Expert Report of John Seymour, P.E.

I have prepared this Expert Report on behalf of Midwest Generation, LLC (MWG) to present my opinions and to address the two expert reports issued by M. James R. Kunkel in the Matter of:

SIERRA CLUB, ENVIRONMENTAL LAW AND POLICY CENTER, PRAIRIE RIVERS NETWORK, and CITIZENS AGAINST RUINING THE ENVIRONMENT
Complainants,
v
MIDWEST GENERATION, LLC,
Respondent
PCB 2013-0015

Section 1: INTRODUCTION

1.1. Background

Since 1999, MWG has operated four electric generating stations at issue in this matter: the Joliet #29 Generating Station ("Joliet #29") located in Joliet, Will County, Illinois; the Powerton Generating Station ("Powerton") located in Pekin, Tazewell County, Illinois; the Waukegan Generating Station ("Waukegan") located in Waukegan, Lake County, Illinois; and the Will County Generating Station ("Will County") located in Romeoville, Will County, Illinois. Prior to 1999, the stations were operated by other entities and pre-1999 documents identify historic areas where ash was placed.[1]

Each of the generating stations includes active ash ponds as an integral part of the generating stations' wastewater treatment systems (MWG Facility NPDES Permits).[2] All of the ash ponds are permitted pursuant to MWG's NPDES permits (IL0064254, IL0002232, IL0002259, and IL0002208) and operate pursuant to the limits, terms, and conditions of the permits. All of the active ash ponds at the MWG facilities are fully lined with 60 mil-thick high density polyethylene (HDPE) liners.

In 2010, MWG voluntarily agreed to Illinois EPA's request to perform hydrogeological assessments around the ash ponds at its generating stations.[3] On June 11, 2012, based on the results of the hydrogeological assessments, Illinois EPA issued Violation Notices (VN) to MWG alleging violations of

---

[1] MWG13-15_8502-8536, MWG13-15_11966-12040, MWG13-15_29502-29532, MWG13-15_25139-25167

[2] MWG's Answer and Defenses to Second Complaint, Answers to Complaint ¶¶1, 3, 5, 7

[3] MWG13-15_364; MWG13-15_384; MWG13-15_407; MWG13-15_421

EXHIBIT
MWG 903

groundwater quality standards purportedly caused by the ash ponds.[4] The VNs listed exceedances of the groundwater quality standards for specific constituents at each station, such as chloride, antimony, and boron.[5]

MWG responded to the VNs, disputing that the ponds were the cause of groundwater exceedances.[6] MWG explained that the ash ponds are not disposal sites because the ash is routinely removed and that the alleged groundwater exceedances were inconsistent and did not show a connection to the ash ponds. Illinois EPA and MWG agreed on a Compliance Commitment Agreement (CCA) for each MWG station to resolve the VNs.[7]

As the CCAs were finalized,[8] Complainants filed a Complaint against MWG alleging open dumping violations, violations of Section 12 of the Illinois Environmental Protection Act, and violations of the Pollution Control Board groundwater regulations (35 Ill. Adm. Code 620.115, 620.301(a), and 620.405). Complainants later amended their Complaint to include historic filled areas on the sites. In support of their Complaint, Complainants presented two reports by James R. Kunkel.[9]

1.2. Contents of Opinion

I have reviewed the Kunkel reports and provide my assessment and opinions, below. In addition, I reviewed operational information, monitoring data, construction data and other documents for each of the stations to develop my opinions. Each of my opinions is supported by a reasonable degree of scientific certainty. The following outlines my approach to support my opinion:

- Section 2: Overview of Opinions
- Section 3: Credentials of John Seymour, P.E.
- Section 4: Summary of Current Conditions and Conceptual Site Models (CSM)
- Section 5: Opinion 1—MWG's Actions are Appropriate for the Sites and are Protective of Human Health and the Environment
- Section 6: Opinion 2—The Remedial Approach Provided in the Kunkel Remedy Report is Not Warranted

---

[4] MWG13-15_328-358
[5] MWG13-15_328-358
[6] MWG13-15_364-437
[7] MWG13-15_553-572, 553-575
[8] MWG13-15_795-806
[9] Kunkel, 2015a and 2015b

Section 2: Overview of Opinions

Opinion 1: MWG's Actions are Appropriate for the Sites and are Protective of Human Health and the Environment.

It is my opinion that MWG's actions at each plant site are appropriate for the measured groundwater impacts and are protective of human health and the environment. This opinion is based on the following:

- An approach that eliminates the exposure pathways to address the potential groundwater impacts is appropriate.
- Establishment of administrative controls such as Groundwater Management Zones (GMZ) and/or Environmental Land Use Controls (ELUC) are effective remedial approaches to reduce the exposure of potential groundwater impacts, are remediation industry-accepted approaches, and are approved State of Illinois methods.
  - GMZs are specified for sites undergoing corrective actions under Title 35, IAC Sections 620 (Bureau of Water) and 740 (Bureau of Land).
  - A minimum of 10 sites in Illinois currently have GMZs established by the IEPA Bureau of Water. IEPA Bureau of Water has not reported any groundwater violations for sites with GMZs.
  - The IEPA Bureau of Land has implemented on the order of 100 ELUCs.[10]
  - ELUCs and GMZs allow control of groundwater use along the exposure pathways by eliminating the ingestion pathway and dermal contact pathway while corrective action is underway.
    - The groundwater ingestion pathway is eliminated by restricting the installation of potable water wells in the area of the GMZs and ELUCs.
    - The dermal contact pathway is eliminated by restricting the access of the industrial properties to only trained workers.
- All of the active ponds were relined to eliminate a potential exposure pathway.
  - The relining of the CCR Ponds with 60-mil thick HDPE is an industry-accepted remediation approach to reduce the potential for groundwater impacts.

[10] The IEPA Bureau of Land also has approved GMZs for many sites.

  - The relining of the CCR Ponds was completed and inspected by an independent third party under construction quality assurance protocols and documented to be completed in accordance with the design documents or subsequently inspected by a qualified third party.
- The lined ponds are properly operated and maintained, which is the industry-accepted standard approach to preclude groundwater impacts. The operation and maintenance is being completed under consistent protocols.
- Groundwater monitoring is an accepted method to assess a remedial approach.
- I reviewed recent groundwater monitoring data and literature on liners to identify if liner defects were likely and if leaks of leachate through alleged liner defects could be impacting groundwater at the subject sites. It is my opinion that groundwater concentrations are not the result of leaks of leachate from the ash currently stored in lined ponds, as outlined below.
  - The leachate from bottom ash currently stored in ash ponds contains constituents at levels that do not exceed IEPA Class I groundwater standards based on neutral leaching analyses of site-specific samples, indicating that the bottom ash in the ponds is not a source of impact to groundwater.
  - The characteristics of ash leachate were identified based on site-specific impounded ash data or on published leachate data from ponds of subbituminous CCR sourced from the Powder River Basin (PRB) in Wyoming that is the source of coal ash from the Plants.
  - The profiles of the constituents in the groundwater do not match the profiles of leachate constituent indicators in the ponds at all four plant sites. This is based on a comparison of the occurrence of groundwater constituents detected in 2014 compared to minimum and maximum sets of indicators of leachate from ash stored in ponds.
- Groundwater conditions do not pose risks to surface water based on Illinois Water Quality Standards and Illinois Water Quality Criteria that are issued by the State of Illinois to be protective of human health and the environment. An assessment of human and ecological receptors in surface water indicates that there is no risk to the surface water environment at each site based on regulatory risk standards and standards of practice for risk assessments. The potential surface water risks were evaluated using a screening level

approach that compared concentrations in groundwater to Illinois Water Quality Standards (WQS) or Water Quality Criteria (WQC).

- Historical ash in fill materials outside of the ponds is not a source and is not a risk to human health and the environment.
  - Ash generated by coal combustion may be classified as CCB when there is beneficial use determined by IEPA as established in 415 Illinois Compiled Statutes 5/3.135. It is analogous to compare the current condition of CCB to the current IEPA criteria. In my opinion, the presence of CCB outside of the pond areas is acceptable for engineering considerations when compared to Illinois requirements.
  - Data obtained from recent samples of ash used as fill from multiple sites show that leachate from the ash meets IEPA Class I standards based on leaching from a soil-like environment.

Opinion 2: The Remedial Approach Provided in the Kunkel Remedy Report is Not Warranted.

It is my opinion that the remedial approach in the Kunkel Remedy Report, which is removal of all CCRs and the ash ponds, is not warranted. In addition to Opinion 1, removal is unwarranted because:

1. based on the concentrations of COIs that have been observed in groundwater around the ponds, MWG's remedial approach is protective of human health and the environment;
2. the concentrations of bottom ash indicator constituents from leachate do not match the groundwater chemistry. This shows that the constituents in groundwater are not from the ponds, the ponds are functioning in accordance with the design, and the ponds do not need to be removed;
3. there is no evidence that historical coal ash outside of the ash ponds is a current source of groundwater impact that needs to be removed; and
4. Kunkel did not follow the Illinois procedures for investigations and remedial activities.

Further, there are many inaccuracies in the Kunkel Expert Report on Ground-Water Contamination that, in general, incorrectly imply that groundwater is more threatened than supported by the data.

The following is provided to demonstrate this opinion:

- The ash ponds do not need to be removed because they are for wastewater treatment purposes and are not landfills for permanent ash disposal.
- The ash ponds are not a source of groundwater impacts because they are lined with 60-mil high density polyethylene (HDPE), which was the accepted standard of the ash pond lining industry, and there is no evidence that the liners are leaking. The liner construction quality is consistent with the ash pond lining quality management standards for long-term use.
  - The liner subgrade was inspected for sharp surfaces prior to installation of the HDPE liner and a protective geotextile was installed below the HDPE liner to avoid the potential for puncture.
  - Available literature on liners concludes that tears usually occur upon placement of overlying cushion and warning materials. MWG avoided this issue by inspecting the HDPE liner for leaks typically after installation of a protective sand cushion layer using the state of the practice electronic leak detection survey technologies.
  - Warning and cushion layers are installed above the HDPE liners to protect them from accidental contact and damage during future dredging operations.
  - The quality of construction was documented by an independent engineering firm that attested that the construction met the project drawings and specifications and manufacturer's recommendations, or subsequently inspected by a qualified third party.
- Operation and maintenance (O&M) of the ash ponds will avoid future leaks because O&M are conducted in accordance with consistent operating procedures that include:
  - Periodic dredging of settled bottom ash is carefully performed using excavators. If the excavator bucket were to encounter the stone warning layer, which is located over the protective layer, which in turn is located over the HDPE liner, it would be obvious to the operator who is instructed to stop excavating. If the HDPE liner was encountered, white HDPE material would be visually observed in the bucket by the excavator operator who would stop work.
  - Previous tears observed in the ash pond liners have been above the impounded water surface with one exception. Tears above impounded water would not be expected to result in leaks. Only one tear was discovered in a pond liner that was below the level of impounded ash and water at the Will County Ash Pond 3S; this

tear occurred when no water was in Ash Pond 3S and was repaired prior to refilling water to the level of the tear in the ash pond. All observed tears were repaired.

- Kunkel incorrectly concludes that all of the former ash ponds leaked and the current ash ponds are leaking. He asserts that the groundwater elevations are above the bottom of the ponds or pond water surface and in turn causing bottom heave. He is incorrect on several bases. First, an uplift pressure argument is relative to the top of the bottom liner. Second, an uplift argument is an issue for soil liners, not geomembrane liners that are at all of the ponds. Third, groundwater levels are not often above the top of the bottom liners and when they are above the bottom liner there are other opposing forces or controls to eliminate uplift.
- Kunkel incorrectly asserts that hydrostatic uplift is causing liner failure for multiple ash ponds. Kunkel does not account for the fact that the hydrostatic uplift pressures at the two ponds where the groundwater levels are above the bottoms of the ponds are resisted by the weight of the sand and protective layers and the weight of overlying pond water.
- Kunkel is incorrect by alleging that there is groundwater mounding at Joliet #29. Kunkel alleges that mounding is occurring by selecting the single highest water level value at MW-9. Yet, the years of data shows the average water level in MW-9 is lower than MW-8, rebutting any notion of a groundwater mound.
- Kunkel is incorrect by alleging that there is groundwater mounding at Waukegan. Kunkel alleges that mounding is occurring based on high groundwater elevations below the pond. My analysis of groundwater contours indicates that the contours reflect the surrounding surface topography.
- Kunkel incorrectly portrays background concentrations by using state-wide data for groundwater at the Joliet #29, Waukegan, and Will County sites. It is my opinion that this approach is inappropriate and also fails to account for those sites where upgradient groundwater is impacted prior to migrating on-site.

Opinion 3: In Addition to Being an Unwarranted Remedy, Kunkel's Remedy Cost Opinion Underestimates the Costs to Implement the Unwarranted Cleanup.

Even if the unwarranted remedy recommended by Kunkel were to be implemented, the Kunkel Remedy Report significantly underestimates the cost of his proposed cleanup.

- Kunkel's proposed remedy fails to incorporate the costs of disposal at a permitted landfill. I estimated the disposal costs associated with Kunkel's proposed remedy to be on the order of $178,000,000 in total for all four sites. This increases the total estimated cost of the unwarranted remedy by 68 percent.
- Kunkel's proposed remedy, consisting of removal of ash-impacted soil and backfilling, results in significant disruptions of the electricity generation facilities. As examples:
  - Kunkel's estimates include areas below equipment such as switchyards, coal handling and transfer equipment, and cooling water conveyance and treatment equipment. Given Kunkel's estimates of the areas and thicknesses of coal ash in these areas, equipment would be down on the order of years at each plant, during which time the plants will experience significant outages and extensive costs to dismantle and reassemble equipment and underground utilities, roadways, etc. and would cause lost service to public and industrial users.
  - The cost to remove and replace the equipment is not included in the cost estimate.
- Kunkel's proposed remedy results in significant impacts to the surrounding communities, including dust, noise, and traffic. Of particular concern is the increased risk of vehicle crashes involving large trucks.
  - Based on Kunkel's estimates of volume of ash-impacted soils, off-site disposal is anticipated to create on the order of 17,000,000 miles of large truck traffic for the four sites.
  - The large amount of truck traffic would be a significant nuisance to the neighboring communities from:
    - The increased road dust and increased road traffic; and
    - The human health risk of large truck crashes (1.42 fatalities per 100,000,000 miles). Based on the above mileage estimate, the human health risk of Kunkel's proposed remedy is on the order of ¼ fatalities and 4.6 injuries based on large traffic crashes alone.

- Therefore, the risk of removal of all coal ash and trucking to an offsite facility is not supported by the risk of leaving the existing materials in place, which is essentially no risk to human health and the environment.

- Kunkel's proposed remedy also fails to consider the impact of vehicle carbon dioxide emissions on climate change. I estimate the carbon dioxide emissions from the large truck traffic and excavation equipment to be on the order of 30,000 tons.

Section 3: Credentials of John Seymour, P.E.

3.1. Introduction

I am a geotechnical engineer with nearly three decades of experience in the U.S., Canada, Spain, Guatemala and Korea in the areas of site remediation, high-rise building deep foundations, and construction management. I have focused on waste management and remediation (Superfund (CERCLA) and RCRA) projects for 25 years, with significant involvement in 17 sites providing professional services in the areas of project management, project coordination (client representative), site characterization, feasibility studies, bench/pilot studies, civil/geotechnical design, construction quality assurance (CQA), and operation and maintenance.

I have completed field studies including geologic and hydrogeologic studies, aquifer testing, seismic surveys, landfill settlement tests, and the characterization of volatile organic compounds (TCE and by-products), semi-volatile organic compounds, PCBs, metals, and saline groundwater intrusion. In addition, I have geotechnical engineering experience with the design and construction of deep foundations, including drilled piers, tie backs, foundation grouting and soil improvement programs, and diaphragm (slurry) walls.

My full curriculum vita is attached as Appendix A.

3.2. My relevant experience

I have provided coal combustion residuals (CCRs) engineering services, regarding management of fly ash, bottom ash and flue gas desulfurization (FGD) waste for ponds and landfills. These services have included geotechnical and environmental evaluations of waste disposal expansions, operations and closure, disposal permit application preparation, for eight U.S coal power generation clients. Overall I have provided relevant consulting engineering services for 7 CCRs ponds and 14 CCR landfills and provided records review, evaluation and engineering scope of work development for 4 additional CCR ponds. I have translated some of this experience into 11 technical papers and completed 2 research guidance documents on CCR ponds (co-investigator), and provided 10 technical presentations at conferences including at conferences focusing on CCR management. The specific types of services I have provided are: investigation of the subsurface soils and bedrock (geology) at CCR disposal sites; CCR waste characterizations in various settings; characterization of site hydrogeology through use of monitoring wells and piezometers and conducting aquifer hydraulic testing; engineering feasibility studies of potential configurations of new ash disposal facilities and expansion of existing ash disposal facilities, including economic evaluations; design engineering management for geotechnical, stormwater, wastewater treatment, and remediation projects; characterization of the nature and extent of contamination and associated risks; construction quality assurance/quality control (QA/QC) plans and implementation; and project management and construction management.

3.3. Materials Reviewed

In order to develop my opinions in this matter, with the assistance of my staff, I reviewed site histories, analyzed facts, reviewed monitoring data, conducted assessments and calculations of risks, and assessed potential impacts. The documents I relied upon are cited within this report.

Section 4: Summary of Current Conditions and Conceptual Site Models

4.1. Joliet #29

4.1.1. Site Description, Site History, and Neighboring Properties

The Joliet #29 site is located along the Des Plaines River in Section 19, Township 35 North, Range 10 East, in the City of Joliet, Will County, Illinois.[11] The Joliet #29 site encompasses approximately 271 acres.[12] The current land use is for coal-fired steam electric power generation.[13] The facility has two generating units each consisting of two boilers and twin turbines that were installed in 1965 to 1966.[14] The Joliet #29 site is in an industrial area; the former Caterpillar, Inc. manufacturing facility is adjacent to the west and there are additional industrial facilities to the north and east.

4.1.2. Description of CCR Management

Fly ash generated by coal combustion is collected using electrostatic precipitators and then transported off-site for beneficial reuse.[15] Bottom ash from the boilers is mainly conveyed automatically by an enclosed pipe system across the Des Plaines River to a permitted landfill.[16] Prior to October 12, 2015, a small fraction of the bottom ash slurry (approximately 5 to 10 percent) was pumped to Ash Pond 1 or Ash Pond 2 for settling when the conveyor system is offline.[17] Subsequently, Ash Pond 1 has been taken out of service and all ash has been removed.[18] Ash Pond 3 is used as a finishing pond for the effluent and is considered to receive a *de minimus* amount of ash.[19] Bottom ash is collected from ash ponds and is transported off-site for disposal in a permitted landfill. Treated water is either recycled or discharged to the Des Plaines River under a National Pollutant Discharge Elimination System (NPDES) Permit.[20]

The following summarizes the approximate dimensions and capacities of Joliet #29 ash ponds[21]:

[11] Patrick, 2010a
[12] MWG13-15_25147
[13] In addition, an industrial wastewater treatment plant formerly existed at the site.
[14] MWG13-15_25147
[15] MWG13-15_25154
[16] MWG13-15_25152; Deposition of Jim DiCola, p. 49
[17] Deposition of Jim DiCola, p. 49.
[18] Teleconference with Pete O'Day
[19] Teleconference with Harrison Estepp; MWG13-15_49742-MWG13-15_49753
[20] MWG13-15_18155; MWG13-15_44279
[21] MWG13-15_30-32

- Ash Pond 1: 168 feet by 419 feet with a depth of 19 feet; capacity is approximately 2,000,000 cubic feet (ft^3)
- Ash Pond 2: 168 feet by 419 feet with a depth of 19 feet; capacity is approximately 2,000,000 ft^3
- Ash Pond 3: Non-rectangular shape with length 340 feet and widths varying between 80 feet and 220 feet; capacity is approximately 1,100,000 ft^3

Construction history and information is provided in Section 5.3.2.1.

4.1.3. Geological Setting

The regional geology beneath the Joliet #29 site consists of approximately 5 to 30 feet of sandy loam, underlain by Silurian Dolomite to approximately 176 feet below ground surface, and Maquoketa shale from approximately 176 to 241 feet below ground surface based on water well logs. The Maquoketa shale is an aquitard that separates the shallow groundwater in the unconsolidated units and the Silurian dolomite from the underlying aquifers.[22]

MWG submitted the results of a potable water well investigation to the Illinois EPA by letter dated July 15, 2009 that identified 17 potable/industrial use wells located within a 2,500-foot radius of the Joliet #29 ash ponds.[23] Only two of the wells (Numbers 19 and 4) are located downgradient from the ash ponds. Both of these industrial use wells are owned by MWG, are drilled at 1,525 feet below ground surface, and are screened below the Maquoketa shale, the primary aquitard separating shallower aquifers from the screened interval of the MWG wells.[24] These wells have consistently been in compliance with the potable water regulations.[25]

Groundwater flow in the shallow, unconsolidated aquifer is mainly controlled by the Des Plaines River with groundwater flowing towards the river during most periods of the year.[26] Groundwater flow in the deeper aquifers is controlled by the regional hydraulic gradient in these aquifers, which is to the northeast.[27]

---

[22] Patrick, 2011a
[23] Patrick, 2011a
[24] Patrick, 2011a; MWG13-15_293-305
[25] MWG13-15_293-305
[26] Patrick, 2011a
[27] Patrick, 2011a

4.1.4. Site-Specific Lithology

I reviewed boring logs and summarize the following lithology generally observed at Joliet #29: fill of varying soil materials was observed near the surface at most locations; at certain borings, ash or cinders were observed in fill materials. Within the vadose zone, unsaturated soils included fine to coarse sand and gravel, limestone fragments, clay, silty clay, and sandy silt. In the shallow aquifer, saturated soils included fine to coarse sand and gravel, limestone fragments, and silty clay. Limestone bedrock was recorded at one boring (B-MW-6) at a depth of 38.5 feet bgs.[28]

4.1.5. Site-Specific Groundwater Elevations

Groundwater elevations at the 11 monitoring wells at the Joliet #29 site (see Figure 4-1) during the period of record varied between 503.94 feet above MSL (at monitoring well MW-4 in May 2013) to 512.33 feet above MSL (at monitoring well MW-2 in September 2012) as summarized in Table 4-1. The highest groundwater elevation is typically found at monitoring well MW-11 during the period of record. The lowest groundwater elevation is typically found at either monitoring well MW-1 or MW-5.[29] Based on my review of the groundwater elevations, groundwater generally flows south to the Des Plaines River.

4.1.6. Site-Specific Groundwater Conditions

I reviewed groundwater concentrations at monitoring wells at the Joliet #29 site, and it is my opinion that there is no groundwater plume. Constituents of interest (COI) that were observed at concentrations exceeding IEPA Class I groundwater standards are listed in Table 4-2. The data shows that there is no spatial trend in COI concentrations in the direction of the groundwater flow. Furthermore, the observed COI concentrations intermittently exceed IEPA Class I groundwater standards. Without evidence that there is spatial or temporal consistency in groundwater impacts, it is my opinion that there is no plume at the Joliet #29 site. Without the existence of a plume, there is no support that there is a source area remaining at the site that could be remediated to reduce groundwater concentrations.

Groundwater conditions at Joliet #29 are impacted by upgradient off-site sources; for example, chloride was found upgradient away from the Joliet ash pond area. See Section 6.5.7.

---

[28] Patrick, 2011a
[29] MWG13-15_48653-55

4.2. Powerton

4.2.1. Site Description, Site History, and Neighboring Properties

The Powerton site is located along the Illinois River in Section 9, Township 24 North, Range 5 West in the City of Pekin, Tazewell County, Illinois.[30] The Powerton site encompasses approximately 1,710 acres, which includes 1,440 acres of Powerton Lake.[31] The current land use is for coal-fired steam electric power generation. The facility has two active electric generating units (Units 5 and 6) that were installed in 1971 to 1973. [32]

Neighboring properties include a cabinetry manufacturer and railroad to the east and wooded and agricultural areas to the north, west, and south.[33]

4.2.2. Description of CCR Management

Fly ash generated by coal combustion is collected using electrostatic precipitators and then transported off-site for mine reclamation.[34] Bottom ash from the boilers is mixed with water to form a slurry that is pumped to dewatering bins where the water is decanted and sent to the Ash Surge Basin for settling.[35] Bottom ash is collected from ash ponds and is sold and transported off-site by a third-party.[36] Treated wastewater is either recycled or discharged under an NPDES permit.

The following summarizes the approximate dimensions and capacities of Powerton ash ponds[37]:

- Ash Surge Basin: 960 feet by 250 feet with a depth of 14 feet; capacity is approximately 4,100,000 ft^3
- Secondary Ash Settling Basin: approximately 320 feet by 220 feet with an estimated depth of 10 feet; capacity is approximately 590,000 ft^3
- Ash Bypass Basin: approximately 256.5 feet by 135 feet; capacity is approximately 264,900 ft^3

---

[30] Patrick, 2011b
[31] MWG13-15_8509
[32] MWG13-15_8516
[33] MWG13-15_8517
[34] MWG13-15_49655
[35] MWG13-15_7401
[36] Deposition of Mark Kelly, p. 41
[37] MWG13-15_20-23; MWG13-15_10983

- Metal Cleaning Basin: 350 feet by 120 feet with a depth of 12 feet; capacity is approximately 720,000 ft^3

Construction history and information is provided in Section 5.3.2.2.

4.2.3. Geological Setting

The regional geology beneath the Powerton site consists of approximately 100 to 125 feet of unconsolidated deposits (mainly alluvial sands and gravels with some minor clay), underlain by the Carbondale Formation, which consists of alternating layers of limestone, shale, coal, and underclay. Groundwater flow in the shallow, unconsolidated aquifer is largely controlled by the Illinois River with groundwater flowing towards the river during most periods of the year.[38]

MWG submitted the results of a potable water well investigation to the Illinois EPA by letter dated July 15, 2009 that identified six wells located within a 2,500-foot radius of the Powerton ash ponds. None of these wells are located downgradient from the ash ponds. Two of these wells supply Powerton with water, which have consistently been in compliance with the potable water regulations.[39]

4.2.4. Site-Specific Lithology

I reviewed boring logs and summarize the following lithology generally observed at Powerton: fill materials consisting of fine to coarse sand, gravel, silty clay, and topsoil were observed near the surface; in certain borings, coal cinders were also observed in fill materials. Within the vadose zone, unsaturated soils included the fill materials previously described, fine to coarse sand and gravel, clayey silt, silty clay, silt, and clay. In the shallow aquifer, saturated soils included fine to coarse sand and gravel, trace silt, and clay.[40]

4.2.5. Site-Specific Groundwater Elevations

Groundwater elevations at the 16 monitoring wells at Powerton (see Figure 4-2) during the period of record have varied between 429.94 feet above MSL (at monitoring well MW-3 in December 2012) to 451.84 feet above MSL (at monitoring well MW-12 in May 2013) as summarized in Table 4-3. The highest groundwater elevations are typically found at either monitoring well MW-6 or MW-12 in a shallow, localized saturated clay/silt unit during the period of record. The lowest groundwater elevations are typically found at either monitoring well MW-3 or MW-4 in a more

[38] Patrick, 2011b
[39] Patrick, 2011b; MWG13-15_293-305
[40] Patrick, 2011b

extensive sand unit underlying the clay/silt unit.[41] Based on my review of the groundwater elevations, there are two groundwater units at the site that are hydraulically connected: 1) groundwater in the sand unit generally flows north to the Illinois River, and 2) groundwater in the clay/silt unit flows west toward Powerton Lake.

4.2.6. Site-Specific Groundwater Conditions

I reviewed groundwater concentrations at monitoring wells at the Powerton site, and it is my opinion that there is no groundwater plume. COI that were observed at concentrations exceeding IEPA Class I groundwater standards are listed in Table 4-4. The data show that there is no spatial trend in COI concentrations in the direction of the groundwater flow in either the sand unit or the clay/silt unit. Furthermore, the observed COI concentrations intermittently exceed IEPA Class I groundwater standards. Without evidence that there is spatial or temporal consistency in groundwater impacts, it is my opinion that there is no plume at the Powerton site. Without the existence of a plume, there is no support that there is a source area remaining at the site that could be remediated to reduce groundwater concentrations.

Groundwater conditions at Powerton are impacted by upgradient off-site sources; for example, nitrate is found upgradient, which is not related to COIs found on the Powerton site. See Section 6.5.7.

4.3. Waukegan

4.3.1. Site Description, Site History, and Neighboring Properties

The Waukegan site is located in Section 15, Township 45 North, Range 12 East in the City of Waukegan, Lake County, Illinois. The Waukegan site encompasses approximately 194 acres. The current land use is for coal-fired steam electric power generation. The facility has two active electric generating units (Units 7 and 8) constructed in 1958, and 1962, respectively.[42]

Neighboring properties include the Johns Mansville Company, which is an active Superfund site, to the north, the former site of the General Boiler Company, and the former site of the

[41] MWG13-15_48722-25

[42] MWG13-15_12003-12018

Greiss-Pfleger Leather Tanning Facility to the west, and the North Shore Water Reclamation District publicly owned treatment works to the south.[43]

The Greiss-Pfleger Leather Tanning Facility operated on land hydraulically upgradient of the Waukegan Generation Station. In 2003, at the neighboring property owner's request, MWG established an Environmental Land Use Control (ELUC) on the western side of its property as an institutional control to prevent against exposure to historically contaminated soil and groundwater that has migrated onto MWG's Waukegan site as the result of past industrial activities on the former Greiss-Pfleger Tannery Site.[44] The Greiss-Pfleger Tannery utilized the chromium tanning process, which consisted of nine steps and involved numerous chemicals including sodium sulfate, diethylamine, sulfhydrate, cyanide salts, sulfuric acid, and borax.[45] Analytical results of the groundwater at/from the tannery indicate that certain inorganic constituents, including arsenic, boron, chromium, lead, and mercury, have migrated onto the Waukegan property.[46] Presently there is a switchyard and substation at the former Greiss-Pfleger Tannery site.

4.3.2. Description of CCR Management

Fly ash generated by coal combustion is collected using electrostatic precipitators and then transported off-site for beneficial reuse.[47] Bottom ash from the boilers is mixed with water to form a slurry that is pumped to ash ponds to be treated by settling.[48] Bottom ash is collected from ash ponds and is transported off-site for beneficial reuse.[49] Treated water is either recycled or discharged to a wastewater treatment plant.[50]

The following summarizes the approximate dimensions and capacities of Waukegan ash ponds[51]:

- West Ash Pond: Non-rectangular with length of 972.5 feet and width up to 437.5 feet with a depth of 22.5 feet; capacity is approximately 7,700,000 ft^3

---

43 MWG13-15_12003-12018, MWG13-15_48644
44 MWG13-15_12713–12738
45 MWG13-15_47089
46 MWG13-15_217-222, MWG13-15_46600, MWG13-15_45512 and MWG13-15_50086-50092
47 MWG13-15_12017
48 MWG13-15_12017
49 MWG13-15_49679-49700
50 MWG13-15_7392
51 MWG13-15_13-15

- East Ash Pond: Non-rectangular with length of 972.5 feet and width up to 437.5 feet with a depth of 22.5 feet; capacity is approximately 6,500,000 ft^3

Construction history and information is provided in Section 5.3.2.3.

4.3.3. Geological Setting

The regional geology beneath the Waukegan consists of approximately 100 feet of sand deposits, underlain by Silurian Dolomite to approximately 360 feet below ground surface, underlain by the Maquoketa shale. The Maquoketa shale is an aquitard that separates the shallow groundwater in the unconsolidated units and the Silurian dolomite from the underlying aquifers. Groundwater in the shallow, unconsolidated aquifer flows towards Lake Michigan, located primarily to the east. Groundwater flow in the deeper aquifers is controlled by the regional hydraulic gradient in these aquifers, which is to the northeast.[52]

MWG submitted the results of a potable water well investigation to the Illinois EPA by letter dated July 15, 2009 that identified eight potable/industrial use wells located within a 2,500-foot radius of the Waukegan ash ponds. There are no potable use wells downgradient of the ash ponds.[53]

4.3.4. Site-Specific Lithology

I reviewed boring logs and summarize the following lithology generally observed at Waukegan. Fill materials consisting of silty clay, clayey silt, gravely clay, silt, sand, fine to coarse gravel, crushed rock, crushed limestone, and cobbles were observed near the surface; in certain borings, coal cinders and ash was observed in fill materials. Within the vadose zone, unsaturated soils included the fill materials previously noted, and fine to coarse sand. In the shallow aquifer, saturated soils included fine to coarse sand and gravel. [54]

4.3.5. Site-Specific Groundwater Elevations

Groundwater elevations at the seven monitoring wells at Waukegan (see Figure 4-3) varied between 579.27 feet above MSL (at monitoring well MW-2 in December 2012) to 584.56 feet above MSL (at monitoring well MW-6 in May 2014) as summarized in Table 4-5. The highest groundwater elevation is typically found at either monitoring well MW-5 or MW-6 during the period of record. The lowest groundwater elevation during each quarterly monitoring event varied between the

---

[52] Patrick, 2011c
[53] Patrick, 2011c; MWG13-15_293-305
[54] Patrick, 2011c

following monitoring wells: MW-1, MW-2, MW-4, or MW-7.[55] Additional upgradient monitoring wells have been installed and monitored at the Waukegan Site in response to the migration of inorganic constituents from the former Greiss-Pfleger Tannery site. Based on my review of the groundwater elevations, groundwater generally flows east to Lake Michigan. Site-wide groundwater contours for the Waukegan site are provided on Figure 4-4. See Section 6.5.7.

4.3.6. Site-Specific Groundwater Conditions

I reviewed groundwater concentrations at monitoring wells at the Waukegan site, and it is my opinion that there is no groundwater plume. COI that were observed at concentrations exceeding IEPA Class I groundwater standards are listed in Table 4-6. Furthermore, the observed COI concentrations intermittently exceed IEPA Class I groundwater standards.

Groundwater conditions at Waukegan are impacted by upgradient and off-site sources; for example, boron was detected exceeding IEPA Class I groundwater standards in upgradient wells from the former Greiss-Pfleger Tannery site. See Section 6.5.7.

4.4. Will County

4.4.1. Site Description, Site History, and Neighboring Properties

The Will County site is located between the Chicago Sanitary and Ship Canal and the Des Plaines River in Section 2, Township 36 North, Range 10 East, in the City of Romeoville, Will County, Illinois. The Will County site encompasses approximately 215 acres and is used for coal-fired steam electric power generation.[56] The facility has one active electric generating unit (Unit 4) constructed in 1963. Neighboring properties include a former drum restoration operation to the northwest,[57] the Citgo Lemont Refinery to the northeast, Hanson Materials (f/k/a Material Service Corp.) to the south, and a ComEd switchyard to the west.[58]

4.4.2. Description of CCR Management

Fly ash generated by coal combustion is collected using electrostatic precipitators and then transported off-site for beneficial reuse.[59] Bottom ash from the boilers is mixed with water to form

[55] MWG13-15_48908-09
[56] MWG13-15_29509
[57] MWG13-15_13242- 13421
[58] MWG13-15_29509
[59] MWG13-15_29516

a slurry that is pumped to Ash Ponds 2S or 3S for settling.[60] Bottom ash is collected from ash ponds and is transported off-site for beneficial reuse. The slurry water is recycled back into the Station for treatment. In 2010, Midwest Generation ceased using Ash Ponds 1N and 1S, and no additional ash or ash slurry is deposited in those ponds; furthermore, the water levels of Ash Ponds 1N and 1S are not allowed to exceed one foot above the base.

The following summarizes the approximate dimensions and capacities of Will County ash ponds:[61]

- Ash Pond 2S: 350 feet by 178 feet with a depth of 7 feet; capacity is 510,000 ft^3; and
- Ash Pond 3S: 322 feet by 234 feet with a depth of 7 feet; capacity is 530,000 ft^3.

Construction history and information is provided in Section 5.3.2.4.

4.4.3. Geological Setting

The regional geology beneath the Will County site consists of approximately 1 to 5 feet of unconsolidated deposits or fill, underlain by Silurian Dolomite to approximately 140 feet below ground surface; the Silurian Dolomite is underlain by the Maquoketa shale. The Maquoketa shale is an aquitard that separates the shallow groundwater in the unconsolidated units and the Silurian dolomite from the underlying aquifers. Groundwater flow in the shallow aquifer is largely controlled by the Des Plaines River and the Chicago Sanitary and Ship Canal with groundwater flowing towards either of the surface water channels during most periods of the year. Groundwater flow in the deeper aquifers is controlled by the regional hydraulic gradient in these aquifers, which is to the southeast.[62]

MWG submitted the results of a potable water well investigation to the Illinois EPA by letter dated July 15, 2009 that identified nine potable wells within a 2,500-foot radius of the Will County Station ash ponds, seven of which are upgradient of the Station. Two of these wells are located between the Des Plaines River and the Chicago Sanitary and Ship Canal. Both of these wells are drilled more than 1,500 feet below ground surface and are screened below the Maquoketa shale, the primary aquitard separating shallower aquifers from the screened interval of the wells.[63]

---

[60] MWG13-15_29516
[61] Schwartz, 2005
[62] Patrick, 2011d
[63] Patrick, 2011d; MWG13-15_293-305

4.4.4. Site-Specific Lithology

I reviewed boring logs and summarize the following lithology generally observed at Will County. Fill materials consisting of fine to coarse sand, gravel, silt, and silty sand were observed near the surface; in certain borings, coal cinders and ash were also observed in fill materials. Within the vadose zone, unsaturated soils included the fill materials previously noted, coarse sand, fine to coarse gravel, clayey gravel, clay, silty clay, and silt. In the shallow aquifer, saturated soils included fine to coarse gravel, coal cinders, coal dust, weathered limestone, sand, silt, silty clay, and clay. Weathered limestone bedrock was encountered between 7 and 12 feet bgs.[64]

4.4.5. Site-Specific Groundwater Elevations

Groundwater elevations at the 10 monitoring wells at Will County (see Figure 4-5) have varied between 579.13 feet above MSL (at monitoring well MW-10 in August 2013) to 583.87 feet above MSL (at monitoring well MW-2 in June 2011) as summarized in Table 4-7. The highest groundwater elevation during each quarterly monitoring event varied between the following monitoring wells: MW-1, MW-2, MW-3, MW-5, and MW-9. The lowest groundwater elevation during each quarterly monitoring event for the period of record was found at monitoring well MW-10.[65]

Based on a review of the groundwater elevations, groundwater generally flows west to the Des Plaines River on the western portion of the site and is understood to flow east to the Chicago Sanitary and Ship Canal on the eastern portion of the site.

4.4.6. Site-Specific Groundwater Conditions

I reviewed groundwater concentrations at monitoring wells at the Will County site, and it is my opinion that there is no groundwater plume. COI that were observed at concentrations exceeding IEPA Class I groundwater standards are listed in Table 4-8. The data show there is no spatial trend in COI concentrations in the direction of the groundwater flow. Furthermore, the observed COI concentrations intermittently exceed IEPA Class I groundwater standards. Without evidence that there is spatial or temporal consistency in groundwater impacts, it is my opinion that there is no plume at the Will County site. Without the existence of a plume, there is no support that there is a source area remaining at the site that could be remediated to reduce groundwater concentrations.

---

[64] Patrick, 2011d

[65] MWG13-15_48850-2

Shallow groundwater conditions at the Will County site are impacted by surface water elevation fluctuations of the Des Plaines River and the Chicago Sanitary and Ship Canal. See Section 6.5.7.

Section 5: Opinion 1—MWG's Actions are Appropriate for the Sites and are Protective of Human Health and the Environment

It is my opinion that MWG's actions for the sites are appropriate for the measured groundwater impacts and are protective of human health and the environment.

5.1. An Elimination of Exposure Pathways is Appropriate

A standard approach that accounts for receptors to address the potential groundwater impacts at the sites is appropriate. An approach that eliminates the exposure pathways has been implemented by completion of a site characterization, comparison of groundwater analytes with State of Illinois water quality standards, and evaluation of the potential exposure routes. This resulted in a decision to reline the ash ponds and implement administrative controls of groundwater use to preclude the exposure to groundwater. Groundwater monitoring is conducted to assess changes in groundwater quality.

The following sections elaborate on the key points associated with the exposure pathways approach:

Section 5.2: Establishment of Administrative Controls is an Effective Remedial Approach

Section 5.3: Active Ponds are Lined to Eliminate a Potential Exposure Pathway

Section 5.4: Groundwater Monitoring is Appropriate to Demonstrate that Groundwater Exposure Pathways are Mitigated

Section 5.5: Recent Groundwater Concentrations are Not the Result of Ash Stored in Lined Ponds

Section 5.6: Groundwater Conditions Do Not Pose Risks to Surface Water Receptors Based on a Risk Screening Assessment

Section 5.7: Historical Ash in Fill Materials Outside of the Ponds is Not Adversely Impacting Groundwater

Section 5.8: Bottom Ash in Inactive Ponds is Not a Source of Groundwater Concentrations

5.2. Establishment of Administrative Controls is an Effective Remedial Approach

5.2.1. Summary of Implementation of Administrative Controls at the Four Sites

A remedial approach has been implemented that includes administrative controls to eliminate the groundwater exposure pathway for ingestion and dermal contact for specific areas. MWG has completed establishing GMZs and/or ELUCs at the four sites as summarized below.

- At Joliet #29, a GMZ has been established over the portion of the site containing the ash ponds extending from the north to the limit of a road and south to the intake canal. Additionally, there is an ELUC on the western side of the property, which MWG installed at the request of Caterpillar to address soil and groundwater contamination originating on Caterpillar property.[66]
- At Powerton, a GMZ has been established over the portion of the site containing the ash ponds extending to the east and south to the limits of a railroad, west to a canal and north to the Illinois River. Furthermore, an ELUC has been implemented to cover the area of the Powerton property that is contained by the GMZ.
- At Waukegan, the Former Tannery Site ELUC was established in a portion of the property, and an additional ELUC has been implemented to cover the remaining Waukegan property to the east that includes the ash ponds.
- At Will County, a GMZ has been established over the portion of the site containing the ash ponds extending west to the Des Plaines River and east to the Chicago Sanitary and Ship Canal. Furthermore, an ELUC has been implemented to cover the area of the Will County Station property that is contained within the GMZ, except for that portion of the GMZ area which is owned by the former property owner.

5.2.2. Demonstration that Administrative Controls are Effective

ELUCs and GMZs are used to eliminate groundwater exposure pathways by eliminating groundwater ingestion pathway and dermal contact pathways while corrective actions are underway. The groundwater ingestion pathway is eliminated by restricting the installation of potable water wells near the ash ponds. The dermal contact pathway is eliminated by restricting the access of the industrial properties to qualified workers.

[66] Carlson, 2010

Administrative controls, including GMZs and ELUCs, are remediation-industry accepted approaches. IEPA has the authority for establishing GMZs as specified in Title 35, Illinois Administrative Code (IAC) Sections 620 and 740.

IEPA has the authority for establishing ELUCs as specified in Title 35, IAC Section 742. The significance of the GMZ with respect to groundwater quality standards is described in 35 IAC Section 620.450 Alternative Groundwater Quality Standards: "Prior to completion of a corrective action described in Section 620.250(a), the standards as specified in Sections 620.410, 620.420, 620.430, and 620.440 are not applicable to such released chemical constituent, provided that the initiated action proceeds in a timely and appropriate manner." In other words, the concentrations of COIs constituents of interest can be higher than the groundwater quality standards within the GMZ.

Within Illinois, a minimum of 10 sites currently have GMZs established by the IEPA Bureau of Water.[67] IEPA Bureau of Water has not reported any groundwater violations for sites with GMZs.[68] Within Illinois, a minimum of 100 sites currently have ELUCs established by the IEPA Bureau of Land.[69]

Thus, it is my opinion that establishment of a GMZ or an ELUC is an effective method to reduce the potential risk for groundwater impacts, are remediation-industry-accepted approaches, and are approved by State of Illinois environmental protection procedures.

5.3. Active Ponds are Lined to Eliminate a Potential Exposure Pathway

A remedial approach has been implemented to address the ponds as a potential source of groundwater impacts that includes the installation of HDPE liners, decommissioning some ash ponds and properly operating and maintaining active ponds.

5.3.1. Summary of Pond Relining and Pond Decommissioning Actions

Midwest Generation has completed remedial actions that include liner installation or pond decommissioning at the four sites as summarized below. It is my opinion that MWG's actions are a reasonable and appropriate remedial approach for addressing groundwater conditions.

---

[67] Telecommunication with IEPA Groundwater Protection Program Hydrogeology Unit Manager
[68] Telecommunication with IEPA Groundwater Protection Program Hydrogeology Unit Manager
[69] Telecommunication with IEPA Site Remediation Program staff member

- At Joliet #29, construction permits were obtained to reline Ash Ponds 1, 2, and 3 with 60-mil thick, high density polyethylene ("HDPE") liners, and the work has been completed. Ash Pond 1 was taken out of service on October 12, 2015.
- At Powerton, construction permits were obtained to reline the Ash Surge Basin, the Secondary Ash Settling Basin, Metal Cleaning Basin, and Bypass Basin, with 60-mil thick, HDPE liners, and the work has been completed.
- The Powerton East Yard Run-off Basin is not part of the ash sluicing flow system and is not used for ash storage.[70]
- At Waukegan, the East Ash Pond and West Ash Pond were relined with HDPE liners in 2003 and 2004, respectively.
- At Will County, Ash Ponds 1 North (1N) and 1 South (1S) were removed from service in 2010.[71] All process water has been diverted from ponds 1N and 1S to existing Ash Ponds 2 South (2S) and 3 South (3S). A dewatering system was implemented in 2013 that is designed to not allow water to exceed a depth of one foot above the bottom of Ponds 1N and 1S.[72]
- Construction permits were obtained to reline Will County Station Ash Ponds 2S and 3S with 60 mil thick, HDPE liners, and the work has been completed.

5.3.2. Pond Liners are Effective at Precluding Groundwater Impacts

I reviewed the design specifications and construction documentation for current pond liners used for active ash ponds at the sites, as summarized in Sections 5.3.2.1 through 5.3.2.4. The current pond liners are consistent with remediation-industry-accepted approaches, which are further described in Section 5.3.2.5. I reviewed the construction quality assurance and quality control (QA/QC) documentation in Section 5.3.2.6. Properly operating and maintaining lined ponds are the industry-accepted approach to preclude groundwater impacts; based on my review of site-specific records in Section 5.3.2.7, operation and maintenance is being conducted under appropriate and consistent protocols. It is my opinion that the current pond liners are effective to preclude quantifiable groundwater impacts, as described further below.

