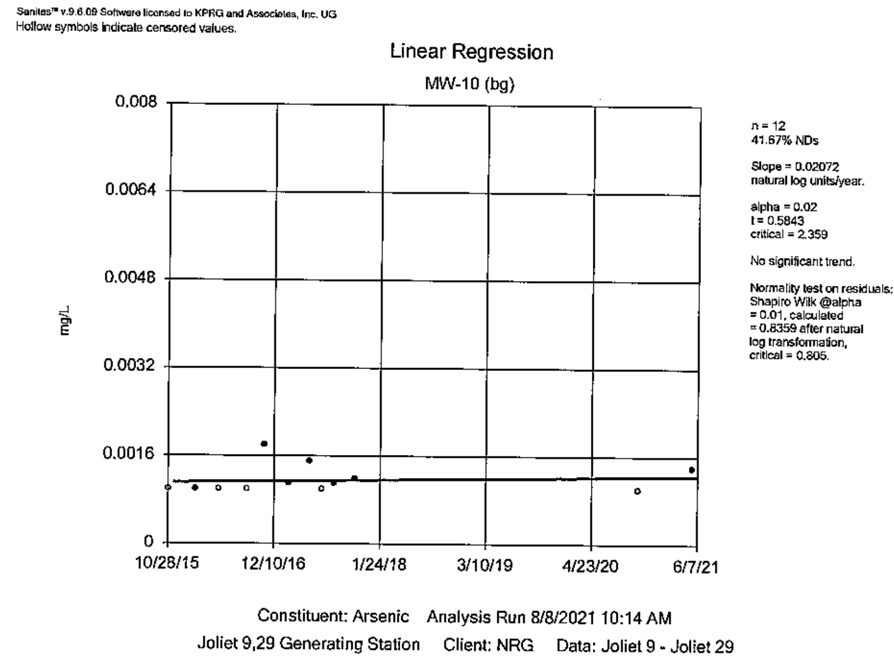
Constituent: Total Dissolved Solids Analysis Run 8/8/2021 10:18 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

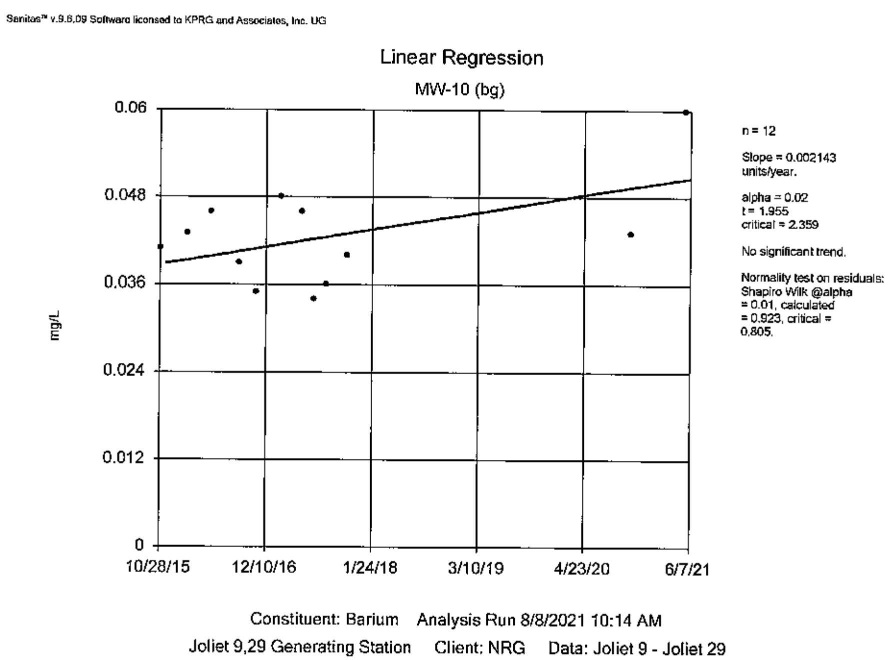
Trend Test Joliet #29 MW-10 UG

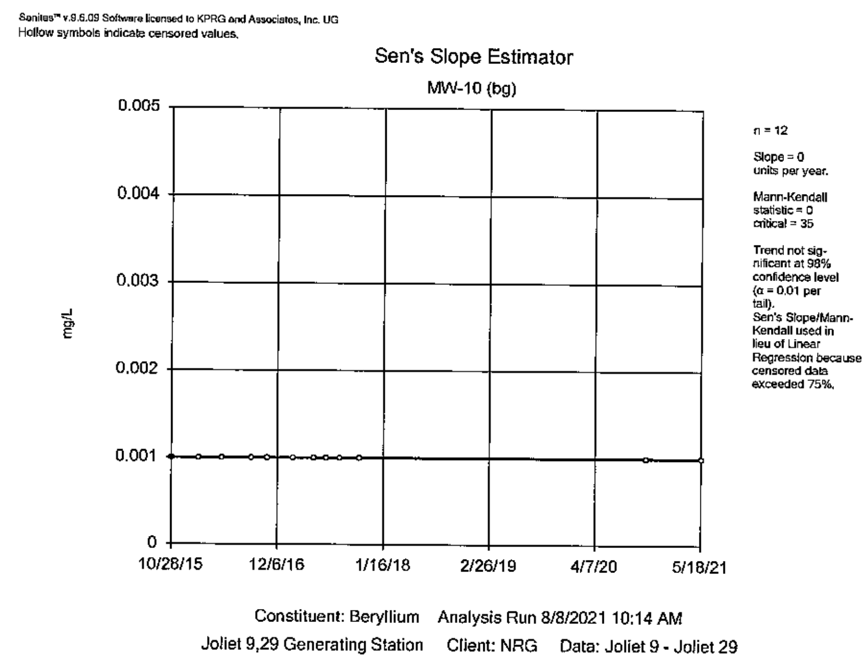
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29 Printed 8/8/2021, 10:15 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Antimony (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Arsenic (mg/L)	MW-10 (bg)	0.02072	0.5843	2.359	No	12	41.67	Yes	natura...	0.02	Param.
Barium (mg/L)	MW-10 (bg)	0.002143	1.955	2.359	No	12	0	Yes	no	0.02	Param.
Beryllium (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Boron (mg/L)	MW-10 (bg)	0.008327	0.4069	2.224	No	19	0	Yes	no	0.02	Param.
Cadmium (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Calcium (mg/L)	**MW-10 (bg)**	**6.638**	**3.416**	**2.235**	**Yes**	**18**	**0**	**Yes**	**no**	**0.02**	**Param.**
Chloride (mg/L)	**MW-10 (bg)**	**25.19**	**2.539**	**2.224**	**Yes**	**19**	**0**	**Yes**	**no**	**0.02**	**Param.**
Chromium (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Cobalt (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Combined Radium 226 + 228 (pCi/L)	MW-10 (bg)	0.0149	0.8027	2.398	No	11	72.73	Yes	no	0.02	Param.
Fluoride (mg/L)	MW-10 (bg)	-0.00...	-1.303	2.249	No	17	0	Yes	no	0.02	Param.
Lead (mg/L)	MW-10 (bg)	0	0	35	No	12	66.67	n/a	n/a	0.02	NP (Nor...
Lithium (mg/L)	MW-10 (bg)	0.000...	0.7936	2.359	No	12	8.333	Yes	no	0.02	Param.
Mercury (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Molybdenum (mg/L)	MW-10 (bg)	-0.00...	-0.8336	2.359	No	12	0	Yes	no	0.02	Param.
pH (n/a)	MW-10 (bg)	0.01492	0.6175	2.249	No	17	0	Yes	no	0.02	Param.
Selenium (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Sulfate (mg/L)	MW-10 (bg)	9.656	2.174	2.235	No	18	0	Yes	no	0.02	Param.
Thallium (mg/L)	MW-10 (bg)	0	0	35	No	12	100	n/a	n/a	0.02	NP (NDs)
Total Dissolved Solids (mg/L)	**MW-10 (bg)**	**49.54**	**2.873**	**2.214**	**Yes**	**20**	**0**	**Yes**	**no**	**0.02**	**Param.**


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
mg/L
0.02
0.016
0.012
0.008
0.004
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because censored data exceeded 75%.
Constituent: Antimony Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Linear Regression
MW-10 (bg)
mg/L
0.008
0.0064
0.0048
0.0032
0.0016
0
10/28/15
12/10/16
1/24/18
3/10/19
4/23/20
6/7/21
n = 12
41.67% NDs
Slope = 0.02072 natural log units/year.
alpha = 0.02
t = 0.5843
critical = 2.359
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.8359 after natural log transformation, critical = 0.805.
Constituent: Arsenic Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Linear Regression
MW-10 (bg)
mg/L
0.06
0.048
0.036
0.024
0.012
0
10/28/15
12/10/16
1/24/18
3/10/19
4/23/20
6/7/21
n = 12
Slope = 0.002143 units/year.
alpha = 0.02
t = 1.955
critical = 2.359
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.923, critical = 0.805.
Constituent: Barium Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
mg/L
0.005
0.004
0.003
0.002
0.001
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because censored data exceeded 75%.
Constituent: Beryllium Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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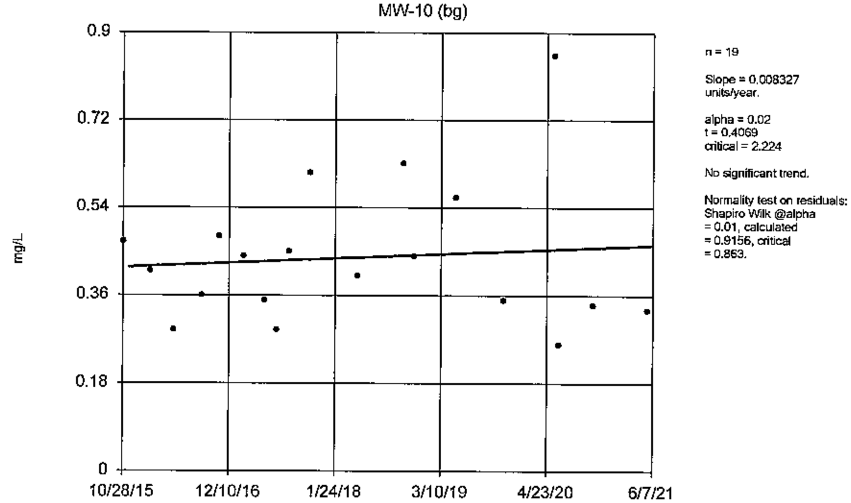
Linear Regression

MW-10 (bg)



Constituent: Boron Analysis Run 8/8/2021 10:14 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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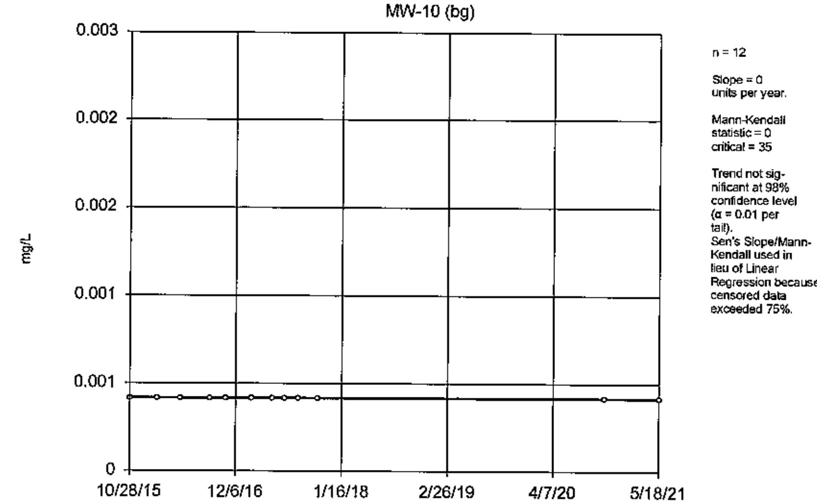
Hollow symbols indicate censored values.

