BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

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 2013-015** **(Enforcement – Water)**

NOTICE OF FILING

TO: Don Brown, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

Attached Service List

PLEASE TAKE NOTICE that I have filed today with the Illinois Pollution Control Board, Midwest Generation, LLC's Motion *In Limine* to Exclude Quarles Opinions with Exhibits, a copy of which is hereby served upon you.

MIDWEST GENERATION, LLC

By: /s/ Jennifer T. Nijman

Dated: February 4, 2022

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CERTIFICATE OF SERVICE

The undersigned, an attorney, certifies that a true copy of the foregoing Notice of Filing, Certificate of Service for Midwest Generation, LLC's Motion *In Limine* to Exclude Quarles Opinions with Exhibits, a copy of which is hereby served upon you was filed on February 4, 2022 with the following:

Don Brown, Clerk
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and that true copies of the Notice of Filing, Certificate of Service for Midwest Generation, LLC's Motion *In Limine* to Exclude Quarles Opinions with Exhibits were emailed on February 4, 2022 to the parties listed on the foregoing Service List.

/s/ Jennifer T. Nijman

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

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 2013-015** **(Enforcement – Water)**

MIDWEST GENERATION, LLC'S
MOTION *IN LIMINE* TO EXCLUDE QUARLES OPINIONS

Pursuant to 35 Ill. Adm. Code 101.500, 101.502 and 101.504, Respondent, Midwest Generation, LLC ("MWG"), submits this Motion *In Limine* requesting the Hearing Officer enter an order excluding the "Expert Opinion of Mark A. Quarles, P.G.", dated January 25, 2021 and "Expert Opinion, Rebuttal Report of Mark A. Quarles, P.G.", dated July 16, 2021. Mr. Quarles's opinions violate the September 14, 2020 Hearing Officer Order because they do not "elaborate and amplify" the previously admitted expert reports.

Complainants' first expert in this matter was James Kunkel, who issued detailed opinions about remedies for the MWG stations. In April 2020, Complainants sought to replace Mr. Kunkel over MWG's objections. In ruling on the request, the Hearing Officer allowed Complainants to name new experts, but only on the condition that "the parties must proceed to build on that information and present more information, including elaboration and amplification." Hearing Officer Order, Sept. 14, 2020, attached as Exhibit 1, p. 3. Complainants' new expert, Mark Quarles, fails to elaborate and amplify and, in fact, admits to never having read Mr. Kunkel's reports or opinions.

As such, his reports and testimony violate the existing Order and must be excluded. Moreover, Mr. Quarles's opinion does not aid the Board, as is required for expert opinion, and his failure to build upon and amplify the Kunkel opinions creates confusion.

Finally, Mr. Quarles's unsubstantiated and unprofessional attacks on the qualifications of experts from Weaver should be excluded as they do not aid the Board.

In support of its Motion, MWG states as follows:

A. BACKGROUND

1. On April 1, 2020, Complainants moved for leave to designate substitute expert witnesses claiming that their previously disclosed and testifying expert, James Kunkel, was "not the best-placed expert to address the remaining issues in this matter." *See* Complainants' Motion for Leave to Designate Substitute Expert Witness and Memorandum in Support, April 1, 2020, p. 6.

2. MWG objected to Complainants' motion because the parties had already presented expert opinions on all elements of the litigation, including remedy, and Complainants had provided no basis for substitution. MWG stated that it would be highly prejudiced by the substitution because it conducted its litigation strategy based upon the complete expert opinions of both parties.

3. MWG also argued that if Complainants were allowed to replace their experts, then the new experts must maintain substantially the same opinions as the original experts. Under Illinois law, substitution of an expert may be allowed under certain circumstances, but it is not an opportunity to "introduce new and different theories in this case." MWG's Response to Complainants' Motion to Designate Substitute Expert Witnesses, April 15, 2020 , p 14, *citing Ind. Ins. Co.*, 2001 U.S. Dist. LEXIS 23256, at *4.

4. On September 14, 2020, the Hearing Officer allowed the parties to name new expert witnesses, but with conditions. The Hearing Officer stated that "Any testimony already given

stands and the <u>*parties must proceed to build on that information and present more information, including elaboration and amplification*</u>." Ex. 1, Hearing Officer Order, Sept. 14, 2020, p. 3 (emphasis added).

5. Following the Hearing Officer's Order, Complainants identified in their "Notice of Expert Witness for Remedy Phase" a new expert witness, Mark Quarles, to replace Mr. Kunkel. Mr. Quarles prepared an opinion and rebuttal opinion, attached as Exhibits 2 and 3 respectively.

B. QUARLES'S OPINION VIOLATES THE HEARING OFFICER ORDER TO ELABOARTE AND AMPLIFY

6. Mr. Quarles simply ignores Mr. Kunkel's previous opinions. In fact, Mr. Quarles admits that he made no attempt to elaborate or amplify Mr. Kunkel's opinions. *See* Quarles Dep. p. 54:21-55:5, attached as Ex. 4. This is a clear and direct violation of the Hearing Officer's order to build on the expert information previously provided and to elaborate and amplify.

7. Mr. Kunkel specifically opined on the issue of a remedy for the four MWG Stations, and issued a separate "Expert Report on Remedy for Ground-water Contamination," attached as Ex. 5 ("Remedy Opinion"). He issued a rebuttal report again detailing his proposed remedy, which was admitted as Hearing Exhibit 407, attached here as Exhibit 6. In his Remedy Opinion, Mr. Kunkel concluded that the remedy for all of the Stations was the complete removal of the CCR surface impoundments and ash-impacted soils. Ex. 5, Kunkel Remedy Opinion. Table 6 of Kunkel's Remedy opinion shows Mr. Kunkel's estimated costs for excavation, hauling, and backfilling at each Station and including the CCR surface impoundments. Ex. 5, Table 6. Mr. Kunkel reiterated in his Rebuttal Report that his opinion for the remedy was CCR removal. Ex. 6, Hearing Ex. 407, p. 12.

8. Mr. Quarles's new opinions make no mention of Mr. Kunkel's remedy opinions. Exs. 2 and 3. In fact, Mr. Quarles admits that he did not review Mr. Kunkel's prior reports, and was not

even aware that Mr. Kunkel had written three reports for this matter that included opinions on remedy. Ex. 4, p. 53:24-54:8. Mr. Quarles similarly did not review Mr. Kunkel's deposition, nor even Mr. Kunkel's testimony during the first hearing. Ex. 4, p. 54:15-20.

9. Mr. Quarles fails to even identify a corrective action or remedy for any of the MWG Stations in his report. Instead, Mr. Quarles recommends that MWG conduct a "nature and extent" investigation at each Station, despite the fact that the groundwater at each of the Stations has been analyzed since 2010.[1] Ex. 1, p. 17. He also agreed that he was not proposing any type of sampling program. Ex. 4, p. 83: 7-8.

10. While Mr. Quarles briefly mentions some possible concepts for a potential remedy in his report, he emphasizes that he is not recommending a remedy at all, and he is not intending to recommend a remedy during the next hearing. Ex. 4, p. 86:24-87:10, p. 106:17-19. In fact, one of the options Mr. Quarles proposes directly contradicts Mr. Kunkel's remedy opinion. Mr. Quarles speculates that pumping and treating the groundwater is a potential remedy. Ex. 2, p. 25. Yet, Mr. Kunkel specifically rejected pump and treat as a remedy in his Rebuttal Expert Opinion. Ex. 6, Hearing Exhibit 407, p. 11.

11. Mr. Quarles's rejection of Mr. Kunkel's opinions directly violates the Hearing Officer's order, which limited new expert opinions to elaboration and amplification. This is no different than *Ind. Ins. Co. v. Valmont Elec., Inc.*, 2011 U.S. Dist. LEXIS 23256, *4 (S.D. Ind. 2001). In that case, the court allowed the plaintiff to substitute its expert, but ordered that the opinions of the new experts to be the same and barred any introduction of new and different theories. *Id.* Because the plaintiff failed to follow the court's directive, the court barred the new expert from testifying on

[1] See Hearing Exs. 809-812, which are the tables of the groundwater analytical results for each of the Stations from 2010 to 2017.

his new opinions. *Id.* Here, due to Complainants' blatant violation of the Hearing Officer's order, Mr. Quarles's opinion must be excluded.

C. QUARLES'S OPINION DOES NOT ASSIST THE BOARD

12. Mr. Quarles's opinion does not aid the Board and his failure to build upon and amplify the Kunkel opinions creates confusion. In evaluating an expert's opinion, the critical issue is whether the expert's testimony aids the trier by explaining a factual issue. *Martin v. Sally*, 314 Ill. App. 3d 308 (2nd Dist. 2003); *See also People v. King*, 2018 IL App. (2d) 151112 (2nd Dist. 2018) (*partially reversed on other grounds*) ("A requirement of expert testimony is that it will assist the trier of fact in understanding the evidence.") "A person will be allowed to testify as an expert if his experience and qualifications afford him knowledge that is not common to laypersons, and where his testimony will aid the trier of fact in reaching its decision." *Johns Manville*, (PCB 14-3, April 26, 2016, B. Halloran), *citing Thompson v. Gordon*, 221 Ill. 2d 414, 428-429; Ill. R. Evid. 702.

13. Here, Mr. Quarles's opinion is of no assistance to the Board. He does not recommend a specific investigation, admits he has not determined the type of nature and extent investigation that should be conducted, and states that he has no plan to do so. Ex. 4, p. 105:22-106:1, 106:17-19. He specifically states that he's "not thinking grid versus non-grid versus discreet versus integrated sampling.· I'm not defining what that sampling program should be." *Id.*, p. 83:6-8. He also admits that he does not know "in totality what information Midwest Gen has collected." *Id.*, p. 143:15-16. Suggesting that an investigation should be done, without any indication or ideas of how it should be conducted, the scope, or where, is a very general conclusion that the Board could certainly reach on its own, if it so desires, after hearing all the evidence. The Board has 10 years of monitoring data and samples covering the Stations, yet Mr. Quarles apparently could not make

the effort of reviewing that information to assess whether gaps existed. Instead, he makes a broad conclusion without any detail to aid the Board.

14. Mr. Quarles's opinion simply adds confusion to an already complex case. Even though Mr. Quarles ignores Kunkel's opinions, Complainants' economic expert, Jonathan Shefftz, specifically and solely relies upon the Kunkel opinions for his estimate of economic benefit. Ex. 7, Shefftz Table 3,[2] Ex. 8, Shefftz Dep. p. 59:6 – 60:23. So now, MWG and the Board are faced with the question of which remedy Complainants will put forward. Is it removal as opined by Mr. Kunkel, relied upon by Mr. Shefftz, but rejected by Mr. Quarles? If so, then no "nature and extent" investigation of the Stations is required and Mr. Quarles's opinion is meaningless and must be excluded. Or is it Mr. Quarles's vague recommendation that an investigation is required? If so, then Mr. Shefftz's reliance upon the Kunkel remedy opinions and costs is baseless.

15. It is exactly this confusing scenario that led the Hearing Officer to order that the existing expert reports stand, and new experts were only permitted to "elaborate and amplify." Complainants violated that Order and, based on the requirement that an expert opinion must assist the Board in understanding the facts (*People v. King*, 2018 IL App. (2d) 151112) , Mr. Quarles's opinions should be excluded.

D. QUARLES UNFOUNDED ATTACK ON WEAVER'S QUALIFICATIONS SHOULD BE EXLUDED

16. At the very least, Mr. Quarles's personal and unsubstantiated attacks on MWG's experts, Douglas Dorgan and Michael Maxwell, should be excluded as improper challenges to credibility that invade the purview of the Board.

[2] See MWG Motion *in Limine* to Exclude Shefftz Opinions, filed on this date. Mr. Shefftz's opinion is marked as Non-Disclosable Information, but the information in Table 3 (attached as Exhibit 6) is not Non-Disclosable Information, accordingly, MWG did not file it pursuant to Part 130 of the Board's Rules.

17. In his rebuttal report, Mr. Quarles provides his "opinions" about the qualifications of MWG's experts, Douglas Dorgan and Michael Maxwell of Weaver Consultants Group ("Weaver Experts"). Ex. 3, Sec. 2.1. His "opinions" are based on nothing more than a review of the Weaver Experts' CVs and an internet search. *Id.* In fact, the Weaver Experts testified that their CVs are only intended to be summaries of their experience, and do not represent the entirety of their many years of practice (25 and 30 years, respectively). Ex. 9, Excerpt of Weaver Dep., p. 38:8-10. MWG's experts further described their technical experience related to coal ash during their deposition, detailing their work on coal ash projects in their lengthy careers. Ex. 9, pp. 25:2- 26:23, 34:4-38:10. Mr. Quarles conveniently ignores the hundreds of site investigations and remedy projects the Weaver Experts have performed, including countless within Illinois, without even having an Illinois license himself nor developed a groundwater remedy in Illinois (Ex. 4, p. 8:7-14, 36:1-3, 37:14-17), and without acknowledging that the remedial concepts remain the same for categories of constituents like metals. Ex. 9, p. 207:20-208:7.

18. There is no doubt that whether an expert is qualified is for the Board to determine. Mr. Quarles's limited, biased, and uninformed "opinions" about two environmental consultants who have been practicing in their fields for more than 30 years does not assist the Board. Under Illinois Rule of Evidence 702, expert testimony must "assist the trier of fact to understand the evidence or to determine a fact in issue." Il. R. Evid. 702. But an expert's opinion is of no assistance when the trier of fact is equally competent to form an opinion on an ultimate fact issue. *People v. King*, 2020 IL 123926, ¶ 38, 443 Ill. Dec. 19, 31, 161 N.E.3d 143, 155 (Supreme Court held admission of expert testimony was a reversable error because the testimony "fell within the ken of an average juror and therefore did not necessitate expert assistance.") *Bachman v. GMC*, 332 Ill. App. 3d 760, 784, 267 Ill. Dec. 125, 148, 776 N.E.2d 262, 285 (4th Dist. 2002) (Court upheld exclusion of expert

witness testimony because opinions were not beyond the average juror). In fact, this Board has stated that it is within its discretion "to determine whether the subject is a proper one for expert testimony and whether the witness is qualified by special knowledge and skill." *People of the State of Illinois v. Consolidated Freightways Corp. of Delaware*, PCB76-107, Oct. 4, 1978 1978 Ill. ENV LEXIS 550, *14.

19. Here, the "jurors" are the Board members, who are statutorily required to be "technically qualified" to serve and quite competent to form an opinion about an expert witness's qualifications. 415 ILCS 5/5(a). Because of their technical qualifications and competency, they do not need Mr. Quarles's one-sided and limited statements to determine whether other experts are qualified to provide an opinion.

20. Certainly, if Complainants truly believe the Weaver Experts should be subject to exclusion based on qualifications, they can attempt to present evidence at the hearing and request the Hearing Officer make that determination after *both* sides are heard. It is not a matter for Complainants' expert to "opine" and there is no specialized knowledge needed. At present, there is no such evidence and Mr. Quarles's attacks on the Weaver Experts should not be allowed to remain in the record.

21. The Hearing Officer should not allow the professional reputations of both Mr. Dorgan and Mr. Maxwell to be improperly and unfairly insulted in a publicly available expert report, without basis and without response. Even if Complainants respond that the Weaver Experts can address this at the hearing, it does not correct the public nature and potential impact of written expert opinions (as opposed to hearing testimony that few will read).

22. An expert is not permitted to opine on the credibility of another witness, which is exactly what Complainants are attempting to do through Mr. Quarles. Mr. Quarles attacks the Weaver

Experts' credibility by stating that their testimony in this case would be "especially concerning" (based on Quarles's conclusions drawn from review of one unrelated case with limited reports found online) and due to alleged "minimal CCR experience". Such general criticisms of credibility are simply unproven statements that are inadmissible. *La Playita Cicero, Inc. v. Town of Cicero,* 2017 U.S. Dist. LEXIS 44868, *26-27 (N.D. Ill. March 28, 2017) (Court excluded expert's general opinions on witness's character and credibility because they were not supported by the facts and would not help the trier of fact).[3]

23. Because the Quarles's opinions on the Weaver experts qualifications do not assist the Board and are not beyond the technical expertise of the Board, Section 2.1 of his Rebuttal opinion should be excluded.

WHEREFORE, for the reasons stated above, MWG requests that the Hearing Officer grant this Motion *In Limine* and enter an order excluding the Expert Opinion of Mark A. Quarles, P.G.", dated January 25, 2021 and "Expert Opinion, Rebuttal Report of Mark A. Quarles, P.G.", dated July 16, 2021, and excluding Mr. Quarles's opinion about the MWG experts.

Respectfully submitted,

Midwest Generation, LLC

By: /s/ Jennifer T. Nijman
One of Its Attorneys

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[3] While the case relates to Federal Rule 702, the key language of Illinois Rule of Evidence 702 is the same, both rules requiring that the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue.

EXHIBIT 1

ILLINOIS POLLUTION CONTROL BOARD
September 14, 2020

SIERRA CLUB, ENVIRONMENTAL LAW AND POLICY CENTER, PRAIRIE RIVERS NETWORK, and CITIZENS AGAINST RUINING THE ENVIRONMENT	)	
Complainants,	)	PCB No. 13-15 (Enforcement – Water)
v.	)	
MIDWEST GENERATION, LLC,	)	
Respondent.	)	

HEARING OFFICER ORDER

On June 20, 2019, an Interim Board Order found respondent, Midwest Generation, LLC, (Midwest) liable for certain violations alleged by Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network, and Citizens Against Ruining the Environment (Citizens Group) and held that the record is insufficient to determine the appropriate relief and any remedy. The Board directed the hearing officer to hold additional hearings to determine the appropriate relief. Sierra Club et al. v. Midwest Generation, LLC, PCB 13-15, slip op. at 92-92 (June 20, 2019).

Summary of Procedural History of Citizens Group Motion to Designate New Experts[1]

On April 1, 2020, the Citizens Group filed a motion for leave to designate substitute expert witnesses with supporting memorandum (Mot.). The Citizens Group request to substitute their expert witnesses for the Board ordered remedy hearing in this matter. Mot. at 1-3. The Citizens Group identified two expert witnesses for the initial hearing in this matter - Dr. James Kunkel and David Schlissel - but only Dr. Kunkel was deposed and later testified at hearing. *Id.* at 2. Complainants argue that "a new expert would be better placed than Dr. Kunkel to address the issues that remain to be resolved in the remedy phase of the litigation." *Id*. Complainants report that David Schlissel "is no longer working in a full-time capacity, has reduced his project load, and does not have availability to re-engage as an expert in this matter." *Id.*

On April 15, 2020, Midwest Gen filed a response to complainants' motion (Resp.). In summary, Midwest Gen argues that discovery has closed, both parties have "presented opinions for the remedy phase of the litigation", and that complainants have not demonstrated good cause to replace their experts for the remedy phase of the Board ordered hearing. Resp. at 1-4,13-15.

[1] The parties respective and numerous motions for leave to file a reply and sur-reply are granted.

Midwest Gen further argues that if the Citizens Group is allowed to substitute its witnesses, "any new expert must maintain substantially the same opinions as the original experts". *Id*. at 12-13.

On May 22, 2020, I issued an order directing the complainants file on or before June 1, 2020, a memorandum elaborating why Dr. Kunkel needs to be replaced and why a substitute expert would be better placed than Dr. Kunkel. Hearing Officer Order at 2 (May 22, 2020). Respondent was directed to file its response on or before June 9, 2020. *Id.*

On May 29, 2020, the Citizens Group filed a memorandum (Memo). Addressing my question of why Dr. Kunkel needs to be replaced and why a substitute expert would be better placed than Dr. Kunkel, complainants argue that providing an answer "requires divulging privileged attorney work product consisting of attorney mental impressions." Memo at 1. Nevertheless, the Citizens Group states that if Dr. Kunkel is substituted for another expert better placed, "to the best of their knowledge, there will be no inconsistency or contradiction with Dr. Kunkel's previous testimony or reports. Complainants expect that a new expert will provide more detail, focus on different elements, and elaborate on different points in comparison to Dr. Kunkel's opinions on [sic]for a number of reasons." *Id.* at 2-3.

Also, on May 29, 2020, complainants, pursuant to 35 Ill. Adm. Code 130.400 *et seq*, filed an Application for Non-Disclosure (Application) of an Article consisting of an Affidavit. The affidavit is titled Confidential Affidavit of Faith E. Bugel Regarding Expert Witness. Complainants argued that the affidavit constituted non-disclosable information pursuant to 35 Ill Adm. Code §101.202 because it contained "information privileged against introduction in judicial proceedings." Application at 2-3. Complainants contended that the affidavit included the mental impressions of Attorney Faith E. Bugel and that those mental impressions were protected from introduction in judicial proceedings by work product privilege. *Id.* at 3.

On June 15, 2020, respondent filed an objection to complainants' Application. In its objection, respondent argued, *inter alia*, that 415 ILCS 5/7 authorizes the Board to designate information as non-disclosable with respect to the public, not with respect to opposing parties. Objection at 3-8.

On July 7, 2020, I found that 35 Ill. Adm. Code §130.400 *et seq.* authorizes the Board to designate information as non-disclosable only with respect to the public and not with respect to opposing parties, I directed complainants to disclose the Affidavit to respondents, barred Midwest from disclosing the Affidavit or the contends therein and ordered that the Affidavit was not to be injected into judicial proceedings. Hearing Officer Order at 2.

On July 21, 2020, Midwest Gen filed a supplemental response to complainants' memorandum that essentially rehashed its opposition to designate new witnesses argued in its April 15, 2020, response.

On August 5, 2020, complainants filed a reply to Midwest's July 21, 2020, supplemental response. (Reply). In its reply, Citizens Group argue that the "Board re-opened discovery when it remanded the case back to the Hearing Officer to conduct discovery in the remedy phase of this matter". Reply at 2. Complainants contend that because discovery is open, any substituted expert opinions will be disclosed in adherence to the strict disclosure requirements of Rule 213. *Id*. at 3. Complainants contend that respondent's July 21, 2020 supplemental response relies exclusively on caselaw which pertained to substitution after the close of discovery, and that the current case is distinguishable because discovery is ongoing. *Id.* at 3-4. Complainants further argue that the cases respondent cites in its supplemental response scrutinize only the timeliness of substitution, not whether substitution was justified. *Id.* at 4-5. Because discovery is ongoing, complainants argue that respondent will face no prejudice by substituting expert witnesses. *Id.* at 5.

DISCUSSION AND ORDER

On June 20, 2019, the Board, in its 93-page Interim Order, found that Midwest Gen violated the Act and Board regulations. Sierra Club *et al.* v. Midwest Generation, LLC, PCB 13-15, slip op. at 92-93 (June 20, 2019). It further found that the record lacks sufficient information for the Board to determine the appropriate remedy and directed the hearing officer to hold additional hearings to determine the appropriate relief and any remedy. *Id.* at 93.

The Board made clear in its Interim Order that it needed more information to arrive at the appropriate relief or any remedy, which leads to the logical conclusion that the experts who testified at the first hearing were not able or did not testify to remedy or relief issues the Board found lacking in the record. The Board's mandate necessarily reopened discovery in this enforcement matter to garner more information it needs to determine an appropriate remedy.

The parties may call additional witnesses to provide more information to the Board for the second hearing in this matter. To hold otherwise, I would fail my duty "to ensure development of a clear, complete, and concise record…". Section 101.610 of the Board's procedural rules. The discovery schedule regarding expert witnesses, including reports and depositions, have yet to be determined. If additional witnesses are identified, neither party will be surprised or prejudiced because it will have knowledge of any new expert reports and depose any new witnesses prior to the hearing. Any testimony already given stands and the parties must proceed to build on that information and present more information, including elaboration and amplification.

IT IS SO ORDERED.

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CERTIFICATE OF SERVICE

It is hereby certified that true copies of the foregoing order were e-mailed on September 14, 2020, to each of the persons on the service list below.

It is hereby certified that a true copy of the foregoing order was e-mailed to the following on September 14, 2020:

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EXHIBIT 2

Expert Opinion of Mark A. Quarles, P.G.

January 2021

Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network, and Citizens Against Ruining the Environment v. Midwest Generation, LLC

Prepared for:

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Prepared by:

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TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose and Scope

BBJ Group, LLC (BBJ) was retained by the "Complainants" (Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network, and Citizens Against Ruining the Environment) to evaluate relevant portions of the current record to assist them in determining necessary steps to select an appropriate groundwater remedy based upon regulatory standards established by the Illinois Environmental Protection Agency (IEPA) and the Illinois Pollution Control Board ("Board").

I requested and reviewed reports and analyses provided by the Complainants from the administrative record, based upon my input of what types of documents would provide the most useful information. Of those documents, the Board's June 29, 2019 Interim Opinion and Order of the Board ("Opinion") regarding operations, storage, fill, and disposal areas, and groundwater contamination and reports that discussed the geologic and hydrogeologic conditions, were the most useful for my analysis. Further, I gathered additional background information developed by Midwest Generation, LLC ("MWG") and provided to the public on its website (https://www.nrg.com/legal/coal-combustion-residuals.html) required by the U.S. Environmental Protection Agency (US EPA) and its Coal Combustion Residuals Rule ("CCR Rule").

Reports and analyses that I relied upon to formulate my opinion are cited in this report and are listed in Section 6, References. The page numbers to those citations throughout this report are based upon the PDF page number(s) in each document.

1.2 Board Opinion and Conclusions

The Complainants filed a seven-count complaint in 2012 against MWG at four coal-fired power plants: Joliet 29 Station (Joliet), Powerton Station (Powerton), Will County Station (Will County), and Waukegan Station (Waukegan). That complaint alleged groundwater contamination and open dumping in violation of the Illinois Environmental Protection Act (Act) and Board regulations. Both the Complainants and MWG agreed that contaminants found in the groundwater at all four stations are known constituents associated with coal combustion wastes (CCWs) or coal combustion residuals ("CCRs"). (Opinion at 78). The Board defines CCWs as "any fly ash, bottom ash, slag, or flue gas or fluid bed boiler desulfurization by-products generated as a result of the combustion of …coal, or … coal in combination with [other material]." (Opinion at 14). CCWs and CCRs are commonly called "coal ash."

The Board concluded in its Opinion that "Environmental Groups met their burden in establishing that it is more probable than not that MWG violated the Act and Board regulations as alleged in the amended complaint." (Opinion at 1). My report cites to the Opinion numerous times because the Opinion and its findings provide a factual foundation for the basis of pollution liability. The Board concluded in its Opinion that the current record was insufficient "to determine the appropriate relief in this proceeding", and that additional hearings were necessary to determine the appropriate relief. (Opinion at 2).

The purpose of the relief is to determine an appropriate remedy to comply with the Act. Given the Board's decision that MWG has not yet thoroughly examined the active and historical disposal and fill areas at each power plant, the next step is for MWG to complete a nature and extent investigation at each of the four stations. Those investigations should be sufficient to support a remedy to comply with the Act. Significant Board conclusions related to past actions by MWG and those that are necessary in the future include:

- Active coal ash ponds or historical coal ash disposal sites or fill areas are sources of the groundwater contamination. (Opinion at 79).
- Historical liners in ash disposal ponds "can and do crack or become damaged on occasions" and that "it is more likely than not that the ash ponds did leach contaminants into groundwater." (Opinion at 26).
- MWG caused or allowed discharge of coal ash constituents into groundwater at all four stations in excess of the Board's Class I groundwater standards and in excess of statewide 90th percentile concentrations for sulfate and boron. (Opinion at 92).
- MWG violated Section 12(a) of the Act at all four stations because MWG caused or allowed discharge of coal ash contaminants into groundwater. (Opinion at 92).
- MWG violated Section 12(d) of the Act at the Powerton station because MWG placed coal ash cinders directly upon the land, thereby creating a water pollution hazard. (Opinion at 86).
- MWG violated Section 21(a) of the Act at all four stations by allowing coal ash to consolidate in the fill areas around the ash ponds and in historical coal ash storage areas and by not taking measures to remove or prevent its leaking contaminants into groundwater – therefore, creating open dumping conditions. (Opinion at 14 and 92).
- Coal ash is more likely than not spread out in the fill areas across of the four power plants and is contributing to groundwater quality exceedences in monitoring wells. (Opinion at 28, 41, 56, 57, 68, and 92).
- Groundwater contamination persists even after MWG concluded corrective actions required by its Compliance Commitment Agreements (CCAs) and Groundwater Management Zones (GMZs). (Opinion at 79). Also, the CCAs at all four stations that required on-going monitoring and inspections were "intended to avoid and detect any further contamination, or monitor the effectiveness of a corrective action, rather than remedy any contamination or remove the contaminant source." (Opinion at 82).
- MWG is liable for exceedences of a Part 620 standards at Waukegan because no GMZ exists, and MWG is also responsible for exceedences prior to establishing GMZs in 2013 at Joliet, Powerton, and Will County. (Opinion at 80). Also, a GMZ is not a permanent solution. (Opinion at 80).
- Although MWG was aware of contamination, MWG did not: undertake any further actions to stop or even identify the specific source(s) and had not taken actions to further investigate historic disposal areas; install additional groundwater monitoring wells; or complete further inspections of the ash ponds or the land around the ash ponds in areas that showed persistent groundwater exceedances. (Opinion at 79).
- Environmental Land Use Controls (ELUCs) at Powerton, Waukegan, and Will County restricted the use of the area for the future (e.g., installing potable water wells). (Opinion at 79). MWG did not "take active actions" to ensure that the contamination does not spread

beyond MWG property. (Opinion at 79). Further, ELUCs established by MWG at Powerton and Will County are not considered to be "corrective actions" because they were designed to protect against exposure to contaminated groundwater, rather than to remedy the contamination. (Opinion at 83).

- There is no evidence to expect that groundwater quality at Joliet, Powerton, or Will County will naturally return to Class I groundwater quality standards. (Opinion at 83).
- There is insufficient information for the Board to determine the appropriate relief. (Opinion at 92).

2.0 DISPOSAL PRACTICES AND GROUNDWATER CONDITIONS

2.1 Joliet Station Coal Ash Disposal

The Board concluded that historical coal ash disposal areas and coal ash fill areas at the Joliet station are likely contributing to groundwater contamination. (Opinion at 28). Further, when discussing liners in disposal areas at Joliet, the Board concluded that liners at existing ash ponds “can and do crack or become damaged on occasions” and that based upon the record, the lined ash ponds likely “did leach contaminants into the groundwater.” (Opinion at 26).

Although Joliet did not become operational until 1966, the station property had been used as a coal ash disposal site (called a “landfill”) prior to that time for the Joliet #9 power plant located across the Des Plaines River. That power plant began burning coal in 1917. (ENSR 1998 Phase 1 Joliet at 12 and 13). As a result, unlined coal ash disposal occurred at Joliet for decades prior to the station become operational.

As of 2020, Joliet had three active coal ash disposal ponds that were constructed in 1978 with Poz-o-Pac™ liners: Ash Pond 1, Ash Pond 2, and Ash Pond 3. Those ponds are illustrated on **Figure 1**. Those ponds were relined with a high-density polyethylene (HDPE) liner placed over the original liner in 2007, 2008, and 2013, respectively. (Opinion at 22). As a comparison, the CCR Rule requires that liners for new and lateral extensions of existing ash ponds be constructed of a composite liner consisting of *both* [emphasis supplied] a geomembrane and at least a two-foot layer of compacted soil with a permeability no greater than $1x10^{-7}$ centimeters per second – or an alternate composite liner that meets the same performance standard. (40 CFR Part 257.71). As discussed below, coal ash from historical disposal activities exists around those ponds. Ash Ponds 1 and 2 were closed between 2015 and 2019, respectively, but Ash Pond 3 remains active. (Opinion at 23). MWG has not yet made a determination on its public website that Ash Pond 3 meets the location restriction requirement that the bottom of the wastes be separated from the uppermost aquifer by a minimum of five feet. (40 CFR Part 257.60).

The Board identified three historical unlined coal ash disposal sites that contain wastes generated before MWG began operating in 1966: the Northeast Area (the landfill area), the Southwest Area, and the Northwest Area, as illustrated on **Figure 2**. (Opinion at 26). An aerial photograph taken in 1973 that illustrates those historical disposal areas is included as **Figure 2**. The Board also concluded that coal ash fill is present around the current (i.e., active) ash ponds, as evidenced by coal ash in borings drilled around those ponds. (Opinion at 28).

A hydrogeologic assessment was performed at Joliet in 2011 by Patrick Engineering, Inc. (Patrick) to evaluate the potential for Ash Ponds 1, 2, and 3 to contaminate groundwater, to characterize the subsurface geologic and hydrogeologic conditions, and to identify potable water wells within 2,500 feet of the ash ponds. In summary, that investigation concluded the following key points:

- The combined size of the three active ash ponds is approximately 10 acres. (Patrick 2011 Joliet at 3).

- Antimony, chloride, manganese, sulfate, and Total Dissolved Solids (TDS) were detected at one or more wells at concentrations that exceeded the Part 620 Class I groundwater quality standards. (Patrick 2011 Joliet at 9).
- The investigation was inconclusive on the contribution of the three ash ponds to the contamination because in some cases, the highest constituent concentrations were reported in hydraulically upgradient wells. (Patrick 2011 Joliet at 9).
- The uppermost aquifer occurred 29 to 34 feet below ground surface (BGS) in sandy loam soils (measured from the top of pond fill embankments). (Patrick 2011 Joliet at 10). The shallow aquifer flowed towards the Des Plaines River during most periods of the year. (Patrick 2011 Joliet at 4 and 10).
- The site is located within the Joliet Depression, which is a "cone of depression of the groundwater surface caused by the large withdrawals of the groundwater from the deeper aquifers due to industrial and municipal use in the area." (Patrick 2011 Joliet at 4).
- The calculated groundwater seepage velocity was 0.30 feet per day, based upon the highest aquifer hydraulic conductivity (3.896×10^{-3} feet/second [ft./sec.]). (Patrick 2011 Joliet at 10).
- The potable water well search identified 17 wells within 2,500 feet of the ash ponds and "most of these wells are screened in much deeper aquifers." (Patrick 2011 Joliet at 10.)

Joliet has a GMZ that was approved by IEPA in August 2013. The GMZ is for an area around and hydraulically downgradient of Ash Ponds 1, 2, and 3. MWG acknowledged that the station was subject to the Class I groundwater classification, and MWG agreed to line Ash Pond 3 with an HDPE liner. (Opinion at 24 and 25). The CCA covering the ash ponds at Joiiet did not include a requirement for an Environmental Land Use Control (ELUC). (Opinion at 24 and 25).

2.2 Powerton Station Coal Ash Disposal

As with Joliet, the Board concluded that historical coal ash disposal areas and coal ash fill areas at Powerton are also likely contributing to groundwater contamination. (Opinion at 42). Further, the Board concluded that liners at existing ash ponds "can and do crack or become damaged on occasions" and that based upon the record, the lined ash ponds likely "did leach contaminants into the groundwater." (Opinion at 40). The Board also concluded that coal ash fill exists beyond the footprints of current disposal areas, and that some of that coal ash is submerged in as much as nine feet of groundwater. (Opinion at 41).

The Powerton station began producing electricity in the late 1920s (units 1 – 4) and was upgraded with new units in the early 1970s. (ENSR 1998 Phase 1 Powerton at 15). As of 2019, the current coal ash disposal or related treatment ponds included four ponds: the Ash Bypass Basin, Ash Surge Basin, Metal Cleaning Basin, and Secondary Settling Basin located in the immediate vicinity of the Former Ash Basin, as illustrated on **Figure 3**. (Opinion at 36 and 37). The Ash Surge Basin and Ash Bypass Basins are currently used to collect bottom ash. (Opinion at 36).

The Former Ash Basin was constructed with the bottom below the uppermost aquifer and therefore does not meet the CCR Rule-required five-foot separation (40 CFR Part 257.60) from the bottom of the pond to the uppermost aquifer. (Location Restrictions FAB Powerton at 1). MWG determined that the required five-foot separation from the uppermost aquifer was met for the Ash Bypass Basin and Ash Surge Basin (Location Restrictions Ash Burge Basin and Bypass Basin Powerton at 1).

The Ash Bypass Basin, Ash Surge Basin, and Metal Cleaning Basin were constructed in 1978 with Poz-o-Pac™ liners. (Opinion at 36). All active ponds were relined with an HPDE liner over the original liner between 2010 and 2013. (Opinion at 36). As a comparison, the CCR Rule requires that liners for new and lateral extensions of existing ash ponds be constructed of a composite liner consisting of *both* [emphasis supplied] a geomembrane and at least a two-foot layer of compacted soil with a permeability no greater than $1x10^{-7}$ centimeters per second – or an alternate composite liner that meets the same performance standard. (40 CFR Part 257.71). The originally constructed bottom elevation of the Ash Surge Basin was 452 feet mean sea level (MSL), the area around it consisted of coal ash and clayey soil fill, and the typical water elevation in the pond was approximately 462 feet MSL. (History of Construction Powerton Ash Surge and Bypass Basins at 14, 22, and 26).

Three historical coal ash storage sites exist according to the Board: East Yard Run-off Basin, Limestone Run-off Basin, and the Former Ash Basin. (Opinion at 40 and 41). The locations of those areas are illustrated on **Figures 3** and **4**. Only the Limestone Runoff Basin was lined as of the Board's Opinion in 2019. Fly ash has never been directed to the active ash ponds, but bottom ash has been sluiced to those ponds. (Opinion at 36). Bottom ash is removed from the basins and hauled off-site for mine disposal. (Opinion at 36).

MWG estimated that coal ash disposal in the Former Ash Basin ended in the 1970s. (History of Construction FAB Powerton at 2). The Former Ash Basin was constructed with a bottom elevation that is below the uppermost aquifer, meaning that coal ash has been submerged in groundwater. (Location Restrictions Powerton at 1). The Former Ash Basin was modified in 2010 by building a berm across the basin to support a railroad spur, forming the North Pond and South Pond sections. That berm was constructed of coal ash. (History of Construction FAB Powerton at 3).

According to the 1955 topographic map provided as **Figure 4,** the ground surface at what is now the Former Ash Basin was approximately 450 feet above MSL and approximately 440 feet MSL where the Ash Surge Basin and Bypass Basin are currently located. An aerial photograph taken in 1961 and a topographic map from 1967 (see also **Figure 4**) illustrate that:

- The Former Ash Basin is a much larger footprint than currently described by KPRG – extending beneath the active ash basins. Plus, wells used in the current groundwater monitoring system are drilled into areas of historical waste placement,
- Another suspected disposal area (not previously recognized by the Board) is located between the intake and discharge channels,
- Another suspected coal ash pond is located southeast of the power plant, and
- Groundwater monitoring wells used by MWG for current compliance purposes are located within areas of historical ash disposal.

A hydrogeologic assessment was also performed at Powerton in 2011 to evaluate the potential for three active ash ponds (Ash Surge Basin, Ash Bypass Basin, and Secondary Settling Basin) to contaminate groundwater, to characterize the subsurface geologic and hydrogeologic conditions, and to identify potable water wells within 2,500 of those ash ponds. In summary, that investigation concluded the following key points:

- The combined size of the three active ash ponds is approximately 11 acres. (Patrick 2011 Powerton at 3).
- Manganese and boron were detected at one or more wells exceeding the Part 620 Class I groundwater quality standards. (Patrick 2011 Powerton at 9).
- The investigation was inconclusive on the contribution of the three ash ponds to the contamination because in some cases, the highest constituent concentrations were reported in hydraulically upgradient wells. (Patrick 2011 Powerton at 9.)
- The uppermost aquifer occurred from 18 to 28 feet BGS in sand, gravel, and clayey soils (measured from the top of basin fill). The shallow aquifer flowed towards the Illinois River located to the north / northwest during "most periods of the year." (Patrick 2011 Powerton at 4 and 9.)
- The potentiometric surface diagram (i.e., groundwater directional flow map) excluded some wells (MW-2, MW-6, and MW-8) around the three active ponds and the Former Ash Basin (MW-2) because the groundwater elevations were "apparent anomalies", being inexplicably different than other wells. The anomalies "could be due to localized differences in lithology or localized areas of recharge", and more data were needed from future sampling events to evaluate those comparatively higher elevations. (Patrick 2011 Powerton at 10 and 22). In fact, Patrick concluded that the accurate groundwater flow direction is unknown and likely shifts seasonally. (Patrick 2011 Powerton at 22).
- The calculated groundwater seepage velocity was 2.27 feet per day based upon the highest aquifer hydraulic conductivity (4.7 x 10^{-3} ft./sec.). (Patrick 2011 Powerton at 10.)
- The potable water well search identified six wells within 2,500 feet of the ash ponds; each well was screened "below 50 feet"; and of those wells, two provide water to Powerton (unspecified use). (Patrick 2011 Powerton at 10.)

Powerton has an ELUC and GMZ that were approved in August and October 2013, respectively. The GMZ and ELUC are for an area around and hydraulically downgradient of the active ash ponds and the Former Ash Basin. In its application for the GMZ, MWG acknowledged that the station was subject to the Class I groundwater quality standards and agreed to re-line the Ash Surge Basin and Secondary Settling Basin with a HDPE liner. (Opinion at 38 and 39).

KPRG completed two Alternate Source Determinations (ASDs) in April 2018 and March 2019 on behalf of MWG to evaluate if groundwater constituents reported in monitoring wells (associated with the CCR Rule monitoring system) were contaminated by leakage from the Ash Surge Basin, the Ash Bypass Basin, or from an alternate "historical" source. KPRG relies on groundwater monitoring results from three "upgradient" wells (MW-01, MW-09, and MW-19) that were used to develop site-specific groundwater protection standards ("GWPs"). (KPRG 2019 Powerton at 7). KPRG concluded that four wells (MW-09, MW-11, MW-12, and MW-19) used in its 2018 ASD were all drilled into historical coal ash. (KPRG Powerton 2019 at 203). KPRG collected samples of current ash material (bottom ash) and water from the basins, analyzed them by the Leaching Environmental Assessment Framework ("LEAF") leaching test method, and compared the results to groundwater quality from adjacent monitoring wells. (KPRG Powerton 2019 at 200 and KPRG Powerton 2020 at 218). Upon completion of those ASD analyses, KPRG concluded that:

- **2018 ASD**: the Ash Surge Basin "is not the source of the downgradient monitoring well SSIs (statistically significant increases) and that there is an alternate source(s) of impacts. However, the data relative to the ABB (Ash Bypass Basin) was not as definitive and potential contribution of leachate from the ABB to the local groundwater impacts could not be ruled out." Further, KPRG added that the Ash Bypass Basin was a possible contaminant source – "considering the identification of a tear in the liner at the end of August 2018." (KPRG 2019 Powerton at 8 and 207).
- **2019 ASD**: the Ash Surge Basin and Ash Bypass Basin "are not the source of downgradient monitoring well detections above established GWPSs and that there is an alternate source(s) of impacts." Most notably, neither KPRG nor MWG attempted to identify the source(s) of that contamination as being a current or historical disposal area. (KPRG 2020 Powerton at 7).

2.3 Waukegan Station Coal Ash Disposal

Similarly, as the Board determined for Joliet and Powerton, the Board concluded that it is likely that historic disposal areas and coal ash fill areas at the Waukegan station are causing or contributing to groundwater quality standard exceedances. (Opinion at 68). Also, the Board concluded that liners at Waukegan "can and do crack or get damaged on occasions" and that it is likely that those ash ponds "did leach contaminants into the groundwater." (Opinion at 66).

The Waukegan station began burning coal to produce electricity in the early 1920s and was upgraded with new units in the 1950s and 1960s. (ENSR 1998 Phase 1 Waukegan at 11). The current coal ash treatment and disposal units includes two ash ponds: the East Ash Basin and the West Ash Basin, as illustrated on **Figure 5**. Although power generation began in the 1920 and coal ash would have been generated, the East and West Basins were not constructed until 1977.

The Board concluded that at least one historical unlined coal ash disposal area exists at the site (called the Former Slag / Fly Ash Storage area located west of West Ash Basin). The Board also concluded that coal ash is present on the property in areas outside of that historical area and outside of the current ash ponds. (Opinion at 67). Those areas are illustrated on **Figure 6**.

Pond construction drawings for the East and West Ash Basins indicate that the area had already been used for disposal, given the presence of existing dikes and the occurrence of slag and fly ash on the ground surface where the East and West Ash Basins were being constructed. (History of Construction Waukegan at 4 and 15). In addition, the planned construction materials of the dikes of the East and West Basins were slag and fly ash. (History of Construction Waukegan at 15). An aerial photograph taken in 1972 (**Figure 6**) – five years prior to construction of the new East and West Basins – illustrates that:

- The former disposal area is located beneath the current East and West Basins,
- The hydraulically downgradient monitoring wells used by MWG for current compliance purposes for the East and West Basins were drilled into historical ash of the original basin, and
- Hydraulically upgradient monitoring wells were sometimes drilled into historical fly ash and slag disposal areas.

MWG has confirmed that it knew of historical, unlined coal ash disposal in the area west of the East and West Basins; MWG has never removed any historical coal from that area; and the area has not been closed with an impermeable cap. (Opinion at 67). The Board concluded that coal ash was buried around the East and West Ash Basins as deep as 22 feet BGS, and that some of that coal ash was saturated in groundwater. (Opinion at 67).

Both the East and West Basins were originally constructed with a Hypalon geomembrane liner, but those liners were relined with an HDPE liner in 2003 and 2004, respectively. (Opinion at 64). As a comparison, the CCR Rule requires that liners for new and lateral extensions of existing ash ponds be constructed of a composite liner consisting of *both* [emphasis supplied] a geomembrane and at least a two-foot layer of compacted soil with a permeability no greater than $1x10^{-7}$ centimeters per second – or an alternate composite liner that meets the same performance standard. (40 CFR Part 257.71). The ponds are used for disposal of bottom ash, and fly ash is transported off-site for beneficial reuse. (Opinion at 64). The reported bottom elevations of the ponds are approximately 585 feet MSL, compared to common groundwater elevations between 582 and 583 feet MSL. (Opinion at 64). As such, there is only approximately two to three feet separating the bottom of the liner from groundwater. MWG concluded however, that the East and West Ash Basins were in compliance with the CCR Rule-required five-foot separation because its statistical analyses indicted that groundwater elevations are below and do not intersect with the bottom of the ash ponds and the liner, and the liner will prevent a "hydraulic connection" to groundwater if "unusually high" groundwater fluctuations occur. (Location Restrictions Waukegan at 2).

A hydrogeologic assessment was also performed at the Waukegan station in 2011 to evaluate the potential for the two active ash ponds (East Ash Pond and West Ash Pond) to contaminate groundwater, to characterize the subsurface geologic and hydrogeologic conditions, and to identify potable water wells within 2,500 of the ash ponds. In summary, that investigation concluded the following key points:

- The combined size of the two active ash ponds is approximately 25 acres. (Patrick 2011 Waukegan at 3).
- Antimony, arsenic, boron, sulfate, and TDS were detected at one or more wells exceeding the Part 620 Class I groundwater quality standards. (Patrick 2011 Waukegan at 9).
- The investigation was inconclusive on the contribution of the two active ash ponds to the contamination because in some cases, the highest constituent concentrations were reported in hydraulically upgradient wells. (Patrick 2011 Waukegan at 9).
- Although the uppermost aquifer occurred at 22 to 23 feet BGS, those measurements were based upon wells drilled from the top of MWG-constructed basin embankments and not the original ground surface. (Patrick 2011 Waukegan at 9 and 18). The top of the groundwater surface was instead very shallow, less than five feet below the adjacent land surface. (Patrick 2011 Waukegan at 18). The shallow groundwater flows towards Lake Michigan. (Patrick 2011 Waukegan at 9).
- The soil types in borings drilled for wells was very porous sand, silt, and gravel. (Patrick 2011 Waukegan at 9).
- The calculated groundwater seepage velocity was 0.59 feet per day based upon the highest aquifer hydraulic conductivity (4.0×10^{-3} ft./sec.). (Patrick 2011 Waukegan at 10).