[70] Mark Kelly Deposition pp 113-4
[71] Fredrick Veenbaas Deposition p. 33-34
[72] MWG13-15_29339; MWG13-15_560-563

5.3.2.1. *Joliet #29 Active Ash Pond Liners*

The following summarizes information regarding ash pond history and construction elements:

- Ash Pond 1 (see Figure 5-1 for a typical construction cross-section)[73]
    - Originally constructed in 1978 with the following layers (from top to bottom):[74]
        - Bituminous seal coat
        - Poz-o-Pac[75]—12 inches thick
        - Compacted granular material—12 inches thick
    - Relined in 2007 under IEPA Water Pollution Control Permit (WPCP) No. 2007-EB-4091 with following layers (from top to bottom):[76]
        - New crushed limestone warning layer—6 inches thick
        - New sand cushion layer—12 inches thick
        - New geotextile cushion—12 ounces per square yard
        - New HDPE liner—60 mil thick
        - New geotextile cushion—16 ounces per square yard
        - Existing Poz-o-Pac—12 inches thick
- Ash Pond 2 (see Figure 5-2 for a typical construction cross-section)
    - Originally constructed in 1978 with the following layers (from top to bottom)[77]
        - Bituminous seal coat
        - Poz-o-Pac—12 inches thick
        - Compacted granular material—12 inches thick
    - Relined in 2008 under IEPA WPCP No. 2007-EB-4091 with following layers (from top to bottom):[78]
        - New crushed limestone warning layer—6 inches thick
        - New sand cushion layer—12 inches thick
        - New geotextile—12 ounces per square yard
        - New HDPE liner—60 mil thick
        - New geotextile cushion—16 ounces per square yard

---

[73] "Typical" is a term of engineering practice that identifies the construction features that are most commonly observed; in this case, throughout the pond.
[74] Schwartz, 2005
[75] The density of Poz-o-Pac is 136.9 pounds per cubic foot. (MWG13-15_30-32)
[76] MWG13-15_18053; MWG13-15_18133-18189; MWG13-15_49362-49507
[77] Schwartz, 2005
[78] MWG13-15_18053; MWG13-15_18133-18189; MWG13-15_49362-49507

        - Existing Poz-o-Pac—12 inches thick
- Ash Pond 3 (see Figure 5-3 for a typical construction cross-section)
    - Originally constructed in 1978 with the following layers (from top to bottom):[79]
        - Bituminous seal coat
        - Poz-o-Pac—12 inches thick
        - Compacted granular material—12 inches thick
    - Relined in 2013 under IEPA WPCP No. 2013-EB-1191 with following layers (from top to bottom):[80]
        - New crushed limestone warning layer—12 inches thick
        - New sand cushion layer—24 inches thick
        - New geotextile cushion—16 ounces per square yard
        - New HDPE liner—60 mil thick
        - New geotextile cushion—16 ounces per square yard
        - Existing Poz-o-Pac—12 inches thick
- Generally, bottom ash is conveyed across the Des Plaines River to a permitted landfill on the south side of the Des Plaines River.[81] Prior to October 12, 2015, a small fraction of the bottom ash (approximately 5 to 10 percent) was pumped into Ash Pond 1 or 2 for settling when the conveyor system requires maintenance.[82] Ash Ponds 1 and 2 were dredged every one to two years, and the ash is disposed off-site.[83] Ash Pond 1 was taken out of service as of October 12, 2015; Ash Pond 2 is still in service.[84] Ash Pond 3 is used as a finishing pond for the effluent and is considered to receive a *de minimus* amount of ash.[85] (See Section 4.1.2.)
- Joliet #29 is planned to be converted to natural gas fuel combustion. Ash Pond 1 has been emptied of ash as of October 12, 2015 and is no longer in service.[86] Ash Pond 2 will remain

---

[79] Schwartz, 2005
[80] MWG13-15_44275-44278; MWG13-15_33867-33997
[81] Deposition of Jim DiCola, p. 49
[82] Deposition of Jim DiCola, p. 49
[83] Jim DiCola Deposition, pp. 103-106
[84] Teleconference with Pete O'Day
[85] MWG13-15_49742-49753
[86] Teleconference with Harrison Estepp; Teleconference with Pete O'Day

in service until the station is converted to natural gas fuel combustion in Spring 2016.[87] Thereafter, it is anticipated that Ash Pond 2 will be decommissioned.[88]

5.3.2.2. Powerton Active Ash Pond Liners

The following summarizes information regarding ash pond history and construction elements:

- Ash Surge Basin (see Figure 5-4 for a typical construction cross-section)
  - Originally constructed in 1978 with the following layers (from top to bottom)[89]
    - Bituminous seal coat
    - Poz-o-Pac—12 inches thick on the bottom
    - Compacted granular material—thickness not specified
    - Additionally, a Hypalon® liner was installed on the sides[90]
  - Relined in 2013 under IEPA WPCP No. 2013-EB-1213 with following layers (from top to bottom):[91]
    - New crushed limestone warning layer—6 inches thick
    - New sand cushion layer—12 inches thick
    - New geotextile—16 ounces per square yard
    - New HDPE liner—60 mil thick
    - New geotextile cushion—16 ounces per square yard
    - Existing Poz-o-Pac—12 inches thick
  - The Ash Surge Basin is the primary ash basin for Powerton. Ash is removed from the basin every six to eight years.[92]
- Secondary Ash Settling Basin (see Figure 5-5 for a typical construction cross-section)
  - Prior to the 2013 relining, the Secondary Ash Settling Basin had a Hypalon® liner.[93]
  - Relined in 2013 under IEPA WPCP No. 2013-EB-1065 with following layers (from top to bottom):[94]

---

[87] Teleconference with Harrison Estepp
[88] Teleconference with Harrison Estepp
[89] Schwartz, 2005
[90] Mark Kelly Deposition, p. 40
[91] MWG13-15_9583-9643; MWG13-15_10812-10815; MWG13-15_33998-34157
[92] Mark Kelly Deposition, p. 41
[93] Mark Kelly Deposition, p. 26-27
[94] MWG13-15_34158-34267

        - New crushed limestone warning layer—6 inches thick
        - New sand cushion layer—12 inches thick
        - New HDPE liner—60 mil thick
        - New geotextile—16 ounces per square yard
        - New sand layer—12 inches thick
        - Underdrain system that removed groundwater during construction and can be used during pond cleanout.
    - The Secondary Ash Settling Basin is considered a low volume ash pond because historically it received approximately 3 feet of ash in approximately 30 years.[95]
- Metal Cleaning Basin (see Figure 5-6 for a typical construction cross-section)
    - Originally constructed in 1978 with the following layers (from top to bottom):[96]
        - Bituminous seal coat
        - Poz-o-Pac—12 inches thick
        - Hypalon® liner along the sloped sides[97]
        - Compacted granular material—12 inches thick
    - Relined in 2010 under IEPA WPCP No. 2009-EB-2748 with following layers (from top to bottom):[98]
        - New crushed limestone warning layer—6 inches thick
        - New sand cushion layer—12 inches thick
        - New geotextile—12 ounces per square yard
        - New HDPE liner—60 mil thick
        - New geotextile—16 ounces per square yard
        - Existing Poz-o-Pac—12 inches thick
    - The Metal Cleaning Basin is not a part of the ash sluice system. It is used during outages for collection of fly ash from high-pressure blasting on the external part of tubes, and as a temporary lay-down area during cleanouts at Powerton. The ash is removed annually.[99]
- Bypass Basin (see Figure 5-7 for a typical construction cross-section)

---

[95] Teleconference with Mark Kelly
[96] Schwartz, 2005
[97] Mark Kelly Deposition, p. 53
[98] MWG13-15_49099-49256; MWG13-15_10209-10212
[99] Mark Kelly Deposition pp. 54-6

- Prior to the 2010 relining, the Bypass Basin was lined on the sides with Hypalon® and lined on the bottom with Poz-o-Pac.[100]
- Relined in 2010 under IEPA WPCP No. 2010-EB-0664 with following layers (from top to bottom):[101]
  - New crushed limestone warning layer—6 inches thick
  - New sand cushion layer—12 inches thick
  - New geotextile—12 ounces per square yard
  - New HDPE liner—60 mil thick
  - New geotextile—16 ounces per square yard
  - Prepared subgrade—thickness not specified
- The Bypass Basin only receives ash when Powerton is emptying the Ash Surge Basin.[102] The Bypass Basin is emptied every six to eight years. [103]

5.3.2.3. Waukegan Active Ash Pond Liners

The following summarizes information regarding ash pond history and construction elements:

- West Ash Pond (see Figure 5-9 for a typical construction cross-section)
  - Originally constructed in 1977 with a Hypalon® liner.[104]
  - Relined in 2004 with following layers (from top to bottom):[105]
    - New crushed limestone warning layer—6 inches thick
    - New sand cushion layer—12 inches thick
    - New HDPE liner—60 mil thick
    - Prepared subgrade—thickness not specified
- East Ash Pond (see Figure 5-8 for a typical construction cross-section)
  - Originally constructed in 1977 with a Hypalon® liner.[106]
  - Relined in 2003 with following layers (from top to bottom):[107]

---

[100] Mark Kelly Deposition p. 58; MWG13-15_9783
[101] MWG13-15_49099-49256; MWG13-15_30421-30424
[102] Mark Kelly Deposition p. 57
[103] Mark Kelly Deposition. pp. 59 & 61
[104] Schwartz, 2005; Christopher Lux Deposition p. 14
[105] MWG13-15_12827-12845; MWG13-15_411
[106] Schwartz, 2005; Christopher Lux Deposition p. 18
[107] MWG13-15_12827-12; MWG13-15_411

- New crushed limestone warning layer—6 inches thick
- New sand cushion layer—12 inches thick
- New HDPE liner—60 mil thick
- Prepared subgrade—thickness not specified

5.3.2.4. Will County Active Ash Pond Liners

The following summarizes information regarding ash pond history and construction elements:

- Ash Pond 2S (see Figure 5-10 for a typical construction cross-section)
  - Originally constructed in 1977 with the following layers (from top to bottom):[108]
    - Bituminous seal coat
    - Poz-o-Pac—36 inches thick
  - Relined in 2013 under IEPA WPCP 2008-EB-1166 with following layers (from top to bottom):[109]
    - New crushed limestone warning layer—6 inches thick
    - New sand cushion layer—12 inches thick
    - New geotextile—12 ounces per square yard
    - New HDPE liner—60 mil thick
    - New geotextile cushion—16 ounces per square yard
    - Existing Poz-o-Pac—30 inches thick
    - Additionally, the sides of the basin have a concrete geocell to further protect the liner.
- Ash Pond 3S (see Figure 5-11 for a typical construction cross-section)
  - Originally constructed in 1977 with the following layers (from top to bottom):[110]
    - Bituminous seal coat
    - Poz-o-Pac—36 inches thick
  - Relined in 2009 under IEPA WPCP 2008-EB-1166 with following layers (from top to bottom):[111]
    - New crushed limestone warning layer—6 inches thick

---

[108] Schwartz, 2005
[109] MWG13-15_34268-34433; MWG13-15_48604-48605
[110] Schwartz, 2005
[111] MWG13-15_33867-33997; MWG13-15_48604-48605

- New sand cushion layer—12 inches thick
- New geotextile—12 ounces per square yard
- New HDPE liner—60 mil thick
- New geotextile cushion—16 ounces per square yard
- Existing Poz-o-Pac—30 inches thick

- Ash Pond 2S and 3S alternate receiving bottom ash (only one pond is in ash service at a time).[112]

5.3.2.5. The Pond Liners are Consistent with Remediation-Industry-Accepted Approaches

I reviewed the pond construction information and compared it to remediation-industry guidance documents for liners. It is my opinion that the current pond liners are consistent with remediation-industry-accepted approaches.

USEPA's Guide for Industrial Waste Management (2012) provides technical considerations for employing liner systems where needed to protect groundwater from contamination and includes the selection of geomembranes, such as HDPE liners, to ensure that the liner system will function as designed. Liners have been studied extensively for purposes of designing landfills and ponds and evaluating leaching rates through the liners. Use of numerical models is common practice for estimating the rates of infiltration through soils, waste and liners, and a 60-mil thick HDPE is appropriate for the design of ash ponds (USEPA, 2012).

Overlying fill layers are typically a material that drains like sand, such that placement of materials over the liner avoids puncturing or tearing (USEPA, 2012). Cushion geotextiles are also often used to protect geomembranes against puncture (NAS, 2007). Thus, for purposes of potentially coarser subgrade materials where a composite liner is not constructed, my opinion is that a subgrade cushion, as used by MWG, is an appropriate method to protect against subgrade punctures.

Basin maintenance activities are anticipated to have potential loads and stresses associated with heavy construction equipment above the HDPE liners. Evaluation of the overburden stress on a geomembrane can be calculated using the methods and equations of Narejo and Corcoran

---

[112] Rebecca Maddox Deposition p. 18

(1996). NRT calculated the overburden stresses on behalf of MWG and found that the resulting stress on HDPE with 18 inches of soil cover would be within the range of conservative design standards.[113]

5.3.2.6. Construction Quality Assurance and Quality Control

Construction quality assurance (CQA) for HDPE geomembrane liners follows two classes of protocols: (1) material testing, installation quality control, and finished product destructive testing; and (2) non-destructive electrical leak location surveys after liners have been installed and covered with a protective material (Darilek and Laine, 2001). Electrical leak location surveys at the completion of liner installation discover more leaks than testing-based protocols because they are conducted after all potential construction damage has occurred but also prior to placement of overlying materials such as protective materials or waste layers. When the electrical leak location survey is conducted after liner installation, the density of leaks discovered in 2.0 millimeter (approximately 79 mil) HDPE was 0.2 leaks per hectare (approximately 0.08 leaks per acre, or 1 leak per 12 acres) based on 170,190 square meters (approximately 42 acres) of liners that had CQA with electrical leak location surveys (Forget et al., 2005). The electrical leak location surveys identify leaks prior to the completion of all liner construction project, so identified leaks are repaired prior to completion of the liner construction project. In summary, when HDPE liners are installed with CQA, the numbers of liner defects or tears are significantly reduced from values cited by Kunkel. Furthermore, there was no correlation between the number of leaks and geomembrane thickness for liner systems (Forget, et al., 2005).

I reviewed the CQA documentation or a third party inspection report for the installation of HDPE liners for the following ash ponds:

- Joliet #29 Ash Ponds No. 1[114], No. 2[115], and No. 3[116]
- Powerton Ash Surge Basin[117], Secondary Ash Settling Basin[118], Metal Cleaning Basin[119], and Bypass Basin[120]
- Waukegan East and West Ash Ponds[121]

---

[113] MWG13-15_49296-49298
[114] MWG13-15_49362-49507
[115] MWG13-15_49362-49507
[116] MWG13-15_33867-33997
[117] MWG13-15_33998-34157
[118] MWG13-15_34158-34267
[119] MWG13-15_49099-49256
[120] MWG13-15_49099-49256
[121] MWG13-15_12827-12845

- Will County Ash Ponds 2S[122] ; additionally, I reviewed the specifications and construction notes for the Will County Ash Pond 3S relining project.[123]

The CQA for the above liner installations demonstrate a high level of quality because of the following reasons:

- The pond linings were designed by Natural Resource Technology, Inc., and inspected by Natural Resource Technology, Inc. for Joliet #29, Powerton, and Will County Stations, and inspected by KPRG for Waukegan.
- All relining construction was completed under a construction quality assurance protocol that included inspections by an independent third party.
- The liner installer inspected the subgrade and certified that it was acceptable for installation of the HDPE liner as discussed below.
- The inspections included traditional leak detection tests of welds and seams as the liner was installed.
- After completion of seaming and covering the liner with a sand cushion layer, the liner had an additional electronic leak detection survey of the surface conducted by a third party (Leak Location Services, Inc.).[124]
- Any defects that were discovered were repaired before ponds were placed in service.
- Each relining construction project was certified by the installer (CAAW Systems, LLC) as complying with the project drawings and specifications and manufacturer recommendations.
- At the Waukegan East and West Ash Ponds, an independent review of the liner quality assurance documentation was performed and found no evidence that leaks would be present below the surface water line of the pond. [125]

---

[122] MWG13-15_34268-34427

[123] MWG13-15_29165-29259; MWG13-15_34517-34550; MWG13-15_29023-29081; MWG13-15_29102-29104

[124] At the Powerton Secondary Settling Basin, an electronic leak detection survey was conducted prior to the placement of the sand cushion layer. At the Waukegan East and West Ash Ponds, an independent review of the liner quality assurance documentation was performed and found no evidence that leaks would be present below the surface water line of the pond.

[125] MWG13-15_12827-12845

5.3.2.7. Operation and Maintenance is Being Conducted under Appropriate and Consistent Protocols

I reviewed operation and maintenance activities for MWG's ash ponds and noted the following that demonstrate that these activities are being conducted under appropriate and consistent protocols.

- The operation of the ponds primarily includes maintaining water level controls in the ponds, daily inspections, groundwater monitoring, discharge monitoring, and removal of bottom ash. Weekly inspections of the ash ponds are now recorded by personnel.[126]
- Protocols are in place to conduct the daily operations that include utilization of experienced plant and corporate operations, engineering, and environmental management personnel. Depositions of Mr. Lux[127], Mr. Kelly[128], Ms. Maddox[129], Mr. DiCola,[130] and Mr. Veenbaas[131] indicated that, in summary, daily inspections of the ponds are completed and if any unusual conditions are observed, the shift supervisor is notified and the repairs are implemented.
- Protocols are in place with the ash cleanout contractors.
  - LaFarge North America, Inc. removes the ash from the Will County and Waukegan ash ponds. Pursuant to the contract, LaFarge must perform all services in a competent manner, in compliance with all standards for the services, and comply with all rules, policies, and procedures.[132] Moreover, in the recently executed contract, LaFarge employees and subcontractors must comply with all policies, procedures, and directives, to remove ash using methods to avoid damage to the liner and to make timely repairs when damage is observed. Thus, before every removal, LaFarge meets with its employees and subcontractors to discuss the best practices to remove the ash, identify all of the markers for the bottoms and edges of the basins, and describe the color of the warning layer. Moreover, equipment is used to remove ash primarily on and near the bottom where the liner is protected by the crushed stone and sand cushion layers and not on the side slopes where the geomembrane liner is exposed. Operators are instructed to stop excavating should

---

[126] MWG13-15_49756-49760; MWG13-15_50095-50148
[127] Christopher Lux Deposition, p. 41
[128] Mark Kelly Deposition, p. 87
[129] Rebecca Maddox Deposition, pp. 73, 145
[130] James DiCola Deposition, p. 114
[131] Frederick Veenbaas Deposition, p. 81
[132] MWG13-15_13032; MWG13-15_49679-49700

a hard layer be encountered that would indicate the protective layer. Additionally, LaFarge managers are onsite continuously during the removal to supervise work to avoid any damage to the liner systems. The protocol for managing incidents includes reporting to LaFarge supervisors followed by reporting to a supervisor at the station and to the station administration.[133]

- The Powerton personnel remove the ash from its ponds with its equipment and deposits the ash into trucks owned and operated by Capital Sales.[134] Prior to ash removal, the Powerton shift supervisor has a pre-work meeting to discuss the proper process of removing ash. In the meeting, the personnel supervisor reminds the personnel of the locations of the warning posts, the warning layer below the ash, and a description of the liner. Additionally, the personnel supervisor reminds each operator not to tear or damage the liner during removal. The protocol for managing incidents includes reporting to the personnel supervisor and to the Powerton Chemical Specialist who is responsible for conducting liner repairs.[135]
- The Joliet #29 contracts with an ash removal contractor on an as-needed basis using a competitive bidding process. The Joliet #29 ash removal project manager holds a kick-off meeting prior to starting work to discuss protocols for proper removal of ash. The meeting includes a description of the ponds, identification of the warning posts, the warning layer, and a description of the liner. The Station project manager inspects work throughout the ash removal process to confirm the work is acceptable. The protocol for managing incidents includes reporting to the Station project manager who would stop work that could cause damage to the liner. Ash would be removed from the vicinity of the damaged location. The Station project manager is responsible for conducting liner repairs.[136]

A demonstration of the effectiveness of the operations protocols is the fact that tears or damages to the HDPE liners have been detected based on inspections and promptly repaired as soon as weather conditions allowed. I reviewed tears or damages that have occurred as of September 2015, and observed that all tears were above the water line of the pond or occurred when the water had been

[133] Teleconference with Mitch Nowicki
[134] Deposition of Mark Kelly, p. 61
[135] Teleconference with Mark Kelly; MWG13-15_48636-48639
[136] Teleconference with Harrison Estepp

drained from the pond.[137] Tears above the water line occurred more frequently because of exposure to mechanical equipment at the facilities. Tears below the water line were not observed are not likely given the documented longevity of HDPE liners and because the areas are protected from exposure to equipment. There is no evidence that the liners are deficient or that infrequent liner tears are a source of groundwater impacts.

5.4. Groundwater Monitoring is Appropriate to Demonstrate that Groundwater Exposure Pathways are Mitigated

Groundwater monitoring is appropriate to demonstrate that groundwater exposure pathways are mitigated and to assess the remedial approach. MWG has specified groundwater monitoring programs for each facility. Groundwater monitoring consulting professionals at KPRG are regularly tracking groundwater conditions, and the results are reported to the IEPA. The results during the period of record show that the groundwater exposure pathways are consistently mitigated, and there is no evidence that further remedial action is required.

5.5. Recent Groundwater Concentrations are Not the Result of Ash Stored in Lined Ponds

I reviewed recent groundwater monitoring data to identify if theoretical leaks of leachate through possible liner defects (as posited by Mr. Kunkel) could be impacting groundwater at the subject sites. It is my opinion that the groundwater concentrations are not the result of leakage from the HDPE-lined ponds.

5.5.1. Typical Characteristics of Leachate for the Ash Stored in Ponds at the Sites

I reviewed the characteristics of leachate that are typical for the ash currently stored in ponds at the sites and selected appropriate constituent indicators. The characteristics of ash leachate are based on site-specific impounded ash data (Section 5.5.1.1) or on published leachate data from ponds of subbituminous CCR sourced from the Powder River Basin (PRB) in Wyoming that is the source of coal for the Plants (Section 5.5.1.2). I reviewed the data, and constituent indicators for leachate from ash currently stored in ponds include at a minimum: barium, boron, and sulfate, and at a maximum: antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, manganese, nickel, selenium, silver, sulfate, and zinc (Section 5.5.1.3).

---

[137] MWG13-15_48563, KPRG 2005c, MWG13-15_11574, 11581, Veenbaas Deposition, p. 78-79,87-90, MWG13-15_14177, Maddox Deposition, p. 94-95, MWG13-15_48636-48639

5.5.1.1. Site-Specific Data and Discussion of Leachate Characteristics for Ash Stored in Site Ponds

Four samples of bottom ash from ponds at Powerton, Waukegan, and Will County were collected between 2004 and 2010 and characterized for leaching under neutral pH conditions (see Table 5-1). ASTM D3987-85 provides a standard test method for the leaching of materials to obtain an aqueous solution under specified testing conditions, including neutral pH of 7 (ASTM, 1985). Analytical neutral leachable procedure (NLET) results for these four bottom ash ponds show metals, sulfate, and total dissolved solids. The following analytes have been detected in bottom ash neutral leaching samples from the ponds:

- barium at concentrations up to 0.27 mg/L, which are less than the IEPA Class I groundwater standard of 2.0 mg/L;
- boron at concentrations up to 2.0 mg/L, which are equal to or less than the IEPA Class I groundwater standard of 2.0 mg/L;
- sulfate at a concentration of 49 mg/L, which is less than the IEPA Class I groundwater standard of 400 mg/L; and
- total dissolved solids at a concentration of 200 mg/L, which is less than the IEPA Class I groundwater standard of 1,200 mg/L.

The analytical results for bottom ash neutral leaching samples from the ponds can be extended to all the site ponds because all bottom ash at all of the four MWG generating stations is from the combustion of coal sourced from the PRB in Wyoming. The analytical results for bottom ash neutral leaching samples show that the leachate in ponds does not have the potential to cause groundwater impacts above IEPA Class I groundwater standards.

5.5.1.2. Published Leachate Data from CCR Ponds for Subbituminous Coal

I identified a report that published leachate data from CCR ponds for subbituminous coal, which is characteristic of coal sourced from the PRB in Wyoming that is the source of coal for the Plants.[138] Analyses for leachate samples from existing CCR facilities were characterized in an Electric Power Research Institute (EPRI) report (EPRI, 2006). The EPRI leachate results for leachate from other facility ponds containing CCR from subbituminous/lignite coal sources are summarized in Table 5-2.

[138] MWG13-15_12847

5.5.1.3. Constituent Indicators for Leachate from Ash Stored in Ponds

Because there are differences between the set of constituents that leach based on site-specific data and published leachate data, I developed two sets of constituent indicators for leachate from ash currently stored in ponds. The first set is the minimum set of constituent indicators that would be expected under neutral conditions. This minimum set of constituent indicators is defined as the constituents that were observed in NLET analyses of bottom ash stored in site ponds. The second set is the maximum set of constituent indicators that may be expected based on other facility leachate data published by EPRI (2006). This maximum set of constituent indicators is defined as all constituents observed in analyses of leachate samples from other facility ponds containing CCR from subbituminous/lignite coal sources (see Table 5-2).

I reviewed the summary of leachate data in Table 5-3, and constituent indicators for leachate from ash currently stored in ponds include at a minimum: barium, boron, and sulfate, and at a maximum: antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, sulfate, and zinc.

5.5.2. Recent Groundwater Concentrations do Not Match Constituent Indicators for Leachate from Ash Stored in Ponds

I compared the occurrence of constituents during groundwater monitoring events in the most recent year, 2014, to the minimum and maximum sets of constituent indicators of leachate from ash currently stored in ponds. Conceptually, if all the constituents detected in groundwater samples from a monitoring well match the constituents detected in leachate from ash currently stored in ponds, and if constituents *not* detected in groundwater samples match the constituents *not* detected in leachate from ash currently stored in ponds, then it would be probable that leachate from ash currently stored in ponds is impacting groundwater. To evaluate whether or not groundwater concentrations match leachate constituent indicators, I calculated the percentage of constituents detected at each groundwater monitoring well that match constituent indicators of leachate from ash currently stored in the ponds ("matching percentages"). I restricted my analysis to the most recent full year of groundwater monitoring, 2014, to account for seasonal variations in constituent concentrations and to reflect groundwater concentrations after MWG's pond relining and pond decommissioning had been completed.

In summary, if the constituents match then it is likely that the leachate from the ash is impacting the groundwater. If the constituents *do not* match then it is likely that the leachate *is not* impacting the groundwater.

My results are tabulated in Tables 5-4 and 5-5 and are summarized as follows:

- At Joliet #29, the percentage of constituents at groundwater monitoring wells that match constituent indicators of leachate from ash currently stored in the ponds ranges from
  - 11 percent to 37 percent based on the minimum set of indicators, and
  - 37 percent to 53 percent based on the maximum set of indicators.
- At Powerton, the percentage of constituents at groundwater monitoring wells that match constituent indicators of leachate from ash currently stored in the ponds ranges from
  - 5 percent to 37 percent based on the minimum set of indicators, and
  - 32 percent to 58 percent based on the maximum set of indicators.
- At Waukegan, the percentage of constituents at groundwater monitoring wells that match constituent indicators of leachate from ash currently stored in the ponds ranges from
  - 16 percent to 26 percent based on the minimum set of indicators, and
  - 42 percent to 58 percent based on the maximum set of indicators.
- At Will County, the percentage of constituents at groundwater monitoring wells that match constituent indicators of leachate from ash currently stored in the ponds ranges from
  - 21 percent to 37 percent based on the minimum set of indicators, and
  - 37 percent to 53 percent based on the maximum set of indicators.

The low matching percentages demonstrate that there are substantial and widespread mismatches between the characteristics of recent groundwater analyzed near the ash ponds and the characteristics of leachate from ash currently stored in the ash basins. Thus, it is my opinion that the recent groundwater impacts are not a result of the ash currently stored in ponds at the sites, but instead are more likely than not a result of historical uses at the sites and the surrounding industrial companies and conditions.[139]

[139] IEPA, 2015 and MWG13-15_29975-29776.

5.6. Groundwater Conditions Do Not Pose Risks to Surface Water Receptors Based on a Risk Screening Assessment

5.6.1. Overview

I worked with my staff to develop an appropriate methodology to assess the exposure to surface waters from groundwater impacts at the sites. We assessed the potential for human health and ecological risks from an assumed exposure to constituents of interest (COIs) in groundwater associated with each of the four sites that may migrate to surface water. These evaluations are conservative as they assume a complete exposure pathway exists between groundwater COIs and receptors in the adjacent surface water bodies, and do not fully analyze attenuation or dilution mechanisms. The screening assessment also considers background and upgradient source COIs that are not from the ponds, thereby overestimating the risk from the pond operations. It is my opinion that groundwater conditions do not pose risks to surface water receptors based on the risk characterization included in Appendix B and described below.

5.6.2. Definition of Risk

"No unacceptable risks" means that the site-specific groundwater concentrations are less than Illinois Water Quality Standards (WQS) or Water Quality Criteria (WQC), which are considered to be protective of human health and the environment in surface water.[140] These WQS/WQC incorporate toxicological (i.e., cause-and-effect) data as well policy-based assumptions, including the state-determined acceptable risk level.

This evaluation includes a refinement step that considers the exceedance location (relative to other wells and receiving water bodies), magnitude, and frequency. If these lines of evidence support that "no unacceptable risks" are likely at the point-of-exposure (i.e., the lake or river), then it is concluded that there is an unlikely potential for risk.

5.6.3. Results of Risk Evaluation

The following summarizes the results of the evaluation. A complete evaluation is in Appendix B attached to this opinion.

Joliet #29: antimony, boron, manganese, and TDS do not pose unacceptable risks because concentrations are lower than WQS/WQC. Concentrations of chloride, sulfate, and iron

[140] WQS are defined in 35 IAC 302, Subpart B (Joliet #29, Powerton, and Will County) and E (Waukegan). WQC are derived by the IEPA under authority of 35 IAC 302, Subpart B.

exceeded WQS/WQC on occasion; however, further evaluation of site-specific conditions indicated an unlikely potential for risk from these COIs.

Powerton: boron, chloride, nitrate, selenium, sulfate, and TDS do not pose unacceptable risks because concentrations are lower than WQS/WQC. Concentrations of arsenic, iron, lead, manganese, thallium, and pH exceeded WQS/WQC on occasion; however, further evaluation of site-specific conditions indicated an unlikely potential for risk from these COIs.

Waukegan: the results of the risk evaluation are complicated by groundwater impacts at the Waukegan site, including groundwater impacts resulting from the migration of inorganic constituents from upgradient and offsite sources. Antimony and manganese do not pose unacceptable risks because concentrations are lower than WQS/WQC. Concentrations of arsenic, chloride, and pH exceeded WQS/WQC on occasion; however, further evaluation of site-specific conditions indicated an unlikely potential for risk from these COIs. Concentrations of boron, iron, sulfate, and TDS exceeded WQS/WQC in wells to the west and southwest of the ponds (MW-05 through MW-09). Importantly, there are no unacceptable risks for boron, iron, sulfate, and TDS in wells MW-01 through MW-04, which represent the most downgradient wells at the site (see Figure 4-4). MW-01 through MW-04 appear to be downgradient of MW-05, MW-06, MW-08, and MW-09, indicating attenuation is occurring. Although no wells are directly downgradient of MW-07, there is no data to indicate that similar attenuation is not occurring in this area.

Will County: antimony, boron, chloride, manganese, and TDS do not pose unacceptable risks because concentrations are lower than WQS/WQC. Concentrations of sulfate and pH exceeded WQS/WQC on occasion; however, further evaluation of site-specific conditions indicated an unlikely potential for risk from these COIs.

5.7. Historical Ash in Fill Materials Outside of the Ponds is Not Adversely Impacting Groundwater

Ash generated by coal combustion may be classified as coal combustion by-product (CCB) and used for purposes of fill material when there is beneficial use determined by IEPA (see Section 5.7.1). Current data obtained from recent ash samples and groundwater collected from multiple sites show that leachate from the historical ash in fill materials meets IEPA Class I groundwater standards based on leaching from a soil- like environment (see Section 5.7.2). It is my opinion that the current conditions of the existing weathered ash are not contributing to groundwater exceedances at the four sites based on leaching analyses of actual ash fill at the sites.

5.7.1. Coal Ash may be Classified as Coal Combustion Byproducts to Allow Beneficial Use

Structural fill and import fill ("fill") at the sites was placed historically, as long as 38 years ago. Ash generated by coal combustion may be classified as CCB when there is beneficial use determined by IEPA as established in 415 Illinois Compiled Statutes 5/3.135. Although the current IEPA criteria were not applicable when the CCB was placed, it is analogous to compare the current condition of CCB to the current IEPA criteria. Additionally, the design and construction of coal ash structural fills is a standard practice, and procedures for using coal combustion products, including fly ash, bottom ash, and boiler slag, to achieve desired geotechnical properties are described in ASTM E2277-14 (2014). In my opinion, the presence of CCB outside of the pond areas is considered an acceptable use when compared to Illinois requirements and the standard ASTM practice.

5.7.2. Investigations of Potential Leaching Characteristics of Historical Ash in Fill Materials at Sites

Data obtained from recent samples of ash used as fill from multiple sites show that leachate from the ash in its current condition meets IEPA Class I standards based on leaching from a soil-like environment (NLET method). These data were obtained during a 2004 investigation at Powerton, a 2005 investigation at Joliet #29, and a 2015 investigation at Will County, as discussed further below. Based on these data, it is reasonable to conclude that historical ash areas at all four MWG sites are not a source of groundwater impacts. Significantly, there is no evidence to conclude, as Kunkel does, that the ash areas are a source.

5.7.2.1. Joliet #29 Investigation

On behalf of Midwest Generation, in June 2005 KPRG performed an investigation of historical ash in fill materials at the Joliet #29 site. This investigation included the collection of historical ash samples from 15 soil borings at the Joliet #29 site. Historical ash samples were analyzed using a neutral leachable procedure (NLET) for metals. KPRG's report found the following conclusions:[141]

- "The ash deposits are consistent and homogenous consisting of interlayered fly ash and bottom ash/slag from the coal combustion process."

[141] KPRG, 2005a

- "The NLET metals data from sample location GP-14A displayed elevated levels of lead and copper at concentrations at least two times higher than the Class I groundwater standard." This area was later further delineated and excavated (see below).
- "The NLET metals data from the remaining 16 sample locations indicate with a high degree of statistical certainty that the criteria established in 415 ILCS 5/3.135 (formerly 415 ILCS 5/3.94) a-5(B) are met and that the material may be considered CCB relative to this criterion...."[142]

A supplemental investigation was performed in the vicinity of GP-14A in November 2005. Eight additional historical ash samples were collected from soil borings and analyzed using NLET for metals. The June 2005 and November 2005 samples were used to delineate the extent of excavation in the vicinity of GP-14A. Approximately 1,062.88 tons of fill material containing historical ash was excavated and disposed off-site at a landfill during the week of November 21, 2005. The excavation was backfilled using surficial materials near the excavation area. Following the excavation, the historic ash in the area met the CCB criteria under 415 ILCS 5/3.135.[143]

Thus, it is my opinion that leachate from historical ash in fill materials at Joliet #29 is not adversely impacting the groundwater.

5.7.2.2. Powerton Investigation

On behalf of MWG, Andrews Environmental Engineering, Inc. (AEEI) performed an investigation in May 2004 of historical ash in fill materials at Powerton[144]. A total of eight historical ash samples were collected from test pits in the Limestone Runoff Basin. Samples were analyzed for NLET metals using ASTM D3987-85. Selenium was detected in two NLET samples and chromium was detected in one NLET sample at concentrations greater than the IEPA Class I groundwater standards. All other metals in the NLET results from the eight ash samples were less than the IEPA Class I groundwater standards.

I reviewed selenium and chromium concentrations in groundwater at Powerton, and only selenium was detected at one location (MW-14) above IEPA Class I groundwater standards during the period of record.[145] Groundwater concentrations measured during the most recent full year of

[142] Of the remaining 16 sample locations, 14 sample locations were located at Joliet #29.
[143] KPRG, 2005c
[144] AEEI, 2004
[145] MWG13-15_48711-48843

quarterly groundwater monitoring in 2014 were all below IEPA Class I groundwater standards, indicating no impacts of selenium or chromium. Thus, it is my opinion based on this analysis, that leachate from historical ash in fill materials at Powerton is not adversely impacting the groundwater.

5.7.2.3. Will County Investigation

On behalf of MWG, KPRG performed an investigation in June and August 2015 of historical ash in fill materials at Will County.[146] This investigation included the collection of 20 historical ash samples from 20 soil borings at the Will County site. Historical ash samples were analyzed using a neutral leachable procedure (NLET) for metals. KPRG's report documented the following conclusions:

- "The ash deposits are consistent and homogenous consisting bottom ash/slag from the coal combustion process."
- "There were no outlier samples, and all samples collected were used in the calculations."
- "The NLET metals data from the 20 sample locations indicate with a high degree of statistical certainty that the criteria established in 415 ILCS 5/3.135 (formerly 415 ILCS 5/3.94) a-5(B) are met and that the material may be considered CCB relative to this criterion for engineering/beneficial reuse."
- "The data set is sufficiently large to support the statistical evaluations based on the variance and specific regulatory threshold relationships."

Thus, it is my opinion that leachate from historical ash in fill materials at Will County is not adversely impacting the groundwater.

5.8. Bottom Ash in Inactive Ponds is Not a Source of Groundwater Concentrations

Data obtained from recent samples of bottom ash accumulated in ash ponds from multiple sites show that leachate from the bottom ash meets IEPA Class I standards based on leaching from the pond environment (NLET) (see Section 5.5.1.1). Based on these data, it is reasonable to conclude that bottom ash accumulated in inactive ash ponds are not a source of groundwater concentrations.[147]

---

[146] KPRG, 2015

[147] The Will County inactive ash ponds 1N and 1S have been modified to prevent more than one foot of standing water. This pond modification will reduce the volume of potential leachate at the Will County inactive ash ponds.

Section 6: Opinion 2—The Remedial Approach Provided in the Kunkel Remedy Report is Not Warranted

It is my opinion that the remedial approach in the Kunkel Remedy Report, which is removal of all CCRs and the ash ponds, is not warranted because:

1. the concentrations of COIs that have been observed in groundwater around the ponds are low, such that MWG's remedial approach to protect human health and the environment is in accordance with Illinois standards (Section 6.1);
2. the bottom ash indicator constituents from leachate do not match the groundwater chemistry, indicating that the constituents in groundwater are not from the ponds, the ponds are functioning in accordance with the design, and the ponds do not need to be removed (Section 6.2), and
3. there is no evidence that coal ash currently outside of the ash ponds is a source of groundwater impacts (Section 6.3).

Further, Kunkel did not follow the Illinois procedures his opinions concerning remedial activities. After the completion of a site investigation, groundwater and soil remediation objectives would need to be developed that consider exposure routes and would be protective of human health and the environment. The selection of remedial technologies needs to consider the feasibility of implementation, whether the technologies will perform satisfactorily and reliably, and whether remediation objectives will be achieved within a reasonable period of time (Section 6.4).

I also found many inaccuracies in the Kunkel Report on Ground-Water Contamination that, in general, portray conditions that imply that groundwater is more threatened than is actually supported by the data.

The following is provided in support of Opinion 2:

- Ash ponds are for wastewater treatment purposes and are not landfills for permanent ash disposal (Section 6.5.1).
- Ash ponds are lined with 60-mil HDPE, which is the accepted standard of the ash pond lining industry. Further, the liner construction quality is consistent with the ash pond lining quality management standards for long-term use based on available construction documentation. (Section 6.5.2)

- O&M of the ash ponds are conducted in accordance with consistent operating protocols. (Section 6.5.3)
- Kunkel incorrectly concludes that all of the former ash ponds leaked and the current ash ponds are leaking. He asserts that the groundwater elevations are above the bottom of the ponds or pond water surface and in turn causing bottom heave. His analysis is incorrect on several bases. First, an uplift pressure argument is relative to the top of the bottom liner. Second, an uplift argument is an issue for soil liners, not geomembrane liners that are at all of the ponds. Third, groundwater levels are rarely above the top of the bottom liners and when they are above the bottom liner there are other opposing forces or controls to eliminate uplift. (Section 6.5.4)
- In addition to errors in Kunkel's groundwater elevation analysis, Kunkel fails to consider the weight of the Poz-o-Pac liner (where present), sand cushion, and limestone warning layers. An appropriate hydrostatic uplift calculation should include at a minimum the weight of sand cushion layers and limestone warning layers that provide downward forces that counteract the upward hydrostatic uplift force. The presence of bottom ash and pond water provide further downward forces that counteract the upward hydrostatic uplift force. (Section 6.5.5)
- Groundwater mounding that the Kunkel Groundwater Contamination Report concluded was an indication of an ongoing leak has not been observed at Joliet #29 monitoring well MW-9. Kunkel alleges that mounding is occurring at Joliet 29 because the groundwater elevation in downgradient MW-9 is higher than upgradient MW-8. However, the majority of the data show that the average water level in MW-9 is lower than MW-8. (Section 6.5.6)
- Kunkel incorrectly portrays background concentrations by using state-wide data for groundwater at the Joliet #29, Waukegan, and Will County sites. It is my opinion that this approach is inappropriate and fails to account for those sites where upgradient groundwater is impacted prior to migrating on-site. (Section 6.5.7)

6.1. MWG's Remedial Approach to Protect Human Health and the Environment is in Accordance with Illinois Standards

Kunkel states that his professional analyses and opinions have an "emphasis on remedy options which, if implemented, would stop or minimize the continuing ground-water contamination from MWG's ash ponds and/or other coal ash disposal areas at the four power plant sites."[148] Kunkel alleges that "[t]he remedy for continued long-term ground-water contamination at the four power plant sites is removal of the leaking ash ponds as well as all or a portion of the coal ash which has been deposited outside the ash ponds. The conclusions in my previous report ([Kunkel Groundwater Contamination Report]) form the bases for this remedy report."[149]

I conclude that further source remediation is not warranted. Observed COI concentrations in groundwater around the ponds are low, such that MWG's remedial approach to protect human health and the environment is in accordance with Illinois standards.

- Bottom ash indicator constituents from leachate do not match the groundwater chemistry (see Section 5.5).
- There is no evidence that historical ash in fill materials outside of the ash ponds is a source of groundwater impacts based on leaching analyses of the existing weathered ash in fill materials and observed groundwater concentrations (see Section 5.7.2).
- Administrative controls eliminate the completion of the groundwater ingestion pathway and dermal exposure pathway (see Section 5.2).
- Groundwater conditions do not pose unacceptable risks to surface water receptors (see Section 5.6).

6.2. Bottom Ash Indicator Constituents from Leachate Do Not Match the Groundwater Chemistry

Kunkel alleges that boron, sulfate, and manganese are valid indicators of groundwater contamination because "EPRI and IEPA deem them to be of concern at all four of the power plant sites and they are typically present in high concentrations in coal ash leachate...." However, the sources cited by Kunkel (EPRI, 2012; Kosson, 2009; and IEPA, 2010) are not specific to the four MWG sites. As demonstrated in Section 5.5.1.3, constituent indicators for leachate from ash currently stored in ponds include at a minimum: barium, boron, and sulfate, and at a maximum: antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, manganese, nickel, selenium, silver, sulfate, and zinc. In order to compare the constituents in the ponds with the groundwater conditions, a more complete selection of constituent indicators should be used.

---

[148] Kunkel Remediation Report, Page 2

[149] Kunkel Remediation Report, Page 2

Kunkel includes removal of the ash ponds as part of his remedy and alleges that "[p]oor liner construction is an initial cause of liner defects which results in leaking ponds and release of contaminated fluids into the underlying ground water."[150] This allegation would imply that recent groundwater concentrations would be substantially impacted by the leachate from bottom ash currently stored in ash ponds. If this were true, constituents that are indicator chemicals for the ash currently stored in ash ponds would match the constituents actually observed in groundwater near the ponds. However, bottom ash indicator constituents from leachate do not match the groundwater chemistry (see Section 5.5). Thus, constituents in groundwater are not from the ponds and the ponds are functioning in accordance with the design.

I conclude that the ponds do not need to be removed.

6.3. There is No Evidence That Historical Coal Ash Outside of the Ash Ponds is a Source of Groundwater Impacts

Kunkel's proposed remedy includes removal of coal ash historically deposited outside the ash ponds, which includes coal ash "utilized in the construction of roadways, pond dikes and also for general land leveling at all four power plants."[151] He further states, without supporting data, that "[t]his coal ash is subject to leaching by rainfall and snowmelt, rising and falling ground-water levels, and this leachate is transported downward causing contamination of the ground water."[152] However, Kunkel's remediation approach is inconsistent with construction practices in Illinois and ASTM standards. The appropriate approach in Illinois for the evaluation of ash used beneficially as fill is to conduct leaching evaluations on actual fill at the sites (see Section 5.7.1). There is no evidence that historical ash in fill materials outside of the ash ponds is a source of groundwater impacts based on leaching analyses of the existing weathered ash in fill materials and observed groundwater concentrations (see Section 5.7.2). I conclude that there is no evidence supporting Kunkel's allegation that leachate from ash used as fill is causing groundwater contamination.

[150] Kunkel Remediation Report, Page 2
[151] Kunkel Remediation Report, Page 2
[152] Kunkel Remediation Report, Page 2

6.4. Kunkel did Not Follow the Illinois Procedures for Investigative and Remedial Activities

Kunkel alleges that "adequately addressing the contamination at the four sites requires the complete removal of the existing ash ponds and selected areas of coal ash deposited outside the ash ponds as the remedy. Coal ash from the ash ponds, coal ash used in construction activities at each site and the coal ash deposited on the ground surface outside the existing ash ponds must be placed in an appropriate landfill for the four MWG power plant sites."[153] However, Kunkel did not follow the Illinois procedures for the investigative and remedial activities. After the completion of a site investigation, groundwater and soil remediation objectives would need to be developed that consider exposure pathways and would be protective of human health and the environment. The selection of remedial technologies needs to consider the feasibility of implementation, whether the technologies will perform satisfactorily and reliably, and whether remediation objectives will be achieved within a reasonable period of time. Kunkel did not demonstrate that any of these steps were followed when he alleged that his proposed remedy is required.