Sen's Slope Estimator

MW-10 (bg)



Constituent: Cadmium Analysis Run 8/8/2021 10:14 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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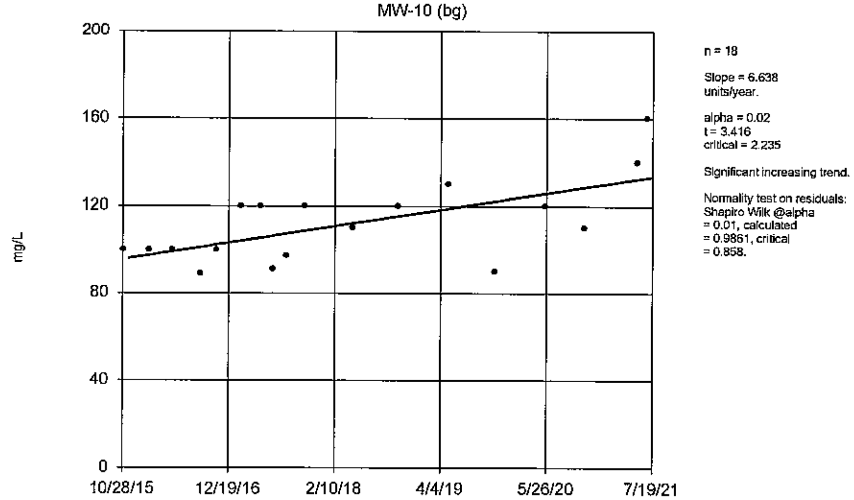
Linear Regression

MW-10 (bg)



Constituent: Calcium Analysis Run 8/8/2021 10:14 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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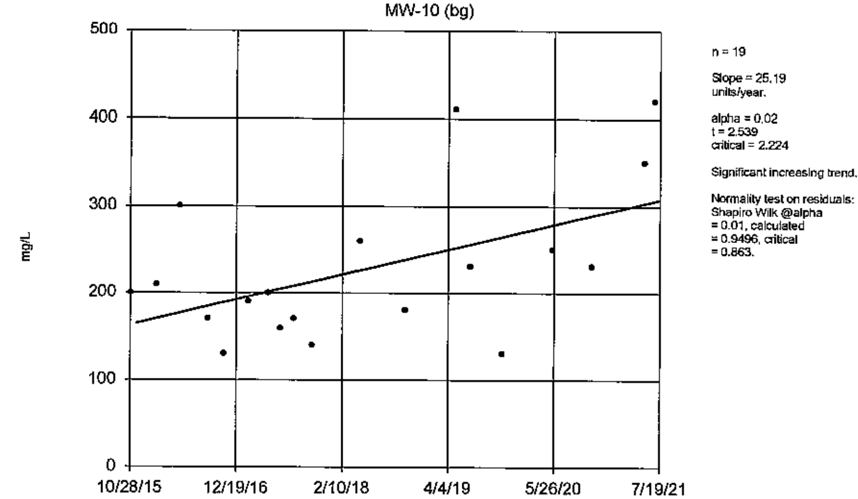
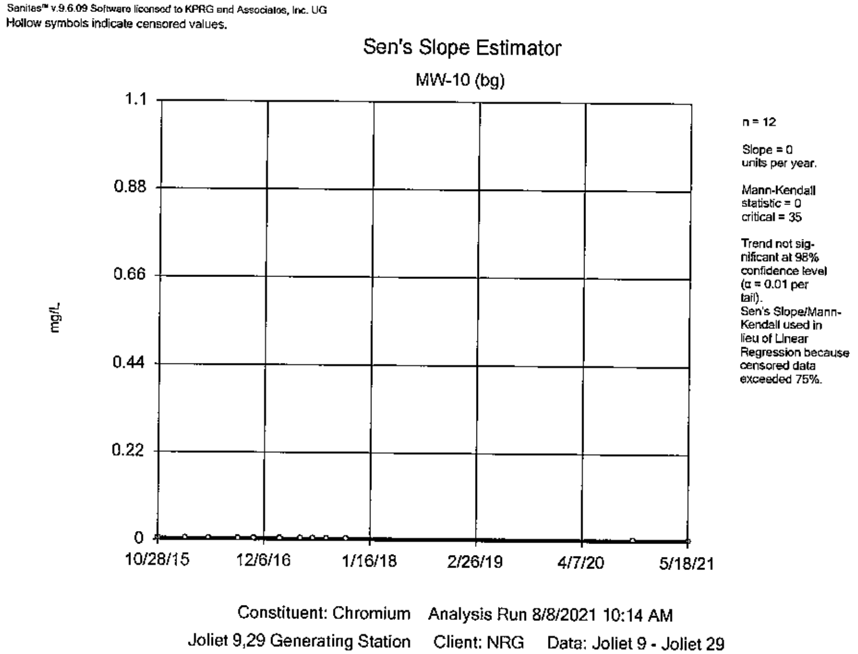
Linear Regression

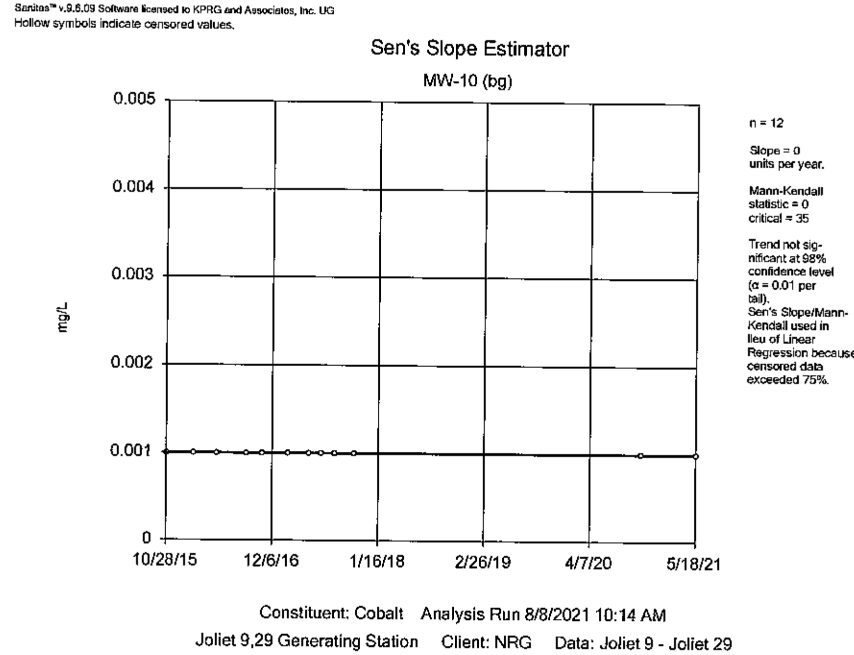
MW-10 (bg)

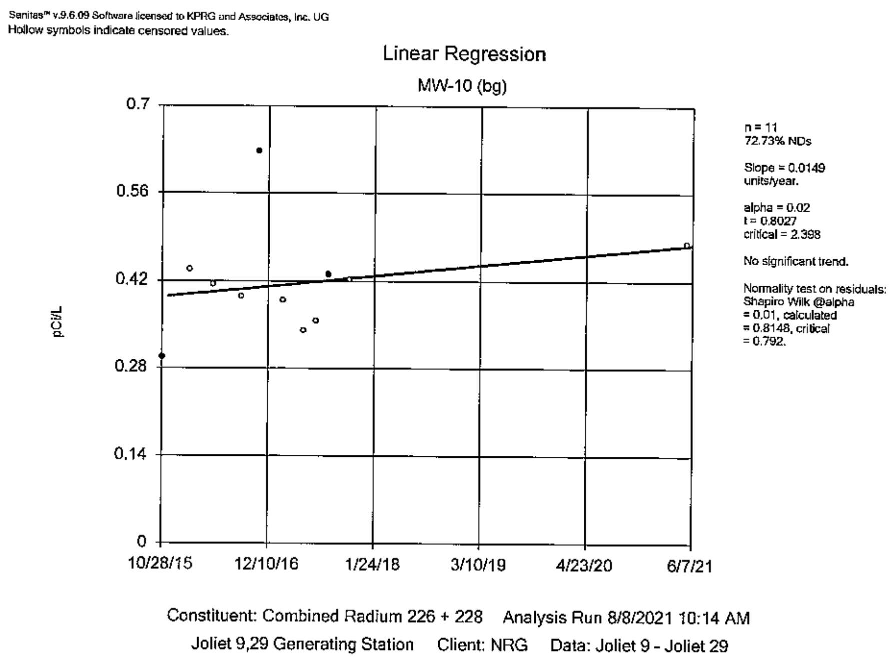


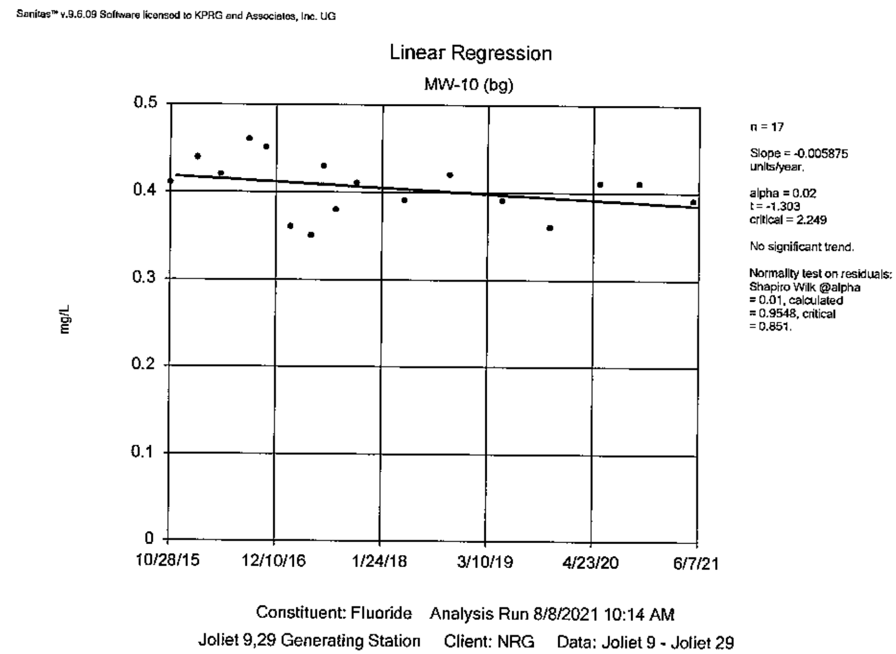
Constituent: Chloride Analysis Run 8/8/2021 10:14 AM