- The potable water well search identified eight wells within 2,500 feet of the ash ponds. None were located to the east or south of the ash ponds towards Lake Michigan. (Patrick 2011 Waukegan at 10).

The Waukegan station does not have a GMZ for any portion of the property but does have an ELUC. The ELUC was originally recorded in 2003 by MWG for a portion of the western property due to past industrial activities at a tannery located on adjacent property to the west, and possible migration of tannery-related contaminants onto MWG property. MWG applied for and received an extension of the tannery related ELUC in August 2013 to extend coverage from the western property boundary, to the area beneath the current ash ponds, and to Lake Michigan to the east. (Opinion at 65).

KPRG completed two ASDs in April 2018 and March 2019 on behalf of MWG to evaluate if groundwater constituents reported in monitoring wells associated with the CCR Rule monitoring system were contaminated by leakage from the East Ash Basin, the West Ash Basin, or from an "alternate" source. (KPRG 2019 Waukegan at 4 and KPRG 2020 Waukegan at 6). Notably, KPRG did not specifically name "historical" disposal areas as possible source(s) in either ASD – as it did for the Powerton ASDs. Similar to the ASDs at Powerton, KPRG collected coal ash (bottom ash) and water from current basins, analyzed them by the LEAF method, and compared the results to groundwater monitoring well results. Upon completion of those analyses, KPRG included that:

- **2018 ASD**: "SSIs for boron, pH, and sulfate were not the result of a release of leachate from the regulated units (East and West Ash Ponds) but rather from other potential source(s)." (KPRG 2019 Waukegan at 6). KPRG concluded that downgradient wells used in its comparative analyses (MW-01 through MW-04) have had historically high concentrations of boron and sulfate (both are indicators of coal ash), and each of those wells were drilled into ash pond embankments that were constructed with coal ash. (KPRG 2019 Waukegan at 105).
- **2019 ASD**: SSIs for calcium and total dissolved solids (TDS) for well MW-16 "are not the result of leakage of leachate from the regulated units but rather from other potential source(s)." (KPRG 2020 Waukegan at 5 and 6). KPRG also concluded that MW-16 was drilled into an embankment at least partially constructed of coal ash and that the constituents in the well are related to "other sources" in the upgradient direction near another well (MW-5). (KPRG 2020 Waukegan at 103 and 104). MW-5 is located within the Former Slag and Fly Ash Storage Area illustrated on **Figure 6**.

2.4 Will County Station Coal Ash Disposal

Similarly, as the Board determined for Joliet, Powerton, and Waukegan, the Board concluded that it is likely that historic disposal areas and coal ash fill areas at Will County are causing or contributing to groundwater standard exceedances. (Opinion at 57). Also, the Board concluded that liners in disposal units at Will County "can and do crack or get damaged on occasions" and that it is likely that those ash ponds "did leach contaminants into the groundwater." (Opinion at 55).

Will County became operational in 1955 and was updated with new boilers in 1957 and 1963. The station is bordered on the east by the Chicago Sanitary & Ship Canal and on the west by the Des Plaines River. (ENSR 1998 Will County at 14). Four ponds were part of the original ash treatment system: Ash Pond 1N, Ash Pond 1S, Ash Pond 2S, and Ash Pond 3S. Those areas are illustrated on **Figure 7**. Those ponds were constructed in 1977 with Poz-o-Pac™ liners, and Ponds 2S and 3S also had a bituminous coating. (Opinion at 52).

The current coal ash disposal system includes two active basins: South Ash Pond 2S and South Ash Pond 3S. Those ponds were relined with HDPE liners over the original liners in 2009. (Opinion at 52). As a comparison, the CCR Rule requires that liners for new and lateral extensions of existing ash ponds be constructed of a composite liner consisting of *both* [emphasis supplied] a geomembrane and at least a two-foot layer of compacted soil with a permeability no greater than $1x10^{-7}$ centimeters per second – or an alternate composite liner that meets the same performance standard. (40 CFR Part 257.71). Bottom ash is collected in those active ponds, and fly ash is transported off-site for beneficial reuse. (Opinion at 51).

The Board concluded that three historical unlined coal ash disposal areas exist at the site: Ponds 1N and 1 South; fill areas outside of the ponds; and an alleged Slag and Bottom Ash Placement Area to the south. (Opinion at 56). Those areas are illustrated in **Figure 8**.

Former Ash Ponds 1N and 1S were removed from service in 2010, yet still contained ash years later. Further, both Ponds 1N and 1S were constructed with bottoms that were at least one foot below average groundwater elevations. According to the record, groundwater was able to seep into the ash basins, and leachate was able to seep out of the basins. (Opinion at 56). According to MWG's analysis, current and active Ash Pond 2S and Ash Pond 3S do not have the CCR Rule-required five-foot separation from the bottom of the ponds to the uppermost aquifer. (Location Restrictions Will County at 1). Groundwater beneath Ash Pond 3S is approximately one foot below the bottom of the pond. (Opinion at 52). Therefore, Ash Pond 3S does not have the required five-foot separation.

Soil borings demonstrated that coal ash is buried outside of the ash ponds. Borings drilled around the ash ponds had coal ash in them up to 12 feet BGS, demonstrating that coal ash was not limited to the current size of Pond 1N. Further, coal ash was saturated in groundwater in the soil boring advanced for well MW-2. (Opinion at 56). Patrick investigations in 2010 and 2011 demonstrated that "thick layers of coal ash" existed around the ash ponds – particularly along the eastern edge of the ponds and within borings associated with five of six monitoring wells considered by KPRG to be hydraulically upgradient wells for compliance monitoring purposes. (Opinion at 56 and KPRGb 2020 Will County at 5). As shown on **Figure 8**, an aerial photograph taken in 1962 and a 1963 topographic map illustrate:

- The current ash ponds were once part of a single large pond.
- Upgradient groundwater monitoring wells used in the current compliance monitoring system were drilled immediately adjacent to (MW-1, MW-3, MW-4, MW-5, and MW-6) or within (MW-2) the footprint of the original ash pond.

A hydrogeologic assessment was also performed at Will County in 2011 to evaluate the potential for four active ash ponds (Ash Pond 1N, Ash Pond 1S, Ash Pond 2S, and Ash Pond 3) to contaminate groundwater, to characterize the subsurface geologic and hydrogeologic conditions, and to identify potable water wells within 2,500 of the ash ponds. In summary, that investigation concluded the following key points:

- The total acreage of the four active ash ponds is approximately eight acres. (Patrick 2011 Will County at 3).
- Manganese, boron, sulfate, and TDS were detected at one or more wells exceeding the Part 620 Class I groundwater quality standards. (Patrick 2011 Will County at 9).
- The investigation was inconclusive on the contribution of the four active ash ponds to the contamination because in some cases, the highest constituent concentrations were reported in hydraulically upgradient wells. (Patrick 2011 Will County at 9).
- Coal, coal cinders, and / or coal ash were detected in the borings drilled for five of the 10 wells installed. (Patrick 2011 Will County at 22, 23, 24, 25, and 27). As such, at least 5 wells used for current compliance monitoring were drilled through coal ash. All ten of the wells were drilled through clay and porous fill that consisted of sand, crushed rock and limestone, cobbles, and gravel. (Patrick 2011 Will County at 22 through 31).
- The uppermost aquifer was found approximately eight to 11 feet BGS and was most commonly present in unconsolidated fill, soil, and coal ash (MW-2) materials above the top of bedrock. (Patrick 2011 Will County at 22 through 31). The wells were however, drilled and screened mostly into the deeper limestone bedrock.
- Groundwater flow is "variable" and in two directions "during most periods of the year" – both eastward to the Chicago Sanitary & Ship Canal and westward into the Des Plaines River. (Patrick 2011 Will County at 4 and 10). Patrick did not develop a potentiometric surface diagram like it did for the other three power plants.
- The aquifer hydraulic conductivity ranged from 2.07×10^{-4} to 6.38×10^{-5} ft./sec. (Patrick 2011 at 10).
- Patrick did not calculate a groundwater velocity rate because it could not calculate "a reliable hydraulic gradient" due to the "apparent complexity of the shallow flow system." (Patrick 2011 at 10).
- The site is located within the Joliet Depression. (Patrick 2011 Will County at 4).
- The potable water well search identified six wells within 2,500 feet of the ash ponds, and three of those wells are located on MWG property. (Patrick 2011 Will County at 32). Patrick concluded that those wells are drilled more than 1,500 feet BGS and are screened beneath an aquitard. (Patrick 2011 Will County at 10).

Although the groundwater seepage velocity was not determined in the 2011 hydrogeologic investigation, more recent groundwater monitoring results at Will County demonstrate that the seepage velocity ranged from 0.5 to 1.0 foot per day. (KPRG 2020 Will County 16).

Will County has an ELUC and GMZ that were approved in September 2013, respectively. The GMZ and ELUC are for an area around and hydraulically downgradient of four ash ponds (Ash Pond 1N, Ash Pond 1S, Ash Pond 2S, and Ash Pond 3S) and extending to the Des Plaines River to the west and the Chicago Sanitary & Ship Canal to the east. The GMZ does not include non-community wells and requires that un-used community wells be properly abandoned. MWG acknowledged that the station was subject to the Class I groundwater classification, and MWG agreed to line Ash Pond 2S with a HDPE liner, remove Ash Pond 1S and Ash Pond 1N from service, and install a dewatering system to keep water levels in Ash Ponds 1S and 1N to less than one foot depth. (Opinion at 53 and 54). Ash Pond 2S was relined with a HPDE liner in 2013, and Ash Pond 3S was relined with a HDEP liner in 2009. (Opinion at 52). As a comparison, the CCR Rule requires that liners for new and lateral extensions of existing ash ponds be constructed of a composite liner consisting of *both* [emphasis supplied] a geomembrane and at least a two-foot layer of compacted soil with a permeability no greater than $1x10^{-7}$ centimeters per second – or an alternate composite liner that meets the same performance standard. (40 CFR Part 257.71).

KPRG completed an ASD in April 2018 on behalf of MWG to evaluate if groundwater constituents reported in monitoring wells associated with the CCR Rule were contaminated by leakage from Ash Pond 2S, Ash Pond 3S, or from an alternate source(s). KPRG collected water and coal ash from each of those bottom ash ponds, completed the LEAF method analyses, and compared the results to upgradient and downgradient monitoring wells. (KPRG 2019 at 86 and 87). Upon completion of that analysis, KPRG included that "SSIs for chloride, fluoride, and TDS are not the result of a release of leachate from the regulated units (Ponds 2S and 3S) but rather from other potential source(s)" because upgradient and downgradient groundwater well concentrations were different than the ash leachate produced in the LEAF analysis. (KPRG 2019 Will County at 7 and 87).

3.0 TECHNICAL ANALYSES

3.1 Regulatory Basis for a Groundwater Remedy

The Board concluded in its Opinion that Class 1, Part 620 groundwater quality standards have been exceeded at each of the four stations between 2010 and 2017. (Opinion at 2). The Board also concluded that are three possible sources of groundwater contamination at each of the four stations: active coal ash ponds / basins, historical coal ash disposal sites, and historical coal ash fill areas. (Opinion at 78, 79, and 90). Given that unlined coal ash disposal at each station began decades ago and shallow groundwater exists at each site, waste constituent leaching to groundwater has likely occurred at Joliet, Powerton, and Waukegan for over 100 years and for nearly 70 years at Will County.

As previously discussed, the Board also concluded monitoring and inspection programs associated with the CCAs were intended to avoid and detect any further contamination or monitor the effectiveness (or not) of a corrective action, rather than remedy the contamination or remove its source. Further, the CCAs, GMZs, and ELUCs have not resulted in MWG undertaking any further action to i.) stop or even identify the specific source(s) of contamination, ii.) further investigate historical disposal and fill areas spread out on the properties, iii.) install additional groundwater monitoring wells, or iv.) further inspect any of the coal ash ponds or areas around those ponds that have evidence of contamination.

Although approved GMZs exist at Joliet, Powerton, and Will County, the Board has concluded that those zones do not prevent MWG from being liable for contamination that occurred prior to 2013 when the GMZs were established. (Opinion at 80). No such GMZ exists for the Waukegan station. (Opinion at 80). The Board concluded that GMZs are not a permanent solution for contamination. (Opinion at 80). Given that the Board concluded that Class I groundwater standards have been exceeded at least as early as 2010, MWG is responsible for contamination from any of the potential sources of coal ash related contamination.

The Board concluded that ELUCs at Powerton, Waukegan, and Will County stations are not considered to be corrective actions because they were designed to protect against exposure of contaminants, rather than remedying the contamination. (Opinion at 65 and 83). As such, the ELUCs do not relieve MWG of its responsibility to complete a groundwater corrective action.

Given that the Board concluded that there is no evidence to expect that groundwater will return to Class I standards naturally – even after completion of the CCA-required corrective actions – MWG is now required to conduct corrective actions. Prior to a remedy being selected, MWG must first identify the source(s) of contamination and then determine the nature and extent of that contamination.

Source identification and completion of a nature and extent investigation is the next step to remedy the violations of Section 12(a) for causing or allowing the discharge of contaminants to the environment; of Section 12(a) for exceeding statewide concentrations of sulfate and boron; of Section 12(d) for depositing coal ash directly upon the ground and creating a water pollution hazard;

and of Section 21(a) for allowing coal ash to consolidate in fill areas and without taking measures to remove it or prevent its leaking of contaminants to groundwater. MWG cannot design and implement remedies to address those violations without first knowing:

- Where the historical and recent coal ash is located throughout the properties at each station and the volume and type of those materials, and
- Under what conditions the coal ash exists on or near the ground surface relative to groundwater and saturation in the disposal areas.

3.2 Missed Opportunities to Define Contaminant Sources

Although MWG has investigated active disposal areas to some degree, those results raise more questions than provide answers. A thorough investigation to define the nature and extent of contamination would define the source(s) of groundwater contamination. As previously discussed, MWG has only completed limited subsurface investigations required by IEPA and according to the CCR Rule. Those investigations were limited in scale and scope and in fact, created significant, additional unanswered questions regarding the source(s) of contamination. For example, consider:

- Hydrogeologic Investigations (2011) were only performed around the active ash basins / ponds at each of the four stations, and each of the investigations were "inconclusive" on the source(s) of contamination. As a result, the source(s) of the contamination has gone undefined.
- ASDs at the Powerton, Waukegan, and Will County stations only investigated the ash and water from the active basins that were being used to store bottom ash – yet historical coal ash disposed in the area could have possibly included fly ash, slag, and cinders, and the ash ponds embankments may have been constructed in part with fly ash, for example. MWG only concluded that the active ponds were not the source of contamination, and that the contamination was from other potential, undefined source(s).

The hydrogeologic investigations performed in 2011 (Patrick) determined without explanation, that the highest constituent concentrations in groundwater were sometimes found in hydraulically *upgradient* [emphasis supplied] wells – in the *opposite direction* [emphasis supplied] of where contaminants from active ash basins are supposed to flow. Boring and well logs from Will County, demonstrate that wells were drilled into coal ash – possibly explaining the higher upgradient concentrations.

The more recent ASDs completed by KPRG, are good examples of continued missed opportunities for MWG to define historical disposal and fill areas as source(s) of contamination. KPRG was careful in its ASDs to only evaluate contaminant potential from the *active* [emphasis supplied] disposal areas. KPRG failed to conclude in the ASDs for Powerton, Waukegan, and Will County that historic sources were likely contributors to current groundwater contamination – despite KPRG mentioning that historic sources were possible sources at both Powerton and Waukegan. KPRG also should have known that historical coal ash was present adjacent to the ash ponds at Will County, and it knew that wells were drilled into historic coal ash at Powerton and Waukegan. KPRG did not specifically conclude that historical coal ash disposal or fill activities were likely responsible for groundwater contamination at any location – choosing instead to conclude that *undefined potential sources* [emphasis supplied] were responsible for the groundwater contamination.

As illustrated in **Figure 4** (Powerton), **Figure 6** (Waukegan), and **Figure 8** (Will County), wells used by MWG and KPRG in the active basin monitoring systems are:

- **Powerton and Waukegan**: Within historical coal ash disposal areas,
- **Will County**: Immediately adjacent to and sometimes in coal ash in the ash basins, and
- **Within the radius of influence of mounded groundwater**: Groundwater would have flowed radially in a 360-degree direction from unlined surface impoundments at all locations where sluicing occurred – resulting in groundwater flowing in the upgradient direction currently interpreted by KPRG.

As previously discussed, KPRG concluded in its ASDs that the active ash ponds were not the sources of groundwater contamination – even though the Board concluded that the liners likely leaked, and the basins were re-lined because of that leakage. Next, Patrick concluded in its 2011 hydrogeologic investigations that groundwater elevation "anomalies" existed around the active basins due to differences in "lithology" or localized areas of "higher recharge." Given these conclusions by KPRG and Patrick, I performed a follow-up analysis. My review of that data indicates that the historically placed coal ash *and* [emphasis supplied] more recent leakage from the Ash Surge Basin may have both contributed to contamination, based upon the following:

- **Recent basin leakage** - Given that the Ash Surge Basin had been lined since 1978 and relined in 2013, there should not have been much "recharge" to groundwater from precipitation because the liner would have prevented most precipitation seepage into groundwater. However, groundwater sampling in April 2020 shows a groundwater elevation (451 feet MSL) that is mounded beneath the ash basins and within one foot of the bottom of the Ash Surge Basin (452 feet MSL) and immediately beneath the 12-inch thick Poz-o-Pac™ liner (451 feet MSL). (Opinion at 36 and KPRG 2020b Powerton at 5). This one-foot separation does not meet the CCR Rule-required five-foot separation for location restrictions – conflicting with KPRG's October 2018 determination that adequate separation exists. The KPRG-prepared potentiometric surface diagram is included in **Figure 9**. In contrast, the potentiometric surface diagram that I prepared using the same elevations illustrates mounded groundwater and radial groundwater flow conditions emanating from the Ash Surge Basin and the Ash Bypass Basin (also in **Figure 9**). Both diagrams show groundwater less than five feet below the bottom of the Ash Surge Basin. The likely logical explanation for the "higher recharge" according to Patrick in 2011 and the 2020 mounded groundwater, is more recent leakage from one or more ash basins.
- **Historical leakage** – Although KPRG concluded that the contamination in wells was not due to leakage from the Ash Surge Basin during completion of the ASDs in 2018 and 2019, KPRG apparently did not consider that MWG constructed the Ash Surge Basin over coal ash or that the embankments of the Ash Surge Basin were constructed partially of bottom ash, cinders, and / or fly ash. (History of Construction at 22 and 35). The historical aerial photograph and topographic map in **Figure 4** illustrate that the Ash Surge Basin and other basins in that area

were constructed over the historical disposal area (i.e. "tailings pond" in the figure) known as the Former Ash Basin.

3.3 Requirements to Identify Contaminant Sources

The Board concluded that the CCAs, GMZs, and ELUCs do not relieve MWG from its responsibilities to identify and investigate all sources of groundwater contamination and even recognized that MWG used the CCAs to "avoid and detect any further contamination." The Board also recognized that MWG failed to install additional groundwater monitoring wells or further inspect the ash pond areas or the areas around those ponds.

Constituents can leach from coal ash and into ground from active or historical sources of contamination. Leachability from coal ash can also vary between fly ash and bottom ash, for example. As a result, both current and historical sources of contamination are possible sources of current groundwater contamination. The leachate quality also can change over time – depending on for example, coal source, pollution control technologies used, and geochemical changes in the basins and underlying groundwater. A remedial strategy that only addresses current or active disposal areas (mainly bottom ash) misses even larger areas of contamination associated with historic disposal and fill areas (also including fly ash, cinders, and slag). Likewise, investigations that focus solely on historical areas might miss leakage from currently active disposal and treatment areas.

Source identification is a critical component of a site investigation. IEPA rules (e.g., 35 Illinois Administrative Code Section 740.420) require that *sources and potential sources* [emphasis supplied] of contamination be identified and thoroughly investigated. As a result, for a remedy to be successful, MWG will need to thoroughly identify known and potential sources of that contamination in areas that have been recently used for coal ash disposal, in addition to any known, suspected, or potential historical source areas. Source identification is just one component of a nature and extent investigation.

3.4 Nature and Extent Investigative Requirements

Given the Board's conclusion that some of the historical basins were unlined and that even the lined ash ponds leaked contaminants into the groundwater, the shallow groundwater has been historically prone to contamination for decades. The extent of that contamination and the geologic and hydrogeologic conditions have not been defined site-wide at each station. Once a source(s) of contamination is identified, additional information should be collected to determine, for example:

- How much coal ash exists in unlined disposal and storage areas,
- What types of coal ash exist (e.g. fly ash, bottom ash, slag, and cinders),
- How much saturated and unsaturated coal ash exists,
- The thickness of any saturated coal ash,
- The vertical and horizontal migration of contaminants into the aquifer,
- The chemical and geochemical conditions in the saturated ash and the aquifer,
- The direction of groundwater flow from the disposal and fill areas, and
- Migration pathways of contaminants from the source(s).

Defining the nature and extent of contamination is a basic foundation of any environmental investigation defined by State and Federal regulations. Consider the following examples from US EPA and IEPA regulations:

- **CCR Rule** (40 CFR Part 257.98 (g.)(1)) – "Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected." The rule also requires that the "characterization must be sufficient to support a complete and accurate assessment of the corrective action measures necessary to effectively clean up all releases from the CCR unit…" The rule specifies that the minimum investigative measures include 1.) installing additional groundwater monitoring wells necessary to define the contaminant plume, 2.) collecting data on the nature and estimated quantity of the release, 3.) installing and sampling at least one additional well at the facility boundary in the direction of groundwater flow, and 4.) sampling all wells to characterize the nature and extent of the release. All such activities are needed for MWG to develop an Assessment of Corrective Measures report. (40 CFR Part 259.96).
- **IEPA Rules** (35 Illinois Administrative Code Section 740.415 and 740.420): A site investigation is required to identify "all or specified recognized environmental conditions at a remediation site, the related contaminants of concern, and associated factors that will aid in the identification of risks to human health, safety, and the environment, the determination of remediation alternatives, and the design and implementation of a Remedial Action Plan." An investigation is required to determine the nature and extent of contamination.

Investigations to define the nature and extent of contamination most commonly incorporate intrusive subsurface investigative techniques such as borings into soil and coal ash and groundwater monitoring wells. Sometimes, such intrusive investigations also include non or less-intrusive geophysical methods to provide a "picture" by depth to guide the intrusive investigation with target sampling points. A thorough investigation is necessary to locate all sources of contamination, determine the nature and extent of that contamination, and determine the characteristics of the site that would be useful to evaluate and select one or more remedies for environmental media (e.g., soil, groundwater, sediment, surface water). Also, without such information, the volume and extent of the waste and affected media will not be known.

The coal ash ponds / basins at each of the four stations are located close to and sometimes adjacent to large surface water bodies (e.g., Des Plaines, Illinois, Lake Michigan, and the Chicago Ship & Sanitary Canal). They are also possibly located in floodplains or certainly close to floodplains, and an actual determination should be made for each power plant. Soil borings and groundwater monitoring wells drilled at each site demonstrate that groundwater is very shallow and in porous soils, and the shallow groundwater flows into receiving surface waters at each station.

MWG is required to complete an investigation to identify sources and potential sources of contamination. Potential sources would include areas suspected of being disposal areas. A thorough investigation to define the nature and extent of contamination would define the possible receptors to coal ash related contamination. Example human and / or ecological receptors and exposure pathways include:

- **Surface water erosion and transport** - Coal ash disposal areas can be prone to erosion and wash-out into a surface water because disposal areas are located very close to rivers, streams, canals, and / or Lake Michigan.
- **Groundwater discharges into vegetated areas** – Disposal areas are commonly located within shallow groundwater areas, and that groundwater can discharge into wetlands and vegetated areas nearby. **Figure 10**, for example, illustrates what seems to be distressed vegetation east of the East Ash Basin at Waukegan recently in June 2020.
- **Groundwater discharges along shorelines** – Shallow groundwater perpetually discharges into the receiving surface water bodies, and those discharges can accumulate coal ash related constituents in the sediments and surface water with human and ecological risks. An example of contaminated coal ash groundwater (e.g., red water seeps) discharging into the Vermillion River and accumulating in sediments is illustrated below:

- **Groundwater connectivity to water supply wells** - the shallow water table aquifer at the stations has the potential to be used for potable, industrial, irrigation, and commercial supplies and can also potentially migrate into deeper aquifers.

As previously discussed for Joliet and Will County stations, those power plants are located within the "Joliet Depression". Pumping of large potable and industrial water wells locally near any power plant, for example, can create a cone of depression (i.e., drawdown) of both deep and shallow aquifers, in addition to changing the direction of groundwater flow of the aquifers. Also, industrial uses of groundwater for manufacturing operations, for example, rely on high quality water, even in the absence of human health-based exceedances. As a result, localized groundwater quality at the stations can have both multiple concerns for receptors. A nature and extent study would thoroughly evaluate possible coal contaminant migration risks with local drinking water and non-drinking water groundwater users.

3.5 Data Implications for Existing Compliance Monitoring

The Board determined that upgradient wells were sometimes located in historical coal ash disposal or fill areas and as a result, that prior disposal may be the cause of those higher upgradient concentrations used by MWG for compliance and reporting purposes. Further, KPRG has admitted that wells used for current IEPA and US EPA compliance monitoring programs are drilled into historical wastes – and that sometimes the unexplained highest contaminant concentrations are in hydraulically upgradient wells.

The significance of "upgradient" groundwater quality cannot be overstated because those hydraulically upgradient wells determine if MWG is required to perform additional investigative or corrective actions according to the CCR Rule, for example. MWG uses those upgradient wells as baseline regulatory comparisons to hydraulically downgradient wells. If MWG uses upgradient wells that are already contaminated from the current ash ponds or historical coal ash, MWG is comparing wells to already contaminated conditions. The groundwater sampling results would therefore only require MWG to perform more in-depth sampling (e.g., for metals like arsenic) and corrective actions if concentrations vary from groundwater quality that is already contaminated.

3.6 Regulatory Implications for Saturated Coal Ash

As previously discussed, the Board concluded existing data demonstrated coal ash was disposed in basins below and within the uppermost aquifers at Powerton, Waukegan, and Will County Stations. The shallow aquifers beneath each of the four stations are porous and have relatively high groundwater seepage velocities. Those seepage velocities indicate the relative ease and speed for contaminants to migrate from disposal areas. A site-wide understanding of where the historical and current disposal areas have affected groundwater quality and how potential receptors have been affected is critical when evaluating remedies.

The US EPA, in its CCR Rule, understood the risks associated with saturated coal ash and coal ash that is located too close to the underlying aquifer. The US EPA requires existing unlined coal ash disposal sites to close if the base of the disposal area is closer than five feet from the upper limit of the uppermost aquifer. (40 CFR Part 257.60). Further, closure-in-place is not allowed unless the closure method controls, minimizes, or eliminates, to the maximum extent feasible, post-closure infiltration of liquids into the wastes (e.g., rainfall and snow) and releases from the unit (e.g., leachate) to groundwater or surface waters. (40 CFR Part 257.102(d).). The degree of coal ash saturation on each power plant property is therefore a very important factor in evaluating remedial alternatives. Only by completing a site-wide investigation of active and historical disposal and fill areas, will MWG know that information.

Constituents can readily leach from coal ash and into groundwater, and groundwater is hydraulically connected to surface waters located close to the disposal and fill areas at each station. Leaching can continue from saturated coal ash slowly and perpetually into the future. Further, leaching conditions can change over time, as the geochemical conditions of the aquifer and coal ash change.

4.0 REMEDIAL ACTION

4.1 Recent Cases of Coal Ash Removal Actions

The CCR Rule requires coal ash disposal sites meeting certain criteria to close by two options: closure-by-removal where wastes are excavated and hauled to a lined disposal area or beneficially used or closure-in-place where wastes remain separated from groundwater and are covered by an impermeable membrane. (40 CFR Part 257.102 (c) and (d)). Saturated coal ash cannot be closed in-place according to the CCR Rule because leaching to groundwater will continue from unlined disposal areas. (40 CFR Part 257.102 (d)(i.)). Also, disposal units that contain coal ash that is located too close to the uppermost aquifer are required to close. (40 CFR Part 257.60(c)(4)).

Utilities across the United States began closure activities in response to the CCR Rule, based upon the results of the required assessments. Commonly, utilities have chosen to close disposal areas by closure-by-removal where the coal ash is excavated and then placed into a lined landfill. A list of 127 coal ash disposal units located in 27 states that was previously provided to MWG, is included in **Table 1**. Of those units, seven MWG ash ponds at Joliet (Ash Pond #2), Powerton (Ash Surge Basin and Ash Bypass Basin), Waukegan (East and West Ponds), and Will County (Ash Ponds 2S and 3S) and seven additional units in Texas owned by MWG's parent company (NRG) are all planned for closure-by-removal.

Nationally and in particular in Illinois, utilities have therefore determined that closure-by-removal is technically feasible and economically reasonable – even for very large disposal areas that are sometimes hundreds of acres in size and contain millions of cubic yards of coal ash. Closure-by-removal is particularly common at power plants where there is not adequate separation between the bottom of the wastes and the uppermost aquifer, or where the disposal area is located close to surface water bodies – conditions that exist at each of the four MWG power plants.

4.2 Investigative Results Used to Evaluate Remedies

Any current groundwater remedy needs to consider that both the historical and current disposal areas are possible source areas, consistent with the Board's conclusion that active *and* historical coal ash disposal areas are likely sources of contamination. To know which historical and active source areas are contributors to contamination, MWG needs to know where all those areas are (i.e., source identification) and under what conditions the coal ash exists in those areas (i.e., nature and extent of contamination).

Source identification and defining the nature and extent of contamination are fundamental first steps for selecting a remedy under IEPA and Federal programs such as the Resource Conservation and Recovery Act (RCRA, 42 U.S.C. Sections 6901 – 6992k), the Comprehensive Environmental Response, Compensation and Liability Act (CERLCA, 42 U.S.C. Sections 9601 - 9675), and other state-equivalent programs.

4.3 Components and Objectives of a Remedial Action Plan

Remedial actions or corrective actions are consistently required by IEPA, other states, and the US EPA when groundwater quality violations occur. Violations require completion of a plan to evaluate and correct that contamination – whether that plan is called a Feasibility Study, Assessment of Corrective Measures, Corrective Action Plan, or Remedial Action Plan.

As previously discussed, the Board concluded that ELUCs are not considered to be "corrective actions" because they were designed to protect against exposure to contaminated groundwater, rather than to remedy the contamination. (Opinion at 83). Also, the Board concluded that there is no evidence to expect that groundwater quality at Joliet, Powerton, or Will County will naturally return to Class I groundwater quality standards. (Opinion at 83). As a result, corrective actions are necessary to reduce constituent concentrations to Class I GWPSs.

The overall objectives of a groundwater corrective action should be to eliminate or reduce future generation of leachate and groundwater contamination; capture, contain, or minimize the groundwater plume; provide adequate treatment to meet IEPA groundwater and surface water quality standards and the 90^{th} percentile background concentrations identified by the Board; mitigate the violations for open dumping; and mitigate ecological and biological impacts that may have occurred. Water quality attainment should not just be limited to human-health drinking water standards, but also consider aquatic toxicity, sediment chemistry and toxicity, and other adverse effects to the environment (e.g., wetlands and vegetation).

Based upon my experience – regardless of the state or Federal regulatory framework that requires such a plan – a remedial action or corrective action plan should include an alternatives analysis that considers multiple potential remedial technologies for each contaminated media (e.g., soil, groundwater). Each of those alternatives are then evaluated individually and collectively – based upon site-specific conditions determined during the nature and extent investigation – to then select a recommended remedial approach. An evaluation of these basic components of possible remedial alternatives is fundamental to evaluating and selecting a remedy:

- Ability of the remedy to protect human health and the environment,
- Ability of the remedy to control, reduce, or eliminate future releases of contaminants,
- Long and short-term effectiveness of the remedy and the degree of certainty that it will achieve the required objectives,
- Feasibility of implementation; and
- Whether remediation objectives will be achieved within a reasonable period of time.

5.0 SUMMARY AND CONCLUSIONS

5.1 Contaminant Sources

The contaminants in groundwater at the four stations are consistent with my experience in other coal ash disposal sites around the country. Leaching of coal ash constituents to groundwater from unlined disposal areas has been likely for nearly 100 years at Joliet, Powerton, and Waukegan and for nearly 70 years at Will County.

The Board concluded that active coal ash ponds and historical coal ash disposal sites and fill areas spread around the power plants are likely sources of the groundwater contamination, and that violations exist due to that contamination. In addition, the Board concluded that violations exist due to placement of coal ash onto the ground surface, thus creating a water pollution hazard, and that groundwater contamination is likely due to leakage and leachate migration from both lined and unlined disposal and fill areas. The Board also concluded that even though some original disposal areas were lined, those liners were susceptible to damage and cracks and likely leaked.

The Phase 1 ESAs by ENSR for each of the four power plants – completed nearly 23 years ago – identified numerous historical disposal and fill areas – yet the Board concluded MWG still had not investigated those areas. Soil borings and well construction diagrams for all sites demonstrate that historic coal ash fill areas are widespread, yet the exact locations and extent of all historic disposal and fill areas remain unknown. Historical coal ash can also contaminate groundwater. Current and historical data also demonstrate that current monitoring wells are drilled into coal ash. Further, MWG's current consultant (KPRG) and prior consultant (Patrick) apparently did not recommend that the nature and extent of that contamination be investigated – despite the knowledge that coal ash existed outside of current ash pond perimeters.

MWG plans to excavate coal ash from seven currently active ash ponds at Joliet, Powerton, Waukegan, and Will County. Even with that excavation of active ash ponds, soil borings drilled around those ash ponds have demonstrated that coal ash will remain after closure-by-removal and will be a likely continued source to groundwater contamination because:

- Coal ash was found in borings around the ash ponds at Joliet, Powerton, Waukegan, and Will County,
- Coal ash was found in ash pond embankments at Powerton and Waukegan,
- Coal ash was used to construct a railroad spur across the Former Ash Basin at Powerton, and
- Coal ash was found beneath the ash ponds at Powerton and Waukegan.

My analysis and the Board's conclusion in its Opinion – and even admitted by KPRG in recent ASDs – all demonstrate that monitoring wells were drilled into legacy ash and / or ash basin embankments that were constructed with coal ash. Even with this knowledge, MWG failed to assign blame or investigate further those previously undefined, "alternate" or potential sources.

Had MWG acknowledged the impact of historical contamination during completion of its ASDs, for example, KPRG and MWG could have assigned blame for groundwater contamination to historic sources – rather than just concluding that the contamination was not from the active ash basins. MWG, KPRG, and Patrick's lack of assigning possible contaminant blame and completing further investigations are consistent with the Board's prior determination that MWG's monitoring and inspection programs for the CCAs were intended to avoid and detect contamination. That avoidance was carried over to the monitoring programs associated with the CCR Rule and the CCAs.

Although MWG relined ash ponds with HDPE liners at each of the four stations, the HDPE liners were placed on top of the original liners that were prone to leak. The addition of the HDPE liner on top of the old liner may not meet the requirements of the CCR Rule, unless MWG demonstrates that a two-foot layer of soil with a hydraulic conductivity no greater than 1 x 10^{-7} centimeters per second also exists beneath the HPDE layer (or an alternate liner that meets the same performance equivalence).

MWG is required to define *probable and possible* [emphasis supplied] sources of contamination in a nature and extent investigation. MWG cannot possibly complete a groundwater remedy without first knowing the locations of all source areas and the conditions the coal ash exists at those locations.

Historical contamination in wells used for active basin compliance activities not only affects the need to identify source areas, complete a nature and extent investigation, and develop a remedy – but that contamination also adversely affects current CCA and CCR Rule compliance monitoring activities. MWG's use of contaminated background or baseline well data for CCR Rule purposes will only trigger the need to complete required assessments (and corresponding analyses of metals) or corrective actions – if groundwater quality worsens from concentrations possibly already indicative of contamination from historical leakage.

5.2 Need for a Nature and Extent Investigation

As discussed above, the first step in determining a suitable remedy at each of the four stations is for MWG to determine the source(s) of contamination, the types of coal ash (e.g. fly ash, bottom ash, cinders, and / or slag), the characteristics of where and how that material exists in the environment, and how much coal ash exists.

The investigation at each station should define the nature and extent of contamination for all active and historical disposal and fill areas. Site-specific factors gathered in an investigation should then be used by MWG to determine possible remedy options and determine how those remedies will be effective in improving groundwater quality over time. The nature and extent study that MWG is required to complete should include these components, at a minimum:

- Sampling, analyses, and field screening activities,
- Characterization of sources and potential sources of contamination,
- A determination of the degree of saturation of coal ash and connectivity to groundwater,
- A three-dimensional analysis (horizontally and vertically) and the nature, direction, and rate of movement of contaminants,
- Characterization of present and post-remediation exposure routes that may potentially threaten human or environmental receptors, and

- Characterization of significant physical features of the remediation site and vicinity that may affect contaminant fate and transport and present a risk to human health, safety, and the environment.

Groundwater elevations can also rise with climate change – possibly submerging even more coal ash in the future. The nature and extent investigations should consider that groundwater elevations might rise in the future and inundate even more coal ash. Precipitation that accumulates in coal ash can mound the groundwater, creating radial, 360-degree groundwater flow from unlined disposal areas. Further, higher hydraulic heads of that mounding can cause increased horizontal seepage velocities and a vertical gradient that can "push" contaminants deeper into the aquifer.

5.3 Remedy Selection

The Board concluded that MWG's use of the CCAs, GMZs, and ELUCs have not resulted in improvement in groundwater quality and will not prevent the continued spread of contaminants from source areas. As a result, MWG is required to complete other actions that result in a remedy that meets IEPA groundwater protection standards, in addition to state and Federal standards for other affected media such as wetlands and sediment.

The groundwater remedy should consider that groundwater at each station should be protected for current *and future* [emphasis supplied] uses. Potential current and future human receptors include not only possible drinking water exposures, but also industrial, commercial, or irrigation users that pump groundwater. The study should also recognize that ecological resources possibly remain threatened in the future without a proper remedy.

The remedies associated with each station should be capable of performing satisfactorily, reliably, and within a reasonable amount of time. Each potential remedy should be thoroughly evaluated in an alternatives analysis that is included in a corrective action or remedial action plan. An insufficiently performed nature and extent investigation risks selection of a remedy that will not meet the required groundwater clean-up objectives.

The same shallow, porous, and relatively rapid flow groundwater conditions that exist at each station that create contaminant migration threats, are favorable for a variety of groundwater remedies. Those factors make groundwater remedies more technologically practical and economically reasonable. Such high groundwater flow rates enable groundwater, for example, to be captured by pumping wells and for chemical treatment additives to be injected into the aquifer.

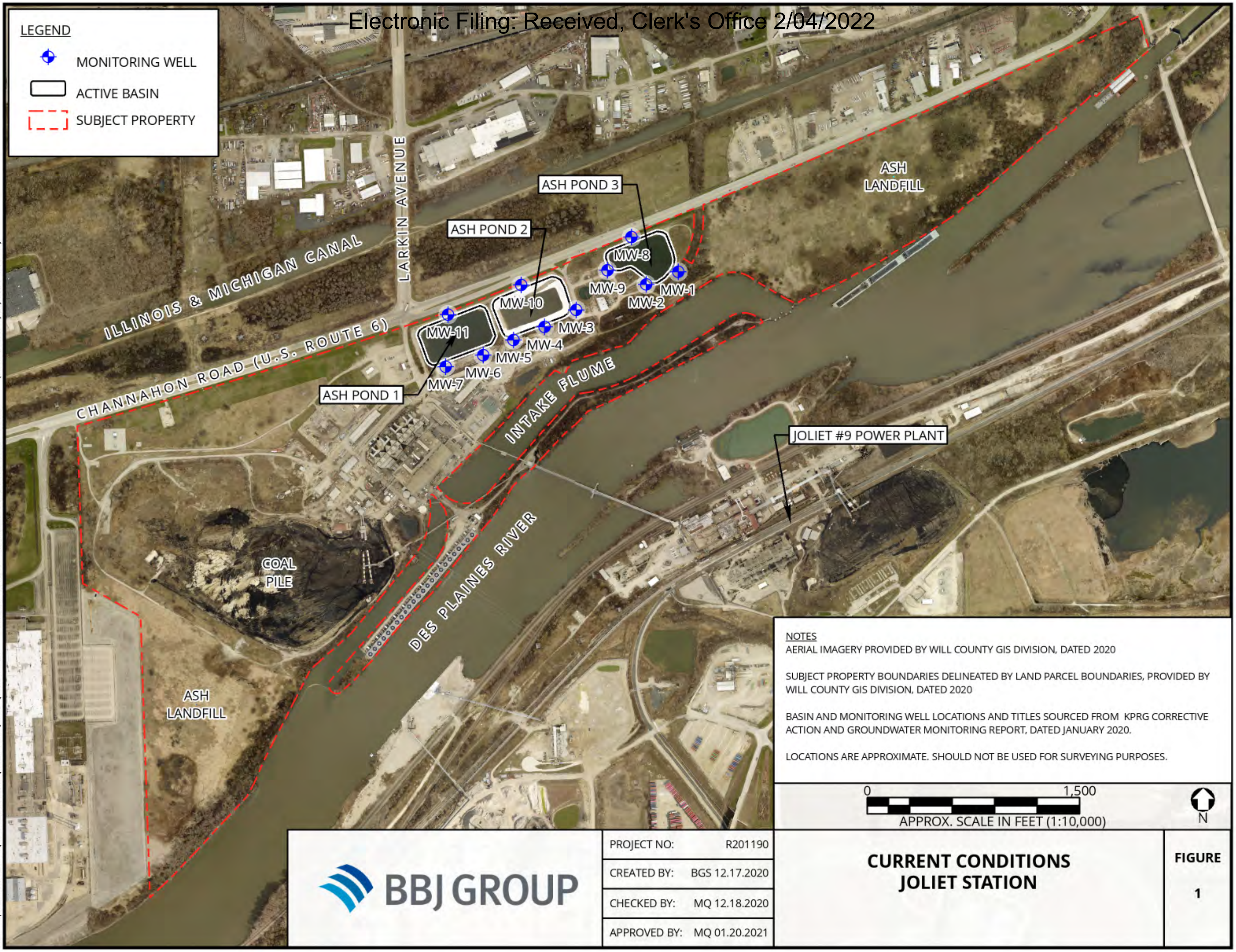
The coal combustion industry and in particular MWG, consider excavation or closure-by-removal to be a technologically practical and economically reasonable closure alternative. Closure of coal ash disposal areas by excavating coal ash and transporting that material to a lined landfill has been common across the United States. Even though MWG plans to close ash ponds at Joliet, Powerton, Waukegan, and Will County by excavation and removal, those closure efforts will be incomplete to remove contaminant sources if historical coal ash remains in adjacent areas or beneath the former active ash ponds. Closure by excavation is expected to improve groundwater quality over time because the source of the contaminants is removed.

6.0 REFERENCES

1. ENSR 1998 Phase 1 Joliet. Phase I Environmental Site Assessment, Joliet #29 Station, Joliet, ENSR Consulting, October 1998.
2. ENSR 1998 Phase 1 Powerton. Phase I Environmental Site Assessment, Powerton Station, ENSR Consulting, October 1998.
3. ENSR 1998 Phase 1 Waukegan. Phase I Environmental Site Assessment, Waukegan Station, ENSR Consulting, October 1998.
4. ENSR 1998 Phase 1 Will County. Phase I Environmental Site Assessment, Will County, ENSR Consulting, October 1998.
5. History of Construction Powerton. History of Construction, Ash Surge Basin and Bypass Basin, Geosyntec Consultants, October 2016.
6. History of Construction Powerton, History of Construction, Former Ash Basin, Geosyntec Consultants, April 2018.
7. History of Construction Waukegan. History of Construction, East and West Basins, Geosyntec Consultants, October 2016.
8. KPRG 2019 Powerton. CCR Compliance Annual Groundwater Monitoring and Corrective Action Report – 2018, Ash Bypass Basin and Ash Surge Basin, KPRG and Associates, January 31, 2019.
9. KPRG 2019 Waukegan. CCR Compliance Annual Groundwater Monitoring and Corrective Action Report – 2018, KPRG and Associates, January 31, 2019.
10. KPRG 2019 Will County. CCR Compliance Annual Groundwater Monitoring and Corrective Action Report – 2018, KPRG and Associates, January 31, 2019.
11. KPRG 2020 Powerton. CCR Compliance Annual Groundwater Monitoring and Corrective Action Report – 2019, Ash Bypass Basin and Ash Surge Basin, KPRG and Associates, January 31, 2020.
12. KPRG 2020b Powerton. Quarterly Groundwater Monitoring Report, Powerton Generating Station, Letter to Ms. Andrea Rhodes from Dale Green, Station Manager July 13, 2020.
13. KPRG 2020 Waukegan. CCR Compliance Annual Groundwater Monitoring and Corrective Action Report – 2019, KPRG and Associates, January 31, 2020.
14. KPRG 2020 Will County. CCR Compliance Annual Groundwater Monitoring and Corrective Action Report – 2019, KPRG and Associates, January 31, 2020.
15. KPRG 2020b Will County. Quarterly Groundwater Monitoring Report, Will County Generating Station, Letter to Ms. Andrea Rhodes from Kristina Cameron, Station Director, July 13, 2020.
16. Location Restrictions Powerton. Placement Above the Uppermost Aquifer Location Restrictions, Former Ash Basin, Geosyntec Consultants, April 2020.
17. Location Restrictions Powerton. Placement Above the Uppermost Aquifer Location Restrictions, Ash Surge Basin and Bypass Basin, Geosyntec Consultants, October 2018.
18. Location Restrictions Waukegan, Placement Above the Uppermost Aquifer Location Restrictions, East and West Basins, Geosyntec Consultants, October 2018.
19. Location Restrictions Will County. Placement Above the Uppermost Aquifer Location Restrictions, South Ash Ponds 2S and 3S, Geosyntec Consultants, October 2018.

20. Patrick 2011 Joliet. Hydrogeologic Assessment Report, Joliet Generating Station No. 29, Joliet, Illinois, Patrick Engineering, Inc., February 2011.
21. Patrick 2011 Powerton. Hydrogeologic Assessment Report, Powerton Generating Station, Patrick Engineering, Inc., February 2011.
22. Patrick 2011 Waukegan. Hydrogeologic Assessment Report, Waukegan Generating Station, Patrick Engineering, Inc., February 2011.
23. Patrick 2011 Will County. Hydrogeologic Assessment Report, Will County Generating Station, Patrick Engineering, Inc., February 2011.

FIGURES



NOTES

AERIAL IMAGERY PROVIDED BY WILL COUNTY GIS DIVISION, DATED 2020

SUBJECT PROPERTY BOUNDARIES DELINEATED BY LAND PARCEL BOUNDARIES, PROVIDED BY WILL COUNTY GIS DIVISION, DATED 2020

BASIN AND MONITORING WELL LOCATIONS AND TITLES SOURCED FROM KPRG CORRECTIVE ACTION AND GROUNDWATER MONITORING REPORT, DATED JANUARY 2020.

LOCATIONS ARE APPROXIMATE. SHOULD NOT BE USED FOR SURVEYING PURPOSES.