- Removal of all ash from the sites is not feasible when all costs and site disruptions are considered (Section 7), and
- Ponds and historical ash are not sources of groundwater impacts (see Sections 5.3 and 5.5); thus removal of all ash will not achieve groundwater remediation objectives.

It is my opinion that Kunkel's remedy is inappropriate based on the Illinois procedures for investigative and remedial activities.

6.5. Responses to Specific Inaccuracies in Kunkel's report on Groundwater Contamination

I noted various inaccuracies in Kunkel's report on Ground-Water Contamination that imply that groundwater is more threatened than supported by the data. The following presents my responses to specific inaccuracies.

[153] Kunkel Remediation Report, Page 3

6.5.1. Ash Ponds are for Wastewater Treatment Purposes and are not Landfills for Permanent Ash Disposal

Kunkel alleges that there "has been and continues to be ground-water contamination from MWG's ash ponds and/or other coal ash disposal areas at the four power plant sites."[154] However, the ash ponds are not coal ash disposal areas as implied by Kunkel. The ash ponds are integral components of the wastewater treatment process for the generating facilities.[155] Furthermore, ash is routinely excavated and beneficially used off-site as evidenced in billing records from waste removal contractors, such as Lafarge.[156] It is my opinion that the vast majority of the potential for leachate from ash generated by the generating stations is appropriately managed by wastewater treatment using lined ash ponds and off-site disposal or beneficial reuse of the separated ash.

6.5.2. Ash Ponds are not Leaking and Construction Quality is Consistent with the Ash Pond Lining Quality Management Standards for Long-Term Use

Kunkel broadly alleges that at all four generating stations have "ash ponds whose liners have leaked and continue to leak due to poor liner construction techniques…."[157] However, Kunkel fails to provide evidence of the leaking for any of the ash ponds at any of the sites. Instead, Kunkel relies on an inapplicable study of other sites to assume leaks are occurring at the MWG ponds.[158] It is my opinion that the MWG ash ponds are not leaking because they are lined with 60-mil HDPE, which is the accepted standard of the ash pond industry. Further, the liner construction quality is consistent with the ash pond lining quality management standards for long-term use based on my review of construction quality assurance documentation. Specifically:

- The liner subgrades were inspected for sharp surfaces prior to installation of the HDPE liner and protective geotextile was installed below the HDPE liners to avoid the potential for puncture (see Section 5.3.2.5 and 5.3.2.6).
- The HDPE liners were inspected for leaks after installation of a protective sand cushion layer using the state of the practice electronic leak detection survey technologies (see Section 5.3.2.5 and 5.3.2.6).

[154] Kunkel Ground-Water Contamination Report, page 2.

[155] MWG13-15_16907-63; MWG13-15_18115-31; MWG13-15_24935-54; MWG13-15_10926-10947

[156] MWG13-15_36-65

[157] Kunkel Ground-Water Contamination Report, page 2.

[158] Kunkel cites Schroeder (1994), which does not consider the frequency of leaks when certain construction quality assurance protocols are followed. See Section 5.3.2.6 for applicable studies.

- Warning and cushion layers are installed above the HDPE liners to protect them from accidental contact and damage during future dredging operations (see Sections 5.3.2.1 through 5.3.2.5).
- The quality of construction was documented by an independent engineering firm that attested that the construction met the project drawings and specifications and manufacturer's recommendations (see Section 5.3.2.6).

Thus, I conclude that it is inaccurate to portray ash ponds as "continuing to leak" when there is no evidence that the current HDPE liners are leaking. Additionally, in my opinion, the CQA documentation indicates the HDPE liner construction is of high quality.

6.5.3. O&M of the Ash Ponds are Not Expected to Cause Leaks and O&M are Conducted in Accordance with Consistent Operating Procedures

Kunkel alleges that at all of the generating stations, ash pond have liners that "have leaked and continued to leak due to ... poor coal ash removal/maintenance practices...."[159] Furthermore, Kunkel alleges that "[r]elining the ash ponds will not reduce the potential for liner damage and subsequent liner leakage as long as dredging of coal ash continues as in the past."[160] However, I conclude that ash removal and maintenance practices are good, and O&M of the ash ponds are not expected to cause leaks based on my review of O&M documentation and practices. Specifically:

- Periodic dredging of settled bottom ash is carefully performed using excavators. If the excavator bucket were to encounter the stone warning layer, which is located over the protective layer, which in turn is located over the HDPE liner, it would be obvious to the operator who is expected to stop excavating. If the HDPE liner were encountered, white HDPE material would be visually observed in the bucket by the excavator operator who would stop work. Based on my review of the O&M documentation, damage of the HDPE liner below the water level during dredging has not been observed at any ash pond (see Section 5.3.2.7).
- Kunkel specifically alleges that "[a]sh pond dredging using heavy equipment likely will damage the plastic liners given the thin (1 ft thick) protective sand layer and 6-in thick warning layer on top of the liners. Typically, at least two feet or more of protective layer is

[159] Kunkel Ground-Water Contamination Report, page 2
[160] Kunkel Ground-Water Contamination Report, page 2

required on top HDPE if heavy equipment is utilized." However, Kunkel did not provide any load bearing analysis that the protective and warning layers would be insufficient for heavy equipment traffic loads. It is my opinion that the protective and warning layers are sufficient based on my review of the overburden stress analysis conducted by NRT for 18 inches of soil cover over the liner (see Section 5.3.2.5).

- Most tears observed in the ash pond liners have been above the impounded water surface (see Section 5.3.2.7). All tears were promptly repaired as allowed by favorable weather conditions. Tears above impounded water would not be expected to result in leaks. The only tear that was potentially below the water line occurred when no water was in the ash pond and was repaired prior to refilling water to the level of the tear in the ash pond.

6.5.4. Groundwater Elevations above the Bottoms of Ash Ponds are Temporary or Seasonal Conditions

Kunkel alleges that at Powerton, "...ash pond water surface elevations are periodically below ground-water table elevations..."[161]; at Waukegan, "...ash pond bottom liners are always below the surface-water elevations in Lake Michigan and also the ground-water table..."[162]; and at Will County, "Ground-water and Des Plaines River surface-water elevations are always above the bottom of the liners..."[163] These statements are misleading and inaccurate. First, an uplift pressure argument is relative to the top of the bottom liner. Second, an uplift argument is a potential issue for soil liners, not geomembrane liners that are at all of the ponds. Third, groundwater levels are not often above the top of the bottom liners and when they are above the bottom liner there are other opposing forces or controls to eliminate uplift.

Uplift pressure under a geomembrane liner is not an indication of failure. In the event that uplift pressures were to occur, the geomembrane would lift vertically out of position and would have to be inspected and repaired prior to service. This would only occur absent weight and pressure from pond materials (section 6.5.5), and has never been reported at any of the ponds.

To demonstrate the inaccuracy of Kunkel's uplift proposition, I evaluated the groundwater elevation and pond bottom data. The data show the following:

---

[161] Kunkel Ground-Water Contamination Report, page 3
[162] Kunkel Ground-Water Contamination Report, page 3
[163] Kunkel Ground-Water Contamination Report, page 4

- Joliet #29 Ash Ponds 1, 2, and 3—groundwater elevations in nearby monitoring wells have always been below the ash pond bottom elevations during the period of record.
- Powerton Ash Surge Basin: The groundwater elevations during the entire period of record at nearby monitoring wells MW-8, MW-11, MW-12, and MW-15 have been below the bottom liner elevation of 452.0 feet above MSL (see Figure 5-2).
- Powerton Secondary Ash Settling Basin: The groundwater elevations during the entire period of record at nearby monitoring well MW-6 have been below the bottom liner elevation of 440.0 feet above MSL (see Figure 5-3). The groundwater elevations at nearby monitoring well MW-7 have been above the bottom of the pond during only 2 of 16 quarterly groundwater monitoring events. However, the groundwater in this area can be controlled by the underdrain system that can relieve uplift pressures when the pond is dewatered and groundwater elevations are high.
- Powerton Metal Cleaning Basin: Groundwater elevations during the entire period of record at nearby monitoring wells MW-13, MW-14, and MW-15 have been below the bottom liner elevation is 457.5 feet above MSL (see Figure 5-4).
- Powerton Ash Bypass Basin: The groundwater elevations during the entire period of record at nearby monitoring wells MW-9 and MW-12 have been below the bottom liner elevation of 459.0 feet above MSL (see Figure 5-5)..
- Waukegan West and East Ash Ponds: Design documentation[164] has demonstrated that the bottom of the ponds is at approximately elevation 585.5 feet above MSL (see Figure 5-6). Groundwater elevations during the entire period of record at nearby downgradient monitoring wells MW-1 through MW- 4 and in upgradient monitoring well MW-5 were a minimum of 579.3 up to a maximum of 584.5 ft MSL which are all below the bottom of the ponds.
- Will County Ash Ponds 2 South and 3 South: The bottom liner elevation is 580.5 feet above MSL (see Figure 5-7). Groundwater elevations have been above the bottom of the pond during the period of record at nearby monitoring wells MW-5, MW-6, and MW-9, and monitoring well MW-10 during 6 of 16 quarterly groundwater monitoring events.

Therefore, groundwater levels are above the bottom liner at only three of the eight ponds which Kunkel claims have uplift pressures. However, for all ponds, the uplift pressures are offset

[164] MWG13-15_49285

by the weight of water in the ponds when they are full. For two ponds, uplift pressures are offset by the weight of overlying cushion and protective layers (See Section 6.5.5), and one pond has a groundwater underdrain to offset uplift pressures.

6.5.5. An Appropriate Analysis of Hydrostatic Uplift Involves Consideration of Counteracting Downward Forces

Kunkel alleges that at Powerton, "[a]sh pond water surface elevations are periodically below ground-water table elevations which likely has resulted, and will likely result in the future, in hydrostatic uplift and liner failure...."[165] Similarly, Kunkel alleges that at Waukegan, "ash pond bottom liners are always below ... the ground-water table which results in hydrostatic uplift pressures which likely has caused, and will likely cause in the future, liner leaks..."[166] Additionally, Kunkel alleges at Will County, "[g]round-water ... elevations are always above the bottom of the liners which likely has caused, and likely will cause in the future, hydrostatic uplift and liner failure." However, Kunkel does not support his allegations with any site-specific calculations or analysis.

In addition to errors in Kunkel's analysis (see Section 6.5.4), Kunkel fails to consider the weight of the Poz-O-Pac, sand cushion, and limestone warning layers. An appropriate hydrostatic uplift calculation should include at a minimum the weight of Poz-O-Pac, sand cushion layers, and limestone warning layers that provide downward forces that counteract the upward hydrostatic uplift force. The presence of bottom ash and wastewater provide further downward forces that counteract the upward hydrostatic uplift force. I calculated the following net resultant hydrostatic uplift forces present when only the pond liner system is present and nearby groundwater elevations are at a maximum. These calculations are for the three ash ponds where groundwater elevations are temporarily or seasonally higher than the bottom elevations and are summarized as follows:

- Powerton Secondary Ash Settling Basin: There is a net resultant uplift force when the pond is empty. This was demonstrated during pond relining when the Illinois River was at an unusually high level causing groundwater levels to rise, and in turn causing inflow into the excavations. The inflow was controlled by a drainage system. During cleanout, the drainage system is available to eliminate hydrostatic uplift. While the ponds are full, however, there

[165] Kunkel Ground-Water Contamination Report, page 3
[166] Kunkel Ground-Water Contamination Report, page 3

is no hydrostatic uplift because of the downward force of water which is 180 to 700 pounds per square foot (psf)[167], depending on the groundwater level.

- Will County Ash Pond 2S: Uplift force is entirely counteracted by the weight of the Poz-O-Pac, sand cushion, and limestone warning layers, with a net resultant downward force of 195 psf.
- Will County Ash Pond 3S: Uplift force is entirely counteracted by the weight of the Poz-O-Pac, sand cushion, and limestone warning layers, with a net resultant downward force of 195 psf.

6.5.6. Kunkel's Conclusion of Groundwater Mounding at Joliet #29 Monitoring Misrepresents Actual Groundwater Elevations

Kunkel alleges that at Joliet #29 "ash Pond 3 must have been leaking because the ground-water elevation in MW-9 was higher (505.66) than that in MW-8 (505.22) which is generally up-gradient from MW-9." However, I reviewed groundwater elevations measured at Joliet #29 monitoring wells MW-8 and MW-9 during the period of record between 2010 and 2014. Groundwater elevations at MW-8 were higher than groundwater elevations at MW-9 during 11 of 16 quarterly groundwater monitoring events (69 percent). Furthermore, the average groundwater elevation at MW-8, 505.67 feet above MSL, was higher than the average groundwater elevation at MW-9, 505.65 feet above MSL, during the period of record. Kunkel selected the largest value for the difference in groundwater elevations between MW-9 and MW-8 to prove a conclusion, yet the overall data do not support the conclusion.

The groundwater elevations across the approximately 18 acres of the site covered by the monitoring well network vary by 0.5 ft on average (see Table 4-1). The measurement accuracy of a typical groundwater level monitor is approximately 0.05 ft. It is my opinion that the accuracy of the readings combined with the narrow differences and variations of groundwater elevations indicate that any mounding would be too subtle to detect.

Therefore, it is my conclusion that the data do not show any mounding.

---

[167] Calculated based on normal pool elevation of 453 ft, average groundwater elevation of 441.5 ft and maximum groundwater elevation of 450 ft.

6.5.7. Kunkel's Conclusion of a Liner Leak at Waukegan is Actually an Expression of Surface Topography

Kunkel prepared groundwater contour maps and concluded that "The "ridge" in the ground-water contours at the ash ponds may indicate a liner leak in the west ash pond,…". I prepared a groundwater contour map (Figure 4-4) of data from May and June 2014 using the information from the Waukegan monitoring wells and ELUC wells. I conclude that the area where a "ridge" was shown in Kunkel's maps is more muted and simply a reflection of the ground surface topography which dips to the north, east and south from the area of the ash ponds. This groundwater "mirroring" of ground surface topography would be expected in an aquifer that is primarily granular (more permeable) material that responds relatively quickly to infiltration and lateral migration. The groundwater mirroring is consistent with the additional information that the ponds are not leaking.[168] (See 5.5.2).

6.5.8. Background Constituent Concentrations Should be Based on Contemporary Data from Upgradient Wells

Kunkel alleges that he compared measured groundwater quality concentrations to "site background water quality."[169] However, Kunkel instead relies on "specific Illinois ground-water quality data which are representative of background on a state-wide level" for Joliet #29, Waukegan, and Will County. It is my opinion that this approach is inappropriate and misrepresentative for sites where upgradient groundwater is impacted prior to migrating on-site (see Sections 4.2.1 and 4.3.1). In particular, Kunkel claims that "indicator pollutants in [Powerton] MW-16 are similar to the IEPA (2013) background network wells for sand and gravel aquifers." However, Kunkel limits his assessment to boron, manganese, and sulfate as the "indicator pollutants" and does not consider other constituents that also comprise background concentrations. It is my opinion that it is inaccurate to portray background concentrations at a state-wide level as representative of background at the sites where there are upgradient monitoring data.

An appropriate approach would be to evaluate background concentrations based on site specific data such as monitoring wells installed at the upgradient site boundaries in locations without the presence of ash materials in fill.

[168] IEPA, 2015 and MWG13-15_29775-29776
[169] Kunkel Ground-Water Contamination Report, page 7.

- Joliet #29—monitoring wells MW-8, MW-10, and MW-11 are near the upgradient site boundary, and the boring logs show that these three wells are not installed in ash fill. Groundwater quality at these three locations are not consistent:
    - MW-8 has historical exceedances of chloride and sulfate above IEPA Class I groundwater standards.[170]
    - MW-10 has historical exceedances of chloride above the IEPA Class I groundwater goal. [171]
    - MW-11 has historical exceedances of boron and chloride above IEPA Class I groundwater standards. [172]

  Thus, background groundwater concentrations at Joliet #29 reflect sources other than the ponds and historical ash fill based on site-specific data because monitoring wells near the upgradient site boundary exceed IEPA Class I groundwater standards prior to migrating below the ponds.

- Powerton—monitoring wells MW-1, MW-9, and MW-16 are near the upgradient site boundary, and the boring logs show that MW-1 and MW-16 are not installed within ash fill. The groundwater concentrations at MW-1 and MW-16 have historical exceedances for nitrate above the IEPA Class I goal and pH has historical exceedances that are both above and below the acceptable IEPA Class I range of goals. [173] MW-16 groundwater also detected barium, boron, chloride, and sulfate. MW-1 groundwater also detected barium, boron, chloride, fluoride, manganese, nitrate, and sulfate. MW-9 groundwater also detected barium, boron, chloride, fluoride, manganese, selenium, and sulfate. Thus, background concentrations at Powerton reflect sources other than the ponds and historical fill areas based on site-specific data because monitoring wells near the upgradient site boundary detect or exceed IEPA Class I groundwater standards prior to migrating below the ponds.
- Waukegan—monitoring wells MW-6 and MW-8 are near the upgradient site boundary, and the boring logs show that MW-6 is not installed within ash fill. An estimate of site-wide groundwater contours for the Waukegan site are provided on Figure 4-4. Groundwater concentrations at MW-6 have several historical exceedances for boron and manganese

---

[170] MWG13-15_48647-48710
[171] MWG13-15_48647-48710
[172] MWG13-15_48647-48710
[173] MWG13-15_48711-48843

above IEPA Class I groundwater standards.[174] Additionally, wells installed for the neighboring and upgradient ELUC, including ELUC MW-10, ELUC MW-11, ELUC MW-12, ELUC MW-14, and ELUC MW-15, show elevated levels for boron and manganese above IEPA Class I groundwater standards.[175] Thus, background concentrations at Waukegan reflect sources other than the ponds and historical fill areas based on site-specific data because monitoring wells near the upgradient site boundary exceed IEPA Class I groundwater standards prior to migrating below the ponds.

- Will County—shallow groundwater conditions at the Will County site are impacted by the Des Plaines River and the Chicago Sanitary and Ship Canal. Groundwater hydraulic gradients are confounded by surface water influences with some groundwater migrating toward the Des Plaines River and some groundwater understood to be migrating toward the Chicago Sanitary and Ship Canal. Thus, background concentrations at Will County cannot be established based on site-specific data. Additionally, due to the unique groundwater conditions at the Will County site, it is not appropriate to use background groundwater quality based on a state-wide level for the Will County site.

---

[174] MWG13-15_48902-48958
[175] MWG13-15_50086-50092

Section 7: Opinion 3—Kunkel Underestimates the Costs to Implement the Unwarranted Cleanup

It is my opinion that the Kunkel Remedy Report significantly underestimates the cost of Kunkel's proposed cleanup to remove all ash ponds and all CCRs in fill at the plants.

- Kunkel's proposed remedy fails to incorporate the costs of disposal at a permitted landfill (see Section 7.1).
- Kunkel's proposed remedy does not account for significant and costly disruption at the generating plants (see Section 7.2).
- Kunkel's proposed remedy results in significant impacts to the surrounding communities, including dust, noise, and traffic (see Section 7.3). Of particular concern is the increased risk of vehicle crashes involving large trucks.
- Kunkel's proposed remedy fails to consider the impact of vehicle carbon dioxide emissions. I estimate the emissions from the large truck traffic to be on the order of 203,840,000 kilograms of carbon dioxide (see Section 7.4).

7.1. Costs of Soil Disposal at a Permitted Landfill

Kunkel's cost estimate for his proposed remedy includes the costs associated with excavation, hauling, and backfill. However, Kunkel fails to include the cost of soil disposal at a permitted landfill, which is essential to his proposed remedy. In my experience, the disposal cost for impacted soil has a unit price of approximately $20 per ton. Assuming a disposal cost of $20 per ton, and using the unit tonnage estimates provided by Kunkel, I estimated the disposal costs associated with Kunkel's proposed remedy as follows:

- Joliet #29—$14,000,000 (708,657 tons)
- Powerton—$93,000,000 (4,645,190 tons)
- Waukegan—$53,000,000 (2,661,395 tons)
- Will County—$18,000,000 (910,525 tons)
- Total Disposal Costs: $178,000,000

Thus, the disposal costs for his proposed remedy increases his estimated cost for excavation, hauling, and backfilling (approximately $260,000,000 total of all four sites site-wide) by 68 percent.

7.2. Kunkel's Proposed Remedy Results in Significant and Costly Disruptions of the Electricity Generation Plants

Kunkel includes estimates of the areas and volumes of ash-impacted soils that he asserts should be removed from the four sites (see Kunkel's Table 6 and Figures 1 through 4 in the Remedy Report). The data are summarized as follows:

- Joliet #29—Top 1.4 feet of soil over 251 acres (566,925 cubic yards of ash-impacted soil)
- Powerton—Top 6.6 feet of soil over 349 acres (3,716,152 cubic yards of ash-impacted soil)
- Waukegan—Top 5.3 feet of soil over 249 acres (2,129,116 cubic yards of ash-impacted soil)
- Will County—Top 2.1 feet of soil over 215 acres (728,420 cubic yards of ash-impacted soil)

As shown on figures within Kunkel' report, the cost estimates include areas below equipment such as switchyards and coal handling and transfer equipment. Removing soil from these areas of the sites would cause substantial operational disruptions, including extended temporary shutdowns, of the generating stations. Before any excavation could occur, MWG would need to decommission and remove or bypass all of the overlying equipment. Power generating stations are fixed structures, and it is not simple to remove and replace equipment.

Following disassembly of equipment, excavation of the soil would require additional time. I identified the allegedly impacted areas with critical generating equipment, and I estimated the acreages so that I could in turn estimate the duration of excavation activities in those areas. The estimates of the durations of excavation activities are as follows:

- Joliet #29 (see Figure 7-1):
    - Electrical switchyard—approximately 3.2 acres
    - Coal handling and transfer equipment—approximately 2.8 acres
    - Depth of soil excavation proposed by Kunkel—1.4 feet
    - I estimate once the equipment are decommissioned or removed or bypassed, that each of these areas could be excavated within one week based on a typical soil excavation production rate of 5,000 cubic yards per day for large projects.

- Powerton (see Figure 7-2):
  - Electrical switchyard—approximately 11.2 acres
  - Coal handling and transfer equipment—approximately 2.2 acres
  - Depth of soil excavation proposed by Kunkel—6.6 feet
  - I estimate that once the equipment are decommissioned or removed or bypassed, the electrical switchyard area and coal handling and transfer equipment area could be excavated within four weeks and one week, respectively, based on a typical soil excavation production rate of 5,000 cubic yards per day for large projects.
- Waukegan (see Figure 7-3):
  - Electrical switchyard—approximately 6.8 acres
  - Coal handling and transfer equipment—approximately 3.9 acres
  - Depth of soil excavation proposed by Kunkel—5.3 feet
  - I estimate that once the equipment are decommissioned or removed or bypassed, the electrical switchyard area and coal handling and transfer equipment area could be excavated within two weeks and one week, respectively, based on a typical soil excavation production rate of 5,000 cubic yards per day for large projects.
- Will County (see Figure 7-4):
  - Electrical switchyard—approximately 9.6 acres
  - Coal handling and transfer equipment—approximately 13.3 acres
  - Depth of soil excavation proposed by Kunkel—5.3 feet
  - I estimate that once the equipment are decommissioned or removed or bypassed, the electrical switchyard area and coal handling and transfer equipment area could be excavated within three weeks and four weeks, respectively, based on a typical soil excavation production rate of 5,000 cubic yards per day for large projects.

Following excavation, the equipment would also need to be reassembled and tested. In some cases, disassembled equipment may not be of sufficient quality to reassemble. For these parts, disassembled parts would need to be demolished and disposed or recycled off-site, and the parts would need to be replaced.

Importantly, Kunkel fails to account for the additional and significant costs to disassemble, reassemble, and test the switchyards and coal handling and transfer equipment. Those costs include the additional personnel and contractors to safely disassemble and reassemble the equipment and additional material costs to safely store the equipment during excavation.

Moreover, the generating units cannot be operated without being supplied coal, and the electrical switchyard is necessary for distributing power. The generating stations would be offline for an extended period of time and would in turn incur significant costs associated with the loss of revenue from the offline generation units. These equipment cannot be practicably bypassed to continue to operate the generating units; furthermore, there is not sufficient space at the sites to disassemble electrical switchyard equipment and the coal handling and transfer equipment simultaneously. Fully disassembling, reassembling, and testing the electrical switchyard equipment and the coal handling and transfer equipment would be on the order of two to five years for each site.[176]

Kunkel's estimation entirely fails to consider the outage costs and loss of revenue during the extended period required to conduct his proposed remediation. During this time, many people, such as plant workers and coal producers, will be out of employment suffering a loss of income that has a trickle-down effect on the local communities.

7.3. Additional Impacts to the Surrounding Communities

In addition to the substantial disruptions to operations of the generating units, the surrounding community would be adversely impacted by the increased risk of vehicle crashes involving large trucks, increased travel times, reduced air quality from diesel exhaust, increased noise, and increased dust.

Protection of the community from adverse effects during implementation of the alternative is a factor that bears upon assessing the reasonableness of Kunkel's proposed remedy. Of particular relevance for these subject sites and the remedy proposed by Kunkel is the increased risk of vehicle accidents involving large trucks.

The U.S. Department of Transportation, National Highway Traffic Safety Administration (NHTSA) reports traffic data for large trucks that are involved in crashes resulting in fatalities or injuries. Based on traffic data for 2013, which is the most recent year of data reported by NHTSA, large trucks accounted for 4 percent of all registered vehicles but accounted for 9 percent of all vehicles involved in fatal crashes (NHTSA, 2015). In 2013, 3,964 people were killed and 95,000 people were injured in

[176] Teleconference with Mark Kelly and Rachel Maddox; teleconference with Fred Veenbaas; teleconference with Pete O'Day

crashes involving large trucks; 71 percent of these fatalities were occupants of other vehicles involved in the crash (NHTSA, 2015). The Insurance Institute for Highway Safety (IIHS) identified the main problem of large truck fatalities as the vulnerability of people traveling in smaller vehicles (IIHS, 2015).

In 2013, 0.73 percent (36.86 fatalities and 690 injuries per 100,000) of registered trucks were involved in a crash resulting in fatalities or injuries (NHTSA, 2015). The involvement rate in 2013 based on the mileage traveled by large trucks was 1.42 fatalities and 27 injuries per 100,000,000 miles (NHTSA, 2015).

I estimated the transportation requirements for hauling ash-impacted soil and import fill based on typical remediation practices for transportation and disposal.

- Trucks for hauling soil and fill have 20-cubic yard capacities;
- One truckload of clean import fill is needed for each truckload of ash-impacted soil disposal;
- Trucks used for disposing ash-impacted soil should not be used for importing clean fill, so trucks return empty after disposing or importing fill;[177]
- Assuming a disposal site for ash-impacted soil is 15 miles away from each site, the round-trip distance is 30 miles per trip;
- Assuming the source of clean import fill to replace the removed soil is 10 miles away from each site, the round-trip distance is 20 miles per trip; and
- For each cubic yard of ash-impacted soil to be excavated, the resulting transportation requirements for the project work is on the order of 2.5 miles per cubic yard ([30 miles per round-trip of ash-impacted soil disposal + [20 miles per round-trip of fill imported] / [20 cubic yards per round trip].

Based on the number of weeks for soil hauling activities developed for the hypothetical scenario, this results in the following total mileage:

- Joliet #29—More than 1,400,000 miles of large truck travel
- Powerton—More than 9,300,000 miles of large truck travel
- Waukegan—More than 5,300,000 miles of large truck travel
- Will County—More than 1,800,000 miles of large truck travel

[177] If trucks were lined with disposal plastic liners or were decontaminated at disposal facilities, trucks could transport soil for disposal and import fill in a single round trip. If these additional costs to the project were incurred to eliminate one leg of the truck route, the mileage may be reduced by approximately 30 percent.

Using Kunkel's proposed remedial approach results in more than 17,000,000 miles of large truck travel for the four sites in total. Using the 2013 mileage-based probability of a fatality involving a large truck based (1.42 fatalities and 27 injuries per 100,000,000 miles), a risk of 0.25 traffic fatalities and 4.6 injuries would be expected for the large truck traffic generated by Kunkel's proposed remedial approach under the hypothetical scenario.

Therefore, I conclude the risk of removal of all coal ash and trucking to an offsite facility is not supported by the risk of leaving the existing materials in place, which is essentially no risk to human health and the environment.

7.4. Estimate of Carbon Dioxide Emissions Associated with Kunkel's Proposed Remedy

Large trucks and heavy construction equipment generate emissions of carbon dioxide from the combustion of fossil fuels (typically diesel for large trucks and heavy construction equipment). Kunkel's assessment of his proposed remedy fails to include this significant impact of vehicle carbon dioxide emissions. The mass of carbon dioxide emitted from large trucks can be easily estimated using emissions factors and the total miles of large trucks as demonstrated below.

USEPA recently developed emissions factors based on Table 2-15 from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2012*, and based on vehicle-miles data for highway vehicles from Table VM-1 of the Federal Highway Administration Highway Statistics 2012 (USEPA, 2014). The transportation emissions factor for medium- and heavy-duty trucks is 1.456 kilograms per vehicle-mile. Based on the estimated large truck mileage in Section 7.2 (17,000,000 miles), the resulting carbon dioxide emissions are approximately 24,800,000 kilograms (equivalent to approximately 27,000 tons).

USEPA estimated the rate of carbon dioxide emissions from a large excavator at 440 pounds per hour. Kunkel estimated the total volume of excavated soil site-wide for the four sites as 7,140,613 cubic yards. Assuming a typical soil excavation production rate of 500 cubic yards per hour for large projects, the total hours of excavation is approximately 14,000 hours of operation for an excavator. This resulting carbon dioxide emissions are approximately 6,160,000 pounds (equivalent to approximately 3,080 tons).

The total carbon dioxide emissions for Kunkel's proposed remedy is approximately 30,000 tons, which is conservative because it does not include emissions from other heavy construction equipment used at the sites, disposal facilities, and import fill sources.

Section 8: Reservation

Due to the delay in the production of documents relied upon by Dr. Kunkel, I am reserving the ability to supplement my opinions in response to any documents or bases for Dr. Kunkel's reports that are presented by the Complainants. In addition, my opinions may be supplemented based on future changes in the construction or operation of the generating stations and in response to any future changes in groundwater conditions observed at the sites.

Section 9: Signature

This report contains 165 pages, including figures, tables, and appendices.

John Seymour, P.E.	2 November 2015 DATE

Section 10: Acronyms

Acronym	Definition
AEEI	Andrews Environmental Engineering, Inc.
CCA	Compliance Commitment Agreement
CCB	Coal combustion by-product
CCR	Coal combustion residual
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
COI	Constituent of Interest
CQA	Construction quality assurance
CSM	Conceptual Site Model
ELUC	Environmental Land Use Control
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
FGD	Flue gas desulfurization
GMZ	Groundwater Management Zone
HDPE	High density polyethylene
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
IIHS	Insurance Institute for Highway Safety
ILCS	Illinois Compiled Statutes
MSL	Mean Sea Level
MWG	Midwest Generation, LLC
NHTSA	National Highway Traffic Safety Administration
NLET	Neutral Leaching Extraction Test
NPDES	National Pollutant Discharge Elimination System
PRB	Powder River Basin
RCRA	Resource Conservation and Recovery Act of 1976, as amended
TCE	Trichloroethylene
TDS	Total dissolved solids
USEPA	United States Environmental Protection Agency
VN	Violation Notice
WPCP	Water Pollution Control Permit
WQC	Illinois Water Quality Criteria
WQS	Illinois Water Quality Standard

Section 11: Works Cited

Amendola Engineering, 2004. "Basin Info." Powerton Generation Station, Prepared for Midwest Generation. May 11th. (MWG13-15_10977 to MWG13-15_10978)

AEEI, 2004. "Draft Sampling Plan Report, Midwest Generation, LLC, Powerton Generating Station". June. (MWG13-15_11302 to MWG13-15_11492)

ASTM, 1985. *ASTM D3987-85(2004) Standard Test Method for Shake Extraction of Solid Waste with Water,* "Scope." ASTM International, West Conshohocken, PA, 1985.

ASTM, 2014. *ASTM E2277-14 Standard Guide for Design and Construction of Coal Ash Structural Fills,* ASTM International, West Conshohocken, PA, February.

Carlson Environmental, 2010. *Remedial Action Completion Report, Joliet Manufacturing Campus – Area 1, 2200 Channahon Road, Joliet, Illinois, Prepared for CenterPoint Properties – Joliet LLC,* August 23.

Commonwealth Edison Company, 1978. "Equipment & Structures List" Location and Plot Plan, Sheet 1 of 4, October 6th. (MWG13-15_18119)

Commonwealth Edison Company, "Remediation Objectives report, Former Greiss-Pfleger Tannery Site, Waukegan, Illinois." 2 Background. (MWG13-15_217 to MWG13-15_222)

Commonwealth Edison Company, 1995. "Joliet Station Units 7&8 Water Flow Schematic" May 10th. (MWG13-15_18155)

Darilek, G.T., and Laine, D.L., 2001. "Costs and Benefits of Geomembrane Liner Installation CQA," Geosynthetics Conference 2001.

DiCola, James, 2012. E-mail to Maria Race, "Re: Pond 3." August 23rd 5:07 PM (MWG13-15_44279)

ENSR Consulting, 1998a. "Phase I Environmental Site Assessment of the Commonwealth Edison Joliet #29 Generating Station, 1800 Channahon Road, Joliet, Illinois." Report prepared for Commonwealth Edison Company. October. (MWG13-15_25138 to MWG13-15_25167)

ENSR Consulting, 1998b. "Phase II Environmental Site Assessment of the Commonwealth Edison Joliet #29 Generating Station, 1800 Channahon Road, Joliet, Illinois." Report prepared for Commonwealth Edison Company. December. (MWG13-15_48440 to MWG13-15_48492)

ENSR Consulting, 1998c. "Phase I Environmental Site Assessment of the ComEd Powerton Generating Station, Manito Road, Pekin, Illinois." Report prepared for Commonwealth Edison Company. October. (MWG13-15_8502 to MWG13-15_8536)

ENSR Consulting, 1998d. "Phase II Environmental Site Assessment of the ComEd Waukegan Generating Station, 1800 Channahon Road, Joliet, Illinois." Report prepared for Commonwealth Edison Company. November. (MWG13-15_45779 to MWG13-15_46054)

ENSR Consulting, 1998e. "Phase I Environmental Site Assessment of the ComEd Waukegan Generating Station, 1800 Channahon Road, Joliet, Illinois." Report prepared for Commonwealth Edison Company. October. (MWG13-15_11966 to MWG13-15_12040)

Forget, B., Rollin, A.L., and Jacquelin, T., 2005. "Lessons learned from 10 years of leak detection surveys on geomembranes." In *Proceedings of Sardinia 2005: The Tenth International Waste Management and Landfilling Symposium*, October 3-7, Cagliari, Italy.

IEPA, 2008. Letter. "MIDWEST GENERATION – Will County Generation Station – Liner Replacement for South Ash Ponds 2 and 3." Illinois Environmental Protection Agency Water Pollution Control Permit, September 25th. (MWG13-15_48604)

IEPA, 2015. Email. "RE: Coal Ash" from L. Dunaway to J. Rabins, January 6th.

IIHS, 2015. "Topics, Fatality Facts, Large Trucks, 2013," Insurance Institute for Highway Safety, Highway Loss Data Institute, website accessed 27 August 2015.

Kammueller, James E., 2010. "Midwest generation, LLC – Powerton Generation Station – NPDES Permit No. IL0002232, Compliance Evaluation Inspection." Memorandum, August 18th. (MWG13-15_10774 to MWG13-15_10777)

Keller, Alan, P.E., 2007. Letter "MIDWEST GENERATION – Joliet 29 – Liner Replacement for Ash Ponds 1 and 2." July 20th. (MWG13-15_18053)

Keller, Alan, P.E., 2013. Letter "MIDWEST GENERATION, LLC – Joliet 29 Generation Station – Liner Replacement – Discharge Tributary to the Des Plaines River." February 25th. (MWG13-15_44275)

Keller, Alan, P.E., 2013. Letter "MIDWEST GENERATION, LLC – Powerton Generation Station – Liner Replacement – Discharge Tributary to the Illinois River." February 25th. (MWG13-15_10812)

KPR and Associates, Inc. 2003. "Ash Pond Sediment Characterization and Cross-Sectional Survey at the Powerton Station Pekin, Illinois." January 23rd. (MWG13-15_10825 to MWG13-15_10925)

KPRG and Associates, Inc. 2005a. "CCB Determination Support, Joliet, Illinois." July 25th. (MWG13-15_19486 to MWG13-15_19668)

KPRG and Associates, Inc., 2005b. Letter "Re: Liner Inspection – West and East Ash Pond at the Waukegan Generation Station." August 31st. (MWG13-15_12827 to MWG13-15_12845)

KPRG and Associates, Inc. 2005c. "Coal Ash and Slag Removal, Joliet Station #29." December 6th. (MWG13-15_18823 to MWG13-15_18990)

KPRG and Associates, Inc. 2008. "All Appropriate Inquiry Phase I Environmental Site Assessment" October 22nd. (MWG13-15_13242)

KPRG and Associates, Inc. 2009. Letter "Re: Phase II environmental Site Investigation 525 East 135th Street/ Romeoville, IL." September 30th. (MWG13-15_13087 to MWG13-15_13239)

KPRG and Associates, Inc., 2011a. Letter "Re: Joliet #29 Former Ash Burial Area Erosion Repair Documentation 2011" September 22nd. (MWG13-15_44148-44152)

KPRG and Associates, Inc., 2011b. Letter "Re: Joliet #29 Former Ash Burial Area Runoff Inspection 2011." August 22nd. (MWG13-15_44153-44155)

KPRG and Associates, Inc., 2014. Letter "Re: Joliet #29 Former Ash Burial Area Runoff Inspection 2014." August 28th. (MWG13-15_44147)

KPRG and Associates, Inc., 2015. "CCB Determination Support, Midwest Generation Will County Station", September 8th. (MWG13-15_49565-49652)

Kunkel, 2015a. *Expert Report on Ground-water Contamination, PCB 2013-015 (Enforcement – Water)*, James R. Kunkel, July 1st.

Kunkel, 2015b. *Expert Report on Remedy for Ground-water Contamination, PCB 2013-015 (Enforcement – Water)*, James R. Kunkel, July 1st.

Leak Location Services, Inc., 2008. Fax "Report for 'Electronic Leak Location Survey for Ash Impoundment 2 at the Midwest Generation Joliet Station' LLSI Project 1007." June 2nd. (MWG13-15_18445-18446)

Lux, Chris, 2013. Email. "Re: Powerton Schedule and Cost Update." March 8th. (MWG13-15_22846-22849)

Maddox, Rebecca, 2010. Email. "Re: ICR – Will County pond information." September 1st. (MWG13-15_48566)

Midwest Generation, 2009. "Hydrogeological Assessment of Midwest Generation Electric Generating Stations: Will County Station, Waukegan Station, Joliet 29 Station, Crawford Station, Powerton Station." July 15th. (MWG13-15_293 to MWG13-15_305)

Midwest Generation, 2012. "Annual NPDES Compliance Evaluation – Midwest Generation Powerton Generating Station." August 22nd. (MWG13-15-10772-10773)

Midwest Generation, 2013. Letter "Application for Permit or Construction Approval, Ash Surge Basin Liner Replacement, Midwest Generation Powerton Generation Station, 13082 East Manito Road, Pekin, Illinois, NPDES Permit No. IL0002232." January 17th. (MWG13-15_9583-9643)

Midwest Generation, 2015a. "Quarterly Groundwater Monitoring Report Joliet #29 Generating Station", April 24th (MWG13-15_48647-48710)

Midwest Generation, 2015b. "Quarterly Groundwater Monitoring Report Powerton Generating Station." April 24th. (MWG13-15_48711-48843)

Midwest Generation, 2015c. "Quarterly Groundwater Monitoring Report Waukegan Generating Station." April 24th. (MWG13-15_48902-48958)

Midwest Generation, 2015d. "Quarterly Groundwater Monitoring Report Will County Generating Station." April 24th. (MWG13-15_48844-48901)

Narejo, D.N. and Corcoran, G., 1996. *Geomembrane Protection Design Manual, First Edition*. GSE. (MWG13-15_49299-49340)

NAS, 2007. *Assessment of the Performance of Engineered Waste Containment Barriers*, National Academy of Sciences/National Research Council, Committee to Assess the Performance of Engineered Barriers, 2007. (Publicly Available)

NHTSA, 2015. "Traffic Safety Facts, 2013 Data, DOT HS 812 150" U.S. Department of Transportation, National Highway Traffic Safety Administration, June 2015.

NRT, 2008. "South Ash Pond Liner replacement – Midwest Generation- Will County Generation Station Romeoville, Illinois." Sheet No. C010, Natural Resource Technology, June 23rd. (MWG13-15_32583)

Patrick, 2011a. Hydrogeologic Assessment Report, Joliet Generating Station No. 29, Joliet, Illinois, Patrick Engineering Inc., February 2011. (MWG13-15_6964-7080)

Patrick, 2011b. Hydrogeologic Assessment Report, Powerton Generating Station, Pekin, Illinois, Patrick Engineering Inc., February 2011. (MWG13-15_7081-7147)

Patrick, 2011c. Hydrogeologic Assessment Report, Waukegan Generating Station, Waukegan, Illinois, Patrick Engineering Inc., February 2011. (MWG13-15_7148-7229)

Patrick, 2011d. Hydrogeologic Assessment Report, Will County Generating Station, Romeoville, Illinois, Patrick Engineering Inc., February 2011. (MWG13-15_7230-7332)

Race, Maria L., 2007. Letter "RE: Application for Permit or Construction Approval, Midwest Generation, Joliet Station 29, Ash Impoundment 1 and 2, 1800 Channahon Road, Joliet, IL, NPDES Permit No: IL0064254" June 21st. (MWG13-15_18133-18189)

Ruettiger, Tonelli & Associates, Inc., 2007. "Ash Removal Exhibit", Midwest Generation Joliet Station No. 29 Ash Impoundment, Sheet 1 of 1, June 27th. (MWG13-15_18192)

Tlachac, Eric J., 2007. email to Maria Race, "RE: Subgrade for Joliet 29 Ash Pond 2 Liner." October 24th. (MWG13-15_13734)

Schwartz, Rebecca, 2005. "Pond Characterizations for Midwest Generation Stations, Joliet 29 & 9, Powerton, Waukegan, Will County." Summer. (MWG13-15_1-34)

Smith, Michael J., 2009. Letter. "Re: Ash Ponds Berm Inspection –VEC Project Number 2009-023 BG08." Valdes Engineering Company, June 29th. (MWG13-15_22863 to MWG13-15_22865)

Smith, Michael J., 2014. Letter. "Re: Ash Pond Berm – Visual Assessment – Valdes Project Number 2014-033 BG-03." Valdes Engineering Company, June 12th. (MWG13-15_44601 to MWG13-15_44612)

Tlachac, Eric J., 2008. E mail to Blake Connolly, "Will County South Ash Pond Liner Design Status." February 21st. (MWG13-15_13737)

USEPA, 1992. Method 1311, Toxicity Characteristic Leaching Procedure. U.S. EPA, July 1992.

USEPA, 2009. *Potential for Reducing Greenhouse Gas Emissions in the Construction Sector*, February 2009.

USEPA, 2012. *Guide for Industrial Waste Management, Part IV, Protecting Ground Water, Chapter 7: Section B, Designing and Installing Liners, Technical Considerations for New Surface Impoundments, Landfills, and Waste Piles*. USEPA OSWER, Office of Resource Conservation and Recovery, April. (Publicly Available)

USEPA, 2014. "Emission Factors for Greenhouse Gas Inventories". 4 April.

J.SEYMOUR EXPERT REPORT

FIGURES

Legend

O Monitoring Well

Note: Locations are approximate and based on MWG, 2015a.