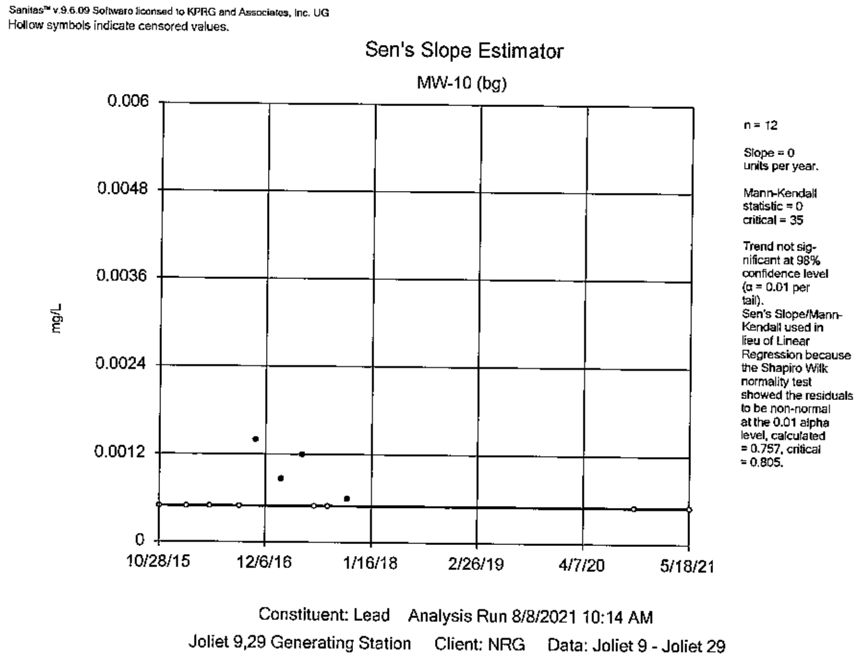
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

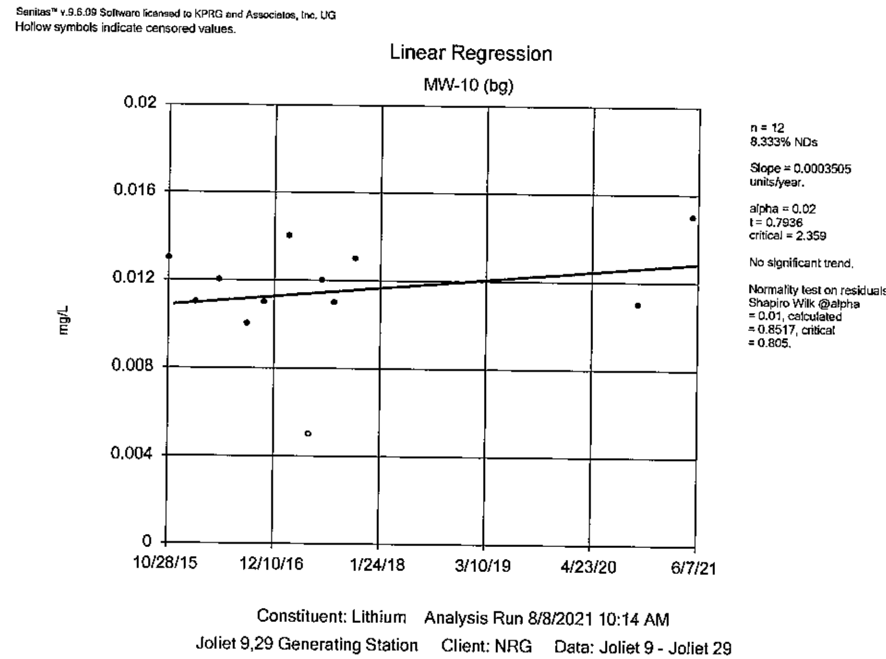

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
mg/L
1.1
0.88
0.66
0.44
0.22
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because censored data exceeded 75%.
Constituent: Chromium Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

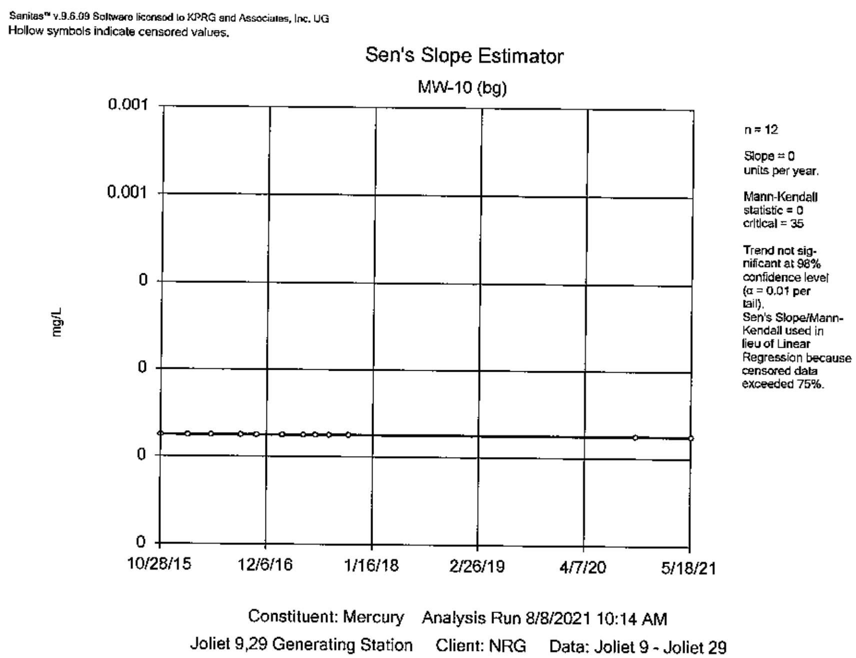

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
mg/L
0.005
0.004
0.003
0.002
0.001
0
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because censored data exceeded 75%.
Constituent: Cobalt Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

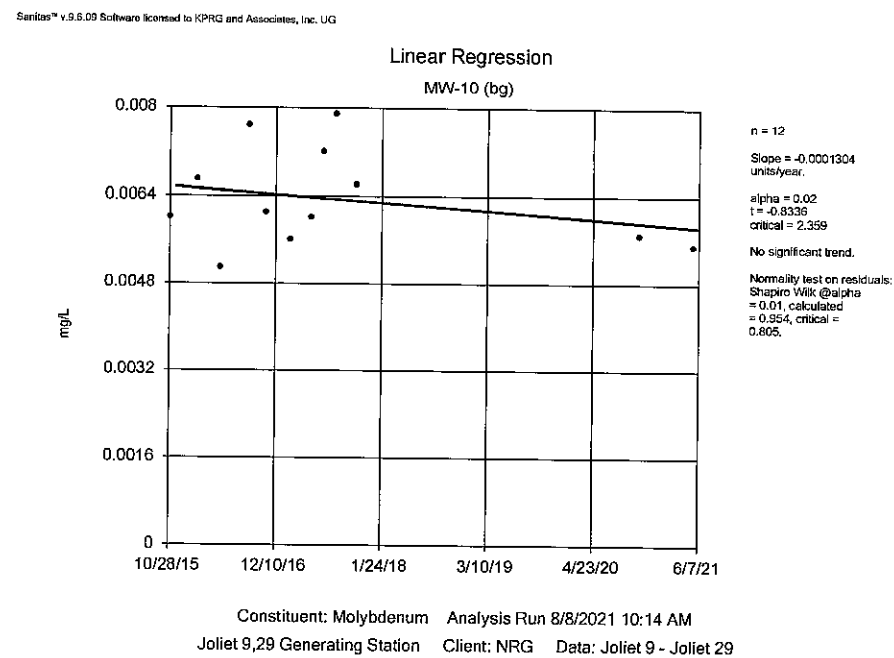

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Linear Regression
MW-10 (bg)
pCi/L
0.7
0.56
0.42
0.28
0.14
0
10/28/15
12/10/16
1/24/18
3/10/19
4/23/20
6/7/21
n = 11
72.73% NDs
Slope = 0.0149 units/year.
alpha = 0.02
t = 0.8027
critical = 2.398
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.8148, critical = 0.792.
Constituent: Combined Radium 226 + 228 Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

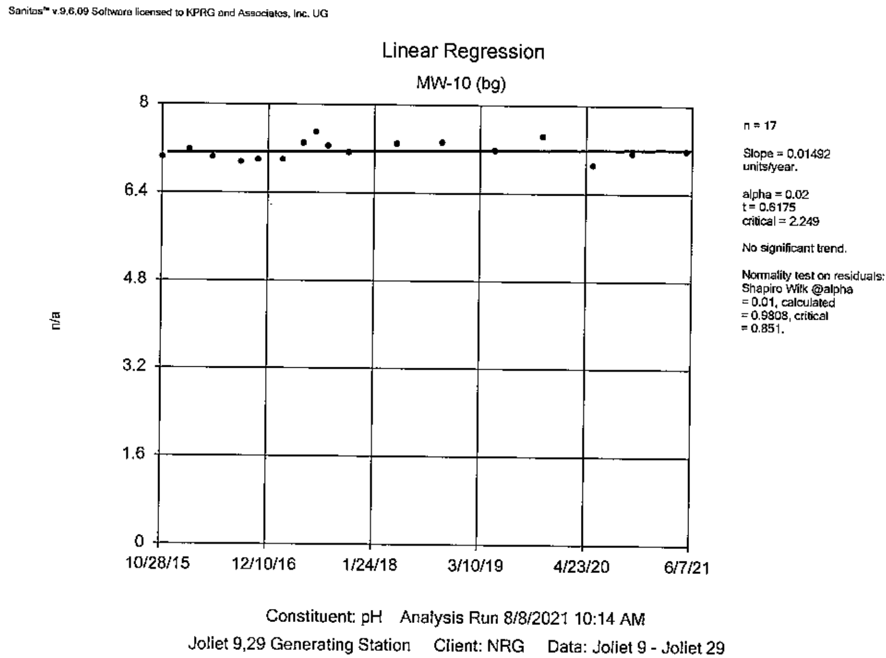

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Linear Regression
MW-10 (bg)
mg/L
0.5
0.4
0.3
0.2
0.1
0
10/28/15
12/10/16
1/24/18
3/10/19
4/23/20
6/7/21
n = 17
Slope = -0.005875 units/year.
alpha = 0.02
t = -1.303
critical = 2.249
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.9548, critical = 0.851.
Constituent: Fluoride Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