BBJ GROUP

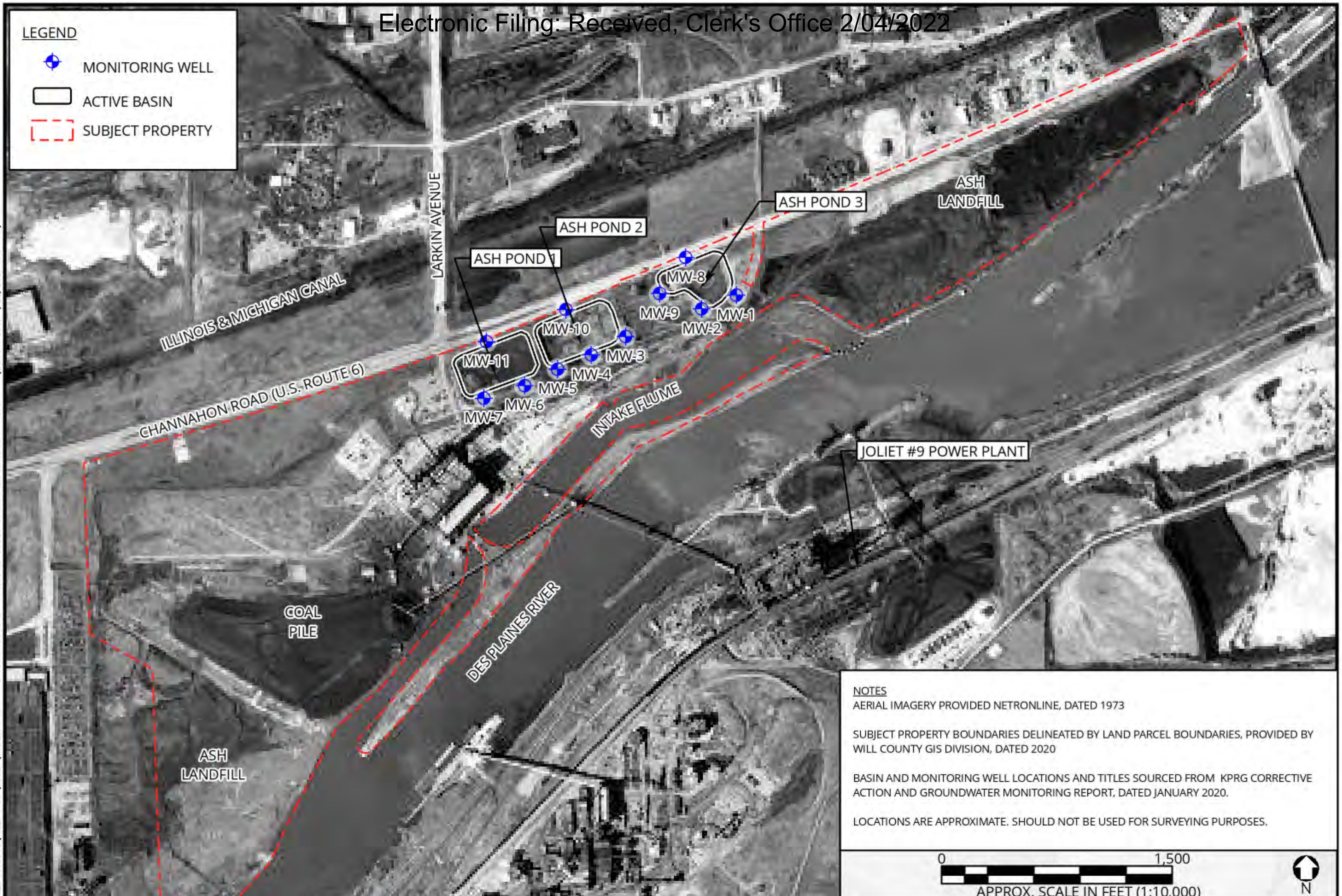
PROJECT NO:	R201190
CREATED BY:	BGS 12.17.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

CURRENT CONDITIONS
JOLIET STATION

FIGURE

1

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\JOLIET\JOLIET.APRX LAYOUT: FIGURE 1 – CURRENT CONDITIONS JOLIET STATION (BSOCKNESS: 1/20/2021 9:35 AM)



NOTES

AERIAL IMAGERY PROVIDED NETRONLINE, DATED 1973

SUBJECT PROPERTY BOUNDARIES DELINEATED BY LAND PARCEL BOUNDARIES, PROVIDED BY WILL COUNTY GIS DIVISION, DATED 2020

BASIN AND MONITORING WELL LOCATIONS AND TITLES SOURCED FROM KPRG CORRECTIVE ACTION AND GROUNDWATER MONITORING REPORT, DATED JANUARY 2020.

LOCATIONS ARE APPROXIMATE. SHOULD NOT BE USED FOR SURVEYING PURPOSES.

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APPROX. SCALE IN FEET (1:10,000)
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BBJ GROUP

PROJECT NO:	R2011900
CREATED BY:	BGS 12.17.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

HISTORIC CONDITIONS - 1973
JOLIET STATION

FIGURE
2

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\JOLIET\JOLIET.APRX LAYOUT: FIGURE 2 – HISTORIC JOLIET STATION CONDITIONS – 1973 (BSOCKNESS: 1/20/2021 9:34 AM)

LEGEND

- MONITORING WELL
- ACTIVE BASIN
- HISTORIC BASIN

NOTES

AERIAL IMAGERY PROVIDED BY TAZWELL COUNTY GIS DEPARTMENT, DATED 2019

BASIN AND MONITORING WELL LOCATIONS AND NAMES SOURCED FROM KPRG QUARTERLY GROUNDWATER MONITORING REPORT, DATED JULY 2020

LOCATIONS ARE APPROXIMATE. SHOULD NOT BE USED FOR SURVEYING PURPOSES.

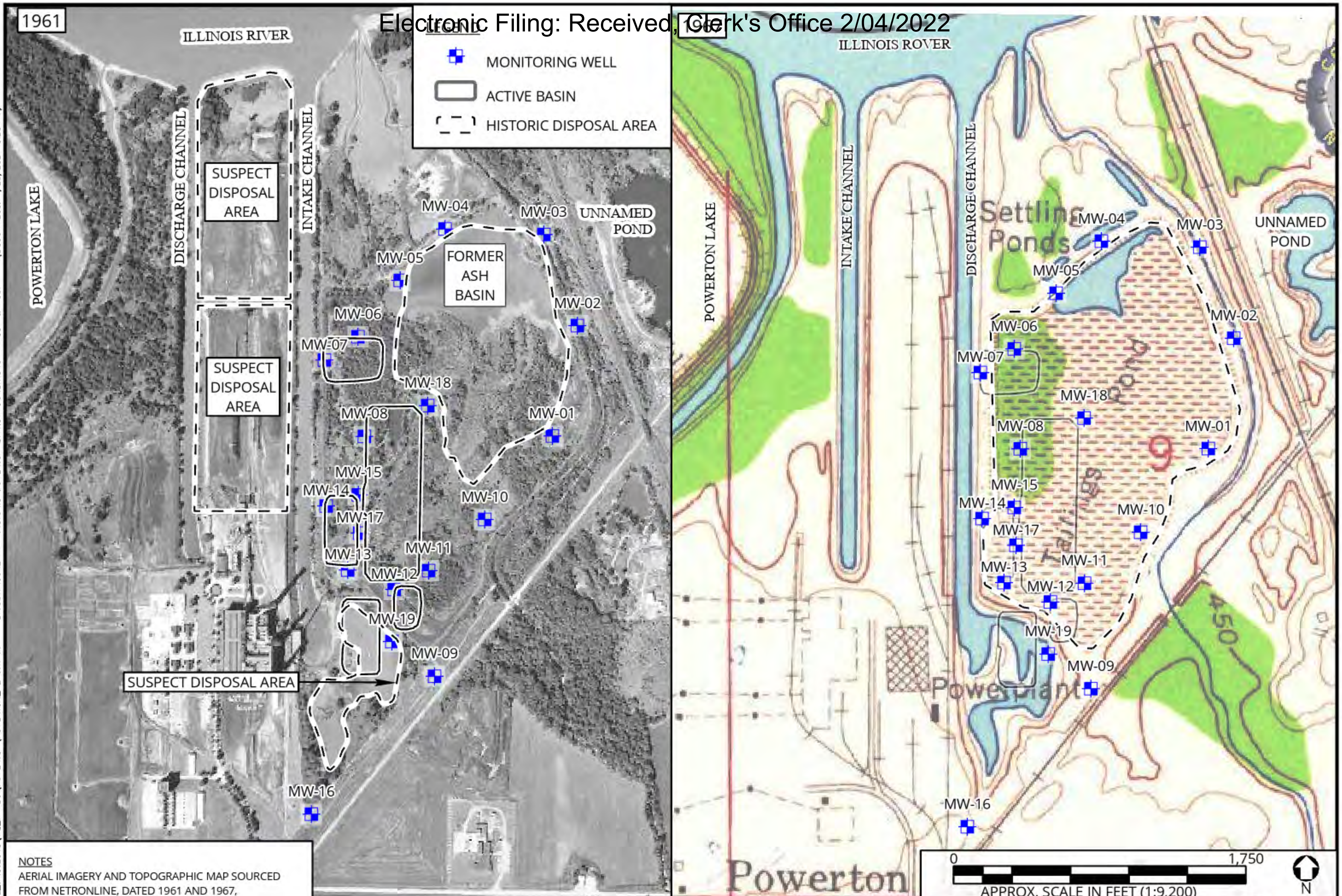
BBJ GROUP

PROJECT NO:	R2011900
CREATED BY:	BGS 12.18.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

CURRENT CONDITIONS
POWERTON STATION

FIGURE
3

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\POWERTON\POWERTON_1216.APRX LAYOUT: FIGURE 3 - SITE VICINITY PLAN PORTRAIT (BSOCKNESS: 1/25/2021 8:11 AM)



NOTES

AERIAL IMAGERY AND TOPOGRAPHIC MAP SOURCED FROM NETRONLINE, DATED 1961 AND 1967, RESPECTIVLEY

BASIN AND MONITORING WELL LOCATIONS AND NAMES SOURCED FROM KPRG QUARTERLY GROUNDWATER MONITORING REPORT, DATED JULY 2020

LOCATIONS ARE APPROXIMATE. SHOULD NOT BE USED FOR SURVEYING PURPOSES.

BBJ GROUP

PROJECT NO:	R2011990
CREATED BY:	BGS 12.17.2020
CHECKED BY:	MQ - 12.18.2020
APPROVED BY:	MQ 01.20.2021

HISTORIC POWERTON STATION CONDITIONS - 1961 & 1967

FIGURE 4

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\POWERTON\POWERTON_1216.APRX LAYOUT: FIGURE 4 - HISTORIC POWERTON STATION CONDITIONS - 1961 & 1967 (BSOCKNESS: 1/20/2021 9:29 AM)

LEGEND

- MONITORING WELL
- MONITORING WELL (NON-CCR RULE)
- ACTIVE BASIN
- SUBJECT PROPERTY

NOTES

AERIAL IMAGERY PROVIDED BY GOOGLE EARTH, DATED JUNE 2020

NOTES CONTINUED

SUBJECT PROPERTY DELINEATED BY PARCEL BOUNDARIES, PROVIDED BY LAKE COUNTY GIS DIVISION, DATED 2020

MONITORING WELL AND BASIN LOCATIONS AND TITLES SOURCED FROM KPRG GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT, DATED JANUARY 2020

LOCATIONS ARE APPROXIMATE. SHOULD NOT BE USED FOR SURVEYING PURPOSES.

BBJ GROUP

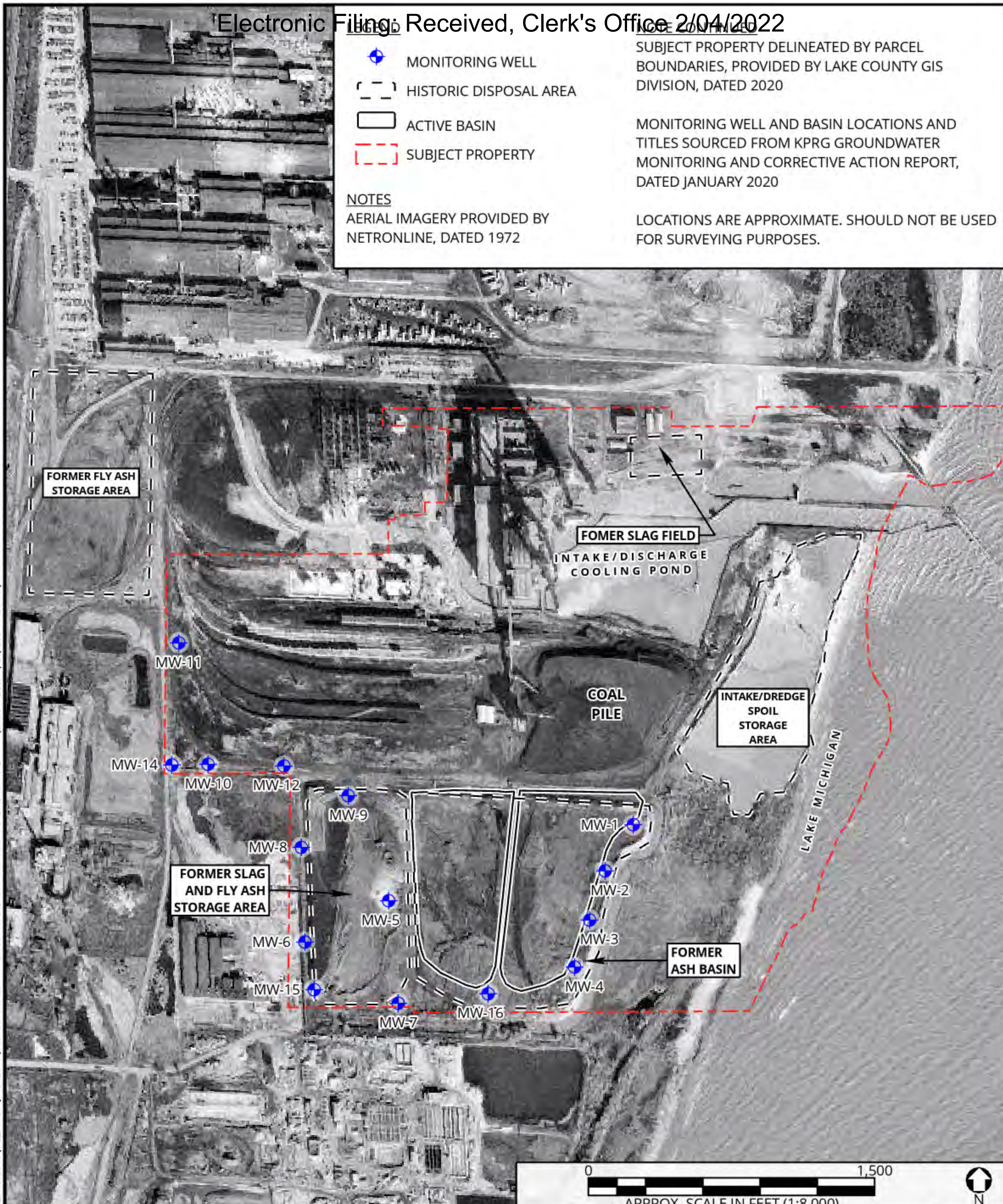
PROJECT NO:	R2011900
CREATED BY:	BGS 12.18.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

CURRENT CONDITIONS
WAUKEGAN STATION

FIGURE

5

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\WAUKEGAN\WAUKEGAN.APRX LAYOUT: FIGURE 5 - SITE AND VICINITY PLAN PORTRAIT (BSOCKNESS: 1/20/2021 12:16 PM)



BBJ GROUP

PROJECT NO:	R2011900
CREATED BY:	BGS 12.18.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

HISTORIC SITE CONDITIONS - 1972
WAUKEGAN STATION

FIGURE 6

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\WAUKEGAN\WAUKEGAN.APRX   LAYOUT: FIGURE 6 - HISTORIC CONDITIONS 1972   (BSOCKNESS: 1/20/2021 1:20 PM)

LEGEND

- MONITORING WELL
- CURRENT BASIN
- SUBJECT PROPERTY

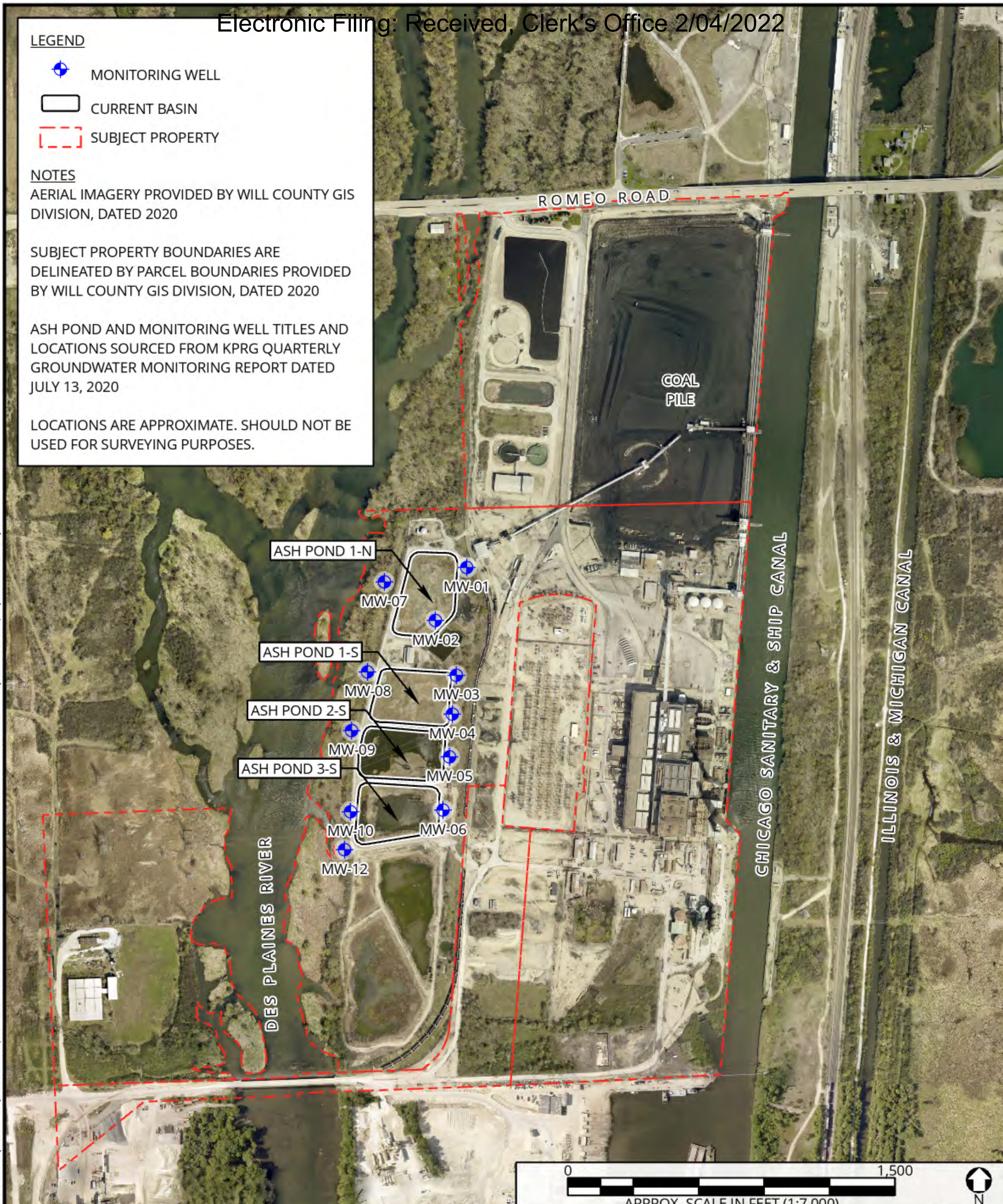
NOTES

AERIAL IMAGERY PROVIDED BY WILL COUNTY GIS DIVISION, DATED 2020

SUBJECT PROPERTY BOUNDARIES ARE DELINEATED BY PARCEL BOUNDARIES PROVIDED BY WILL COUNTY GIS DIVISION, DATED 2020

ASH POND AND MONITORING WELL TITLES AND LOCATIONS SOURCED FROM KPRG QUARTERLY GROUNDWATER MONITORING REPORT DATED JULY 13, 2020

LOCATIONS ARE APPROXIMATE. SHOULD NOT BE USED FOR SURVEYING PURPOSES.



BBJ GROUP

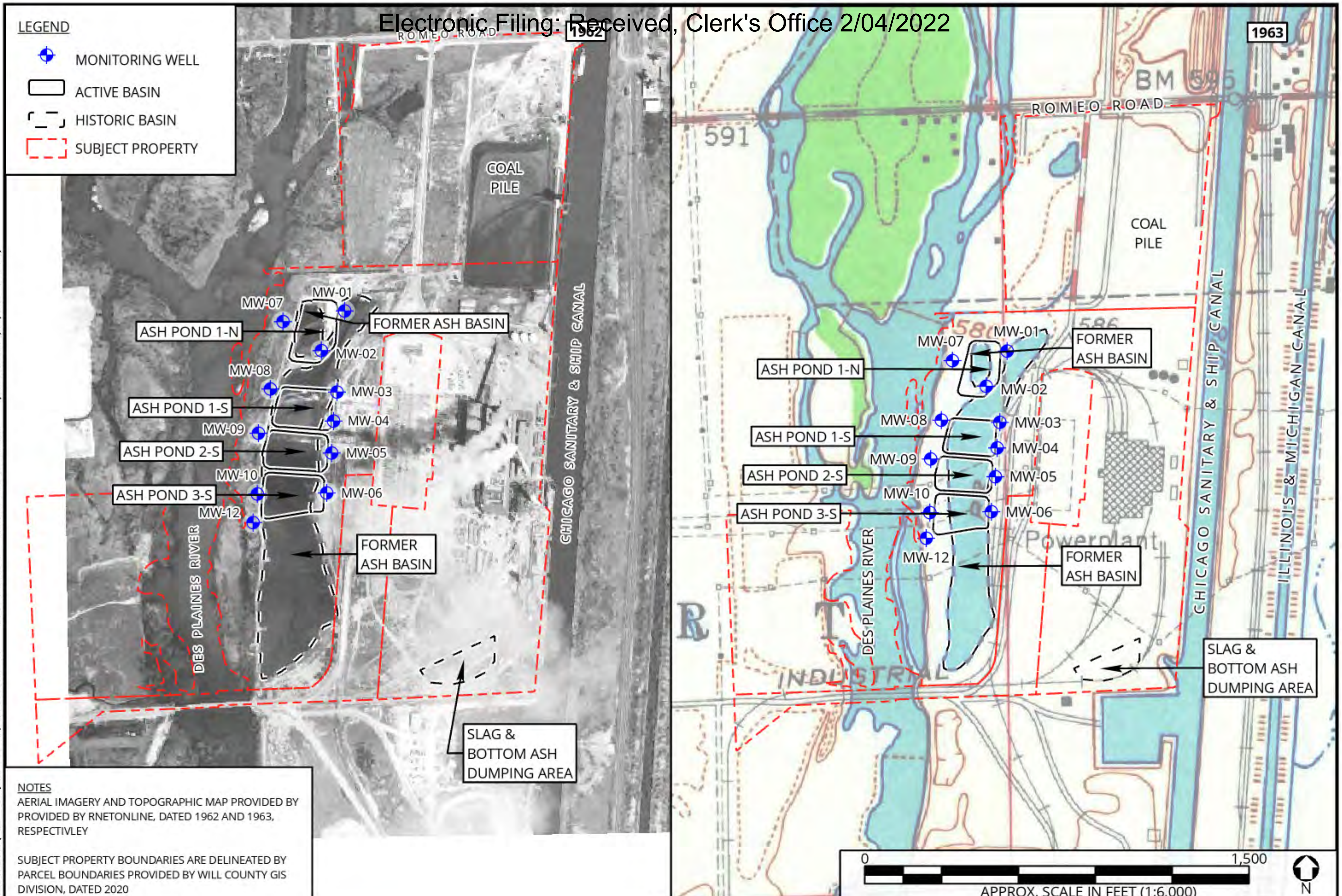
PROJECT NO:	R2011900
CREATED BY:	BGS 12.18.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

CURRENT CONDITIONS
WILL COUNTY STATION

FIGURE

7

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\WILL COUNTY\WILL COUNTY.APRX LAYOUT:FIGURE 7 - SITE AND VICINITY PLAN PORTRAIT (BSOCKNESS: 1/20/2021 11:13 AM)



NOTES

AERIAL IMAGERY AND TOPOGRAPHIC MAP PROVIDED BY PROVIDED BY RNETONLINE, DATED 1962 AND 1963, RESPECTIVLEY

SUBJECT PROPERTY BOUNDARIES ARE DELINEATED BY PARCEL BOUNDARIES PROVIDED BY WILL COUNTY GIS DIVISION, DATED 2020

ASH POND AND MONITORING WELL TITLES AND LOCATIONS SOURCED FROM KPRG QUARTERLY GROUNDWATER MONITORING REPORT, DATED JULY 13, 2020

LOCATIONS ARE APPROXIMATE. SHOULD NOT BE USED FOR SURVEYING PURPOSES.

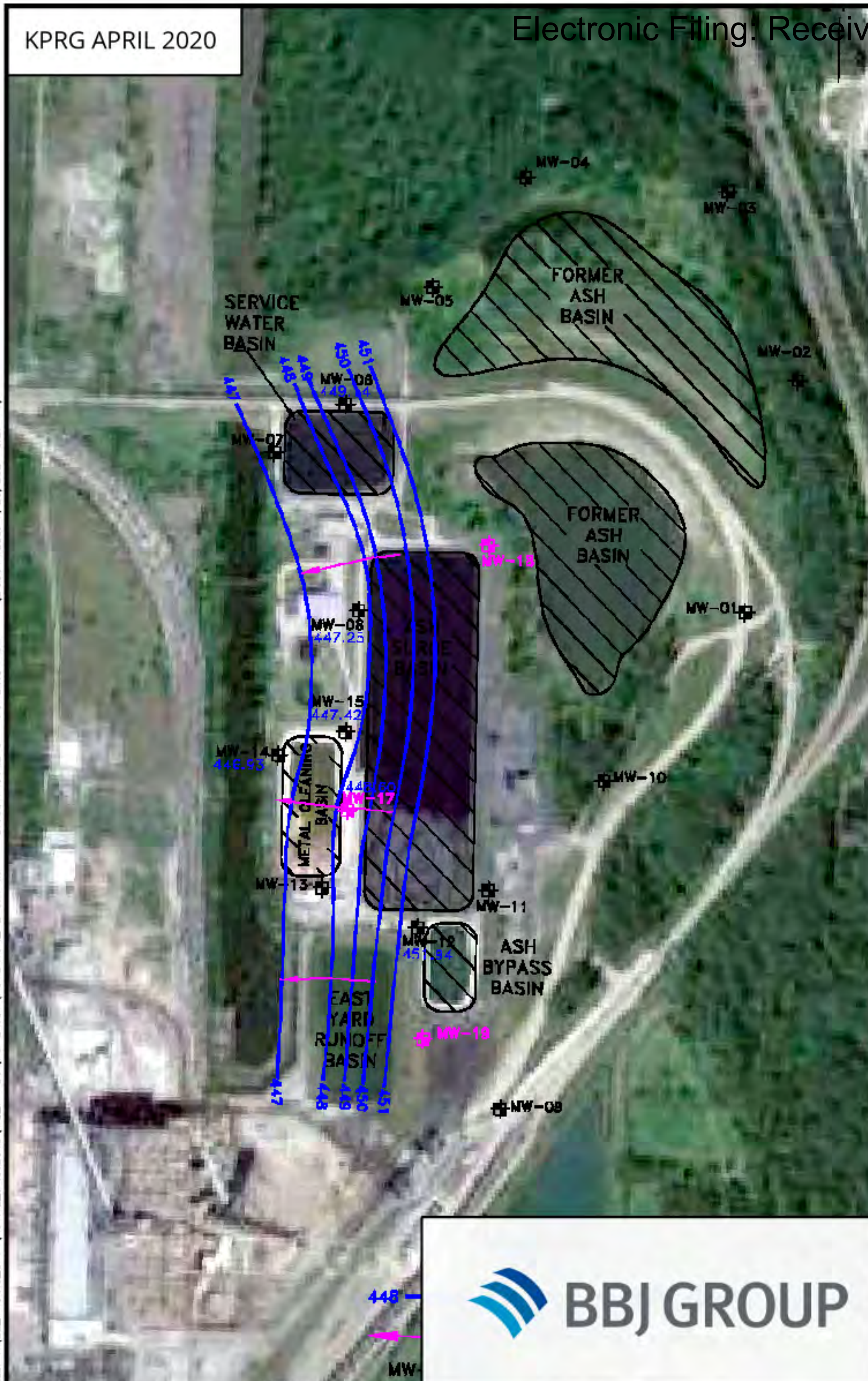
BBJ GROUP

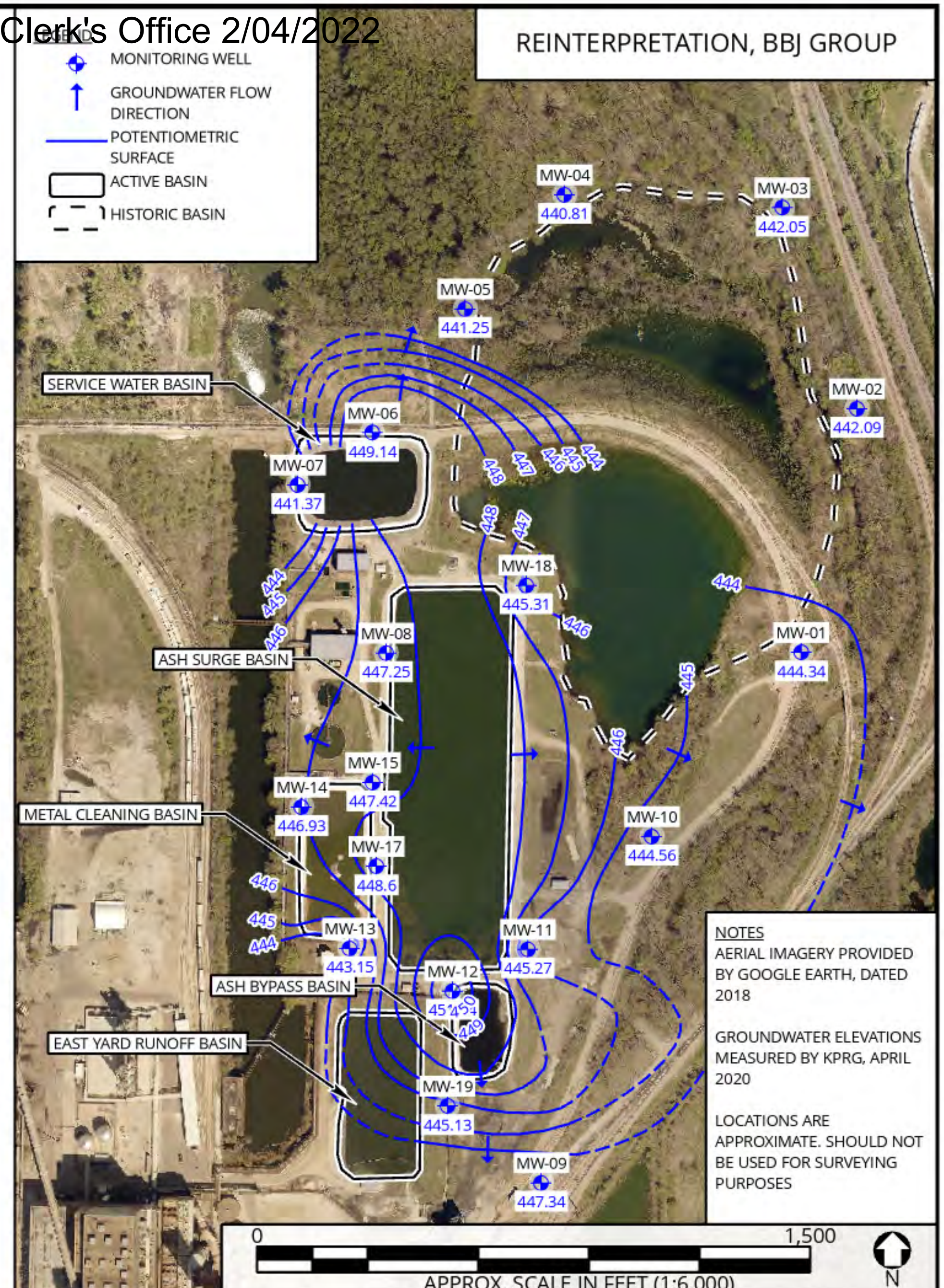
PROJECT NO:	R2011900
CREATED BY:	BGS 12.18.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

HISTORIC SITE CONDITIONS - WILL COUNTY STATION 1962 & 1963

FIGURE 8

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MO_PANDC\WILL COUNTY\WILL COUNTY.APRX LAYOUT:FIGURE 8 - HISTORIC SITE CONDITIONS (BSOCKNESS: 1/20/2021 3:14 PM)





BBJ GROUP

PROJECT NO:	R2011900
CREATED BY:	BGS 12.18.2020
CHECKED BY:	MQ 12.18.2020
APPROVED BY:	MQ 01.20.2021

ACTIVE ASH BASIN POTENTIOMETRIC SURFACE APRIL 2020 - POWERTON STATION

FIGURE 9

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\POWERTON\POWERTON_1216.APRX LAYOUT FIGURE 9 - POWERTON GW (BSOCKNESS: 1/20/2021 9:27 AM)

BBJ GROUP		POTENTIAL GROUNDWATER DISCHARGE RECEPTOR AREA WAUKEGAN STATION	FIGURE 10
PROJECT NO:	R2011900		
CREATED BY:	BGS 12.18.2020		
CHECKED BY:	MQ 12.18.2020		
APPROVED BY:	MW 01.20.2021		

FILE: T:\ZZ_ARCGIS_DATA\ACTIVE_PROJECTS\MQ_PANDC\WAUKEGAN\WAUKEGAN.APRX LAYOUT FIGURE 10 – GROUNDWATER DISCHARGE (BSOCKNESS: 1/20/2021 12:40 PM)

Table 1

Example Coal Ash Removal Action Sites

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
Joliet #29 Generating Station	NRG	Ash Pond 2	Open	Removal	IL
Powerton Generating Station	NRG	Ash By-pass Basin	Open	Removal	IL
Powerton Generating Station	NRG	Ash Surge Basin	Open	Removal	IL
Waukegan Station	NRG	East Ash Pond	Open	Removal	IL
Waukegan Station	NRG	West Ash Pond	Open	Removal	IL
Will County Station	NRG	Ash Pond 2 South	Open	Removal	IL
Will County Station	NRG	Ash Pond 3 South	Open	Removal	IL
Limestone Electric Generating Station	NRG	Bottom Ash Cooling Pond	Open	Removal	TX
Limestone Electric Generating Station	NRG	E Pond (Unit 019)	Open	Removal	TX
Limestone Electric Generating Station	NRG	Secondary E Pond Unit (Unit 003)	Open	Removal	TX
Limestone Electric Generating Station	NRG	ST-18 Unit	Open	Removal	TX
Limestone Electric Generating Station	NRG	Stormwater Pond (Unit 002)	Open	Removal	TX

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
W.A. Parish Electric Generating Station	NRG	Air Preheater Pond	Open	Removal	TX
W.A. Parish Electric Generating Station	NRG	FGD Emergency Pond	Open	Removal	TX
William C. Gorgas Electric Generating Plant	Alabama Power	Gypsum Pond	Notice of Intent to Close	Removal	AL
White Bluff Plant	Entergy	Recycle Pond A	Notice of Intent to Close	Removal	AR
Cherokee Station	Xcel Energy	Center Ash Pond	Closed	Removal	CO
Cherokee Station	Xcel Energy	Cooling Tower Retention Pond	Closed	Removal	CO
Cherokee Station	Xcel Energy	East Ash Pond	Closed	Removal	CO
Cherokee Station	Xcel Energy	West Ash Pond	Closed	Removal	CO
Pawnee Station	Xcel Energy	Ash Water Recovery Pond	Closed	Removal	CO
Pawnee Station	Xcel Energy	Bottom Ash Storage Pond	Closed	Removal	CO
Valmont Station	Xcel Energy	CCR Impoundment 3A	Closed	Removal	CO
Valmont Station	Xcel Energy	CCR Impoundment 3B	Closed	Removal	CO
Valmont Station	Xcel Energy	EPRI Ash Settling Pond	Closed	Removal	CO
Big Bend Power Station	TECO Energy	Economizer Ash and Pyrite Pond System	Notice of Intent to Close	Removal	FL
Big Bend Power Station	TECO Energy	West Slag Disposal Pond	Notice of Intent to Close	Removal	FL

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
Crystal River Energy Complex	Duke Energy	Backup FGD Blowdown Treatment Pond	Notice of Intent to Close	Removal	FL
Crystal River Energy Complex	Duke Energy	Primary FGD Blowdown Treatment Pond	Notice of Intent to Close	Removal	FL
Plant Jack McDonough	Georgia Power Company	Ash Pond 2	Closed	Removal	GA
Plant McIntosh	Georgia Power Company	Ash Pond 1	Notice of Intent to Close	Removal	GA
Plant McManus	Georgia Power Company	AP-1, inactive	Notice of Intent to Close	Removal	GA
Plant Yates	Georgia Power Company	Ash Pond 1	Closed	Removal	GA
Plant Yates	Georgia Power Company	Ash Pond A	Closed	Removal	GA
Plant Yates	Georgia Power Company	Ash Pond B	Notice of Intent to Close	Removal	GA
Ottumwa Generating Station	Interstate Power and Light Company	Zero Liquid Discharge Pond	Notice of Intent to Close	Removal	IA
Prairie Creek Generating Station	Interstate Power and Light Company	Beneficial Use Storage Area	Closed	Removal	IA
Prairie Creek Generating Station	Interstate Power and Light Company	PCS Beneficial Use Storage Area	Closed	Removal	IA
Hennepin Power Station	Luminant (formerly Dynegy Inc.)	Hennepin Old West Polishing Pond	Notice of Intent to Close	Removal	IL
Cayuga Generating Station	Duke Energy	Secondary Ash Settling Pond	Notice of Intent to Close	Removal	IN
Gibson Generating Station	Duke Energy	East Settling Basin	Notice of Intent to Close	Removal	IN

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
Gibson Generating Station	Duke Energy	North Settling Basin	Notice of Intent to Close	Removal	IN
Gibson Generating Station	Duke Energy	South Settling Basin	Notice of Intent to Close	Removal	IN
Michigan City Generating Station	Northern Indiana Public Service Company	Michigan City Boiler Slag Pond	Notice of Intent to Close	Removal	IN
Michigan City Generating Station	Northern Indiana Public Service Company	Primary Settling Pond 2	Notice of Intent to Close	Removal	IN
Lawrence Energy Center	Westar Energy	Area 2 Pond	Notice of Intent to Close	Removal	KS
Lawrence Energy Center	Westar Energy	Area 3 Pond	Notice of Intent to Close	Removal	KS
Lawrence Energy Center	Westar Energy	Area 4 Pond	Notice of Intent to Close	Removal	KS
Nearman Creek Power Station	Kansas City Board of Public Utilities	Bottom Ash Pond	Notice of Intent to Close	Removal	KS
Tecumseh Energy Center	Westar Energy	Bottom Ash Settling Pond	Notice of Intent to Close	Removal	KS
Big Sandy Plant	American Electric Power, Kentucky Power Co.	Bottom Ash Pond	Closed	Removal	KY
East Bend Electric Plant	Duke Energy	Ash Basin	Notice of Intent to Close	Removal	KY
Ghent Generating Station	Kentucky Utilities Company	Gypsum Stack	Notice of Intent to Close	Removal	KY
Ghent Generating Station	Kentucky Utilities Company	Reclaim Pond/Gypsum	Notice of Intent to Close	Removal	KY

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
		Stack Surge Pond			
Mill Creek Generating Station	Louisville Gas & Electric Company	Clearwell Pond	Notice of Intent to Close	Removal	KY
Mill Creek Generating Station	Louisville Gas & Electric Company	Construction Runoff Pond	Notice of Intent to Close	Removal	KY
Mill Creek Generating Station	Louisville Gas & Electric Company	Dead Storage Pond	Notice of Intent to Close	Removal	KY
Mill Creek Generating Station	Louisville Gas & Electric Company	Emergency Pond	Notice of Intent to Close	Removal	KY
Brayton Point Power Station	Brayton Point LLC	Basin A	Closed	Removal	MA
Brayton Point Power Station	Brayton Point LLC	Basin B	Closed	Removal	MA
Brayton Point Power Station	Brayton Point LLC	Basin C	Closed	Removal	MA
BC Cobb Power Plant	Consumers Energy Co.	Bottom Ash Pond	Notice of Intent to Close	Removal	MI
BC Cobb Power Plant	Consumers Energy Co.	Ponds 0-8	Notice of Intent to Close	Removal	MI
DE Karn Power Plant	Consumers Energy Co.	Bottom Ash Pond	Notice of Intent to Close	Removal	MI
James DeYoung Power Plant	Holland Board of Public Works	Ash Pond 1	Closed	Removal	MI
James DeYoung Power Plant	Holland Board of Public Works	Ash Pond 2	Closed	Removal	MI
James DeYoung Power Plant	Holland Board of Public Works	Ash Pond 3	Closed	Removal	MI
JC Weadock Power Plant	Consumers Energy Co.	Bottom Ash Pond	Notice of Intent to Close	Removal	MI
JH Campbell Power Plant	Consumers Energy Co.	Unit 3 North & 3 South	Notice of Intent to Close	Removal	MI

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
JH Campbell Power Plant	Consumers Energy Co.	Units 1-2 North and 1-2 South	Notice of Intent to Close	Removal	MI
St. Clair Power Plant	DTE Electric Co.	Scrubber Impoundment	Notice of Intent to Close	Removal	MI
Black Dog Plant	Xcel Energy	Inactive Ash Pond 1	Closed	Removal	MN
Black Dog Plant	Xcel Energy	Inactive Ash Pond 2	Closed	Removal	MN
Black Dog Plant	Xcel Energy	Inactive Ash Pond 3	Closed	Removal	MN
Boswell Energy Center	Minnesota Power	Old Bottom Ash Surface Impoundment	Notice of Intent to Close	Removal	MN
Fox Lake Generating Station	Interstate Power and Light Company	Inactive Surface Impoundment	Closed	Removal	MN
Columbia Municipal Power Plant	City of Columbia	More's Lake Surface Impoundment	Notice of Intent to Close	Removal	MO
Iatan Generating Station	KCP&L	North Ash / South Ash Impoundment	Notice of Intent to Close	Removal	MO
James River Power Station	City Utilities of Springfield	East Pond	Closed	Removal	MO
James River Power Station	City Utilities of Springfield	West Pond	Closed	Removal	MO
John Twitty Energy Center	City Utilities of Springfield	East Pond	Closed	Removal	MO
John Twitty Energy Center	City Utilities of Springfield	West Pond	Closed	Removal	MO
Thomas Hill Energy Center	Associated Electric Coop.	Cell 2 West	Notice of Intent to Close	Removal	MO
Lewis & Clark Station	Montana-Dakota Utilities Co.	Temporary Storage Pad	Notice of Intent to Close	Removal	MT
Asheville Steam Electric Plant	Duke Energy	1982 Ash Basin	Closed	Removal	NC

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
Buck Steam Station	Duke Energy	Additional Primary Pond (Ash Basin 1)	Notice of Intent to Close	Removal	NC
Buck Steam Station	Duke Energy	Primary Pond (Ash Basin 2)	Notice of Intent to Close	Removal	NC
Buck Steam Station	Duke Energy	Secondary Pond (Ash Basin 3)	Notice of Intent to Close	Removal	NC
Cliffside Steam Station	Duke Energy	Inactive Units 1 - 4 Basin	Notice of Intent to Close	Removal	NC
Dan River Steam Station	Duke Energy	Primary Ash Basin	Notice of Intent to Close	Removal	NC
H.F. Lee Energy Complex	Duke Energy	Active Ash Basin	Notice of Intent to Close	Removal	NC
L.V. Sutton Energy Complex	Duke Energy	1971 Ash Basin	Notice of Intent to Close	Removal	NC
L.V. Sutton Energy Complex	Duke Energy	1984 Ash Basin	Notice of Intent to Close	Removal	NC
W.H. Weatherspoon Power Plant	Duke Energy	1979 Ash Basin	Notice of Intent to Close	Removal	NC
Coyote Station	Otter Tail Power Company	Nelsen Pond	Notice of Intent to Close	Removal	ND
Coyote Station	Otter Tail Power Company	Slag Pond	Notice of Intent to Close	Removal	ND
Coyote Station	Otter Tail Power Company	Sluice Outfall	Notice of Intent to Close	Removal	ND
B.L. England Generating Station	RCCM	Slag Ponds	Notice of Intent to Close	Removal	NJ
Hudson Generating Station	PSEG Power LLC	Bottom Ash Pond	Closed	Removal	NJ

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
Hudson Generating Station	PSEG Power LLC	North Fly Ash Pond	Closed	Removal	NJ
Hudson Generating Station	PSEG Power LLC	South Fly Ash Pond	Closed	Removal	NJ
Mercer Generating Station	PSEG Power LLC	North Fly Ash Pond	Closed	Removal	NJ
Mercer Generating Station	PSEG Power LLC	South Fly Ash Pond	Closed	Removal	NJ
Four Corners Power Plant	Arizona Public Service Co.	Upper Retention Sump	Notice of Intent to Close	Removal	NM
Reid Gardner Generating Station	NV Energy	SI B-1	Notice of Intent to Close	Removal	NV
Reid Gardner Generating Station	NV Energy	SI B-2	Notice of Intent to Close	Removal	NV
Reid Gardner Generating Station	NV Energy	SI B-3	Notice of Intent to Close	Removal	NV
Reid Gardner Generating Station	NV Energy	SI E-1	Notice of Intent to Close	Removal	NV
Muskogee Generating Station	OG&E Energy Corp.	Emergency Ash Basin	Notice of Intent to Close	Removal	OK
Brunner Island Steam Electric Station	Talen Energy	Ash Basin No. 6	Notice of Intent to Close	Removal	PA
New Castle Generating Station	GenOn	North Ash Pond	Closed	Removal	PA
Cross Generating Station	Santee Cooper	Gypsum Pond	Closed	Removal	SC
W.S. Lee Steam Station	Duke Energy	Secondary Ash Basin	Notice of Intent to Close	Removal	SC

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
Wateree Generating Station	South Carolina Electric & Gas	Ash Pond	Notice of Intent to Close	Removal	SC
Winyah Generating Station	Santee Cooper	Slurry Pond 2	Closed	Removal	SC
Big Stone Plant	Otter Tail Power Company	Slag Pond Area	Closed	Removal	SD
Big Stone Plant	Otter Tail Power Company	Temporary Storage Area	Closed	Removal	SD
Bremo Power Station	Dominion Energy	East Ash Pond, Inactive	Notice of Intent to Close	Removal	VA
Bremo Power Station	Dominion Energy	West Ash Pond, Inactive	Notice of Intent to Close	Removal	VA
Chesterfield Power Station	Dominion Energy	Lower Ash Pond	Notice of Intent to Close	Removal	VA
Possum Point Power Station	Dominion Energy	Pond A	Notice of Intent to Close	Removal	VA
Possum Point Power Station	Dominion Energy	Pond B	Notice of Intent to Close	Removal	VA
Possum Point Power Station	Dominion Energy	Pond C	Notice of Intent to Close	Removal	VA
Possum Point Power Station	Dominion Energy	Pond E	Notice of Intent to Close	Removal	VA
Columbia Energy Center	Wisconsin Power & Light Co.	Secondary Pond	Notice of Intent to Close	Removal	WI
Nelson Dewey Station	Wisconsin Power & Light Co.	WPDES Pond	Closed	Removal	WI
Mount Storm Power Station	Dominion Energy	Low Volume Waste Sedimentation Ponds	Notice of Intent to Close	Removal	WV

Appendix A

CV, Mark A Quarles, P.G.