1,000 500 0 1,000 Feet

Joliet #29 Station Monitoring Wells

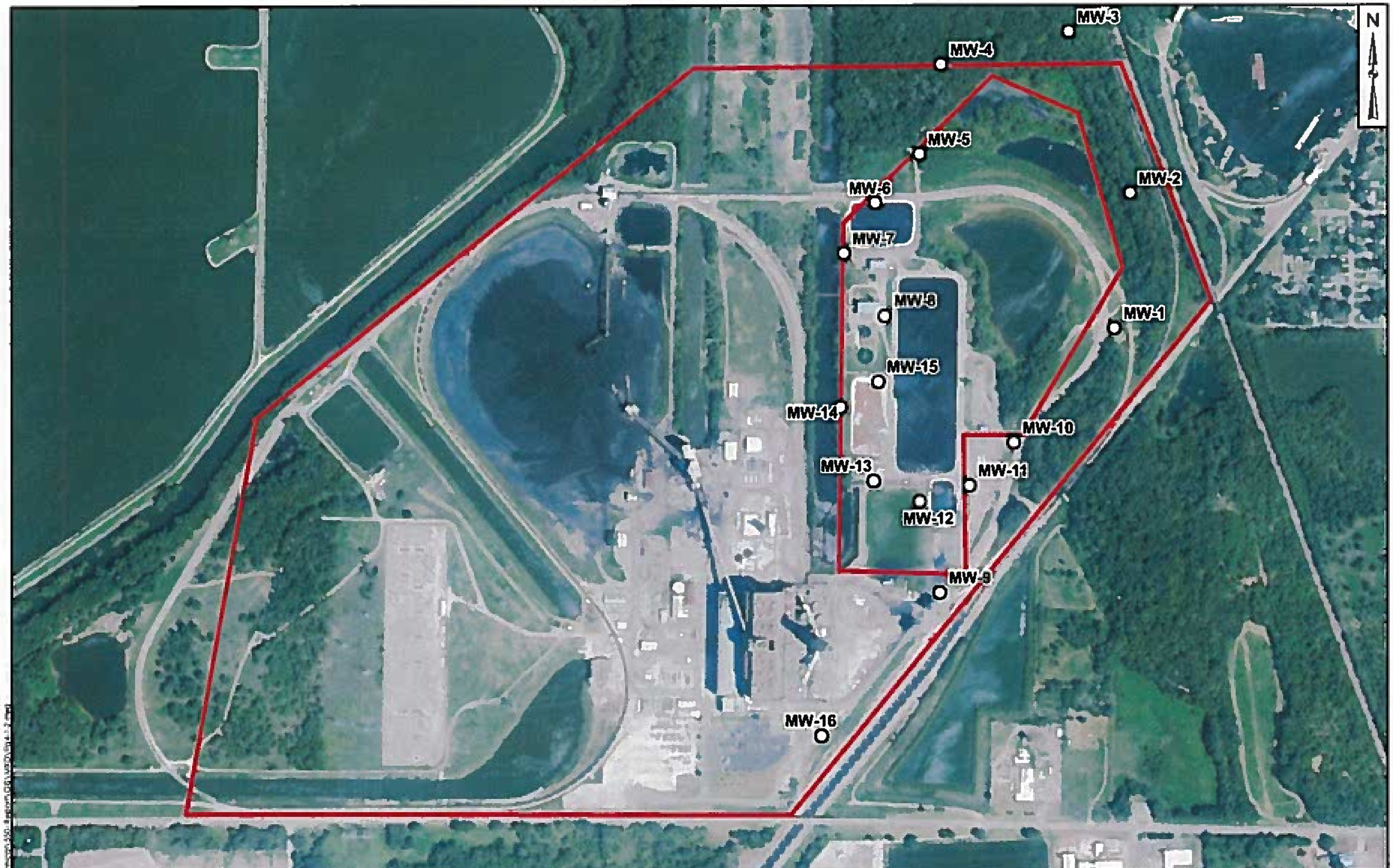
Joliet, Illinois

Geosyntec consultants

October 2015

Chicago

Figure 4-1



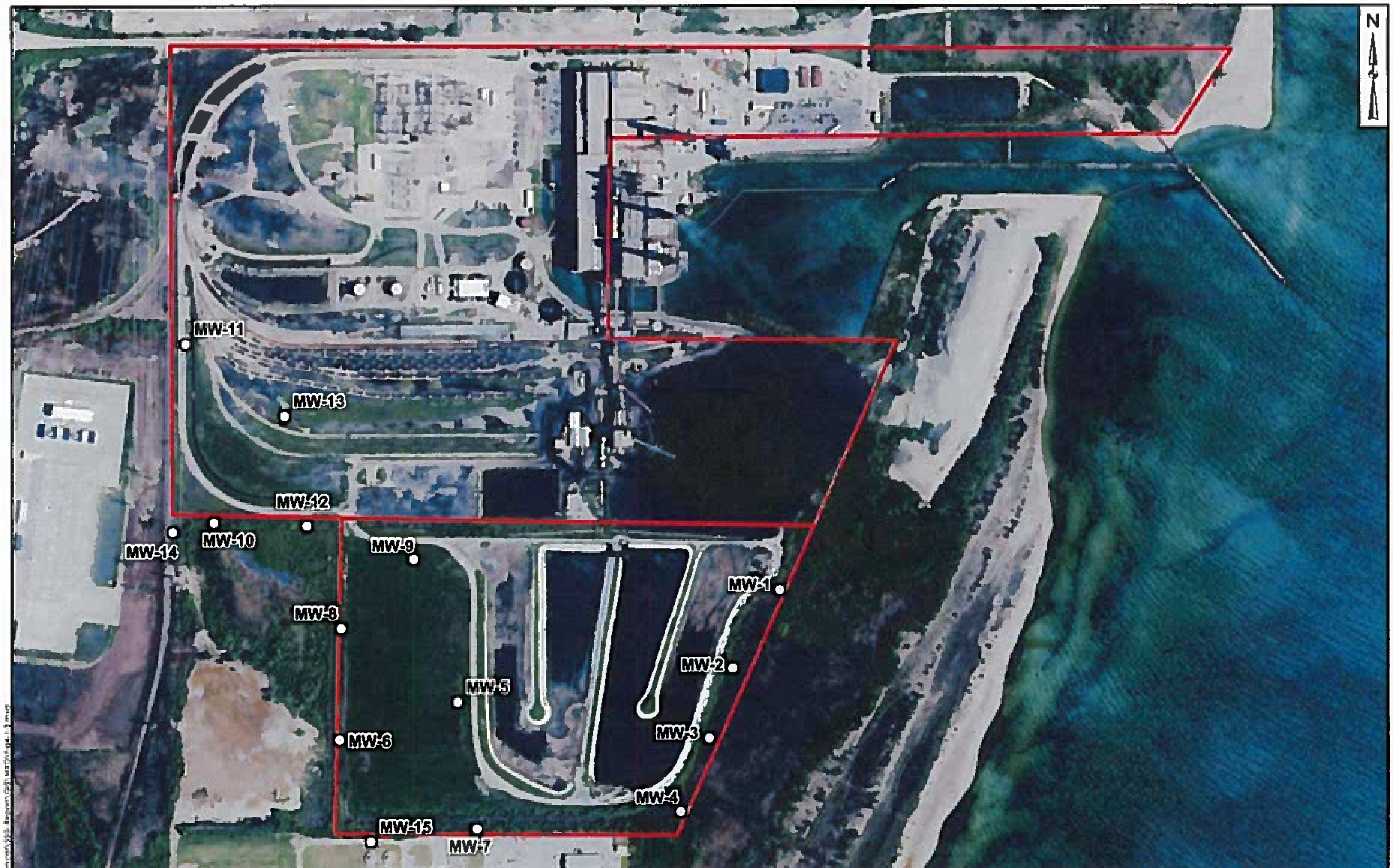
Legend

- Approx. Site Area and Ponds
- O Monitoring Well

Note: Locations are approximate and based on MWG, 2015b.

1,000 500 0 1,000 Feet

Powerton Station Monitoring Wells **Pekin, Illinois**	Geosyntec consultants	Figure **4-2**
October 2015	Chicago	



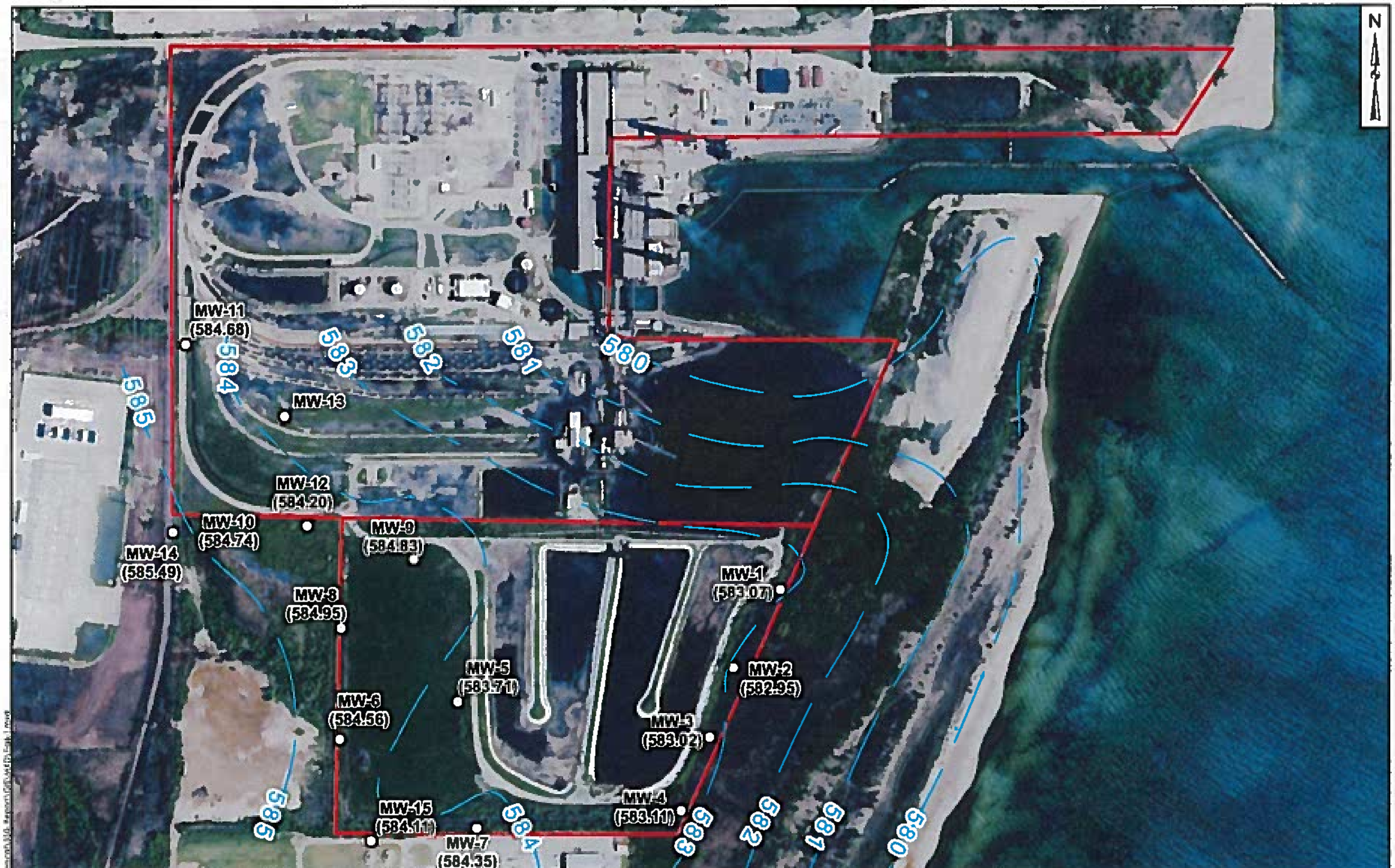
Legend

- O Monitoring Wells
- Approx. Site Area and Ponds

Notes: Locations are approximate and based on MWG, 2015c and MWG13-15_44135.

800 400 0 800 Feet

Waukegan Station Monitoring Wells Waukegan, Illinois	Geosyntec consultants	Figure 4-3
October 2015	Chicago	



Legend

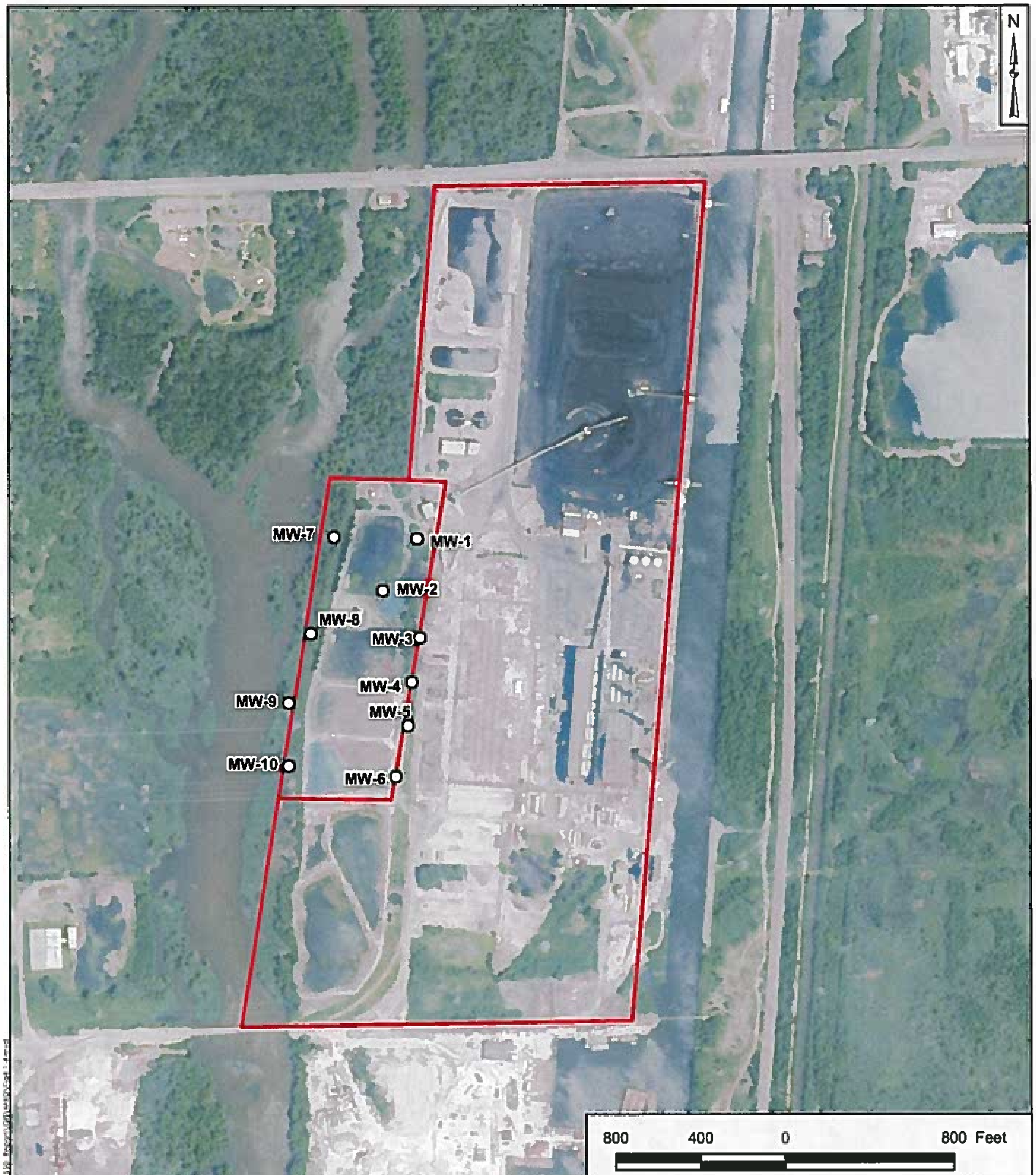
- Monitoring Well (May or June 2014 Groundwater Elevation in Feet Mean Sea Level)
- Approx. Site Area and Ponds
- Approximate Groundwater Elevation Contours for May and June 2014 (feet Mean Sea Level)

Notes: Locations are approximate and based on MWG, 2015c and MWG13-15_44135.

Groundwater elevation contours are based on June 2014 and May 2014 groundwater elevations reported in MWG, 2015c and MWG13-15_44128.

800 400 0 800 Feet

Waukegan Station Groundwater Elevation Contours Waukegan, Illinois	Geosyntec consultants	Figure 4-4
October 2015	Chicago	



Legend

○ Monitoring Wells

Approx. Site and Ponds

Note: Locations are approximate and based on MWG, 2015d.

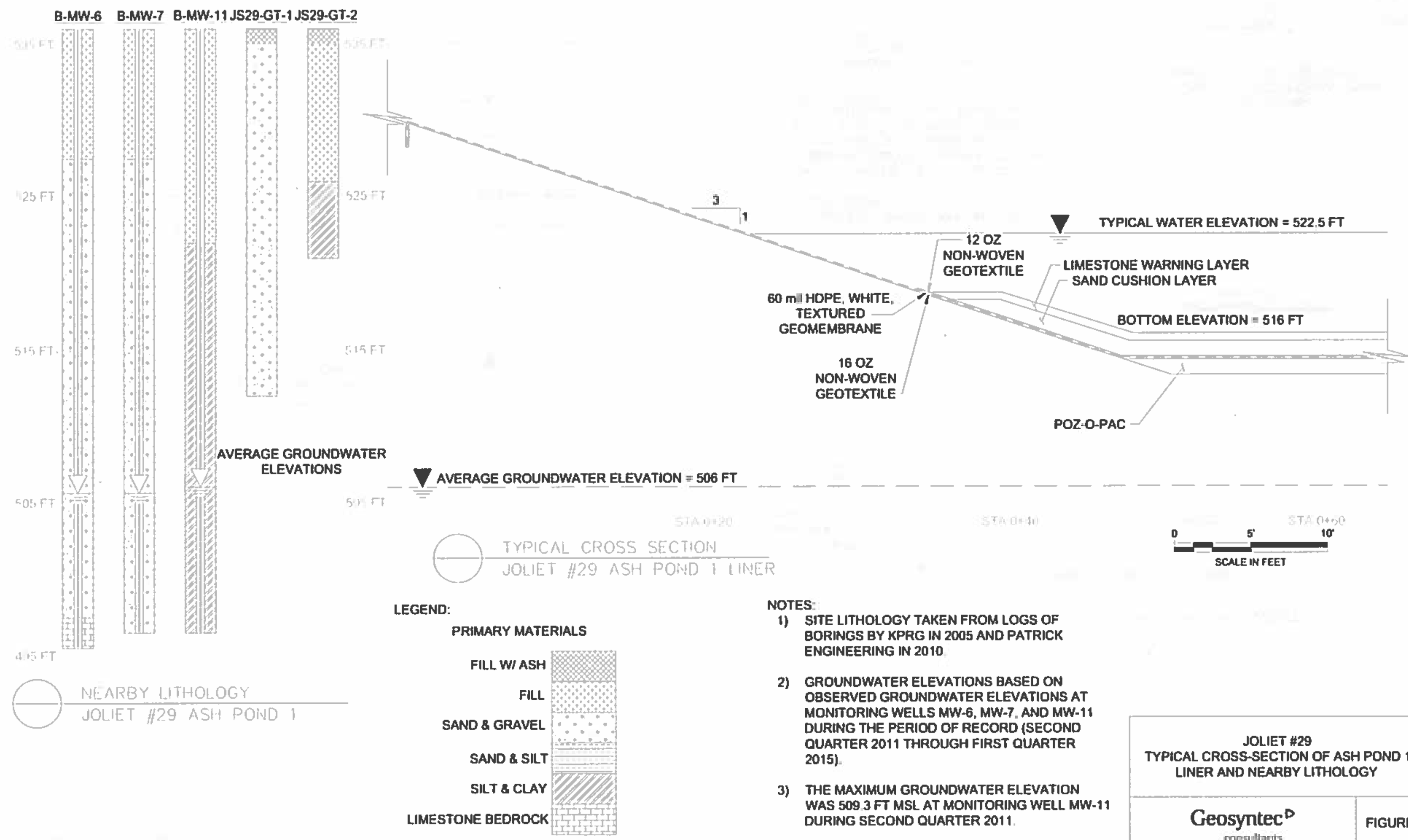
Will County Station Monitoring Wells

Romeoville, Illinois

Geosyntec consultants

Figure 4-5

Chicago | October 2015



NOTES:

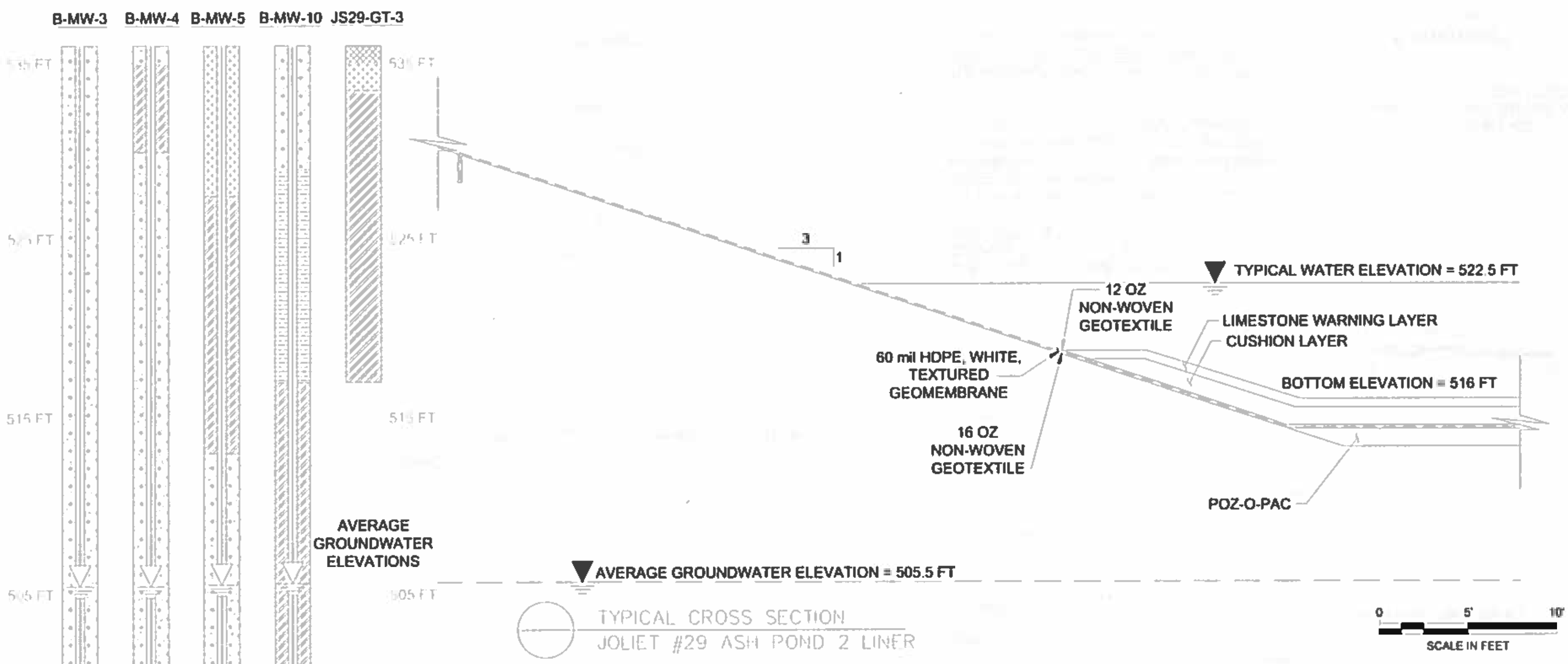
1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-6, MW-7, AND MW-11 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

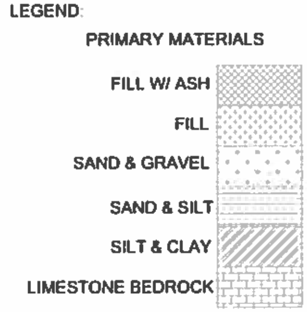
3) THE MAXIMUM GROUNDWATER ELEVATION WAS 509.3 FT MSL AT MONITORING WELL MW-11 DURING SECOND QUARTER 2011.

JOLIET #29 TYPICAL CROSS-SECTION OF ASH POND 1 LINER AND NEARBY LITHOLOGY	
Geosyntec consultants	FIGURE 5-1
PROJECT NO. CHE8303	OCTOBER 2015

G:\CWP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550- REPORT\CAD\JOLIET ASH POND 1



LEGEND:



NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-3, MW-4, MW-5, AND MW-10 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

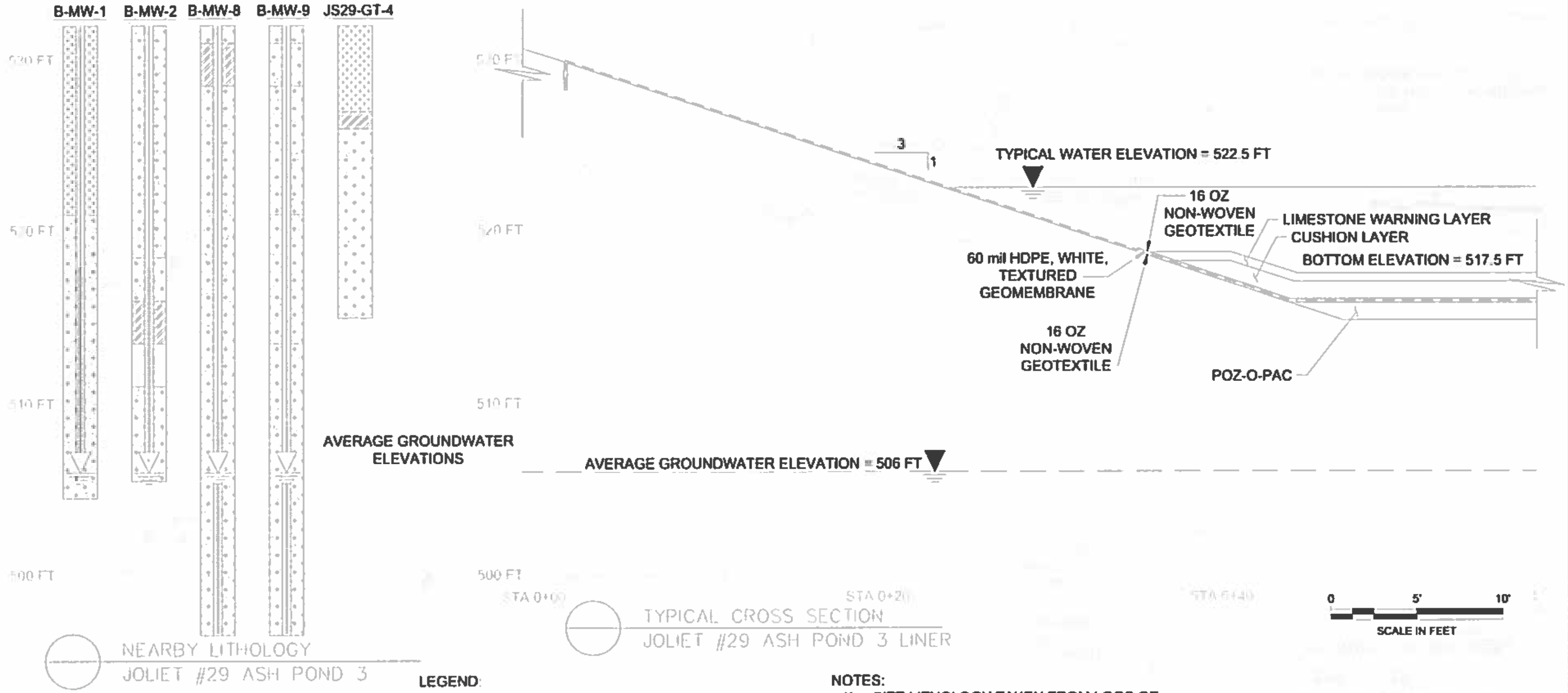
3) THE MAXIMUM GROUNDWATER ELEVATION WAS 508.2 FT MSL AT MONITORING WELL MW-10 DURING SECOND QUARTER 2011.

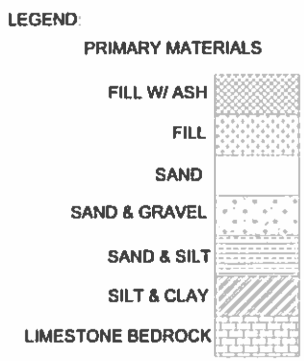
JOLIET #29
TYPICAL CROSS-SECTION ASH POND 2
LINER AND NEARBY LITHOLOGY

Geosyntec consultants

PROJECT NO: CHE8303 | OCTOBER 2015

FIGURE 5-2





NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-1, MW-2, MW-8, AND MW-9 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 512.3 FT MSL AT MONITORING WELL MW-2 DURING THIRD QUARTER 2012.

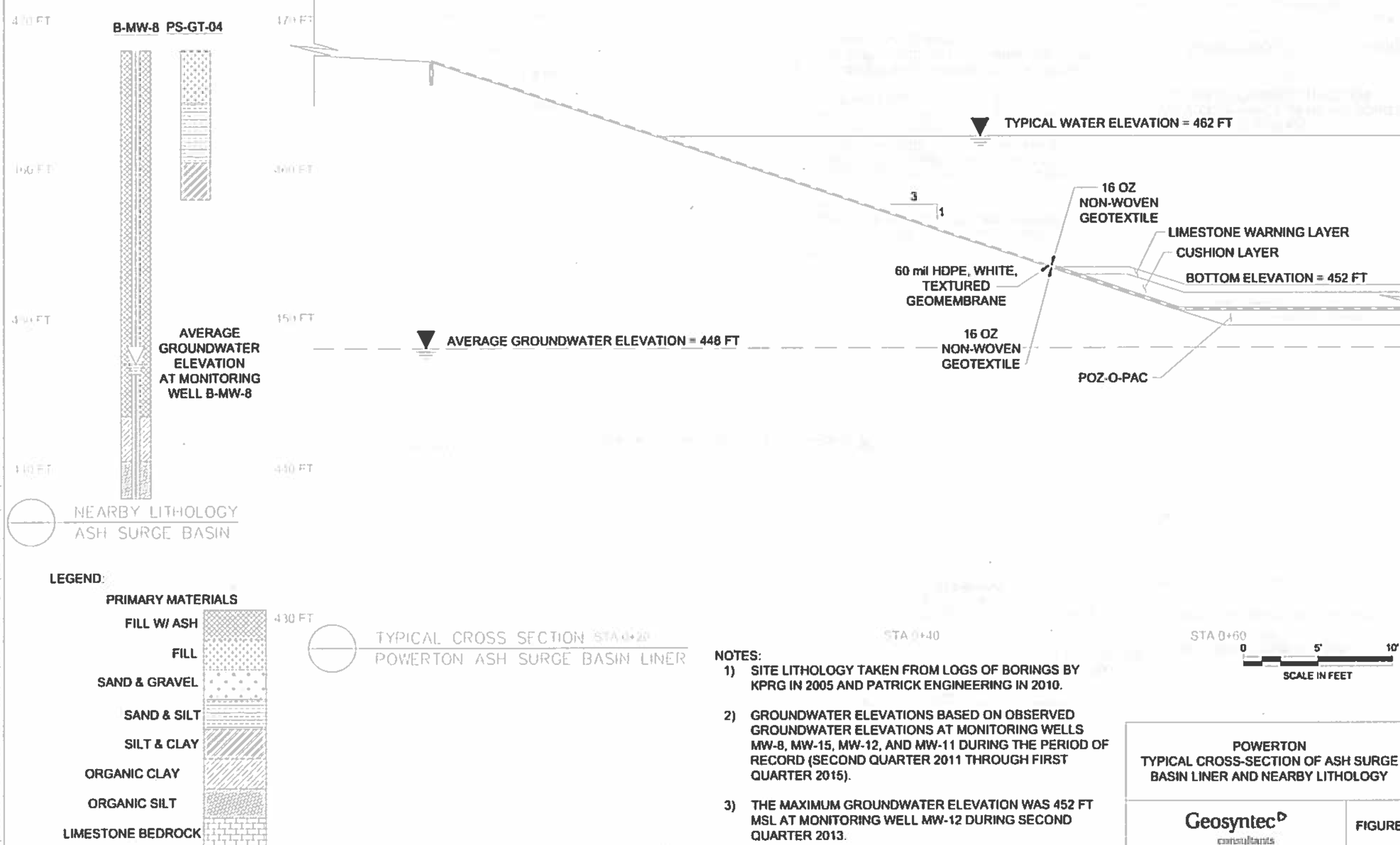
JOLIET #29
TYPICAL CROSS-SECTION OF ASH POND 3 LINER AND NEARBY LITHOLOGY

Geosyntec consultants

PROJECT NO: CHE8303 | OCTOBER 2015

FIGURE 5-3

G:\CAP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550- REPORT\CAD\JOLIET ASH POND 3



NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-8, MW-15, MW-12, AND MW-11 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 452 FT MSL AT MONITORING WELL MW-12 DURING SECOND QUARTER 2013.

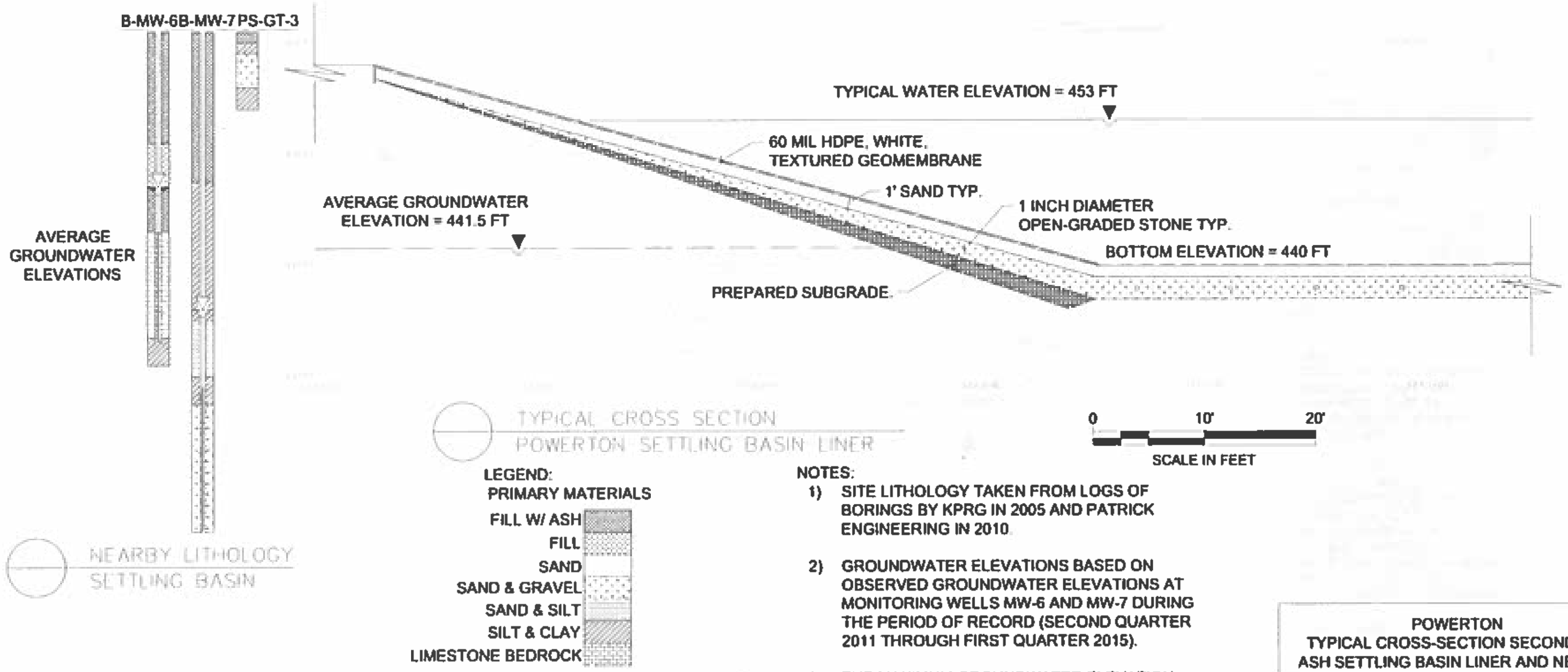
POWERTON
TYPICAL CROSS-SECTION OF ASH SURGE BASIN LINER AND NEARBY LITHOLOGY

Geosyntec consultants

FIGURE 5-4

PROJECT NO: CHE8303 | OCTOBER 2015

G:\CWP\CHE8303-MIDWEST GEN-CONFIDENTIAL\500 - TECHNICAL\550 - REPORT\CAD\POWERTON POND



NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-6 AND MW-7 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 450 FT MSL AT MONITORING WELL MW-6 DURING FIRST QUARTER 2014.

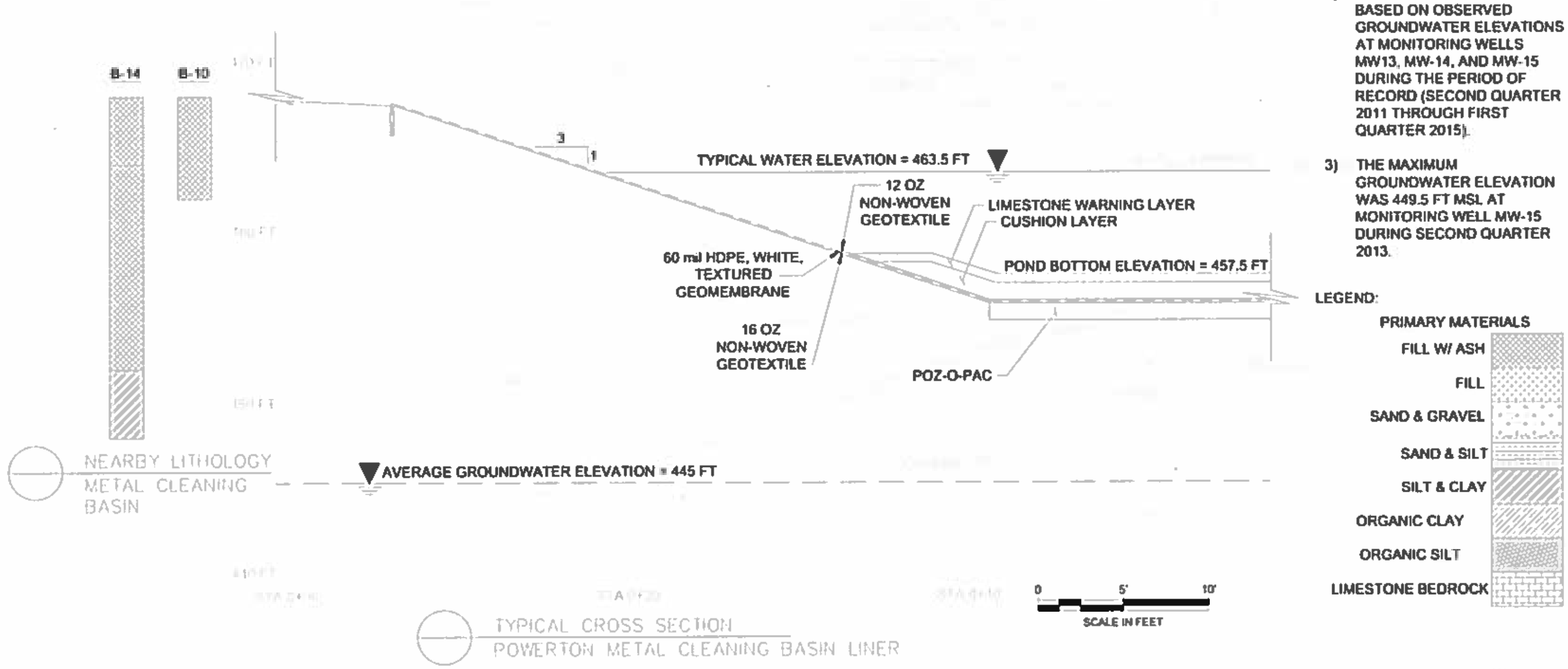
POWERTON
TYPICAL CROSS-SECTION SECONDARY ASH SETTLING BASIN LINER AND NEARBY LITHOLOGY

Geosyntec consultants

FIGURE 5-5

PROJECT NO: CHE8303 | OCTOBER 2015

G:\CAP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550 - REPORT\CAD\SECONDARY ASH SURGE



NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY ENSR IN 1998

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW13, MW-14, AND MW-15 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 449.5 FT MSL AT MONITORING WELL MW-15 DURING SECOND QUARTER 2013.

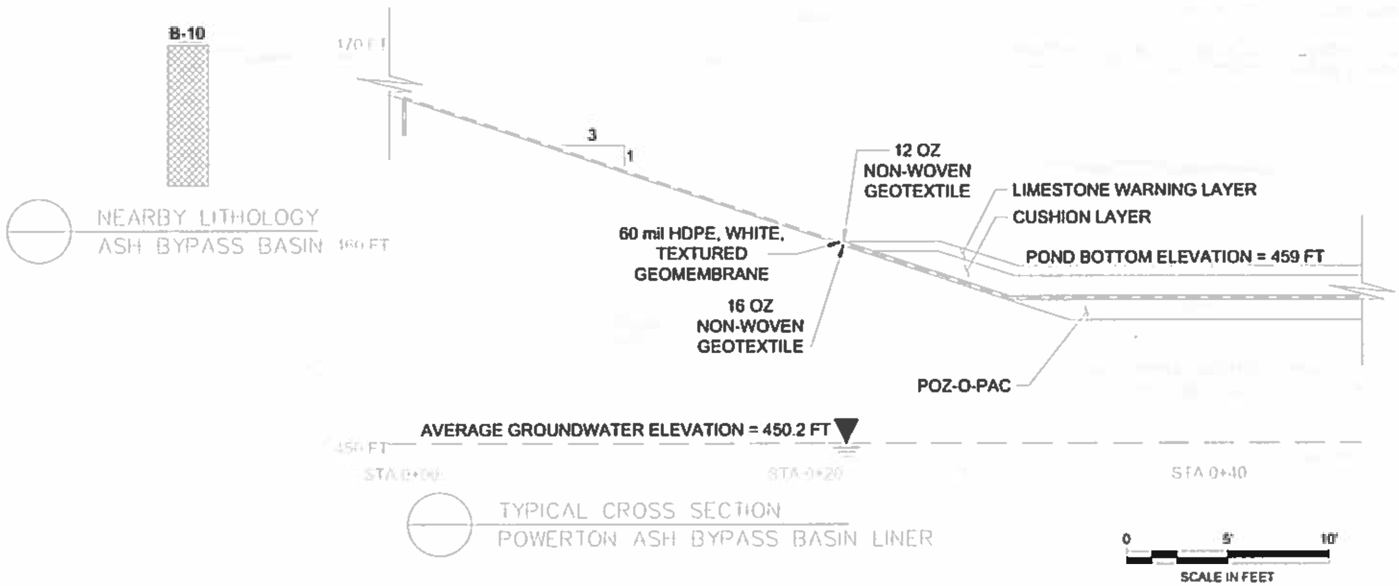
POWERTON
TYPICAL CROSS-SECTION OF METAL CLEANING BASIN LINER AND NEARBY LITHOLOGY

Geosyntec consultants

PROJECT NO. CHE8303 | OCTOBER 2015

FIGURE 5-6

G:\CAP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550- REPORT\CAD\METAL CLEANING BASIN



NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY ENSR IN 1998.

2) GROUNDWATER ELEVATION BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELL MW-12 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 452 FT MSL AT MONITORING WELL MW-12 DURING SECOND QUARTER 2013.

LEGEND:

PRIMARY MATERIALS

FILL W/ ASH

FILL

SAND & GRAVEL

SAND & SILT

SILT & CLAY

ORGANIC CLAY

ORGANIC SILT

LIMESTONE BEDROCK

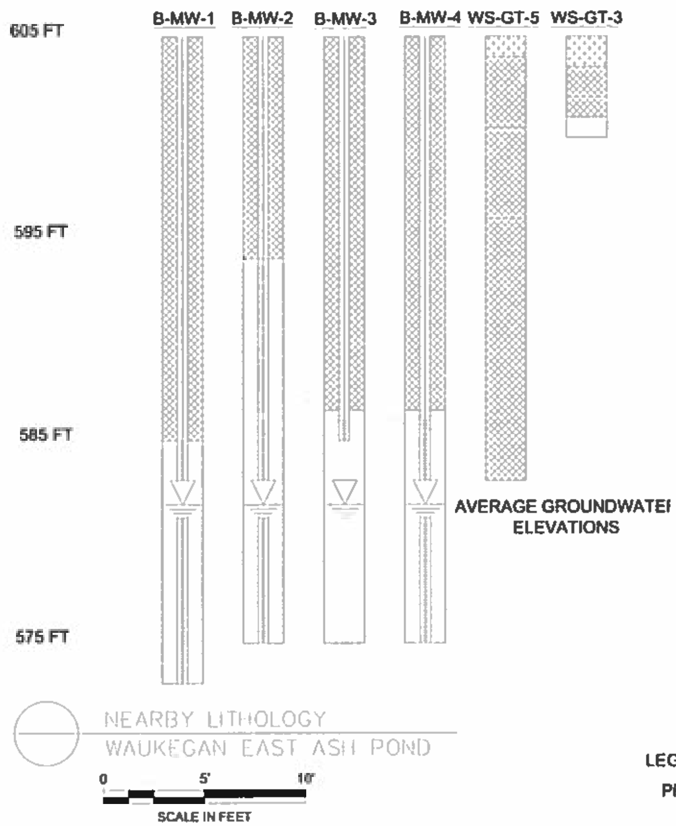
POWERTON
TYPICAL CROSS-SECTION OF ASH BYPASS BASIN LINER AND NEARBY LITHOLOGY

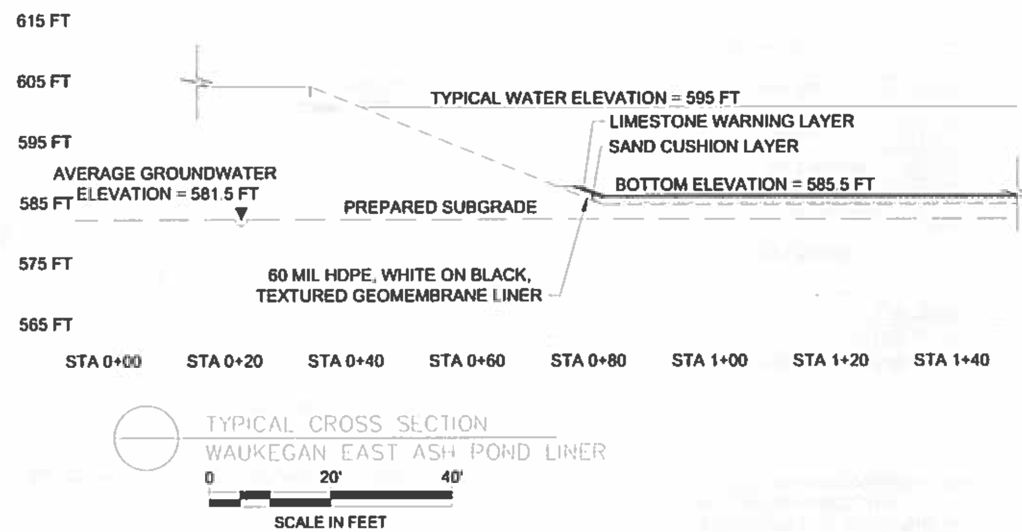
Geosyntec consultants

FIGURE 5-7

PROJECT NO: CHE8303 | OCTOBER 2015

G:\CWP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550 - REPORT\CAD\ASH BYPASS BASIN





LEGEND:

PRIMARY MATERIALS

- FILL W/ ASH
- FILL
- SAND
- SAND & GRAVEL
- SAND & SILT
- SILT & CLAY
- LIMESTONE BEDROCK

NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-1, MW-2, MW-3, AND MW-4 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 583.4 FT MSL AT MONITORING WELL MW-4 DURING SECOND QUARTER 2011.