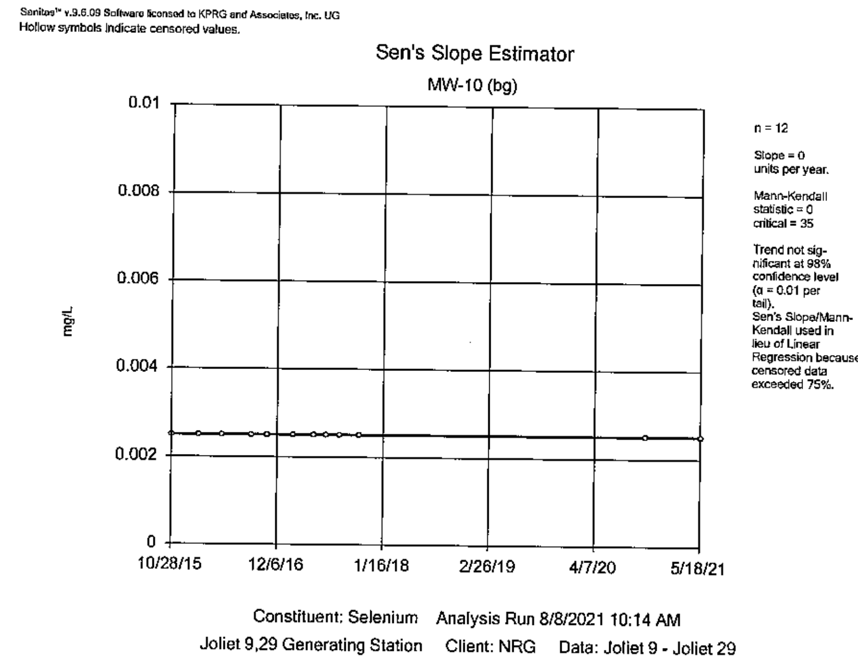

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
0.006
0.0048
0.0036
0.0024
0.0012
0
mg/L
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because the Shapiro Wilk normality test showed the residuals to be non-normal at the 0.01 alpha level, calculated = 0.757, critical = 0.805.
Constituent: Lead Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

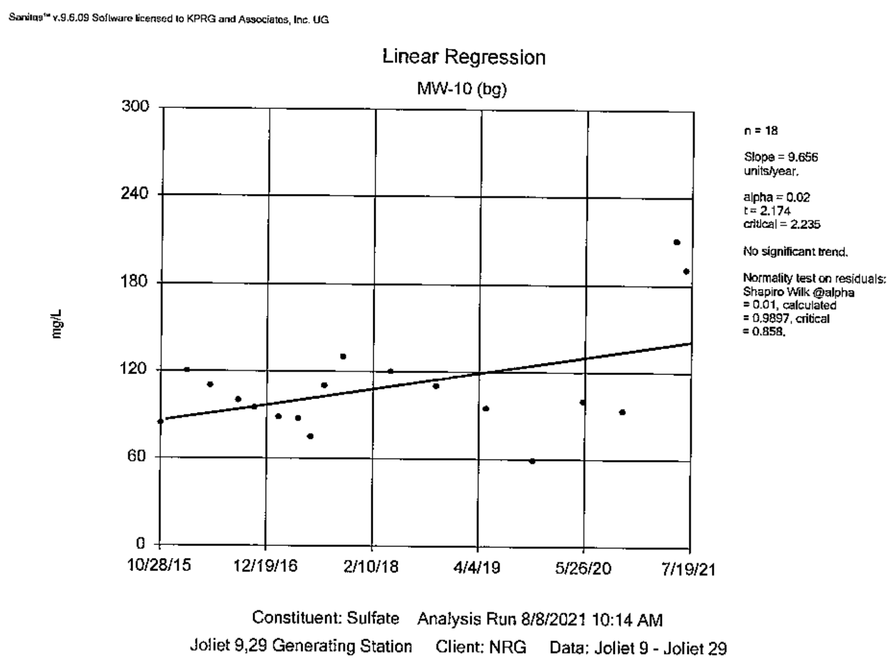

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Linear Regression
MW-10 (bg)
0.02
0.016
0.012
0.008
0.004
0
mg/L
10/28/15
12/10/16
1/24/18
3/10/19
4/23/20
6/7/21
n = 12
8.333% NDs
Slope = 0.0003505 units/year.
alpha = 0.02
t = 0.7936
critical = 2.359
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.8517, critical = 0.805.
Constituent: Lithium Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

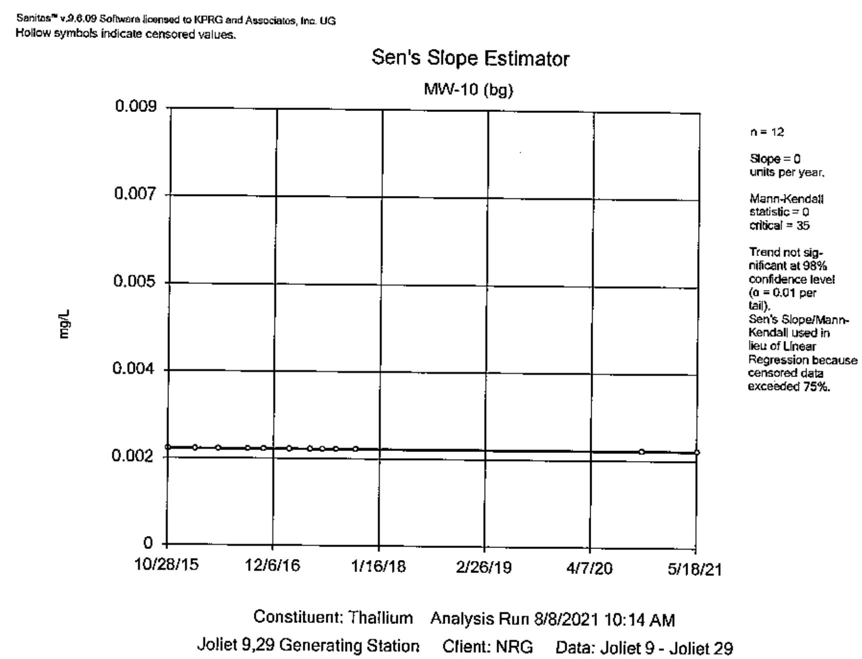

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
0.001
0.001
0
0
0
0
mg/L
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because censored data exceeded 75%.
Constituent: Mercury Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

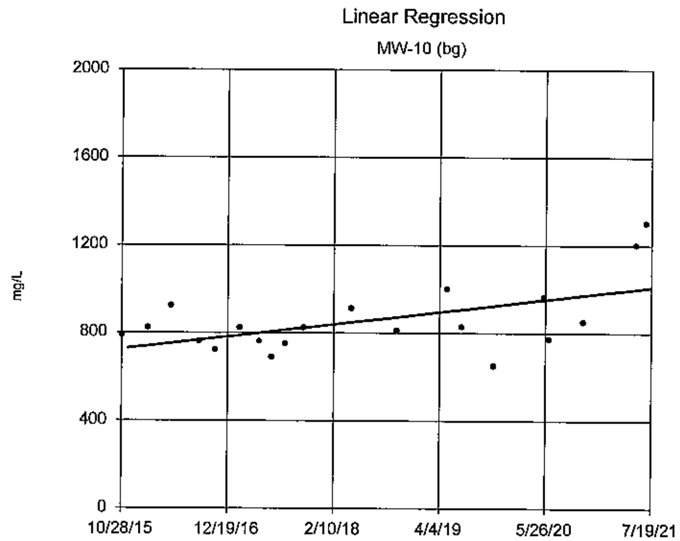

Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Linear Regression
MW-10 (bg)
0.008
0.0064
0.0048
0.0032
0.0016
0
mg/L
10/28/15
12/10/16
1/24/18
3/10/19
4/23/20
6/7/21
n = 12
Slope = -0.0001304 units/year.
alpha = 0.02
t = -0.8336
critical = 2.359
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.954, critical = 0.805.
Constituent: Molybdenum Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Linear Regression
MW-10 (bg)
8
6.4
4.8
3.2
1.6
0
n/a
10/28/15
12/10/16
1/24/18
3/10/19
4/23/20
6/7/21
n = 17
Slope = 0.01492 units/year.
alpha = 0.02
t = 0.6175
critical = 2.249
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.9808, critical = 0.851.
Constituent: pH Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
0.01
0.008
0.006
0.004
0.002
0
mg/L
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0
critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because censored data exceeded 75%.
Constituent: Selenium Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Linear Regression
MW-10 (bg)
300
240
180
120
60
0
mg/L
10/28/15
12/19/16
2/10/18
4/4/19
5/26/20
7/19/21
n = 18
Slope = 9.656 units/year.
alpha = 0.02
t = 2.174
critical = 2.235
No significant trend.
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.9897, critical = 0.858.
Constituent: Sulfate Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29


Sanitas™ v.9.6.09 Software licensed to KPRG and Associates, Inc. UG
Hollow symbols indicate censored values.
Sen's Slope Estimator
MW-10 (bg)
0.009
0.007
0.005
0.004
0.002
0
mg/L
10/28/15
12/6/16
1/16/18
2/26/19
4/7/20
5/18/21
n = 12
Slope = 0 units per year.
Mann-Kendall statistic = 0
critical = 35
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope/Mann-Kendall used in lieu of Linear Regression because censored data exceeded 75%.
Constituent: Thallium Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29



n = 20

Slope = 49.54 units/year.

alpha = 0.02
t = 2.873
critical = 2.214

Significant increasing trend.