Mark Quarles, P.G.
Senior Geologist, Nashville Branch Manager

Education

MBA Vanderbilt – Owen Graduate School of Management, 2001

B.S., Environmental Engineering Technology, Western Kentucky University, 1985

Professional Registration

Professional Geologist – Tennessee (#3834)

Professional Geologist – New York (#779)

Professional Geologist – Georgia (#2266)

Water Pollution Control Operator (Class II) - Massachusetts

GENERAL CAREER BACKGROUND

Mr. Quarles has provided consulting services for a variety of local, state, US EPA, and international regulatory programs for a diverse list of clients — including industrial manufacturers, law firms, municipal governments, commercial developers, and non-profit organizations. He has served as Client Manager, Project Manager, and Senior Geologist for projects in multiple states and has managed teams of geologists, chemists, natural resource specialists, environmental engineers, and environmental scientists.

Coal combustion waste experience has included investigations for over 100 coal combustion waste disposal sites across the United States, with a particular emphasis on these states: Alabama, Florida, Georgia, Illinois, Iowa, Kentucky, New York, North Carolina, South Carolina, and Tennessee. The work has evaluated disposal site designs, operation and monitoring programs, and closure plans relative to the US EPA RCRA Subtitle D, Coal Combustion Residuals Rule ("CCR Rule"), and state-equivalent programs.

In addition to coal combustion wastes, Mr. Quarles has experience with environmental compliance programs associated with US EPA and state-equivalent standards for voluntary Brownfield programs, hazardous wastes (RCRA Subtitle C), corporate environmental audits, Superfund (CERLCA), municipal and industrial landfill siting and design (RCRA Subtitle D), due diligence property transactional standards (ASTM), wastewater and stormwater discharges (Clean Water Act), potable water supply (Safe Drinking Water Act), oil storage (Oil Pollution Control Act), threatened and endangered species (Endangered Species Act), dredge and Fill (404 Permits), sediment contamination, stream alternation permits, and wetlands.

Mr. Quarles has testified as a subject matter expert in Federal and State Courts, administrative hearings, and public hearings.

REPRESENTATIVE CCR PROGRAM EXPERIENCE

General CCR Rule Compliance

Mr. Quarles has evaluated site conditions and compared them to the technical standards associated with the CCR Rule and state-equivalent programs, in addition to standards established by the Electric Power Research Institute. The services have included expert opinion technical reports, expert testimonies, and comments at public hearings regarding Environmental Impact Statements, CCR Rule compliance, proposed investigations to define the nature and extent of contamination, proposed closure plans, and proposed corrective action measures.

Electric Power Industry and Governmental Research
Mr. Quarles has used historical research dating to the 1970s by the Electric Power Research Institute, the US EPA, internal utilities, peer-reviewed publications, and governmental research organizations to determine coal-fired power plant operational standards and known risks to water quality.

Forensic Analyses
Mr. Quarles has reviewed historical reports, topographic maps, and aerial photographs to determine where historical disposal operations occurred, the likelihood of wastes being placed below the seasonal high groundwater table, and when groundwater contamination mostly likely occurred.

Utility Rate Case Support
Mr. Quarles has testified at rate case hearings regarding compliance with the CCR Rule and state-equivalent programs. Services have included reviewing proposed investigations to identify legacy waste disposal activities, estimating when groundwater contamination most likely occurred, reviewing investigations to determine the nature and extent of contamination, and reviewing proposed groundwater corrective actions.

REPRESENTATIVE CCR PROJECT EXPERIENCE

CCR Rate Case Hearings – Raleigh, North Carolina
Served as Senior Geologist associated with rate casing hearings before the North Carolina Utilities Commission. Services included an extensive review of historical internal documents and discovery, proposed closure plans for landfills and surface impoundments, and groundwater monitoring plans relative to the CCR Rule and the Coal Ash Management Act.

CCR Compliance - Georgia
Served as Senior Geologist for reviewing draft closure plans for surface impoundments. Proposed closure methods included closure-by-removal and closure-in-place with an engineered cap. The plans were reviewed relative to the CCR Rule, Georgia EPD regulations and standards, and draft permit conditions.

CCR Compliance and Litigation – Gallatin, Tennessee
Served as Senior Geologist and litigation subject matter expert regarding CCR contamination of groundwater, surface and groundwater used as public drinking water supplies, connectivity of groundwater to surface waters, off-site contamination of river sediments, and leaching of constituents with the proposed cap-in-place closure. Forensic investigations demonstrated that wide-spread karst conditions of sinkholes and sinking streams existed beneath the impoundments,

impounded conditions raised the localized groundwater, wastes were submerged in groundwater, and continued leaching would occur with the proposed cap-in-place.

CCR Rule Compliance – Multiple Sites, Iowa
Served as Senior Geologist to review surface impoundment and landfill historic construction documents, groundwater monitoring reports, alternate source determinations, and / or proposed groundwater remedies at eight power plants.

CCR Compliance and Litigation – Kingston, Tennessee
Served as Senior Geologist and field sampling team member in response to a dike failure that released 5.4 million cubic yards of coal combustion wastes into the Emory, Clinch, and Tennessee Rivers. Services included reviewing defendant discovery documents and field sampling results, completing surface water and private property sampling (including polarized microscopic analyses), and preparing written testimonies.

CCR NPDES Permit Comments – Ithaca, New York
Reviewed a proposed NPDES permit for a leachate and stormwater collection pond associated with a Part 360 landfill permit.

CCR Environmental Impact Statement – Kingston, Tennessee
Reviewed an EIS associated with a proposed bottom ash dewatering system. Compared the proposed plan to other utility-owned power plants and systems for water minimization, waste avoidance, and land disposal.

CCR Compliance and Litigation – Eden, North Carolina
Served as Senior Geologist and litigation subject matter expert regarding the nature and extent of contamination due to the failure of an unlined CCR surface impoundment. Services included an extensive review of historical industry practices and defendant discovery documents regarding construction, operation and maintenance, inspections, and the life expectancy of the underlying corrugated metal pipe that ultimately failed. Private property sampling was also completed.

Flue Gas Desulfurization (FGD) Landfill – Gallatin, Tennessee
Reviewed the Part 1 / 2 permit application for a proposed Subtitle D CCR landfill. The services included a review of the hydrogeologic characterization plan, the proposed groundwater monitoring system, and the proposed landfill design regarding separation from the uppermost aquifer and leachate control.

CCR Impoundment Dewatering Plans – Multiple Locations, Georgia
Served as Senior Geologist to review dewatering plans associated with

closure of surface impoundments. The work included research regarding changes in water quality associated with standing water in the impoundments, pore water within the submerged solid wastes, and groundwater. Those results were then compared to the NPDES permits to understand likely compliance, expected changes in water quality over time, and protection of the receiving streams.

CCR-RELATED LEGAL TESTIMONIES

Application of Duke Energy Progress, LLC for Adjustment of Rates and Charges Applicable to Electric Service in North Carolina before the North Carolina Utilities Commission on behalf of the Sierra Club. Written and oral testimonies. April 2020.

Application of Duke Energy Carolinas, LLC for Adjustment of Rates and Charges Applicable to Electric Service in North Carolina before the North Carolina Utilities Commission on behalf of the Sierra Club. Written and oral testimonies. February 2020.

Michael Beck et al versus Duke Energy Carolinas and Duke Energy Business Services. North Carolina State Court. Written testimony regarding the Dan River Plant spill and damage to private property and the Dan River. 2019.

Application of Duke Energy Carolinas, LLC for Adjustment of Rates and Charges Applicable to Electric Service in North Carolina before the North Carolina Utilities Commission on behalf of the Sierra Club. Written and oral testimonies. January 2018.

Application of Duke Energy Progress, LLC for Adjustment of Rates and Charges Applicable to Electric Service in North Carolina before the North Carolina Utilities Commission on behalf of the Sierra Club. Written and oral testimonies. October 2017.

SELC on behalf of the Tennessee Clean Water Network and Tennessee Scenic Rivers Association versus Tennessee Valley Authority, US District Court, Middle District of Tennessee. Written and oral testimonies. 2017.

Chesney versus Tennessee Valley Authority – US District Court. Written testimony. 2011.

PEER-REVIEWED PUBLICATIONS

Quarles, M. and Chris Groves, “Forensic Hydrogeology: Evaluating a Karst Critical Zone Enormously Altered by Coal Combustion Residuals,” Geologic Society of America conference, Denver, Colorado, September 2016.

Quarles, M., "A Case Study in Karst Hydrogeology and Contaminant Fate and Transport," National Groundwater Association 51st Annual Convention and Exposition, December 1999.

Quarles, M. and Allen P. Lusby, "Enhanced Biodegradation of Kerosene-Affected Groundwater and Soil," 1994 Annual Conference of the Academy of Hazardous Materials Managers, October 1994.

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EXHIBIT 3

BBJ GROUP

Expert Opinion, Rebuttal Report of Mark A. Quarles, P.G.

July 2021

Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network, and Citizens Against Ruining the Environment v. Midwest Generation, LLC

Prepared for:

Sierra Club
50 F Street NW
8th Floor
Washington, DC 20001

Prepared by:

Mark A. Quarles, P.G.
Georgia Professional Geologist No. 2266
New York Professional Geologist No. 779
Tennessee Professional Geologist No. 3834

TABLE OF CONTENTS

1.0 INTRODUCTION

This section of the report includes the purpose and scope of my rebuttal and opinions of the Illinois Pollution Control Board ("Board").

1.1 Purpose and Scope

BBJ Group, LLC (BBJ) was retained by the "Complainants" (Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network, and Citizens Against Ruining the Environment) to evaluate relevant portions of the current record to assist them in determining necessary steps to select an appropriate groundwater remedy based upon regulatory standards established by the Illinois Environmental Protection Agency ("IEPA") and the Board. The Complainants filed a seven-count complaint in 2012 against Midwest Generation, LLC ("MWG") at four coal-fired power plants: Joliet 29 Station ("Joliet"), Powerton Station ("Powerton"), Will County Station ("Will County"), and Waukegan Station ("Waukegan").

In development of my first expert report (*Expert Opinion of Mark A. Quarles, P.G.*, January 2021), I requested and reviewed reports and analyses provided by the Complainants for the four power plants in Illinois from the administrative record, based upon my input of what types of documents would provide the most useful information. Of those documents, the Board's June 29, 2019 Interim Opinion and Order of the Board (Opinion) regarding operations, storage, fill, and disposal areas, and groundwater contamination and reports that discussed the geologic and hydrogeologic conditions, was the most useful for my analysis. Further, I gathered additional background information developed by MWG and provided to the public on its publicly available website (https://www.nrg.com/legal/coal-combustion-residuals.html) required by the U.S. Environmental Protection Agency ("US EPA") and its Coal Combustion Residuals Rule ("CCR Rule").

The Respondents responded to my expert report with their analysis in the *Expert Report on Relief and Remedy* by Weaver Consultants Group ("WCG", April 22, 2021). That report was co-written by Douglas G. Dorgan, Jr., L.P.G. and Michael B. Maxwell, L.P.G. The report included WCG's description of background information of the four power plants; its rebuttal opinions on my analyses included in my first expert report; its understanding of the CCR Rule; and its opinion on appropriate future actions associated with a remedy for contamination identified by the Complainants and confirmed by the Board.

This expert report provides my technical and regulatory rebuttals to WCG's analyses. My individual conclusions are in Section 2 for brevity and clarity, and my global report conclusions are included in Section 3. The documents that I relied upon to formulate my opinions are cited in this report and are listed in Section 4, References. The page numbers to those citations throughout this report are based upon the *PDF page number(s) in each document* [emphasis added].

1.2 Board Opinion and Conclusions

The complaint alleged groundwater contamination and open dumping in violation of the Illinois Environmental Protection Act ("Act") and Board regulations. Both the Complainants and MWG agreed that contaminants found in the groundwater at all four stations are known constituents associated with coal combustion wastes ("CCWs") or CCRs. (Opinion at 78). The Board defines CCWs as "any fly ash, bottom ash, slag, or flue gas or fluid bed boiler desulfurization by-products generated as a result of the combustion of…coal, or… coal in combination with [other material]." (Opinion at 14). CCWs and CCRs are commonly called "coal ash."

The Board concluded in its Opinion that "Environmental Groups met their burden in establishing that it is more probable than not that MWG violated the Act and Board regulations as alleged in the amended complaint." (Opinion at 1). My report cites to the Opinion numerous times because the Opinion and its findings provide a factual foundation for the basis of pollution liability. The Board concluded in its Opinion that the current record was insufficient "to determine the appropriate relief in this proceeding", and that additional hearings were necessary to determine the appropriate relief. (Opinion at 2).

The purpose of the relief is to determine an appropriate remedy to comply with the Act. Given the Board's decision that MWG has not yet thoroughly examined the active and historical disposal and fill areas at each power plant (Opinion at 79), the next step is for MWG to complete a nature and extent investigation at each of the four stations. Those investigations must be sufficient to support a remedy to comply with the Act. Significant Board conclusions related to past actions by MWG and those that are necessary in the future regarding sources of contamination and selecting a remedy include:

- None of the fill areas of the historic coal ash storage areas has any permits at all"; "none of them "confine the refuse" to ensure that no nuisances or hazards to public health or safety exists because, other than ash ponds, none of the other areas separate the coal ash from the ground or surface water infiltration and leaking into the groundwater." (Opinion at 90 and 91).

- MWG "allowed the waste to be consolidated on the site" in "fill areas and historic storage sites that have no liners, covers, or any other protection from the surface of groundwaters", and "the record shows no actions by MWG to remove the coal ash from those areas or prevent leaking of contaminants from those areas in any other way." (Opinion at 91).

- Groundwater contamination persists even after MWG concluded corrective actions required by its Compliance Commitment Agreements (CCAs) and Groundwater Management Zones (GMZs). (Opinion at 79). Also, the CCAs at all four stations that required on-going monitoring and inspections were "intended to avoid and detect any further contamination, or monitor the effectiveness of a corrective action, rather than remedy any contamination or remove the contaminant source." (Opinion at 82).

- MWG is liable for exceedences of a Part 620 standards at Waukegan because no GMZ exists, and MWG is also responsible for exceedences prior to establishing GMZs in 2013 at Joliet, Powerton, and Will County. (Opinion at 80). Also, a GMZ is not a permanent solution. (Opinion at 80).

- Although MWG was aware of contamination, MWG did not: (i) undertake any further actions to stop or even identify the specific source(s) and had not taken actions to further investigate historic disposal areas, (ii) install additional groundwater monitoring wells, or (iii) complete further inspections of the ash ponds or the land around the ash ponds in areas that showed persistent groundwater exceedances. (Opinion at 79).

- Environmental Land Use Controls (ELUCs) at Powerton, Waukegan, and Will County restricted the use of the area for the future (e.g., installing potable water wells). (Opinion at 79). Further, ELUCs established by MWG at Powerton and Will County are not considered to be "corrective actions" because they were designed to protect against exposure to contaminated groundwater, rather than to remedy the contamination. (Opinion at 83).

- MWG did not "take active actions" to ensure that the contamination does not spread beyond MWG property. (Opinion at 79).

- There is no evidence to expect that groundwater quality at Joliet, Powerton, or Will County will naturally return to IEPA Class I Groundwater Quality Standards. (Opinion at 83).

- There is insufficient information for the Board to determine the appropriate relief. (Opinion at 92).

2.0 TECHNICAL AND REGULATORY REBUTTAL ANALYSES

This section of the report includes my responses, rebuttals, and conclusions to claims made by WCG in its report.

2.1 Qualifications of Respondent Experts

This subsection of the report describes the qualifications of the respondent experts.

2.1.1 Douglas G. Dorgan, L.P.G

The WCG report described Mr. Dorgan's 35 years of experience performing remedial investigations, planning, design, and construction associated with "a wide range of industrial, commercial, and institutional properties." (WCG at 8). The only CCR-related experience that he cited in the expert opinion report was his experience supervising closure of CCR Rule regulated ash ponds – without specifying what that supervision entailed, if that experience included any investigative or corrective actions, how many power plants were involved, or how many ash ponds were involved. (WCG at 6-7). His resume did not include any CCR related experience or representative projects, nor did it include any project(s) where he served as an expert witness for any CCR related matter. (WCG at 77-79).

In short, Mr. Dorgan has minimal CCR related expertise that qualify him to be an expert in CCR matters related to designing groundwater monitoring systems, investigating the nature and extent of CCR contamination, or initiating CCR groundwater corrective actions.

2.1.2 Michael B. Maxwell, L.P.G.

The WCG report described Mr. Maxwell's 24 years of experience "providing services related to site investigation, remedial investigation, planning, design, and construction for a wide range of industrial, commercial, and institutional properties." The only CCR-related experience he cited in the expert opinion report was his "various different projects involving regulatory compliance / permitting, investigation, and remediation of coal ash surface impoundments, and coal ash fill disposal sites." (WCG at 8). Each of Mr. Maxwell's stated CCR experience projects involved his direct oversite of groundwater monitoring programs and analyses. His resume expanded on that CCR-related experience by describing the following three projects:

- An unspecified industrial waste (coal ash) disposal facility in northwest Indiana that is a Superfund site under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). He managed groundwater monitoring activities, an undefined "closure", and wetland investigations. (WCG at 80).

- An undefined power plant in Indiana. He "assisted in the design and installation of the initial groundwater monitoring system, including preparation of the Groundwater Sampling and Analysis Plan, oversaw the collection of the initial eight rounds of background data, as well as the statistical evaluation of the groundwater monitoring data" under the requirements of the CCR Rule. That groundwater monitoring data "was intended to support the preparation and regulatory approval of Closure Plans for both facilities." (WCG at 81).

- Two unspecified former coal ash impoundment sites in northern New Jersey. He "managed the review of Groundwater Monitoring Reports" where the surface impoundments were closed by removal (i.e., wastes were apparently excavated and hauled away). (WCG at 81).

To evaluate Mr. Maxwell's stated CCR expertise, I searched publicly available utility websites in Indiana (required by the CCR Rule) to gather more information related to Mr. Maxwell's expertise. My search determined Mr. Maxwell's involvement with the Indianapolis Power & Light Company ("IPL"), Harding Street Generating Station located in Indianapolis, Indiana (http://ccr-hardingstreet.com/Home/default.aspx) – suggesting that this site is the undefined power plant in Indiana mentioned in his report. WCG prepared the Sampling and Analysis Plan "with consideration for the requirements" of the CCR Rule and Indiana Department of Environmental Management ("IDEM") for groundwater monitoring. (Sargent & Lundy 2016 at 50). Mr. Maxwell certified that the groundwater monitoring system was designed and constructed to comply with the CCR Rule (Sargent & Lundy 2016 at 55) and certified the Sampling and Analysis Plan.

My review of the Harding Street site, through documents obtained from the publicly available website, indicated that:

- Mr. Maxwell designed and installed a nested, cluster well system where multi-depth wells were installed to measure constituent concentrations in different depths of the aquifer. (Sargent & Lundy 2016 at 62). The nested wells monitor groundwater concentrations at two to three depths per well location. Sampling of the new wells began in April 2016.

- The groundwater monitoring system designed and installed by Mr. Maxwell was rejected by IDEM. In 2018, IDEM "raised a concern that the upgradient wells were not suitable locations for determining background water quality unaffected by the ash pond system." IDEM recommended that the facility investigate other areas for background well(s). Three additional background wells were installed, and the prior upgradient wells certified by WCG became "downgradient" monitoring wells. (ATC 2019 at 2, 3, and 4).

- The new groundwater monitoring system – with the new background wells – was certified by another consulting firm, ATC Group Services (ATC) in March 2019. (ATC 2019 at 1). Mr. Maxwell's *upgradient* wells were determined to be *hydraulically downgradient* [emphasis added] of the impoundment, meaning that groundwater from beneath the disposal unit(s) flowed towards the wells.

- The new ATC-certified monitoring system and statistical analyses determined that statistically significant increases (SSIs) of boron, calcium, chloride, fluoride, and pH occurred in groundwater at downgradient wells, indicating contamination of groundwater from the unlined impoundment(s) in downgradient wells. (ATC 2019 at 4).

- Groundwater contamination from the site has migrated off-site. (IPL 2020 at 1). Further, assessment monitoring in 2018 determined that concentrations of arsenic, lithium, and molybdenum exceeded groundwater protection standards. (Haley Aldrich 2019 at 7 and 8).

- In response to the contamination, IPL initiated a nature and extent investigation and developed a Corrective Measures Assessment report that created a Conceptual Site Model (CSM) and evaluated seven potential groundwater corrective action options. (Haley Aldrich 2019 at 17 through 30).

In summary, Maxwell has very limited CCR related experience: four projects in 24 years of environmental consulting. That small number of projects does not support his or MWG's claim that he is an "expert" in the CCR Rule; designing, installing, and sampling CCR disposal unit groundwater monitoring systems; investigating the nature and extent of CCR contamination; or designing and implementing groundwater corrective actions to achieve groundwater protection standards required by the CCR Rule.

Mr. Maxwell's role as a testifying expert in this case is especially concerning given that one of his demonstrative example projects was rejected by IDEM and another consulting firm. As previously discussed, Mr. Maxwell claimed in his resume that his work was "intended" to support closure of a surface impoundment at the Indiana facility. That intended purpose was never realized because the groundwater monitoring system and his determination for upgradient and downgradient well designations were rejected and disapproved by the regulatory agency.

2.2 "Issues" with My Prior Expert Report

WCG concluded that it had four main "issues" with my prior expert report, where it determined that I relied too heavily on the 2019 Board Opinion and that I either "incorrectly" applied a regulatory standard or that I failed to consider specific data or factors. (WCG at 26-27). I disagree with those conclusions.

First, WCG believed that my prior expert report relied too heavily on the Board's Opinion and resulted in a report that presented "little independent analysis." (WCG at 26). The historical aspects of waste disposal have already been covered by MWG and Complainant experts during the liability phase of this case. My first expert report discussed the facts associated with each site that would affect the ability to establish a remedy, and the Board's opinion was the best summary of that history. As a result, I relied on the Board's Opinion. Consider that the Board has already established MWG's liability when it concluded in its Opinion that:

- "Environmental Groups met their burden in establishing that it is more probable than not that MWG violated the Act and Board regulations as alleged in the amended complaint." (Opinion at 1).

- "It is immaterial whether any specific ash pond or any specific historic ash fill area can be pinpointed as a source to find MWG liable." (Opinion at 79).

- "Contaminants are leaking from MWG's property and that MWG's active coal ash ponds or historical coal ash storage sites of fill areas are the source of that contamination." (Opinion at 79).

- "MWG knew that contaminants that include coal ash constituents are leaking from its property but did not fully investigate specific sources or prevent further release." (Opinion at 79).

- The "Board concludes that MWG caused or allowed open dumping of the coal ash at its Station." (Opinion at 87).

While my first expert report relied heavily on the Board's Opinion, it also included substantial independent analyses of numerous technical and regulatory considerations, contrary to WCG's claim. Those analyses were included in Sections 3.0, 4.0, and 5.0 (and subsections) in my prior report. My analyses included for example, the types and extent of investigations performed by or on behalf of MWG; Alternative Source Determinations (ASDs); recent and historical leakages from disposal units; CCR Rule and Illinois-specific requirements to characterize the nature and extent of contamination; groundwater migration pathways; and groundwater monitoring system sampling and statistical analyses, among others. As a result, there is no evidence to support WCG's claim that my report did not include substantial independent analyses.

Next, WCG claimed that I incorrectly applied the requirements of the CCR Rule to "the entirety of the Stations, including both the Federal CCR regulated units and the historical fill areas." (WCG at 26). In short, I am aware that the CCR Rule does not include design, closure, or operational standards for historical fill areas. My prior report discussed that the Board concluded that both active and historical disposal areas are sources of groundwater contamination and that Title 35, Environmental Protection, Part 620 Groundwater Quality standards apply to both areas. Although historical disposal areas may not be covered by the CCR Rule, they are not exempt from the requirements to protect water quality.

WCG implied that I should have mentioned or included proposed Illinois CCR Regulations (35 ILL. ADM. Code 845) in my prior analysis. I did not include the proposed rules because 1) the rules had not been finalized and were therefore not enforceable and 2) the proposed Illinois rules must be at least as stringent as the Federal CCR Rule, which I cited extensively in my prior expert report.

WCG also claimed in its report that I should have considered the entire record in my first expert report. (WCG at 26). Also, as discussed in Section 1.1, my report relied on the Opinion and its findings to provide a factual foundation for the basis of pollution liability. My first report did not need to review the entire record because the Board had already reviewed the historical record when it concluded that it was more probable than not that MWG violated the Act and Board regulations. I therefore disagree that I should have reviewed the entire record prior to development of my first expert report. In development of this rebuttal expert report, I reviewed data and analyses that WCG claims to be recent and extensive. (WCG at 26).

Next, WCG claimed that I performed no independent analysis to "demonstrate that there are or will be source areas at the Stations." (WCG at 27). WCG is attempting in its report to re-litigate the Board's prior decision on sources of contamination. As previously discussed, the Board already concluded in its Opinion in the liability phase of this case that there are active or historical sources of contamination and that it is "immaterial" which source(s) has caused the contamination. (Opinion at 79)

WCG also claimed that I indicated that the surface impoundments at each station are intended for "permanent disposal of coal ash", without providing specific examples where I made that claim in my report. (WCG at 26). In response to that comment, I acknowledge that the active impoundments at the stations are not meant for permanent disposal, meaning the CCRs are periodically removed (e.g., by dredging).

WCG also claimed that I failed to consider the extensive environmental data collected by MWG that is relevant to deciding the appropriate remedy at each of the stations. (WCG at 26-27). First, the Board already decided that MWG was liable for groundwater contamination associated with active and historical disposal areas. Further, my analyses in my prior report determined that even more data were needed to evaluate and select a potential remedy.

This report further discusses the need for collecting additional station-specific data because the historical data presented by WCG in its report do not represent an accurate or thorough evaluation of site-specific conditions necessary to evaluate and select a remedy.

2.3 Regulatory Framework

This subsection of the report discusses the regulatory framework for the sites.

2.3.1 US EPA and Illinois CCR Rules

WCG concluded that both US EPA CCR Rule and Illinois CCR regulations apply to the existing and inactive surface impoundments at the four stations. (WCG at 10-12 and 28). WCG concluded that historic and unconsolidated CCR fill areas "are not unregulated" and that both the Act and the Board have other regulations that apply to those areas. (WCG at 28). While the historic fill areas are not "regulated" by the CCR Rule or the Illinois CCR regulations, groundwater protection has always been required by the Act.

The WCG report specifically identifies what it and MWG believe to be regulated disposal units according to the US EPA CCR Rule (referred to by WCG as "Federal" Rules) and the Illinois CCR regulations. WCG and MWG take that determination several steps further, concluding that:

- "There should be a distinction made between areas of the Stations that are subject to the Federal CCR Rules (40 CFR 257) and/or the IL CCR Surface Impoundment regulations (35 Ill. Adm. Code 845) and those areas of the Stations which are not subject to those regulations." (WCG at 26).

- "CCR has been found at various locations at the four Stations; however, based on MWG assessments, all of the CCR does not necessarily fall under the same regulations" and "Federal and IL CCR Rules apply to each of the four Stations" and specifically, those rules apply to both existing and inactive surface impoundments. (WCG at 28).

WCG did not provide its own opinion on the regulatory status of all of the disposal units and historical disposal areas at each facility, choosing instead to rely on MWG's claims. WCG did, however, conclude that "when the vast quantity of available data collected at the Stations and available in the regulatory record associated with the Federal CCR Rules is considered, the data and information indicate that sufficient investigation of historical fill areas identified at the Stations has already occurred." (WCG at

38). WCG concluded that a risk-based approach to groundwater corrective action is its preferred route for the historical disposal areas (WCG at 58-60).

WCG stated that "MWG has concluded that there are no areas at these Stations that fall within the definition of CCR landfill." (WCG at 11). Although according to WCG no currently active landfills or fill areas meet the CCR Rule definition as a "landfill", ENSR identified two historical ash landfills at Joliet. (ENSR 1998 Joliet at 11, 12, and 26). For more information about those two ash landfills, see Section 2.4.3 of this report.

In summary, investigations and remedial actions at each station are foremost regulated by the Illinois Environmental Protection Act – a statute that requires groundwater protection from pollutants that originate from any source. The CCR Rule and Illinois CCR regulations secondarily establish investigative and remedial standards for currently active CCR areas. The Board determined in the liability phase that it is immaterial what source(s) caused groundwater contamination. (Opinion at 79). Knowledge gained by completing a thorough nature and extent investigation at each station is "material" to adequately select a groundwater remedy.

2.3.2 Nature and Extent Foundation

WCG criticized me for not identifying a specific remedy for each of the stations. (WCG at 27). That criticism is not warranted. First, selection of a remedy is a process that begins by first defining the nature and extent of contamination. That information is the foundational information that supports development of remedial alternatives analysis by MWG. MWG has not yet defined the nature and extent of contamination at each station and therefore, neither MWG nor WCG are capable of selecting an appropriate remedy without first understanding the nature and extent of contamination. Selecting a remedy without such information, risks implementing a remedy that is inappropriate to achieve the required groundwater protection standards and to cure the violations.

As discussed in my prior expert report (see Sections 3.4 and 5.2), I concluded that MWG should first complete comprehensive investigations at each station to define the nature and extent of all CCR related contamination and discussed the typical investigative components and goals of such investigations. Nature and extent investigations are the foundation of evaluating and selecting a remedial approach, and MWG bears the responsibility to properly evaluate site conditions and to select a remedial approach.

WCG also criticized me for not evaluating specific factors used by the Board when selecting a remedy and specifically criticized me for not considering the "technical practicability or economic reasonableness of a remedy, the suitability of the stations to the area at which they are located, and any due diligence to comply, including entry into and compliance with the CCAs." (WCG at 27). It is not possible to discuss the technical practicability and economic reasonableness for remedies without first completing a nature and extent investigation at each station and then evaluating potential remedial options to be considered. The foundation of those decisions is a thorough nature and extent investigation, which MWG has yet to perform at each station.

I continue to support my opinion in my prior expert report that MWG should complete a comprehensive nature and extent investigation to support future remedial actions. The CCR Rule, the

Illinois CCR regulations, and the Illinois Site Remediation Program all require that a nature and extent investigation be performed to collect data sufficient to evaluate and select a remedial action. (40 CFR §§ 257.95(g)(1), 257.97(d)(1); 35 Ill. Admin. Code §§ 845.650(d)(1), 845.670(f)(1); 415 ILCS § 5/58.6(b)(1)).

2.3.3 Groundwater Remedial Standard

Regarding groundwater contamination, the Board has already concluded in the liability phase of the case that active or historical CCR disposal and fill areas at each station have contributed to groundwater contamination. (Opinion at 79). WCG and MWG's proposed "risk-based" approach did not address the violations identified by the Board, including violations of Section 12(a) of the Act by virtue of exceeding Part 620 groundwater standards, violations of Section 12(a) by virtue of exceeding 90^{th} percentile boron and sulfate concentrations, violations of Section 12(d) at Powerton, and violations of Section 21(a) of the Act at all four stations. (Opinion at 2).

In contrast to WCG's efforts in its report to differentiate contamination from active or historical areas, the Board concluded that "*it is immaterial whether any specific ash pond of any specific historical ash fill area can be pinpointed as a source to find MWG liable* [emphasis added]." (Opinion at 79). Also, the Board concluded that CCRs that are scattered at each station are more likely to be contributing to groundwater quality exceedences in monitoring wells. (Opinion at 28, 41, 56, 57, 68, and 92). When discussing groundwater quality at Joliet, Powerton, and Will County, the Board concluded that there is no evidence to expect that groundwater quality at those stations will naturally return to Class I groundwater quality standards. (Opinion at 83). Similarly in my opinion, there is no credible reason to believe that groundwater will naturally improve to Class I standards at Waukegan.

The Board was explicit in its Opinion that MWG was liable for exceedences of Class I Groundwater Protection Standards established in Part 620. In addition, both the CCR Rule and the Illinois CCR regulations require groundwater to be remediated to specific numeric (e.g., Maximum Contaminant Levels, MCLs) or to background groundwater quality not affected by CCR operations. (35 Ill. Admin. Code § 845.600; 40 CFR §§ 257.95(h); 257.97(b)(2)). Neither of those rules allow a risk-based remediation approach using monitored natural attenuation, unless it can be demonstrated that the groundwater protection standards will be met with that approach.

WCG and MWG's preferred risk-based approach of monitored natural attenuation is not likely to meet Part 620 numeric groundwater protection standards at the stations. I agree with the Board's conclusion that groundwater will not naturally improve to meet standards. Also, a risk-based approach will not remedy the violations for open dumping – a practice that the Board concluded did not prevent the leaking of contaminants into groundwater. (Opinion at 92). I also agree with the Board's conclusion that CCRs placed in historical fill areas will continue to leach to groundwater, if not removed or properly remediated.

2.3.4 GMZs, CCAs, and ELUCs

The Board concluded in its Opinion that GMZs, CCA, and ELUCs are not likely to improve groundwater quality to meet Part 620 groundwater standards. (Opinion at 83). I agree with that conclusion.

As previously discussed in Section 1.2 of this report, the Board concluded that 1) there is groundwater contamination at each station; 2) the likely causes of that contamination are historic fill areas, active impoundments, or inactive impoundments; 3) there is no evidence to expect that groundwater quality at Joliet, Powerton, or Will County stations will "naturally" return to Class I groundwater quality; 4) groundwater contamination persists even after MWG concluded corrective actions required by its CCAs and GMZs; and 5) the CCAs used by MWG are intended to avoid and detect any further contamination, or monitor the effectiveness of a corrective action, rather than remedy any contamination or remove the contaminant source.

Despite the Board's conclusions above, WCG concluded that no further investigative or remedial actions are needed. Instead, WCG concluded that past use of GMZs, CCAs, and ELUCs are reasons to *continue with them* [emphasis added] as a groundwater remedial action in the future. (WCG at 52, 55, and 56).

My analysis of WCG and MWG's proposed continued use of GMZs, CCAs, and ELUCs determined that groundwater improvement to Part 620 standards is not likely, consistent with the Board's prior finding that groundwater improvement to Part 620 groundwater standards is not likely.

2.3.5 Closure-in-Place Presumptive Remedy

WCG proposed to construct a low permeability cover system ("cap") over the Former Slag/Fly Ash Storage Area ("FS/FAS Area") at Waukegan as a "presumptive remedy" to improve groundwater quality. (WCG at 57). The area is located west of the West Ash Pond. By name, the "Former Slag/Fly Ash Storage Area" contains both fly ash and slag. WCG claimed the area has an "absence of risk"; the cap will "enhance the natural attenuation remedy"; the cap will reduce the time needed to reach Part 620 groundwater standards; and the cap will "restore" groundwater quality to those standards. (WCG at 57). There is no credible evidence to support those claims.

The electrical power industry has recognized that closure-in-place of surface impoundments without fully dewatering CCRs will not improve groundwater and in fact, a cover system might increase constituent concentrations. WCG's plan to construct a cap over saturated CCRs at the FS/FAS Area at Waukegan might *increase* [emphasis added] groundwater contaminant concentrations, rather than improving conditions stated by WCG. The Electric Power Research Institute (EPRI) published an investigative report of its findings in 2001, concluding the following conditions that do not support WCG's claim that a cap is an appropriate groundwater remedy (EPRI 2001 at 8):

- The key factor for achieving groundwater concentration reduction was dewatering the ash prior to constructing a cover system.
- Groundwater quality did not improve, regardless of constructing a cap, when CCRs remained below the uppermost aquifer water. Dewatering and closure were not effective because leaching continued from the saturated ash.
- Groundwater constituent concentrations *increased* [emphasis added] when saturated CCRs remained, because the contact time of groundwater moving through the saturated ash increased

when the hydraulic gradient of the standing water in the impoundment was removed. A cap would have had little or no effect on this process.

WCG's explanation of what a presumptive remedy is mentioned that a cover system is a remedy for a surface impoundment, but "usually after removal of liquids." As a follow-up to that explanation, I reviewed both the CCR Rule and Illinois CCR regulations to determine the conditions that must be present to meet the closure-in-place performance standards of leaving CCRs in-place with an engineered cover system.

The US EPA recognized the importance of separating CCRs from groundwater when it established two closure options for CCR ponds or impoundments: closure-in-place or closure-by-removal. The Illinois CCR regulations mirror those two closure options. According to those rules (CCR Rule, Part 257.102 and Illinois Regulations, Section 845.750 a)1) and 2)), a cover system for closure-in-place must ensure at a minimum, that the impoundment is closed in a manner that:

- "Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere,"

- "Preclude the probability of future impoundment of water, sediment, or slurry."

The requirement to "control, minimize or eliminate" releases to groundwater in a closure-in-place scenario cannot be achieved if the CCRs remain saturated from seepage from standing water in the ponds or from contact with the uppermost aquifer. Although standing water may not exist on the ground surface from a legacy pond, saturation can exist in the CCRs that remain belowground. If water remains in either case, contaminants can continue to leach to groundwater.

I disagree with WCG's conclusions that the cap will enhance the natural attenuation process and improve groundwater quality to Part 620 standards. In fact, the cap might make quality even worse. I agree with WCGs conclusion that construction of a cap is sometimes "technically practical" and "economically reasonable" (WCG at 58); however, I disagree that its WCG-stated use for Waukegan is likely to improve groundwater quality. WCG's plan to construct a cap over the FS/FAS Area would not meet the CCR Rule or Illinois CCR regulations for closure, if the disposal area were an active pond.

The Board concluded that saturated CCRs exist in the FS/FAS Area at Waukegan. WCG explained that the risks of a release from a landfill are "significantly lower than CCR surface impoundments or active CCR landfills" and that the primary reason for that reduced risk is the reported absence of a "constant head of water on top of the CCR materials, as is the case with surface impoundments and active landfills." (WCG at 38-39). That constant head of water pressure increases the water contamination risk from both active ponds and historical fill where ash remains saturated, as noted by WCG when it concluded that the weight and pressure of water in surface impoundments is "more likely to result in releases to the environment." (WCG at 39). WCG also concluded that the lower risk of landfills is supported by a "substantial amount of data historically collected at each of the four Stations", without specifying what that "substantial amount" of data was. (WCG at 39). Similar to standing water in impoundments that cause leachate to be "pushed" downward, saturated pore water in historical fill areas (e.g., Waukegan) can also create additional weight, and that pressure is likely to increase releases to groundwater. Without such data that should have been discussed in its report, WCG cannot claim that that landfills at the stations are less likely to contaminate groundwater.

Use of the cap at this FS/FAS Area at Waukegan is the *only* [emphasis added] disposal area at *any of the four* [emphasis added] stations that WCG concluded needed any remedial action other than monitored natural attenuation, GMZs, or ELUCs. Notably, WCG did not discuss any remedy or investigation at the two ash landfills at Joliet that have never been investigated with borings or wells.

WCG did not define what a "presumptive remedy" is other than describing the low permeability cap as "a technology that regulators believe, based upon prior experience, will be the most appropriate remedy for a specified type of site." (WCG at 57). WCG also concluded that "capping is a proven remedial technology that has been used for decades and is particularly prevalent as a means of closing solid and hazardous waste landfills, and surface impoundments (usually after removal of liquids) under RCRA." (WCG at 57). Further, WCG concluded that a cap would reduce infiltration and mitigate potential leaching from ash materials to groundwater. (WCG at 57). WCG stated that the cap should be designed by an Illinois-licensed Professional Engineer. (WCG at 58).

Although not defined by WCG, WCG's use of the term "presumptive remedy" seems to be related to WCG's statement that it is "a means of closing solid and hazardous waste landfills, and surface impoundments (usually after removal of liquids) under RCRA." (WCG at 57). According to US EPA (US EPA 1993 at 1), a presumptive remedy for a municipal solid waste landfill, as an example,is described as:

> *Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program's past experience to streamline site investigation and speed up selection of cleanup actions. Over time presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.*

First, CCRs at the FS/FAS Area are saturated belowground. The Board determined in the liability phase of this case that CCRs were buried in this area as deep as 22 feet below ground surface, and that some of that coal ash was saturated in groundwater. (Opinion at 67). Given that CCRs are submerged in groundwater, the cap will not prevent lateral inflow of groundwater into the wastes. Even if MWG constructs a cap over the FS/FAS Area, leaching to groundwater will continue because CCRs will remain saturated and / or in contact with groundwater. Those same saturated conditions at Waukegan might also exist at other historic fill areas at other stations, including the two ash landfills at Joliet, for example.

I investigated US EPA guidance on the proper use of a presumptive remedy for a landfill, as an example. Although the FS/FAS Area is not a "landfill", the US EPA guidance is relevant because it discusses how such a remedy should or should not be used. In short, WCG's recommended use as a method to improve groundwater quality by reducing leaching and promoting monitored natural attenuation is *not consistent* [emphasis added] with US EPA requirements. "Containment" can be a remedy for landfills to prevent direct contact with wastes, to minimize infiltration into the wastes, to control surface water runoff, and to control and treat landfill gas. (US EPA 1993 at 6).

The US EPA considers remediating groundwater at a landfill to be a non-presumptive remedy – meaning that other remedial alternatives should be chosen for long-term groundwater restoration. (US EPA 1993 at 2). WCG plans to neither collect nor treat the groundwater at Waukegan, other than relying on monitored natural attenuation and reducing infiltration to improve groundwater quality.

Notable is that WCG stated that the cap should be designed by an Illinois-licensed Professional Engineer. Neither Mr. Dorgan nor Mr. Maxwell are licensed engineers capable of designing and certifying the cover system to meet WCG's stated purpose. Also notable in the WCG conclusions is their acceptance that MWG is required to "restore" groundwater to Class I, numeric groundwater quality standards. (WCG at 57). There is no indication that monitored natural attenuation with the cover system will "restore" the groundwater to Class I standards, consistent with the Board's prior conclusion. (Opinion at 83).

In summary, WCG's plan to construct a cover system and to leave saturated CCRs in-place at Waukegan, cannot be expected to restore groundwater quality or to improve conditions to meet Part 620 standards. In fact, groundwater quality might get worse. Water would remain impounded belowground in the saturated CCRs. WCG's plan would *not* [emphasis added] meet the minimum CCR Rule or Illinois CCR regulation performance standards as closure – much less a groundwater remedy – because CCRs would remain saturated after the cover system is constructed, unless all of the CCRs are completely dewatered and excavated with adequate separation from the uppermost aquifer.

2.3.6 Risk-Based Closure and Monitored Natural Attenuation

WCG concluded that the data support "monitored natural attenuation" as an "appropriate remedy" at Joliet, Powerton, and Will County and that a low permeability cap over the FS/FAS Area at Waukegan is the "presumptive remedy" that will enhance natural attenuation of constituents. (WCG at 49, and 56-57). I continue to agree with the Board's prior conclusion that groundwater quality will not improve with the prior status quo of not initiating any "active" remedial technique.

Although WCG did not determine how many years or decades groundwater contamination will continue at each station, it concluded that remediation may require multiple, undefined decades to complete. (WCG at 55). WCG did not recommend any remedial action that requires more investigation nor any corrective action where contaminants are removed or actively treated (e.g., excavation or closure-by-removal, hydraulic containment, groundwater pumping and ex-situ treatment, in-situ groundwater treatment). Further, WCG did not perform any alternatives analysis that compared timeframes of meeting groundwater quality standards.

Instead of initiating active remedial measures, MWG plans to continue GMZs and ELUCs that "can be implemented in lieu of active remediation, when exposures can be controlled." (WCG at 56). WCG also concluded that "risk-based remediation" with GMZs and ELUCs is "particularly beneficial" where sites are industrial in nature, site access can be controlled, and "there are no off-site complete or potentially complete exposure pathways that would result in unacceptable impact to human health or the environment at the Stations." (WCG at 56).

Given WCG's conclusion that a risk-based, monitored natural attenuation is appropriate at each of the stations, I researched use of that approach with CCR Rule and Illinois CCR regulations. In short, the regulations *do not allow monitored natural attenuation* [emphasis added] as a groundwater remedy or consider the farthest downgradient wells as regulatory points of compliance, based upon the following:

- Neither the Federal CCR Rule nor the Illinois CCR regulations allow a risk-based remedial approach. Instead, both regulations (35 Ill. Admin. Code §§ 845.600, 845.660(a)(1); 40 CFR §§ 257.97 (b)(2)) require that MWG remediate to numeric standards for inorganic constituents, unless background concentrations are higher.

- Neither the Federal CCR Rule nor the Illinois CCR regulations consider the point of compliance to be the most downgradient monitoring wells, the property line, or receiving stream, as implied by WCG. Instead, numeric groundwater protection standards must be met at the "waste boundary." (35 Ill. Admin. Code §§ 845.600, 845.660(a)(1); 40 CFR § 257.91). Both regulations define the "waste boundary" as "a vertical surface located at the hydraulically downgradient limit of the CCR surface impoundment. The vertical surface extends down into the uppermost aquifer." (35 Ill. Admin. Code § 845.120; 40 CFR § 257.53). As a result, groundwater protection standards must be met near the source(s) of the contamination – not far downgradient as discussed by WCG.

In summary, WCG's planned risk-based approach and monitored natural attenuation to "restore" groundwater quality is not supported by facts. Also, monitored natural attenuation will not remedy all of the violations identified by the Board. (Opinion at 2). Further, WCG's risk-based approach does not meet the minimum requirements for selecting monitored natural attenuation as the final groundwater remedy at each station because of the following:

- MWG has still not defined the nature and extent of contamination at each station, as required by the CCR Rule, Illinois CCR regulations, or the Site Remediation Program (Section 740.420).

- MWG still has not yet performed an in-depth alternatives analysis sufficient to evaluate multiple groundwater remedial options.

- Risk-based closures are not allowed by the CCR Rule or the Illinois CCR regulations.

- MWG will remain liable for exceedences of Part 620 standards prior to establishing GMZs in 2013 at Joliet, Powerton, and Will County and would remain liable at Waukegan even if a new GMZ is created. Also, as the Board concluded, a GMZ is not a permanent solution. (Opinion at 80).

- There continues to be no evidence to expect that groundwater quality at any station will naturally return to Class I Groundwater Quality Standards with the proposed risk-based approach.

- MWG would continue to rely on CCAs that the Board concluded was "intended to avoid and detect any further contamination, or monitor the effectiveness of a corrective action, rather than remedy any contamination or remove the contaminant source." (Opinion at 82).

2.3.7 Beneficial Use of CCRs

WCG did not identify in its report, any area(s) at any of the four stations where MWG specifically applied for and received regulatory approval for any beneficial reuse, nor did it specifically mention how or if CCRs had been beneficially used on-site at any station. (WCG at 13).

The Board concluded in its Opinion that the placement and uses of CCRs at the four stations do not meet the definition of a "beneficial use" and that the CCRs in areas outside of ash ponds are discarded "waste". (Opinion at 89). WCG discussed use of various leaching tests that MWG has used to support beneficial use determinations, but did not demonstrate that MWG had applied for and received approval for a beneficial use at any station. Further, WCG did not discuss Illinois-specific requirements for beneficial use.

As previously discussed, CCRs that remain on-site at each station constitute a waste, consistent with the Board's opinion. WCG discussed the useability of beneficial use leaching methods and generally not US EPA-approved CCR leaching tests, to support its belief that the nature and extent of contamination due to waste disposal has been sufficiently defined at each station. I disagree with WCG's conclusion that the nature and extent of contamination has been defined, based upon my analyses in Section 2.4.1 of this report.

WCG did not demonstrate that the historic fill areas at any station meet the definition of a beneficial use according to the CCR Rule. For MWG to legally beneficially use CCRs according to the CCR Rule (Part 257.53, Definitions), MWG's placement of CCRs must meet *each of four conditions* [emphasis added] and especially requires MWG to demonstrate that environmental releases to groundwater, surface water, soil and air will not exceed regulatory standards. The four criteria specified in the CCR Rule (Part 257.53) include:

1. The CCR must provide a functional benefit;

2. The CCR must substitute for the use of a virgin material, conserving natural resources that would otherwise need to be obtained through practices, such as extraction;

3. The use of the CCR must meet relevant product specifications, regulatory standards, or design standards when available, and when such standards are not available, the CCR is not used in excess quantities; and

4. When unencapsulated use of CCR involving placement on the land of 12,400 tons or more in non-roadway applications, the user must demonstrate and keep records, and provide such documentation upon request, that environmental releases to groundwater, surface water, soil and air are comparable to or lower than those from analogous products made without CCR, or that environmental releases to groundwater, surface water, soil and air will be at or below relevant regulatory and health-based benchmarks for human and ecological receptors during use.