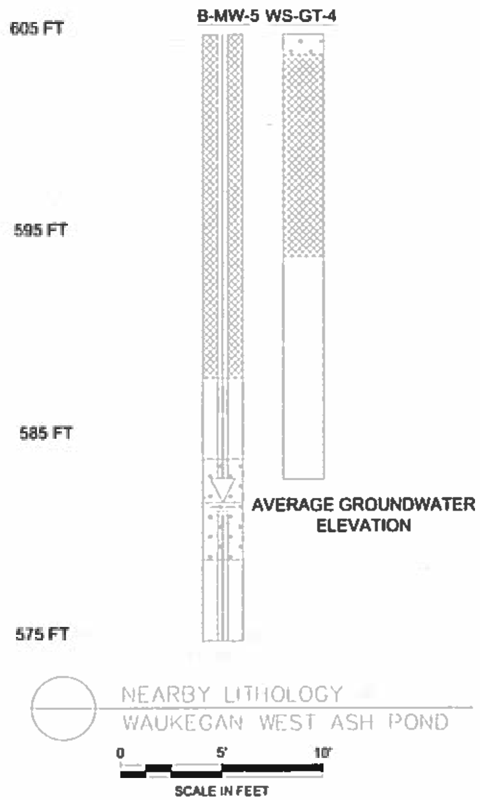
WAUKEGAN
TYPICAL CROSS SECTION OF EAST ASH POND LINER AND NEARBY LITHOLOGY

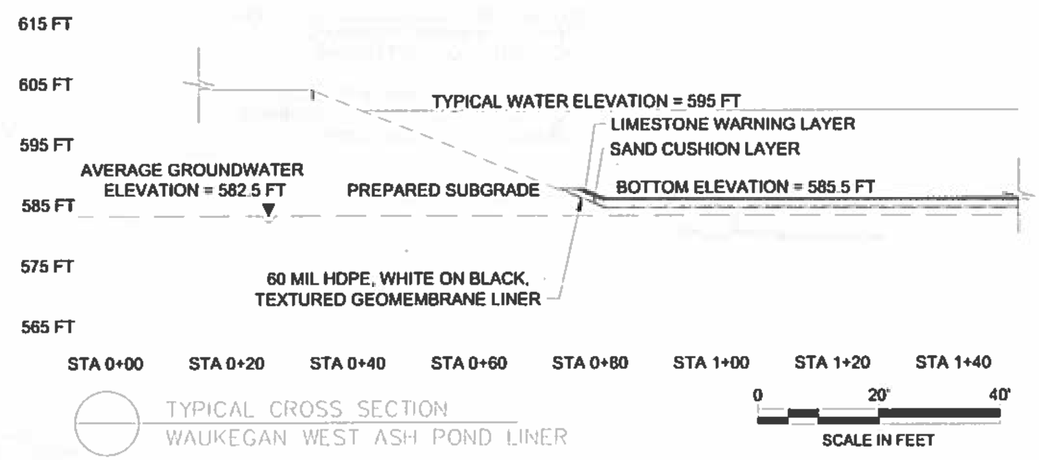
Geosyntec consultants

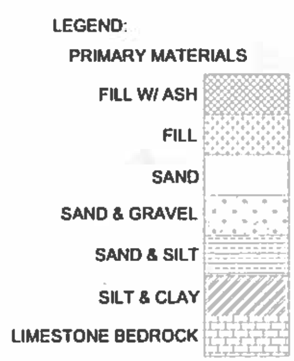
FIGURE 5-8

PROJECT NO: CHE8303 | OCTOBER 2015

G:\CMP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550- REPORT\CAD\WAUKEGAN EAST







NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELL MW-5 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 584.5 FT MSL AT MONITORING WELL MW-5 DURING SECOND QUARTER 2011.

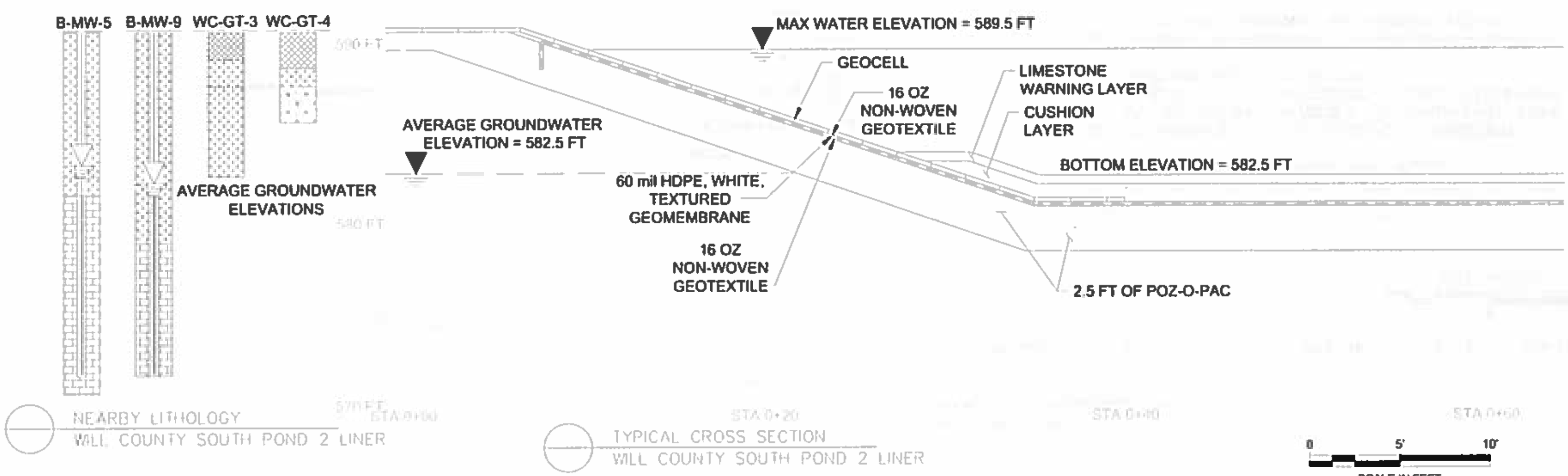
WAUKEGAN
TYPICAL CROSS SECTION OF WEST ASH POND LINER AND NEARBY LITHOLOGY

Geosyntec consultants

FIGURE 5-9

PROJECT NO: CHE8303 | OCTOBER 2015

G:\CWP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550- REPORT\CAD\WAUKEGAN WEST



LEGEND:

PRIMARY MATERIALS

- FILL W/ ASH
- FILL
- SAND & GRAVEL
- SAND & SILT
- SILT & CLAY
- ORGANIC CLAY
- ORGANIC SILT
- LIMESTONE BEDROCK

NOTES:

1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.

2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-4, MW-5, AND MW-9 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).

3) THE MAXIMUM GROUNDWATER ELEVATION WAS 583.5 FT MSL AT MONITORING WELL MW-9 DURING FIRST QUARTER 2012.

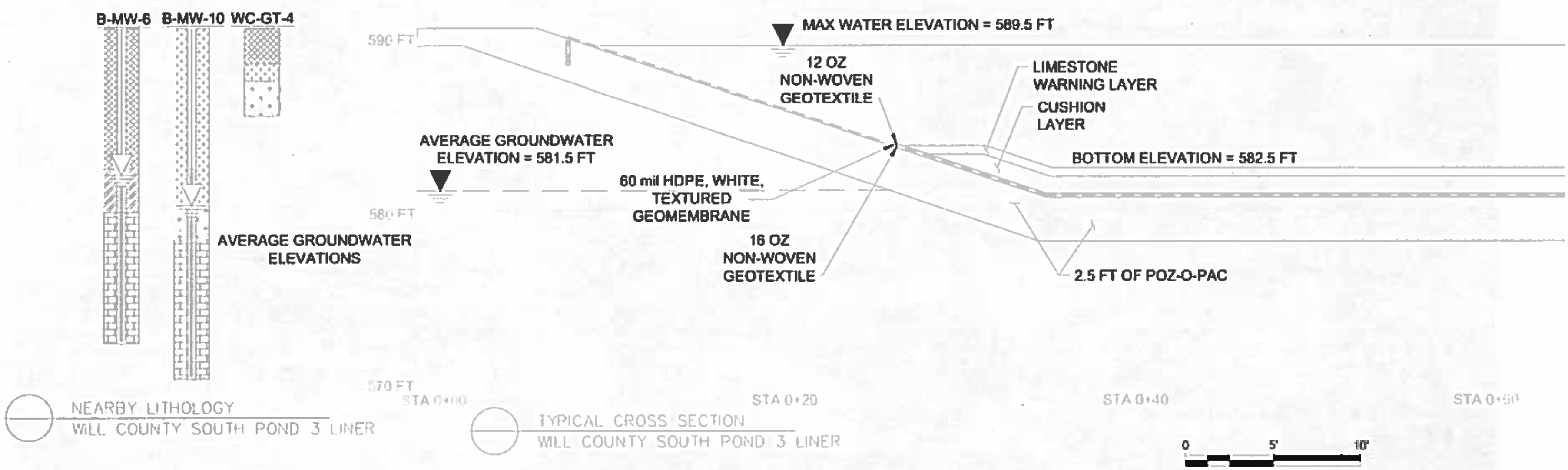
WILL COUNTY
TYPICAL CROSS-SECTION OF SOUTH ASH POND NO. 2 AND NEARBY LITHOLOGY

Geosyntec consultants

PROJECT NO: CHE8303 | OCTOBER 2015

FIGURE 5-10

G:\CWP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550- REPORT\CAD\WILL COUNTY POND 2



LEGEND:

PRIMARY MATERIALS
- FILL W/ ASH
- FILL
- SAND & GRAVEL
- SAND & SILT
- SILT & CLAY
- ORGANIC CLAY
- ORGANIC SILT
- LIMESTONE BEDROCK

NOTES:
1) SITE LITHOLOGY TAKEN FROM LOGS OF BORINGS BY KPRG IN 2005 AND PATRICK ENGINEERING IN 2010.
2) GROUNDWATER ELEVATIONS BASED ON OBSERVED GROUNDWATER ELEVATIONS AT MONITORING WELLS MW-6 AND MW-10 DURING THE PERIOD OF RECORD (SECOND QUARTER 2011 THROUGH FIRST QUARTER 2015).
3) THE MAXIMUM GROUNDWATER ELEVATION WAS 582.5 FT MSL AT MONITORING WELL MW-6 DURING SECOND QUARTER 2011.

WILL COUNTY
TYPICAL CROSS-SECTION OF SOUTH ASH POND NO. 3 AND NEARBY LITHOLOGY

Geosyntec consultants

PROJECT NO: CHE8303 | OCTOBER 2015

FIGURE 5-11

G:\CWP\CHE8303-MIDWESTGEN-CONFIDENTIAL\500 - TECHNICAL\550 - REPORT\CAD\WILL COUNTY POND 3

Legend

- Coal Handling and Transfer Area
- Electrical Switchyard
- Approx. Site Area and Ponds

Note: Locations are approximate and based on aerial photographs.

1,000 500 0 1,000 Feet

Joliet #29 Station Equipment Areas Joliet, Illinois	Geosyntec consultants	Figure 7-1
October 2015	Chicago	

Legend

- Coal Handling and Transfer Area
- Electrical Switchyard
- Approx. Site Area and Ponds

Note: Locations are approximate and based on aerial photographs.

1,000 500 0 1,000 Feet

Powerton Station Equipment Areas **Pekin, Illinois**	Geosyntec consultants	Figure **7-2**
October 2015	Chicago	

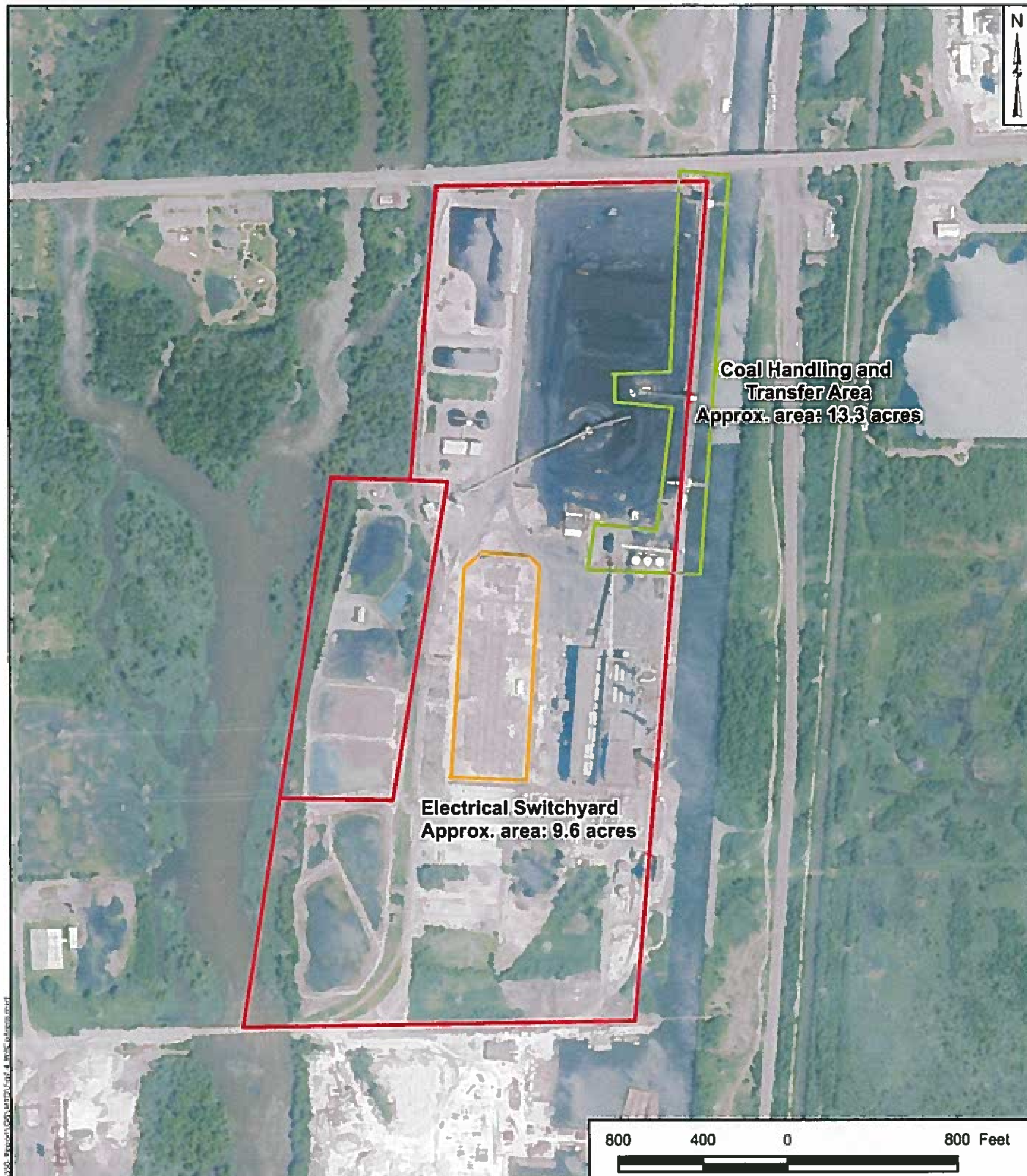
Legend

- Coal Handling and Transfer Area
- Electrical Switchyard
- Approx. Site Area and Ponds

Note: Locations are approximate and based on aerial photographs.

800 400 0 800 Feet

Waukegan Station Equipment Areas **Waukegan, Illinois**	Geosyntec consultants	Figure **7-3**
October 2015	Chicago	



Legend

- Coal Handling and Transfer Area
- Electrical Switchyard
- Approx. Site and Ponds

Note: Locations are approximate and based on aerial photographs.

Will County Station Equipment Areas

Romeoville, Illinois

Geosyntec consultants

Chicago | October 2015

Figure 7-4

J.SEYMOUR EXPERT REPORT

TABLES

Table 4-1
Groundwater Elevations at Joliet No. 29 Generating Station

Date	Groundwater Elevations [1] (feet above MSL)											Statistics (feet above MSL)			
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	Site-Wide Average	Minimum	Maximum	Range
6/14/2011	507.69	507.62	507.97	507.93	507.87	507.83	507.83	507.91	507.88	508.19	509.29	508.00	507.62	509.29	1.67
9/14/2011	505.21	505.13	505.17	505.15	505.05	505.19	505.21	505.25	505.22	505.23	505.49	505.21	505.05	505.49	0.44
12/7/2011	505.39	505.36	505.38	505.34	505.23	505.36	505.37	505.49	505.46	505.43	505.77	505.42	505.23	505.77	0.54
3/15/2012	505.47	505.43	505.45	505.43	505.32	505.45	505.46	505.57	505.53	505.51	505.80	505.49	505.32	505.80	0.48
6/19/2012	505.23	505.18	505.23	505.21	505.11	505.26	505.28	505.32	505.29	505.28	505.51	505.26	505.11	505.51	0.40
9/19/2012	510.52	512.33	505.12	505.11	505.06	505.26	505.26	505.22	505.66	505.16	505.35	506.37	505.06	512.33	7.27
12/20/2012	505.42	505.33	505.25	505.25	505.22	505.25	505.24	505.40	505.36	505.30	505.44	505.31	505.22	505.44	0.22
3/5/2013	505.30	505.31	505.38	505.39	505.24	505.37	505.40	505.45	505.50	505.41	505.66	505.40	505.24	505.66	0.42
5/23/2013	505.81	505.82	505.87	503.94	506.03	506.06	506.17	505.91	505.91	505.99	506.46	505.82	503.94	506.46	2.52
7/22/2013	504.94	505.10	505.16	505.13	505.09	505.28	505.27	505.17	505.22	505.28	505.44	505.19	504.94	505.44	0.50
10/15/2013	504.93	505.05	505.04	505.07	504.99	505.12	505.13	505.13	505.10	505.10	505.32	505.09	504.93	505.32	0.39
2/21/2014	NM	505.99	505.29	505.99	505.97	506.10	506.16	505.94	505.30	505.35	506.19	505.83	505.29	506.19	0.90
5/1/2014	505.73	505.73	505.70	505.71	505.56	505.71	505.71	505.84	505.82	505.80	506.20	505.77	505.56	506.20	0.64
8/18/2014	506.75	506.05	506.26	506.28	506.10	506.22	506.27	506.19	506.18	506.41	507.14	506.35	506.05	507.14	1.09
10/23/2014	505.80	505.79	505.82	505.86	505.65	505.75	505.79	505.78	505.82	505.89	506.28	505.84	505.65	506.28	0.63
2/10/2015	NM	505.17	505.19	505.19	505.12	505.23	505.24	505.18	505.22	505.27	505.49	505.23	505.12	505.49	0.37

Abbreviations:
"MSL" = mean sea level
"NM" = not measured

Notes:
1. Groundwater elevations were reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015a).

Table 4-2
Summary of Joliet #29 Constituents of Interest

Constituent of Interest
Antimony
Boron
Chloride
Iron
Manganese
pH
Sulfate
TDS

Note:

1. Constituents of Interest are based on concentrations reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015a).

Table 4-3

Groundwater Elevations at Powerton Generating Station

Date	Groundwater Elevations[1] (feet above MSL)																Statistics (feet above MSL)			
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16	Site-Wide Average	Minimum	Maximum	Range
9/19/2011	439.95	433.27	432.73	431.63	432.77	445.71	433.40	446.76	443.64	439.99	440.49	449.88	446.06	448.13	448.29	NA	440.85	431.63	449.88	18.25
12/12/2011	439.78	434.78	433.88	433.28	434.13	446.30	434.64	446.85	443.08	440.01	440.51	450.03	447.39	448.28	449.16	NA	441.47	433.28	450.03	16.75
3/19/2012	442.40	437.48	436.94	434.93	435.71	446.17	436.04	447.66	443.78	442.03	441.63	451.18	437.72	448.11	447.82	NA	441.97	434.93	451.18	16.25
4/4/2012	441.39	436.92	435.67	434.15	434.93	445.81	435.10	447.27	443.49	441.06	441.03	450.83	436.84	445.28	446.73	NA	441.10	434.15	450.83	16.68
6/25/2012	437.84	433.69	432.86	432.38	433.23	445.99	433.77	447.06	442.55	438.39	439.54	450.38	437.79	443.71	446.78	NA	439.73	432.38	450.38	18.00
9/18/2012	435.37	431.30	430.71	430.34	430.99	445.63	431.39	446.70	440.29	436.06	437.31	449.95	437.73	446.80	447.49	NA	438.54	430.34	449.95	19.61
12/12/2012	435.06	431.12	429.94	430.28	430.98	447.37	431.38	447.23	439.77	435.79	437.09	449.18	437.40	444.89	446.71	441.16	438.46	429.94	449.18	19.24
2/27/2013	439.56	436.02	436.39	434.36	434.93	448.45	435.30	448.53	441.69	439.50	439.79	451.07	437.99	447.29	448.48	442.56	441.37	434.36	451.07	16.71
5/29/2013	446.35	444.38	444.87	443.93	444.11	443.12	449.93	447.82	449.35	446.90	447.35	451.84	445.45	448.37	449.36	449.74	447.05	443.12	451.84	8.72
7/29/2013	441.71	434.84	434.87	432.86	433.63	449.46	433.88	448.53	444.99	441.21	441.49	449.45	437.59	447.59	448.70	446.17	441.69	432.86	449.46	16.60
10/21/2013	435.98	431.64	430.91	430.60	431.41	448.12	432.19	447.12	441.05	436.73	437.95	447.83	437.56	444.92	447.70	442.54	439.02	430.60	448.12	17.52
3/6/2014	442.20	442.74	442.23	442.09	442.36	449.65	442.61	447.89	444.36	442.64	443.65	451.45	443.96	446.32	447.52	444.36	444.75	442.09	451.45	9.36
5/27/2014	442.00	440.91	440.70	439.49	439.99	447.32	439.81	446.86	444.82	442.23	443.02	450.22	442.19	446.55	447.14	445.54	443.67	439.49	450.22	10.73
8/28/2014	439.33	436.20	434.72	435.10	436.01	447.00	438.63	446.35	443.42	440.07	441.27	449.49	440.82	445.81	446.52	443.83	441.54	434.72	449.49	14.77
10/29/2014	441.92	439.27	439.45	436.01	436.33	446.49	435.75	446.16	444.08	441.45	441.37	449.21	438.47	445.55	446.22	444.76	442.03	435.75	449.21	13.46
2/23/2015	441.45	435.54	436.26	432.09	432.97	447.80	433.66	446.67	443.11	440.88	440.57	451.43	437.57	441.69	446.41	443.74	440.74	432.09	451.43	19.34

Abbreviations:

"MSL" = mean sea level

"NA" = not available because monitoring event is before the well construction

Notes:

1. Groundwater elevations were reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015b).

Table 4-4
Summary of Powerton Constituents of Interest

Constituent of Interest
Arsenic
Boron
Chloride
Iron
Lead
manganese
Nitrogen/Nitrate
pH
Selenium
Sulfate
TDS
Thallium

Note:

1. Constituents of Interest are based on concentrations reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015b).

Table 4-5
Groundwater Elevations at Waukegan Generating Station

Date	Groundwater Elevations [1] (feet above MSL)							Statistics (feet above MSL)			
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	Site-Wide Average	Minimum	Maximum	Range
6/13/2011	583.34	583.31	583.34	583.35	584.55	NA	NA	583.58	583.31	584.55	1.24
9/13/2011	581.14	581.19	581.18	581.19	582.66	NA	NA	581.47	581.14	582.66	1.52
12/6/2011	581.15	581.22	581.22	581.23	582.82	NA	NA	581.53	581.15	582.82	1.67
3/14/2012	581.18	581.23	581.22	581.20	582.98	NA	NA	581.56	581.18	582.98	1.80
6/18/2012	580.86	580.89	580.92	580.88	582.22	NA	NA	581.15	580.86	582.22	1.36
9/28/2012	579.65	579.73	579.68	579.55	581.13	NA	NA	579.95	579.55	581.13	1.58
12/19/2012	579.42	579.27	579.45	579.34	580.65	580.89	579.57	579.80	579.27	580.89	1.62
3/7/2013	580.35	580.50	580.49	580.36	582.18	582.63	580.83	581.05	580.35	582.63	2.28
6/6/2013	582.38	582.34	582.38	582.38	583.44	583.58	582.61	582.73	582.34	583.58	1.24
7/25/2013	581.40	581.34	581.41	581.33	582.60	582.71	581.28	581.72	581.28	582.71	1.43
11/4/2013	581.32	581.23	581.29	581.13	582.03	582.71	580.80	581.50	580.80	582.71	1.91
3/10/2014	581.94	581.84	581.88	581.87	582.88	583.83	582.04	582.33	581.84	583.83	1.99
5/16/2014	583.07	582.95	583.02	583.11	583.71	584.56	584.35	583.54	582.95	584.56	1.61
8/21/2014	581.81	581.76	581.87	581.69	582.36	582.70	581.13	581.90	581.13	582.70	1.57
11/6/2014	582.01	581.91	581.97	581.86	582.54	582.92	581.39	582.09	581.39	582.92	1.53
2/17/2015	582.42	582.21	582.22	582.14	582.38	583.39	581.14	582.27	581.14	583.39	2.25

Abbreviations:
"MSL" = mean sea level
"NA" = not available because monitoring event is before the well construction

Notes:
1. Groundwater elevations were reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015c).

Table 4-6
Summary of Waukegan Constituents of Interest

Constituent of Interest
Antimony
Arsenic
Boron
Chloride
Iron
Manganese
pH
Selenium
Sulfate
TDS
Vanadium

Note:

1. Constituents of Interest are based on concentrations reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015c).

Table 4-7
Groundwater Elevations at Will County Generating Station

Date	Groundwater Elevations [1] (feet above MSL)										Statistics (feet above MSL)			
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	Site-Wide Average	Minimum	Maximum	Range
6/15/2011	583.67	583.87	583.76	583.49	583.47	582.52	582.96	582.24	582.81	580.90	582.97	580.90	583.87	2.97
9/15/2011	583.25	583.29	582.85	581.47	582.47	581.95	582.41	581.28	581.28	580.04	582.03	580.04	583.29	3.25
12/8/2011	583.44	583.56	583.36	582.07	583.17	582.16	582.82	582.38	583.36	580.59	582.69	580.59	583.56	2.97
3/16/2012	583.41	583.54	583.45	582.08	583.14	582.10	582.76	582.41	583.52	580.73	582.71	580.73	583.54	2.81
6/20/2012	583.20	583.31	582.95	581.60	582.60	581.76	582.24	581.54	581.51	579.70	582.04	579.70	583.31	3.61
6/24/2012	583.25	583.34	582.93	581.45	582.37	581.71	582.59	581.36	580.88	579.69	581.96	579.69	583.34	3.65
12/18/2012	583.27	583.39	583.10	581.71	582.79	581.75	582.67	582.22	583.10	579.92	582.39	579.92	583.39	3.47
3/6/2013	583.47	583.60	583.42	582.07	583.16	582.10	582.76	582.04	583.13	580.74	582.65	580.74	583.60	2.86
6/3/2013	583.37	583.35	583.53	582.00	583.22	582.24	582.46	582.06	582.46	580.43	582.51	580.43	583.53	3.10
8/14/2013	582.18	581.97	581.79	581.89	581.70	581.29	581.04	580.95	580.56	579.13	581.25	579.13	582.18	3.05
10/29/2013	581.87	581.76	581.86	582.07	582.16	581.21	580.99	581.05	581.87	579.37	581.42	579.37	582.16	2.79
2/20/2014	582.59	582.64	582.66	582.15	582.31	581.20	581.80	581.62	581.23	580.32	581.85	580.32	582.66	2.34
5/20/2014	583.31	583.22	583.37	583.14	583.09	582.02	582.29	581.69	582.76	580.79	582.57	580.79	583.37	2.58
8/13/2014	583.33	583.25	583.35	583.32	583.26	582.45	581.97	581.53	582.02	580.57	582.51	580.57	583.35	2.78
10/21/2014	583.21	583.11	583.30	583.04	583.01	581.77	582.20	581.51	581.40	580.50	582.31	580.50	583.30	2.80
2/4/2015	583.12	582.89	583.17	582.93	582.96	581.66	581.79	581.25	581.97	580.12	582.19	580.12	583.17	3.05

Abbreviations:
"MSL" = mean sea level

Notes:
1. Groundwater elevations were reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015d).

Table 4-8
Summary of Will County Constituents of Interest

Constituent of Interest
Antimony
Arsenic
Boron
Chloride
Manganese
pH
Selenium
Sulfate
TDS

Note:

1. Constituents of Interest are based on concentrations reported in the First Quarter 2015 groundwater monitoring reports submitted by MWG to IEPA (MWG, 2015d).

Table 5-1
Summary of Neutral Leachate Extraction Test (NLET) Analyses of Bottom Ash at MWG Generating Stations

Analytical Results for Leachate Analyses Performed on Settled Coal Combustion Residuals as Reported in MWG Documents				
Generating Station:	Powerton	Waukegan		Will County
Sample Date:	March 2007	July 2004	July 2004	December 2010
Sample ID:	Powerton Bottom Ash	Bottom Ash-1	Bottom Ash-2	3 South Bottom Ash
Methods 6010B/6020/7041A/7470A/7841 (mg/L)				
Antimony	<0.0060	<0.0060	<0.0060	<0.0060
Arsenic	<0.050	<0.050	<0.050	<0.050
Barium	0.27	0.19	0.12	<0.50
Beryllium	<0.0040	<0.004	<0.004	<0.0040
Boron	<0.10	1.1	2	1.3
Cadmium	<0.0050	<0.005	<0.005	<0.0050
Chromium	<0.025	<0.050	<0.050	<0.025
Cobalt	<0.025	<0.050	<0.050	<0.025
Copper	<0.025	<0.050	<0.050	<0.025
Iron	<0.10	<0.10	<0.10	<0.10
Lead	<0.0075	<0.0075	<0.0075	<0.0075
Manganese	<0.025	<0.050	<0.050	<0.025
Mercury	<0.0020	<0.0020	<0.0020	<0.0020
Nickel	<0.025	<0.050	<0.050	<0.050
Selenium	<0.050	NA	NA	<0.050
Silver	<0.025	<0.050	<0.050	<0.025
Thallium	<0.0020	<0.0020	<0.0020	<0.0020
Zinc	<0.10	<0.10	<0.10	<0.10
Methods 8260B and 8270C				
VOCs and SVOCs	NA	NA	NA	NA
Methods 8081A and 8151A				
Pesticides	NA	NA	NA	NA
Method 9056 (mg/L)				
Sulfate	NA	NA	NA	49
SM 2540C (mg/L)				
Total dissolved solid	NA	NA	NA	200
Sources	MWG13-15_10948	MWG13-15_12809	MWG13-15_12809	MWG13-15_14713

Abbreviations:

"mg/L" = milligrams per liter
"NA" = not analyzed by the laboratory
"<" = less than the indicated analytical detection limit
"MWG" = Midwest Generation
"NLET" = Neutral Leaching Extraction Test (ASTM D3987-85)

Table 5-2

Summary of Ash Leachate Samples by Management Method and Coal Type (Source: EPRI, 2006)

Analytical Constituent or Parameter	**Analytical Results for Samples of Leachate Collected from Landfills and Impoundments as Reported by EPRI, 2006**				
	Facility Type:	Landfill		Impoundment	
	Coal Source Type:	Bituminous	Subbituminous/ Lignite	Bituminous	Subbituminous/ Lignite
Leachate pH (SU)	Minimum value	6.5	8.8	4.3	**8.0**
	Median value	6.9	10.0	7.6	**8.9**
	Maximum value	7.4	11.0	11.0	**12.0**
Aluminum Leachate Concentration (mg/L)[1]	Minimum value	<0.002	0.1	<0.0059	**0.7**
	Median value	0.0	2.9	0.1	**4.2**
	Maximum value	0.1	17.5	15.1	**5.9**
Antimony Leachate Concentration (mg/L)[1]	Minimum value	0.00014	0.00067	0.00029	**0.00024**
	Median value	0.00250	0.00090	0.00610	**0.00048**
	Maximum value	0.00910	0.00520	0.05900	**0.00062**
Arsenic Leachate Concentration (mg/L)[1]	Minimum value	0.0014	0.0041	0.0051	**0.0041**
	Median value	0.0062	0.0450	0.0580	**0.0051**
	Maximum value	0.0110	0.0840	1.3800	**0.0064**
Boron Leachate Concentration (mg/L)[1]	Minimum value	11.10	6.08	0.21	**0.47**
	Median value	23.05	18.40	1.09	**0.86**
	Maximum value	89.50	41.50	112.00	**3.89**
Barium Leachate Concentration (mg/L)[1]	Minimum value	0.023	<0.018	<0.030	**0.036**
	Median value	0.045	0.018	0.141	**0.140**
	Maximum value	0.050	0.063	0.545	**0.350**
Beryllium Leachate Concentration (mg/L)[1]	Minimum value	<0.0002	<0.0002	<0.0002	**<0.0002**
	Median value	<0.0002	<0.001	<0.0004	**<0.001**
	Maximum value	<0.0008	<0.001	0.0	**<0.001**
Calcium Leachate Concentration (mg/L)	Minimum value	235.0	6.3	12.0	**<2.5**
	Median value	405.0	19.0	51.0	**43.0**
	Maximum value	431.0	596.0	681.0	**81.0**

Table 5-2

Summary of Ash Leachate Samples by Management Method and Coal Type (Source: EPRI, 2006)

Analytical Constituent or Parameter		**Analytical Results for Samples of Leachate Collected from Landfills and Impoundments as Reported by EPRI, 2006**			
	Facility Type:	Landfill		Impoundment	
	Coal Source Type:	Bituminous	Subbituminous/ Lignite	Bituminous	Subbituminous/ Lignite
Cadmium Leachate Concentration (mg/L)[1]	Minimum value	0.0	0.0	<0.0002	**<0.0003**
	Median value	0.0	0.0	0.0	**<0.0003**
	Maximum value	0.0	0.1	0.0	**0.0**
Chloride Leachate Concentration (mg/L)	Minimum value	15.0	11.0	4.5	**31.0**
	Median value	29.0	28.0	15.0	**72.0**
	Maximum value	73.0	92.0	87.0	**85.0**
Cobalt Leachate Concentration (mg/L)[1]	Minimum value	0.0	<0.00042	<0.0002	**<0.00004**
	Median value	0.0	0.0	0.0	**<0.001**
	Maximum value	0.1	0.1	0.0	**0.0011**
Carbonate Leachate Concentration (mg/L)	Minimum value	0.0	2.5	<0.01	**1.1**
	Median value	0.1	50.0	0.1	**4.4**
	Maximum value	0.2	152.0	16.0	**36.0**
Chromium Leachate Concentration (mg/L)[1]	Minimum value	<0.0002	0.0005	<0.0002	**0.00066**
	Median value	0.0002	2.0000	<0.0005	**0.0028**
	Maximum value	0.0200	5.1000	0.0290	**0.1080**
Copper Leachate Concentration (mg/L)[1]	Minimum value	<0.00091	0.0016	<0.00038	**0.0024**
	Median value	0.0011	0.0430	0.0019	**0.0071**
	Maximum value	0.0028	0.4940	0.4520	**0.0120**
Iron Leachate Concentration (mg/L)[1]	Minimum value	<0.008	<0.003	<0.005	**<0.025**
	Median value	0.0	<0.050	0.0	**<0.050**
	Maximum value	0.1	0.0	14.7	**<0.050**
Lead Leachate Concentration (mg/L)[1]	Minimum value	<0.00012	<0.0002	<0.0001	**<0.00014**
	Median value	<0.00014	0.0	<0.00015	**<0.0002**
	Maximum value	0.00012	0.00029	0.00800	**0.00021**

Table 5-2

Summary of Ash Leachate Samples by Management Method and Coal Type (Source: EPRI, 2006)

Analytical Constituent or Parameter	**Analytical Results for Samples of Leachate Collected from Landfills and Impoundments as Reported by EPRI, 2006**				
	Facility Type:	Landfill		Impoundment	
	Coal Source Type:	Bituminous	Subbituminous/ Lignite	Bituminous	Subbituminous/ Lignite
Lithium Leachate Concentration (mg/L)[1]	Minimum value	0.4	<0.0044	0.0	**<0.007**
	Median value	5.7	<0.020	0.2	**<0.020**
	Maximum value	23.600	0.027	1.060	**0.016**
Magnesium Leachate Concentration (mg/L)	Minimum value	69.0	0.5	0.1	**<0.05**
	Median value	188.0	6.7	6.8	**21.0**
	Maximum value	236.0	57.0	72.0	**28.0**
Manganese Leachate Concentration (mg/L)[1]	Minimum value	0.1	<0.0015	<0.0002	**<0.0002**
	Median value	2.1	0.0	0.1	**<0.004**
	Maximum value	4.110	0.008	4.170	**0.014**
Mercury Leachate Concentration (mg/L)[2]	Minimum value	0.0000021	0.0000140	0.0000004	**0.0000054**
	Median value	0.0000030	0.0000180	0.0000014	**0.0000074**
	Maximum value	0.0000038	0.0000370	0.0000052	**0.0000094**
Molybdenum Leachate Concentration (mg/L)[1]	Minimum value	0.8	2.7	0.0	**<0.030**
	Median value	3.28	5.72	0.21	**0.08**
	Maximum value	9.63	25.40	6.03	**0.52**
Nickel Leachate Concentration (mg/L)[1]	Minimum value	0.0	0.0	<0.0006	**<0.0006**
	Median value	0.0180	0.0080	0.0071	**0.0037**
	Maximum value	0.1890	0.0750	0.0720	**0.0071**
Potassium Leachate Concentration (mg/L)	Minimum value	23.0	73.0	<2.2	**5.5**
	Median value	170.0	80.0	9.2	**7.7**
	Maximum value	219.0	120.0	277.0	**40.0**
Selenium Leachate Concentration (mg/L)[1]	Minimum value	0.0007	0.0066	0.0001	**0.0018**
	Median value	0.0490	0.4130	0.0130	**0.0025**
	Maximum value	0.0910	1.7600	0.2830	**0.1810**

Table 5-2

Summary of Ash Leachate Samples by Management Method and Coal Type (Source: EPRI, 2006)

Analytical Constituent or Parameter	**Analytical Results for Samples of Leachate Collected from Landfills and Impoundments as Reported by EPRI, 2006**				
	Facility Type:	Landfill		Impoundment	
	Coal Source Type:	Bituminous	Subbituminous/ Lignite	Bituminous	Subbituminous/ Lignite
Silicon Leachate Concentration (mg/L)[1]	Minimum value	2.3	0.2	0.7	**2.2**
	Median value	6.1	1.5	4.7	**3.4**
	Maximum value	9.4	9.9	18.5	**10.3**
Silver Leachate Concentration (mg/L)[1]	Minimum value	<0.0002	<0.0002	<0.0002	**<0.0002**
	Median value	<0.0002	<0.0002	<0.0002	**<0.0002**
	Maximum value	<0.0002	0.0	0.0	**<0.0002**
Sodium Leachate Concentration (mg/L)	Minimum value	80.0	840.0	3.8	**53.0**
	Median value	188.0	1700.0	19.0	**56.0**
	Maximum value	455.0	3410.0	72.0	**653.0**
Strontium Leachate Concentration (mg/L)[1]	Minimum value	1.3	<0.030	0.2	**0.5**
	Median value	4.6	0.3	0.7	**0.6**
	Maximum value	10.3	12.0	5.6	**1.8**
Thallium Leachate Concentration (mg/L)[1]	Minimum value	<0.0001	<0.0001	<0.0001	**<0.0001**
	Median value	0.0	<0.0001	0.0	**<0.0001**
	Maximum value	0.0	<0.0005	0.0	**<0.0001**
Uranium Leachate Concentration (mg/L)[1]	Minimum value	0.0	0.0	<0.0001	**<0.00002**
	Median value	0.0190	0.0057	0.0007	**0.0011**
	Maximum value	0.0370	0.0210	0.0610	**0.0012**
Vanadium Leachate Concentration (mg/L)[1]	Minimum value	<0.00083	0.004	0.003	**0.010**
	Median value	0.003	0.635	0.039	**0.017**
	Maximum value	0.044	5.020	0.754	**0.236**
Zinc Leachate Concentration (mg/L)[1]	Minimum value	<0.002	<0.002	0.0	**<0.002**
	Median value	0.0450	<0.005	0.0087	**0.0084**
	Maximum value	0.2890	0.0120	0.0900	**0.0110**

Table 5-2
Summary of Ash Leachate Samples by Management Method and Coal Type (Source: EPRI, 2006)

Analytical Constituent or Parameter	**Analytical Results for Samples of Leachate Collected from Landfills and Impoundments as Reported by EPRI, 2006**				
	Facility Type:	Landfill		Impoundment	
	Coal Source Type:	Bituminous	Subbituminous/ Lignite	Bituminous	Subbituminous/ Lignite
Bicarbonate Leachate Concentration (mg/L)	Minimum value	100.0	1.0	0.0	**1.1**
	Median value	229.0	108.0	28.0	**110.0**
	Maximum value	265.0	481.0	535.0	**241.0**
Carbonic Acid Leachate Concentration (mg/L)	Minimum value	<0.01	<0.01	<0.01	**<0.01**
	Median value	<0.01	<0.01	<0.01	**<0.01**
	Maximum value	0.0	<0.01	3.4	**<0.01**
Sulfate Leachate Concentration (mg/L)	Minimum value	845.0	2870.0	45.0	**91.0**
	Median value	2350.0	3830.0	171.0	**131.0**
	Maximum value	2440.0	6690.0	1830.0	**1120.0**
Total Inorganic Carbon Leachate Concentration (mg/L)	Minimum value	24.0	1.7	0.8	**5.9**
	Median value	55.0	32.0	5.5	**22.0**
	Maximum value	80.0	105.0	115.0	**49.0**
Total Organic Carbon Leachate Concentration (mg/L)	Minimum value	1.3	5.3	<0.09	**0.4**
	Median value	4.1	49.0	0.6	**6.0**
	Maximum value	4.6	55.0	22.0	**7.9**
Dissolved Oxygen Leachate Concentration (%)	Minimum value	16.0	0.2	2.9	**1.6**
	Median value	53.0	14.0	40.0	**4.5**
	Maximum value	95.0	87.0	165.0	**35.0**
Leachate Oxidation-Reduction Potential (mV)	Minimum value	213.0	111.0	41.0	**225.0**
	Median value	247.0	240.0	240.0	**289.0**
	Maximum value	280.0	276.0	409.0	**303.0**
Leachate Electrical Conductivity (umho/cm)	Minimum value	2000.0	6174.0	174.0	**680.0**
	Median value	3682.0	7690.0	578.0	**990.0**
	Maximum value	4915.0	12760.0	2980.0	**4020.0**

Table 5-2

Summary of Ash Leachate Samples by Management Method and Coal Type (Source: EPRI, 2006)

Analytical Constituent or Parameter	**Analytical Results for Samples of Leachate Collected from Landfills and Impoundments as Reported by EPRI, 2006**				
	Facility Type:	Landfill		Impoundment	
	Coal Source Type:	Bituminous	Subbituminous/ Lignite	Bituminous	Subbituminous/ Lignite
Leachate Temperature (°C)	Minimum value	14.0	11.0	10.0	**16.0**
	Median value	15.0	17.0	22.0	**30.0**
	Maximum value	17.0	22.0	32.0	**36.0**

1. Leachate concentration was reported in micrograms per liter (µg/L) in EPRI, 2006. The reported concentrations were converted to milligrams per liter (mg/L) by dividing the reported concentration by 1,000 µg/mg.

Table 5-3

Comparison of Ash Leachate Characteristic Values to IEPA Class I Groundwater Standards

	MWG Bottom Ash Samples		Impoundments from PRB-Sourced Coal by EPRI			IEPA Class I Groundwater Standards
	NLET		Samples of leachate			
Constituent	Min	Max	Min	Median	Max	
Antimony	<0.0060	<0.0060	0.00024	0.00048	0.00062	0.006
Arsenic	<0.050	<0.050	0.0041	0.0051	0.0064	0.01
Barium	<0.50	0.27	0.036	0.14	0.35	2
Beryllium	<0.0040	<0.0040	<0.0002	<0.001	<0.001	0.004
Boron	<0.10	2	0.47	0.86	**3.89**	2
Cadmium	<0.0050	<0.0050	<0.0003	<0.0003	0.0021	0.005
Chromium	<0.025	<0.050	0.00066	0.0028	**0.108**	0.1
Cobalt	<0.025	<0.050	<0.00004	<0.001	0.0011	1
Copper	<0.025	<0.050	0.0024	0.0071	0.012	0.65
Iron	<0.10	<0.10	<0.025	<0.05	<0.05	5
Lead	<0.0075	<0.0075	<0.00014	<0.0002	0.00021	0.0075
Manganese	<0.025	<0.050	<0.0002	<0.004	0.014	0.15
Mercury	<0.0020	<0.0020	0.0000054	0.0000074	0.0000094	0.002
Nickel	<0.050	<0.050	<0.0006	0.0037	0.0071	0.1
Selenium	<0.050	<0.050	0.0018	0.0025	**0.18**	0.05
Silver	<0.025	<0.050	<0.0002	<0.0002	<0.0002	0.05
Sulfate	49	49	91	131	**1120**	400
Thallium	<0.0020	<0.0020	<0.0001	<0.0001	<0.0001	0.002
Zinc	<0.10	<0.10	<0.002	0.0084	0.011	5

Abbreviations:

"mg/L" = milligrams per liter
"NA" = not analyzed by the laboratory
"<" = less than the indicated analytical detection limit
"MWG" = Midwest Generation
"NLET" = Neutral Leaching Extraction Test (ASTM D3987-85)
"PRB" = Powder River Basin

Notes:

Bold font indicates a detection above IEPA Class I Groundwater Standards.
Underlined values indicate detections relevant to Section 5.5.1.3 of the report text.