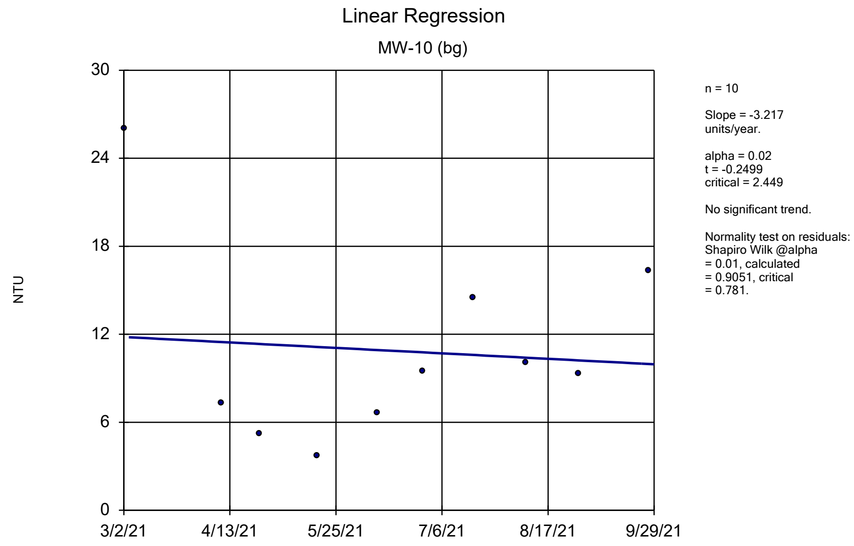
Normality test on residuals: Shapiro Wilk @alpha = 0.01, calculated = 0.9879, critical = 0.868.

Constituent: Total Dissolved Solids   Analysis Run 8/8/2021 10:14 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Trend Test Joliet #29 MW-10 Turbidity

Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29   Printed 10/7/2021, 2:47 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Turbidity (NTU)	MW-10 (bg)	-3.217	-0.2499	2.449	No	10	0	Yes	no	0.02	Param.



Constituent: Turbidity Analysis Run 10/7/2021 2:45 PM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Shapiro-Wilk Normality Test

Constituent: Antimony   Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	0	0.859	No
	square	-1	0.859	No
	cube root	0	0.859	No
	cube	-1	0.859	No
	natural log	-1	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Arsenic Analysis Run 8/12/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	0.7417	0.859	No
	square root	0.7553	0.859	No
	square	0.709	0.859	No
	cube root	0.7594	0.859	No
	cube	0.6705	0.859	No
	natural log	0.7669	0.859	No
	x^4	0.6288	0.859	No
	x^5	0.5868	0.859	No
	x^6	0.5469	0.859	No

Shapiro-Wilk Normality Test

Constituent: Barium Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	0.9036	0.859	Yes
	square root	0.9268	0.859	Yes
	square	0.8453	0.859	No
	cube root	0.9336	0.859	Yes
	cube	0.7769	0.859	No
	natural log	0.9454	0.859	Yes
	x^4	0.7058	0.859	No
	x^5	0.6383	0.859	No
	x^6	0.5782	0.859	No

Shapiro-Wilk Normality Test

Constituent: Beryllium   Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	-1	0.859	No
	square	-1	0.859	No
	cube root	0	0.859	No
	cube	-1	0.859	No
	natural log	0	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Boron Analysis Run 8/12/2021 9:57 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 19, alpha = 0.05)				
	no	0.8874	0.901	No
	square root	0.9339	0.901	Yes
	square	0.7655	0.901	No
	cube root	0.9464	0.901	Yes
	cube	0.6355	0.901	No
	natural log	0.9662	0.901	Yes
	x^4	0.5242	0.901	No
	x^5	0.4401	0.901	No
	x^6	0.3805	0.901	No

Shapiro-Wilk Normality Test

Constituent: Cadmium Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	0	0.859	No
	square	-1	0.859	No
	cube root	0	0.859	No
	cube	-1	0.859	No
	natural log	-1	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Calcium   Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 18, alpha = 0.05)				
	no	0.9087	0.897	Yes
	square root	0.9244	0.897	Yes
	square	0.866	0.897	No
	cube root	0.9288	0.897	Yes
	cube	0.8107	0.897	No
	natural log	0.9362	0.897	Yes
	x^4	0.7474	0.897	No
	x^5	0.6816	0.897	No
	x^6	0.6183	0.897	No

Shapiro-Wilk Normality Test

Constituent: Chloride Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 19, alpha = 0.05)				
	no	0.8777	0.901	No
	square root	0.9191	0.901	Yes
	square	0.7794	0.901	No
	cube root	0.9306	0.901	Yes
	cube	0.6854	0.901	No
	natural log	0.9492	0.901	Yes
	x^4	0.6097	0.901	No
	x^5	0.5532	0.901	No
	x^6	0.5122	0.901	No

Shapiro-Wilk Normality Test

Constituent: Chromium   Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	0	0.859	No
	square	-1	0.859	No
	cube root	0	0.859	No
	cube	-1	0.859	No
	natural log	0	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Cobalt Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	-1	0.859	No
	square	-1	0.859	No
	cube root	0	0.859	No
	cube	-1	0.859	No
	natural log	0	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Combined Radium 226 + 228 Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 11, alpha = 0.05)				
	no	0.8951	0.85	Yes
	square root	0.928	0.85	Yes
	square	0.8127	0.85	No
	cube root	0.9372	0.85	Yes
	cube	0.7228	0.85	No
	natural log	0.9527	0.85	Yes
	x^4	0.6393	0.85	No
	x^5	0.5689	0.85	No
	x^6	0.513	0.85	No

Shapiro-Wilk Normality Test

Constituent: Fluoride   Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 17, alpha = 0.05)				
	no	0.9672	0.892	Yes
	square root	0.9655	0.892	Yes
	square	0.9683	0.892	Yes
	cube root	0.9648	0.892	Yes
	cube	0.9663	0.892	Yes
	natural log	0.963	0.892	Yes
	x^4	0.9612	0.892	Yes
	x^5	0.9531	0.892	Yes
	x^6	0.9424	0.892	Yes

Shapiro-Wilk Normality Test

Constituent: Lead Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	0.6248	0.859	No
	square root	0.6354	0.859	No
	square	0.598	0.859	No
	cube root	0.6385	0.859	No
	cube	0.5677	0.859	No
	natural log	0.6439	0.859	No
	x^4	0.5377	0.859	No
	x^5	0.5103	0.859	No
	x^6	0.4864	0.859	No

Shapiro-Wilk Normality Test

Constituent: Lithium Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	0.8624	0.859	Yes
	square root	0.8009	0.859	No
	square	0.9403	0.859	Yes
	cube root	0.7781	0.859	No
	cube	0.9555	0.859	Yes
	natural log	0.7307	0.859	No
	x^4	0.9304	0.859	Yes
	x^5	0.8884	0.859	Yes
	x^6	0.8422	0.859	No

Shapiro-Wilk Normality Test

Constituent: Mercury Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	0	0.859	No
	square	-1	0.859	No
	cube root	0	0.859	No
	cube	-1	0.859	No
	natural log	-1	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Molybdenum   Analysis Run 8/12/2021 9:57 AM

Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	0.9372	0.859	Yes
	square root	0.9461	0.859	Yes
	square	0.916	0.859	Yes
	cube root	0.9488	0.859	Yes
	cube	0.8913	0.859	Yes
	natural log	0.9537	0.859	Yes
	x^4	0.8644	0.859	Yes
	x^5	0.8366	0.859	No
	x^6	0.8087	0.859	No

Shapiro-Wilk Normality Test

Constituent: pH Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 17, alpha = 0.05)				
	no	0.9714	0.892	Yes
	square root	0.9723	0.892	Yes
	square	0.9693	0.892	Yes
	cube root	0.9726	0.892	Yes
	cube	0.9671	0.892	Yes
	natural log	0.9732	0.892	Yes
	x^4	0.9645	0.892	Yes
	x^5	0.9617	0.892	Yes
	x^6	0.9587	0.892	Yes

Shapiro-Wilk Normality Test

Constituent: Selenium   Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	0	0.859	No
	square	-1	0.859	No
	cube root	-1	0.859	No
	cube	-1	0.859	No
	natural log	0	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Sulfate Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 18, alpha = 0.05)				
	no	0.8207	0.897	No
	square root	0.8813	0.897	No
	square	0.6916	0.897	No
	cube root	0.8989	0.897	Yes
	cube	0.5848	0.897	No
	natural log	0.9281	0.897	Yes
	x^4	0.5095	0.897	No
	x^5	0.4593	0.897	No
	x^6	0.4261	0.897	No

Shapiro-Wilk Normality Test

Constituent: Thallium Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 12, alpha = 0.05)				
	no	-1	0.859	No
	square root	0	0.859	No
	square	-1	0.859	No
	cube root	-1	0.859	No
	cube	-1	0.859	No
	natural log	0	0.859	No
	x^4	-1	0.859	No
	x^5	-1	0.859	No
	x^6	-1	0.859	No

Shapiro-Wilk Normality Test

Constituent: Total Dissolved Solids   Analysis Run 8/12/2021 9:57 AM
Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-10 (bg) (n = 20, alpha = 0.05)				
	no	0.849	0.905	No
	square root	0.8818	0.905	No
	square	0.7774	0.905	No
	cube root	0.892	0.905	No
	cube	0.7043	0.905	No
	natural log	0.9111	0.905	Yes
	x^4	0.6359	0.905	No
	x^5	0.5759	0.905	No
	x^6	0.5252	0.905	No

Shapiro-Wilk Normality Test

Constituent: Turbidity   Analysis Run 10/7/2021 2:42 PM

Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29

Well	Transformation	Calculated	Critical	Normal
MW-03 (n = 10, alpha = 0.05)				
	no	0.6987	0.842	No
	square root	0.8252	0.842	No
	square	0.5517	0.842	No
	cube root	0.8704	0.842	Yes
	cube	0.4778	0.842	No
	natural log	0.9265	0.842	Yes
	x^4	0.4348	0.842	No
	x^5	0.4084	0.842	No
	x^6	0.3921	0.842	No
MW-04 (n = 10, alpha = 0.05)				
	no	0.6444	0.842	No
	square root	0.7365	0.842	No
	square	0.5248	0.842	No
	cube root	0.7711	0.842	No
	cube	0.4592	0.842	No
	natural log	0.8401	0.842	No
	x^4	0.4208	0.842	No
	x^5	0.398	0.842	No
	x^6	0.3846	0.842	No
MW-05 (n = 10, alpha = 0.05)				
	no	0.8561	0.842	Yes
	square root	0.9502	0.842	Yes
	square	0.6485	0.842	No
	cube root	0.97	0.842	Yes
	cube	0.5159	0.842	No
	natural log	0.9831	0.842	Yes
	x^4	0.4452	0.842	No
	x^5	0.4082	0.842	No
	x^6	0.3887	0.842	No
MW-10 (bg) (n = 10, alpha = 0.05)				
	no	0.8725	0.842	Yes
	square root	0.9473	0.842	Yes
	square	0.6983	0.842	No
	cube root	0.9654	0.842	Yes
	cube	0.5657	0.842	No
	natural log	0.9871	0.842	Yes
	x^4	0.4837	0.842	No
	x^5	0.4356	0.842	No
	x^6	0.4075	0.842	No