WCG also did not demonstrate that CCRs in historic fill areas at each station meet Illinois specific requirement for the proper beneficial use of CCRs, even though there are regulatory requirements in 415 ILCS 5/3.135. The regulation defines nine acceptable uses of coal combustion by-products that qualify as a beneficial use. Among numerous other standards included in that Illinois regulation, a coal combustion by-product cannot exceed an Illinois Class I groundwater quality standard for any metal constituent when tested by the ASTM D-3987-95 leaching test method. Although WCG mentioned MWG's use of the Neutral Leaching Extraction Test ("NLET"), Toxicity Characteristic Leaching Procedure ("TCLP"), and Synthetic Precipitation Leaching Procedure ("SPLP") tests when describing its prior testing programs, WCG did not determine if those leaching tests are the same method required by 415 ILCS 5/3.135. (WCG at 38, 40-41, 47). Leaching tests are discussed in more detail in Section 2.4.1.

In summary, the CCRs that remain in historic fill areas at each station are a waste. Further, there is no indication that MWG applied for or received approval for a beneficial use that would meet the CCR Rule or Illinois-specific requirements. MWG's analytical methods used to predict waste leachability were inappropriate.

2.4 Extent and Adequacy of Prior Investigations

This subsection of the report discusses the extent and adequacy of prior investigations at the stations.

2.4.1 General Use of Leaching Tests by MWG

Leaching tests are meant to be a *predictor* [emphasis added] of actual leaching conditions that might exist. The best demonstration of CCR impact on groundwater comes from actual groundwater samples, and samples collected from numerous wells at each station have demonstrated that CCR constituents have contaminated groundwater. Although MWG completed leaching tests from select unmonitored areas at each station, the best investigation that MWG should have performed would have been to install groundwater monitoring wells and to sample for CCR constituents. Leaching potential can change over time and can vary depending on site-specific conditions, such as depth below the standing water in a pond and depth below ground surface in the aquifer.

As discussed in Section 2.3.7, MWG completed leaching tests for beneficial use determinations, but those tests are not US EPA-approved to determine CCR leachability. WCG concluded that leaching data collected from CCR surface impoundment samples and soil obtained from historical fill areas indicates that "not all coal ash is necessarily a source that will contribute to groundwater contamination." (WCG at 27). Further, WCG concluded that the historical testing program "are sufficient to adequately characterize the historical coal ash fill areas at the Joliet 29 Station for the purposes of assessing a remedial approach" and "the historical data…are sufficient to adequately characterize the historical coal ash fill areas" at the Powerton, Will County, and Waukegan. (WCG at 42, 44, 45, and 47). I disagree with those WCG's conclusions regarding the usefulness of the leaching data to determine that no nature and extent investigation is needed. I also disagree with WCG that leaching data are sufficient to select monitored natural attenuation as its recommended remedial action, or any other remedial action. MWG should have instead completed comprehensive investigations using the Leaching Environmental Assessment Framework ("LEAF") test method of subsurface samples as a component of a nature and extent investigation.

WCG discussed MWG's use of the NLET to also "characterize the potential for the coal ash to result in impacts to groundwater" from both surface impoundments and historical fill areas. (WCG at 13). WCG discussed MWG's reliance on the NLET to "support beneficial use demonstrations" but did not provide its independent analysis on the adequacy of those tests for MWG's intended purpose. (WCG at 13). Similarly, WCG concluded that the NLET data "indicates that the coal ash sampled from the Federal CCR surface impoundments exhibits concentrations of metals less than the Class I Groundwater Quality Standards", implying the adequacy of the prior testing program. (WCG at 38; see also 40, 41, 43, 44, and 45). As such, WCG believes that no additional leaching tests are needed at any of the four stations to further characterize the potential for groundwater contamination. I disagree with that conclusion and MWG's use of the NLET test to make groundwater leachability predictions for long-term groundwater protection and remedial design purposes. MWG should have instead used the LEAF test as a groundwater quality predictor at each station. WCG described the NLET testing programs (WCG report Section 4.1.3) where MWG analyzed individual composite samples from Powerton (2007), Will County (2010), and Waukegan (2004) and compared the results to Illinois Class I Groundwater Quality Standards (35 Ill. Adm. Code 620.410). (WCG at 38). Each of the four samples collected from three stations "did not exhibit any metals concentrations above the Class I Groundwater Quality Standards." (WCG at 38). MWG's use of a single composite sample from multiple borings into CCRs at Powerton, Will County, and Waukegan cannot be used to support any groundwater leaching determination. A single composite sample would not adequately characterize the likely variable wastes by CCR type, plant processes, or age. As a result, the sampling programs at Powerton, Will County, and Waukegan did not properly characterize the wastes.

WCG discussed MWG's investigation of the Northwest Fill Area at the Joliet station "to determine whether a CCB classification was feasible", using both NLET and TCLP tests on that a single composite sample. (WCG at 40). WCG determined that the subsurface materials were generally homogenous, consisting of interlayered fly ash and bottom ash/slag. A total of 20 samples were collected from 20 borings across a 13.2-acre area, resulting in *only one* composited [emphasis added] sample for such a large area. (WCG at 40). Individual discrete boring samples would have instead been capable of finding "hot spots" and a spatial range of contaminant concentrations, while the single composite sample used by MWG would have resulted in a diluted sample from multiple areas. As a result, the single test collected at Joliet was incapable of characterizing the wastes in that area.

MWG used the LEAF test sporadically and more recently in 2018 to support its opinion that existing groundwater contamination was not due to sources regulated by Federal and Illinois CCR Rules. MWG also used that test recently while completing ASDs for Powerton, Will County, and Waukegan stations to determine, in its opinion, that currently active surface impoundments are not responsible for groundwater contamination, but instead due to other unnamed sources. (WCG at 35-37). MWG collected CCR and water samples from active impoundments for LEAF analyses. I agree that the LEAF test is a more appropriate method to predict leachability of constituents from CCRs. The LEAF test analyzes leachability at multiple pHs that are possible in the subsurface, due to changes in geochemical conditions over time and at different depths in the subsurface.

Given that MWG relied on the NLET test to determine leachability potential to groundwater based upon a beneficial use analysis by MWG, I evaluated MWG's use of that test for its stated purpose. In summary, MWG's use and WCG's endorsement of the previously used leaching tests were incorrect for the following reasons:

- The NLET test is not designed or meant to determine field leaching conditions. The Illinois beneficial use standards in 415 ILCS 5 / 3.135 require the use of ASTM D3987-85 (a test method current as of 1985) and a comparison of the leached constituent concentrations to Class I Groundwater Protection Standards. It is unclear if the NLET procedure is the same procedure as the ASTM test. Regardless, MWG and WCG's use of the test as an indicator of field condition groundwater quality is explicitly incorrect. According to the ASTM standard for the test (ASTM 1985 at 1):

    - "*This test method is not intended to provide an extract that is representative of the actual leachate produced from a solid waste in the field or to produce extracts to be used as the sole basis of engineering design*."
    - *"This test method is not intended to simulate site-specific leaching conditions. It has not been demonstrated to simulate actual disposal site leaching conditions."*
    - *"This test is intended to be a rapid means for obtaining an extract of solid waste" and the "extract may be used to estimate the release of certain constituents of a solid waste under laboratory conditions prescribed in this procedure."*

- The US EPA determined that the LEAF test method and actual pore water samples from CCRs in field conditions are the two most appropriate, robust, and technically defensible methods to predict constituent leaching potential to groundwater. (Federal Register 2015 at 141). MWG apparently recognized this fact when it used the LEAF test more recently to blame groundwater on sources other than active and inactive impoundments in the ASDs for some stations, rather than the NLET and TCLP tests that it used in the past.

- MWG's testing program focused primarily on sampling bottom ash and was not a comprehensive assessment of all types of coal ash that might be present at a station, specifically excluding current and historical fly ash and other types of CCRs. The IEPA recognizes that "coal ash can vary depending on the source of the coal, the processing of coal, the burning of the coal and the method of the collection of the ash." (IEPA 2010 at 1). This IEPA conclusion is consistent with my 13 years of performing CCR related investigations. As such, the LEAF analyses used by MWG were only performed to evaluate very limited samples of CCRs produced in current coal burning operations.

In summary regarding leaching tests that MWG used as beneficial use determinations, WCG did not provide its opinion on the adequacy of MWG's use of those tests as a groundwater quality predictor, nor the adequacy of the types, frequency of samples, and locations of the CCRs that were sampled. In my opinion, MWG incorrectly used those tests to determine possible impacts to groundwater, and WCG failed to understand how or why those tests were inappropriate, demonstrating their lack of expertise in CCR related matters.

2.4.2 Investigative Comments Common to Multiple Stations

Coal Sources and Contaminant Variability

WCG concluded that the current source of coal for power operations at each station is subbituminous coal sourced from Wyoming's Powder River Basin. (WCG at 14, 16, 20, and 23). WCG did not determine where historical sources of coal originated. As previously discussed, CCRs can vary in constituent content based upon numerous factors specific to that original coal, types of pollution control equipment, and the type of coal ash (e.g., fly ash versus bottom ash). MWG's very limited sampling programs, as discussed in Section 2.4.1, would have only determined leaching conditions for that single sample and likely not have been representative of site-wide conditions – even if MWG had used the correct leaching method.

Other than the three borings installed at Waukegan where samples were collected belowground in the historical FA Area, the LEAF tests performed more recently on behalf of MWG would have only included tests on Powder River Basin coal-related CCRs from currently active impoundments, and not any other coal sources used over the decades of burning coal at each station that might be present elsewhere at the stations.

There is no indication that MWG nor its current or prior consultants considered these coal-specific and site-specific factors in its waste sampling program to determine leaching conditions or its arguments that no further testing is needed to characterize the wastes at each station. As a result, WCG's conclusion that the "historical data as described above are sufficient to adequately characterize the historical coal ash fill areas" at the four stations is not based upon credible science. (WCG at 42, 44, 45, and 47).

Phase I and II Environmental Site Assessments

Phase II Environmental Site Assessments (ESAs) are usually performed after completion of a Phase I ESA. Both are usually performed prior to buying or selling a property. A Phase II ESA is only completed if the historical records and site inspection performed during the Phase I ESA resulted in the need for an intrusive investigation (e.g., soil borings, surface samples, groundwater wells). Neither is meant to define the nature and extent of contamination. Given the very limited scale and scope of those reports, neither WCG nor MWG can rely on those documents to support the opinion that an in-depth analysis is not needed at any station.

Phase I ESAs rely significantly information disclosed verbally by a property owner, historical regulatory databases, visual conditions observed during a site walk, a review of historical ownership records, and aerial photographs. WCG explained that Phase II ESAs were performed at each station in 1998. (WCG at 39, 43, 44, and 46). According to the Phase II ESAs, each Phase II report was prepared after completion of a Phase I ESA report that was prepared according to ASTM standard E1527-97. A Phase I ESA is performed to identify "recognized environmental conditions", otherwise known as "RECs". A "REC" might be for example, a historical waste disposal area, stained soils around a petroleum storage tank, as examples. If a REC is identified, a Phase II ESA is performed. As ENSR concluded in the Phase II ESAs for each station, "the Phase II ESA alone is *not an exhaustive investigation* [emphasis added] which can be used to determine the extent of contamination, nor the cost of any suggested remediation." (ENSR 1998 at 7, each station).

As described above, the Phase II ESAs provide minimal value to the remedy phase of this case – other than identifying historical disposal and fill areas and indicating that MWG was aware that these historical disposal areas existed at least as early as 1998. The Phase II ESAs were not meant to define the nature and extent of contamination.

Liner Replacements and Contaminant

As discussed in my prior expert report, the Board concluded that historical liners "can and do crack" and that it is "more likely than not that the ash ponds did leak contaminants into groundwater." Although MWG replaced liners at Joliet (2008), Powerton (2010, 2013), Waukegan (2003 and 2004), and Will County (2009), those impoundments that remained active could have leaked and caused groundwater contamination that is currently present. (WCG at 14, 16-17, 21, and 24)

Leakage to shallow groundwater can be expected with damage and cracks in a liner. (Opinion at 26, 40, 55, 66). Neither MWG nor WCG stated in their analyses that they considered the possibility that currently identified contaminated groundwater could be due to leakage from currently active and inactive impoundments that has co-mingled plume with leakage prior to liner reconstruction and from contamination associated with historical fill. Prior relatively recent leakage from cracked or damaged liners could have contributed to current groundwater contamination.

Nature and Extent Investigations

WCG concluded that no additional investigations are required at the Federal and State-regulated surface impoundments to determine the nature and extent of contamination at each of the four stations. (WCG at 52-54). Similarly, and as previously discussed, WCG concluded that no such investigations are warranted for historical disposal areas. (WCG at 32-33). As discussed in Section 2.3.2 of this report, a nature and extent investigation is the foundation for evaluating remedial alternatives. I disagree with WCG that no additional investigations are needed at each station to evaluate and select a groundwater remedy. In fact, the sparse investigations performed at each site and described by WCG support the need for more in-depth analyses by MWG, as discussed in Sections 2.4.3, 2.4.4, 2.4.5, and 2.4.6 of this report.

In support of its belief that no additional investigations are needed at each station, WCG more specifically concluded that:

- The Federal and State CCR surface impoundments "do not need to be investigated further because the existing Federal / State CCR Rules already sufficiently address any required investigation." (WCG at 32). I disagree with that conclusion. Both the Federal CCR Rule and the Illinois CCR Regulations require that MWG investigate the nature and extent of contamination (40 CFR §§ 257.95(g)(1), 257.97(d)(1); 35 Ill. Admin. Code §§ 845.650(d)(1), 845.670(f)(1)).

- "The record indicates that the Federal CCR surface impoundments are operated pursuant to the Federal CCR Rules, which are deemed sufficiently protective of human health and the environment." (WCG at 32).

- "A rigorous groundwater monitoring program is being implemented at each of the Stations"; "the groundwater monitoring program is largely based upon the RCRA Subtitle D groundwater monitoring program"; the program includes "detection" or "assessment" groundwater monitoring; and "the groundwater concentrations are compared to statistically derived background concentrations to evaluate whether the regulated units are adversely impacting groundwater." (WCG at 32). I disagree with those conclusions. As my previous expert report concluded regarding the use of improperly located or constructed background wells, any such use by WCG might not trigger the need for a more detailed investigation or corrective action under either the CCR Rule or Illinois CCR regulations.

Background Groundwater Quality

A correct and accurate determination of true background groundwater is essential, as IDEM recognized when it rejected Mr. Maxwell's monitoring system for one of his cited CCR experience projects. As discussed in my prior report, background wells that were drilled adjacent to formerly unlined disposal areas or into CCRs should not be considered "background" to which downgradient wells are then compared. I continue to support that conclusion. MWG's background or "upgradient" groundwater quality determinations are questionable because sometimes the highest concentrations of constituents were reported in hydraulically upgradient wells. Plus, some of those wells were drilled into CCRs.

I disagree with WCG's conclusion that I "incorrectly opined" that the "existing background groundwater data are not sufficient for evaluating whether the regulated CCR units have impacted groundwater quality." (WCG at 32). I also disagree with WCG's conclusion that "the existing background groundwater data utilized to evaluate whether the Federal CCR Surface Impoundments are adversely impacting groundwater are appropriate for satisfying the regulatory requirements in the Federal CCR Rules and determining background concentrations at the Stations." (WCG at 32). WCG carefully worded those conclusions to specifically apply to "regulated CCR units" and "Federal CCR Surface Impoundments." More simply, WCG is attempting to blame the groundwater contamination on what it apparently believes are "unregulated" sources such as historical fill areas and ash used to construct active disposal areas – in an apparent attempt to avoid more stringent, numeric groundwater clean-up standards under the CCR Rule and Illinois CCR regulations. As the Board concluded in its Opinion, it is immaterial in the liability phase of this case what type of CCR or source area has caused groundwater contamination. However, for purposes of a remedy, it is "material" to define all sources of contamination to establish a remedy.

Sources of Groundwater Contamination

As discussed above, MWG and WCG have concluded that the contamination is not due to current or "regulated" disposal areas but instead due to un-named sources. Regardless, the CCRs that are present at the site and have resulted in groundwater contamination originating from coal burning processes. MWG is responsible for meeting Part 620 groundwater protection standards according to the Board – regardless of source. The Board affirmed that conclusion when it concluded in its Opinion that it is "immaterial" whether a source is from an active or historic source area. The historical fill areas contain a wider range of CCRs – including bottom ash, fly ash, cinders, and slag – compared to the current impoundments that collect bottom ash. Further, those historical areas likely include CCRs that originated from multiple sources of coal and from different air pollution control technologies. As a result, investigations are needed to define the nature and extent of all source areas.

MWG completed ASDs at Powerton, Waukegan, and Will County and concluded that groundwater contamination was not due to currently "regulated" impoundments, but rather another un-named source(s). (WCG at 34-37). If WCG was correct that the active disposal areas are not the source(s) of groundwater contamination, historical sources that MWG has not yet defined are the likely sources.

When discussing why it believed that existing groundwater data do not implicate the current disposal areas, again WCG carefully worded their argument to blame other un-named contaminant sources, by concluding:

- "Upgradient wells identified by KPRG in the monitoring programs for the Stations are not affected by the regulated units because the wells are upgradient based on groundwater elevation contour maps." (WCG at 33). However, that conclusion assumes that the ponds never leaked, and that groundwater never flowed radially from the leaky pond – towards the area that WCG now considers upgradient. As previously discussed, the Board concluded that the currently active impoundments had liners that were known or suspected to have leaked prior to being replaced. Leaking liners could have created radial groundwater flow conditions where current "upgradient" wells would have been hydraulically downgradient from impoundments.

- "There is no evidence of mounding from the units". (WCG at 33). My prior report contradicts that conclusion, providing an example analysis that I performed for Powerton (see Section 3.2, prior report). Also, WCG concluded that "groundwater elevation contour maps produced annually, most recently for data collected in 2020 and 2021, in accordance with the CCR monitoring at each Station do not indicate groundwater mounding in proximity of the regulated units." (WCG at 33). In my opinion, unlined impoundments with standing free water in them and saturated CCRs beneath that standing water would have produced higher leakage rates with mounding and radial flow conditions. WCG concluded that standing water creates higher contamination conditions, consistent with my opinion. (WCG at 38-39). Mounding would have been likely during the time when prior liners from the current disposal areas were known or suspected of leaking, and the mounded conditions can continue for years, even after a new liner has been constructed.

- "The units are lined, and those liners are functioning as designed to control infiltration from the surface impoundments." (WCG at 33). In response to that conclusion, active ponds could have leaked prior to liner replacement and could be currently leaking. Also, WCG did not provide proof that the current liners are not leaking, just that they were designed to "control infiltration." As the Board already concluded, liners sometimes leak. (Opinion at 26, 40, 55 and 66).

- "Based on the lack of groundwater mounding observed at the Stations, the upgradient wells represent the character of groundwater flowing from areas upgradient of the CCR surface impoundments and that the identified upgradient groundwater quality is the correct basis for comparison to the groundwater quality after it has passed beneath the CCR Surface Impoundments." (WCG at 33). In my opinion, WCG's conclusion that the upgradient wells represent the "character of groundwater flowing from areas upgradient of the CCR impoundments" ignores the fact that current impoundments were known or suspected of leaking historically; leaking impoundments would have created radial flow into what WCG now determines to be "upgradient"; some upgradient wells were drilled into CCRs in prior footprints of existing impoundments and historical disposal areas; and residual contamination can remain in the upgradient well areas.

- "The scope of the ASDs associated with the Powerton, Will Co., and Waukegan Stations is appropriate and complies with the Federal CCR Rules and likely also the Illinois CCR Rules." (WCG at 54). In response to that comment, WCG did not opine that the ASDs meet the Illinois requirements, only stating that compliance is "likely."

- "The Federal CCR Rules and the Illinois CCR Rules require the owner/operator to evaluate whether the *regulated unit(s)* [emphasis added] are adversely impacting groundwater, but neither require an exhaustive site-wide study to identify a specific alternate source." (WCG at 54). In response to that conclusion, both regulations require that MWG define the "nature and extent" of contamination, regardless of whether the investigation is "exhaustive" in WCG's opinion. Also, a nature and extend investigation is the foundation of an alternatives analysis that is needed to evaluate and select a remedial alternative.

Use of LEAF Analytical Results

As discussed in Section 2.4.1, the best demonstration that leaching has not contaminated groundwater is to install groundwater wells in potential source areas. Regarding MWG's use of the LEAF for the ASDs, the US EPA determined that the LEAF method is the best predictor for leachability because it tests for constituents over multiple ranges of pH. I agree with the US EPA that the LEAF method is the best predictive leaching test, and I agree with MWG's recent use of the LEAF method to estimate leaching potential. The LEAF test is the best analytical laboratory test to predict leachability over a wide range of pHs that would be expected at each station. However, I disagree with how MWG used the LEAF test to formulate its conclusions.

Metal solubility from a solid waste (e.g., fly ash, bottom ash, slag, cinders) is largely determined by pH for some metals (e.g., arsenic), while less important for others (e.g., boron and calcium). As previously discussed, the US EPA determined that the best test to determine metals solubility of ash is to collect pore water samples directly from the CCR in an impoundment, rather than predicting leachability with laboratory tests.

Common to recent ASD demonstrations was MWG's use of the LEAF method. WCG explained that each of the samples underwent leaching over a range of 8 pH values and under "natural pH" conditions, which is the actual pH of the sample itself. WCG concluded that "the natural pH results are believed to be the most applicable to field conditions because the natural pH represents the best approximation of field conditions." (WCG at 35, 36, and 37). I disagree that the "natural pH" condition is the most representative predictor of leachability. In my opinion, conditions of pH change by such factors as depth below ground, source coal, waste type and age, and sulfate content. A correct use of the LEAF data would be for MWG to use the results of multiple pH leaching ranges (of the eight) and to evaluate specific pH conditions by depth at each pond or historic fill area – rather than MWG using just one pH result (natural pH).

WCG's conclusion that the "natural" pH represents the "most applicable to field conditions" fails to understand that the best measure is actual pore water samples from multiple depths from an impoundment, and not a laboratory test. Second, WCG's fails to understand that if an impoundment leaks, that leachate and water can and likely will change geochemically once it reaches the underlying soil and aquifer. Slight changes in pH for example, can increase the mobility of some constituents. Plus, those geochemical conditions can and likely will change over time, making constituents more mobile.

Groundwater Elevations for Aquifer Separation

WCG determined the "average" and "highest recorded" groundwater elevations reported for each station for all wells in a comparison to known impoundment bottom elevations, in an apparent attempt to demonstrate separation from the bottom of the ponds and the uppermost aquifer. (WCG at 14, 16, and 21-22). Those elevations are only approximate because no wells at any station measure groundwater elevations directly beneath a pond or fill area. While such an analysis is useful to determine the amount of separation between the wastes and the uppermost aquifer, it is also important to understand that MWG obtained groundwater elevations from wells located around the *perimeter* of impoundments and not *beneath* [emphasis added] the impoundments. As a result, WCG's analyses cannot be definitive for all ash ponds at each station to determine true groundwater elevations beneath the liners.

2.4.3 Joliet Specific Comments

WCG illustrated historical soil borings, groundwater monitoring wells, sediment, and surface sample locations that were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 66). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- No samples have been collected from the two ash landfills that WCG identified in its report ("Southwest Historical Fill Area" and the "Northeast Historical Fill Area"). (WCG at 62 and 66). Those two disposal areas represent significant historical waste disposal areas that were identified by ENSR in 1998 – yet MWG has still not defined the nature and extent of contamination in those areas.

- The only historic area with a high density of samples collected was from the Northwest Historic Fill Area. (WCG at 66). Virtually all of those sample locations were, however, only collected for beneficial use leaching tests. As a result, the nature and extent of contamination in this area is still not defined.

- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. (WCG at 66).

WCG stated that "in addition to coal ash surface impoundments, according to the case record, three other areas at Joliet 29 Station are suspected to contain historical coal ash" and "some" of these areas have been historically investigated. WCG also concluded that MWG excavated wastes from "some of these areas" and hauled that waste to an "appropriately permitted landfill." (WCG at 15). Notable in that discussion is that WCG did not explain why "some" – but not all – areas were investigated and why wastes from "some of these areas" were excavated and transported to a permitted landfill, while other wastes remained in-tact. MWG's choice to excavate CCRs from a small area does not explain why it chose to not remove CCRs elsewhere at the station.

WCG summarized the results of a 2004 and 2005 investigation over the 13.2-acre Northwest Fill area, and that investigation included 15 borings (approximately one boring per acre). Notable in that investigation, three borings did not contain CCRs, but off-set borings close to those three borings did encounter CCRs. (WCG at 40). This randomness of CCR occurrence in those borings, as demonstrated by an actual investigation into areas presumed to contain CCRs, demonstrates the importance of completing a comprehensive nature and extent investigation to locate and characterize wastes. MWG will not know where the CCRs exist without performing a comprehensive investigation. Also, notable is that the investigation is the disparity of only one boring per acre (43,560 square feet) for the Northwest Fill Area, compared to the four borings per acre for the FS/FAS Area at Waukegan (see Section 2.4.5).

WCG also summarized the results of CCR and soil characterization in 2005 for the eventual excavation and transport of "52 loads of soil / CCR weighing 1,062.88 tons" to an off-site landfill as an unspecified "remedial action". (WCG at 41). WCG did not explain the purpose of that remedial action or why that area was targeted. Further WCG did not explain why other CCRs from other areas at the station were not also excavated and transported to a landfill. CCRs that were not excavated have the same long-term potential to contaminate groundwater.

WCG summarized the results of a 2020 investigation around monitoring well MW-09, which according to WCG "has historically exhibited fluctuating concentrations of TDS and sulfate in the groundwater exceeding the 35 Ill. Adm. Code 620 Class 1 Groundwater Quality Standards." (WCG at 41). A total of 18 soil borings were advanced in the vicinity of MW-09, compared to only one boring per acre collected at the Northwest Area containing historical fill. (WCG at 41). WCG concluded that the water quality exceedences and acidic pH at the well were due to oxidation of a naturally occurring, localized pocket of residual sulfide minerals due to oxidation from the underlying bedrock – and not due to "station operations" or leakage from a CCR pond. (WCG at 42). Contrary to that conclusion, in my experience, localized occurrences of acidic (low pH) groundwater, high sulfate and / or sulfide concentrations in groundwater, and high concentrations of Total Dissolved Solids (TDS) in groundwater are very commonly associated with groundwater contaminated due to a release of constituents from CCRs.

In summary, I disagree with WCG's conclusion that the "historical data as described above are sufficient to adequately characterize the historical coal ash fill areas at the Joliet 29 Station for the purposes of assessing a remedial approach". (WCG at 42), based upon my prior comments associated with the NLET analyses, the above investigation summaries, the absence of any investigations at two ash landfills, the randomness of their excavation and remedial actions, and their randomness of collecting analytical data from all areas.

2.4.4 Powerton Specific Comments

WCG illustrated historical soil borings, groundwater monitoring wells, test pit, sediment, and surface sample locations that were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 67). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- The only historic area with a high density of samples collected was in the Former Ash Basin, adjacent to the Ash Surge Basin. All of those samples were collected, however, only for beneficial use leaching tests. As a result, the nature and extent of that contamination and leaching potential has still not yet been defined.

- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. Those sporadic locations demonstrate that the investigation was not meant to define the nature and extent of contamination in the specific areas or station wide.

- No samples have been collected from the additional, unrecognized historical ash management area ("Suspect Disposal Area") identified in my prior expert report (Section 2.2) and located south of the East Yard Runoff Basin (not illustrated on the WCG figure, see Figure 4, my prior expert report). That area represents a potential large source of contaminants that MWG has not yet investigated.

- No samples have been collected from the Suspect Disposal Area located between the intake and discharge canals (not illustrated on the WCG figure, but see Figure 4, my prior expert report). That area represents a potential large source of contaminants, and those areas are adjacent to the canals that are hydraulically connected to the Illinois River.

WCG commented that I did not "present the basis for the conclusion that there are additional, unrecognized historical ash management areas" in my previous expert report, referring to my identification of a suspected CCR disposal area located between the intake and discharge channels, as illustrated in Figure 4 of my prior expert report. (WCG at 20). That claim is incorrect. As I stated in that report, I based that claim upon my review of a 1961 aerial photograph that was included in Figure 4. WCG stated that it "was unable to independently substantiate Quarles' characterization of these two suspected disposal areas." (WCG at 20). WCG's explanation did not explain if they even attempted to independently substantiate my claim. As a result, those two areas remain a previously unidentified and suspected disposal area.

WCG disagreed with my interpretation of groundwater flow directions in my previous expert report (Section 3.2) where I opined that there was evidence of groundwater mounding and radial flow beneath the Ash Surge Basin and Ash Bypass Basin. (WCG at 33). I continue to support my prior conclusion that I correctly evaluated groundwater flow conditions at the Ash Surge Basin and Bypass Basin. To support their opinion, WCG concluded that I inappropriately combined groundwater elevation data from "monitoring wells screened in two different saturated zones into one contour map." (WCG at 33). That conclusion apparently relates to Figure 9 of my prior expert report, which illustrates radial flow from the Ash Surge Basin and MWG-reported groundwater elevations within approximately one foot of the bottom of the impoundment. WCG also stated that my diagram "is inconsistent with industry standard of practice and results in his inaccurate conclusion that there is mounding under the Ash Surge Basin and the Bypass Basin." (WCG at 34). WCG presented technical facts that it believed supported their conclusions:

- Wells that I used in my analysis were "screened in two different saturated zones." (WCG at 33).
- Although there are two distinct "units" of groundwater, WCG concluded that the two units are "hydraulically connected." (WCG at 34).
- Six wells (MW-6, MW-8, MW-12, MW-14, MW-15, and MW-17) were screened "within a confining clay/silt unit and the overlying gravel, sand, and cinders unit." (WCG at 34).
- Twelve other wells are screened "within the deeper unit consisting of mostly gravel and sand", and one well (MW-18) is screened across "both deep and shallow sand units separated by a confining clay unit." (WCG at 34).

WCG admitted that the two upper "units" of groundwater are *hydraulically connected* [emphasis added]. This conclusion supports my prior analysis that groundwater elevations from both "units" *should be combined* [emphasis added] to form a single diagram, consistent with competent industry and hydrogeologic professional practices. WCG's claim that I incorrectly used groundwater elevations from two different zones to create a potentiometric surface diagram demonstrates their lack of expertise in hydrogeology and the CCR Rule. A correct diagram *should include* [emphasis added] all interconnected aquifer wells to form a single diagram because the upper and lower units are hydraulically connected.

According to both the CCR Rule and Illinois CCR regulations (35 Ill. Admin. Code § 845.120; 40 CFR § 257.53): the *Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.* They key portion of this definition that rebuts WCG's claim that my prior groundwater flow diagram was incorrect is the "as well as lower aquifers that are hydraulically connected" portion. The uppermost aquifer at Powerton is both the shallow and inter-connected deeper zones as a single uppermost aquifer where groundwater elevations from both connected zones should be combined to form a single groundwater flow diagram.

My prior report (Section 3.2) concluded that the bottom of the Ash Surge Basin is within approximately one foot of the uppermost aquifer beneath that impoundment. WCG did not rebut that conclusion in its report. If WCG agrees with my conclusion, it therefore disagrees with the 2019 conclusion made by Geosyntec when it certified that both the Ash Surge Basin and the Ash Bypass Basin met the required five-foot minimum distance as required by the CCR Rule. (Geosyntec 2019 at 1).

In summary, WCG's summary of prior investigations demonstrates the need for additional investigations in areas already investigated and the need for new investigations where there have been none. Further, my analysis of uppermost aquifer groundwater conditions and WCG's comments regarding my interpretation, demonstrate that WCG lacks a clear understanding of hydrogeologic and CCR Rule fundamentals that are necessary for an expert opinion.

2.4.5 Waukegan Specific Comments

WCG concluded that the historical data presented in its report "are sufficient to adequately characterize the historical coal ash fill area at the Waukegan station." (WCG at 47). I disagree with that conclusion.

WCG illustrated historical soil borings, groundwater monitoring wells, sediment, and surface sample locations that were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 69). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected, demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- The only historic area with a high density of samples collected was from the FS/FAS Area located adjacent to the West Ash Pond.This is the area that the Board concluded contains CCRs up to 22 feet below ground surface, some of which are saturated. (Opinion at 67). Although investigations have been completed in this area, the nature and extent of contamination has not yet been defined.

- No high density samples have been collected around the East and West Ash Pond, other than the FS/FAS Area. My prior expert report (see Section 2.3) determined that both ponds were constructed over and within historic ash from an ash pond onto which the newer lined ponds were constructed. The nature and extent of those CCRs have not yet been defined.

- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. Those sporadic locations demonstrate that the investigation was not meant to define the nature and extent of contamination in the specific areas or station-wide.

- No samples have been collected from the Former Fly Ash Storage Area located at the northwest corner of the property (not illustrated on the WCG figure, see Figure 6, my prior expert report). The area represents a significant potential source of groundwater contamination – yet MWG has never performed an in-depth analysis of that area.

No samples have been collected from the Former Slag Field located north of the Intake / Discharge Channel / Cooling Pond (not illustrated on the WCG figure, but see Figure 6, my prior expert report). That area also represents a potential significant source of groundwater contamination that is adjacent to the intake / cooling water pond that is connected to Lake Michigan.

MCG reported that MWG completed an investigation in November 2020 of the FS/FAS Area located west of the West Pond to determine if off-site contamination from the former Greiss-Pfleger Tannery and General Boiler properties could be contributing to observed groundwater concentrations in a well in that area. (WCG at 46-47). That investigation consisted of 40 borings over an approximate 9-acrea area (four borings per acre). (WCG at 46). MWG again used the LEAF test and also used the SPLP to evaluate leachability at select borings. (WCG at 47). WCG concluded that "all LEAF results for samples at the natural pH are below the applicable Class I Groundwater Quality Standard, except boron and arsenic." (WCG at 47). WCG concluded that based on the results that "sufficient information is available to determine if a remedy is appropriate to address potential leaching of CCR-related constituents from ash in the FS Area to groundwater at concentrations exceeding Class 1 Groundwater Quality Standards", without explaining why the investigation was sufficient to select a remedy or what the potential option(s) might be. (WCG at 47). I disagree with WCG's conclusion that the leaching tests were sufficient to define the leachability of the CCRs for remedial purposes.

As discussed in Section 2.3.5, MWG plans to close the FS/FAS Area by constructing a cap over the wastes that are at least 22 feet below ground and are sometimes saturated. Also, as discussed in Section 2.3.5, that closure method will not prevent continued leaching of CCR constituents to groundwater and in fact, the concentrations might even increase. If the FS/FAS Area is considered to be an active pond according to the CCR Rule and the Illinois CCR regulations, closure-in-place would not be a closure option because CCRs would remain saturated. The only remaining closure option would therefore be closure-by-removal – where MWG would be required to excavate all CCRs and transport them to a lined landfill. MWG's plan to construct a cap is not a long-term remedy that would be expected to improve groundwater conditions.

In summary, MWG chose to initiate a more in-depth investigation at the FS/FAS Area, while not performing any investigations at other historical disposal areas. Those areas need to be investigated. Further, the investigation that it performed at the FS/FAS Area was not sufficient to evaluate the leaching conditions of the area. The prior investigation in that area demonstrates that CCRs are saturated – yet MWG plans to construct a cap over that waste. That plan might worsen groundwater quality, according to EPRI, as previously discussed in Section 2.3.5.

2.4.6 Will County Specific Comments

WCG illustrated historical soil borings, groundwater monitoring wells, sediment, and surface sample locations that were samples were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 68). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected, demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- No areas of high density samples occur anywhere on the property – demonstrating that no thorough investigation has been performed

- Virtually no soil borings have been advanced at the large Former Ash Basin located south of Ash Pond 3S, and no groundwater monitoring wells exist in that area (not illustrated on the WCG figure, but see Figure 2, my prior expert report). As a result, the nature and extent of contamination has not been defined in that area.

- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. Those samples were mainly collected around the power plant, and not the impoundments. As a result, that investigation was not sufficient to define the nature and extent of contamination anywhere at the station.

- Only two widely spaced samples were collected at the Former Slag / Bottom Ash Disposal area located at the southeastern end of the property. Given the possibility that random CCRs exist in that area, more borings are needed to define the nature and extent of contamination.

WCG described investigations at two historical CCR fill areas: the Former Slag / Bottom Ash Disposal Area and one located adjacent to (east) of Pond 1N. (WCG at 44-45). Significant disparity was present in the density of the borings and the types of analyses used by MWG – demonstrating the haphazard nature of those two investigations. Two borings were advanced at the Former Slag / Bottom Ash Disposal Area – compared to 20 borings that were advanced in a grid pattern east of Pond 1N. (WCG at 44-45). Total metals analyses were analyzed at the Former Slag / Bottom Ash Disposal Area , while NLET leaching tests were performed from the borings adjacent to Pond 1N. (WCG at 44-45). A properly completed nature and extent investigation would have instead used consistent methodologies.

In summary, MWG has still not defined the nature and extent of contamination at areas that it has previously investigated – nor has it thoroughly investigated other historical disposal areas that are known to exist.

2.5 Decreasing Groundwater Concentration Trend

WCG concluded that their "analysis of the historical groundwater quality data indicates that groundwater concentrations are decreasing at the Joliet 29, Powerton, and Will County Stations." (WCG at 47). I disagree with that conclusion, based in part, upon the results of WCG's analyses and its conclusions.

WCG's analysis included approximately 10 years of groundwater well data collected from select wells that are "were at the farthest downgradient locations" because "these wells are most relevant because they best represent groundwater quality after the natural groundwater mechanisms of advective dispersion, and attenuation have impacted groundwater concentrations" before reaching the downgradient property line. (WCG at 48). WCG completely ignored some wells at the stations in its analyses – even though those wells have a history of contamination that has exceeded water quality standards. WCG's choice of using wells that are the farthest downgradient locations ignores that the CCR Rule requires that MWG demonstrate compliance at the "waste boundary" nearest the wastes, as discussed in Section 2.3.6 of this report.

WCG concluded that "the majority of trend tests" from Joliet, Powerton, and Will County indicated a decreasing trend, and that results for Waukegan were neither skewed upward or downward. (WCG at 49). WCG based this conclusion only on the results where a trend was observed, rather than the complete data set. (WCG at 49).

A close examination of WCG's results however, demonstrates the "decreasing" trend conclusion to be incorrect. The data instead demonstrate that the majority of constituent concentrations are either increasing or had no trend, and that the decreasing trend results do not meet the desired confidence level, according to the following:

- Joliet: of the 132 tests that it performed, 74 percent exhibited either an upward trend (10%) or no trend (64%). Only 26 percent exhibited a downward trend. Of those with a downward trend, only

32 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 95).

- Powerton: of the 233 tests performed, 70 percent exhibited either an upward trend (6%) or no trend (64%). Only 30 percent exhibited a downward trend. Of those with a downward trend, only 35 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 98).

- Waukegan: of the 135 tests performed, 81 percent exhibited either an upward trend (21%) or no trend (60%). Only 19 percent exhibited a downward trend. Of those with a downward trend, only 35 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 104).

- Will County: of the 140 tests performed, 73 percent exhibited either an upward trend (16%) or no trend (57%). Only 27 percent exhibited a downward trend. Of those with a downward trend, only 34 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 101).

My review of the groundwater concentration trend analyses identified other significant flaws in WCG's trend analyses and use of the monitoring data to make remedial decisions. Those flaws include:

- WCG failed to include all historically contaminated wells in its statistical analyses. For example:

  - Joliet. MW-9. That well has repeatedly had high concentrations of iron, manganese, nickel, sulfate, and total dissolved solids that have exceeded water quality standards. (Joliet 2021 at 18, 116, 118, 120, 126, and 128). This well has a history of groundwater quality violations and has been a focus of a prior MWG investigation to attempt to explain contaminant concentrations in groundwater.
  - Powerton. MW-9 has repeatedly had high concentrations of boron that have exceeded water quality standards. (Powerton 2021 at 20 and 125). MW-11 has repeatedly had high concentrations of arsenic that have exceeded water quality standards. (Powerton 2021 at 22 and 122).
  - Waukegan. MW-5 has repeatedly had high concentrations of arsenic, boron, iron, manganese, and sulfate. (Waukegan 2021 at 13, 172, 175, 183, 185, and 194). MW-7 has repeatedly had high concentrations of boron and sulfate. (Waukegan 2021 at 15, 175 and 194).
  - Will County. MW-2 has repeatedly had high concentrations of arsenic, boron, and sulfate. (Will County 2021 at 11, 82, 85, and 103). MW-3 has repeatedly had high concentrations of boron. (Will County 2021 at 12 and 85)). MW-4 has repeatedly had high concentrations of boron and sulfate. (Will County 2021 at 13, 85, and 103). MW-5 has repeatedly had high concentrations of boron and sulfate. (Will County 2021 at 14, 85, and 103).

- MWG failed to include manganese in its trend analyses, despite that constituent exceeding groundwater quality standards.

- The wells evaluated by WCG were not always near the disposal areas – meaning that the concentrations nearest the units at the waste boundaries would likely be much higher.

- The analysis assumes that the downgradient wells are properly located and screened (by depth) at the site and within the aquifer to intercept groundwater contamination.

- The analysis assumes that historical disposal areas that are currently unmonitored do not need to be monitored and the groundwater in those unmonitored areas is not contaminated.

- The analysis assumes that the downgradient concentrations will not get worse from upgradient source areas.

- WCG did not determine how many years will be needed to meet each groundwater protection standard, if a standard was exceeded.

In summary, the statistical analyses for wells at each station do not support WCG's claim that concentrations are decreasing at any station. Further, the decreasing trend results reported by WCG were not statistically valid at the desired confidence level.

2.6 Risks to Off-Site Receptors

WCG also concluded that "there is no unacceptable risk to off-site receptors at the four stations." (WCG at 50). I disagree with that conclusion because MWG has not yet collected enough information to conclude that risks to all possible off-site receptors have been defined.

WCG concluded that "each of the Stations are bordered by surface water and the shallow groundwater unit at each of the Stations discharges into either the adjacent river or Lake Michigan (in the case of Waukegan)." (WCG at 50). WCG concluded that their surface water risk evaluation "indicate that downgradient groundwater conditions at each of the four Stations do not pose an unacceptable risk to surface water receptors." (WCG at 52). Although WCG did not define what "receptors" it considered, human and aquatic life are assumed because WCG compared groundwater concentrations to human and aquatic life surface water quality standards.

WCG's determination that there were no unacceptable risks to off-site ecological receptors misses the fact that groundwater discharges into receiving streams can accumulate in sediments along shorelines and in wetlands, for example. WCG's analysis also relies on dilution of contaminated groundwater once it reaches a surface water and assumed ingestion and direct contact exposures.

There is no indication that MWG has ever inspected shorelines for unpermitted discharges of CCR-impacted groundwater or the presence of contaminated sediments that commonly exist, in my opinion, where CCR-contaminated groundwater discharges into a receiving stream. My previous expert report (Section 3.4) discussed groundwater discharge impacts to sediments, vegetation, and surface water. Contaminated sediments and wetlands provide habitat to macro-invertebrate organisms and birds, for example, and provide habitat for fish and aquatic life.

In summary, WCG's "risk" analysis" for off-site receptors is incomplete because it did not consider any receptors other than humans and aquatic life in its analysis. Plus, it is not valid because MWG has not yet defined the nature and extent of contamination along the shorelines of each station where groundwater discharges into the receiving surface water.

3.0 SUMMARY AND CONCLUSIONS

This report included summaries and conclusions embedded throughout Section 2 as direct rebuttals to WCG comments in their report, in addition to other related information relevant to the report sections and subsections. This section includes global summaries and conclusions for major sections of this report, as follows:

- Respondent experts have minimal CCR experience that qualify them to opine on CCR matters related to the CCR Rule, groundwater monitoring systems, investigating the nature and extent of contamination, and designing groundwater corrective actions.

- My prior expert report and this rebuttal report continues to rely on the Board's Opinion during the liability phase of this case because it was and continues to be the best historical source of information and to establish remedial objectives that MWG is required to meet at each station. The Board concluded that it is immaterial in the liability phase that a contaminant source is from a historical fill area or an active CCR disposal or collection area. Knowledge gained by completing a thorough nature and extent investigation at each station is "material" to adequately select a groundwater remedy.

- Regulatory standards applicable to establishing a remedy at each site include the Act, the CCR Rule, and the Illinois CCR regulations. According to the Opinion, MWG is required to remedy groundwater contamination and cure the violations identified by the Board, regardless of the source of the contamination.

- MWG has not yet performed a nature and extent investigation at each station sufficient to evaluate and select a groundwater remedy. The data that WCG presented in its report support the fact that neither historical fill nor current disposal areas have been thoroughly investigated. Given that there is no foundation to support site conditions by nature and extent investigations, WCG's proposed monitored natural attenuation groundwater remedy is not supported by credible science.

- WCG's proposed closure-in-place remedy at Waukegan does not meet the minimum performance standards established in the CCR Rule or Illinois CCR regulations, nor is it likely to improve groundwater quality according EPRI. Saturated CCRs belowground will continue to leach constituents into the uppermost aquifer, even with a low permeability cap over the wastes. Plus, the cap will not prevent the uppermost aquifer from flowing laterally into the CCRs beneath the cap.

- WCG's proposed risk-based approach that relies on monitored attenuation is not likely to achieve Part 620 groundwater protection standards or cure the other violations identified by the Board. Plus, WCG's risk assessment only included human and fish / aquatic life receptors. Also, risk-based closures are not allowed by the CCR Rule or the Illinois CCR regulations. WCG failed to include other receptors such as sediments along river and lake shorelines, vegetation, and wetlands, as examples. As a result, the risk assessments are incomplete. As with any remedial measure, monitored natural attenuation would have to be accompanied by source control and a nature and extent investigation at each station.

- MWG's use of random and sometimes incorrect leaching tests have been insufficient to estimate leachability of CCR contaminants because MWG selected the wrong tests for the intended purpose, in addition to incorrectly evaluating the results associated with the US EPA-preferred LEAF method.

- Although MWG replaced damaged or cracked liners at the stations, groundwater contamination prior to those replacements would have been likely due to the shallow groundwater conditions. That legacy contamination can still exist around the ponds and be present in both hydraulically upgradient and downgradient groundwater monitoring wells. CCR constituents in upgradient wells can invalidate statistical comparisons that are used to trigger corrective actions because the downgradient wells are compared to upgradient wells that are also contaminated.

- WCG's conclusion that constituent concentrations in groundwater are decreasing at Joliet, Powerton, and Will County is not correct. In fact, constituent concentrations are increasing or exhibit no trend at all four stations.