Table 5-4

Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments

Based on Site-Specific NLET Results for Bottom Ash and Actual Leachate Sample Results for Bituminous Ash Stored in Impoundments

Constituent	Constituent is an Indicator of Leachate from Ash Currently Stored in Impoundments [1]	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2] — Joliet No. 29 Generating Station										
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11
Antimony	Yes (Table 5-2)											
Arsenic	Yes (Table 5-2)			x	x		x	x				x
Barium	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x	x
Beryllium												
Boron	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x	x
Cadmium	Yes (Table 5-2)					x			x			
Chromium	Yes (Table 5-2)											
Cobalt	Yes (Table 5-2)				x		x			x		
Copper	Yes (Table 5-2)					x	x	x	x			
Iron					x				x	x		
Lead	Yes (Table 5-2)								x			
Manganese	Yes (Table 5-2)	x				x		x	x	x		
Mercury	Yes (Table 5-2)											
Nickel	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x	x
Selenium	Yes (Table 5-2)		x	x		x	x	x			x	x
Silver												
Sulfate	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x	x
Thallium												
Zinc	Yes (Table 5-2)								x			
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		10	10	9	10	7	7	7	7	10	10	9
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		53%	53%	47%	53%	37%	37%	37%	37%	53%	53%	47%

Table 5-4
Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments
Based on Site-Specific NLET Results for Bottom Ash and Actual Leachate Sample Results for Bituminous Ash Stored in Impoundments

Constituent	Constituent Is an Indicator of Leachate from Ash Currently Stored in Impoundments [1]	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2]															
		Powerton Generating Station															
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16
Antimony	Yes (Table 5-2)																
Arsenic	Yes (Table 5-2)						x	x	x	x		x	x	x	x	x	
Barium	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Beryllium																	
Boron	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cadmium	Yes (Table 5-2)														x		
Chromium	Yes (Table 5-2)																
Cobalt	Yes (Table 5-2)						x	x		x	x	x					
Copper	Yes (Table 5-2)			x	x	x					x						
Iron							x	x	x		x	x	x	x	x	x	
Lead	Yes (Table 5-2)		x	x				x		x	x						
Manganese	Yes (Table 5-2)				x	x	x	x	x	x	x	x	x	x	x	x	x
Mercury	Yes (Table 5-2)																
Nickel	Yes (Table 5-2)			x	x	x	x	x		x	x	x	x		x	x	
Selenium	Yes (Table 5-2)	x				x				x	x			x	x	x	
Silver																	
Sulfate	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Thallium															x		
Zinc	Yes (Table 5-2)			x													
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		11	11	8	9	8	9	8	11	6	7	9	10	10	9	9	11
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		58%	58%	42%	47%	42%	47%	42%	58%	32%	37%	47%	53%	53%	47%	47%	58%

Table 5-4

Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments

Based on Site-Specific NLET Results for Bottom Ash and Actual Leachate Sample Results for Bituminous Ash Stored in Impoundments

	Constituent is an Indicator of Leachate from Ash Currently Stored in	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2]						
		Waukegan Generating Station						
Constituent	Impoundments [1]	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7
Antimony	Yes (Table 5-2)							
Arsenic	Yes (Table 5-2)	x	x	x	x	x	x	x
Barium	Yes (Table 5-2)	x	x	x	x	x	x	x
Beryllium								
Boron	Yes (Table 5-2)	x	x	x	x	x	x	x
Cadmium	Yes (Table 5-2)							
Chromium	Yes (Table 5-2)							
Cobalt	Yes (Table 5-2)							
Copper	Yes (Table 5-2)	x					x	
Iron			x			x	x	x
Lead	Yes (Table 5-2)			x				
Manganese	Yes (Table 5-2)	x	x	x	x	x	x	x
Mercury	Yes (Table 5-2)							
Nickel	Yes (Table 5-2)					x		
Selenium	Yes (Table 5-2)	x	x	x	x		x	
Silver								
Sulfate	Yes (Table 5-2)	x	x	x	x	x	x	x
Thallium								
Zinc	Yes (Table 5-2)							
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		8	10	8	9	10	9	11
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		42%	53%	42%	47%	53%	47%	58%

Table 5-4

Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments

Based on Site-Specific NLET Results for Bottom Ash and Actual Leachate Sample Results for Bituminous Ash Stored in Impoundments

Constituent	Constituent Is an Indicator of Leachate from Ash Currently Stored in Impoundments [1]	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2]									
		Will County Generating Station									
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10
Antimony	Yes (Table 5-2)										
Arsenic	Yes (Table 5-2)		x	x	x	x	x	x	x	x	x
Barium	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x
Beryllium											
Boron	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x
Cadmium	Yes (Table 5-2)										
Chromium	Yes (Table 5-2)										
Cobalt	Yes (Table 5-2)	x		x	x						
Copper	Yes (Table 5-2)										
Iron		x	x	x	x		x	x	x		x
Lead	Yes (Table 5-2)										
Manganese	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x
Mercury	Yes (Table 5-2)				x						
Nickel	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x
Selenium	Yes (Table 5-2)	x		x	x	x	x	x	x	x	
Silver											
Sulfate	Yes (Table 5-2)	x	x	x	x	x	x	x	x	x	x
Thallium											
Zinc	Yes (Table 5-2)										
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		9	10	8	7	8	9	9	9	8	10
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		47%	53%	42%	37%	42%	47%	47%	47%	42%	53%

Abbreviations:

"TCLP" = Toxicity Characteristic Leaching Procedure (USEPA Method 1311)

"x" = constituent was detected above analytical detection limits during at least one quarterly groundwater monitoring event in 2014

Table 5-4
Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments
Based on Site-Specific NLET Results for Bottom Ash and Actual Leachate Sample Results for Bituminous Ash Stored in Impoundments

Notes:

1. Indicators of leachate from ash currently stored in impoundments are based on leachate sample results for bituminous ash stored in impoundments (Table 5-2) as denoted in this table as "Y TCLP)", and actual leachate sample results for bituminous ash stored in imp
2. Shading of cells is described below.
   - Green shading indicates that a constituent that is an indicator of leachate from ash currently stored in the impoundments was not detected during quarterly groundwater monitoring in 2014.
   - Blue shading indicates that a constituent that is not an indicator of leachate from ash currently stored in the impoundments was detected during at least one quarterly groundwater monitoring event in 2014.
   - No shading indicates that either (1) a constituent that is an indicator of leachate from ash currently stored in the impoundments was detected during at least one quarterly groundwater monitoring event in 2014, or (2) a constituent that is not an indicator of leachate from ash currently stored in the impoundments was not detected during quarterly groundwater monitoring in 2014.
3. Green and blue shading (see Note 2) demonstrate observed constituents that are not consistent with indicators of leachate from ash currently stored in impoundments.

Table 5-5
Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments
Based on Site-Specific NLET Results for Bottom Ash

Constituent	Constituent is an Indicator of Leachate from Ash Currently Stored in Impoundments [1]	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2] — Joliet No. 29 Generating Station										
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11
Antimony												
Arsenic				x	x		x	x				x
Barium	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x	x
Beryllium												
Boron	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x	x
Cadmium						x			x			
Chromium												
Cobalt					x		x			x		
Copper						x	x	x	x			
Iron					x				x	x		
Lead									x			
Manganese		x				x		x	x	x		
Mercury												
Nickel		x	x	x	x	x	x	x	x	x	x	x
Selenium			x	x		x	x	x			x	x
Silver												
Sulfate	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x	x
Thallium												
Zinc									x			
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		2	2	3	4	5	5	5	7	4	2	3
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		11%	11%	16%	21%	26%	26%	26%	37%	21%	11%	16%

Table 5-5

Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments Based on Site-Specific NLET Results for Bottom Ash

Constituent	Constituent is an Indicator of Leachate from Ash Currently Stored in Impoundments [1]	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2]															
		Powerton Generating Station															
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16
Antimony																	
Arsenic							x	x	x	x		x	x	x	x	x	
Barium	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Beryllium																	
Boron	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cadmium															x		
Chromium																	
Cobalt							x	x		x	x	x					
Copper				x	x	x					x						
Iron							x	x	x		x	x	x	x	x	x	
Lead			x	x				x		x	x						
Manganese					x	x	x	x	x	x	x	x	x	x	x	x	x
Mercury																	
Nickel				x	x	x	x	x		x	x	x	x		x	x	
Selenium		x				x				x	x			x	x	x	
Silver																	
Sulfate	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Thallium															x		
Zinc				x													
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		1	1	4	3	4	5	6	3	6	7	5	4	4	7	5	1
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		5%	5%	21%	16%	21%	26%	32%	16%	32%	37%	26%	21%	21%	37%	26%	5%

Table 5-5
Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments
Based on Site-Specific NLET Results for Bottom Ash

Constituent	Constituent is an Indicator of Leachate from Ash Currently Stored in Impoundments [1]	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2] Waukegan Generating Station						
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7
Antimony								
Arsenic		x	x	x	x	x	x	x
Barium	Yes (Table 5-1)	x	x	x	x	x	x	x
Beryllium								
Boron	Yes (Table 5-1)	x	x	x	x	x	x	x
Cadmium								
Chromium								
Cobalt								
Copper		x					x	
Iron			x			x	x	x
Lead				x				
Manganese		x	x	x	x	x	x	x
Mercury								
Nickel						x		
Selenium		x	x	x	x		x	
Silver								
Sulfate	Yes (Table 5-1)	x	x	x	x	x	x	x
Thallium								
Zinc								
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		4	4	4	3	4	5	3
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		21%	21%	21%	16%	21%	26%	16%

Table 5-5

Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments Based on Site-Specific NLET Results for Bottom Ash

Constituent	Constituent is an Indicator of Leachate from Ash Currently Stored in Impoundments [1]	Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring [2] — Will County Generating Station									
		MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10
Antimony											
Arsenic			x	x	x	x	x	x	x	x	x
Barium	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x
Beryllium											
Boron	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x
Cadmium											
Chromium											
Cobalt		x		x	x						
Copper											
Iron		x	x	x	x		x	x	x		x
Lead											
Manganese		x	x	x	x	x	x	x	x	x	x
Mercury					x						
Nickel		x	x	x	x	x	x	x	x	x	x
Selenium		x		x	x	x	x	x	x	x	
Silver											
Sulfate	Yes (Table 5-1)	x	x	x	x	x	x	x	x	x	x
Thallium											
Zinc											
Number of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		5	4	6	7	4	5	5	5	4	4
Percentage of Observed Constituents that are not Consistent with Indicators of Leachate from Ash Currently Stored in Impoundments [3]		26%	21%	32%	37%	21%	26%	26%	26%	21%	21%

Abbreviations:

"NLET" = neutral leaching extraction test (ASTM D3987-85)

"x" = constituent was detected above analytical detection limits during at least one quarterly groundwater monitoring event in 2014

Table 5-5
Summary of Constituents Detected during Most Recent Year (2014) of Quarterly Groundwater Monitoring Compared to Indicators of Leachate from Ash Currently Stored in Impoundments
Based on Site-Specific NLET Results for Bottom Ash

Notes:

1. Indicators of leachate from ash currently stored in impoundments is based on site-specific NLET results for bottom ash (Table 5-1).
2. Shading of cells is described below.
   - Green shading, which is not applicable ot this Table 2-6, would indicate that a constituent that is an indicator of leachate from ash currently stored in the impoundments was not detected during quarterly groundwater monitoring in 2014.
   - Blue shading indicates that a constituent that is not an indicator of leachate from ash currently stored in the impoundments was detected during at least one quarterly groundwater monitoring event in 2014.
   - No shading indicates that either (1) a constituent that is an indicator of leachate from ash currently stored in the impoundments was detected during at least one quarterly groundwater monitoring event in 2014, or (2) a constituent that is not an indicator of leachate from ash currently stored in the impoundments was not detected during quarterly groundwater monitoring in 2014.
3. Green and blue shading (see Note 2) demonstrate observed constituents that are not consistent with indicators of leachate from ash currently stored in impoundments.

J.SEYMOUR EXPERT REPORT

APPENDIX A
JOHN SEYMOUR CURRICULUM VITAE

Geosyntec
consultants

JOHN SEYMOUR, P.E.

remediation
geoenvironmental engineering
geotechnical engineering
coal combustion residuals management

EDUCATION

M.S., Geotechnical Engineering, University of Michigan, Ann Arbor, Michigan, 1980
B.S., Civil Engineering, Michigan Technological University, Houghton, Michigan, 1976

PROFESSIONAL REGISTRATIONS

Illinois P.E. Number 062-040562
Michigan P.E. Number 6201033056
West Virginia P.E. Number 017091
Wisconsin P.E. Number 26727

CAREER SUMMARY

Mr. Seymour is a geotechnical engineer with nearly three decades of experience in the U.S., Canada, Spain, Guatemala and Korea in the areas of site remediation, deep foundations, and construction management. He has focused on waste management and remediation (Superfund (CERCLA) and RCRA) projects for 25 years, having had significant involvement in 17 sites providing professional services in the areas of project management, project coordination (client representative), site characterization, feasibility studies, bench/pilot studies, civil/geotechnical design, construction quality assurance (CQA), and operation and maintenance.

He has completed field studies including geologic and hydrogeologic studies, aquifer testing, seismic surveys, landfill settlement tests, and the characterization of volatile organic compounds (TCE and by-products), semivolatile organic compounds, PCBs, lead, and saline groundwater intrusion.

He has provided coal combustion residuals (CCRs) engineering services, regarding waste management of fly ash, bottom ash and flue gas desulfurization (FGD) waste for impoundments and landfills. These services have included geotechnical and environmental evaluations of waste disposal expansions, operations and closure, disposal permit application preparation for eight U.S coal power generation clients. Overall he has provided relevant consulting engineering services for 7 CCRs impoundments and 14 CCR landfills and provided records review, evaluation and engineering scope of work development for 4 additional CCR impoundments. He has

Geosyntec consultants

translated some of his experience into 11 technical papers and recently submitted two final draft research guidance documents on CCR impoundments (co-investigator), and provided 10 technical presentations at conferences including at conferences focusing on CCR management.

His clients have primarily included major industrial manufacturers (utilities, automotive, tools, appliances) and waste management/disposal companies. He has been the lead in the design of 11 landfills. He has been the project lead for several major (multi-million dollar) remediation sites. He also has assisted in remedy negotiations with state and federal agencies at many sites.

In addition, he has geotechnical engineering experience with the design and construction of deep foundations, including drilled piers, tie backs, foundation grouting and soil improvement programs, and diaphragm (slurry) walls.

Highlights of Mr. Seymour's representative experience include:

Geoenvironmental

J. C. Weadock Plant CCR Facility Engineering Study, Consumers Energy Company, *Michigan*. Mr. Seymour is the project director and senior technical reviewer for a study of the existing CCR facility. The study is to assess the future use and closure of the facility considering current regulations and future proposed federal regulations regarding CCRs under RCRA and the effluent limitation guidelines and standards for the steam electric power generating industry under the Clean Water Act.

Rivesville and Albright Power Plants, *FirstEnergy, West Virginia*. Engineer of Record for the design of the closure of two CCR landfills.

Coal Combustion Residuals Pond Closure Guidance Documents, Electric Power Research Institute, *Nationwide*. Mr. Seymour is a co-investigator/author and project manager for the completion of two guidance documents relating to CCR pond closures. They include: (i) "Coal Combustion Residuals Pond Closure- Dewatering and Capping Guidance", and (ii) "Coal Combustion Residuals Pond Closure- Construction over Closed Ponds".

Confidential Power Plant, *Southern Ohio*. Mr. Seymour is the project manager for the conceptual design of a 300-acre fly ash disposal pond closure.

General James M. Gavin Power Plant, *American Electric Power, Cheshire, Ohio*. He managed the design of and the Permit to Install (PTI) application for a 50,000,000 cuyd residual waste landfill for the solid waste permit application under existing OEPA rules which incorporated relevant portions of the U.S. EPA proposed RCRA Subtitle D regulations.

Geosyntec consultants

General James M. Gavin Power Plant, *American Electric Power, Cheshire, Ohio.* Mr. Seymour was the project manager for the focused feasibility evaluation (FFE) for a coal combustion residuals (CCR) landfill expansion and the resulting design and permit application for a landfill expansion.

Monroe Power Plant, *DTE Energy, Monroe, MI.* Mr. Seymour managed the FGD Gypsum Disposal Facility Preliminary Engineering Study and was the project manager to assess disposal options for new flue gas desulphurization (FGD) gypsum that will be generated at this coal fired electrical generating station. Mr. Seymour is the project director and engineer of record to conduct an evaluation of the earthen containment dike around the ash basin and to assess the potential for a failure due to operating issues.

Planta Las Palmas CCB Landfill Development Studies, *Duke Energy International Guatemala, Guatemala.* Mr. Seymour completed studies to optimize the development of a new coal ash landfill and prepare site investigation bid specifications. He was the project manager to prepare the detailed design and construction bid documents for the coal storage area, ash landfill, leachate treatment pond with discharge structure, and the power plant water intake structure.

Wauconda Landfill Superfund Site Cover Evaluation, *Wauconda Task Force, Wauconda, IL.* Mr. Seymour was the project manager for the evaluation of the existing soil cover over Superfund site.

R. Paul Smith CCB Landfill Expansion, *Allegheny Energy Supply, Berkeley County, WV.* Mr. Seymour was the project manager for the design and construction quality assurance of a coal combustion byproducts landfill at a coal-fired power plant in Maryland with the landfill located in adjacent West Virginia.

MIG/DeWane Landfill Superfund Site Remedial Design, *Allied Waste Industries, Belvidere, IL.* Assisted the client with negotiations of a Statement of Work with the Illinois EPA for this CERCLA site. He is conducting a remedial design of a new cover system and gas collection system over the 50 acre landfill.

Confidential Landfill Remedial Action Support Services, *Republic Services, north-central IL.* Providing technical support to legal counsel for the remedy selection process at a 40-acre solid waste facility closed in the 1970s and developed into a park.

Planta Arizona, CCB Landfill Design Consulting, *Duke Energy International Guatemala, Guatemala.* Mr. Seymour provided consulting to DEIG to layout a new coal ash disposal facility for a coal-fired electrical generating station.

Cardinal Plant Landfill Studies, *American Electric Power, Brilliant, OH.* Completed a feasibility study to assess the potential to develop a new flue gas desulphurization (FGD) waste landfill over an existing fly ash disposal area at a coal-fired power plant.

Geosyntec consultants

Yeoman Creek Landfill Superfund Site, *PRP Group, Waukegan, IL.* Mr. Seymour was the project manager and Project Coordinator for this CERCLA site closure.

Utility Company, *Multiple Sites, WI.* Contaminated site consulting services and ash landfill design, construction inspection/management services. Mr. Seymour was the Contract Manager and project manager for multiple sites, including evaluation of existing groundwater remediation system to improve performance and evaluate alternate technologies in Wisconsin, and development of an approach to address existing environmental impacts at an MGP site along the Fox River in Wisconsin

Albion-Sheridan Township Landfill, *Cooper Industries and Corning, Inc., Albion, MI.* Project Coordinator, at CERCLA site. Provided solid and hazardous waste closure, construction management, remedial design, QA officer, closure certification, solid and hazardous waste remediation.

McGraw-Edison Facility, *Cooper Industries, Centerville, IA.* Project manager for CERCLA Site that was a manufacturing facility in Iowa to remediate TCE in soil and groundwater. Provided design review and engineering oversight for the installation of an iron reactive permeable barrier wall for treatment of TCE in groundwater and a hydro-fracture enhanced vapor extraction system, including over one year of performance monitoring and evaluation, and fate and transport modeling of the TCE.

J&L Landfill, *LTV Steel Company, Rochester Hills, MI.* Project Coordinator at this CERCLA site. Provided solid and hazardous waste landfill closure, construction management, remedy negotiation, closure design, QA officer, closure P.E. certification, solid and hazardous waste.

Monroe Stamping Plant Lagoon Closure, *Ford Motor Company, Monroe, MI.* Project manager for the resident engineering services for this facility where 55 acres of lagoons were closed as a hazardous waste landfill under a RCRA corrective action.

Rasmussen Landfill, *PRP Group, Green Oak Township, MI.* Project coordinator at CERCLA solid and hazardous waste site. Provided work plans, pre-design and remedial design, construction management for a hazardous waste landfill cover and groundwater pump and treat system, and closure P.E. certification. The project included: removal of hazardous waste drums; preload program to estimate waste consolidation; groundwater aquifer testing; and groundwater modeling.

Motor Wheel Disposal Site, *WR Grace, Inc., Lansing, MI.* Project manager for cost allocation arbitration case among potentially responsible parties at CERCLA landfill.

Brownfield Redevelopment Site, *WEPCo, Racine, WI.* Project manager and remediation design engineer for brownfield development with manufactured gas plant wastes (organic and inorganic compounds) in groundwater and soil, and VOCs in soil gas;

Geosyntec consultants

included groundwater aquifer testing, site investigation, aquifer modeling, remedial design, construction engineering/resident engineering, operation monitoring for a groundwater extraction system, and soil gas collection system for commercial and residential development at a former manufactured gas plant site.

Janesville Disposal Facility, *City of Janesville, Janesville, WI.* Groundwater design task manager for this CERCLA site. The site had several landfills that required RCRA cap design and a groundwater extraction system design to prevent groundwater discharge to the Rock River. Based upon the reports, aquifer testing and groundwater modeling, developed the concept to eliminate the groundwater extraction and treatment system because the surface water discharge criteria would not be exceeded and there were no receptors between the landfill and the river.

National Industrial Environmental Services, *Chemical Waste Management, Inc., near Wichita, KS.* Project engineering, design and project management for CERCLA/RCRA facility corrective action. The project included remediation of VOC groundwater contamination, treatment of sludges containing acids and metals and organics (SVOCs and VOCs) and sludge disposal into two new hazardous waste landfill cells and litigation support. The project also included aquifer tests, groundwater modeling, air monitoring, geophysical surveys, agency reporting, two RCRA Part B permit applications, and technical support for two trials.

Equilon (Shell Oil) Wood River Facility, *Shell Oil Company, Roxana, IL.* RCRA Corrective Action project management for a refinery along the Mississippi River that had numerous disposal areas. This project included: i) preparation of a RCRA Facility Investigation (RFI) investigation work plan; ii) conduct of the RFI; iii) certification of closure of one RCRA management unit; and iv) RCRA Part B submittal.

Berlin & Farro Liquid Incineration Site, *PRP Group, Swartz Creek, MI.* Conducted a CERCLA RI/FS, baseline risk assessment, negotiations with Region V EPA and MDEQ for cleanup, and litigation support. The RI included investigation of soil, soil gas, groundwater, surface water and sediment, and included seismic reflection and resistivity geophysical investigations.

Butterworth Landfill, *PRP Group, Grand Rapids, MI.* Completion of a remedial design work plan that included predesign sampling of soil, groundwater, river sediment, and fish in the Grand River at this 180 acre solid and hazardous waste landfill under CERCLA.

Bailey Dump Superfund Site, *Texas Water Commission, Bridge City, TX.* Site manager to perform a remedial investigation over a two-month period to characterize uncontrolled hazardous waste landfill under CERCLA.

Geosyntec consultants

Salt Intrusion Groundwater Modeling and Feasibility Study, *Morton Salt/Rohm & Haas, Inc., Manistee, MI.* Project manager for conduct of a feasibility study and groundwater transport model to assess methods to mitigate salt intrusion into an unconfined aquifer in Manistee.

Hartley & Hartley Landfill, *Joint Defense Group, Bay City, MI.* Project manager for site regulated by the NRC as an SDMP site regarding licensing, leachate management system design, and MDEQ/MDNR interface. The site contained low-level radiological thorium-bearing slag and hazardous and solid waste.

LUST Sites. Management and/or director for over 10 leaking underground storage tank projects in Michigan and Illinois.

Litigation Assignments

Confidential Client, 2014. Mr. Seymour was retained as an expert in the field of CCR landfill design over a closed coal ash pond.

Confidential Client, 2013. Mr. Seymour was retained as an expert in the field of CCR ponds for the arbitration of a major insurance claim.

AmForge Site Expert Witness, *Arvin-Meritor, Chicago, IL, 2006.* Provided engineering support in the areas of contaminant fate and transport, risk assessment, and site characterization in cost recovery case. The cost recovery was undertaken by private parties brought under CERCLA.

Geotechnical

Baby Creek Overflow Treatment Facility, *Detroit Water and Sewerage Department, Detroit, MI.* Project manager for the geotechnical investigation and foundation design for a combined sewer treatment system.

Co-generation Power Facility, *Sarnia, Canada.* Project manager for geotechnical site investigation for a co-generation (steam and electricity) facility.

Vila Olympica Building, *Bovis International, Barcelona, Spain.* Project manager to provide deep foundation geotechnical engineering at this 50 story high rise building along the Mediterranean coast.

Lucky-Goldstar Building, *Lucky Development Company, Seoul, South Korea.* Resident engineer and quality control manager for construction of the deep foundation and foundation grouting program.

Phase I Dam Safety Inspections, *U.S. Army Corps of Engineers, Multiple Sites, MO.* Field inspection of five dams and reporting writing for approximately 15 dams undergoing Phase I (non-intrusive) safety inspections.

***Ann Arbor Wastewater Treatment Plant**, City of Ann Arbor, MI.* Field resident engineering support for construction of this new facility. His responsibilities included oversight of groundwater dewatering to avoid "bottom heave" of the excavation, compaction control and QC inspection of civil construction.

***Beaver Valley Power Station**, Duquesne Light, Shippingport, PA.* Field resident engineering for foundation construction of an 888 megawatt nuclear fuel power plant.

PROFESSIONAL EXPERIENCE

Geosyntec Consultants, Chicago, IL, 2001-present
URS Corporation, Detroit, MI, 1997 – 2001
Woodward-Clyde Consultants (later URS), Chicago, IL and Detroit, MI, 1980-1997
Townsend and Bottum, Ann Arbor, MI, 1978-1979
Stone & Webster, Shippingport, PA, 1976-1978

AFFILIATIONS

American Society of Civil Engineers

Midwest Coal Ash Association

Society of American Military Engineer

REPRESENTATIVE PUBLICATIONS

15-05 "Reliability Analysis of an Existing Ash Basin Embankment" at the World of Coal Ash Conference, Nashville, TN, Omer Bozok, Burak F. Tanyu, Paul Sabatini, and John Seymour

15-01 "Conditions of Coal Ash Embankments", at the U.S. Society on Dams Conference, April 2015 I Louisville, KY, John Seymour, P.E., Omer Bozok, Amanda Hughes, Ph.D., Brad Bodine, P.E; & World of Coal Ash Conference, Nashville, TN, May 2015.

13-04 "Challenges of Closing Large Fly Ash Ponds", World of Coal Ash Conference, Lexington, Kentucky, April 2013.

11-05 "Advances in Design of Landfills over CCR Ponds and CCR Landfills", Proceedings from the World of Coal Ash conference, Denver, CO, John Seymour, P.E. and Michael F. Houlihan, P.E. BCEE, May 2011.

11-06 "Case Study: Stability of Two Horizontal to One Vertical Embankment", Proceedings from ASCE Geo-Frontiers 2011, Advances in Geotechnical

Engineering, Burak Tanyu, PhD, W. Neal, P.E., J Seymour, P.E., M ASCE, D. Bodine, P.E. M ASCE, and O. Bozok.

08-04 "Use of Tire Chips in the Final Cover System of a Superfund Site Landfill", ACSE Proceedings from GeoCongress 2008 titled: "The Challenge of Sustainability in the Geoenvironment", Majdi A. Othman, M. ASCE, Ph.D., P.E., and John Seymour, P.E.

INVITED PRESENTATIONS

15-06 "Slope Stability, Inspections, and Monitoring Considerations under the CCR Rule", Technical Short Course Teacher at the EPRI CCR Program Summer Meeting, June 2015, Bar Harbor, ME.

13-12 "CCR Pond Closures: Major Difficulties and Solutions", presentation to the Utility Solid Waste Activities Group, Washington, D.C., December, 2013.

13-04 Presentation of: "Challenges of Closing Large Fly Ash Ponds", at the World of Coal Ash Conference, Lexington, Kentucky, April 2013.

13-04 "Hot Topics Regarding Coal Combustion Residuals Management, presentation to Winston & Strawn Environmental Group, Chicago, Illinois, April 2013.

11-05 Presentation of: "Advances in Design of Landfills over CCR Ponds and CCR Landfills", at the World of Coal Ash conference, Denver, CO, May 2011.

09-04 "Geotechnical Design Considerations for Landfill Construction Over an Ash Pond", World of Coal Ash, Lexington, KY, May 2009

J.SEYMOUR EXPERT REPORT

APPENDIX B
SURFACE WATER RISK CHARACTERIZATION

Appendix B to Expert Report of John Seymour, P.E.
Surface Water Risk Characterization

Section 1: Introduction

This focused risk characterization evaluates the potential for human health and ecological risks from an assumed exposure to constituents of interest (COIs) in groundwater associated with each of the four sites that may migrate to surface water. COIs are defined as described in Sections 4.1.6, 4.2.6, 4.3.6, and 4.4.6 of the Expert Report of John Seymour. These evaluations are conservative as they assume a complete exposure pathway exists between groundwater COIs and receptors in the adjacent surface water bodies, and do not fully analyze attenuation or dilution mechanisms. The screening assessment also considers background and upgradient source COIs that are not from the ponds, thereby overestimating the risk from the ponds.

Section 2: Risk Evaluation Methods

2.1. Methods Overview

For this evaluation, potential risks to human health and the environment from COIs that could possibly migrate to surface water were evaluated using a screening-level approach that compared estimates of exposure to estimates of effect. This approach is commonly used to screen for the potential for risk and determine if additional assessment is required.

2.2. Definition of Risk

It is assumed that there are "no unacceptable risks" if site-specific groundwater concentrations are less than Illinois Water Quality Standards (WQS) or Water Quality Criteria (WQC) for surface water, which are considered to be protective of human health and the environment. These WQS/WQC incorporate toxicological (i.e., does-response) data as well policy-based assumptions, including the state-determined acceptable risk level. Therefore, a conclusion of "no unacceptable risk" is a conclusion based upon regulatory processes. If a site concentration is greater than a WQS/WQC, it cannot be concluded that a risk exists, only that further evaluation may be warranted or necessary. At this step, site-specific conditions are typically evaluated in a quantitative and/or qualitative manner to refine preliminary conclusions of the screening step. For this evaluation, the refinement step considers the exceedance location (relative to other wells and receiving water bodies), magnitude, and frequency. If these lines of evidence support that "no unacceptable risks" are likely at the point-of-exposure (i.e., the lake or river), then it is concluded that there is an unlikely potential for risk.

2.3. Risk Evaluation Inputs

Exposure and effect estimates used in this screening-level approach are discussed below.

Exposure: COI concentrations reported for onsite groundwater monitoring wells were conservatively assumed to represent exposure point concentrations (EPCs) for human and ecological receptors. This overestimates risk as human and ecological exposure to groundwater within these sites represents an incomplete exposure pathway. In other words, there are no onsite exposures and, therefore, no onsite risks. Human and ecological receptors may be present in the adjacent surface water bodies; however, groundwater is expected to undergo dilution and attenuation as it migrates through the subsurface and then mixes with surface water. Thus, this assumption overestimates risks to potential off-site receptors by overestimating the exposure concentration.

Effect: Effects values for this evaluation were Illinois chronic WQS or, if a WQS was not available, Illinois chronic WQC. Surface water effects values and their sources are provided in Table B-1. The Illinois Environmental Protection Agency (IEPA) specifies that acute WQS "*...shall not be exceeded at any time except for those waters for which a zone of initial dilution (ZID) has been approved by the Agency...*" For this evaluation, it was assumed that a ZID has not been approved and, thus, chronic values would be applicable. However, given the conservative assumptions about exposure, acute values could provide a secondary line of evidence for evaluating risk.

Section 3: Site-Specific Risk Evaluations

3.1. Risk Evaluation – Joliet #29 Generating Station

3.1.1. Estimates of Exposure and Effect

Groundwater in the vicinity of the Joliet #29 Power Generating Station ash ponds discharges south to the Des Plaines River via the adjoining intake channel. Based on groundwater data collected between December 2010 and February 2015 from onsite monitoring wells (MW-01 through MW-11), COIs for this site are: antimony, boron, chloride, iron, manganese, sulfate, and total dissolved solids (TDS).

Analytical data used in this evaluation is provided in Table B-2-1. Well-specific summary statistics calculated for COIs are provided in Table B-2-2 (average concentrations) and Table B-2-3 (maximum concentrations). Additionally, the mean of averages and the mean of maximums are calculated to provide a preliminary estimate of area-wide EPCs. Monitoring well locations are shown in Figure 4-1.

3.1.2. Results of Risk Evaluation

Based on comparisons of maximum detected concentrations at the site to WQS/WQC, there are no unacceptable risks from antimony, boron, manganese, and TDS.

Maximum detected concentrations of chloride and sulfate exceeded chronic WQS in one well each (MW-08 and MW-09, respectively); however, the magnitude of exceedance was low and average concentrations within these wells were below chronic WQS. Therefore, there is an unlikely potential for risk from chloride and sulfate.

Maximum and average iron concentrations in well MW-09 exceeded the WQS. Maximum iron concentrations in MW-07 and MW-08 also exceeded the WQS; however, iron was infrequently detected (1 detection in 18 samples) in these wells and average iron concentrations were less than the WQS. Notably, in wells nearer to the river and downgradient of MW-09 (e.g., MW-03 and MW-04), iron has not been detected. Therefore there is an unlikely potential for risk from iron.

3.2. Risk Evaluation – Powerton Generating Station

3.2.1. Estimates of Exposure and Effect

The site area has two groundwater flow regimes. Groundwater in the vicinity of the Powerton Generating Station ash ponds that is within the silt/clay unit discharges in a westerly direction to the adjoining intake channel; groundwater that is within the gravelly sand unit discharges in a northerly direction to the Illinois River. Based on groundwater analytical data collected between December 2010 and February 2015 from onsite monitoring wells (MW0-01 through MW-16), COIs for this site are: arsenic, boron, chloride, iron, lead, manganese, nitrate, selenium, sulfate, thallium, pH, and TDS.

Analytical data used in this evaluation is provided in Table B-3-1. Well-specific summary statistics calculated for each COI are from this data are provided in Table B-3-2 (average concentrations) and Table B-3-3 (maximum concentrations). Additionally, the mean of averages and the mean of maximums are calculated to provide a preliminary estimate of area-wide EPCs. Monitoring well locations are shown in Figure 4-2.

3.2.2. Results of Risk Evaluation

Based on comparisons of maximum detected concentrations at the site to WQS/WQC, there are no unacceptable risks from boron, chloride, nitrate, selenium, sulfate, and TDS.

Maximum detected concentrations of arsenic exceeded the chronic WQS in wells MW-07 and MW-06; however, the magnitude of exceedance was low (<2x) and average concentrations within these wells were below the chronic WQS. The maximum detected concentration of lead exceeded the chronic WQS in well MW-12; however, the magnitude of exceedance was low (<4x) and the average concentration within this well was below the chronic WQS. The maximum detected concentration of thallium exceed the chronic WQC in well MW-14; however, the magnitude of exceedance was low (<2x) and the average concentration within this well was below the chronic WQC. Field-measured pH levels were periodically less than or greater than the WQS range; however, on average, pH levels were well within the range. Therefore, based on the screening-level comparisons and site-specific conditions, there is an unlikely potential for risk form arsenic, lead, thallium, and pH.

Maximum and average manganese concentrations in in wells MW-07, MW-11, and MW-13 exceeded the WQS. These wells are reported to be screened within the gravelly-sand unit where groundwater flows in a northerly direction toward the Illinois River (i.e., the receiving water body). However, maximum and average manganese concentrations reported in several downgradient wells located nearer to the river (MW-03, MW-04, and MW-05) were below the chronic WQS, indicating attenuation is occurring. Maximum manganese concentrations in wells MW-06 and MW-10 also exceeded the WQS at least once. MW-10 is reported to be screened within the gravelly-sand unit and is also upgradient of wells MW-03, MW-04, and MW-05. Exceedances within this well were of low magnitude (<2x) and the well-specific average concentration was less than the WQS. MW-06 exceedances were infrequent (1 in 18 samples), of low magnitude (<3x), and occurred in a monitoring well located adjacent to the intake channel, which conveys water from the river to the Site. Therefore, the transport of manganese via the channel to the river is not probable and there is an unlikely potential for risk from manganese.

Within the northerly-flowing gravelly-sand unit, maximum iron concentrations in wells MW-07, MW-10, MW-11, and MW-13 exceeded the chronic WQS. Importantly, however, maximum and average iron concentrations reported in several downgradient wells located nearer to the river (MW-03, MW-04, and MW-05) were below the chronic WQS. Within each of the five wells within the westerly-flowing silt-clay later, average and maximum iron concentrations exceeded the chronic WQS. These wells with exceedances are located adjacent to and flow westerly toward the intake channel, which conveys water from the river to the site. Thus, transport of iron via the channel to the river is not probable. Therefore, there is an unlikely potential for risk from iron.

3.3. Risk Evaluation – Waukegan Generating Station

3.3.1. Estimates of Exposure and Effect

Groundwater in the vicinity of the Waukegan Generating Station ash ponds discharges in an easterly direction to adjacent Lake Michigan. Based on the groundwater data collected between October 2010 and February 2015 from onsite monitoring wells (MW-01 through MW-09), COIs for this site are: antimony, arsenic, boron, chloride, iron, manganese, sulfate, pH, and TDS. Note that these COIs include inorganic constituents from upgradient and offsite sources, such as boron, which is migrating on to the Waukegan site from the former Greiss-Pfleger Tannery site.

Analytical data used in this evaluation is provided in Table B-4-1. Well-specific summary statistics calculated for COIs are provided in Table B-4-2 (average concentrations) and Table B-4-3 (maximum concentrations). Additionally, the mean of averages and the mean of maximums are calculated to provide a preliminary estimate of area-wide EPCs. Monitoring well locations are shown in Figure 4-3.

3.3.2. Results of Risk Evaluation

Based on comparisons of maximum detected concentrations to WQS/WQC, there are no unacceptable risks from antimony and manganese.

Maximum detected concentrations of the remaining COIs exceeded WQS/WQC in at least one well. Arsenic exceedances were limited to two samples from MW-01, are of low magnitude (<2x), and the average concentration in MW-01 was less than the WQS. Chloride exceedances were limited to two samples from MW-05, are of low magnitude (<2x), and the average concentration was less than the WQS. Elevated pH levels were limited to wells MW-01, MW-02, and MW-03; however, on average, pH levels were within the WQS range. Therefore, there is an unlikely potential for risk form arsenic, chloride, and pH.

In individual wells MW-05 through MW-09, which are west and southwest of the ponds, average concentrations of boron, iron, sulfate, and TDS exceeded chronic WQS on one or more occasions. Importantly, there are no unacceptable risks for boron, iron, sulfate, and TDS in wells MW-01 through MW-04, which represent the most downgradient wells at the site. MW-01 through MW-04 appear to be downgradient of MW-05, MW-06, MW-08, and MW-09, indicating attenuation is occurring. Although no wells are directly downgradient of MW-07, there is no data to indicate that similar attenuation is not occurring in this area.

3.4. Risk Evaluation – Will County Generating Station

3.4.1. Estimates of Exposure and Effect

Groundwater in the vicinity of the Will County Generating Station ash ponds discharges in a westerly direction to the adjacent Des Plaines River. Based on the groundwater data collected between December 2010 and February 2015 from onsite monitoring wells (MW-01 through MW-10), COIs for this site are: antimony, boron, chloride, manganese, sulfate, pH, and TDS.

Analytical data used in this evaluation is provided in Table B-5-1. Well-specific summary statistics calculated for COIs are provided in Table B-5-2 (average concentrations) and Table B-5-3 (maximum concentrations). Additionally, the mean of averages and the mean of maximums are calculated to provide a preliminary estimate of area-wide EPCs. Monitoring well locations are shown in Figure 4-5.

3.4.2. Results of Risk Evaluation

Based on comparisons of maximum detected concentrations to WQS/WQC, there are no unacceptable risks from antimony, boron, chloride, manganese, and TDS.

Maximum detected concentrations of sulfate exceeded the chronic WQS in two wells (MW-04 and MW-05). These two wells are located east (upgradient) of the ponds and are not adjacent to the river; no sulfate exceedances have occurred in those wells that are adjacent to the river (MW-07, MW-08, MW-09, and MW-10). Therefore, there is an unlikely potential for risk from sulfate.

Field-measured pH levels in individual wells were variable and periodically were less than or greater than the WQS range; however, with the exception of one well (MW-09), average pH levels were well within the range. For MW-09, pH levels exceeded the range in the majority of samples evaluated herein. MW-09 is located adjacent to the Des Plaines River; however, given that average pH concentrations in the remaining nine wells, including wells adjacent to the river, were within the acceptable range, there is an unlikely potential for risk from pH.

Table B-1
Surface Water Effects Values
Midwest Generation

Constituent	CAS	Units	Surface Water Effects Values [1]							
			General Use [2]				Lake Michigan Basin [3]			
			Chronic		Acute [4]		Chronic		Acute [4]	
Antimony	7440-36-0	mg/L	0.32	(2e)	1.2	(2e)	0.32	(3d)	1.2	(3d)
Arsenic	7440-38-2	mg/L	0.19	(2a)	0.36	(2a)	0.148	(3a)	0.34	(3a)
Boron	7440-42-8	mg/L	7.6	(2a)	40.1	(2a)	7.6	(3a)	40.1	(3a)
Chloride	16887-00-6	mg/L	500	(2b)	--		500	(3b)	--	
Iron	7439-89-6	mg/L	1.0	(2b)	--		1.0	(3b)	--	
Lead	7439-92-1	mg/L	0.0485	(2a,i)	0.231	(2a,i)	n/a		n/a	
Manganese	7439-96-5	mg/L	3.04	(2a,ii)	7.15	(2a,ii)	3.04	(3a)	7.15	(3a)
Nitrate	14797-55-8	mg/L	--		--		n/a		n/a	
pH	--	s.u.	6.5 - 9.0	(2d)	--		6.5 - 9.0	(3c)	--	
Selenium	7782-49-2	mg/L	1.0	(2b)	--		n/a		n/a	
Sulfate	18785-72-3	mg/L	site-specific	(2c)	--		500	(3b)	--	
Joliet #29	18785-72-3	mg/L	1350	(2c)	--		500	(3b)	--	
Powerton	18785-72-3	mg/L	1430	(2c)	--		500	(3b)	--	
Waukegan	18785-72-3	mg/L	1410	(2c)	--		500	(3b)	--	
Will County	18785-72-3	mg/L	1480	(2c)	--		500	(3b)	--	
Thallium	7440-28-0	mg/L	0.0037	(2f)	0.086	(2e)	n/a		n/a	
Total Dissolved Solids	--	mg/L	--		--		1,000	(3c)	--	

Notes

(1) Illinois Water Quality Standards (WQS) are used as surface water effects values for evaluating hypothetical human and ecological exposure scenarios. In the absence of a WQS, Illinois Water Quality Criteria (WQC) are used. Values are applicable to total (rather than dissolved) concentrations.

(2) Concentration represents an Illinois General Use WQS as defined in 35 IAC 302, Subpart B or an Illinois WQC (lower of aquatic life and human health WQC):

(a) 35 IAC 302.208(e), Numerical Water Quality Standards for the Protection of Aquatic Life
(i) Standard for total lead is a hardness (H)-dependent value, calculated as follows (see also footnote 5):
Chronic = exp[-2.863+1.273*ln(H)]*1E-3 mg/µg
Acute = exp[-1.301+1.273*ln(H)]*1E-3 mg/µg
(ii) Standard for total manganese is a hardness (H)-dependent value, calculated as follows (see also footnote 5):
Chronic = exp[4.0635+0.7467*ln(H)]*1E-3 mg/µg
Acute = exp[4.9187+0.7467*ln(H)]*1E-3 mg/µg
(b) 35 IAC 302.208(g), Single-Value Standards
(c) 35 IAC 302.208(h)(2)(A), Water Quality Standard for Sulfate; standard is hardness (H) and chloride (Cl) dependent, and calculated as follows (see also footnotes 5 and 6):
Chronic = exp[1276.7+5.508*(H)-1.457(Cl)]*0.65
(d) 35 IAC 302.204, pH
(e) Illinois WQC for the protection of aquatic life.
(f) Illinois WQC for the protection of human health (applicable to chronic values only).

(3) Concentration represents an Illinois Lake Michigan Basin WQS as defined in 35 IAC 302, Subpart E. Note that of the four subject sites, Lake Michigan Basin WQS are only applicable to the Waukegan Power Generating Station. "n/a" indicates a constituent is not of interest at the Waukegan Power Generating Station.

(a) 35 IAC 302.504(a), Lake Michigan Basin Water Quality Standards for Chemical Constituents. WQS for manganese and lead are calculated using the hardness-dependent GU equations.
(b) 35 IAC 302.504(b)
(c) IAC 302.503, pH
(d) If a Lake Michigan Basin WQS was not available, the General Use WQS was assumed to be applicable.