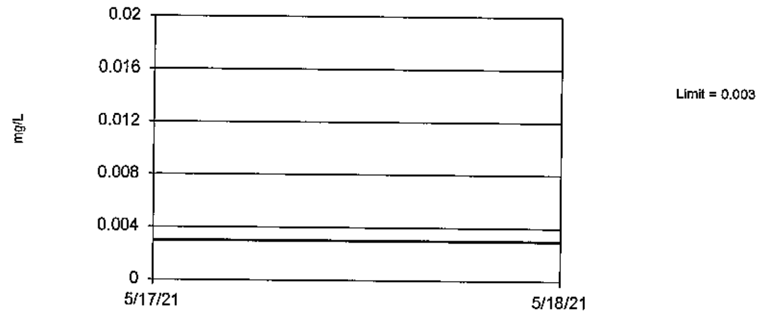
Joliet #29 Interwell PL MW-10 All Values

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29 Printed 8/8/2021, 11:41 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	%NDs	Transform	Alpha	Method
Antimony (mg/L)	n/a	0.003	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2
Arsenic (mg/L)	n/a	0.0018	n/a	n/a	3 future	n/a	12	41.67	n/a	0.009156	NP (normality) 1 of 2
Barium (mg/L)	n/a	0.0628	n/a	n/a	3 future	n/a	12	0	No	0.000399	Param 1 of 2
Beryllium (mg/L)	n/a	0.001	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2
Boron (mg/L)	n/a	0.8306	n/a	n/a	3 future	n/a	19	0	sqrt(x)	0.000399	Param 1 of 2
Cadmium (mg/L)	n/a	0.0005	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2
Chromium (mg/L)	n/a	0.005	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2
Cobalt (mg/L)	n/a	0.001	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2
Combined Radium 226 + 228 (pCi/L)	n/a	0.626	n/a	n/a	3 future	n/a	11	72.73	n/a	0.01058	NP (NDs) 1 of 2
Fluoride (mg/L)	n/a	0.486	n/a	n/a	3 future	n/a	17	0	No	0.000399	Param 1 of 2
Lead (mg/L)	n/a	0.0014	n/a	n/a	3 future	n/a	12	66.67	n/a	0.009156	NP (NDs) 1 of 2
Lithium (mg/L)	n/a	0.01864	n/a	n/a	3 future	n/a	12	8.333	No	0.000399	Param 1 of 2
Mercury (mg/L)	n/a	0.0002	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2
Molybdenum (mg/L)	n/a	0.008878	n/a	n/a	3 future	n/a	12	0	No	0.000399	Param 1 of 2
pH (n/a)	n/a	7.569	6.733	n/a	3 future	n/a	17	0	No	0.000...	Param 1 of 2
Selenium (mg/L)	n/a	0.0025	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2
Sulfate (mg/L)	n/a	214.7	n/a	n/a	3 future	n/a	18	0	x^(1/3)	0.000399	Param 1 of 2
Thallium (mg/L)	n/a	0.002	n/a	n/a	3 future	n/a	12	100	n/a	0.009156	NP (NDs) 1 of 2

Prediction Limit

Interwell Non-parametric



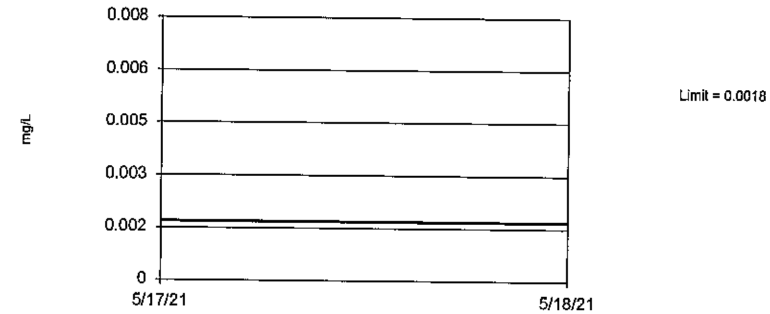
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Antimony Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Prediction Limit

Interwell Non-parametric



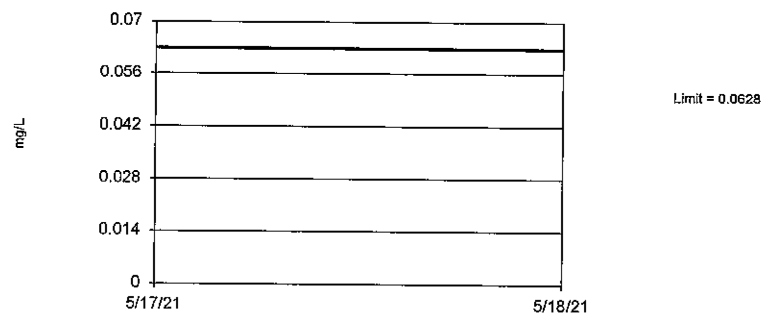
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 12 background values. 41.67% NDs. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Arsenic Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Prediction Limit

Interwell Parametric



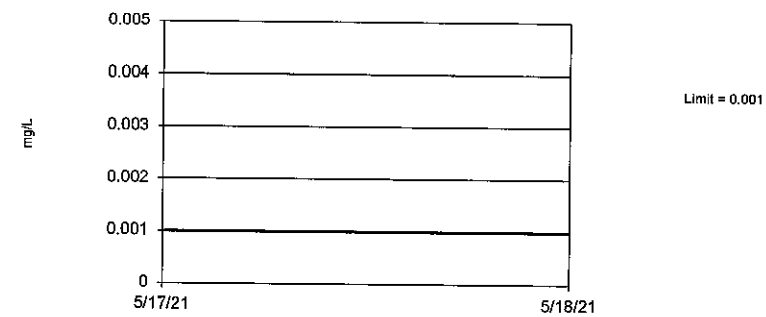
Background Data Summary: Mean=0.04258, Std. Dev.=0.00709, n=12. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9036, critical = 0.859. Kappa = 2.851 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Barium Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Beryllium Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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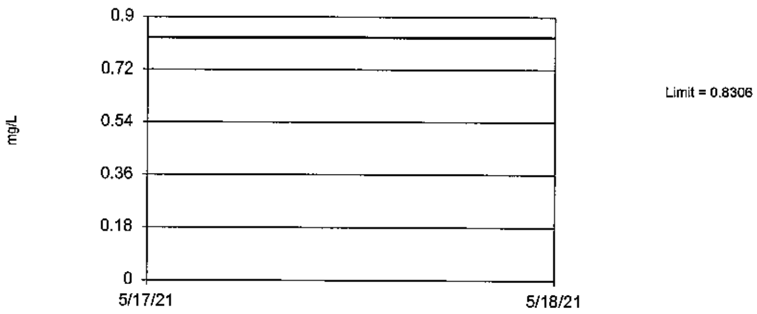
Prediction Limit

Interwell Parametric



Background Data Summary (based on square root transformation): Mean=0.6538, Std. Dev.=0.1026, n=19. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9339, critical = 0.901. Kappa = 2.511 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Boron Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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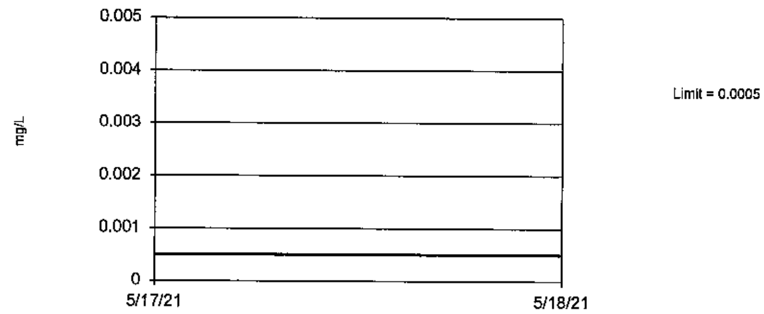
Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Cadmium Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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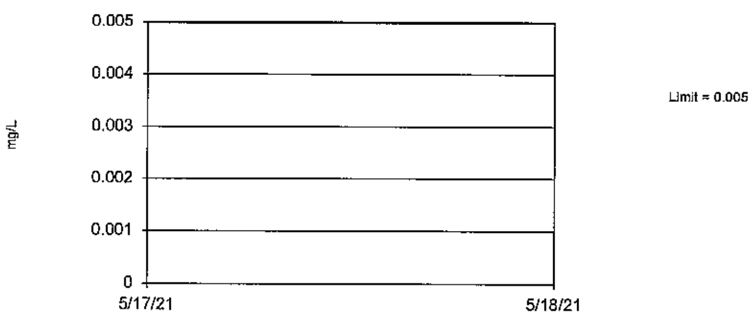
Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Chromium Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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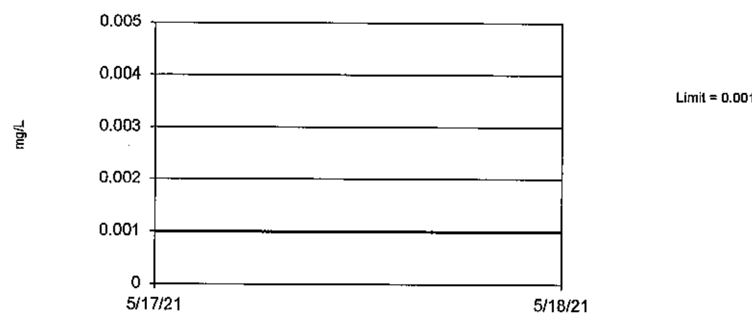
Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Cobalt Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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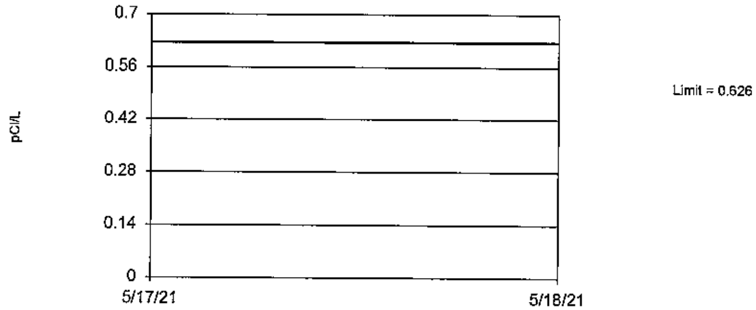
Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 11 background values. 72.73% NDs. Annual per-constituent alpha = 0.1199. Individual comparison alpha = 0.01058 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Combined Radium 226 + 228 Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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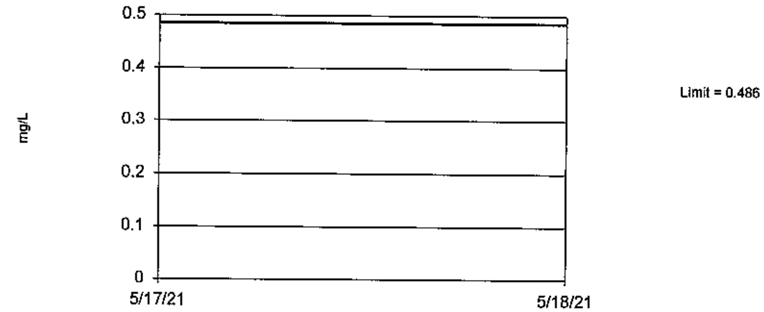
Prediction Limit