4.0 REFERENCES

1. ASTM 1985. Standard Test Method for Shake Extraction of Solid Waste with Water, 1985 (re-approved 2004).
2. ATC 2019. 2018 CCR Annual Groundwater Monitoring and Corrective Action Report, ATC Group Services, LLC, January 31, 2019 at available at http://s2.q4cdn.com/671160882/files/doc_downloads/2019/IPL-HSS-2018-Annual-GWM-and-CA-Report-1-31-19-Final.pdf.
3. ENSR 1998 Joliet. Phase II Environmental Site Assessment of Commonwealth Edison Joliet #29 Generating Station, ENSR, October 1998.
4. ENSR 1998 Powerton. Phase II Environmental Site Assessment of ComEd Powerton Generating Station, ENSR, October 1998.
5. ENSR 1998 Waukegan. Phase II Environmental Site Assessment of Commonwealth Edison Generating Station, October 1998.
6. ENSR 1998 Will County. Phase II Environmental Site Assessment of Commonwealth Edison Will County Generating Station, October 1998.
7. EPRI 2001. Evaluation and Modeling of Cap Alternatives at Three Unlined Coal Ash Impoundments, Technical Report, September 2001.
8. Federal Register 2015. Federal Register, Hazardous and Solid Waste Management Systems; Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule. April 17, 2015.
9. Geosyntec 2018. Placement Above the Uppermost Aquifer Location Restrictions, Ash Surge Basin and Bypass Basin, Powerton Station, October 2018. Available at http://3659839d00eefa48ab17-3929cea8f28e01ec3cb6bbf40cac69f0.r20.cf1.rackcdn.com/POW_ASB_LRI.pdf.
10. Haley & Aldrich 2019. Report on Corrective Measures Assessment, Harding Street Generating Station, Indianapolis, Indiana, Haley Aldrich, September 2019. Available at http://s2.q4cdn.com/671160882/files/doc_downloads/2019/IPL-Harding-St.-CMA-Final.pdf.
11. IEPA 2010. Coal Combustion Residue Management in Illinois. Available at http://www.epa.state.il.us/water/ash-impoundment/documents/coal-ash-fact-sheet.pdf.
12. IPL 2020. Letter from Mark Holbrook to Randy Jones, Hanson Aggregates, February 10, 2020.
13. Joliet 2021. Annual and Quarterly Groundwater Monitoring Report, Joliet #29 Generating Station, January 21, 2021.
14. Powerton 2021. Annual and Quarterly Groundwater Monitoring Report, Powerton Generating Station, January 15, 2021.
15. Sargent & Lundy 2016. Sampling and Analysis Plan, Harding Street Station Coal Combustion, Indianapolis, Indiana, Attachment C, June 28, 2016, prepared for Sargent & Lundy, LLC and Indianapolis Power & Light, Ash Pond System Closure & Post-Closure Plan, July 28, 2016. Available at https://kheprw.org/wp-content/uploads/2018/04/Harding-Street-Coal-Ash-Closure-Plan-Compressed.pdf.
16. Waukegan 2021. Annual and Quarterly Groundwater Monitoring Report, Waukegan Generating Station, January 21, 2021.
17. Will County 2021. Annual and Quarterly Groundwater Monitoring Report, Will County Generating Station, January 21, 2021.

EXHIBIT 4

ILLINOIS POLLUTION CONTROL BOARD

SIERRA CLUB, ENVIRONMENTAL LAW AND POLICY CENTER, PRAIRIE RIVERS NETWORK, AND CITIZENS AGAINST RUINING THE ENVIRONMENT,	)	
Complainants,	)	PCB 2013-015
vs.	)	Enforcement-Water
MIDWEST GENERATION, LLC,	)	
Respondent.	)	

Zoom video conference, evidence deposition, of MARK QUARLES, pursuant to notice, commencing at 10:00 a.m., Tuesday, October 12, 2021, before Connie L. James, CSR.

Reported by: Connie L. James
CSR No. 084.002510

A. Yes.
Q. And so you're familiar with how a deposition works?
A. I am, yes.
Q. You're a professional geologist, right?
A. Correct.
Q. You are not licensed in Illinois, is that correct?
A. (No verbal response.)
Q. You have to say it out loud.
A. Yes.
Q. And you are not a professional engineer, correct?
A. That's right.
Q. Now, I understand you have a Bachelor's Degree in Environmental Engineering from Western Kentucky University, is that right?
A. That's correct.
Q. You currently work for BBJ?
A. I do.
Q. And you joined BBJ in February of 2020?
A. That's correct.
Q. Have you ever been fired from any position you held since receiving your Bachelor's Degree?

Q. Have you ever developed a groundwater remedy in Illinois, an Illinois project?
A. I have not.
Q. Do you have an understanding of how a site is remediated under Illinois law?
MR. WANNIER: Objection to the extent it calls for a legal opinion.
THE WITNESS:
A. Well, when you say how a site is remediated under Illinois law, how a site technically is remediated would be consistent technically with -- regardless of what state, the processes are the same, and then every state is going to have its own standards to which the results are compared.
MS. NIJMAN:
Q. Have you reviewed the Tiered Approach to Corrective Action, commonly known as TACO, T A C O?
A. I have reviewed that regulation.
Q. Can you describe how it works?
A. Well, it's a tier-based evaluation similar to what you refer to as a Brownfield development. And I think that term is also used in the description and discussion of TACO.
Q. I'm sorry. Are you saying that TACO is

limited to Brownfield's development?
MR. WANNIER: Objection to the extent that calls for a legal conclusion.
THE WITNESS:
A. I'm saying, I'm saying that I believe TACO mentions in its ability that a Brownfield development is commonly the type of project that uses a TACO approach.
MS. NIJMAN:
Q. But you would agree that TACO could be more broadly applied?
MR. WANNIER: Objection. Outside the scope.
THE WITNESS:
A. I haven't, I haven't performed a project in Illinois using TACO, so my knowledge of TACO, other than just a cursory review of its, of its approach, is very limited.
MS. NIJMAN:
Q. Okay. Thank you. Have you ever personally designed a risk analysis for a site?
A. Would you define a risk analysis?
Q. An analysis of whether the waste material at a site causes a risk to human health or the environment.

A. Yes.
Q. And Mark Quarles, P.G. --
A. Can you blow that up?
Q. Yeah. And the Mark Quarles, P.G., listed as an author, that's you, right?
A. It is, yeah.
Q. Did you ever question or formally renounce any of the conclusions in this report?
MR. WANNIER: Objection. Vague.
THE WITNESS:
A. I have no idea. I don't recall ever renouncing anything, but I don't recall that report that was written fifteen years ago, the particulars of it.
MS. NIJMAN:
Q. Are you aware that Dr. Anne Maest renounced the conclusions in the report?
A. I'm not.
Q. Do you recognize the name James Kunkle?
A. I do recognize that name.
Q. From what?
A. I think he had some involvement in the prior phase of this case.
Q. Did you review any of the reports Mr. Kunkle

prepared for this case?
A. No, not in detail.
Q. What do you mean by not in detail?
A. I can't even -- I didn't even review his entire report.
Q. Okay. Are you aware he wrote three reports in this case?
A. I'm not.
Q. Do you know if Mr. Kunkle's reports are in your files?
A. It's quite possible that it is in an electronic file.
Q. You don't know?
A. I don't.
Q. Did you review Mr. Kunkle's deposition transcript for this case?
A. I did not.
Q. Did you review his hearing transcript for this case?
A. I did not.
Q. So you have not attempted to elaborate or amplify Mr. Kunkle's opinions?
MR. WANNIER: Objection. Vague.

MS. NIJMAN:
Q. You can answer.
MR. WANNIER: You can answer.
THE WITNESS:
A. I haven't.
MS. NIJMAN:
Q. Okay. Now, your report, Exhibit 1, cites on several occasions to the Federal CCR Regulations, correct?
A. It does.
Q. And you're familiar with those regulations, right?
A. I am.
Q. And you've also cited in your rebuttal report to the Illinois CCR Rules, correct?
A. I did.
Q. And are you familiar with the Illinois CCR Rules?
A. Yeah.
Q. And you would agree that both the federal and Illinois CCR Rules or Regulations apply to defined CCR impoundments?
MR. WANNIER: Objection. Legal conclusion.

A. Define scope.
Q. Well, are you thinking like a grid pattern across the stations?
MR. WANNIER: Objection. Vague. Foundation.
THE WITNESS:
A. I'm not thinking grid versus non-grid versus discreet versus integrated sampling. I'm not defining what that sampling program should be.
MS. NIJMAN:
Q. Okay. Would you agree that there may be areas of CCR ash that do not constitute a source?
A. No. If there's ash that's disposed of in historical fill areas, in all likelihood they are a source of groundwater contamination or certainly the probable or possible source of contamination.
Q. Well, you limited your answer to historical fill areas, that's not part of my question. I'm looking a little more broadly. Could there be areas of CCR ash not in a historic fill area that are not a source?
MR. WANNIER: Objection. Incomplete hypothetical.
THE WITNESS:
A. If you designed and operated a surface

investigation as to foundation of that could result in a remedy that doesn't meet the required cleanup objectives.

The second to the last paragraph is that kind of talking about conditions on site that might be or would be favorable to what folks might call an active remediation system. The groundwater is shallow, there's underlying ash porous and flows readily through the sand and gravel portions of the aquifer.

So those factors make an active treatment more practical and economically reasonable. And I mention, for example, pumping wells and/or chemical treatment, additives that are injected in the groundwater as examples.

And then the last paragraph talks about the coal combustion industry as well as Midwest Gen have considered electing over by removal to be a practical and economically reasonable closure alternative and that it's common -- I think I presented 127 examples around the country where that's been chosen -- and that closure by removal or excavation would remove the source of contaminants to be expected to improve groundwater quality over time.

Q. Thank you. But you are not recommending one

or more of these remedies in your report?
MR. WANNIER: Objection to the extent it mischaracterizes.
You can answer.
THE WITNESS:
A. I'm not recommending. I am presenting conditions and factors associated with the four plants that exist relative to potential opportunities for a remedy to be satisfactorily, reliably and within a reasonable amount of time.
MS. NIJMAN:
Q. So in the second to last paragraph you mentioned you talked about the potential, as an example, of captured by pumping wells and chemical treatment additives to be injected into the aquifer, do you see that reference?
A. Yes, ma'am.
Q. How does "capture by pumping wells" work when a facility is surrounded by canals or streams?
MR. WANNIER: Objection. Incomplete hypothetical.
THE WITNESS:
A. How does the system work when it's surrounded by streams, is that your question?

Q. And you reviewed the board's findings as to Joliet station, correct?
A. I did.
Q. And the board found groundwater impacts from CCRs in one location at that station, at MW9, correct?
A. I don't remember particularly if there were other wells that exceeded standards, but MW9 was certainly one of those.
Q. And MW9 is certainly within the GMZ, right? If you need to look at your maps and your report, feel free.
A. I don't believe I show the GMZ in the maps and my reports.
Q. MW9 is right near Pond 3, right?
A. Yeah --
MR. WANNIER: Objection. Vague as to the meaning of right in there.
THE WITNESS:
A. You know, I'd say GMZ is for an area around a hydraulically downgradient Ash Pond 1, 2 and 3, so I don't show the actual GMZ in my figures for Joliet.
Q. Have you determined what type of nature and extent investigation would be necessary at Joliet based on the board's findings?

A. I haven't.
Q. And you don't plan to?
A. Well, it's not my job to define the nature and -- design the investigation, it's Midwest Gen's.
Q. And you're not making any recommendations to Midwest Gen as to the nature of the investigation at Joliet 29?
MR. WANNIER: Objection. Mischaracterizes. Vague.
THE WITNESS:
A. Well, certainly recommendations would be to investigate areas that historical disposal and/or affiliate areas that were identified by the board and any others that have come up in the record, that would be a great starting spot.
Q. Anything else?
A. Like I said I haven't come up with a plan nor do I intend to, but that would be a great starting spot.
Q. Okay. Turning to Page 6, and that's a carryover of -- This is Page 6 of the Quarles Deposition Exhibit 1, which is a carryover of Section 2.2, Powerton Station Coal Ash Disposal. On Page 6 do you see, starting in the third full

MR. WANNIER: Objection. Incomplete hypothetical. Calls for speculation.
THE WITNESS:
A. I don't. And that's much of the information as we were previously talking about today under the nature and extent investigation study is that we discussed collecting information that would be sufficient to help someone design and implement a remedy.
MS. NIJMAN:
Q. What additional information in the FS/FAS area would be necessary?
MR. WANNIER: Objection. Calls for speculation.
THE WITNESS:
A. I don't know what -- in totality what information Midwest Gen has collected. But, again, I did talk about how some of the waste are 22 feet below ground surface. So how much is above groundwater, how much is below ground water, whether the hydraulic characteristics of the aquifer determined by actual testing, what is the extent of fly ash versus bottom ash versus cinders versus slag, all of that information would be very useful in evaluating a pumping and extraction and dewatering system at that location.

EXHIBIT 5

James R. Kunkel, Ph.D., P.E.
11341 West Exposition Drive
Lakewood, CO 80226

In the Matter of:	)	
	)	
SIERRA CLUB, ENVIRONMENTAL LAW AND POLICY CENTER, PRAIRIE RIVERS NETWORK, and CITIZENS AGAINST RUINING THE ENVIRONMENT	)	
	)	PCB 2013-015
Complainants,	)	
	)	(Enforcement – Water)
v.	)	
	)	
MIDWEST GENERATION, LLC,	)	
	)	
Respondent.	)	

Expert Report on Remedy for Ground-water Contamination

James R. Kunkel, Ph.D., P.E.

July 1, 2015

This expert report provides my professional technical analyses of possible remedy opinions and costs related to stopping or minimizing on-going ground-water contamination caused by leaky ash ponds and coal ash deposition on the ground surface outside the ash ponds at four coal-fired power plants (Joliet #29, Powerton, Waukegan, and Will County) in Illinois owned by Midwest Generation, LLC (MWG). My professional analyses and opinions are presented in the following paragraphs for each of the four power plants with 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.

SUMMARY OF CONCLUSIONS

- The remedy at all four power plant sites is the removal, hauling and backfilling of the existing ash ponds and selected areas of ash–impacted soils in order to reduce the ground-water contamination source terms;
- At Joliet #29, the remedy includes the ash ponds and the northeast ash landfill comprising approximately 393,000 tons of material. This remedy is estimated to cost between approximately $11.6 and $16.9 million;
- At Powerton, the remedy includes the ash ponds comprising approximately 1,354,000 tons of material. This remedy is estimated to cost between approximately $39.7 and $58.2 million;
- At Waukegan, the remedy includes the ash ponds and the ash/slag storage area comprising approximately 967,000 tons of material. This remedy is estimated to cost between approximately $28.3 and $41.5 million;
- At Will County, the remedy includes the ash ponds comprising approximately 186,000 tons of material. This remedy is estimated to cost between approximately $5.5 and $8.0 million; and
- For all four sites combined, the total remedy cost range is between approximately $84.9 and $124.6 million.

INTRODUCTION

General

The 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, 2015) form the bases for this remedy report. Those conclusions were that continued use of the ash ponds results in liner leaks due primarily to liner damage from dredging of the coal ash, liner leaks due to high ground-water tables in the vicinity of the ash ponds cause hydrostatic uplift when the pond water levels are below the water table, and ash deposits leached by rainfall, snowmelt and rising/falling ground-water levels. Poor liner construction is an initial cause of liner defects which results in leaking ponds and release of contaminated fluids into the underlying ground water. Existing unlined or Poz-o-Pac lined ash ponds also have caused ground-water contamination.

Also, coal ash was utilized in the construction of roadways, pond dikes and also for general land leveling at all four power plants (Kunkel, 2015). Coal ash also was stored or disposed of outside the ash ponds as a method of temporary or final coal ash disposal and placed on the ground surface. This 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.

Methodology

Based on existing soil borings and written documentation by MWG at the four power plant sites, I have been able to compile a database of estimated coal ash-impacted soil thickness for coal ash outside the ash ponds. I utilized this database to estimate the quantities of coal ash subject to leaching for each site. At

some sites the areal extent and depth of coal ash outside the ash ponds is extensive, as discussed below. I calculated the volumes of coal ash-impacted soil outside the ash ponds at each site by multiplying the total area defined by soil borings times the average thickness of coal ash-impacted soils based on those borings. If the ash ponds were removed, removal of the area outlined by the soil borings adjacent to the ash ponds, except at the Joliet #29 and Waukegan sites, would constitute a minimal remedy for those sites. At Joliet, the remedy is removal of not only the ash ponds, but also the northeast ash landfill. At Waukegan, the remedy is removal of not only the ash ponds, but also additional ash outside the ash ponds.

Continued use of ash ponds at the Joliet #29, Powerton, Waukegan and Will County generating stations is limited due to geographical restrictions contained in the USEPA (2014) coal combustion residual rule. That rule, in part, states that existing ash ponds must have their "base located no less than five feet above the uppermost aquifer" and "that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the pond and uppermost aquifer due to normal fluctuations in groundwater elevations (including groundwater elevations during the wet season)." Ash ponds constructed without a composite (or alternative composite) liner that meets the USEPA (2014) rule must either be retrofitted with an acceptable composite liner or closed. None of the MWG ash ponds at the four sites of interest meet either of the above requirements.

In-place capping of existing ash ponds is not a remedy due to the high likelihood that the existing ash pond liners at all four sites are either leaking, likely to leak due to high water table elevations, or do not meet the geographical restrictions of USEPA (2014). Rather, 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.

The cost of removing the coal ash at each site, whether site-wide or only for the ash ponds, was based on local bid tabulations for removal and disposal of contaminated soils in northern Illinois and southern Wisconsin. Eleven different contractor bids were utilized for the years 2013 and 2014 which are representative of current soil removal and disposal costs. The unit costs utilized include the cost for a volume of uncontaminated soil equal to the volume of coal ash-impacted soil that would replace the contaminated soil removed. Pond removal costs at the four MWG power plant sites were estimated as though the ponds were coal ash-impacted soil having the same thickness defined by nearby soil borings. These soil borings were typically at the pond sites.

At all of the sites, I recommend that additional soil borings be done to better define the areal extent and thickness of coal ash-impacted soils. The number and locations of additional soil borings are based on engineering judgement. The unit cost of these additional soil borings assumes a geoprobe with a two-person crew. Additional monitoring also is recommended at the four MWG power plant sites as part of the remedies. The cost of these additional monitoring wells also assumed a drill rig with a two person crew.

<u>Cost Bases</u>

Local Bid Tabulations for Removal Existing Coal Ash-Impacted Soils and Ash Ponds. The cost basis for excavation, hauling, and backfilling with uncontaminated soil is based on 11 bid tabulations for northern Illinois and southern Wisconsin in 2013 and 2014 as shown in Table 1. The average unit cost from the bid tabulations is $29.27 per ton of material excavated, hauled and backfilled. The average unit cost for similar excavation and hauling of coal ash/soil estimated for MWG by Patrick Engineering. Inc. (Bates Nos. 6823-6843) was given as $42.95 per ton for loading and hauling only to a municipal solid waste (MSW) landfill in Illinois. The Patrick unit cost of $42.95 per ton is credible based on the off-site disposal at a MSW facility. The average bid tabulation unit cost of $29.27 per ton for soil contaminated with coal ash was utilized as a

reasonable value in estimating the cost to remove and dispose of coal ash-impacted soils from the four power plant sites; whereas, the Patrick unit cost of 42.95 was utilized as a higher estimate. Therefore, a range of unit costs from $29.27 to $42.95 per ton were utilized at each power plant site to estimate the costs to remove the existing ash ponds and ash-impacted soils at each site, haul the material removed to an existing landfill and backfill the excavated areas. An additional contractor mobilization cost of approximately $25,000 was added to the total excavation, hauling and backfilling cost at each site, although this mobilization cost is small compared to the excavation, hauling and backfilling cost.

Additional Soil Borings. The cost of additional soil borings at each site was assumed based on the existing soil borings already completed at the site as well as the locations of suspected or known site coal ash disposal which had not been well documented either in its areal extent or thickness. I assumed that a daily geoprobe cost was $1,500.00 per day for a two-person crew. No mobilization or de-mobilization costs were assumed in addition to this daily rate. I assumed that 8 geoprobe soil borings per day could be completed. This cost also is small compared to the excavation, hauling and backfilling costs for ash-impacted soils at each site.

Additional Ground-water Monitoring Wells. The cost of additional ground-water monitoring wells is not estimated in this report, because the numbers and locations of these monitoring wells are unknown at this time. However, additional ground-water monitoring is not a necessary prerequisite for the minimal remedy discussed above.

JOLIET #29

Coal Ash-Impacted Soil Estimates

The quantity of coal ash impacted soils at the Joliet site is based on the total land area inside the solid red perimeter line shown on Figure 1. This total area was estimated to be 251 ac including the areas described for the ponds and the old coal ash landfills (Bates Nos. 48403-48414). Within this 251-ac site area is a smaller pond area located inside the dashed red perimeter line. This pond area was estimated to be 15 ac. Additionally, within the 251-ac site area, there are two old coal ash landfill areas northeast and southwest of the power plant and ponds as shown on Figure 1. These two coal ash landfills are estimated to have areas of 44 and 34 ac respectively. The coal ash-impacted soil area for the pond area and northeast landfill is summarized for the Joliet #29 site on Table 6.An estimate of the coal ash-impacted soil volumes for the site area and the ash pond area was made from existing soil borings shown on Figure 1 and the average estimated thickness of coal ash-impacted soils from the borehole logs summarized in Table 2. Because no definitive soil borings showing coal ash thickness are available for the northeast coal ash landfill, it is not possible to make precise estimates of the coal ash volumes at that site. However, it was assumed that, on average, the coal ash-impacted soil thickness at the northeast ash landfill was 4 ft. This assumption is based upon spreading dump truck loads of ash using a dozer.

Utilizing the site area (251 ac) and its average coal ash thickness of 1.4 ft as shown in Table 2, the total site-wide coal ash-impacted soils is calculated to be on the order of 567,000 yds^3 as shown in Table 6. However, there may be over 281,000 yds^3 in just the old northeast coal ash landfill depending on future soil boring data. The ash pond area of 15 ac is estimated to have approximately 33,880 yds^3 of coal ash-impacted soils (Table 6). The total volume of coal ash-impacted soils at the Joliet #29 power plant site may range from approximately 33,900 to 567,200 yds^3. Approximately 314,000 yds^3 may be in the pond area and northeast landfill areas. Removal of the coal ash-impacted soils and the ash ponds in these two areas would significantly reduce the potential ground-water contamination source-term at the Joliet #29 plant site in my opinion.

Additional Soil Borings

Visual inspection of Figure 1 indicates that only about one-half of the Joliet #29 total site area has soil borings which could characterize the thickness of coal ash-impacted soils. Thus, I conclude that additional soil borings are required at the site, especially in the northeast coal ash landfill area. I recommend that at least one geoprobe soil boring per two acres be completed with 20 around the perimeter of the northeast coal ash landfill and 22 in the interior of the landfill for a total of 42 soil borings. An additional 15 soil borings should be completed in the area north and east of the existing coal pile at the Joliet #29 site. A minimum 57 total additional soil borings for the Joliet #29 site are necessary to assess the thickness of coal ash-impacted soils in areas without any soil borings.

Additional Ground-water Monitoring

Leaching of coal ash at the old northeast coal ash landfill is most likely partly responsible for the ground-water contamination seen in the Joliet #29 ground-water monitoring wells. Additionally, it is likely that ground-water contamination from leaching of coal ash at the old southwest coal ash landfill also is occurring but is not monitored by the existing up-gradient ground-water monitoring wells. To confirm this, additional ground-water monitoring wells should be installed in the northeast coal ash landfill area. The number and cost of these additional ground-water monitoring wells are not estimated.

Coal Ash-Impacted Soil Remedy Cost for Joliet #29

For the Joliet #29 power plant site, the remedy is the removal of coal ash-impacted soil as well as the existing ash ponds. The cost of this remedy is the cost of coal ash-impacted soil excavation and hauling to an approved off-site landfill and backfilling with soil to achieve the pre-removal ground-surface contours. This remedy also would include 57 additional soil borings to better characterize the coal ash-impacted soil thickness of the northeast coal ash landfill as well as the area north and east of the existing coal storage area.

The volume of coal ash-impacted soils is the volume shown in Table 6 for the northeast coal ash landfill and the pond areas (a total of 59 ac) totaling approximately 314,000 yds^3. Assuming a dry unit weight per yd^3 of 1.25 tons and a low unit cost of $29.27 per ton, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $11.5 million as shown in Table 6. If the high unit cost of $42.95 per ton is used, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $16.9 million, also as shown in Table 6.

The cost of 57 additional geoprobe soil borings at the site, assuming 8 borings per day and $1,500 per day for a geoprobe unit, is estimated to be $11,000. The average mobilization cost for the coal ash-impacted soil equipment is estimated to be approximately $25,000, also as shown in Table 1. Therefore the total estimated cost for the coal ash-impacted soil remedy ranges from approximately $11.6 to $16.9 million for the Joliet #29 site. If only the pond areas are reclaimed, the coal ash-impacted soil remedy ranges from approximately $1.3 to $1.8 million. These estimates are highly dependent on the coal ash-impacted soil thickness assumed for the northeast coal ash landfill. A rather small change in this thickness will significantly change the total estimated cost for this remedy.

POWERTON

Coal Ash-Impacted Soil Estimates

The quantity of coal ash impacted soils at the Powerton site is based on the total land area inside the solid blue perimeter line shown on Figure 2. The total land area of the Powerton site is 2,314 ac (Bates Nos. 48415-48426) which includes Powerton Lake. Only the land area shown in the solid blue perimeter line was utilized as the site area where coal ash-impacted soils may be present. This site area was estimated to be 349 ac, which includes the area described for the ponds and the former ash pond shown inside the solid

red line. Within this 349-ac area is a smaller pond area located inside the dashed blue line. This pond area was estimated to be 73 ac. Additionally, within the 73-ac total area, there is the unlined Former Ash Pond area shown inside the solid red line on Figure 2. These coal ash-impacted areas are summarized for the Powerton site on Table 6.

From existing soil borings shown on Figure 2 and the average estimated thickness of ash-impacted soils from the borehole logs summarized in Table 3, an estimate of the coal ash-impacted soil volumes for the site area and the ash pond area was made. Because no definitive soil borings showing coal ash thickness are available for the northeast and southwest areas of the site, it is not possible to make precise estimates of the coal ash volumes at these two sites. However, it was assumed that the average coal ash-impacted soil thickness shown in Table 3 for the site area is representative and is equal to 6.6 ft.

Utilizing the average total site area (349 ac) and its average coal ash thickness of 6.6 ft, as shown in Table 3, the total site-wide coal ash-impacted soils is calculated to be on the order of 3,720,000 yds^3 as shown in Table 6. The ash pond area of 73 ac is estimated to have approximately 1,084,000 yds^3 of coal ash-impacted soils (Table 6) based on an average coal ash-impacted soil thickness of 9.2 ft for the pond area. The total volume of coal ash-impacted soils at the Powerton power plant site may range from approximately 1,084,000 to 3,720,000 yds^3. Removal of the 1,084,000 yds^3 of coal ash-impacted soils and the ash ponds at Powerton would reduce the ground-water contamination source-term at the Powerton plant site.

Additional Soil Borings

Visual inspection of Figure 2 indicates that only the extreme northeast and southwest portions of the Powerton total site area lack soil borings which could characterize the thickness of coal ash-impacted soils. Thus, additional soil borings are required at the site especially in these two areas. I recommend that at least one geoprobe soil boring be completed every 300 ft around the perimeter of the northeast and southwest extremes of the site for a total of 15 soil borings. These would be the minimum total additional soil borings for the Powerton site in order to assess the thickness of coal ash-impacted soils in those areas.

Additional Ground-water Monitoring

Monitoring Well MW-16 is an up-gradient ground-water monitoring well. However, to better assess potential down-gradient ground-water quality impacts and to establish whether removal of the existing ash ponds is an acceptable remedy at the Powerton site, I recommend that at least one or more ground-water monitoring wells be located north of the site between MW-4 and the Illinois River and at least one ground-water monitoring well be located southwest of soil boring B-31. Additional ground-water monitoring also should be located near the location of soil boring GT-2. Figure 2 shows the locations of the existing ground-water monitoring wells and soil borings. The number and cost of these additional ground-water monitoring wells are not estimated in this report.

Coal Ash-Impacted Soil Remedy Cost for Powerton

For the Powerton site, the remedy is the removal of coal ash-impacted soil as well as the existing ash ponds. The cost of this remedy is the cost of coal ash-impacted soil excavation and hauling to an approved off-site landfill and backfilling with soil to achieve the pre-removal ground-surface contours. This remedy also would include 15 additional soil borings to better characterize the coal ash-impacted soil thickness of the northeast and southwest areas of the site as well as the area north and east of the existing coal storage area.

I assumed that the volume of coal ash-impacted soils is the volume shown in Table 6 for the pond areas (73 ac) totaling approximately 1,084,000 yds^3. Assuming a dry unit weight per yd^3 of 1.25 tons and a low unit cost of $29.27 per ton, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $39.6 million as shown in Table 6. If the high unit cost of $42.95 per ton is

used, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $58.2 million, also as shown in Table 6.

The cost of 15 additional geoprobe soil borings at the site, assuming 8 borings per day and $1,500 per day for a geoprobe unit, is estimated to be $3,000. The average mobilization cost for the coal ash-impacted soil equipment is estimated to be approximately $25,000 also as shown in Table 1. Therefore, the total estimated cost for the coal ash-impacted soil remedy ranges from approximately $39.7 to $58.2 million for the Powerton site. These estimates are highly dependent on the assumed coal ash-impacted soil thickness estimated for the ash pond area.

WAUKEGAN

Coal Ash-Impacted Soil Estimates

The quantity of coal ash-impacted soils at the Waukegan site is based on the total land area inside the red perimeter line shown on Figure 3. This site area was estimated to be 249 ac (Bates Nos. 48427-48432), including the area described for the ponds and the former coal ash/slag storage area shown inside the solid blue line. Within this 249-ac area is a smaller pond and coal ash/slag storage area located inside the dashed red and solid red perimeter line. This pond and coal ash/slag area was estimated to be 44 ac, as shown on Figure 3. These coal ash-impacted areas are summarized for the Waukegan site on Table 6.

I calculated the coal ash-impacted soil volumes for the site area and the ash pond area from existing soil borings shown on Figure 3 and the average estimated thickness of coal ash-impacted soils from the borehole logs summarized in Table 4. The average coal ash-impacted soil thickness for the site area, based on the available soil borings, is 5.3 ft. Utilizing the average site area (249 ac) and its average coal ash thickness of 5.3 ft as shown in Table 4, the site-wide coal ash-impacted soils is calculated to be on the order of 2,129,000 yds^3, as shown in Table 6. The ash pond and coal ash/slag storage areas of 44 ac is estimated to have approximately 774,000 yds^3 of coal ash-impacted soils (Table 6), based on an average coal ash-impacted soil thickness of 10.9 ft for these areas. The total volume of coal ash-impacted soils at the Waukegan power plant site may range from approximately 774,000 to 2,129,000 yds^3. Removal of the 774,000 yds^3 of coal ash-impacted soils, the ash ponds and coal ash/slag storage area would significantly reduce the ground-water contamination source-term at the Waukegan plant site.

Additional Soil Borings

Visual inspection of Figure 3 indicates that the Waukegan total site area most likely has sufficient soil borings to adequately characterize the thickness of coal ash-impacted soils. Thus, no additional soil borings are required at the site.

Additional Ground-water Monitoring

Visual inspection of Figure 3 indicates that the Waukegan total site area likely has sufficient ground-water monitoring to adequately monitor the impacts of removal of the ash ponds and the coal ash/slag storage area. Thus, no additional ground-water monitoring wells are required at the Waukegan site.

Coal Ash-Impacted Soil Remedy Cost for Waukegan

For the Waukegan power plant site, the removal of coal ash-impacted soils in the coal ash/slag storage area as well as the existing ash ponds is assumed to be the remedy. The cost of this remedy is the cost of coal ash-impacted soil excavation and hauling to an approved off-site landfill and backfilling with soil to achieve the pre-removal ground-surface contours.

I assumed that the volume of coal ash-impacted soils is the volume shown in Table 6 for the coal ash/slag and ash pond areas (a total of 44 ac) totaling approximately 774,000 yds^3. Assuming a dry unit weight per yd^3 of 1.25 tons and a unit cost of $29.27 per ton, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $28.3 million, as shown in Table 6. If the high unit cost of $42.95 per ton is used, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $41.5 million, also as shown in Table 6.

The average mobilization cost for the coal ash-impacted soil equipment is estimated to be approximately $25,000, also as shown in Table 1. Therefore, the total estimated cost for the coal ash-impacted soil remedy ranges from approximately $28.3 to $41.5 million for the Waukegan site. This estimate is highly dependent on the assumed coal ash-impacted soil thickness.

WILL COUNTY

Coal Ash-Impacted Soil Estimates

The quantity of coal ash-impacted soils at the Will County site is based on the total land area inside the red perimeter line shown on Figure 4. This total area was estimated to be approximately 215 ac (Bates Nos. 48433-48438) including the area described for the ponds shown inside the dashed red line. Within this 215-ac area is a smaller pond area located inside the dashed red and solid red perimeter line. This pond area was estimated to be 20 ac, as shown on Figure 4. These coal ash-impacted areas are summarized for the Will County site on Table 6.

From existing soil borings shown on Figure 4 and the average estimated thickness of coal ash-impacted soils from the borehole logs summarized in Table 5, I made an estimate of the coal ash-impacted soil volumes for the total area and the ash pond area. The average coal ash-impacted soil thickness for the site area, based on the available soil borings, is 2.1 ft. Utilizing the average total site area (215 ac) and its average coal ash thickness of 2.1 ft, as shown in Table 5, the total site-wide coal ash-impacted soils are calculated to be on the order of 728,000 yds^3, as shown in Table 6. The ash pond area of 20 ac is estimated to have approximately 148,000 yds^3 of coal ash-impacted soils (Table 6) based on an average coal ash-impacted soil thickness of 4.6 ft for that area. The total volume of coal ash-impacted soils at the Will County power plant site may range from approximately 148,000 to 728,000 yds^3. Removal of the 148,000 yds^3 of coal ash-impacted soils and the ash ponds would significantly reduce the ground-water contamination source-term at the Will County plant site.

Additional Soil Borings

Visual inspection of Figure 4 indicates that the Will County total site area most likely has sufficient soil borings to adequately characterize the thickness of coal ash-impacted soils. Thus, no additional soil borings are required at the site.

Additional Ground-water Monitoring

Visual inspection of Figure 4 indicates that the Will County total site area most likely has ground-water monitoring to adequately assess the impacts of removal of the ash ponds area. I recommend that one up-gradient ground-water monitoring well be installed at the north boundary of the site near East Romeo Road and the Des Plaines River to assess overall ground-water flow direction at the site. However, this is not a prerequisite for the remedy discussed above.

Coal Ash-Impacted Soil Remedy Cost for Will County

For the Will County site, the remedy is the removal of coal ash-impacted soils in the existing ash pond area. The cost of this remedy is the cost of coal ash-impacted soil excavation and hauling to an approved off-site landfill and backfilling with soil to achieve the pre-removal ground-surface contours.

For purposes of this report, the volume of coal ash-impacted soils is assumed to be the volume shown in Table 6 for the ash pond area (a total of 20 ac) totaling approximately 148,000 yds^3. Assuming a dry unit weight per yd^3 of 1.25 tons and a low unit cost of $29.27 per ton, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $5.4 million, as shown in Table 6. If the high unit cost of $42.95 per ton is used, the estimated cost to excavate, haul and backfill this volume of coal ash-impacted soil is approximately $8.0 million, also as shown in Table 6.

The average mobilization cost for the coal ash-impacted soil equipment is estimated to be approximately $25,000, also as shown in Table 1. Therefore, the total estimated cost for the coal ash-impacted soil remedy would range from approximately $5.5 to $8.0 million for the Will County site. This estimate is highly dependent on the assumed coal ash-impacted soil thickness.

CONCLUSIONS

- The remedy at all four power plant sites is the removal, hauling and backfilling of the existing ash ponds and selected areas of ash–impacted soils in order to reduce the ground-water contamination source terms;
- At Joliet #29, the remedy includes the ash ponds and the northeast ash landfill comprising approximately 393,000 tons of material. This remedy is estimated to cost between approximately $11.6 and $16.9 million;
- At Powerton, the remedy includes the ash ponds comprising approximately 1,354,000 tons of material. This remedy is estimated to cost between approximately $39.7 and $58.2 million;
- At Waukegan, the remedy includes the ash ponds and the ash/slag storage area comprising approximately 967,000 tons of material. This remedy is estimated to cost between approximately $28.3 and $41.5 million;
- At Will County, the remedy includes the ash ponds comprising approximately 186,000 tons of material. This remedy is estimated to cost between approximately $5.5 and $8.0 million; and
- For all four sites combined, the total remedy cost range is between approximately $84.9 and $124.6 million.

REFERENCES

ENSR Consulting. 1998b. Phase II Environmental Site Assessment of the Cornmonwealth Edison Joliet #29 Generating Station, 1800 Channahon Road, Joliet, Illinois. Report prepared for Commonwealth Edison Company. December. 4 Sections. 5 tables. 6 figs. 3 appendices. (MWG13-15_2459-2495)

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. 7 Sections. 2 figs. (MWG13-15_143-176)

ENSR Consulting. 1998d. Phase II Environmental Site Assessment of the ComEd Waukegan Generating Station, 10 Greenwood Avenue, Waukegan, Illinois. Report prepared for Commonwealth Edison Company. November 16. 4 Sections. 5 tabs. 6 figs. 3 appendices. (MWG13-15_5058-5092) (MWG13-15_11966-12002)

ENSR Consulting. 1998e. Commonwealth Edison Company, Phase II Environmental Site Assessment, Will County Generating Station, 529 East Romeo Road, Romeoville, Illinois. Report prepared for Commonwealth Edison Company. December 7. 4 Sections. 5 tabs. 6 figs. 3 appendices. (MWG13-15_5699-6039)

KPRG and Associates, Inc. 2005a. Summary Letter, Geotechnical Analysis of Soil Surrounding Settling Basins/Ponds. Report prepared for Midwest Generation EME, LLC. October 13. 6 p. 1 table, 4 Attachments. (MWG13-15_24264-24386)

KPRG and Associates, Inc. 2005b. Coal Ash and Slag Removal Summary Letter, Coal Ash and Slag Removal, Joliet Station #29. Report prepared for Midwest Generation, LLC. December. 3 p. 1 figure, 1 table, 3 Attachments. (MWG13-15_18823-19015)

KPRG and Associates, Inc. 2005c. Inspection Summary Letter, Liner Inspection West and East Ash Pond at the Waukegan Generation Station. Report prepared for Midwest Generation EME, LLC. 4 p., Attachment 1, Photographs. (MWG13-15_12828-12845)

KPRG and Associates, Inc., 2009a. Inspection Summary Letter, Joliet #29 Former Ash Burial Area Runoff Inspection 2009. Report prepared for Midwest Generation, LLC. August 27. 3 p. 1 Attachment. (MWG13-15_19442-19452)

KPRG and Associates, Inc. 2009b. Erosion Repair Documentation, Joliet #29 Former Ash Burial Area Runoff Erosion Repair Documentation. Report prepared for Midwest Generation, LLC. September 26. 3 p. Attachments. (MWG13-15_19430-19441)

KPRG and Associates, Inc., 2010. Erosion Repair Documentation, Joliet #29 Former Ash Burial Area Runoff Erosion Repair Documentation 2010. Report prepared for Midwest Generation, LLC. September 16. 3 p. 1 Attachment. (MWG13-15_19461-19468)

KPRG and Associates, Inc. 2012a. Inspection Summary Letter and Repair Cost Estimate, Joliet #29 Former Ash Burial Area Runoff Inspection 2012. Report prepared for Midwest Generation, LLC. September 19. 3 p. 1 Attachment. (MWG13-15_19470-19473)

KPRG and Associates, Inc. 2012b. Joliet #29 Former Ash Burial Area Runoff Erosion Repair Documentation 2012. Report prepared for Midwest Generation, LLC. September 26. 3 p. 1 Attachment. (MWG13-15_19474-19481)

KPRG and Associates, Inc. 2013. 2013 Inspection Summary Letter, Joliet #29 Former Ash Burial Area Runoff Inspection 2013. Report prepared for Midwest Generation, LLC. August 21. 1 p. (MWG13-15_19483-19483)

Kunkel, J.R., 2015. Case Number PCB 2013-015. Expert Report on Ground-water Contamination. June 1. 42 p. 8 tables, 31 figures.

Patrick Engineering, Inc. (Patrick) 2011a. Hydrogeologic Assessment Report, Joliet Generating Station No. 29, Joliet, Illinois. Report submitted to the Illinois Environmental Protection Agency. February, Patrick Project No. 21053.070. 9 p., 3 tabs. 5 figs, Apps. A through D. (Comp. 003487-003609)

Patrick Engineering, Inc. (Patrick) 2011b. Hydrogeologic Assessment Report, Powerton Generating Station, Pekin, Illinois. Report submitted to the Illinois Environmental Protection Agency. February, Patrick Project No. 21053.070. 9 p., 3 tabs, 5 figs, Apps. A through D. (Comp. 003611-003683)

Patrick Engineering, Inc. (Patrick) 2011c. Hydrogeologic Assessment Report, Waukegan Generating Station, Waukegan, Illinois. Report submitted to the Illinois Environmental Protection Agency. February, Patrick Project No. 21053.070. 9 p., 3 tabs, 5 figs, Apps. A through D. (Comp. 003684-003775)

Patrick Engineering, Inc. (Patrick) 2011d. Hydrogeologic Assessment Report, Will County Generating Station, Romeoville, Illinois. Report submitted to the Illinois Environmental Protection Agency. February, Patrick Project No. 21053.070. 9 p., 3 tabs, 5 figs, Apps. A through D. (Comp. 003776-003886)

U.S. Environmental Protection Agency (USEPA). 2010. 2010 Questionnaire for the Steam Electric Generating Effluent Guidelines ("the 2010 EPA survey"). Questionnaires for Joliet #29, Powerton, Waukegan, and Will County. (MWG13-15_823-2458)

U.S. Environmental Protection Agency (USEPA). 2014. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities [RIN-2050-AE81; FRL-9149-4]. December 10. 745 p. (Comp. 018103-018847)

ATTACHMENTS

Table 1 Summary of Bid Tabulation Unit Costs for Removal of Contaminated Soils
Table 2 Summary of Joliet #29 Ash Deposits Located Outside the Ash Ponds Based on Monitoring Well and Soil Boring Logs
Table 3 Summary of Powerton Ash Deposits Located Outside the Ash Ponds Based on Monitoring Well and Soil Boring Logs
Table 4 Summary of Waukegan Ash Deposits Located Outside the Ash Ponds Based on Monitoring Well and Soil Boring Logs
Table 5 Summary of Will County Ash Deposits Located Outside the Ash Ponds Based on Monitoring Well and Soil Boring Logs
Table 6 Summary of Ash-Impacted Soil Volumes and Removal Costs for each MWG Power Plant

Figure 1 Joliet #29 Soil Boring Locations
Figure 2 Powerton Soil Boring Locations
Figure 3 Waukegan Soil Boring Locations
Figure 4 Will County Soil Boring Locations

Table 1

Summary of Bid Tabulation Unit Costs for Removal of Contaminated Soils (Case No. PCB 2013-015)

	Unit Cost ($)[3]			
	Item 1	Item 2		
Contractor	Mobilization (Lump Sum)	Contaminated Soil Excavation, Hauling & Backfilling ($/Ton)	Contractor Location (State)	Source
1	6,829.00	18.50	WI	(1)
2	44,000.00	40.00	WI	(1)
3	12,000.00	25.07	WI	(1)
4	17,750.00	25.00	WI	(1)
5	45,000.00	26.40	WI	(1)
6	36,000.00	25.00	WI	(1)
7	23,000.00	41.00	IL	(1)
8	16,800.00	35.00	IL	(1)
9	--	26.00	WI	(2)
10	--	31.00	WI	(2)
11	--	29.05	WI	(2)
Average	$25,172.38	$29.27		
Std. Dev	$14,661.66	$6.91		
Max.	$45,000.00	$41.00		
Min.	$6,829.00	$18.50		
N	8	11		
Patrick[4]	--	$42.95	Illinois	Bates Nos. 6823-6843

(1) Project 13-2032 KEP Interim Action Soil Remediation. Bid Date: October 16, 2013.
(2) Project 14-2033 Soil Remediation. Bid Date: November 12, 2014.
(3) The unit cost includes the cost of contaminated soil excavation, hauling, and backfilling.
(4) Not included in the statistics and does not include backfilling.

Table 2

Summary of Joliet #29 Ash Deposits Located Outside the Ash Ponds Based on Monitoring Well and Soil Boring Logs (Case No. PCB 2013-015)

Boring or Monitoring Well ID[(1)]	Depths of Ash[(2)] (ft. bgs)	Thickness of Ash[(3)] (ft)	Source[(4)]
MW-1	N/A[(5)]	--	Patrick (2011a)
MW-2	N/A	--	Patrick (2011a)
MW-3	N/A	--	Patrick (2011a)
MW-4	N/A	--	Patrick (2011a)
MW-5	N/A	--	Patrick (2011a)
MW-6	N/A	--	Patrick (2011a)
MW-7	N/A	--	Patrick (2011a)
MW-8	N/A	--	Patrick (2011a)
MW-9	N/A	--	Patrick (2011a)
MW-10	N/A	--	Patrick (2011a)
MW-11	N/A	--	Patrick (2011a)
B-1	N/A	--	ENSR (1998b)
B-3	A[(6)]	Unknown	ENSR (1998b)
B-4	A	Unknown	ENSR (1998b)
B-6	A		ENSR (1998b)
B-8	N/A	--	ENSR (1998b)
B-9	A	Unknown	ENSR (1998b)
B-10	A	Unknown	ENSR (1998b)
B-11	A	Unknown	ENSR (1998b)
B-12	N/A	--	ENSR (1998b)
B-13	A	Unknown	ENSR (1998b)
B-14	N/A	--	ENSR (1998b)
B-15	N/A	--	ENSR (1998b)
B-16	A	Unknown	ENSR (1998b)
B-17	A	Unknown	ENSR (1998b)
B-18	N/A	--	ENSR (1998b)
B-19	A	Unknown	ENSR (1998b)
B-20	N/A	--	ENSR (1998b)
JS29-GT-1	0 - 1	1	KPRG (2005a)
JS29-GT-2	0 - 1	1	KPRG (2005a)
JS29-GT-3	0 - 1	1	KPRG (2005a)
JS29-GT-4	N/A	--	KPRG (2005a)
JS29-GT-5	N/A	--	KPRG (2005a)
JS29-GT-6	0 - 2.5	2.5	KPRG (2005a)
Former Ash Disposal Area (Northeast of Plant Site and Ash Ponds)	Unknown	Unknown	KPRG (2009a, b), KPRG (2010), KPRG (2012a, b), KPRG (2013), ENSR (1998b)
Former Ash Disposal Area (Southwest of Plant Site and Ash Ponds)	Unknown	Unknown	ENSR (1998b)
	Mean	1.4	
	Std. Dev.	0.75	
	Max.	2.5	
	Min.	1	
	N	4	

(1) MW designates a monitoring well. All other designations are borings.
(2) Depth below ground surface from boring logs.
(3) Difference in maximum and minimum depth bgs.
(4) Reference or Bates Numbers.
(5) N/A = no ash in boring log.