(4) Chronic values are used as the primary effects values for this evaluation; however, acute values are also presented for discussion purposes.
(5) Site-specific hardness data is not available. However, based on data from the Illinois Water Quality Database (http://ilrdss.isws.illinois.edu/WQ/), a value of 200 mg/L is considered a conservative estimate for the Site.
(6) Sulfate WQS calculated using the average chloride concentration for available data, which are as follows:

Joliet #29 212
Powerton 121
Waukegan 141
Will Count 72.3

Definitions
"--" = value not available
n/a = not applicable
mg/L = milligram per liter
s.u. = standard unit

Table B-2-1
Groundwater Analytical Results for Constituents of Interest; December 2010 to February 2015
Midwest Generation – Joliet #29 Generating Station - Joliet, Will County, Illinois

Well	Constituent	Effects Values [1]	Units	Groundwater Analytical Results (Year [Month]): 2010 [12]	2011 [03]	2011 [06]	2011 [09]	2011 [12]	2012 [03] [2]	2012 [06]	2012 [09] [3]	2012 [12]	2013 [03]	2013 [05/06] [4]	2013 [07]	2013 [10]	2014 [02]	2014 [05]	2014 [08]	2014 [10]	2015 [02]
MW-01	Antimony	0.32	mg/L	0.0043	NS	<0.003	NS	NS	NS	NS	<0.003	NS	NS	0.0052	NS	NS	NS	NS	<0.003	<0.003	NS
MW-01	Boron	7.6	mg/L	0.31	NS	0.29	NS	NS	NS	NS	0.38	NS	NS	0.33	NS	NS	NS	NS	0.22	0.21	NS
MW-01	Chloride	500	mg/L	140	NS	170	NS	NS	NS	NS	120	NS	NS	210	NS	NS	NS	NS	120	79	NS
MW-01	Iron	1	mg/L	<0.1	NS	<0.1	NS	NS	NS	NS	<0.1	NS	NS	<0.1	NS	NS	NS	NS	<0.1	<0.1	NS
MW-01	Manganese	3.0	mg/L	<0.0025	NS	<0.0025	NS	NS	NS	NS	<0.0025	NS	NS	<0.0025	NS	NS	NS	NS	0.012	0.015	NS
MW-01	Sulfate	1350	mg/L	180	NS	81	NS	NS	NS	NS	240	NS	NS	140	NS	NS	NS	NS	59	65	NS
MW-01	Total Dissolved Solids	--		590	NS	670	NS	NS	NS	NS	610	NS	NS	700	NS	NS	NS	NS	550	570	NS
MW-02	Antimony	0.32	mg/L	0.012	NS	0.0042	0.0032	<0.003	<0.003	NS	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-02	Boron	7.6	mg/L	0.31	NS	0.35	0.44	0.74	0.22	NS	0.35	0.42	0.41	0.35	0.29	0.41	0.34	0.25	0.22	0.22	0.23
MW-02	Chloride	500	mg/L	140	NS	230	140	140	280	NS	120	150	260	250	310	180	240	350	280	240	190
MW-02	Iron	1	mg/L	<0.1	NS	<0.5	<0.1	<0.1	<0.1	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-02	Manganese	3.0	mg/L	<0.0025	NS	<0.013	0.0025	<0.0025	<0.0025	NS	<0.0025	<0.0025	<0.0025	<0.0025	0.0036	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-02	Sulfate	1350	mg/L	190	NS	67	110	150	110	NS	190	140	130	150	140	130	61	68	85	92	67
MW-02	Total Dissolved Solids	--		600	NS	720	690	750	800	NS	580	720	840	860	980	660	830	1100	850	810	730
MW-03	Antimony	0.32	mg/L	0.004	<0.003	<0.003	0.0065	0.016	0.013	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-03	Boron	7.6	mg/L	0.24	0.36	0.46	0.24	0.23	0.26	0.31	0.22	0.28	0.29	0.74	0.67	0.27	0.45	0.27	0.37	0.45	0.52
MW-03	Chloride	500	mg/L	260	240	300	160	260	250	260	330	290	260	380	210	250	200	300	220	180	160
MW-03	Iron	1	mg/L	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-03	Manganese	3.0	mg/L	0.1	0.048	<0.013	0.0076	0.008	0.0095	0.014	0.011	0.0076	0.0068	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-03	Sulfate	1350	mg/L	120	160	120	120	160	190	160	150	110	140	250	260	210	89	110	84	130	58
MW-03	Total Dissolved Solids	--		930	1100	1000	930	1100	1000	1100	1000	1100	950	1300	1000	910	890	1100	810	760	700
MW-04	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	0.0067	0.0057	<0.003	<0.003	<0.003	<0.003	0.012	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-04	Boron	7.6	mg/L	0.46	0.37	0.38	0.25	0.34	0.29	0.48	0.34	0.38	0.4	0.4	0.5	0.45	0.35	0.32	0.35	0.41	0.44
MW-04	Chloride	500	mg/L	270	270	250	150	200	210	270	260	250	230	270	200	210	220	270	210	160	180
MW-04	Iron	1	mg/L	<0.1	<0.1	<0.5	0.22	<0.1	<0.1	<0.1	<0.1	<0.1	0.46	0.17	<0.1	<0.1	<0.1	0.18	<0.1	<0.1	0.14
MW-04	Manganese	3.0	mg/L	0.33	0.048	0.018	0.066	0.029	0.018	0.082	0.043	0.029	0.067	0.0081	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0044
MW-04	Sulfate	1350	mg/L	300	140	84	74	170	210	110	180	130	110	120	170	230	110	140	89	160	65
MW-04	Total Dissolved Solids	--		1100	1000	890	770	970	930	1100	980	1000	880	900	840	860	870	860	760	720	730
MW-05	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	0.004	0.0035	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-05	Boron	7.6	mg/L	0.42	0.52	0.47	0.57	0.49	0.54	0.44	0.55	0.65	0.59	0.69	0.81	0.55	0.34	0.36	0.95	0.57	0.69
MW-05	Chloride	500	mg/L	150	240	220	120	190	210	220	240	210	230	180	110	140	240	370	120	120	220
MW-05	Iron	1	mg/L	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-05	Manganese	3.0	mg/L	0.0065	<0.0025	<0.013	<0.0025	<0.0025	<0.0025	0.004	0.081	<0.0025	0.0037	<0.0025	<0.0025	<0.0025	<0.0025	0.035	0.0062	<0.0025	0.0076
MW-05	Sulfate	1350	mg/L	110	160	100	140	140	190	130	210	210	150	200	290	180	130	160	360	240	230
MW-05	Total Dissolved Solids	--		750	990	850	800	900	930	1000	990	1000	960	1100	910	680	840	1100	1000	730	1000
MW-06	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0045	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-06	Boron	7.6	mg/L	0.32	0.44	0.32	0.27	0.3	0.25	0.26	0.25	0.31	0.33	0.23	0.23	0.22	0.26	0.17	0.26	0.19	0.22
MW-06	Chloride	500	mg/L	130	270	140	140	130	240	210	190	150	160	170	120	120	370	340	120	100	150
MW-06	Iron	1	mg/L	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-06	Manganese	3.0	mg/L	0.14	0.033	<0.013	0.036	0.024	0.015	0.008	0.0087	0.0076	0.0047	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-06	Sulfate	1350	mg/L	140	140	87	100	130	110	91	85	120	120	96	110	150	100	120	91	140	140
MW-06	Total Dissolved Solids	--		650	1000	650	620	710	800	860	760	710	690	690	350	570	930	990	600	530	710
MW-07	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-07	Boron	7.6	mg/L	0.51	0.39	0.25	0.29	0.35	0.3	0.25	0.31	0.41	0.39	0.21	0.21	0.24	0.3	0.15	0.22	0.17	0.21
MW-07	Chloride	500	mg/L	430	320	140	99	140	300	170	170	140	190	170	95	130	470	350	110	98	210
MW-07	Iron	1	mg/L	<0.1	<0.1	<0.5	[illegible]	<0.1	<0.1	0.13	<0.1	<0.1	<0.1	0.41	<0.1	<0.1	<0.1	<0.1	<0.1	0.13	0.13
MW-07	Manganese	3.0	mg/L	0.29	0.014	<0.013	0.08	0.0073	0.015	0.069	0.0041	0.0063	0.0044	0.012	<0.0025	<0.0025	<0.0025	<0.0025	0.0033	0.0091	0.0048
MW-07	Sulfate	1350	mg/L	250	120	85	110	160	140	190	130	90	150	150	74	190	170	110	82	120	260
MW-07	Total Dissolved Solids	--		1200	970	580	650	780	870	760	760	760	720	740	540	650	1200	860	570	520	1000

Table B-2-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation – Joliet #29 Generating Station - Joliet, Will County, Illinois

Well	Constituent	Effects Values (1)	Units	Groundwater Analytical Results (Year [Month]) 2010 [12]	2011 [03]	2011 [06]	2011 [09]	2011 [12]	2012 [03] (2)	2012 [06]	2012 [09] (3)	2012 [12]	2013 [03]	2013 [05/06] (4)	2013 [07]	2013 [10]	2014 [02]	2014 [05]	2014 [08]	2014 [10]	2015 [02]
MW-08	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-08	Boron	7.6	mg/L	0.29	0.16	0.12	0.2	0.16	0.13	0.2	0.46	0.33	0.25	V	0.18	0.19	0.16	0.15	0.19	0.16	0.64
MW-08	Chloride	500	mg/L	130	350	150	79	120	410	190	130	130	200	300	210	110	270	**700**	170	140	470
MW-08	Iron	1	mg/L	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	0.24	<0.1	<0.1	0.23	<0.1	<0.1	0.11	<0.1	<0.1	<0.1	**10**
MW-08	Manganese	3.0	mg/L	0.0051	0.0026	0.017	<0.0025	<0.0025	0.0042	0.016	0.023	0.0044	<0.0025	0.0065	<0.0025	<0.0025	0.0039	<0.0025	0.017	0.0069	1.1
MW-08	Sulfate	1350	mg/L	210	87	52	120	170	130	110	180	130	150	99	72	74	54	460	59	73	600
MW-08	Total Dissolved Solids	--		670	990	580	690	800	1000	740	710	730	830	860	740	560	740	2100	610	560	2000
MW-09	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-09	Boron	7.6	mg/L	0.36	0.32	0.29	0.35	0.31	0.38	0.34	0.59	0.44	0.36	0.3	0.29	0.29	0.3	0.27	0.29	0.24	0.3
MW-09	Chloride	500	mg/L	140	230	290	190	190	170	250	160	150	190	290	280	280	270	340	270	230	390
MW-09	Iron	1	mg/L	<0.1	0.18	**7.3**	**3.0**	**1.5**	**5.5**	**8**	**4.7**	**13**	**15**	**160**	**50**	**25**	**12**	**8.4**	**190**	**45**	**33**
MW-09	Manganese	3.0	mg/L	1.1	1.6	0.95	0.82	0.66	1.3	1.2	0.68	0.44	0.43	1.6	0.81	0.52	0.34	0.3	0.72	0.38	0.54
MW-09	Sulfate	1350	mg/L	**1400**	1100	580	750	130	**1600**	**1500**	**1600**	1100	700	1300	1000	680	560	560	880	960	820
MW-09	Total Dissolved Solids	--		2600	2400	1500	1700	2400	2600	2800	2900	2000	1700	3000	2300	1700	1600	1700	2100	1700	2400
MW-10	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-10	Boron	7.6	mg/L	0.5	0.54	0.54	0.41	0.52	0.52	0.53	0.43	0.49	0.49	0.25	0.3	0.42	0.4	0.39	0.48	0.56	0.52
MW-10	Chloride	500	mg/L	200	300	7.1	170	180	180	290	230	200	210	240	210	220	240	300	200	170	210
MW-10	Iron	1	mg/L	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.32	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-10	Manganese	3.0	mg/L	0.12	0.0076	<0.013	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.01	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0049
MW-10	Sulfate	1350	mg/L	130	130	89	100	190	250	170	110	120	84	120	130	140	55	120	73	110	93
MW-10	Total Dissolved Solids	--		860	1100	980	730	890	890	1100	870	860	830	850	910	880	870	890	910	740	810
MW-11	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-11	Boron	7.6	mg/L	0.47	2.6	2.2	1.1	1.2	1.4	0.85	0.68	0.57	1.1	0.34	0.88	0.49	1.2	1.3	1.6	2	1.1
MW-11	Chloride	500	mg/L	160	270	280	86	140	240	150	150	140	190	160	91	140	430	340	120	84	270
MW-11	Iron	1	mg/L	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	0.23	<0.1	0.42	0.15	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.17
MW-11	Manganese	3.0	mg/L	0.052	0.0047	<0.013	0.0053	0.0047	<0.0025	0.014	<0.0025	0.042	0.016	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.27
MW-11	Sulfate	1350	mg/L	140	150	110	110	160	140	150	100	150	110	100	100	110	130	100	91	120	290
MW-11	Total Dissolved Solids	--		770	1000	710	590	790	850	760	740	730	770	670	570	690	1100	850	720	580	1300

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) Manganese results for March 2012 for wells MW-02, MW-03, and MW-04 were qualified as "" by the laboratory, which denotes instrument-related QC exceeds the control limits.
(3) Boron results for September 2012 were qualified as "" by the laboratory, which denotes instrument-related QC exceeds the control limits.
(4) Boron results for May 2013 for well MW-03 were qualified as "V" by the laboratory. A qualifier definition was not identified.

mg/L = milligrams per liter
"--" = value not available
"<" = constituent was not detected; the reporting limit is presented
bold/shading = concentration exceeds effects value

Table B-2-2
Comparison Of Average Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation -- Joliet #29 Generating Station - Joliet, Will County, Illinois

Constituent	Units	Effects Value (1)	Groundwater Analytical Results - Average Concentrations (2)											Average (3)
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07	MW-08	MW-09	MW-10	MW-11	
Antimony	mg/L	0.32	0.00258	0.00243	0.00336	0.00261	0.00175	0.00167	0.003 U	0.003 U	0.003 U	0.003 U	0.00367 U	0.00202
Boron	mg/L	7.6	0.29	0.347	0.368	0.384	0.567	0.268	0.287	0.234	0.334	0.461	1.17	0.428
Chloride	mg/L	500	140	219	251	227	196	181	207	241	239	209	191	209
Iron	mg/L	1.0	0.1 U	0.125 U	0.122 U	0.112	0.122 U	0.122 U	0.303	0.638	**28.5**	0.0761	0.104	**2.73**
Manganese	mg/L	3.04	0.00533	0.0018	0.0127	0.0428	0.00906	0.0163	0.0295	0.0675	0.799	0.00918	0.0237	0.0924
Sulfate	mg/L	1350	128	118	146	144	185	115	143	157	968	123	131	214
Total Dissolved Solids	mg/L	--	618	783	982	898	918	712	785	884	2170	887	788	948

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) Average of concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the average reporting limit is presented in the table, indicated with a "U" qualifier. Otherwise, non-detect results were included in the average calculation assuming one-half the reporting limit.
(3) Average of concentrations (averages) presented in the table, assuming one-half the reporting limit for non-detect results.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit; reporting limit presented
bold/shading = concentration exceeds effects value

Table B-2-3
Comparison Of Maximum Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation -- Joliet #29 Generating Station - Joliet, Will County, Illinois

Constituent	Units	Effects Value (1)	Groundwater Analytical Results - Maximum Concentrations (2)											Average (3)
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07	MW-08	MW-09	MW-10	MW-11	
Antimony	mg/L	0.32	0.0052	0.012	0.016	0.012	0.004	0.0045	0.003 U	0.003 U	0.003 U	0.003 U	0.015 U	0.00611
Boron	mg/L	7.6	0.38	0.74	0.74	0.5	0.95	0.44	0.51	0.64	0.59	0.56	2.6	0.786
Chloride	mg/L	500	210	350	380	270	370	370	470	**780**	390	300	430	393
Iron	mg/L	1.0	0.1 U	0.5 U	0.5 U	0.46	0.5 U	0.5 U	**3.8**	**10**	**160**	0.32	0.42	**16**
Manganese	mg/L	3.04	0.015	0.0036	0.1	0.33	0.081	0.14	0.29	1.1	1.6	0.12	0.27	0.368
Sulfate	mg/L	1350	240	190	260	300	360	150	260	600	**1600**	250	290	409
Total Dissolved Solids	mg/L	--	700	1100	1300	1100	1100	1000	1200	2100	3000	1100	1300	1360

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) Maximum detected concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the maximum reporting limit is presented in the table, indicated with a "U" qualifie
(3) Average of concentrations (maximums) presented in the table, assuming one-half the reporting limit for non-detect results.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit; reporting limit presented
bold/shading = concentration exceeds effects value

Table B-3-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation -- Powerton Generating Station - Pekin, Tazewell County, Illinois

Well	Constituent	Effects Value [1]	Units	Groundwater Analytical Results (Year (Month)) 2010 (12)	2011 (02/03)	2011 (04)	2011 (06)	2011 (08)	2011 (09/10)	2011 (12)	2012 (03/04)	2012 (06)	2012 (09)	2012 (12)	2013 (02)	2013 (05)	2013 (07)	2013 (10)	2014 (03) [2]	2014 (05) [3]	2014 (08) [4]	2014 (10)	2015 (02)
MW-01	Arsenic	0.19	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	0.001	<0.001	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MW-01	Boron	7.6	mg/L	0.45	0.26	--	0.33	--	1	0.48	0.29	0.46	1.8	<2	1.7	0.47	0.48	0.62	0.53	0.26	0.16	0.075	0.059
MW-01	Chloride	500	mg/L	46	37	--	40	--	41	26	53	42	43	41	38	160	140	46	48	73	58	42	37
MW-01	Iron	1	mg/L	<NP	<0.01	--	<0.01	--	<0.01	<0.01	<0.01	<0.01	<0.01	0.17	<0.01	0.43	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-01	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	0.0008	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-01	Manganese	3.04	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	0.0027	0.018	<0.001	0.027	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0043
MW-01	Nitrogen/Nitrate	--	mg/L	7.2	4.3	--	5.7	--	11	4.1	7.3	6.5	5.4	7.2	7.4	0.23	0.42	4.5	4.7	2.2	1.5	4.4	4.1
MW-01	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	0.23	0.42	4.5	4.7	2.2	1.5	4.4	4.1
MW-01	pH	6.5 - 9.0	s.u.	7.46	7.43	--	7.58	--	7.37	6.29	7.59	7.45	7.06	6.98	9.53	7.00	6.75	7.12	7.65	7.15	7.25	7.25	6.93
MW-01	Selenium	1	mg/L	0.0016	0.0022	--	0.0016	--	0.0036	0.0027	0.0025	0.0042	0.005	<0.005	0.0045	<0.0025	<0.0025	0.0042	0.004	<0.0025	<0.0025	<0.0025	<0.0025
MW-01	Sulfate	1430	mg/L	50	30	--	39	--	83	31	61	68	72	91	77	330	270	85	99	51	36	54	43
MW-01	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-01	Total Dissolved Solids	--	mg/L	490	340	--	410	--	510	440	470	580	710	640	640	840	870	660	590	440	150	410	470
MW-02	Arsenic	0.19	mg/L	0.0018	0.0015	--	0.0017	--	<0.001	<0.001	<0.001	0.0011	0.0012	<0.005	0.0011	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0015
MW-02	Boron	7.6	mg/L	0.38	0.23	--	0.35	--	0.83	0.69	0.27	0.74	0.65	0.8	0.29	0.21	1.4	2.7	0.28	0.38	1.1	0.078	0.082
MW-02	Chloride	500	mg/L	45	43	--	44	--	46	40	53	51	45	48	52	53	48	90	88	91	58	44	54
MW-02	Iron	1	mg/L	<NP	<0.01	--	<0.01	--	<0.01	<0.01	<0.01	<0.01	<0.01	0.046	0.026	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-02	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0013	<0.0005
MW-02	Manganese	3.04	mg/L	<NP	0.0012	--	0.0022	--	<0.001	<0.001	<0.001	<0.001	0.0019	0.0063	<0.001	<0.0025	0.006	0.006	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-02	Nitrogen/Nitrate	--	mg/L	7.5	4.5	--	4.7	--	4.3	6.9	5.1	4.4	2.9	2.4	5.7	0.44	0.59	1.1	2.4	4	0.28	4.3	5.9
MW-02	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	0.48	0.59	1.1	2.4	4	0.28	4.3	5.9
MW-02	pH	6.5 - 9.0	s.u.	7.91	7.78	--	7.20	--	7.52	6.41	7.92	7.35	7.32	7.38	7.53	7.39	7.03	7.20	8.21	7.19	7.01	7.37	8.13
MW-02	Selenium	1	mg/L	0.0017	0.0032	--	0.0014	--	0.0032	0.0037	<0.001	0.0039	0.0016	<0.005	0.0032	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-02	Sulfate	1430	mg/L	52	42	--	53	--	70	69	55	73	69	95	53	96	140	190	53	63	76	49	57
MW-02	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-02	Total Dissolved Solids	--	mg/L	480	420	--	470	--	460	490	440	500	510	520	440	340	560	770	430	440	460	440	510
MW-03	Arsenic	0.19	mg/L	0.0017	<0.001	--	0.0011	--	0.0012	0.0012	0.0012	<0.001	0.0015	<0.005	0.0013	0.0012	0.0013	0.0011	<0.001	<0.001	<0.001	<0.001	<0.001
MW-03	Boron	7.6	mg/L	0.75	0.18	--	0.24	--	0.64	0.7	0.56	0.63	0.64	0.63	0.65	0.21	0.47	0.46	0.14	0.15	0.37	0.14	0.32
MW-03	Chloride	500	mg/L	39	52	--	59	--	62	39	54	57	54	58	53	55	60	57	120	100	79	47	47
MW-03	Iron	1	mg/L	<NP	<0.01	--	<0.01	--	0.042	<0.01	<0.01	<0.01	<0.01	0.036	0.019	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-03	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	0.00097	<0.0005	<0.0005	<0.0005
MW-03	Manganese	3.04	mg/L	0.0047	0.0023	--	<0.001	--	0.0037	0.0014	<0.001	0.0033	0.002	0.034	0.011	<0.0025	<0.0025	0.0039	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-03	Nitrogen/Nitrate	--	mg/L	9.4	5.2	--	5.4	--	0.2	0.2	2.1	0.37	0.08	0.13	2	0.15	<0.1	<0.1	2.6	5.3	<0.1	2.4	2
MW-03	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	0.15	<0.1	<0.1	2.6	5.3	<0.1	2.4	2
MW-03	pH	6.5 - 9.0	s.u.	7.43	7.55	--	7.33	--	7.30	6.58	7.18	7.36	7.46	7.41	7.46	7.31	7.22	7.25	8.34	7.27	6.97	7.43	7.75
MW-03	Selenium	1	mg/L	<NP	0.0036	--	0.0015	--	0.0036	0.0021	0.0067	0.0018	0.0033	<0.005	0.0048	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-03	Sulfate	1430	mg/L	64	42	--	47	--	66	45	72	84	74	74	64	82	99	96	65	65	100	40	46
MW-03	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-03	Total Dissolved Solids	--	mg/L	480	410	--	440	--	460	480	450	520	520	460	500	310	460	430	490	440	490	440	400
MW-04	Arsenic	0.19	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	0.0012	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MW-04	Boron	7.6	mg/L	0.77	0.83	--	0.33	--	0.84	0.79	0.78	0.83	0.76	0.74	0.97	0.23	0.67	0.81	0.81	0.94	1	0.77	0.94
MW-04	Chloride	500	mg/L	150	77	--	43	--	86	8.1	58	75	110	130	90	54	70	150	130	92	95	96	74
MW-04	Iron	1	mg/L	<NP	0.017	--	<0.01	--	<0.01	<0.01	<0.01	<0.01	<0.01	0.14	0.059	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-04	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-04	Manganese	3.04	mg/L	0.77	0.68	--	0.41	--	0.69	0.35	0.089	0.26	0.5	0.027	0.007	<0.0025	0.13	0.27	0.026	0.029	0.24	0.075	1.018
MW-04	Nitrogen/Nitrate	--	mg/L	0.34	0.73	--	2.7	--	0.06	0.07	0.65	1.1	0.46	1	1.8	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	0.14	0.3
MW-04	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	0.14	0.3
MW-04	pH	6.5 - 9.0	s.u.	7.27	7.48	--	7.26	--	7.22	6.37	7.24	7.04	7.13	7.14	7.37	7.30	7.02	7.00	8.00	7.04	7.06	7.20	7.63
MW-04	Selenium	1	mg/L	0.0022	0.0037	--	0.0022	--	0.0039	0.002	0.0045	0.0035	0.0032	<0.005	0.013	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-04	Sulfate	1430	mg/L	110	140	--	48	--	61	6.7	160	94	170	150	130	92	190	260	200	320	260	390	100
MW-04	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-04	Total Dissolved Solids	--	mg/L	680	620	--	470	--	580	520	660	600	800	720	640	350	670	980	780	980	880	1100	580

Table B-3-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation – Powerton Generating Station - Pekin, Tazewell County, Illinois

Well	Constituent	Effects Value [1]	Units	2010 [12]	2011 [02/03]	2011 [04]	2011 [06]	2011 [08]	2011 [09/10]	2011 [12]	2012 [03/04]	2012 [06]	2012 [09]	2012 [12]	2013 [02]	2013 [05]	2013 [07]	2013 [10]	2014 [01] [2]	2014 [05] [3]	2014 [08] [4]	2014 [10]	2015 [02]
				Groundwater Analytical Results (Year (Month))																			
MW-05	Arsenic	0.19	mg/L	0.0011	<0.001	--	<0.001	--	<0.001	0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MW-05	Boron	7.6	mg/L	0.95	0.93	--	0.79	--	0.79	0.77	0.82	0.74	0.65	0.66	0.66	0.7	0.64	0.83	0.7	0.76	0.71	<0.05	1.1
MW-05	Chloride	500	mg/L	150	120	--	89	--	160	140	82	100	150	170	110	92	150	170	120	80	140	120	79
MW-05	Iron	1	mg/L	0.13	0.05	--	0.046	--	0.082	0.036	<0.01	<0.01	<0.01	0.43	0.052	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-05	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-05	Manganese	3.04	mg/L	0.51	0.49	--	0.48	--	0.64	0.5	0.26	0.41	1	0.59	0.21	0.67	0.29	0.62	0.077	0.043	0.016	<0.0025	0.058
MW-05	Nitrogen/Nitrate	--	mg/L	<NP	<0.02	--	0.08	--	<0.02	<0.02	1.6	0.04	0.04	0.04	0.19	<0.1	<0.1	0.34	0.74	2.2	0.11	0.2	0.74
MW-05	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	<0.1	<0.1	0.34	0.77	2.2	0.11	0.2	0.74
MW-05	pH	6.5 - 9.0	s.u.	7.24	7.36	--	7.29	--	7.05	6.34	7.14	7.00	6.94	6.94	8.01	6.87	6.82	6.89	7.69	7.01	6.86	7.30	7.52
MW-05	Selenium	1	mg/L	0.0019	0.003	--	<0.001	--	0.0045	0.0023	0.0028	0.0033	0.0031	<0.005	0.0029	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0028	<0.0025	<0.0025
MW-05	Sulfate	1430	mg/L	160	170	--	110	--	250	170	120	130	200	200	180	310	290	260	180	150	200	310	110
MW-05	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-05	Total Dissolved Solids	--	mg/L	740	680	--	640	--	890	820	590	700	890	840	790	990	1000	1100	840	640	870	910	570
MW-06	Arsenic	0.19	mg/L	0.0042	0.0024	--	0.0029	--	0.0031	0.0036	0.002	0.0021	0.0022	<0.005	0.0017	0.0027	0.0037	0.0039	0.001	0.2	0.0024	0.0016	0.0011
MW-06	Boron	7.6	mg/L	0.5	0.35	--	0.43	--	0.61	0.63	0.39	0.46	0.57	0.45	0.39	1	0.62	0.51	0.34	0.35	0.52	0.34	0.34
MW-06	Chloride	500	mg/L	180	200	--	160	--	210	150	150	200	190	240	200	99	200	210	230	230	230	240	110
MW-06	Iron	1	mg/L	1.6	1.6	--	1.7	--	1.8	1.9	1.7	1.9	1.9	1.6	1.1	1.8	2.2	1.8	1.5	32	1	0.81	1
MW-06	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00082	<0.0005
MW-06	Manganese	3.04	mg/L	0.68	0.68	--	0.63	--	0.66	0.63	0.61	0.71	0.64	0.61	0.5	1.3	0.7	0.58	0.68	8	0.71	0.57	0.86
MW-06	Nitrogen/Nitrate	--	mg/L	0.037	<0.02	--	<0.02	--	0.04	0.06	<0.02	<0.02	0.04	0.06	0.02	<0.1	<0.1	0.16	<0.1	<0.1	<0.1	0.11	<0.1
MW-06	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	<0.1	<0.1	0.16	<0.1	<0.1	<0.1	0.11	<0.1
MW-06	pH	6.5 - 9.0	s.u.	7.67	7.97	--	7.62	--	7.61	7.35	7.68	7.59	7.73	7.68	9.30	7.23	7.37	7.55	8.21	7.45	7.73	7.60	8.05
MW-06	Selenium	1	mg/L	0.0034	<0.001	--	<0.001	--	0.0025	0.0033	<0.001	0.0013	0.0023	<0.005	0.001	0.003	<0.0025	0.0065	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-06	Sulfate	1430	mg/L	210	250	--	280	--	260	170	250	450	340	440	320	560	440	310	410	530	300	380	360
MW-06	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-06	Total Dissolved Solids	--	mg/L	950	990	--	1100	--	970	1000	1100	1100	1200	1200	1100	1400	1200	1100	1100	1400	1300	1100	1100
MW-07	Arsenic	0.19	mg/L	0.026	0.085	--	0.12	--	0.18	0.23	0.22	0.15	0.18	0.26	0.17	0.12	0.32	0.3	0.15	<0.001	0.19	0.31	0.18
MW-07	Boron	7.6	mg/L	0.61	0.44	--	0.43	--	0.38	0.34	0.35	0.41	0.36	0.41	0.47	0.52	0.41	0.46	0.37	1	0.33	0.27	0.39
MW-07	Chloride	500	mg/L	170	200	--	140	--	130	81	99	130	130	150	160	180	150	160	170	150	160	150	130
MW-07	Iron	1	mg/L	8	7.5	--	19	--	22	24	21	19	21	18	37	15	30	30	17	0.15	14	35	22
MW-07	Lead	0.0485	mg/L	0.039	<0.001	--	0.0014	--	<0.001	<0.001	<0.001	0.0013	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	0.0011	<0.0005	<0.0005	<0.0005	0.0066
MW-07	Manganese	3.04	mg/L	3.5	5.9	--	6.4	--	12	12	11	9.3	8	6.7	9.5	5.7	11	5.9	5.8	0.33	4.6	13	7
MW-07	Nitrogen/Nitrate	--	mg/L	0.043	0.08	--	<0.02	--	0.31	0.03	<0.02	0.02	<0.02	0.03	0.06	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-07	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-07	pH	6.5 - 9.0	s.u.	NM	7.04	--	6.78	--	6.83	6.45	6.79	6.91	6.93	6.97	6.87	6.69	6.68	6.82	7.20	6.67	7.00	6.94	6.90
MW-07	Selenium	1	mg/L	0.0043	0.0026	--	0.0025	--	0.0073	0.0054	0.0013	0.006	0.0047	<0.005	0.0031	0.0028	<0.0025	0.0056	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-07	Sulfate	1430	mg/L	120	49	--	25	--	9.1	3.3	3	18	25	43	36	120	42	80	95	52	71	16	50
MW-07	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-07	Total Dissolved Solids	--	mg/L	860	1100	--	1300	--	1300	1300	1400	1300	1300	1100	1200	1000	1100	1200	1200	1200	1300	1300	1100
MW-08	Arsenic	0.19	mg/L	0.0052	0.0039	--	0.0044	--	0.0036	0.0052	0.0038	0.004	0.0041	0.0062	0.005	0.0036	0.0041	0.0037	0.003	<0.001	0.0025	0.0022	0.0026
MW-08	Boron	7.6	mg/L	0.93	0.72	--	0.64	--	0.82	0.82	0.57	0.57	1	0.93	1.1	0.91	1.2	0.93	0.83	0.44	0.8	0.72	0.81
MW-08	Chloride	500	mg/L	180	210	--	140	--	210	190	170	200	210	220	200	230	220	260	230	340	380	340	260
MW-08	Iron	1	mg/L	0.56	2.1	--	1.7	--	0.97	0.94	3.3	1.2	1.3	2.1	6.5	2.3	6.6	1.3	0.89	0.24	0.62	0.53	0.17
MW-08	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-08	Manganese	3.04	mg/L	0.15	0.27	--	0.29	--	0.18	0.2	0.27	0.2	0.2	0.23	0.41	0.25	0.48	0.16	0.2	0.7	0.17	0.13	0.11
MW-08	Nitrogen/Nitrate	--	mg/L	<NP	<0.02	--	0.1	--	1.6	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-08	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-08	pH	6.5 - 9.0	s.u.	8.24	8.17	--	7.66	--	8.24	7.87	7.97	8.20	8.23	8.09	7.72	7.81	7.39	8.16	8.46	7.72	8.12	7.89	8.62
MW-08	Selenium	1	mg/L	0.0036	0.0013	--	<0.001	--	0.0031	0.0036	0.0018	0.0018	<0.001	<0.005	0.002	0.0029	<0.0025	0.0048	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-08	Sulfate	1430	mg/L	160	240	--	140	--	200	200	300	440	330	360	330	460	380	350	320	300	240	290	160
MW-08	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-08	Total Dissolved Solids	--	mg/L	890	990	--	970	--	940	990	1200	1200	1200	1200	1100	1300	1300	1300	1200	1400	1400	1200	1100

Table B-3-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation – Powerton Generating Station - Pekin, Tazewell County, Illinois

Well	Constituent	Effects Value [1]	Units	Groundwater Analytical Results (Year [Month])																			
				2010 [12]	2011 [02/03]	2011 [04]	2011 [06]	2011 [08]	2011 [09/10]	2011 [12]	2012 [03/04]	2012 [06]	2012 [09]	2012 [12]	2013 [02]	2013 [05]	2013 [07]	2013 [10]	2014 [01] [2]	2014 [05] [3]	2014 [08] [4]	2014 [10]	2015 [02]
MW-09	Arsenic	0.19	mg/L	<NP	0.0018	--	0.0017	--	<0.001	0.0012	<0.001	0.0017	<0.001	<0.005	0.0013	<0.001	<0.001	<0.001	0.0021	<0.001	<0.001	<0.001	<0.001
MW-09	Boron	7.6	mg/L	2.1	1.9	--	1.9	--	2.5	2.7	2.6	2.6	2.9	3.2	4.3	3.2	2.5	1.6	1.7	2.5	2.4	1.6	3
MW-09	Chloride	500	mg/L	25	28	--	28	--	30	30	30	27	28	31	27	29	33	42	25	34	33	32	34
MW-09	Iron	1	mg/L	<NP	0.066	--	<0.01	--	<0.01	<0.01	0.014	<0.01	<0.01	<0.01	0.024	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-09	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	0.00051	<0.0005	<0.0005	<0.0005	<0.0005
MW-09	Manganese	3.04	mg/L	0.23	0.45	--	0.48	--	0.14	0.28	0.22	0.34	0.11	0.1	0.19	0.053	0.038	0.019	0.84	0.36	0.031	0.022	0.024
MW-09	Nitrogen/Nitrate	--	mg/L	2.9	5.6	--	5.6	--	3.7	2.6	5	2.8	6.3	10	12	11	7.9	4.6	3.2	11	1.6	5.9	13
MW-09	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	11	7.9	4.6	3.2	11	1.6	5.9	13
MW-09	pH	6.5 - 9.0	s.u.	7.22	7.34	--	7.10	--	7.32	6.31	7.28	7.30	7.18	7.10	8.00	7.21	6.63	7.19	7.53	6.99	7.09	7.29	7.53
MW-09	Selenium	1	mg/L	0.0024	0.0072	--	0.0017	--	0.0043	0.0041	0.0072	0.0047	0.0044	0.009	0.015	0.016	0.014	0.0047	0.003	0.0074	0.0061	0.0084	0.0091
MW-09	Sulfate	1430	mg/L	110	110	--	110	--	130	110	120	130	120	130	140	140	130	90	110	110	100	160	130
MW-09	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-09	Total Dissolved Solids	--	mg/L	500	510	--	540	--	500	520	530	520	580	560	520	600	610	430	560	540	490	630	570
MW-10	Arsenic	0.19	mg/L	<NP	<0.001	--	0.0015	--	<0.001	<0.001	<0.001	0.0015	0.0014	<0.005	0.001	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MW-10	Boron	7.6	mg/L	0.48	0.48	--	0.52	--	0.42	0.57	0.54	0.54	0.42	0.46	0.64	0.98	1.9	0.61	2.1	3.2	1.9	0.84	0.83
MW-10	Chloride	500	mg/L	40	43	--	43	--	49	42	45	46	45	45	37	41	40	54	40	37	57	62	22
MW-10	Iron	1	mg/L	<NP	<0.01	--	0.044	--	<0.01	<0.01	<0.01	0.015	0.012	0.016	<0.01	2.7	<0.1	0.18	0.19	0.11	0.34	<0.1	0.22
MW-10	Lead	0.0485	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	0.012	<0.0005	<0.0005	0.0008	<0.0005	<0.0005	<0.0005	<0.0005
MW-10	Manganese	3.04	mg/L	2.1	2.8	--	3.4	--	2.3	2.3	2.3	2.6	2.5	2.2	1.9	3.4	1.5	2	3.1	1.6	2.1	1.1	1.3
MW-10	Nitrogen/Nitrate	--	mg/L	3	4	--	2.1	--	4.5	4.9	6	2.9	5.2	4.8	3.3	1.9	1.5	1.2	2	2.1	0.41	0.67	0.9
MW-10	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	1.9	1.6	1.2	2	2.1	0.43	0.71	0.94
MW-10	pH	6.5 - 9.0	s.u.	7.04	7.01	--	6.88	--	7.04	6.48	7.03	6.95	6.96	7.03	8.39	6.87	6.85	7.02	7.90	7.09	6.74	7.16	7.36
MW-10	Selenium	1	mg/L	0.0042	0.0064	--	0.0043	--	0.0057	0.0065	0.0056	0.0056	0.0058	0.0074	0.0083	0.0043	0.0087	0.008	<0.0025	0.0073	0.0057	0.0048	0.0028
MW-10	Sulfate	1430	mg/L	62	64	--	67	--	64	72	76	63	58	59	69	92	150	90	160	140	110	95	46
MW-10	Thallium	0.0037	mg/L	<NP	<0.001	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-10	Total Dissolved Solids	--	mg/L	530	520	--	650	--	470	540	530	550	580	420	440	580	550	620	670	630	590	550	530
MW-11	Arsenic	0.19	mg/L	0.0021	0.0025	--	0.0019	--	0.0016	0.0019	0.0021	0.0032	0.0038	0.03	0.045	0.028	0.038	0.038	0.057	0.036	0.068	0.045	0.022
MW-11	Boron	7.6	mg/L	1.6	1.8	--	1.6	--	1.5	1.8	2.3	1.9	2.6	<2	1.4	1.3	1.5	1.2	1.1	1.4	0.97	0.89	1.7
MW-11	Chloride	500	mg/L	70	66	--	120	--	53	87	54	150	52	83	84	79	110	79	67	70	120	91	66
MW-11	Iron	1	mg/L	0.44	0.01	--	0.029	--	0.018	<0.01	<0.01	0.056	2	0.7	2.4	3.1	3.9	3.3	4.8	3.8	4.5	5	3
MW-11	Lead	0.0485	mg/L	<NP	<NP	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	0.0023	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-11	Manganese	3.04	mg/L	3.3	3.6	--	2.9	--	2.2	2.5	2.9	3.7	4.7	12	11	7.5	8	7.3	7.9	8	8.4	6.6	5.5
MW-11	Nitrogen/Nitrate	--	mg/L	0.41	0.17	--	0.04	--	0.74	1.5	0.39	<0.02	4.6	0.39	0.33	1.1	<0.1	0.18	0.34	0.27	<0.1	<0.1	<0.1
MW-11	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	1.1	<0.1	0.18	0.34	0.27	<0.1	<0.1	<0.1
MW-11	pH	6.5 - 9.0	s.u.	7.88	7.13	--	7.02	--	7.31	6.40	7.32	7.15	7.30	7.28	8.27	6.99	7.08	7.23	8.00	7.10	7.12	7.37	7.55
MW-11	Selenium	1	mg/L	0.0026	0.0015	--	0.0018	--	0.004	0.0031	0.0039	0.0039	0.004	<0.005	0.0014	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-11	Sulfate	1430	mg/L	170	160	--	210	--	140	160	130	320	170	200	150	240	280	180	210	170	200	200	120
MW-11	Thallium	0.0037	mg/L	<NP	<NP	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-11	Total Dissolved Solids	--	mg/L	740	710	--	930	--	620	710	740	1000	760	970	840	850	980	770	760	660	860	790	700
MW-12	Arsenic	0.19	mg/L	0.0088	0.013	--	0.0064	--	0.0087	0.0089	0.0042	0.014	0.011	0.022	0.0066	0.0031	0.016	0.018	0.0025	0.0017	0.0028	0.0019	<0.001
MW-12	Boron	7.6	mg/L	1.6	1.4	--	1.3	--	1.2	1.3	0.92	1.2	1.1	0.85	1.1	3.7	1.1	1.1	0.41	0.69	0.73	0.59	0.58
MW-12	Chloride	500	mg/L	170	180	--	180	--	190	210	170	190	170	210	190	200	190	180	220	220	210	200	210
MW-12	Iron	1	mg/L	5.5	6.3	--	5.6	--	4	3.1	4.8	8.2	8.9	6.4	5.8	8.9	4.5	0.23	3.4	0.39	0.17	0.33	1.7
MW-12	Lead	0.0485	mg/L	<NP	<NP	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.17
MW-12	Manganese	3.04	mg/L	0.32	0.58	--	0.26	--	0.37	0.25	0.13	0.71	0.64	1.7	0.38	0.24	1.3	1.5	0.23	0.65	1.2	1.2	0.17
MW-12	Nitrogen/Nitrate	--	mg/L	<NP	<NP	--	0.14	--	<0.02	<0.02	0.04	<0.2	0.03	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-12	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	--	NR	--	NR	NR	NR	NR	NR	NR	NR	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-12	pH	6.5 - 9.0	s.u.	7.65	7.51	--	6.98	--	7.66	7.38	7.22	7.40	7.50	7.37	8.36	7.17	7.29	7.73	7.99	7.14	7.37	7.33	7.61
MW-12	Selenium	1	mg/L	0.0026	0.0027	--	<0.001	--	0.0023	0.0034	0.0043	0.0038	0.0016	<0.005	0.002	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-12	Sulfate	1430	mg/L	290	270	--	350	--	360	300	310	430	370	300	350	410	420	270	530	560	310	420	450
MW-12	Thallium	0.0037	mg/L	<NP	<NP	--	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-12	Total Dissolved Solids	--	mg/L	980	1000	--	1100	--	970	970	1000	1200	1200	1100	1000	1200	1200	1000	1400	1300	1100	1000	1300

Table B-3-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation – Powerton Generating Station - Pekin, Tazewell County, Illinois