Interwell Parametric



Background Data Summary: Mean=0.4047, Std. Dev.=0.03145, n=17. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9672, critical = 0.892. Kappa = 2.586 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Fluoride Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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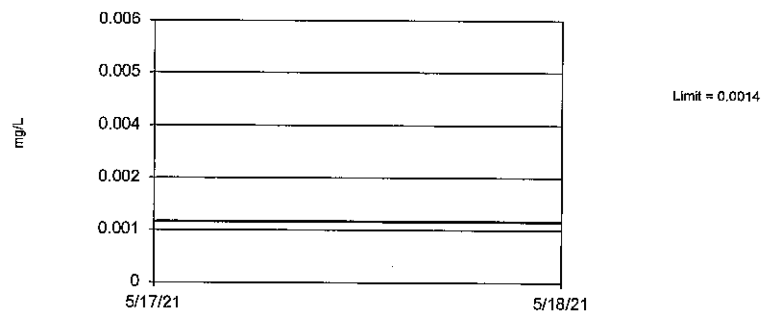
Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 12 background values. 66.67% NDs. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Lead Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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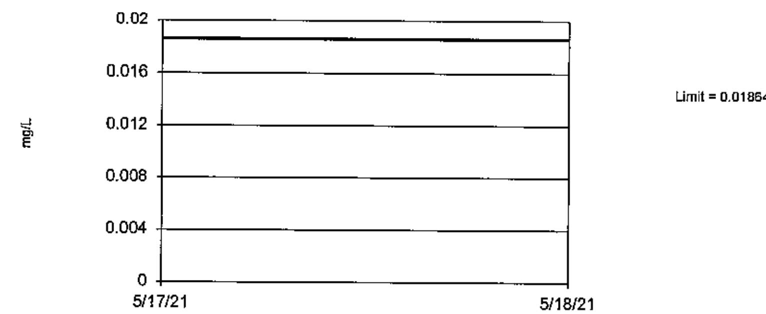
Prediction Limit

Interwell Parametric



Background Data Summary: Mean=0.0115, Std. Dev.=0.002505, n=12, 8.333% NDs. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8624, critical = 0.859. Kappa = 2.851 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Lithium Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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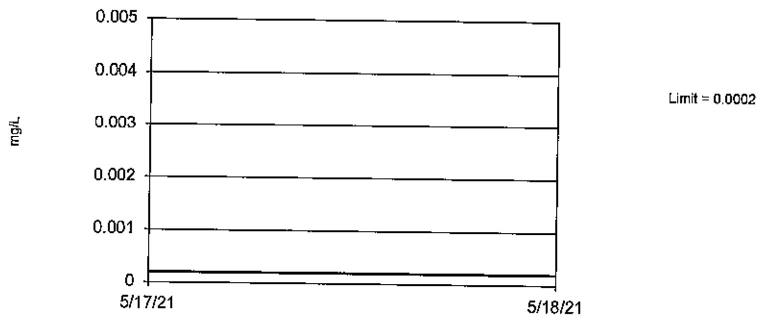
Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Mercury Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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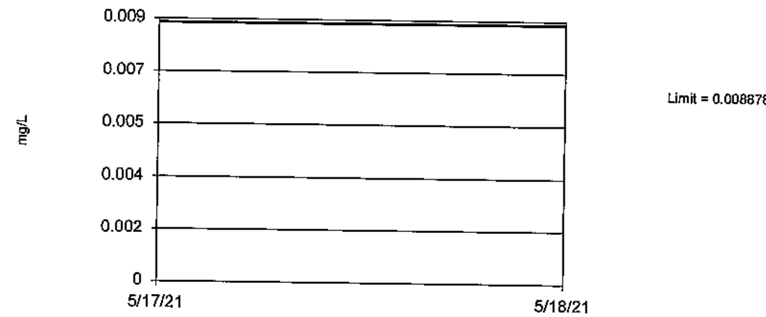
Prediction Limit

Interwell Parametric



Background Data Summary: Mean=0.006342, Std. Dev.=0.0008898, n=12. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9372, critical = 0.859. Kappa = 2.851 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Molybdenum Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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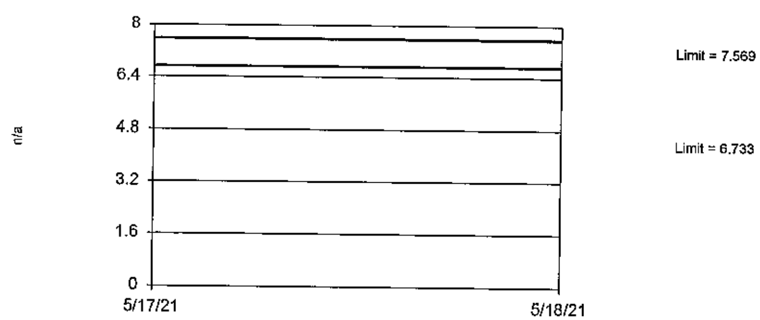
Prediction Limit

Interwell Parametric



Background Data Summary: Mean=7.151, Std. Dev.=0.1617, n=17. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9714, critical = 0.892. Kappa = 2.586 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.0001995. Assumes 3 future values.

Constituent: pH Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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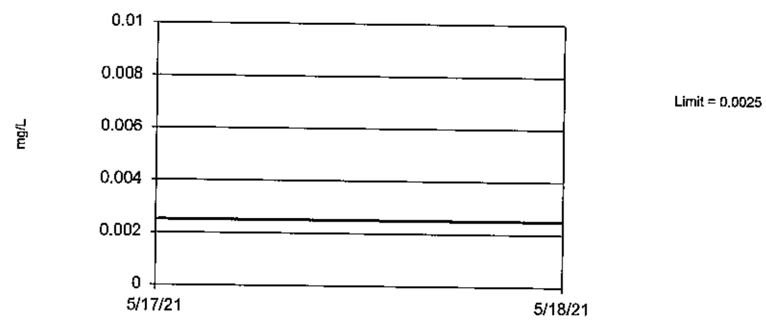
Prediction Limit

Interwell Non-parametric



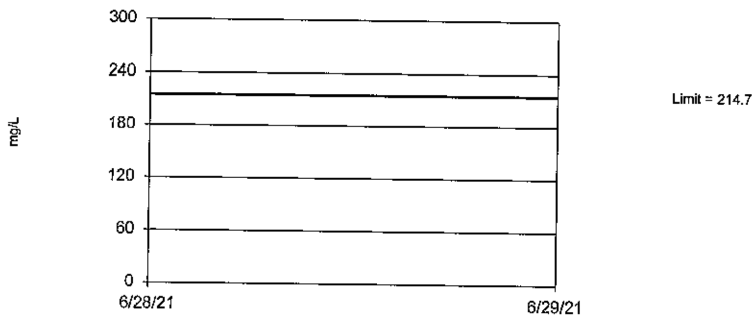
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Selenium Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Prediction Limit

Interwell Parametric



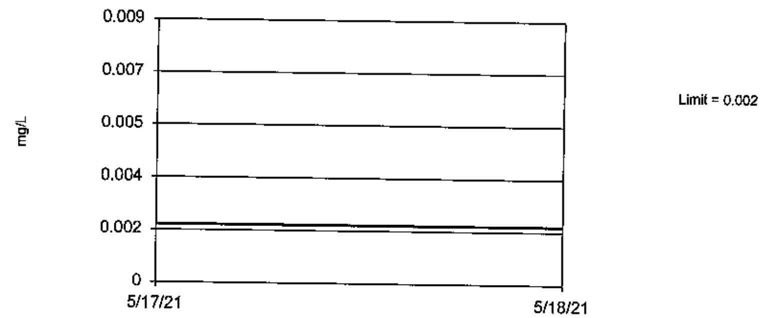
Background Data Summary (based on cube root transformation): Mean=4.739, Std. Dev.=0.4901, n=18. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8989, critical = 0.897. Kappa = 2.549 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Sulfate Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 12) were censored; limit is most recent reporting limit. Annual per-constituent alpha = 0.1045. Individual comparison alpha = 0.009156 (1 of 2). Assumes 3 future values. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Thallium Analysis Run 8/8/2021 11:39 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

Joliet #29 Interwell PL MW-10 Original 8

Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29   Printed 8/8/2021, 11:34 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	%NDs	Transform	Alpha	Method
Calcium (mg/L)	n/a	143	n/a	n/a	3 future	n/a	8	0	No	0.000399	Param 1 of 2
Chloride (mg/L)	n/a	368	n/a	n/a	3 future	n/a	8	0	No	0.000399	Param 1 of 2
Total Dissolved Solids (mg/L)	n/a	1031	n/a	n/a	3 future	n/a	8	0	No	0.000399	Param 1 of 2

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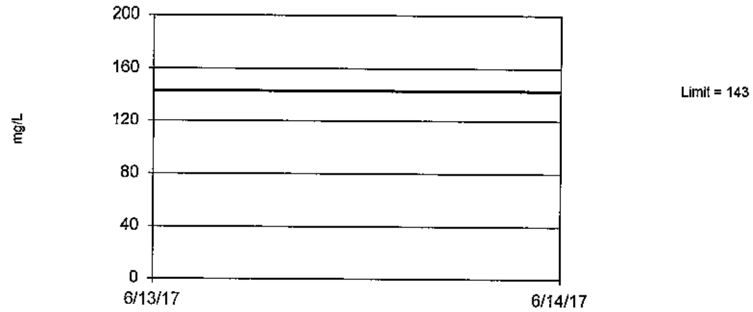
Prediction Limit

Interwell Parametric



Background Data Summary: Mean=102.5, Std. Dev.=11.66, n=8. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8198, critical = 0.818. Kappa = 3.469 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Calcium Analysis Run 8/8/2021 11:32 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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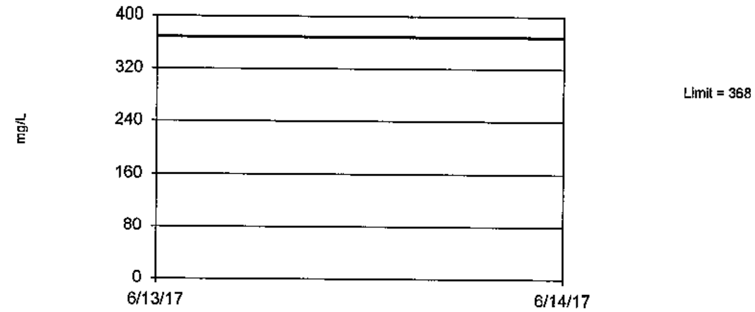
Prediction Limit

Interwell Parametric



Background Data Summary: Mean=195, Std. Dev.=49.86, n=8. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8907, critical = 0.818. Kappa = 3.469 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Chloride Analysis Run 8/8/2021 11:32 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