Table 3

Summary of Powerton Ash Deposits Located Outside the Ash Ponds
Based on Monitoring Well and Soil Boring Logs (Case No. PCB 2013-015)

Boring or Monitoring Well ID[(1)]	Depths of Ash[(2)] (ft. bgs)	Thickness of Ash[(3)] (ft)	Source[(4)]
MW-1	N/A[(5)]	0	Patrick (2011b)
MW-2	N/A	0	Patrick (2011b)
MW-3	N/A	--	Patrick (2011b)
MW-4	N/A	--	Patrick (2011b)
MW-5	0 - 12.5	12.5	Patrick (2011b)
MW-6	0 - 18	18	Patrick (2011b)
MW-7	0 - 13.5	13.5	Patrick (2011b)
MW-8	0 - 24.5	24.5	Patrick (2011b)
MW-9	0 - 17	17	Patrick (2011b)
MW-10	N/A	0	Patrick (2011b)
MW-11	0 - 16	16	Bates Nos. 40059-40062
MW-12	0 - 18.5	18.5	Bates Nos. 40059-40062
MW-13	0 - 15	15	Patrick (2011e)
MW-14	0 - 18.5	18.5	Patrick (2011e)
MW-15	0 - 20	20	Patrick (2011e)
MW-16	N/A	0	REF?
B-1	N/A	0	ENSR (1998c)
B-4	N/A	0	ENSR (1998c)
B-5	N/A	0	ENSR (1998c)
B-6	N/A	0	ENSR (1998c)
B-9	0 - 8	8	ENSR (1998c)
B-10	0 - 6	6	ENSR (1998c)
B-11	0 - 7	7	ENSR (1998c)
B-12	0 - 6	6	ENSR (1998c)
B-13	0 - 8	8	ENSR (1998c)
B-14	4 - 16	12	ENSR (1998c)
B-15	N/A	0	ENSR (1998c)
B-16	N/A	0	ENSR (1998c)
B-17	N/A	0	ENSR (1998c)
B-18	N/A	0	ENSR (1998c)
B-19	0 - 12	12	ENSR (1998c)
B-21	0 - 3.5	3.5	ENSR (1998c)
B-22	0 - 4	4	ENSR (1998c)
B-23	0 - 12	12	ENSR (1998c)
B-25	0 - 4	4	ENSR (1998c)
B-26	4 - 8	4	ENSR (1998c)
B-27	8 - 20	12	ENSR (1998c)
B-30	0 - 0.5	0.5	ENSR (1998c)
B-31	4 - 20	16	ENSR (1998c)
B-32	N/A	0	ENSR (1998c)
B-33	16 - 20	4	ENSR (1998c)
B-34	N/A	0	ENSR (1998c)
B-35	N/A	0	ENSR (1998c)
B-36	N/A	0	ENSR (1998c)
PS-GT-1	N/A	0	KPRG (2005a)
PS-GT-2	N/A	0	KPRG (2005a)
PS-GT-3	0 - 1	1	KPRG (2005a)
PS-GT-4	N/A	0	KPRG (2005a)

Table 3

Summary of Powerton Ash Deposits Located Outside the Ash Ponds
Based on Monitoring Well and Soil Boring Logs (Case No. PCB 2013-015)

Boring or Monitoring Well ID[(1)]	Depths of Ash[(2)] (ft. bgs)	Thickness of Ash[(3)] (ft)	Source[(4)]
PS-GT-5	2 - 4	2	KPRG (2005a)
PS-GT-6	1 - 6	5	KPRG (2005a)
PS-GT-7	2 - 13	11	KPRG (2005a)
PS-GT-8	2.5 - 15	12.5	KPRG (2005a)
PS-GT-9	3 - 14	11	KPRG (2005a)
AP-3	0 - 2	2	Bates Nos. 14225-14269
AP-4	0 - 19	19	Patrick (2008)
AP-5	0 - 9.7	9.7	Patrick (2008)
AP-6	0 - 10	10	Patrick (2008)
AP-8	0 - 5.3	5.3	Patrick (2008)
AP-9	0.5 - 10	9.5	Patrick (2008)
AP-10	0.5 - 10	9.5	Patrick (2008)
AP-11	N/A	0	Patrick (2008)
AP-12	0 - 3	3	Patrick (2008)
AP-13	0 - 8	8	Patrick (2008)
AP-14	0 - 7.5	7.5	Patrick (2008)
AP-15	0 - 5	5	Patrick (2008)
AP-16	0 - 9.5	9.5	Patrick (2008)
APB-1-08	1 - 31	30	Patrick (2008)
APB-2-08	1 - 23	22	Patrick (2008)
APB-3-08	N/A	0	Patrick (2008)
APB-4-08	N/A	0	Patrick (2008)
APB-5-08	N/A	0	Patrick (2008)
APB-6-08	N/A	0	Patrick (2008)
APB-7-08	N/A	0	Patrick (2008)
APB-8-08	N/A	0	Patrick (2008)
APB-9-08	1 - 4.5	3.5	Patrick (2008)
APB-10-08	N/A	0	Patrick (2008)
	Mean	6.6	
	Std. Dev.	7.30	
	Max.	30	
	Min.	0	
	N	74	

(1) MW designates a monitoring well. All other designations are borings.
(2) Depth below ground surface from boring logs.
(3) Difference in maximum and minimum depth bgs.
(4) Reference or Bates Numbers.
(5) N/A means no ash identified in boring log.

Table 4

Summary of Waukegan Ash Deposits Located Outside the Ash Ponds
Based on Monitoring Well and Soil Boring Logs (Case No. PCB 2013-015)

Boring or Monitoring Well ID[(1)]	Depths of Ash[(2)] (ft. bgs)	Thickness of Ash[(3)] (ft)	Source[(4)]
MW-1	0 - 20	20	Patrick (2010c)
MW-2	0 - 11	11	Patrick (2010c)
MW-3	0 - 18.5	18.5	Patrick (2010c)
MW-4	0 - 18.5	18.5	Patrick (2010c)
MW-5	0.5 - 17	16.5	Patrick (2010c)
MW-6	N/A[(5)]	0	IEPA (2012c)
MW-7	1 - 9.5	8.5	IEPA (2012c)
MW-8	3 - 4.5	1.5	Bates No. 45648
MW-9	6 - 9.5	3.5	Bates No. 45649
MW-10	?	?	?
MW-11	?	?	?
MW-12	?	?	?
MW-13	?	?	?
MW-14	?	?	?
MW-15	0 - 5	5	Bates No. 11932
B-1	0 - 4	4	ENSR (1998d)
B-2	N/A	0	ENSR (1998d)
B-3	N/A	0	ENSR (1998d)
B-4	0 - 4	4	ENSR (1998d)
B-6	0.5 - 1	0.5	ENSR (1998d)
B-7	0 - 1	1	ENSR (1998d)
B-8	0 - 2	2	ENSR (1998d)
B-9	0 - 3	3	ENSR (1998d)
B-10	0 - 2	2	ENSR (1998d)
B-11	0.5 - 3	2.5	ENSR (1998d)
B-12	Borehole not logged		ENSR (1998d)
B-13	0 - 4	4	ENSR (1998d)
B-14	0 - 3	3	ENSR (1998d)
B-15	0 - 2	2	ENSR (1998d)
B-16	0 - 2	2	ENSR (1998d)
B-17	0 - 4	4	ENSR (1998d)
B18	N/A	0	ENSR (1998d)
B19	0 - 4	4	ENSR (1998d)
B20	0 - 6	6	ENSR (1998d)
B-21	N/A	0	ENSR (1998d)
B-22	0 - 1.5	1.5	ENSR (1998d)
B-23	N/A	0	ENSR (1998d)

Table 4

Summary of Waukegan Ash Deposits Located Outside the Ash Ponds Based on Monitoring Well and Soil Boring Logs (Case No. PCB 2013-015)

Boring or Monitoring Well ID[1]	Depths of Ash[2] (ft. bgs)	Thickness of Ash[3] (ft)	Source[4]
WS-GT-1	1 - 3	2	KPRG (2005a)
WS-GT-2	N/A	0	KPRG (2005a)
WS-GT-3	1.5 - 4	2.5	KPRG (2005a)
WS-GT-4	1 - 19.5	18.5	KPRG (2005a)
WS-GT-5	1 - 22	21	KPRG (2005a)
	Mean	5.3	
	Std. Dev.	6.58	
	Max.	21	
	Min.	0	
	N	36	

(1) MW designates a monitoring well. All other designations are borings.
(2) Depth below ground surface from boring logs.
(3) Difference in maximum and minimum depth bgs.
(4) Reference or Bates Numbers.
(5) N/A means no ash indicated in boring log.

Table 5

Summary of Will County Ash Deposits Located Outside the Ash Ponds Based on Monitoring Well and Soil Boring Logs (Case No. PCB 2013-015)

Boring or Monitoring Well ID(1)	Depths of Ash(2) (ft. bgs)	Thickness of Ash(3) (ft)	Source(4)
MW-1	0 - 5	5	Patrick (2011d)
MW-2	0 - 12	12	Patrick (2011d)
MW-3	0 - 7.5	7.5	Patrick (2011d)
MW-4	0 - 6	6	Patrick (2011d)
MW-5	N/A(5)	0	Patrick (2011d)
MW-6	0 - 8	8	Patrick (2011d)
MW-7	N/A	0	Patrick (2011d)
MW-8	N/A	0	Patrick (2011d)
MW-9	N/A	0	Patrick (2011d)
MW-10	N/A	0	Patrick (2011d)
B-1	1 - 3	3	ENSR (1998e)
B-2	0.5 - 3	2.5	ENSR (1998e)
B-3	0 - 1	1	ENSR (1998e)
B-4	1 - 2	1	ENSR (1998e)
B-5	0 - 1.3	1.3	ENSR (1998e)
B-6	N/A	0	ENSR (1998e)
B-7	0 - 1	1	ENSR (1998e)
B-8	N/A	0	ENSR (1998e)
B-9	0 - 0.5	0.5	ENSR (1998e)
B-10	0 - 1	1	ENSR (1998e)
B-11	0 - 0.75	0.75	ENSR (1998e)
B-12	0 - 2	2	ENSR (1998e)
B-13	0 - 1	1	ENSR (1998e)
B-14	N/A	0	ENSR (1998e)
B-15	N/A	0	ENSR (1998e)
B-16	N/A	0	ENSR (1998e)
B-17	Bore Hole not Logged		ENSR (1998e)
B-18	N/A	0	ENSR (1998e)
WC-GT-1	N/A	0	KPRG (2005a)
WC-GT-2	0 - 2.5	2.5	KPRG (2005a)
WC-GT-3	0 - 9.5	9.5	KPRG (2005a)
WC-GT-4	0 - 2	2	KPRG (2005a)
WC-GT-5	N/A	0	KPRG (2005a)
	Mean	2.1	
	Std. Dev.	3.16	
	Max.	12	
	Min.	0	
	N	32	

(1) MW designates a monitoring well. All other designations are borings.
(2) Depth below ground surface from boring logs.
(3) Difference in maximum and minimum depth bgs.
(4) Reference or Bates Numbers.
(5) N/A means no ash indicated in boring log.

Table 6

Summary of Ash-Impacted Soil Volumes and Removal Costs for each MWG Power Plant (Case No. PCB 2013-015)

Plant Site and Area	Potentially Impacted Site Area (ac)	Estimated Depth of Ash-Impacted Soils (ft)	Estimated Volume of Ash-Impacted Soils (yds^3)	Estimated Weight of Ash-Impacted Soils[7] (tons)	Low Unit Cost[5] ($/ton)	High Unit Cost[8] ($/ton)	Low Estimated Cost for Excavation, Hauling and Backfilling ($)	High Estimated Cost for Excavation, Hauling and Backfilling ($)
Joliet #29[1]								
Site-wide	251	1.4	566,925	708,657	$29.27	$42.95	$20,742,381	$30,436,804
NE Ash Landfill[6]	44	4	280,916	351,145	$29.27	$42.95	$10,278,011	$15,081,672
Pond Areas	15	1.4	33,880	42,350	$29.27	$42.95	$1,239,585	$1,818,933
Powerton[2]								
Site-wide	349	6.6	3,716,152	4,645,190	$29.27	$42.95	$135,964,711	$199,510,911
Pond Areas	73	9.2	1,083,515	1,354,393	$29.27	$42.95	$39,643,093	$58,171,194
Waukegan[3]								
Site-wide	249	5.3	2,129,116	2,661,395	$29.27	$42.95	$77,899,032	$114,306,915
Pond Areas	44	10.9	773,755	967,193	$29.27	$42.95	$28,309,749	$41,540,954
Will County[4]								
Site-wide	215	2.1	728,420	910,525	$29.27	$42.95	$26,651,067	$39,107,049
Pond Areas	20	4.6	148,427	185,533	$29.27	$42.95	$5,430,561	$7,968,657

(1) Figure 1 and Table 2
(2) Figure 2 and Table 3
(3) Figure 3 and Table 4
(4) Figure 4 and Table 5
(5) The unit cost includes the cost of contaminated soil excavation, hauling, and backfilling based on 11 bid tabulations in northern Illinois and southern Wisconsin for 2013 and 2014.
(6) Assumed 4 ft ash thickness.
(7) Assumed 1.25 tons per yd^3.
(8) From Patrick (Bates Nos. 6823-6843).

Electronic Filing: Received, Clerk's Office 2/04/2022

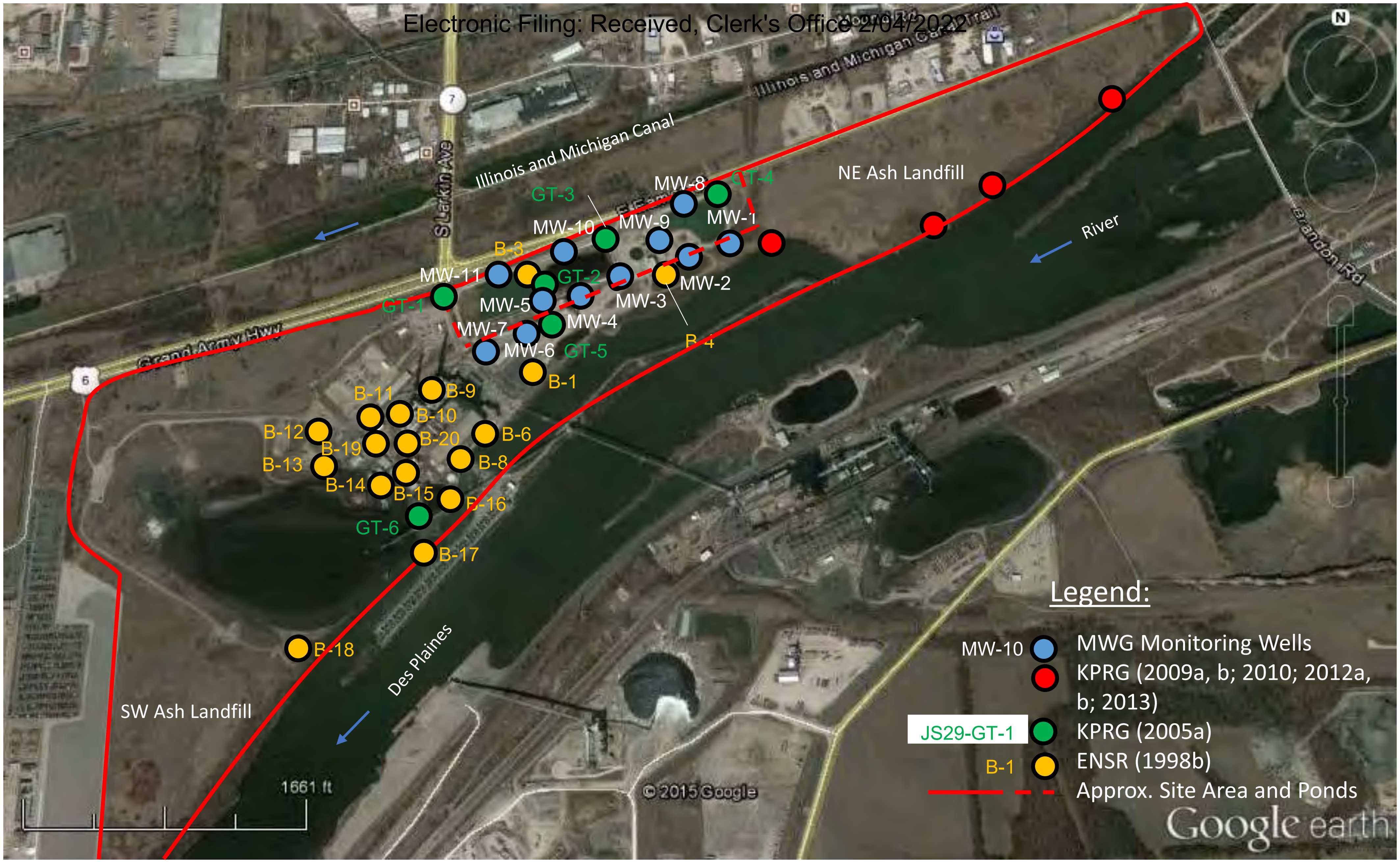


Figure 1 Joliet #29 Soil Boring Locations (PCB 2013-015)

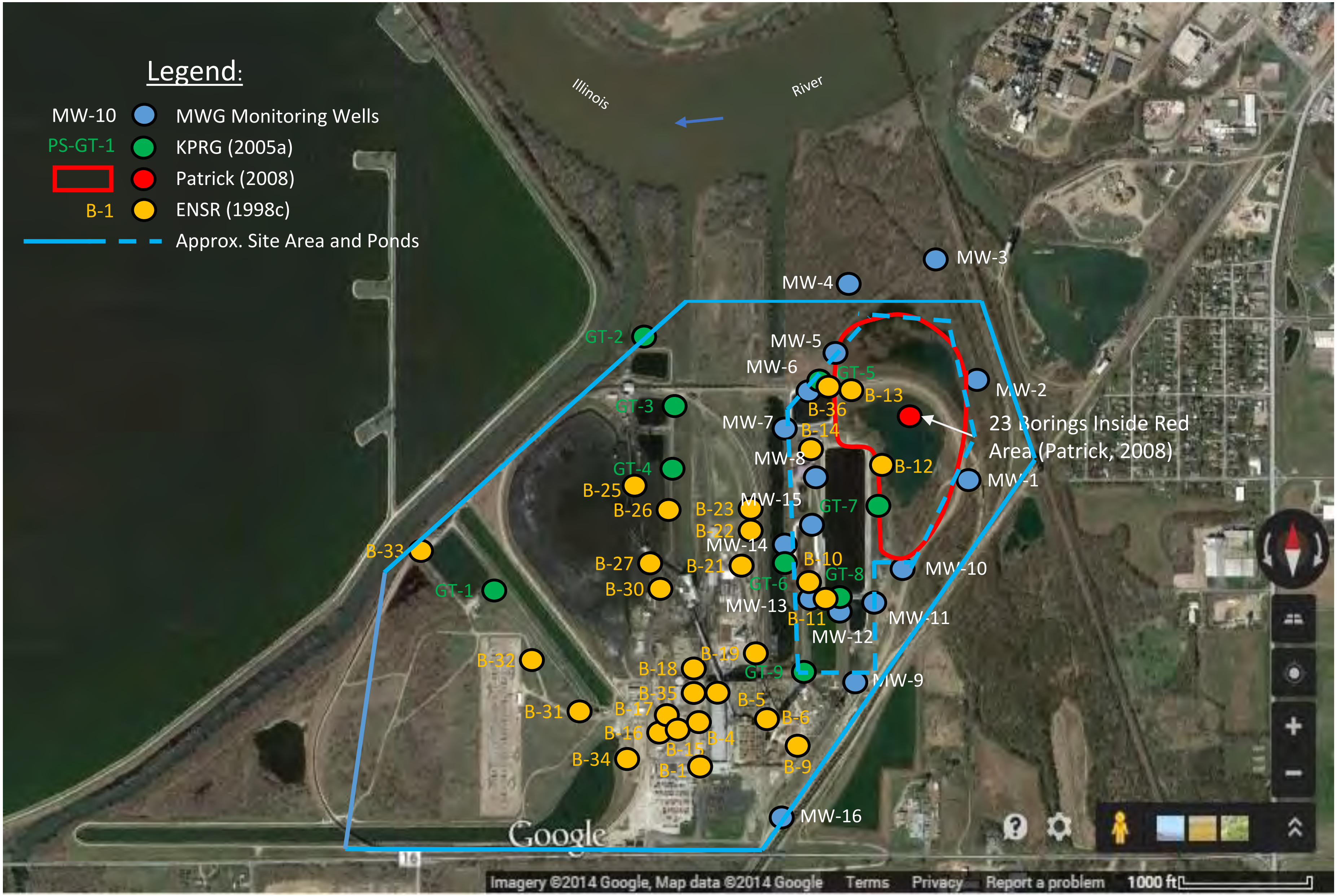


Figure 2 Powerton Soil Boring Locations (PCB 2013-015)

Electronic Filing: Received, Clerk's Office 2/04/2022

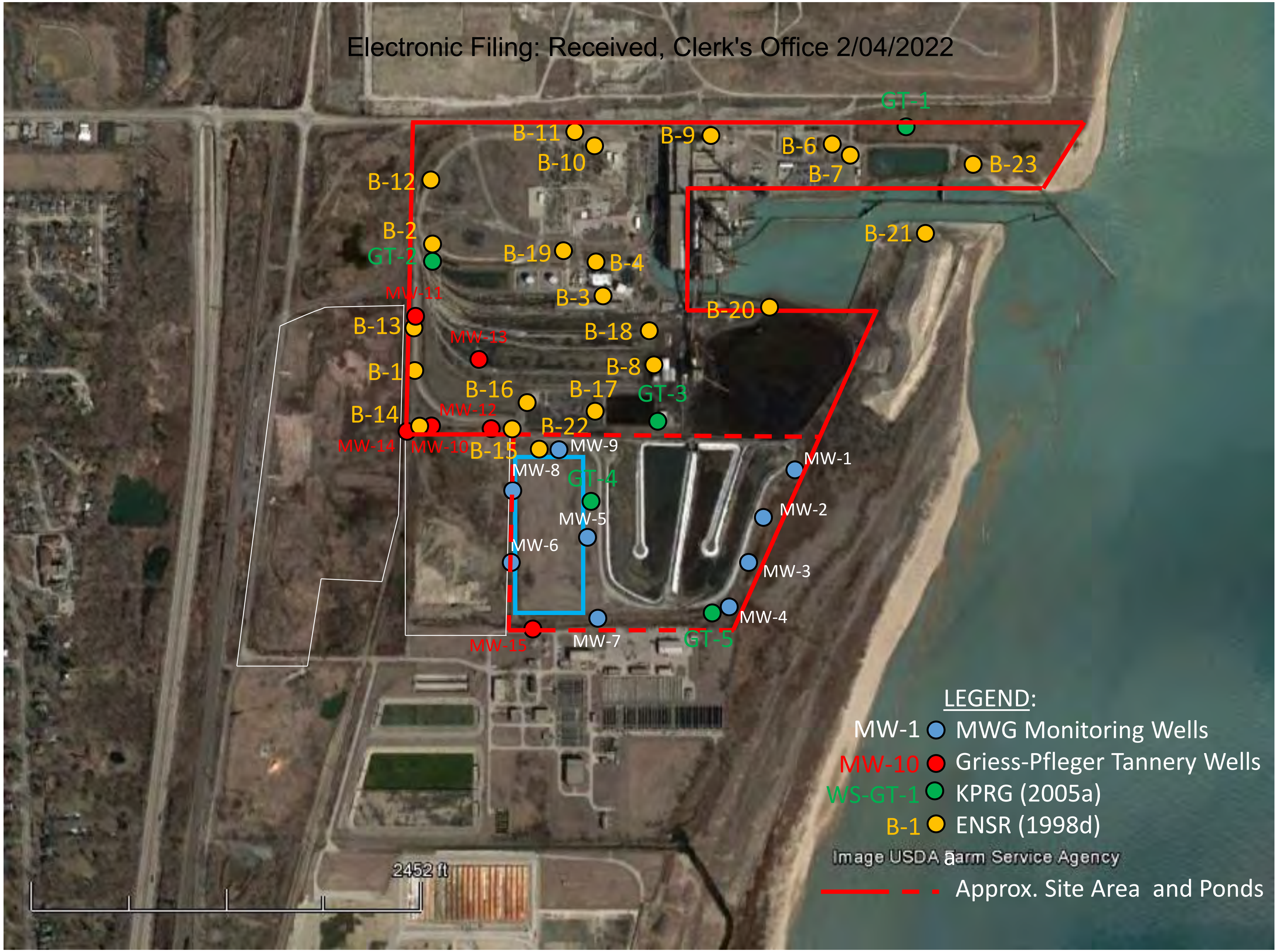


Figure 3 Waukegan Soil Boring Locations (PCB 2013-015)

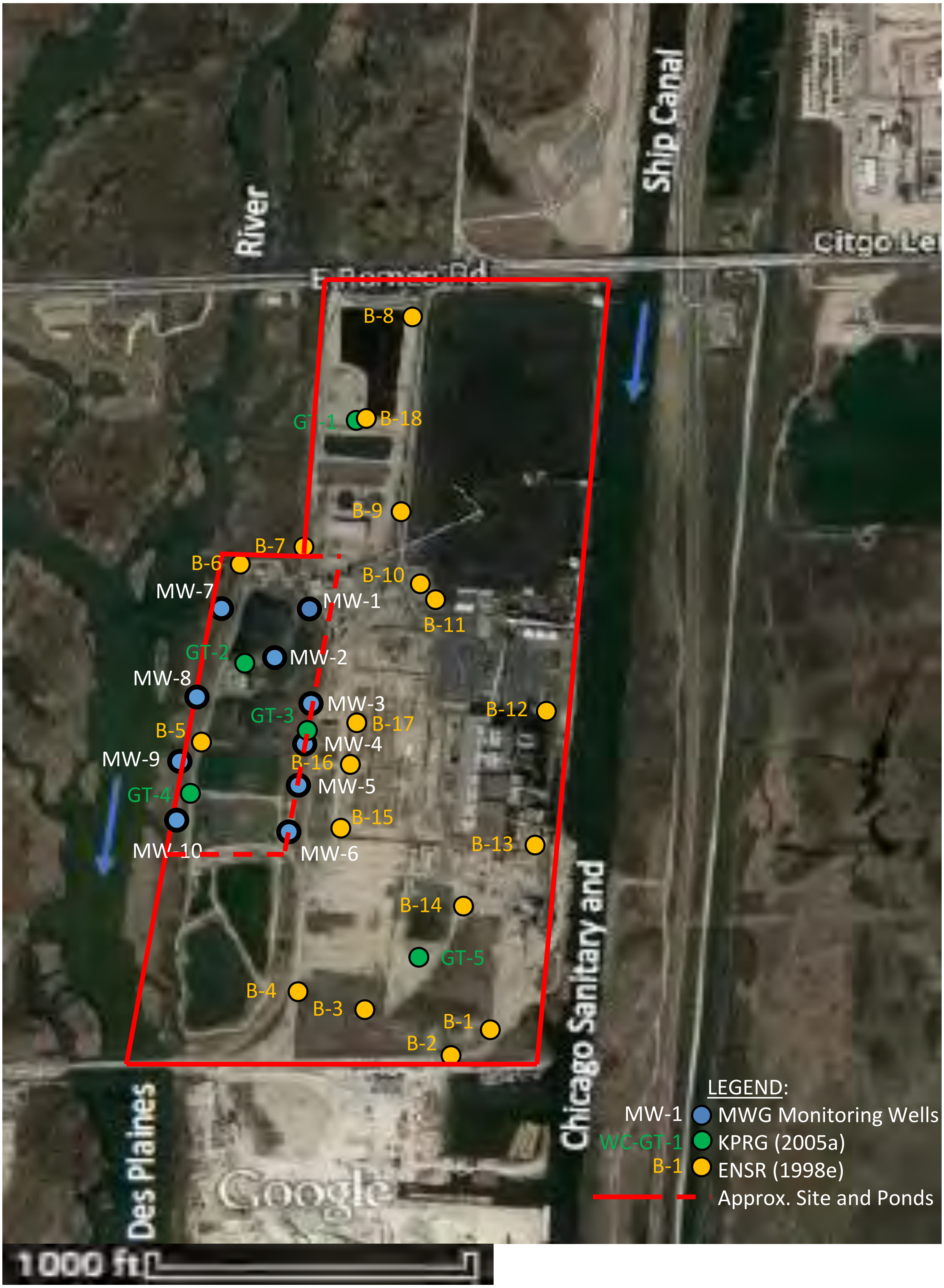


Figure 4 Will County Soil Boring Locations (PCB 2013-015)

EXHIBIT 6

James R. Kunkel, Ph.D., P.E.
11341 West Exposition Drive
Lakewood, CO 80226

In the Matter of:	)	
	)	
SIERRA CLUB, ENVIRONMENTAL	)	
LAW AND POLICY CENTER,	)	
PRAIRIE RIVERS NETWORK, and	)	
CITIZENS AGAINST RUINING THE	)	
ENVIRONMENT	)	
Complainants,	)	PCB 2013-015
v.	)	(Enforcement – Water)
MIDWEST GENERATION, LLC,	)	
Respondent.	)	
	)	
	)	
	)	
	)	

Rebuttal Report to Expert Report of John Seymour, P.E.

James R. Kunkel, Ph.D., P.E.

December 8, 2015

Tel: 303-986-0562 Cel: 720-443-9136

INTRODUCTION,

This expert rebuttal report provides my responses to expert opinions of John Seymour, P.E. related to my Expert Report on Ground-water Contamination (Kunkel, 2015a) and my Expert Report on Remedy for Ground-water Contamination (Kunkel 2015b) for Midwest Generation, LLC's (MWG's) Joliet #29, Powerton, Waukegan, and Will County coal-fired power plants.

My rebuttal responses will emphasize, but not necessarily be limited to, the following:

- Much of Seymour's expert report (Seymour, 2015) is unsound and incorrectly interprets the available data and information;
- The indicator pollutants I use for ground-water contamination from coal ash are consistent with USEPA, EPRI and IEPA documents;
- The concentrations of the indicator pollutants in ground water at the four plant sites are much higher than background. This shows that the ground water at the four sites is likely contaminated by a coal ash source. I utilized the same background data for the indicator pollutants as IEPA utilized in their coal ash assessment, except at Powerton where background data at MW-16 (the only true background well at the four plant sites) agrees with the IEPA background for sand and gravel aquifers;
- At Joliet #29, Powerton and Will County sites, no other potential sources of indicator pollutants, except coal ash, are present up-gradient. At Waukegan, ground-water from the Greiss-Phleger Tannery site is not reaching the monitoring well network. Even if boron from the tannery site were reaching the monitoring network, the concentrations of boron in the tannery ELUC wells (up-gradient) are much lower than in monitoring wells located within the old ash storage area just west of the ash ponds. Therefore, I conclude that none of the boron is coming from the tannery;
- The ground-water concentrations are temporally and spatially consistent at each of the four plant sites;
- Ground-water contamination at all four plant sites has generally remained the same, at high concentrations for the monitoring period between Dec. 2010 through present, which confirms my opinion that the actions taken by MWG will not solve the ground-water contamination issues at the four sites;
- MWG's actions will not significantly reduce or eliminate ground-water contamination from coal ash at the four sites; and
- My proposed remedy (Kunkel, 2015b) is economically reasonable compared to other source-term removal remedies or ground-water remediation.

CONTAMINATION IN THE MONITORING WELLS AT THE FOUR SITES IS COMING FROM COAL ASH

I chose the correct indicator pollutants, which are those accepted by other experts and regulators (Kosson and others, 2009; EPRI, 2012; IEPA, 2013; USEPA, 2015). These indicator pollutants, comprised of boron (B), manganese (Mn) and sulfate (SO_4), are known to be the result of leaching of coal ash. As I indicated in my contamination report (Kunkel, 2015a), it is highly unlikely that the presence of these indicator pollutants together in the high concentrations found in the ground water at the four sites is the result of naturally occurring hydrogeologic formations or industrial processes other than coal-fired power plants. USEPA (2015) proposes using the following indicator constituents of ground-water contamination: B, chloride (Cl), conductivity, fluoride (F), pH, SO_4, sulfide (S^{2-}), and total dissolved solids. EPA makes special note of B and SO_4: "The high mobility of boron and sulfate explains the prevalence of these constituents in damage cases that are associated with groundwater impacts." (USEPA, 2015, p. 21456). In its technical support document for coal combustion waste impoundments in Illinois, IEPA (2013) states that "Boron, sulfate, and manganese are the same contaminants that have been found in recent hydrogeologic assessments of groundwater in multiple confirmed sample results collected from down-gradient dedicated monitoring wells adjacent to surface impoundment units containing

CCW at power generating facilities in Illinois. These contaminants were found to be attributable to these surface impoundment units".

I chose the correct background concentrations. IEPA (2013), in its technical support document for coal combustion waste impoundments in Illinois, utilized certain ground-water background concentrations for sand and gravel aquifers and bedrock aquifers to assess if contamination was present. I utilized these same background concentrations for my indicator pollutants at the Joliet #29, Waukegan and Will County sites because there are no up-gradient, background wells at these sites. The monitoring wells at these sites are immediately adjacent to the coal ash ponds and cannot be considered to be either up-gradient or background, because they are impacted by the coal ash ponds. At Powerton, MW-16 is likely up-gradient and has background ground-water concentrations of the indicator pollutants which closely match IEPA's background concentrations for sand and gravel aquifers. In my contamination report, the concentrations of indicator pollutants in MW-16 were utilized as up-gradient, background ground-water concentrations at Powerton.

The indicator contaminants are present in ground water in concentrations much higher than background. There is no evidence that there are up-gradient, off-site sources for the indicator pollutants at the four sites. Seymour (2015, numerous pages) opines that the post-2013 continuing ground-water contamination at the four sites is being caused by up-gradient, off-site sources. My ground-water contamination report (Kunkel, 2015a) describes the historical land uses up-gradient and off-site at each of MWG plant areas. At Joliet, the historical land use north and east of the property was mostly undeveloped land with the Des Plaines River on the south border of the property. There is no evidence of sources of B, Mn or SO_4 that could migrate on-site from adjacent properties. At Joliet #29, B concentrations are up to 21.7 times higher than the background B concentration of 0.12 mg/L. Mn concentrations are up to 22.2 times higher than the background Mn concentration of 0.072 mg/L. SO_4 concentrations are up to 7.4 times higher than the background SO_4 concentration of 54 mg/L. I conclude from this that there is past and continuing ground-water contamination by the indicator pollutants of B, Mn and SO_4 at the Joliet #29 site and this contamination is from on-site sources.

At Powerton, the historical and current land use comprises the Illinois River to the north, industrial and residential properties to the east, agricultural land to the south, and Lake Powerton (Powerton Fish and Wildlife Area) to the west. There is no indication that these land uses could be sources for B, Mn, and SO_4 at the site. This is confirmed by Well MW-16, which is considered to be an up-gradient, background well. At Powerton, B concentrations are up to 21.5 times higher than the background B concentration of 0.20 mg/L. Mn concentrations are up to 4,330 times higher than the background Mn concentration of 0.003 mg/L. SO_4 concentrations are up to 32.6 times higher than the background SO_4 concentration of 43 mg/L at MW-16. I conclude from this that there is past and continuing ground-water contamination by the indicator pollutants of B, Mn and SO_4 at the Powerton site and this contamination is from on-site sources.

At Waukegan, the historical land use of interest was the Greiss-Phleger Tannery, which MWG alleges is the up-gradient source of B at the coal ash pond monitoring wells. This is highly unlikely for three reasons: (1) the ground-water flow away (down-gradient) from the tannery site is not toward the coal ash ponds or the monitoring wells, (2) the concentrations of B in the MW-10 through MW-14 (MW-13 is inactive) ELUC monitoring wells are the direct result of these wells having their screens completed in coal ash, and (3) the B concentrations in MW-10 through MW-14 are much less than those in the MW-5, MW-6, MW-7, MW-8, MW-9 and MW-15.

For example, Figure 1 shows recent MWG ground-water B concentration data for monitoring wells MW-5 through MW-15. Wells MW-10 through -14 (MW-13 is inactive) are ELUC wells which are up-gradient from the old coal ash storage area, and wells MW-5 through -9 and MW-15 are downgradient from the old coal ash storage area. Interpretation of the B concentrations on Figure 1 clearly show that the up-gradient wells (dashed lines) have B concentrations much lower than the down-gradient wells (solid lines). ENSR (1998d) boreholes

located near wells MW-10 through MW-14 (MW-13 is inactive) show that there is ash present in the soil which can account for the B and Mn concentrations at these monitoring wells, which were not part of the ash pond ground-water monitoring network.

At Waukegan, B concentrations in MW-1 through MW-9 are up to 408 times higher than the background B concentration of 0.12 mg/L. Mn concentrations are up to 13.8 times higher than the background Mn concentration of 0.072 mg/L. SO_4 concentrations are up to 22.2 times higher than the background SO_4 concentration of 54 mg/L. I conclude from this that there is past and continuing ground-water contamination by the indicator pollutants of B, Mn and SO_4 at the Waukegan site and this contamination is from on-site sources.

At Will County, the historical and current land uses consist of undeveloped land to the north, the Chicago Sanitary and Ship (CSS) Canal to the east, a quarry to the south, and the Des Plaines River to the west. There is no indication that these land uses could be sources for B, Mn and SO_4 in ground water at the site. At Will County, B concentrations are up to 22.1 times higher than the background B concentration of 0.12 mg/L. Mn concentrations are up to 34.5 times higher than the background Mn concentration of 0.072 mg/L. SO_4 concentrations are up to 45.3 times higher than the background SO_4 concentration of 54 mg/L. I conclude from this that there is past and continuing ground-water contamination by the indicator pollutants of B, Mn and SO_4 at the Will County site and this contamination is from on-site sources.

My rebuttal responses above to Seymour's allegations regarding the ground-water contamination at the four MWG plant sites include several important facts which show Seymour is incorrect in his allegations or has misinterpreted the ground-water quality data and other information which universally has been agreed to by MWG and IEPA since before the site characterization in late 2010.

The Leachate Test that Seymour Utilized is not Representative of Field Conditions in the Coal Ash Ponds

Seymour (2015, p. 40) claims that *"Recent Groundwater Concentrations are Not the Result of Ash Stored in Lined Ponds"*, but rather ground-water contamination is from up-gradient, off-site sources entering each site. Seymour (2015, p. 51) concludes that *"Bottom Ash Indicator Constituents from Leachate Do Not Match the Groundwater Chemistry"*. Seymour bases these conclusions on the neutral leaching procedure from the American Society for Testing and Materials (ASTM) given in its D3987 test. This test, as established by IEPA in *415 Illinois Compiled Statutes 5/3.135* to determine if coal ash may be classified for beneficial use, is not appropriate or valid for establishing long-term leaching of coal ash (ASTM, 2012), which is occurring at the four plant sites. In its most recent publication of the neutral leaching test, ASTM (2012), in part, states the following in the Significance and Use section of the ASTM D3987-12 procedure:

- "4.1 This practice is intended as a rapid means for obtaining an extract of solid waste. The extract may be used to estimate the release of constituents of the solid waste under the laboratory conditions described in this procedure".
- "4.2 This practice is not intended to provide an extract that is representative of the actual leachate produced from a solid waste in the field or to produce extracts to be used as the sole basis of engineering design".
- "4.3 This practice is not intended to simulate site-specific leaching conditions. It has not been demonstrated to simulate actual disposal site leaching conditions".

Hattaway and others (2013) have proposed guidelines for a suite of test methods for coal ash which are more representative of field conditions. This suite of tests is known as the Leaching Environmental Assessment Framework (LEAF) and is designed to replace the single-point pH tests such as the Toxicity Characteristic Leaching Procedure (TCLP), Synthetic Precipitation Leaching Procedure (SPLP) and ASTM D3987, which

typically utilize large liquid to solids (by weight) ratios which are not representative of field conditions. An appropriate LEAF test for the ash pond solids is EPA 1313 (Hattaway and others, 2013). LEAF tests were utilized by the USEPA (Kosson and others, 2009) in their coal ash characterization report. I relied on Kosson and others (2009) for my opinions in my ground-water contamination report (Kunkel, 2015a).

The two main reasons that the ASTM D3987 test does not accurately measure field leaching of coal ash is that (1) the liquid to solids ratio within the ponds and in the ground water is much lower than the 20 (liquid) to 1 (solids) ratio of the laboratory test, and (2) the pH of the laboratory test (pH = 7) is not representative of either the coal ash in the ponds or outside the ponds.

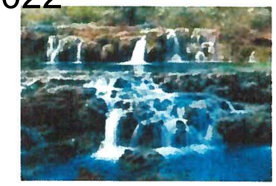
I conclude from the above that the use of ASTM D3987 by Seymour and other MWG consultants is incorrect and gives concentrations in the resulting test extracts which are much lower than would be expected from field conditions.

<u>Seymour's Matching Analysis of Coal Ash Leachate is Flawed</u>
Seymour's matching analyses is flawed for two reasons. Firstly, detection monitoring does not work on the assumption that you must match each ground-water constituent; instead the principle is that any one of the indicator pollutants can suggest the presence of coal ash leachate (EPRI, 2012). Secondly, a pollutant is not absent just because it is present at a concentration less than the detection limit. The detection limits used in the ASTM D3987-85 test procedure were sometimes 200 times higher than the quarterly ground-water detection limits. The constituents that were not detected in the ASTM test were, in fact, shown to be detected in the MWG 2014 quarterly ground water as well as in actual coal ash pond leachate for subbituminous/lignite impoundment leachate values (Seymour, 2015, Table 5-2). Seymour should have utilized those pond leachate data found in his Table 5-2 for his matching analyses.

Not only was Seymour's approach to matching flawed, but it was misapplied. If he had applied his approach correctly, he would have found a near-100 percent match to all the MWG 2014 quarterly ground-water sampling data. For example, I reanalyzed the "matching" of the ASTM D3987-85 test procedure results obtained by Seymour (Table 5-1) to the 2014 MWG quarterly ground-water sampling data at the Waukegan plant site. Seymour (2015, Table 5-5) indicated that there was a match of between 74 and 84 percent of the time between the ASTM D3987-85 test procedure results and the Waukegan ground-water results for wells MW-1 through MW-7 for the 2014 quarterly data. I have reanalyzed the match because the detection limits used in the ASTM D3987-85 test procedure were sometimes 200 times higher than the quarterly ground-water detection limits. I also utilized the EPRI (Seymour, 2015, Table 5-2) subbituminous/lignite impoundment leachate values and detection limits for comparison to the MWG 2014 quarterly ground-water values to determine if there was a match to ground-water concentrations if the ASTM D3987-85 test procedure results in Seymour's (2015) Table 5-1 showed a non-detect.

The attached Table 1 is my reanalysis of the Waukegan 2014 quarterly ground-water data to Seymour's list of indicator constituents which are found in impoundment coal ash leachate. My interpretation is that there is a nearly perfect match of the Waukegan 2014 quarterly ground-water data to indicator constituents of coal ash leachate presented by Seymour (2015) in his Tables 5-1 and 5-2. This match varies from a 95 percent match to the impoundment leachate indicator constituents for wells MW-2, MW-5, MW-6 and MW-7, to a 100 percent match for wells MW-1, MW-3 and MW-4.

Analyses of my Table 1 shows that the ASTM D3987-85 test procedure results (Seymour, 2015, Table 5-1) and the EPRI impoundment leachate results (Seymour, 2015, Table 5-2) showed consistency for all the leachate indictor constituents except for iron. Therefore, my method of matching using MWG's 2014 quarterly ground-



water data and Seymour's (2015) Tables 5-1 and 5-2 provide near perfect matches to the observed ground-water contamination at Waukegan.

Additionally, if only my three indicator pollutants (B, Mn and SO_4) are analyzed, there is a 100 percent match to Seymour's leachate indicator constituents. Therefore, I further conclude that Seymour's use of the results from the ASTM D3987 to determine if the leachate "matches" the chemistry of the ground water underlying the ponds is incorrect and a gross misuse of the ASTM D3987 procedure and that there were leachate data available from his Table 5-2 which should have been utilized for these matches.

The Leachate Test that Seymour Utilized is not Representative of Field Conditions in Coal Ash Deposits Outside the Ash Ponds

Seymour (2015, p. 45) claims that *"Historical Ash in Fill Materials Outside of the Ponds is Not Adversely Impacting Groundwater"*, but rather ground-water contamination is from up-gradient, off-site sources entering each site. Seymour (2015, p. 52) concludes that *"There is No Evidence That Historical Coal Ash Outside of the Ash Ponds is a Source of Groundwater Impacts"*. Leaching of coal ash deposits outside the ash ponds at the four plant sites involves two possible scenarios: (1) leaching of coal ash by percolating rainfall and snowmelt, and (2) leaching of coal ash by the rising and falling of seasonal ground-water levels.

Leachate from this intermittent wetting and drying of coal ash will be significantly different than the extractant resulting from the ASTM D3987 procedure. Therefore, the ASTM D3987 procedure utilized by Seymour and other MWG consultants to characterize the coal ash outside the ponds is not applicable. In fact, the chemical process going on beneath the ponds, which leaked in the past and may continue to leak now, is one of pore-water equilibrating with the ash and or soil/ash mixtures in the ground water. This means that there are much lower liquid-to-solids ratios in the coal ash within the ponds and in the coal ash/soil outside the ponds. Additionally, a variable pH depending on the expected initial liquid pH, i.e. rain water, higher pH ground water, or other leaching solutions also is different than the neutral pH of 7 utilized in the ASTM D3987 test procedure.

Values of pH in the environment vary with both space and time. Rainfall pH (typically acidic; pH <7) is very different from ground-water pH (typically basic; pH >7) as well as coal ash leachate pH (typically basic). All rainfall ranges in pH from about 5.6 to 6.0 (nationwide) due to dissolution of CO_2 which forms carbonic acid (Skilling, 2002). In and near Chicago, June and August rainfall is most acidic with a pH of about 4.65. At other times during the year pH varies from about 4.79 to 5.68. Thus, using a neutral pH of 7.0 for the ASTM D3987 leach test will underestimate the concentrations of inorganics in leachate produced by the test procedure. Additionally, the ASTM D3987 procedure's Significance and Use item 4.1 through 4.3 above indicate that the test is not representative of field conditions (ASTM, 2012).

Time series data of ground-water quality collected at the four sites since late 2010 also shows that the existing ground water at all four sites is typically greater than pH 7 and often is greater than pH 8. As with lower (acidic) pH values, higher, more basic pH can facilitate greater leaching than neutral pH. This indicates that the use of the ASTM D3987 procedure to assess leachate concentrations from coal ash is invalid. As indicated above, the processes occurring both at the ground surface and beneath the ground surface relative to coal ash leaching are not single-point pH related but rather chemical equilibration of the liquid phase with the solid coal ash phase to produce the site-specific concentrations of contaminants presented in MWG's quarterly reports. An appropriate LEAF test for the coal ash within and outside the ash ponds is EPA 1313 (Hattaway and others, 2013), the same test procedure utilized by Kosson and others (2009) to characterize coal ash leachate. I relied on Kosson and others (2009) for my opinions in my ground-water contamination report (Kunkel, 2015a).

Seymour is Incorrect that there is no Evidence of Spatial and Temporal Consistency in Ground-Water Impacts

Seymour (2015, pp. 15, 18, 21 and 23) claims that there is no "... evidence that there is spatial or temporal consistency in groundwater impacts, [and] it is my opinion that there is no plume ..." at the four MWG plant sites. This is incorrect. A contaminant plume can exist without spatial or temporal consistency but in this case there is both spatial and temporal consistency as well as a contaminant plume at each of the four plant sites. The monitoring networks at each plant site show consistently high ground-water contamination by the indicator pollutants since monitoring began. Nearly all the monitoring wells are downgradient from the coal ash ponds and other coal ash deposits.

What variability there is in the ground-water concentrations is consistent with continued contamination from coal ash. Continued leaching of coal ash outside the ponds by rising and falling ground-water levels will contribute to the observed ground-water contamination at each of the plant sites. Seasonal variations in ground-water contamination from the indicator pollutants would be expected at each site due to these rising and falling ground-water levels. There is both spatial and temporal consistency in accordance with seasonal variability.

MWG'S ACTIONS ARE NOT APPROPRIATE TO SIGNIFICANTLY REDUCE OR ELIMINATE GROUND-WATER CONTAMINATION FROM COAL ASH AT THE FOUR SITES

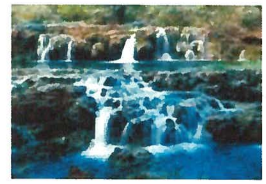
My rebuttal responses to MWG's past actions at the four power plant sites include the following:

- The Compliance Commitment Agreement (CCA) remedies for each of the four sites will not reduce existing or future ground-water contamination from coal ash deposits and leaky liners;
- Liner construction did not follow normally acceptable engineering standards;
- Dredging of coal ash from the ponds will continue to be a potential source of liner tears and leaks;
- GMZ's and ELUC's do not address the continuing ground-water contamination at the four sites; and
- Monitoring is not addressing the reduction or elimination of ground-water contamination.