Well	Constituent	Effects Value [1]	Units	Groundwater Analytical Results (Year (Month))																			
				2010 (12)	2011 (02/03)	2011 (04)	2011 (06)	2011 (08)	2011 (09/10)	2011 (12)	2012 (03/04)	2012 (06)	2012 (09)	2012 (12)	2013 (02)	2013 (05)	2013 (07)	2013 (10)	2014 (03)[2]	2014 (05)[2]	2014 (08)[2]	2014 (10)	2015 (02)
MW-13	Arsenic	0.19	mg/L	0.011	0.0069	0.0063	0.0057	0.0048	0.0066	0.023	0.027	--	--	0.041	0.029	0.031	0.029	0.024	0.028	0.024	0.031	0.028	0.028
MW-13	Boron	7.6	mg/L	3.9	3.1	2.6	3	2.7	3	4.1	4	--	--	3.6	4.2	1.6	3.8	3.5	2.9	3.5	3	2.2	3.5
MW-13	Chloride	500	mg/L	160	120	100	86	110	110	180	170	--	--	210	170	190	190	180	190	180	190	180	180
MW-13	Iron	1	mg/L	0.69	0.052	0.077	<0.01	0.043	<0.01	0.11	0.2	--	--	0.066	0.28	1.3	1.4	0.29	1.8	0.74	0.63	0.98	0.69
MW-13	Lead	0.0485	mg/L	<NP	<NP	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--	--	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-13	Manganese	3.04	mg/L	5	3.3	2.7	2.9	2.6	3.6	3.5	3.5	--	--	3.7	3.5	3.8	4	2.8	2.9	3.4	3.5	3.8	3.8
MW-13	Nitrogen/Nitrate	--	mg/L	0.14	1.3	1.8	2.2	3.6	1.6	0.07	0.06	--	--	<0.02	<0.02	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-13	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	NR	NR	NR	NR	NR	NR	--	--	NR	NR	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-13	pH	6.5 - 9.0	s.u.	7.68	7.53	7.26	6.75	7.13	7.31	7.19	8.49	--	--	7.92	8.26	7.65	7.61	7.81	8.67	7.73	7.82	7.72	8.20
MW-13	Selenium	1	mg/L	0.0046	0.0046	0.0045	0.0029	0.0056	0.004	0.0036	0.0037	--	--	<0.005	0.0025	0.01	0.0095	<0.0025	<0.0025	<0.0025	0.0047	0.0045	<0.0025
MW-13	Sulfate	1430	mg/L	1400	770	580	540	440	660	1100	1100	--	--	1100	730	880	1000	690	660	630	740	1400	1000
MW-13	Thallium	0.0037	mg/L	<NP	<NP	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--	--	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-13	Total Dissolved Solids	--	mg/L	2600	1600	1400	1300	1100	1500	2100	2300	--	--	1900	1600	2000	2000	1700	1900	2100	2300	2200	2300
MW-14	Arsenic	0.19	mg/L	0.024	0.019	0.0084	0.003	0.0062	0.015	0.0033	0.0039	--	--	0.0053	0.0066	0.0023	0.0016	<0.001	0.0016	0.0011	0.0052	0.0063	0.0011
MW-14	Boron	7.6	mg/L	2	1.9	1.9	1.9	1.8	1.9	1.9	1.8	--	--	<2	1.9	1.7	1.7	2	1.6	1.8	1.9	2.2	2.2
MW-14	Chloride	500	mg/L	160	160	160	160	240	200	200	190	--	--	190	92	160	190	190	220	140	190	180	180
MW-14	Iron	1	mg/L	2.3	0.94	0.36	0.3	0.71	2	0.12	0.77	--	--	0.012	0.02	<0.1	<0.1	0.39	1.2	0.6	4.4	5.3	8.17
MW-14	Lead	0.0485	mg/L	<NP	<NP	<0.001	<0.001	<0.001	<0.001	<0.001	0.0035	--	--	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00078	<0.0005
MW-14	Manganese	3.04	mg/L	0.68	0.81	0.29	0.36	0.57	0.84	0.067	0.63	--	--	0.11	0.12	0.72	0.32	1.2	1.3	0.34	1.8	1.3	0.15
MW-14	Nitrogen/Nitrate	--	mg/L	0.036	<NP	1	0.27	0.05	<0.02	0.33	0.31	--	--	0.32	3.5	<0.1	<0.1	0.16	<0.1	0.22	<0.1	<0.1	0.24
MW-14	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	NR	NR	NR	NR	NR	NR	--	--	NR	NR	<0.1	<0.1	0.18	<0.1	0.22	<0.1	<0.1	0.24
MW-14	pH	6.5 - 9.0	s.u.	7.55	7.75	7.27	7.15	7.08	7.40	6.05	8.35	--	--	7.13	8.21	7.03	6.93	7.11	7.72	6.99	7.17	7.31	7.28
MW-14	Selenium	1	mg/L	0.0024	0.0015	0.065	0.0035	0.003	0.0017	0.0037	0.022	--	--	0.0055	0.15	<0.0025	<0.0025	<0.0025	0.02	0.014	<0.0025	<0.0025	0.023
MW-14	Sulfate	1430	mg/L	960	820	770	810	940	850	880	990	--	--	810	390	800	900	840	680	720	1100	1300	850
MW-14	Thallium	0.0037	mg/L	0.0019	0.0018	0.0035	0.0039	0.0027	0.0016	0.0016	0.0034	--	--	0.0025	0.0043	0.0025	0.0043	0.0022	0.0023	0.0026	0.0023	<0.002	<0.002
MW-14	Total Dissolved Solids	--	mg/L	1800	1700	1800	1900	2000	1800	1800	2200	--	--	1700	1300	2000	2100	2100	1900	1700	2400	2200	2200
MW-15	Arsenic	0.19	mg/L	0.0099	0.0092	0.0064	0.0052	0.0053	0.011	0.0097	0.0061	--	--	0.011	0.0078	0.0037	0.0046	0.0066	0.0072	0.0019	0.0029	0.0039	0.0017
MW-15	Boron	7.6	mg/L	1.6	1.4	1.5	1.6	1.3	1.2	1.2	1.4	--	--	<2	1.7	1.5	1.6	1.2	1.1	1.2	0.95	0.74	1.1
MW-15	Chloride	500	mg/L	180	190	190	170	210	180	200	200	--	--	220	200	210	220	210	240	220	240	230	240
MW-15	Iron	1	mg/L	3.3	3.4	2.1	0.7	2.1	3.4	2.4	1.1	--	--	1.9	1.5	0.83	1.3	1.4	2	0.37	0.78	2.1	[illegible]
MW-15	Lead	0.0485	mg/L	<NP	<NP	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	--	--	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-15	Manganese	3.04	mg/L	0.56	0.42	0.36	0.6	0.37	0.48	0.39	0.25	--	--	0.51	0.35	0.27	0.3	0.43	0.59	0.3	0.95	0.87	0.4
MW-15	Nitrogen/Nitrate	--	mg/L	0.03	0.086	0.04	0.07	0.05	<0.02	0.07	0.12	--	--	0.12	0.02	<0.1	<0.1	0.22	<0.1	0.4	<0.1	<0.1	0.18
MW-15	Nitrogen/Nitrate, Nitrite	--	mg/L	NR	NR	NR	NR	NR	NR	NR	NR	--	--	NR	NR	<0.1	<0.1	0.22	<0.1	0.4	<0.1	<0.1	0.18
MW-15	pH	6.5 - 9.0	s.u.	7.43	7.23	7.06	6.79	6.89	7.37	6.84	8.23	--	--	7.30	8.09	6.71	6.93	7.18	7.75	6.89	7.45	7.36	7.53
MW-15	Selenium	1	mg/L	0.0042	0.0079	0.017	0.004	0.002	0.004	0.0047	0.025	--	--	<0.005	0.0024	0.0065	<0.0025	0.013	<0.0025	0.033	<0.0025	0.003	0.064
MW-15	Sulfate	1430	mg/L	300	220	270	650	250	180	140	200	--	--	320	280	570	460	420	260	390	620	660	460
MW-15	Thallium	0.0037	mg/L	<NP	<NP	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--	--	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-15	Total Dissolved Solids	--	mg/L	1000	1000	1100	1600	1000	890	840	1000	--	--	1100	1100	1700	1400	1400	1300	1300	1800	1600	1400
MW-16	Arsenic	0.19	mg/L	--	--	--	--	--	--	--	--	--	--	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MW-16	Boron	7.6	mg/L	--	--	--	--	--	--	--	--	--	--	<0.2	0.13	0.2	0.26	0.35	0.17	0.17	0.15	0.14	0.17
MW-16	Chloride	500	mg/L	--	--	--	--	--	--	--	--	--	--	26	18	19	21	35	230	20	25	24	24
MW-16	Iron	1	mg/L	--	--	--	--	--	--	--	--	--	--	0.012	0.019	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-16	Lead	0.0485	mg/L	--	--	--	--	--	--	--	--	--	--	<0.005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
MW-16	Manganese	3.04	mg/L	--	--	--	--	--	--	--	--	--	--	0.022	0.0053	<0.0025	<0.0025	<0.0025	0.0035	<0.0025	<0.0025	<0.0025	0.0025
MW-16	Nitrogen/Nitrate	--	mg/L	--	--	--	--	--	--	--	--	--	--	18	23	20	13	19	16	21	22	28	28
MW-16	Nitrogen/Nitrate, Nitrite	--	mg/L	--	--	--	--	--	--	--	--	--	--	NR	NR	20	13	19	16	21	22	28	28
MW-16	pH	6.5 - 9.0	s.u.	--	--	--	--	--	--	--	--	--	--	7.38	8.31	7.10	7.18	7.27	7.85	7.20	7.41	7.30	7.56
MW-16	Selenium	1	mg/L	--	--	--	--	--	--	--	--	--	--	<0.005	0.0015	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
MW-16	Sulfate	1430	mg/L	--	--	--	--	--	--	--	--	--	--	37	31	50	55	55	34	40	35	54	27
MW-16	Thallium	0.0037	mg/L	--	--	--	--	--	--	--	--	--	--	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MW-16	Total Dissolved Solids	--	mg/L	--	--	--	--	--	--	--	--	--	--	520	420	460	440	540	800	390	440	510	490

Table B-3-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation -- Powerton Generating Station - Pekin, Tazewell County, Illinois

Well	Constituent	Effects Value [1]	Units	Groundwater Analytical Results (Year [Month])																			
				2010 [12]	2011 [02/03]	2011 [04]	2011 [06]	2011 [08]	2011 [09/10]	2011 [12]	2012 [03/04]	2012 [06]	2012 [09]	2012 [12]	2013 [02]	2013 [05]	2013 [07]	2013 [10]	2014 [03] [2]	2014 [05] [3]	2014 [08] [4]	2014 [10]	2015 [02]

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) The manganese result for March 2014 for MW-07 was qualified as "E" by the laboratory. A qualifier definition was not identified.
(3) The total dissolved solids result for May 2014 for MW-12 was qualified as "H" by the laboratory. A qualifier definition was not identified.
(4) Chloride results for August 2014 for wells MW-02, MW-06, MW-07, and MW-12 were qualified as "^" by the laboratory, which denotes instrument-related QC exceeds the control limits.

mg/L = milligrams per liter
s.u. = standard units
"--" = value was not available
"<" = constituent was not detected; the reporting limit is presented
bold/shading = concentration exceeds effects value

Table B-3-2
Comparison Of Average Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation – Powerton Generating Station - Pekin, Tazewell County, Illinois

Constituent	Units	Effects Value [1]	Groundwater Analytical Results - Average Concentrations [2]																	Average [3]
			Gravelly Sand Unit [4]											Silt/Clay Unit [4]						
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-07	MW-09	MW-10	MW-11	MW-13	MW-16	MW-06	MW-08	MW-12	MW-14	MW-15		
Arsenic	mg/L	0.19	0.00061	0.00099	0.00104	0.00062	0.00067	0.167	0.00096	0.00081	0.0237	0.0214	0.0014 U	0.0135	0.00376	0.0083	0.00647	0.00645		0.0161
Boron	mg/L	7.6	0.579	0.637	0.438	0.767	0.735	0.442	2.51	0.968	1.53	3.23	0.184	0.489	0.819	1.16	1.84	1.29		1.1
Chloride	mg/L	500	56.2	55.2	60.7	88.2	123	147	30.3	43.8	83.4	161	44.2	191	233	194	178	208		119
Iron	mg/L	1	0.055	0.0282	0.0293	0.0359	0.0773	**18.6**	0.0297	0.22	**2.11**	0.531	0.0431	**2.72**	**1.8**	**4.39**	**11**	**1.59**		**2.08**
Lead	mg/L	0.0485	0.0005	0.00053	0.00051	0.001 U	0.001 U	0.00313	0.00049	0.00116	0.00054	0.001 U	0.001 U	0.0005	0.001 U	0.00988	0.00064	0.00048		0.0013
Manganese	mg/L	3.04	0.0035	0.00187	0.00423	0.31	0.381	**7.76**	0.218	2.26	**5.99**	**3.49**	0.00408	1.1	0.257	0.657	0.645	0.467		1.47
Nitrogen/Nitrate	mg/L	--	4.9	3.75	2.09	0.561	0.358	0.0557	6.37	2.85	0.593	0.622	20.8	0.0482	0.121	0.0417	0.372	0.0926		2.73
Nitrogen/Nitrate, Nitrite	mg/L	--	2.76	2.38	1.58	0.149	0.558	0.1 U	7.28	1.36	0.261	0.1 U	20.9	0.0713	0.1 U	0.1 U	0.111	0.131		2.36
pH	s.u.	6.5 - 9.0	7.33	7.44	7.38	7.21	7.13	6.85	7.2	7.08	7.31	7.71	7.46	7.74	8.03	7.48	7.3	7.28		7.4
Selenium	mg/L	1	0.00256	0.00194	0.00222	0.00304	0.00213	0.00309	0.00715	0.0057	0.00215	0.00401	0.0014	0.00193	0.00199	0.00198	0.0179	0.0112		0.0044
Sulfate	mg/L	1430	87.2	75.3	68.1	160	194	47.6	121	85.4	189	857	41.8	348	289	372	856	369		260
Thallium	mg/L	0.0037	0.00147 U	0.00147 U	0.00147 U	0.00147 U	0.00147 U	0.00147 U	0.00147 U	0.00147 U	0.0015 U	0.0015 U	0.0018 U	0.00147 U	0.00147 U	0.0015 U	0.00252	0.0015 U		0.000861
Total Dissolved Solids	mg/L	--	548	482	456	701	806	1210	539	553	801	1880	501	1150	1160	1110	1920	1250		942

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) Average of concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the average reporting limit is presented in the table, indicated with a "U" qualifier. Otherwise, non-detect results were included in the average calculation assuming one-half the reporting limit.
(3) Average of concentrations (averages) presented in the table, assuming one-half the reporting limit for non-detect results.
(4) Groundwater in the gravelly sand unit flows in a northerly direction. Groundwater in the localized silt/clay units flows in a westerly direction. Summary statistics do not distinguish between these two units.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit
bold/shading = concentration exceeds effects value

Table B-3-3
Comparison Of Maximum Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation -- Powerton Generating Station - Pekin, Tazewell County, Illinois

Constituent	Units	Effects Value (1)	Groundwater Analytical Results - Maximum Concentrations (2)																	Average (3)
			Gravelly Sand Unit (4)											Silt/Clay Unit (4)						
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-07	MW-09	MW-10	MW-11	MW-13	MW-16	MW-06	MW-08	MW-12	MW-14	MW-15	
Arsenic	mg/L	0.19	0.001	0.0018	0.0017	0.0012	0.0011	**0.31**	0.0021	0.0015	0.068	0.041	0.005 U	**0.2**	0.0062	0.022	0.024	0.011	0.0434
Boron	mg/L	7.6	1.8	2.7	0.75	1	1.1	1	4.3	3.2	2.6	4.2	0.35	1	1.2	3.7	2.2	1.7	2.05
Chloride	mg/L	500	160	91	120	150	170	200	42	62	150	210	230	240	380	220	240	240	182
Iron	mg/L	1	0.43	0.046	0.042	0.14	0.43	**35**	0.066	**2.7**	**5.8**	**1.8**	0.019	**32**	**6.6**	**8.9**	**5.3**	**3.2**	5.79
Lead	mg/L	0.0485	0.0008	0.0013	0.00097	0.005 U	0.005 U	0.039	0.00051	0.012	0.0023	0.005 U	0.005 U	0.00082	0.005 U	**0.17**	0.0035	0.0012	0.0153
Manganese	mg/L	3.04	0.027	0.0063	0.034	1.018	1	**13**	0.84	**3.8**	**12**	**5**	0.022	**8**	0.7	1.7	1.8	0.95	3.12
Nitrogen/Nitrate	mg/L	--	11	7.5	9.4	2.7	2.2	0.31	13	6	4.6	3.6	28	0.16	1.6	0.14	3.5	0.4	5.88
Nitrogen/Nitrate, Nitrite	mg/L	--	4.7	5.9	5.3	0.5	2.2	0.1 U	13	2.1	1.1	0.1 U	28	0.16	0.1 U	0.1 U	0.24	0.4	3.99
pH	s.u.	6.5 - 9.0	**6.39-9.53**	**6.41-8.21**	6.58-8.34	**6.37-8**	**6.34-8.81**	**6.45-7.2**	**6.31-8**	**6.03-8.39**	**6.40-8.27**	6.75-8.67	7.1-8.31	**7.23-9.3**	7.39-8.46	6.98-8.36	**6.05-8.35**	6.71-8.23	6.6-8.35
Selenium	mg/L	1	0.005	0.0039	0.0067	0.013	0.0045	0.0073	0.016	0.0087	0.004	0.01	0.0015	0.0065	0.0048	0.0043	0.15	0.068	0.0196
Sulfate	mg/L	1430	330	190	100	390	310	120	160	160	320	1400	55	560	460	560	1300	660	442
Thallium	mg/L	0.0037	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.0043**	0.002 U	0.00121
Total Dissolved Solids	mg/L	--	870	770	520	1100	1100	1400	630	670	1000	2600	800	1400	1400	1400	2400	1800	1240

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) Maximum detected concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the maximum reporting limit is presented in the table, indicated with a "U" qualifier. For pH, the range is presented.
(3) Average of well-specific concentrations (maximums) presented in the table. If the maximum is a non-detect result, one-half the reporting limit was used as a surrogate concentration in the calculation. For pH, the range presented in the "average" column is the average minimum and average maximum.
(4) Groundwater in the gravelly sand unit flows in a northerly direction. Groundwater in the localized silt/clay units flows in a westerly direction. Summary statistics (averages) do not distinguish between these two units.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit
bold/shading = concentration exceeds effects value

Table B-4-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to May 2014
Midwest Generation -- Waukegan Generating Station - Waukegan, Lake County, Illinois

Well	Constituent	Effects Values [1]	Units	Groundwater Analytical Results (Year [Month])																	
				2010 [10]	2011 [03]	2011 [06]	2011 [09]	2011 [12]	2012 [03] [2]	2012 [06]	2012 [09] [3]	2012 [12]	2013 [03]	2013 [06]	2013 [07]	2013 [11]	2014 [03]	2014 [05]	2014 [08]	2014 [11]	2015 [02]
MW-01	Antimony	0.32	mg/L	0.0052	<0.003	<0.003	<0.003	<0.003	<0.003	0.0056	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-01	Arsenic	0.148	mg/L	0.054	0.04	0.17	0.077	0.057	0.078	0.07	0.07	0.091	0.098	0.036	0.055	0.046	0.031	0.036	0.019	0.31	0.036
MW-01	Boron	7.6	mg/L	2.6	2	2.6	2.5	2.8	2.5	2	1.9	1.9	2.2	2.2	2.3	3.1	1.9	2	2	2.2	1.7
MW-01	Chloride	500	mg/L	39	48	52	41	32	47	46	47	48	45	34	42	28	33	31	79	70	31
MW-01	Iron	1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-01	Manganese	3.04	mg/L	<0.0025	0.0027	0.0086	0.02	0.011	0.0052	<0.0025	<0.0025	<0.0025	0.0047	0.011	0.011	0.021	0.0073	<0.0025	0.026	0.0054	<0.0025
MW-01	pH	6.5 - 9.0	s.u.	10.41	9.92	9.97	8.78	8.62	9.54	9.75	10.78	10.47	9.85	8.37	8.81	8.42	8.99	8.88	7.92	10.54	8.88
MW-01	Sulfate	500	mg/L	350	230	260	280	330	390	300	240	200	250	260	300	260	130	170	130	270	170
MW-01	Total Dissolved Solids	1000	mg/L	460	470	460	570	750	630	630	450	460	510	660	580	580	290	300	460	450	300
MW-02	Antimony	0.32	mg/L	0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-02	Arsenic	0.148	mg/L	0.025	0.016	0.012	0.0087	0.0094	0.0094	0.011	0.011	0.0089	0.012	0.009	0.0087	0.0091	0.0085	0.0062	0.0081	0.0095	0.0062
MW-02	Boron	7.6	mg/L	2.2	2.2	2	1.7	1.9	2	2.6	2.1	1.9	2.2	1.9	2.1	2.2	2.8	2.6	3	3	3.2
MW-02	Chloride	500	mg/L	42	45	46	45	50	53	48	55	54	50	52	47	55	51	57	47	48	57
MW-02	Iron	1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.16	<0.1	<0.1	0.16
MW-02	Manganese	3.04	mg/L	0.0034	0.018	0.032	0.018	0.035	0.028	0.031	0.025	0.023	0.039	0.051	0.069	0.034	0.085	0.16	0.05	0.041	0.16
MW-02	pH	6.5 - 9.0	s.u.	9.90	9.31	8.65	7.82	7.77	7.82	7.9	8.24	7.94	8.95	7.63	7.61	7.97	8.38	7.65	8.13	8.61	7.63
MW-02	Sulfate	500	mg/L	230	160	150	200	180	200	210	270	210	230	220	260	290	370	280	210	350	280
MW-02	Total Dissolved Solids	1000	mg/L	410	400	410	460	490	400	520	540	500	520	550	530	770	670	710	550	510	710
MW-03	Antimony	0.32	mg/L	0.0051	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-03	Arsenic	0.148	mg/L	0.0043	0.0041	0.0049	0.0077	0.0049	0.0071	0.003	0.0044	0.0031	0.0018	0.0014	0.0025	0.005	0.0013	0.002	0.0041	0.0029	0.002
MW-03	Boron	7.6	mg/L	1.7	2.2	2.3	1.6	1.6	1.5	1.3	1.4	1.9	2	2.5	1.8	1.9	1.1	1.2	2.3	2.3	1.6
MW-03	Chloride	500	mg/L	53	49	53	49	51	52	41	47	49	45	39	43	25	37	37	89	64	37
MW-03	Iron	1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-03	Manganese	3.04	mg/L	<0.0025	0.0059	0.0044	<0.0025	0.0054	0.0036	0.007	0.0034	0.0034	0.015	0.0062	0.0031	0.0082	0.0069	0.0028	0.0083	0.0035	0.0028
MW-03	pH	6.5 - 9.0	s.u.	9.31	8.58	8.64	9.2	8.61	8.89	7.58	9.14	8.22	8.55	7.13	7.46	7.26	7.38	8.47	7.82	6.95	8.47
MW-03	Sulfate	500	mg/L	120	130	130	97	110	140	150	260	240	240	290	240	140	170	100	110	240	100
MW-03	Total Dissolved Solids	1000	mg/L	280	350	340	300	380	340	420	480	520	470	860	530	380	340	210	470	400	210
MW-04	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-04	Arsenic	0.148	mg/L	0.006	0.0077	0.0059	0.0058	0.0065	0.0068	0.0091	0.0079	0.008	0.0081	0.0032	0.0044	0.0055	0.0062	0.0061	0.0064	0.008	0.0061
MW-04	Boron	7.6	mg/L	2	2.1	2	1.8	2.1	2.2	2.5	2.2	2.5	2.4	2.3	2.5	2.8	3	2.7	1.5	1.6	2
MW-04	Chloride	500	mg/L	39	47	45	59	60	71	53	55	55	50	51	42	46	41	34	33	36	34
MW-04	Iron	1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MW-04	Manganese	3.04	mg/L	0.058	0.035	0.028	0.36	0.025	0.038	0.041	0.028	0.031	0.034	0.016	0.024	0.036	0.074	0.052	0.046	0.035	0.052
MW-04	pH	6.5 - 9.0	s.u.	7.8	8.54	7.69	7.42	7.35	7.25	7.51	8.63	8.41	8.93	7.25	7.18	7.35	7.99	7.76	7.74	7.53	7.76
MW-04	Sulfate	500	mg/L	250	170	160	160	160	280	250	210	220	230	260	300	270	360	140	130	200	140
MW-04	Total Dissolved Solids	1000	mg/L	430	400	380	470	480	490	540	440	510	460	660	610	630	680	470	370	280	470
MW-05	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-05	Arsenic	0.148	mg/L	0.0076	0.0082	0.0013	<0.001	0.01	0.01	0.0098	0.012	0.011	0.012	<0.001	0.0013	0.0086	0.0097	0.009	0.0019	0.0097	0.009
MW-05	Boron	7.6	mg/L	28	33	13	30	37	44	47	41	37	33	13	29	33	31	36	35	36	38
MW-05	Chloride	500	mg/L	100	120	540	220	110	50	50	170	220	68	600	210	49	45	47	47	42	47
MW-05	Iron	1	mg/L	3.5	2.8	0.95	0.42	5.6	6.6	5.9	5.1	3.9	4	0.41	3.3	4.6	5.5	5.5	4	8.6	5.3
MW-05	Manganese	3.04	mg/L	0.71	0.6	0.28	0.03	0.99	0.76	0.75	0.57	0.48	0.51	0.17	0.44	0.54	0.62	0.49	0.65	0.62	0.49
MW-05	pH	6.5 - 9.0	s.u.	7.21	7.56	6.72	6.87	7.15	7.45	6.97	7.32	7.36	7.33	6.61	6.74	7.2	7.64	7.07	7.06	7.3	7.07
MW-05	Sulfate	500	mg/L	920	780	1500	810	1100	980	800	710	550	680	1200	890	870	640	630	640	840	630
MW-05	Total Dissolved Solids	1000	mg/L	1500	1800	3300	2300	2300	2000	2100	1900	1800	1600	3500	2000	1600	1400	1500	1600	1500	1500
MW-06	Antimony	0.32	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-06	Arsenic	0.148	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	0.0029	0.0019	0.0065	0.0096	0.0034	0.0017	0.0043	0.0083	0.0045	0.0043
MW-06	Boron	7.6	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	1.1	2.8	6.7	4.3	2.4	2	2.2	2.9	3.7	3.5
MW-06	Chloride	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	110	61	48	69	85	8	84	98	97	84
MW-06	Iron	1	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	2.6	3	4.2	16	4.1	0.19	3	9.3	6.7	3
MW-06	Manganese	3.04	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	0.21	0.36	0.75	0.72	0.44	0.0073	0.17	0.38	0.44	0.17
MW-06	pH	6.5 - 9.0	s.u.	NS	NS	NS	NS	NS	NS	NS	NS	7.52	7.42	6.83	6.88	7.24	7.94	7.18	7.11	7.33	7.18
MW-06	Sulfate	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	160	380	390	360	350	93	170	120	240	170
MW-06	Total Dissolved Solids	1000	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	940	1100	1100	1100	1200	190	870	950	890	870
MW-07	Antimony	0.32	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-07	Arsenic	0.148	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	0.0099	0.017	0.01	0.011	0.012	0.0096	0.0098	0.011	0.0095	0.0098
MW-07	Boron	7.6	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	43	49	42	44	45	39	37	40	41	37
MW-07	Chloride	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	60	54	44	33	53	34	35	36	48	35
MW-07	Iron	1	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	12	12	13	13	15	11	12	11	9.4	12
MW-07	Manganese	3.04	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	0.46	0.49	0.48	0.46	0.46	0.46	0.6	0.4	0.34	0.6

Table B-4-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to May 2014
Midwest Generation – Waukegan Generating Station - Waukegan, Lake County, Illinois

Well	Constituent	Effects Values [1]	Units	Groundwater Analytical Results (Year [Month])																		
				2010 [10]	2011 [03]	2011 [06]	2011 [09]	2011 [12]	2012 [03] [2]	2012 [06]	2012 [09] [3]	2012 [12]	2013 [03]	2013 [06]	2013 [07]	2013 [11]	2014 [03]	2014 [05]	2014 [08]	2014 [11]	2015 [02]
MW-07	pH	6.5 - 9.0	s.u.	NS	NS	NS	NS	NS	NS	NS	NS	7.27	8.24	7.09	7.1	7.18	7.67	6.89	7.25	7.46	6.89
MW-07	Sulfate	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	**630**	**710**	**650**	**860**	**770**	**540**	330	**690**	**800**	330
MW-07	Total Dissolved Solids	1000	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	**1800**	**1800**	**1800**	**1800**	**1800**	**1600**	**1300**	**1600**	**1500**	**1300**
MW-08	Antimony	0.32	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.003	<0.003	<0.003	<0.003
MW-08	Arsenic	0.148	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0049	0.0057	0.0054	0.0049
MW-08	Boron	7.6	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**19**	**24**	**28**	NS
MW-08	Chloride	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	50	56	30	50
MW-08	Iron	1	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**5**	**7**	**6.2**	**5**
MW-08	Manganese	3.04	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.31	0.33	0.33	0.31
MW-08	pH	6.5 - 9.0	s.u.	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.92	6.97	7.16	6.92
MW-08	Sulfate	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	250	370	500	250
MW-08	Total Dissolved Solids	1000	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1000	**1200**	**1200**	1000
MW-09	Antimony	0.32	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.003	<0.003	<0.003	<0.003
MW-09	Arsenic	0.148	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0012	<0.001	<0.001	0.0012
MW-09	Boron	7.6	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**16**	6.3	**13**	NS
MW-09	Chloride	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	370	380	430	370
MW-09	Iron	1	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.81	0.12	0.14	0.81
MW-09	Manganese	3.04	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.14	0.05	0.048	0.14
MW-09	pH	6.5 - 9.0	s.u.	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.94	6.9	7.2	6.94
MW-09	Sulfate	500	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	360	230	430	360
MW-09	Total Dissolved Solids	1000	mg/L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**1400**	**1300**	**1400**	**1600**

Notes
(1) Illinois Lake Michigan (LM) Basin Water Quality Standards (WQS) and Illinois LM Basin Water Quality Criteria (WQC) are used as surface water effects values.
(2) Manganese results for March 2012 for wells MW-01 through MW-05 were qualified as "^" by the laboratory, which denotes instrument-related QC exceeds the control limits.
(3) Iron results for September 2012 for wells MW-01 through MW-05 were qualified as "^" by the laboratory, which denotes instrument-related QC exceeds the control limits.
(2) Antimony results for November 2014 for wells MW-01 through MW-03 and MW-05 through MW-09 were qualified as "^" by the laboratory, which denotes instrument-related QC exceeds the control limits.

mg/L = milligrams per liter
NS = not sampled
"--" = value not available
"<" = constituent was not detected; the reporting limit is presented
bold/shading = concentration exceeds effects value

Table B-4-2
Comparison Of Average Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation -- Waukegan Generating Station - Waukegan, Lake County, Illinois

Constituent	Units	Effects Value [1]	Groundwater Analytical Results - Average Concentrations [2]									Average [3]
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07	MW-08	MW-09	
Antimony	mg/L	0.32	0.00193	0.00225	0.0017	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.00165
Arsenic	mg/L	0.148	0.0708	0.0105	0.00369	0.00654	0.00734	0.00474	0.0105	0.00523	0.00097	0.0134
Boron	mg/L	7.6	2.24	2.31	1.79	2.23	**31.9**	3.16	**40.7**	**23.7**	**11.8**	**13.3**
Chloride	mg/L	500	44.1	50.1	47.8	47.3	152	74.4	43.2	46.5	388	99.3
Iron	mg/L	1.0	0.1 U	0.0622	0.1 U	0.1 U	**4.11**	**5.3**	**11.8**	**5.8**	0.47	**3.1**
Manganese	mg/L	3.04	0.00786	0.0512	0.00513	0.0563	0.539	0.365	0.475	0.32	0.0945	0.213
Sulfate	mg/L	500	251	239	167	216	**819**	243	**639**	343	345	362
pH	s.u.	6.5 - 9.0	**9.38**	8.22	8.2	7.78	7.15	7.26	7.3	6.99	7	7.7
Total Dissolved Solids	mg/L	1000	501	536	404	487	**1950**	921	**1630**	1100	**1480**	**1000**

Notes
(1) Illinois Lake Michigan (LM) Basin Water Quality Standards (WQS) and Illinois LM Basin Water Quality Criteria (WQC) are used as surface water effects values.
(2) Average of concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the average reporting limit is presented in the table, indicated with a "U" qualifier. Otherwise, non-detect results were included in the average calculation assuming one-half the reporting limit.
(3) Average of concentrations (averages) presented in the table, assuming one-half the reporting limit for non-detect results.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit
bold/shading = concentration exceeds effects value

Table B-4-3
Comparison Of Maximum Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation – Waukegan Generating Station - Waukegan, Lake County, Illinois

Constituent	Units	Effects Value [1]	Groundwater Analytical Results - Maximum Concentrations [2]									Average [3]
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07	MW-08	MW-09	
Antimony	mg/L	0.32	0.0056	0.015	0.0051	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.00386
Arsenic	mg/L	0.148	**0.21**	0.025	0.0077	0.0091	0.012	0.0096	0.012	0.0057	0.0012	0.0325
Boron	mg/L	7.6	3.1	3.2	2.5	3	**47**	6.7	**49**	**28**	**16**	**17.6**
Chloride	mg/L	500	79	57	89	71	**600**	110	60	56	430	172
Iron	mg/L	1.0	0.1 U	0.16	0.1 U	0.1 U	**8.6**	**16**	**13**	**7**	0.81	**5.08**
Manganese	mg/L	3.04	0.026	0.16	0.015	0.36	0.99	0.75	0.6	0.33	0.14	0.375
Sulfate	mg/L	500	390	370	290	360	**1200**	390	**880**	500	430	**534**
pH	s.u.	6.5 - 9.0	**7.92-10.78**	**7.61-9.98**	**6.95-9.21**	7.18-8.93	6.61-7.64	6.83-7.94	6.89-8.24	6.92-7.16	6.9-7.2	7.09-8.56
Total Dissolved Solids	mg/L	1000	750	770	860	680	**3500**	**1200**	**1800**	**1200**	**1600**	**1370**

Notes

(1) Illinois Lake Michigan (LM) Basin Water Quality Standards (WQS) and Illinois LM Basin Water Quality Criteria (WQC) are used as surface water effects values.

(2) Maximum detected concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the maximum reporting limit is presented in the table, indicated with a "U" qualifier. For pH, the range is presented.

(3) Average of well-specific concentrations (maximums) presented in the table. If the maximum is a non-detect result, one-half the reporting limit was used as a surrogate concentration in the calculation. For pH, the range presented in the "average" column is the average minimum and average maximum.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit; reporting limit presented
bold/shading = concentration exceeds effects value

Table B-5-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation – Will County Generating Station - Romeoville, Will County, Illinois

Well	Constituent	Effects Values [1]	Units	Groundwater Analytical Results [Year [Month]]																	
				2010 [12]	2011 [03]	2011 [06]	2011 [09]	2011 [12]	2012 [03]	2012 [06]	2012 [09]	2012 [12] [2]	2013 [03]	2013 [05/06]	2013 [08]	2013 [10]	2014 [02]	2014 [05]	2014 [08]	2014 [10]	2015 [02]
MW-01	Antimony	0.32	mg/L	<0.003	<0.003	<0.003	<0.003	0.0063	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-01	Boron	7.6	mg/L	1.8	1.6	1.8	1.7	1.6	1.5	2.1	1.9	1.9	1.9	2.4	2.3	2.6	2.4	2.5	1.2	0.96	0.96
MW-01	Chloride	500	mg/L	110	210	110	120	140	190	170	120	160	220	190	120	160	120	87	35	29	30
MW-01	Manganese	3.04	mg/L	0.2	0.15	0.22	0.16	0.17	0.16	0.16	0.15	0.18	0.17	0.13	0.22	0.28	0.3	0.26	0.24	0.17	0.079
MW-01	pH	6.5 - 9.0	s.u.	7.89	8.05	7.28	7.57	7.16	7.84	7.55	7.7	7.79	8.41	7.56	7.18	7.04	8.96	7.19	6.91	7.12	7.41
MW-01	Sulfate	1350	mg/L	530	390	280	320	270	430	390	390	290	310	460	540	430	390	230	91	150	99
MW-01	Total Dissolved Solids	--		1100	1100	1100	760	770	910	950	790	880	930	1100	1300	1300	1300	890	600	600	570
MW-02	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	0.0073	0.017	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-02	Boron	7.6	mg/L	1.8	1.7	2.3	2.3	1.7	1.7	2	2.2	1.8	1.7	1.9	2.2	2.4	2.4	2.8	3	3.6	3.8
MW-02	Chloride	500	mg/L	110	250	180	110	120	140	150	110	130	190	200	170	180	170	130	100	97	130
MW-02	Manganese	3.04	mg/L	0.032	0.032	0.043	0.036	0.031	0.031	0.038	0.029	0.033	0.029	0.041	0.041	0.043	0.044	0.024	0.074	0.083	0.064
MW-02	pH	6.5 - 9.0	s.u.	8.62	8.62	8	8.11	7.8	8.34	8.23	8.33	8.4	7.79	8	7.93	8.06	8.97	7.74	7.59	6.94	8.14
MW-02	Sulfate	1350	mg/L	430	280	400	330	220	330	340	280	250	260	250	300	280	210	300	340	510	400
MW-02	Total Dissolved Solids	--		870	970	900	720	650	810	850	690	710	740	890	900	950	1000	1000	1100	1200	1200
MW-03	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-03	Boron	7.6	mg/L	2.7	2.4	2.6	3.3	2.8	2.7	3.1	3.9	3.4	3.2	3.7	3.6	3.5	3.2	3.3	3.5	3.6	2.9
MW-03	Chloride	500	mg/L	54	250	100	130	100	95	88	96	100	87	110	100	110	69	62	91	57	41
MW-03	Manganese	3.04	mg/L	0.34	0.31	0.34	0.26	0.29	0.27	0.37	0.24	0.25	0.29	0.22	0.19	0.16	0.45	0.25	0.16	0.29	0.47
MW-03	pH	6.5 - 9.0	s.u.	7.21	7.72	7.01	7.18	6.55	7.24	6.79	7.12	7.21	7.88	7.21	7.2	7.24	7.03	7.21	7.39	6.06	7.11
MW-03	Sulfate	1350	mg/L	330	270	240	250	280	320	500	440	480	390	610	530	540	560	560	570	570	320
MW-03	Total Dissolved Solids	--		940	1000	990	1000	930	1000	1400	1100	1100	1100	1200	1200	1100	1200	1200	1100	1100	1100
MW-04	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-04	Boron	7.6	mg/L	3.7	3.3	3.6	4.3	3	4	5.3	6.2	5.2	4.5	3.8	5.1	5.6	4.6	4.2	4.8	4.5	3.9
MW-04	Chloride	500	mg/L	120	190	120	170	150	150	140	170	170	150	110	120	89	110	85	67	82	120
MW-04	Manganese	3.04	mg/L	0.52	0.58	0.7	1	0.62	0.6	0.7	0.99	0.62	0.47	0.44	0.58	0.65	0.72	0.49	0.88	0.64	0.52
MW-04	pH	6.5 - 9.0	s.u.	7.37	7.66	7.23	7.21	6.58	7.27	7.1	7.29	7.34	6.61	7.07	7.15	6.74	7.03	6.96	6.75	5.87	7.13
MW-04	Sulfate	1350	mg/L	1500	1500	1600	4000	1400	2000	2000	3200	2300	2000	1500	2200	1300	1400	1100	1200	1600	1100
MW-04	Total Dissolved Solids	--		2500	2600	2800	6000	3100	3700	4300	4400	4000	3600	2900	3500	2400	2800	2500	2200	2600	2600
MW-05	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-05	Boron	7.6	mg/L	2.6	2.7	3.2	4	3.2	2.9	2.3	3.8	2.5	2.6	3.6	3.5	4.1	2.7	2.9	2.7	4.7	2.4
MW-05	Chloride	500	mg/L	110	150	140	150	130	170	150	160	150	140	110	120	130	130	160	170	81	200
MW-05	Manganese	3.04	mg/L	0.0079	0.0067	0.055	0.13	0.038	0.032	0.014	0.073	0.023	0.036	0.15	0.06	0.11	0.053	0.11	0.062	0.2	0.046
MW-05	pH	6.5 - 9.0	s.u.	9.50	9.51	7.44	7.38	8.2	9.3	9.41	7.54	9.37	7.43	7	7.88	6.75	8.45	7.07	7.36	6.87	9.7
MW-05	Sulfate	1350	mg/L	580	570	540	690	500	370	410	540	280	320	650	500	560	690	1700	610	840	430
MW-05	Total Dissolved Solids	--		1000	1300	1400	1500	1000	1000	750	1100	820	940	1600	1100	1300	1400	1600	1400	2100	1100
MW-06	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-06	Boron	7.6	mg/L	2.7	2.5	2.4	3	2.5	2.5	2.9	3	3	2.7	2.8	2.9	3.7	3	2.9	2.8	3.4	3.2
MW-06	Chloride	500	mg/L	120	210	150	120	120	110	92	110	110	130	110	91	76	55	120	120	81	49
MW-06	Manganese	3.04	mg/L	0.073	0.051	0.047	0.024	0.038	0.029	0.033	0.038	0.034	0.03	0.082	0.023	0.083	0.099	0.056	0.028	0.11	0.12
MW-06	pH	6.5 - 9.0	s.u.	8.89	9.65	9.27	9.44	8.82	9.39	9.07	9.17	9.18	8.22	8.41	9.12	8.5	8.27	8.52	8.16	7.26	8.38
MW-06	Sulfate	1350	mg/L	500	540	570	420	440	380	450	550	360	370	360	400	310	270	320	200	420	310
MW-06	Total Dissolved Solids	--		990	1100	1200	870	880	900	770	890	820	840	880	860	790	780	840	660	800	770
MW-07	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-07	Boron	7.6	mg/L	4.7	5	5.7	3.4	5	5.1	5.6	5.5	5.1	4.3	2.6	3.5	3	4	4.8	3.9	5.1	3
MW-07	Chloride	500	mg/L	160	140	140	160	150	130	120	150	140	140	190	180	180	210	190	200	190	170
MW-07	Manganese	3.04	mg/L	0.12	0.11	0.15	0.18	0.2	0.2	0.19	0.19	0.19	0.15	0.043	0.064	0.049	0.16	0.12	0.1	0.12	0.031
MW-07	pH	6.5 - 9.0	s.u.	8.61	8.79	8.13	7.91	7.69	8.16	7.92	8.02	7.75	8.08	8.14	8.43	8.07	8.18	8.22	8.26	7.88	8.68
MW-07	Sulfate	1350	mg/L	610	650	1000	710	710	770	670	600	480	400	390	460	530	380	540	570	680	400
MW-07	Total Dissolved Solids	--		1300	1500	1600	1400	1300	1400	1300	1200	1200	1000	1100	1100	1200	1300	1300	1300	1500	1100

Table B-5-1
Groundwater Analytical Results for Constituents of Interest: December 2010 to February 2015
Midwest Generation – Will County Generating Station - Romeoville, Will County, Illinois

Well	Constituent	Effects Values [1]	Units	Groundwater Analytical Results [Year (Month)]																	
				2010 (12)	2011 (03)	2011 (06)	2011 (09)	2011 (12)	2012 (03)	2012 (06)	2012 (09)	2012 (12) [2]	2013 (03)	2013 (05/06)	2013 (08)	2013 (10)	2014 (02)	2014 (05)	2014 (08)	2014 (10)	2015 (02)
MW-08	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-08	Boron	7.6	mg/L	1.7	1.3	1.7	2.3	1.9	1.5	2	2.6	2.1	1.8	1.9	2.4	3.2	2	2.5	2.4	2.8	2.3
MW-08	Chloride	500	mg/L	93	270	200	160	130	160	160	150	150	150	190	170	150	180	160	170	180	170
MW-08	Manganese	3.04	mg/L	0.33	0.44	0.47	0.45	0.4	<0.005	0.36	0.41	0.43	0.33	0.47	0.31	0.42	0.39	0.35	0.3	0.44	0.31
MW-08	pH	6.5 - 9.0	s.u.	7.65	8.17	7.47	7.3	6.99	7.61	7.36	7.31	7.43	7.87	7.19	7.46	6.87	8.18	7.04	7.09	7.03	7.24
MW-08	Sulfate	1350	mg/L	440	440	420	600	330	330	370	630	380	360	270	440	650	330	450	430	730	530
MW-08	Total Dissolved Solids	--		930	1200	1100	1300	980	910	1000	1200	1200	1000	1100	1100	1600	1300	1400	1200	1500	1400
MW-09	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-09	Boron	7.6	mg/L	2.2	1.4	1.7	2	1.9	1.4	1.8	2	1.7	1.5	1.7	1.8	2.2	1.4	1.5	1.7	1.9	1.4
MW-09	Chloride	500	mg/L	100	280	230	190	140	200	160	160	130	140	160	170	110	270	250	210	200	200
MW-09	Manganese	3.04	mg/L	<0.0025	<0.0025	<0.013	<0.0025	<0.0025	<0.0025	<0.0025	0.0036	<0.0025	<0.0025	<0.0025	0.0043	<0.0025	<0.0025	<0.0025	<0.0025	0.0025	0.0026
MW-09	pH	6.5 - 9.0	s.u.	**10.88**	**10.87**	**10.44**	**10.37**	**9.95**	**10.56**	**10.31**	**10.23**	**10.42**	**10.39**	**9.93**	**9.86**	**10.01**	**9.69**	**9.71**	**9.26**	8.73	**9.48**
MW-09	Sulfate	1350	mg/L	410	320	410	400	270	340	340	380	310	250	320	310	310	220	380	310	430	300
MW-09	Total Dissolved Solids	--		800	1000	940	850	660	820	880	800	780	600	690	700	680	780	880	870	820	810
MW-10	Antimony	0.32	mg/L	<0.003	<0.003	<0.015	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MW-10	Boron	7.6	mg/L	2.1	1.8	2.2	2.8	2.5	2.1	2.1	3.2	2.7	2.7	2.7	2.3	3.8	2.5	2.2	2.1	3.3	3.3
MW-10	Chloride	500	mg/L	92	130	150	120	120	100	120	140	140	130	140	130	140	140	140	140	140	110
MW-10	Manganese	3.04	mg/L	0.25	0.22	0.25	0.27	0.29	0.25	0.26	0.23	0.29	0.29	0.24	0.14	0.22	0.18	0.12	0.12	0.25	0.38
MW-10	pH	6.5 - 9.0	s.u.	7.61	8.14	7.53	7.45	7.1	7.59	7.39	7.6	7.47	7.54	7.53	7.38	7.27	**9.18**	7.54	7.54	6.84	7.32
MW-10	Sulfate	1350	mg/L	370	370	350	420	290	330	350	380	270	350	350	300	330	290	270	260	380	260
MW-10	Total Dissolved Solids	--		990	960	990	1000	1100	990	1000	970	1100	1000	1100	900	920	1000	940	880	1100	1100

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) Antimony results (all non-detects) for December 2012 for wells MW-01 through MW-10 were qualified as "^" by the laboratory, which denotes instrument-related QC exceeds the control limits.

mg/L = milligrams per liter
s.u. = standard units
"--" = value not available
"<" = constituent was not detected; the reporting limit is presented
bold/shading = concentration exceeds effects value

Table B-5-2
Comparison Of Average Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation -- Will County Generating Station - Romeoville, Will County, Illinois

Constituent	Units	Effects Value[1]	Groundwater Analytical Results - Average Concentrations[2]										Average[3]
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07	MW-08	MW-09	MW-10	
Antimony	mg/L	0.32	0.00177	0.00302	0.00367 U	0.00367 U	0.00367 U	0.00367 U	0.00367 U	0.00367 U	0.00367 U	0.00367 U	0.00195
Boron	mg/L	7.6	1.84	2.29	3.19	4.42	3.13	2.88	4.41	2.13	1.73	2.58	2.86
Chloride	mg/L	500	129	148	96.8	129	142	110	163	166	183	129	140
Manganese	mg/L	3.04	0.189	0.0416	0.286	0.651	0.067	0.0554	0.132	0.367	0.00199	0.236	0.20
Sulfate	mg/L	1480	333	317	431	**1920**	599	398	586	452	334	329	570
pH	s.u.	6.5 - 9.0	7.59	8.09	7.13	7.02	8.12	8.76	8.16	7.4	**10**	7.56	7.98
Total Dissolved Solids	mg/L	--	942	897	1100	3250	1250	869	1280	1190	798	1000	1260

Notes
(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.
(2) Average of concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the average reporting limit is presented in the table, indicated with a "U" qualifier. Otherwise, non-detect results were included in the average calculation assuming one-half the reporting limit.
(3) Average of concentrations (averages) presented in the table, assuming one-half the reporting limit for non-detect results.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit
bold/shading = concentration exceeds effects value

Table B-5-3
Comparison Of Maximum Groundwater Analytical Results To Surface Water Effects Values
Midwest Generation – Will County Generating Station - Romeoville, Will County, Illinois

Constituent	Units	Effects Value [1]	Groundwater Analytical Results - Maximum Concentrations [2]										Average [3]
			MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07	MW-08	MW-09	MW-10	
Antimony	mg/L	0.32	0.0063	0.017	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.00833
Boron	mg/L	7.6	2.6	3.6	3.9	6.2	4.7	3.7	5.7	3.2	2.2	3.8	3.96
Chloride	mg/L	500	220	250	250	190	170	210	210	270	280	150	220
Manganese	mg/L	3.04	0.3	0.083	0.45	1	0.2	0.12	0.2	0.47	0.0043	0.38	0.32
Sulfate	mg/L	1480	540	510	610	**4800**	**1700**	570	1000	730	430	420	1130
pH	s.u.	6.5 - 9.0	6.91-8.96	6.94-8.97	**6.06-7.88**	**5.87-7.66**	**6.75-9.70**	**7.26-9.65**	7.69-8.79	6.87-8.18	**8.73-10.88**	**6.84-9.18**	6.99-8.99
Total Dissolved Solids	mg/L	--	1300	1200	1400	6000	2100	1200	1600	1600	1000	1100	1850

Notes

(1) Illinois General Use Water Quality Standards (WQS) and Illinois Water Quality Criteria (WQC) are used as surface water effects values.

(2) Maximum detected concentrations reported between December 2010 and February 2015. If a constituent was not detected during this timeframe, the maximum reporting limit is presented in the table, indicated with a "U" qualifier. For pH, the range is presented.

(3) Average of well-specific concentrations (maximums) presented in the table. If the maximum is a non-detect result, one-half the reporting limit was used as a surrogate concentration in the calculation. For pH, the range presented in the "average" column is the average minimum and average maximum.

mg/L = milligram per liter
s.u. = standard units
"--" = value not available
U = constituent not detected above its reporting limit
bold/shading = concentration exceeds effects value