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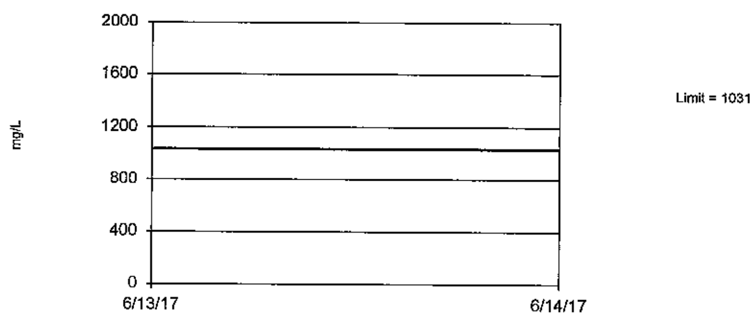
Prediction Limit

Interwell Parametric



Background Data Summary: Mean=785, Std. Dev.=70.91, n=8. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9512, critical = 0.818. Kappa = 3.469 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Total Dissolved Solids Analysis Run 8/8/2021 11:32 AM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

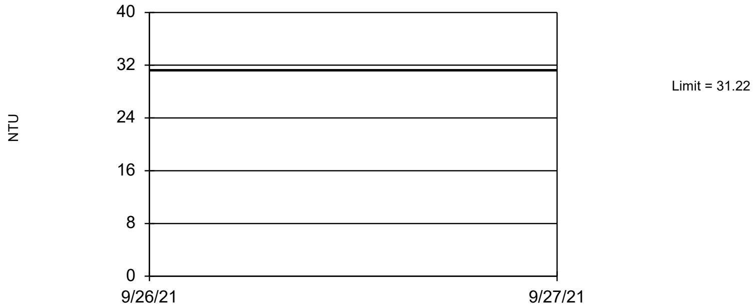
Interwell Prediction Limit Joliet #29 MW-10 Turbidity

Joliet 9,29 Generating Station   Client: NRG   Data: Joliet 9 - Joliet 29   Printed 10/7/2021, 2:48 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	%NDs	Transform	Alpha	Method
Turbidity (NTU)	n/a	31.22	n/a	n/a	3 future	n/a	10	0	No	0.000399	Param 1 of 2

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=10.86, Std. Dev.=6.601, n=10. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8725, critical = 0.842. Kappa = 3.084 (c=22, w=3, 1 of 2, event alpha = 0.026). Report alpha = 0.001197. Individual comparison alpha = 0.000399. Assumes 3 future values.

Constituent: Turbidity Analysis Run 10/7/2021 2:47 PM

Joliet 9,29 Generating Station Client: NRG Data: Joliet 9 - Joliet 29

ATTACHMENT 10
PE CERTIFICATION

Attachment 10 – No Attachment

<u>ATTACHMENT 11</u>
<u>OWNER CERTIFICATION</u>

Attachment 11 – Owner Certification

I, William Naglosky, as an authorized representative of Midwest Generation, certify that the public notification and public meeting requirements were completed in accordance with 35 Ill. Adm. Code 845.240.

Signature: William Naglosky

Title: Plant Manager.

Midwest Generation, LLC
Joliet 29 Generating Station
Ash Pond 2 Closure Alternatives Assessment
Public Meeting General Summary

INTRODUCTION

In accordance with Title 35 of the Illinois Administrative Code ("35 IAC") Section 845.240, Midwest Generation, LLC (MWG) posted the public meeting notice on the Closure Plans for Joliet 29 Generating Station's Pond 2 on its publicly available website and provided a copy of such notice to the Illinois Environmental Protection Agency (Illinois EPA or Agency) to email to its listserv for this facility. The bilingual public meeting notice was also mailed to all residents within at least 1 mile of the facility on November 6, 2021, which totaled 4,401 residential mailing addresses. The notice was also posted in 35 public locations within 10 miles of the facility boundary.

The public meetings for Joliet 29 Generating Station's Pond 2 were held on December 8, 2021 from 10:00 a.m. to 12:00 p.m. and on December 9, 2021 from 6:00 p.m. to 8:00 p.m. The meetings were held virtually, and participants were invited to attend via Zoom or telephone. Twelve members of the public attended the December 8th meeting, and six members of the public attended the December 9th meeting (the remaining attendees were MWG affiliate employees and consultants). Attendees who wished to sign up for a copy of the meeting summary and/or be added to Illinois EPA's listserv for the facility were asked to sign up via a link to a Google form that was provided within the chat function of the Zoom meeting and posted on MWG's website, midwestgenerationllc.com. Seven attendees requested a copy of the meeting summary, three of whom requested transmittal of their email address to the Agency to be added to the Agency's listserv for the facility. It was also announced that the link would be available on MWG's public website for two weeks. After an introduction and approximate 30-minute presentation on the proposed closure construction plan, the public was given approximately 1 hour and 15 minutes during each meeting to ask questions and provide comments.

This document serves as a summary of the issues and questions raised during the meeting.

MWG proposes to close Pond 2 by removing and disposing of the remaining warning layer (limestone and sand), decontaminating the geomembrane liner, and repurposing the pond to treat station wastewaters.

SUMMARY OF ISSUES AND QUESTIONS RAISED DURING THE MEETING

Meeting – General

Several attendees commented on the virtual format of the meeting. MWG had initially intended and even made plans to hold the public meeting in-person. But as the date of the public meeting got closer, case rates in the region were troubling, so it was decided the safest and most prudent thing to do was to hold the meetings virtually.

Groundwater

Several attendees inquired about the groundwater monitoring network and the groundwater monitoring results. The groundwater monitoring network consists of four monitoring wells: one upgradient and three downgradient. By regulation, the upgradient well must accurately reflect background groundwater quality and not be affected by the CCR surface impoundment, and downgradient monitoring wells must be placed as close to the CCR surface impoundment as possible. The wells were sampled quarterly for CCR parameters for two years starting in 2015 under the Federal CCR Rule before switching to semi-annual sampling. Quarterly monitoring resumed in April 2021, when the Part 845 rule became effective. The proposed groundwater protection standards are based on a statistical evaluation of background groundwater quality.

In response to a specific question, the proposed groundwater protection standard for chloride is 368 parts per million (ppm). There were no exceedances of proposed groundwater protection standards for any constituent during the most recent round of sampling. Monitoring Well MW-9 is not included as part of the monitoring network for Pond 2 because it is not influenced by Pond 2. It is downgradient of Pond 3, neither up nor downgradient of Pond 2.

Groundwater monitoring after closure by removal is required for at least three years after completion of closure and the results meet the requirements specified under Section 845.740(b).

Closure Costs

Questions were asked about closure costs. Lincoln Stone Quarry was included in the cost analysis for closure by removal of Pond 2 as a potential final disposal location for the warning layer and geomembrane liner. Costs were not determinative in selecting closure by removal.

Poz-o-Pac

Several questions were posed about the Poz-o-Pac material located underneath Pond 2. This material is the pond's original liner when it was constructed in the late 1970s. Poz-o-Pac is a cementitious material and has been used as a supporting surface for things like roads, highways, and parking lots (in addition to similar pozzolan-stabilized base materials). Poz-o-Pac consists of a chemically stabilized mixture of lime, fly ash, and aggregate. Fly ash reacts with hydrate lime to create a cementitious paste that holds the aggregate together, ultimately forming a concrete-like material. Accordingly, the fly ash and aggregate were encapsulated and bound together to form Pond 2's Poz-o-Pac liner and, thus, would not leach out. The Poz-o-Pac liner remains in place under the geomembrane liner at Pond 2. Groundwater monitoring shows no impacts from CCR constituents.

According to the Federal Highway Administration, Poz-o-Pac was used at over 100 sites throughout Illinois between 1955 and 1985.

Rail System

Several questions were raised about using rail to transport ash and the rail and conveyor system located at Joliet 9. When the Joliet Stations burned coal, coal was delivered via rail to the Joliet 9 Station. It would be offloaded at Joliet 9 and then transported to Joliet 29 via a conveyor system on a suspension bridge over the Des Plaines River. The system was designed to transfer coal in one direction. It was neither designed to transfer CCR (a different material than coal) nor to move material from Joliet 29 to Joliet 9. While the rail line at Joliet 9 is still in place and available for pass through operations, the dumping and conveyor systems are no longer operational. To use the rail system at Joliet 9, new loading and unloading equipment, as well as a new conveyor system, would need to be installed, requiring extensive environmental permitting. Necessary permits include NPDES, stormwater, and air construction permits. In contrast, MWG estimates the material in Pond 2 could be completely removed in less than two weeks with trucks.

Final Disposal

Attendees questioned the final disposal location of the warning layer, and geomembrane liner if necessary. No coal ash remains in Pond 2. The warning layer, which consists of limestone and sand, remains and this is what would need to be disposed at a landfill that is permitted to accept that waste stream. Disposing of the warning layer and the liner in the Lincoln Stone Quarry was in the closure analysis as an alternative but was ultimately excluded because the Lincoln Stone Quarry is not permitted to accept Pond 2's waste streams.

Onsite Landfill

An onsite landfill was considered and ultimately ruled out because of the lengthy process of siting a new landfill, lack of available space vertically and horizontally, and obtaining the approvals needed versus the limited quantity of warning layer needing to be disposed from Pond 2. The station operates in the middle of the oblong shaped property that is approximately 238 acres. At least half, if not more, of the property is used for station operations.

Liner

Decontamination of the liner system consists of excavating the warning layer, washing down the geomembrane liner, and then taking confirmatory wipe samples (or another method if required by IEPA) of the liner. Once decontaminated, Pond 2 would be repurposed for use of treatment of station wastewaters, like stormwater, plant drains, and water purification system and sand filter backwash (for pretreatment of boiler water). The wastewaters in Pond 2 would continue to be regulated by the Station's wastewater permit.

SUMMARY OF REVISIONS, CHANGES, AND CONSIDERATIONS

Public engagement is an important part of the permitting process. Midwest Generation valued the opportunity to hear and consider the comments of community members and others who participated in the public meetings. At this time, Midwest Generation is proceeding with the proposal for closing Pond 2 by removing and disposing of the remaining warning layer (limestone and sand), decontaminating the geomembrane liner, and repurposing the pond to treat station wastewaters as presented at the public meetings. Taking public comments into consideration, the full analysis continues to indicate that the proposed plan – which remains subject to regulatory review and approval – prioritizes the environment and community well-being.

Timestamp	Email Address	Name	The Illinois Environmental Protection Agency is creating a listserv for the facility. Would you like us to transmit your email address to the Agency to be added to the listserv?
12/8/2021 10:23:57	senatorconnor@gmail.com	John Connor	Yes
12/8/2021 11:54:40	kcourtney@elpc.org	Kiana Courtney	Yes
12/14/2021 13:43:57	jduffey@northstar.com	John Duffey	Yes