The CCA remedies for each of the four sites will not reduce existing or future ground-water contamination from coal ash deposits and leaky liners. The CCAs (IEPA, 2012a, b, c and d) set forth various supposedly remedial actions by MWG to eliminate ground-water contamination at the four sites. Ground water at the four sites is contaminated with constituents including Sb, As, B, Cl, Fe, Mn, NO_3, Hg, SO_4 and Se. Additionally, ground-water at the sites is affected by high pH and TDS immediately up-gradient and down-gradient from the ash ponds. The CCA remedies will not, in my opinion, reduce the ground-water contamination at any of the four sites because:

(1) Continued ground-water monitoring will not eliminate the ash pond liner leaks nor leaching of contaminants from past coal ash placement outside the existing ash ponds;
(2) None of the coal ash pond liners meet the engineering standards given by the USEPA (2015) coal ash rule;
(3) There is no provision in the CCA for cessation of use and removal of coal ash from the three ash ponds;
(4) There is no provision in the CCA for clean-up and removal of fill/construction coal ash placed outside the ash ponds nor for coal ash disposed of on land surface;
(5) Since MWG is continuing to use the same ash dredging techniques as in the past, relining the ash ponds will not reduce liner damage and subsequent liner leakage; and
(6) Hydrostatic uplift of plastic liners can occur at high ground-water levels.

Without removal of the coal ash sources at the four plant sites, ground-water contamination will continue unabated into the future. Creation of a Groundwater Management Zone (GMZ) or an Environmental Land Use Control (ELUC) area and installation of additional ground-water monitoring wells will not prevent the existing coal



ash sources from continuing to cause ground-water contamination into the future. Only partial or total removal of the coal ash sources can reduce ground-water contamination at the four power plant sites.

Liner construction during lining or relining of the coal ash ponds at the four sites did not follow normally acceptable engineering standards. Seymour (2015, p. 54) says that *"Ash Ponds are not Leaking and Construction Quality is Consistent with the Ash Pond Lining Quality Management Standards for Long-Term Use".* Seymour (2015, p. 54. Footnote 158) claims that "... Schroeder (1994) [...] does not consider the frequency of leaks when certain construction quality assurance protocols are followed". This is untrue. Schroeder and others (1994) relate the frequency of liner construction defects to the degree of contact the plastic liner makes with the underlying subbase as summarized in Kunkel (2015a). They define this contact as either poor, fair, good or excellent. No matter how good the construction quality assurance is, there is a small likelihood that the degree of contact will be excellent, which can be achieved only in the laboratory or in small field lysimeters. Good contact is defined by Schroeder and others (1994) as good field installation with well-prepared, smooth soil surface and geomembrane wrinkle control to insure good contact between geomembrane and adjacent soil that limits the drainage rate through a liner defect.

Schroeder and others (1994) also discusses a liner placement quality known as "geotextile separating geomembrane liner and drainage limiting soil" which assumes liner leakage spreading, with the rate of leakage determined by the in-plane transmissivity of the geotextile separating the geomembrane and the adjacent soil or Poz-o-Pac layer that would have otherwise limited the drainage (Schroeder and others, 1994). In the case of the four MWG plant sites, the subbase is either unspecified prepared subgrade or Poz-o-Pac (Seymour, 2015, pp. 28–35). It is well documented by MWG that when some of the ponds were relined, the Poz-o-Pac was partially removed and geotextile placed between the Poz-o-Pac and/or soil subbase and the HDPE liner (Bates Nos. 9584, 9642, , 28418-28586, 49477-49478). The surface of the remaining Poz-o-Pac could not have been smooth enough to ensure a "good" contact with the HDPE liner. This conclusion is strongly supported by Bates Nos. 66-69, which mention that the MWG Poz-o-Pac liners are in "poor" condition. This type of construction is not standard engineering practice.

My opinion is that the existing ponds at the four plant sites do not meet the engineering standards set by the USEPA (2015) coal ash rule for lined ponds. That rule states (p. 21474) that, for existing coal ash surface impoundments, "... the owner or operator of an existing CCR surface impoundment must document whether or not such unit was constructed with any one of the following: (i) A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec; (ii) A composite liner that meets the requirements of §257.70(b); or (iii) An alternative composite liner that meets the requirements of §257.70(c). (2) The hydraulic conductivity of the compacted soil must be determined using recognized and generally accepted methods".

§257.70(b) of the rule states:

> "... A *composite liner* must consist of two components; the upper component consisting of, at a minimum, a 30-mil geomembrane liner (GM), and the lower component consisting of at least a two foot layer of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} centimeters per second (cm/sec). GM components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. The GM or upper liner component must be installed in direct and uniform contact with the compacted soil or lower liner component. The composite liner must be: (1) Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the CCR or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation; (2) Constructed of materials that provide appropriate shear resistance of the upper and lower component interface to

prevent sliding of the upper component including on slopes; (3) Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift; and (4) Installed to cover all surrounding earth likely to be in contact with the CCR or leachate".

§257.70(c) of the rule states:

"If the owner or operator elects to install an alternative composite liner, all of the following requirements must be met: (1) An *alternative composite liner* must consist of two components; the upper component consisting of, at a minimum, a 30-mil GM, and a lower component, that is not a geomembrane, with a liquid flow rate no greater than the liquid flow rate of two feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. GM components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. If the lower component of the alternative liner is compacted soil, the GM must be installed in direct and uniform contact with the compacted soil. (2) The owner or operator must obtain certification from a qualified professional engineer that the liquid flow rate through the lower component of the alternative composite liner is no greater than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity of 1×10^{-7} cm/sec. The hydraulic conductivity for the two feet of compacted soil used in the comparison shall be no greater than 1×10^{-7} cm/sec. The hydraulic conductivity of any alternative to the two feet of compacted soil must be determined using recognized and generally accepted methods. The liquid flow rate comparison must be made using Equation 1 of this section, which is derived from Darcy's Law for gravity flow through porous media.

(Eq. 1) $$\frac{Q}{A} = q = k\left(\frac{h}{t} + 1\right)$$

Where, Q = flow rate (cubic centimeters/second);
A = surface area of the liner (squared centimeters);
q = flow rate per unit area (cubic centimeters/second/squared centimeter);
k = hydraulic conductivity of the liner (centimeters/second);
h = hydraulic head above the liner (centimeters); and
t = thickness of the liner (centimeters).

(3) The alternative composite liner must meet the requirements specified in paragraphs (b)(1) through (4) of this section".

There is no evidence in the record that MWG's coal ash ponds meet the above definitions of a lined pond in the USEPA (2015) coal ash rule.

Seymour (2015, p. 55) says that *"O&M of the Ash Ponds are Not Expected to Cause Leaks and O&M are Conducted in Accordance with Consistent Operating Procedures".* Dredging of coal ash from the ponds will continue to be a potential source of liner tears and leaks. Excavators can damage plastic liners if less than 2-ft of soil overlies the plastic. Seymour's use of static load bearing calculations of equipment is not acceptable to assess the potential for liner damage from equipment because movement of the equipment, especially turning the equipment or suddenly braking the equipment, is a dynamic load which can cause stresses which will tear the liner. Even with 2 ft of protective soil over the liner, turns and sudden braking by trucks, excavators, and even pickups is discouraged (Narejo and Corcoran, 1996, Bates Nos. 49293-49361). MWG has photographs

and other documentation showing construction equipment on the pond liners covered only with the 1-ft sand "cushion" layer (Bates Nos. 49495, 49504). This is not acceptable engineering practice for liner construction.

GMZ's and ELUC's do not address the continuing ground-water contamination at the four sites. The GMZ's and ELUC's may not be large enough to ensure that they are effective in eliminating ground-water exposure pathways at the four sites. During establishment of the GMZ's/ELUC's, no consideration was given to the extent of other coal ash deposits at each site. GMZ's and ELUC's generally have not and will not lead to reductions in ground-water contamination at the four plant sites because they do not provide partial or total removal of the coal ash source terms which lead to ground-water contamination. At Will County, retirement of the Ponds 1-N and 1-S did not remove all of the coal ash and water and thus coal ash leachate has continued to enter the ground water.

Monitoring is not addressing the reduction or elimination of ground-water contamination. There were and are pathways for contamination from the ponds to enter the ground water prior to and after ash pond lining. The evidence does not show that site characterization, ground-water analytics, and implementation of administrative controls have eliminated exposure pathways nor ground-water impacts at any of the four sites. Kunkel (2015a) on Figures 5 through 7, 13 through 15, 22 through 25, and 29 through 31 shows the time series of the indicator pollutants at the four plant sites since monitoring began at the end of 2010. These figures show the following:

(1) At Joliet #29, the indicator pollutant concentrations in ground-water have increased in four monitoring wells and stayed essentially the same in seven monitoring wells.
(2) At Powerton, the indicator pollutant concentrations in ground-water have increased in six monitoring wells and stayed essentially the same in 10 monitoring wells.
(3) At Waukegan, the indicator pollutant concentrations in ground-water have increased in five monitoring wells and essentially stayed the same in 10 monitoring wells.
(4) At Will County, the indicator pollutant concentrations in ground water have increased in seven monitoring wells and essentially stayed the same in three monitoring wells.

The monitoring data do not show that contamination has been significantly reduced, let alone eliminated, after lining the ponds. My opinion is that ground-water monitoring does not show mitigation of ground-water contamination or exposure pathways.

Temporary or seasonal water table elevations at or above the pond liners (not necessarily the pond bottoms) are causes for concern due to the potential for hydrostatic uplift, reduction of the load-bearing capacity of the underlying soils, and ground-water inflows through cracks in the old Poz-o-Pac liners. Additionally, temporary or seasonal water table elevations at or above the pond liners are not permitted under the USEPA (2015) coal ash rule. Under the rule, the liners must be 5 ft above the highest ground-water elevation of the uppermost aquifer (§257.60 of the rule). Thus, except for possibly the Joliet #29 site, none of the MWG coal ash ponds can attain this 5-ft distance under their present locations.

It is untrue that hydrostatic uplift is a potential issue only for soil liners and not geomembrane liners. I have personal experience at the Colstrip Montana Steam Electric Station where ground-water hydrostatic uplift on a plastic liner caused the liner to fail. A rock underdrain was installed to reduce the ground-water hydrostatic uplift pressures. Also see §257.70(b) of the USEPA (2015) coal ash rule.

Seymour's evaluation of hydrostatic uplift assumed that the Poz-o-Pac liners were impermeable and added weight to offset the hydrostatic uplift. We have documentation at the Will County site that the Poz-o-Pac is cracked and allows ground-water to percolate upward into at least one ash pond (Bates Nos. 28850, 28862). We know that, as of 2006, all of the Poz-o-Pac liners dated from the late 1970s and were in poor condition (Bates

66-69). It is therefore reasonable to expect that other Poz-o-Pac liners are cracked, especially those ponds where part of the Poz-o-Pac was removed to maintain ash storage capacity when they were relined. If the ground-water rises above the bottom of the ponds only temporarily, there could still be hydrostatic uplift and the potential for liner failure.

Seymour (2015, p. 37) states that liner leak testing was done either prior to or after placement of the 1-ft sand "cushion" layer. Evidence (Bates Nos. 49495, 49504) shows that trucks drove on this 1-ft sand cushion layer to place the 6-in crushed limestone warning layer. This is not good engineering practice because the turning trucks, dozer spreading of the crushed limestone, and sudden braking or reversals of equipment could cause liner tears. No additional liner leak testing was done after placement of the 6-in crushed limestone warning layer in the ponds.

After dredging of the ash ponds using heavy equipment, there is no visual method to check for liner leaks caused by the dredging equipment. MWG has documented liner tears during dredging (for example, Bates No. 44621), but it is highly likely that some liner tears have gone unnoticed because of coal ash and the warning layer covering these liner failures.

ECONOMIC REASONABLENESS OF THE PROPOSED REMEDY

My remedy report (Kunkel, 2015b) has the only economically reasonable remedy to reduce the source terms for the indicator pollutants at the four plant sites. This remedy removes the coal ash ponds and selected ash storage areas outside the ash ponds. MWG's remedies of establishing GMZ's, ELUC's and ground-water monitoring does nothing to reduce the source terms. Lining of the coal ash ponds at the four plant sites also has not significantly reduced the indicator pollutant ground-water contamination at the four sites.

I conclude that removal of at least some of the coal ash source terms at the four plant sites is the most cost-effective method to reduce continuing ground water contamination. Other ground-water "clean-up" methods such as pump-and-treat or natural attenuation will be effective only if all, or a portion of, the source terms are removed. Additionally, pump-and-treat for B and SO_4 involves elaborate and expensive treatment processes such as membrane technologies and also would involve treatment of large volumes of water because all four plant sites are adjacent to water bodies. I conclude that source removal is more cost-effective than pump-and-treat, because it is more effective in reducing ground-water contamination and less costly. Source removal also is more cost-effective than natural attenuation even though natural attenuation is less costly.

MWG's remedial approach does not address all of the ground-water contamination source terms at the four sites. Seymour misinterprets the Kunkel (2015b) remedy report, which does not recommend removal of all the coal ash at the four plant sites, but rather removal of only the ash ponds and ash immediately adjacent to the ash ponds, the former fly ash disposal area at Waukegan, and, for Joliet #29, additional removal of the northeast ash landfill.

Seymour (2015, p. 63) objects to Kunkel's *"Costs of Soil Disposal at a Permitted Landfill."* Seymour states "It is my opinion that the Kunkel Remedy Report significantly underestimates the cost of proposed cleanup to remove all ash ponds and all CCRs in fill at the plants". He continues that Kunkel's proposed remedy (1) "... fails to incorporate the costs of disposal at a permitted landfill ..."; (2) "... does not account for significant and costly disruption at the generating plants ..."; (3) "... results in significant impacts to the surrounding communities, including dust, noise, and traffic ..."; and (4) "... fails to consider the impact of vehicle carbon dioxide emissions ...".

I utilized a cost range of $29.27 (low unit cost) to $42.95 (high unit cost) per ton for estimating the cost to remove the existing coal ash ponds and coal ash-impacted soils at each site, to haul the material removed to an existing landfill and to backfill the excavated areas for the proposed remedy. The unit soil tonnages and costs for the proposed remedy are based on a total impacted area of 196 acres for all four sites rather than the 1,064 acres assumed by Seymour (2015, p. 64). The remedy includes only ash pond removal and ash fill very near the ponds at the four sites, except at Waukegan where the costs include removal of the former fly ash disposal area, and at Joliet #29 where the costs include the removal of ash from the old NE Ash Landfill (Kunkel, 2015b, Table 6). Thus, all of Seymour's objections and his estimated costs and impacts are unwarranted because the remedy at any one of the four sites is most likely no different than a moderate construction project.

CONCLUSIONS

I have shown in this rebuttal report that:

(1) Much of Seymour's expert report (Seymour, 2015) is unsound and incorrectly interprets the available data and information;
(2) The indicator pollutants I use for ground-water contamination from coal ash are consistent with USEPA, EPRI and IEPA documents;
(3) The concentrations of the indicator pollutants in ground water at the four plant sites are much higher than background;
(4) I utilized the same background data for the indicator pollutants as IEPA utilized in their coal ash assessment, except at Powerton where background data at MW-16 (the only true background well at the four plant sites) agrees with the IEPA background for sand and gravel aquifers;
(5) At Joliet #29, Powerton and Will County sites, no other potential sources of indicator pollutants, except coal ash, are present up-gradient;
(6) At Waukegan, ground-water from the Greiss-Phleger Tannery site is not reaching the monitoring well network and, therefore, I conclude that none of the boron is coming from the tannery;
(7) The ground-water concentrations are temporally and spatially consistent at each of the four plant sites;
(8) Ground-water contamination at all four plant sites has generally remained the same, at high concentrations for the monitoring period between Dec. 2010 through present;
(9) MWG's actions will not significantly reduce or eliminate ground-water contamination from coal ash at the four sites; and
(10) My proposed remedy (Kunkel, 2015b) is economically reasonable compared to other source-term removal remedies or ground-water remediation.

Yours truly,

JAMES R. KUNKEL, Ph.D., P.E.

REFERENCES

American Society for Testing and Materials (ASTM). 2012. ASTM D3987-12 Standard Test Method for Shake Extraction of Solid Waste with Water. West Conshohocken, PA.

Electric Power Research Institute (EPRI). 2012. Groundwater Quality Signatures for Assessing Potential Impacts from Coal Combustion Product Leachate. EPRI Report No. 1017923. Nov. 15.

ENSR Consulting. 1998d. Phase II Environmental Site Assessment of the ComEd Waukegan Generating Station, 10 Greenwood Avenue, Waukegan, Illinois. Report prepared for Commonwealth Edison Company. November 16. 4 Sections. 5 tabs. 6 figs. 3 appendices. (MWG13-15_5058-5092) (MWG13-15_11966-12002)

Hattaway, J., C.D. Hardin and J.L. Daniels. 2013. Recommended Guidelines for Use and Application of the Leaching Environmental Assessment Framework (LEAF) for Coal Combustion Residuals. 2013 World of Coal Ash (WOCA) Conference. April 22-25 in Lexington, KY. http://www.flyash.info/

Illinois Environmental Protection Agency (IEPA). 2012a. Compliance Commitment Agreement, Violation Notice: W-2012-00059, Midwest Generation, LLC, Joliet #29 Generating Station; ID Number: 6284, October 24. (Comp. 009580-009585)

Illinois Environmental Protection Agency (IEPA). 2012b. Compliance Commitment Agreement, Violation Notice: W-2012-00057, Midwest Generation, LLC, Powerton Generating Station; ID Number: 6282, October 24. (Comp. 009610-009617)

Illinois Environmental Protection Agency (IEPA). 2012c. Compliance Commitment Agreement, Violation Notice: W-2012-00056, Midwest Generation, LLC, Waukegan Generating Station; ID Number: 6281, October 24. (Comp. 003887-003922) (Comp. 009168-009624)

Illinois Environmental Protection Agency (IEPA). 2012d. Compliance Commitment Agreement, Violation Notice: W-2012-00058, Midwest Generation, LLC, Will County Generating Station; ID Number: 6283, October 24. (Comp. 009564-009568)

Illinois Environmental Protection Agency (IEPA). 2013. Illinois Environmental Protection Agency, Subtitle G, Coal Combustion Waste Impoundments at Electrical Coal Fired Power Plants Technical Support Document (TSD), Attachment A to the Illinois Ash Pond Closure Rule Proposal. Comp. 019067-019298) (Comp. 021826-022057)

Kosson, D.S., F. Sánchez, P. Kariher, L.H. Turner, R. Delapp, and P. Seignette. 2009. Characterization of Coal Combustion Residues from Electric Utilities--Leaching and Characterization Data. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/151.

Kunkel, J.R. 2015a. Expert Report on Ground-water Contamination. Report prepared for Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network and Citizens Against Ruining the Environment. PCB 2013-015. 42 p, 8 tables, 31 figures. July 1.

Kunkel, J.R. 2015b. Expert Report on Remedy for Ground-water Contamination. Report prepared for Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network and Citizens Against Ruining the Environment. PCB 2013-015. 11 p, 6 tables, 4 figures. July 1.

Narejo, D.N. and G. Corcoran. 1996. Geomembrane Protection Design Manual. First Edition. GSE Lining Technology. 5 Chapters. References.

Seymour, John. 2015. Expert Report of John Seymour, P.E. Report prepared for Midwest Generation, LLC. November 2. 78 p. 20 figs. 13 tabs. 2 appendices.

Schroeder, P. R., Aziz, N. M., Lloyd, C. M. and Zappi, P. A. 1994. The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3. EPA/600/R-94/168a. September. U.S. Environmental Protection Agency Office of Research and Development, Washington, DC. 94 p. Appendix A. (Publicly available).

Skilling, T. 2002. "What's the pH of our rainwater?" Chief Meteorologist at WGN-TV: email to Matt Dunning from asktomwhy@tribune.com. Chicago. January 4.

United States Environmental Protection Agency (USEPA). 2015. 40 CFR Parts 257 and 261 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule. Federal Register, vol. 80, no. 74. April 17. pp. 21302-21501.

ATTACHMENTS

Figure 1 Boron Concentrations in Ground Water at Wells MW-5 through -12 and MW-14 and -15 at Waukegan Site

Table 1 Summary of Constituents Detected in Ground Water at the Waukegan Site Compared to Detection in Bottom Ash Based on the ASTM D3987-85 Test Procedure and Impoundment Ash Leachate Samples

Figure 1 Boron Concentrations in Ground Water at Wells MW-5 through -12 and MW-14 and MW-15 at Waukegan Site

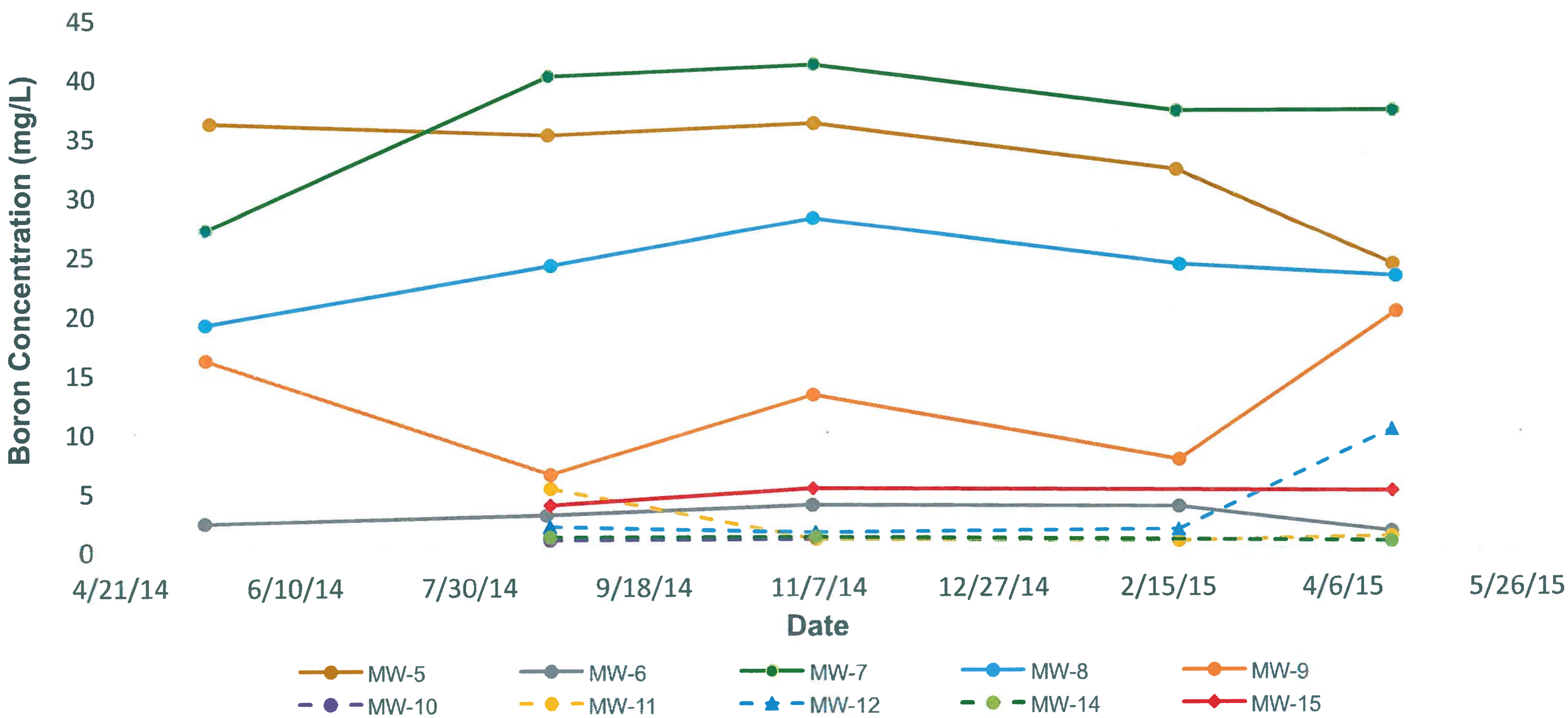


Table 1 Summary of Constituents Detected in Ground Water at the Waukegan Site Compared to Detection in Bottom Ash Based on the ASTM D3987-85 Test Procedure and Impoundment Ash Leachate Samples

Constituent	Detection Limit in Ground Water[1] (mg/L)	Detection Limit in ASTM D3987-85 Test[2] (mg/L)	Constituents Detected in Ground-water During 2014 Quarterly Sampling[1]						
			MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7
Antimony	0.003	0.006							
Arsenic	0.001	0.05	X[3]	X	X	X	X	X	X
Barium	0.0025	0.5	X	X	X	X	X	X	X
Beryllium	0.001	0.004							
Boron	0.5	0.1	X	X	X	X	X	X	X
Cadmium	0.0005	0.005							
Chromium	0.005	0.025							
Cobalt	0.001	0.025							
Copper	0.002	0.025	X					X	
Iron	0.1	0.1		X			X	X	X
Lead	0.0005	0.0075			X				
Manganese	0.0025	0.025	X	X	X	X	X	X	X
Mercury	0.0002	0.002							
Nickel	0.002	0.025					X		
Selenium	0.0025	0.05	X	X	X	X		X	
Silver	0.0005	0.025							
Sulfate	50	0.002	X	X	X	X	X	X	X
Thallium	0.002	0.002							
Zinc	0.02	0.1							
Number of Observed Constituents that are NOT Consistent with Indicators of Leachate from Ash Currently Stored in the Ash Ponds[4]			0	1	0	0	1	1	1
Percent of Observed Constituents that are NOT Consistent with Indicators of Leachate from Ash Currently Stored in the Ash Ponds			0	5	0	0	5	5	5
Percent of Observed Constituents that ARE Consistent with Indicators of Leachate from Ash Currently Stored in the Ash Ponds			100	95	100	100	95	95	95

(1) From MWG quarterly ground-water monitoring reports.
(2) From Table 5-1 of Seymour (2015).
(3) X means the constituent was detected in ground water at the Waukegan site and also observed in impoundment leachate (Seymour, 2015, Table 5-2) (CONSISTENT).
(4) means an ash leachate indicator constituent as defined by Seymour (2015, Table 1) was NOT detected by the ASTM D3987-85 test procedure in Waukegan ash pond bottom ash at the detection limit used in the MWG quarterly ground-water monitoring reports (INCONSISTENT).
(5) means the ash leachate indicator constituent as defined by Seymour (2015, Table 1) was NOT detected in the Waukegan site ground water or the ASTM D3987-85 test procedure in the Waukegan bottom ash (CONSISTENT).

EXHIBIT 7*

*Exhibit 7 is an excerpt of Jonathan S. Shefftz' Opinion on Economic Benefit of Noncompliance and Economic Impact of Penalty Payment and Compliance Costs Report, which is marked as Non-Disclosable Information. The page in Exhibit 7 is not Non-Disclosable Information.

Table 3: ECONOMIC BENEFIT FROM DELAYED AND/OR AVOIDED COMPLIANCE MEASURES

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)
	Site Name and Total Remedy Costs	Per-Year Cost Estimate: Amount	Date	Cost Index: Choice	Value	Depreciate?	Recurring?	On-Time Compliance Scenario: Date	Cost Index Value	Adjusted Cost for Inflation	After-Tax Value	PV Factor at: 25-Jan-21	After-Tax PV	Delayed Compliance Scenario: Date	Cost Index Value	Adjusted Cost for Inflation	After-Tax Value	PV Factor at: 25-Jan-21	After-Tax PV	Economic Benefit
(1)	Joliet:	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-11	181.1	$3,099,354	$1,823,040	1.5966	$2,910,730	1-Jan-22	200.1	$3,423,880	$2,447,732	0.9515	$2,329,083	$581,647
(2)	Site-Wide =	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$3,270,494	$1,923,705	1.5252	$2,933,992	1-Jan-23	204.9	$3,506,054	$2,506,478	0.9022	$2,261,452	$672,540
(3)	$20,742,381	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-13	192.6	$3,296,165	$1,938,804	1.4626	$2,835,644	1-Jan-24	209.8	$3,590,053	$2,566,529	0.8555	$2,195,695	$639,948
(4)	NE Landfill =	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$3,323,548	$1,954,911	1.3997	$2,736,294	1-Jan-25	214.7	$3,674,269	$2,626,735	0.8111	$2,130,499	$605,794
(5)	$10,278,011	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-15	185.0	$3,166,099	$1,898,393	1.3364	$2,536,989	1-Jan-26	219.6	$3,758,778	$2,687,150	0.7691	$2,066,614	$470,375
(6)	Pond Areas =	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$3,075,394	$1,844,006	1.2814	$2,362,937	1-Jan-27	224.7	$3,845,229	$2,748,955	0.7292	$2,004,645	$358,292
(7)	$1,239,585	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-17	185.6	$3,176,367	$1,886,444	1.2306	$2,321,539	1-Jan-28	229.9	$3,933,670	$2,812,180	0.6915	$1,944,534	$377,005
(8)	Total =	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-18	192.6	$3,296,165	$2,356,429	1.1753	$2,769,436	1-Jan-29	235.1	$4,024,308	$2,876,978	0.6556	$1,886,027	$883,408
(9)	**$32,259,977**	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-19	194.3	$3,325,259	$2,377,228	1.1076	$2,633,102	1-Jan-30	240.7	$4,118,879	$2,944,587	0.6216	$1,830,367	$802,735
(10)		$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-20	196.6	$3,364,621	$2,405,368	1.0555	$2,538,977	1-Jan-31	246.3	$4,215,673	$3,013,785	0.5894	$1,776,350	$762,627
(11)	Powerton:	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-11	181.1	$16,871,392	$9,923,753	1.5966	$15,844,615	1-Jan-22	200.1	$18,637,959	$13,324,277	0.9515	$12,678,410	$3,166,205
(12)	Site-Wide =	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$17,802,998	$10,471,723	1.5252	$15,971,243	1-Jan-23	204.9	$19,085,270	$13,644,060	0.9022	$12,310,259	$3,660,985
(13)	$135,964,711	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-13	192.6	$17,942,739	$10,553,919	1.4626	$15,435,881	1-Jan-24	209.8	$19,542,521	$13,970,948	0.8555	$11,952,310	$3,483,570
(14)	Pond Areas =	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$18,091,796	$10,641,594	1.3997	$14,895,068	1-Jan-25	214.7	$20,000,956	$14,298,683	0.8111	$11,597,414	$3,297,654
(15)	$39,643,093	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-15	185.0	$17,234,718	$10,333,937	1.3364	$13,810,150	1-Jan-26	219.6	$20,460,978	$14,627,553	0.7691	$11,249,655	$2,560,495
(16)	Total =	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$16,740,967	$10,037,884	1.2814	$12,862,693	1-Jan-27	224.7	$20,931,580	$14,963,987	0.7292	$10,912,324	$1,950,369
(17)	**$175,607,804**	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-17	185.6	$17,290,615	$10,268,896	1.2306	$12,637,340	1-Jan-28	229.9	$21,413,007	$15,308,159	0.6915	$10,585,108	$2,052,232
(18)		$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-18	192.6	$17,942,739	$12,827,264	1.1753	$15,075,476	1-Jan-29	235.1	$21,906,398	$15,660,884	0.6556	$10,266,626	$4,808,850
(19)		$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-19	194.3	$18,101,112	$12,940,485	1.1076	$14,333,342	1-Jan-30	240.7	$22,421,198	$16,028,915	0.6216	$9,963,639	$4,369,703
(20)		$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-20	196.6	$18,315,382	$13,093,666	1.0555	$13,820,971	1-Jan-31	246.3	$22,948,096	$16,405,594	0.5894	$9,669,594	$4,151,376
(21)	Waukegan:	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-11	181.1	$10,203,931	$6,001,952	1.5966	$9,582,930	1-Jan-22	200.1	$11,272,363	$8,058,612	0.9515	$7,667,988	$1,914,942
(22)	Site-Wide =	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$10,767,373	$6,333,369	1.5252	$9,659,515	1-Jan-23	204.9	$11,542,900	$8,252,019	0.9022	$7,445,327	$2,214,188
(23)	$77,899,032	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-13	192.6	$10,851,889	$6,383,081	1.4626	$9,335,724	1-Jan-24	209.8	$11,819,448	$8,449,724	0.8555	$7,228,838	$2,106,887
(24)	Pond Areas =	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$10,942,040	$6,436,108	1.3997	$9,008,637	1-Jan-25	214.7	$12,096,713	$8,647,940	0.8111	$7,014,194	$1,994,443
(25)	$28,309,749	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-15	185.0	$10,423,673	$6,250,035	1.3364	$8,352,472	1-Jan-26	219.6	$12,374,937	$8,846,842	0.7691	$6,803,867	$1,548,605
(26)	Total =	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$10,125,049	$6,070,980	1.2814	$7,779,443	1-Jan-27	224.7	$12,659,561	$9,050,320	0.7292	$6,599,847	$1,179,596
(27)	**$106,208,781**	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-17	185.6	$10,457,480	$6,210,697	1.2306	$7,643,148	1-Jan-28	229.9	$12,950,730	$9,258,477	0.6915	$6,401,944	$1,241,204
(28)		$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-18	192.6	$10,851,889	$7,758,016	1.1753	$9,117,749	1-Jan-29	235.1	$13,249,137	$9,471,808	0.6556	$6,209,324	$2,908,425
(29)		$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-19	194.3	$10,947,674	$7,826,492	1.1076	$8,668,902	1-Jan-30	240.7	$13,560,492	$9,694,395	0.6216	$6,026,076	$2,642,826
(30)		$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-20	196.6	$11,077,266	$7,919,137	1.0555	$8,359,016	1-Jan-31	246.3	$13,879,163	$9,922,214	0.5894	$5,848,236	$2,510,780
(31)	Will County:	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-11	181.1	$3,082,219	$1,812,961	1.5966	$2,894,638	1-Jan-22	200.1	$3,404,952	$2,434,200	0.9515	$2,316,207	$578,431
(32)	Site-Wide =	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$3,252,413	$1,913,070	1.5252	$2,917,772	1-Jan-23	204.9	$3,486,670	$2,492,621	0.9022	$2,248,950	$668,822
(33)	$26,651,067	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-13	192.6	$3,277,942	$1,928,086	1.4626	$2,819,967	1-Jan-24	209.8	$3,570,205	$2,552,340	0.8555	$2,183,557	$636,410
(34)	Pond Areas =	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$3,305,174	$1,944,103	1.3997	$2,721,166	1-Jan-25	214.7	$3,653,956	$2,612,213	0.8111	$2,118,721	$602,445
(35)	$5,430,561	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-15	185.0	$3,148,595	$1,887,897	1.3364	$2,522,964	1-Jan-26	219.6	$3,737,997	$2,672,294	0.7691	$2,055,189	$467,775
(36)	Total =	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$3,058,392	$1,833,812	1.2814	$2,349,873	1-Jan-27	224.7	$3,823,971	$2,733,757	0.7292	$1,993,562	$356,311
(37)	**$32,081,628**	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-17	185.6	$3,158,806	$1,876,015	1.2306	$2,308,704	1-Jan-28	229.9	$3,911,922	$2,796,633	0.6915	$1,933,784	$374,920
(38)		$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-18	192.6	$3,277,942	$2,343,401	1.1753	$2,754,125	1-Jan-29	235.1	$4,002,060	$2,861,072	0.6556	$1,875,600	$878,524
(39)		$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-19	194.3	$3,306,876	$2,364,085	1.1076	$2,618,545	1-Jan-30	240.7	$4,096,108	$2,928,308	0.6216	$1,820,248	$798,297
(40)		$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-20	196.6	$3,346,020	$2,392,070	1.0555	$2,524,940	1-Jan-31	246.3	$4,192,367	$2,997,123	0.5894	$1,766,529	$758,411

Notes:

(a)		Line number, for reference only. (b) Compliance measure. (c) Cost estimate for compliance measure. (d) Date for cost estimate.
(e)		CCI= Construction Cost Index (*Engineering News Record*) PCI= Plant Cost Index (*Chemical Engineering* mag.) PPI= Producer Price Index & ECI= Employment Cost Index (U.S. Bureau of Labor Statistics)
(f)		Monthly value for selected cost index used for inflation adjustments.
(g)		Whether measure is a capital investment that is depreciated over time for tax purposes (i.e., as opposed to fully expensed the year in which it is incurred).
(h)		Whether measure is an annually recurring cost (and hence avoided entirely each year over the period of noncompliance).
(i)	On-Time Compliance Scenario:	For capital investments, mid-point for each year-long period of On-Time Compliance Scenario; for O&M, date when costs first start.
(j)		Monthly value for selected cost index used for inflation adjustments.
(k)		Original cost estimate adjusted for inflation from cost estimate date (i.e., original cost estimate divided by associated cost index value, then multiplied by date-specific value).
(l)		Inflation-adjusted cost adjusted for tax deductibility (i.e., either tax rate from Table 2 if fully expensed, or tax shield present value from Table 4 if depreciated).
(m)		Value of a dollar brought to present from scenario start date, calculated as: {1 + Table 2 yr-specific Column "p"} ^ {(pv date - Table 3 Column "i" or "i" & "o" avg for recurring costs}/365.25}.
(n)		After-tax inflation-adjusted cost multiplied by present value factor.
(o) through (t)		Identical calculations for the Delayed Compliance Scenario except for different start date, and any measures that are avoided entirely are not incorporated here.
(u)		Difference of the after-tax present values in the scenarios for the On-Time Compliance Scenario versus the Delayed Compliance Scenario.

EXHIBIT 8

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:)
SIERRA CLUB, ENVIRONMENTAL LAW AND)
POLICY CENTER, PRAIRIE RIVERS)
NETWORK, AND CITIZENS AGAINST)
RUINING THE ENVIRONMENT,)
COMPLAINANTS,)
-VS-)NO. PCB 2013-015
MIDWEST GENERATION, LLC,)(ENFORCEMENT - WATER)
RESPONDENT.)

DISCOVERY DEPOSITION OF
JONATHAN S. SHEFFTZ
CHICAGO, ILLINOIS
OCTOBER 28, 2021

ATKINSON-BAKER, A VERITEXT COMPANY
(800) 288-3376
WWW.DEPO.COM

REPORTED BY: CHERYL LYNN MOFFETT, CSR NO. 084-002218
FILE NO. 4949402

P.E., dated July 1, 2015. Correct?

A. Correct.

(WHEREUPON, Shefftz Exhibit No. 5 was marked for ID.)

BY MS. GALE:

Q. So, turning to Exhibit 5, the Kunkel remedy report. Do you have that in front of you or is it on your computer or do I need to put it on the screen?

A. It's on my computer. I'm looking at it on my computer.

Q. Okay. Great. And this is the report that you relied upon?

A. Yes. I didn't match it up with what's on my computer, but -- I mean what's in my original file outside of -- per my original files outside of the new folder I created for the deposition exhibits. But the date matches up, the name matches up. I didn't remember the cute picture of the waterfall, but the rest of it seems to be what I remember.

Q. Very good. Did you review any other report by Dr. Kunkel?

A. I have no recollection of that, and I don't see any citations of that here. So.

Q. Okay.

A. It doesn't appear like I did.
Q. And --
A. Actually let me go look at my second report and see if I mentioned anything like that.
No, I don't see any reference to a subsequent report by him in my July 2021 report.
Q. Okay. We can certainly go to the pages reviewed, but I believe you state in your report that you reviewed and relied upon Table 6 of Dr. Kunkel's report? Is that correct?
A. I can look at my report to see where I specifically mention that.
So, on Page 22.
Q. Yes.
A. I say specifically -- so, we're on the first bullet point, second sentence. Specifically I used the low-end estimates from Table 6 of the expert report.
Q. Okay. Thank you. Did you rely on anything else in this remedy report for your opinion in your January 2021 report?
A. Yes. I used the date of his report as my cost estimate date. Otherwise, my recollection is that was it.
Q. Okay. And, you know, you do not have an

EXHIBIT 9

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

\- - - - - - - - - - - - - - - - x

In the Matter of: :
SIERRA CLUB, :
ENVIRONMENTAL LAW AND : PCB No.
POLICY CENTER, PRAIRIE : 2013-015
RIVERS NETWORK, and :
CITIZENS AGAINST RUINING :
THE ENVIRONMENT, :
Complainants, :
v. :
MIDWEST GENERATION, LLC, :
Respondent. :

\- - - - - - - - - - - - - - - - x

Deposition of

DOUGLAS G. DORGAN, JR., and MICHAEL B. MAXWELL

Conducted Virtually

Wednesday, October 6, 2021

9:27 a.m. CT

Job No.: 402611

Pages: 1 - 228

Reported By: Courtney Petros, RPR, CSR

percent.

Q Okay. And I want to turn to your experience. In your description of your experience, it mentioned that you have experience with closure of Federal CCR ponds, right?

MR. DORGAN: That's correct.

Q How many have you been involved in the closure of?

MR. DORGAN: Two recent ones.

Q Any more than the recent ones?

MR. DORGAN: Not under the new CCR rules, no.

Q Were you involved in the closure of any coal ash ponds before the Federal CCR rules were --

THE REPORTER: Ms. Bugel, I'm sorry. Your question broke up a little bit. Could you repeat it?

MS. BUGEL: Yes.

Q The question is were -- to Mr. Dorgan -- were you involved in the closure of any coal ash ponds before the Federal CCR rules were effective?

MR. DORGAN: I've been involved in other projects involving coal ash before the CCR rules came into effect. The other one, I believe, that I represent in my resume is the project in the Town of Pines in Indiana.

Q Any other coal ash projects besides the two Federal CCR pond closures and the Town of Pines, Indiana?

MR. DORGAN: Yeah. I've been working for 35 years, plus, now in this area. So the number of projects that I've done that have involved coal ash have occurred at different times and different locations, different states. Certainly didn't include a comprehensive list of all of them, but there have been other projects that involved coal ash and other combustion byproducts that I've worked on.

Q Can you identify any others by name?

MR. DORGAN: I've done the projects at the National Steel Facility in northwest Indiana, the Gary Tar Pit, any number of Illinois site remediation program closures that involve ash and other materials. I've also been involved in the Johns Manville project, which is north of the Waukegan plant, that involved historic cinders.

Q Any others that you recall?

you knew of them?
MR. MAXWELL: I reviewed the majority of them in some capacity.
Q And turning to your experience that you also discuss in the report, you mentioned that you were involved in the permitting, closure, remediation, and corrective action at a northwest Indiana site, right? Does that sound right?
MR. MAXWELL: That sounds accurate. Yes.
Q And you also mentioned you were involved in groundwater monitoring installation, results, statistical analysis at two Indiana surface impoundments, right?
MR. MAXWELL: That sounds like it is a correct reference. Yes.
Q And then I also noted you said that you were involved in Federal CCR closure plans. Were those for the same Indiana surface impoundments that we just discussed?
MR. MAXWELL: Yes. The -- I'm sorry. I don't know that I understand your question. Could you --
Q Okay. Yes. I can rephrase.
MR. MAXWELL: I'm not sure what sites

you're referring to.
Q Right. That's what I want to find out. Let me try it this way.
You've been involved in Federal CCR closure plans for surface impoundments, correct?
MR. MAXWELL: Yes.
Q Where are those surface impoundments located?
MR. MAXWELL: They are located in Indiana.
Q And are those the same surface impoundments where you were involved in the groundwater monitoring installation, statistical analysis, and so -- and analysis of results?
MR. MAXWELL: Yes.
Q Besides the items we just discussed, do you have any other professional experience with coal ash?
MR. MAXWELL: My professional resume lists my experience with -- with coal ash.
Q Are there any projects that you can identify regarding coal ash that I have not just identified in my questions?
MR. MAXWELL: I'm not sure that you've encompassed all of my experience, no.

THE REPORTER: I'm sorry. I -- for some reason, I did not hear that answer. Could you repeat it?
MR. MAXWELL: I don't believe that you've covered all of my experience with coal ash.
Q And my question is, what have I missed?
MR. MAXWELL: So there is actually one other site in Indiana that Mr. Dorgan mentioned that I've been involved with as well.
Q And is that the Pines site?
MR. MAXWELL: That's right.
Q And now I'm remembering. Did you also have a New Jersey project that you did?
MR. MAXWELL: There was a groundwater monitoring aspect of a CCR site that -- that was located in New Jersey, yes.
Q Do you -- would it assist your recollection if you looked at your CV?
MR. MAXWELL: That would help, yes.
Q Oh, feel free to look at your CV, which I know is also attached to your report.
MS. BUGEL: And, for the record, I see that beginning at Bates page 81492.
MR. MAXWELL: I would point out that I

have been involved -- in addition to the -- the CCR closure projects and CCR projects, I've been involved in other projects that involved combustion of various materials.

In particular, practicing here in Chicago, the urban fill materials that are frequently encountered here in Chicago often do contain cinders. And so I've got extensive experience in terms of dealing with site investigation, closure of sites that are located in the Chicagoland area that may have cinders as a -- as an issue.

Q In those situations, are cinders considered coal ash?

MR. MAXWELL: Some sites, it's possible that coal ash may be attached to them. Honestly, in the field, when you're looking at fill soil, let's say, it's easier to tell if something is -- is -- is burned than it is to tell maybe what was burned, if that makes sense.

Q Yes. Looking at your CV, is there any other coal ash experience that we haven't discussed?

MR. MAXWELL: As I mentioned, there's -- there may be other coal ash sites that -- that --

where coal ash was at least a minor component in projects that I've been involved with during my 25 years of practicing here in Chicago. I can't necessarily recall the names of those projects as we sit here today.

Q And looking at your CV, the names of those projects aren't listed there either?

MR. MAXWELL: My CV is intended to represent a summary of things that I've done. It doesn't necessarily represent the entirety.

MS. BUGEL: Okay. I am going to pause for just a second. I'm having a technical problem with my connection to the power. It should just take me ten seconds. Okay. We're back in business. Thank you.

Q Okay. The next item we're turning to is the Interim Board Order of June 20th, 2019.

MS. BUGEL: Abel, are you able to pull that up on a screen share?

MR. RUSS: Yes. Can you tell me the exhibit number?

MS. BUGEL: That's exhibit -- Remedy Deposition Exhibit 1.

(Exhibit 1, previously marked, is attached options for managing the conditions that exist at the four stations. Removal would be an option where necessary. Some removal has taken place in the past, as we've noted.

We considered other options as well, but as we began refining those options, the one based upon the risks posed by the sites relative to the sensitive receptors, we felt that the remedy that we laid out for each of the four sites was the appropriate -- both the technically practicable and economically reasonable and achieves the degree of protection of human health and the environment that's important to achieve.

So that's -- after considering the other options, we -- we landed on this particular remedy approach to align with those particular criteria.

Q And, specifically, as to Waukegan and the FS area, did you explore removal as an option for the FS area?

MR. DORGAN: I would say we considered removal, but we felt that the more technically practicable and economically reasonable option was to put a cap across it, which is a very standard methodology for controlling conditions like this.

It's approvable. We've approved many of them in the state of Illinois. And as a consequence, we felt confident that it was one that would be both effective and approvable and would achieve the performance goals, which is to, over time, restore the groundwater to conditions that fall below the groundwater protection standards.

Q When you say approvable, what do you mean?

MR. DORGAN: In terms of -- a cap like this would typically be designed and then submitted for agency review and, ultimately, approval before you would go out and construct it.

Q And you referenced standard methodology as well. Is removal a standard methodology in the United States?

MS. NIJMAN: Objection. Overbroad. Vague.

Q And you can still answer.

MR. DORGAN: Again, a removal action, and really any kind of remedial action, is highly dependent upon the conditions that you're attempting to mitigate as far as being protective of human health and the environment.

I've certainly been involved in projects