BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

In the Matter of:	)	
	)	
SIERRA CLUB, ENVIRONMENTAL LAW AND POLICY CENTER, PRAIRE RIVERS NETWORK, and CITIZENS AGAINST RUINING THE ENVIRONMENT	)	PCB No-2013-015 (Enforcement – Water)
Complainants,	)	
v.	)	
MIDWEST GENERATION, LLC, Respondents	)	

NOTICE OF SERVICE

To: Don Brown, Clerk of the Board
Illinois Pollution Control Board
100 West Randolph Street
Suite 11-500
Chicago, IL 60601

PLEASE TAKE NOTICE that I have o January 25, 2021, served a true and correct copy of the **Expert Opinion of Mark A. Quarles, P.G.**, and **EXPERT OPINION on Economic Benefit of Noncompliance and Economic Impact of Penalty Payment and Compliance Costs** via electronic mail to the parties listed on the attached service list before 5:00 p.m. Central Time.

Dated: January 25, 2021

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned, Faith Bugel, an attorney, certifies that a true copy of the foregoing **NOTICE OF SERVICE** was filed electronically on January 25, 2021 with the following:

Don Brown, Clerk of the Board
Illinois Pollution Control Board
100 West Randolph Street
Suite 11-500
Chicago, IL 60601

And that true copies of the **Expert Opinion of Mark A. Quarles, P.G.**, and **EXPERT OPINION on Economic Benefit of Noncompliance and Economic Impact of Penalty Payment and Compliance Costs** were served via electronic mail to the electronic parties on the foregoing service list before 5 p.m. Central Time on January 25, 2021 to the email addresses of the parties' counsel. The entire package is 3 pages.

Respectfully submitted,

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EXPERT OPINION

on

Economic Benefit of Noncompliance

and

Economic Impact of Penalty Payment and Compliance Costs

In:

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

Pollution Control Board of the State of Illinois
PCB No-2013-015

Submitted on:
January 25, 2021

Expert Report of:
Jonathan S. Shefftz

d/b/a JShefftz Consulting
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Expert Opinion of Jonathan S. Shefftz

Economic Benefit of Noncompliance and Economic Impact of Penalty Payment and Compliance Costs

January 25, 2021

1. Summary of Opinion

I have been asked by Counsel for Petitioners in this matter to provide an expert analysis of financial economic factors relevant to the setting of a civil penalty and the determination of compliance costs.

Specifically, in this report I address:

- The economic benefit of environmental regulatory noncompliance that potentially accrued to Respondent Midwest Generation, LLC.
- The economic impact on Respondent and on its ultimate parent company, NRG Energy, Inc., from a penalty payment and from the costs of compliance with a Board order.

My opinion is as follows:

- Based on my analysis of compliance measures and associated costs estimates that have been provided to me by Petitioners' counsel, Respondent's economic benefit from failing to implement these measures in a timely manner is approximately $66 million.
- All of my economic benefit calculations and results are present value figures calculated as of January 25, 2021, i.e., the date of this expert report. Therefore the economic benefit will continue to grow after this date until Respondent effectively pays back its economic benefit in the form of a civil penalty. I provide details in my report for the monthly increase in my

economic benefit results for each month of delay in paying any penalty past my present value date.

- For the economic impact of a penalty payment and compliance costs, the named Respondent Midwest Generation, LLC has reported net income averaging $93 million over 2017 through 2019 and has reported net cash provided by operating activities averaging $132 million over the same three-year period. Yet although the named Respondent Midwest Generation, LLC is a legally separate entity from its ultimate parent NRG Energy, Inc., the Respondent is so closely intertwined with its ultimate parent NRG Energy as to have no significant independent financial and managerial existence. NRG Energy even describes the potential liability from this case in its filings with the U.S. Securities and Exchange Commission ("SEC") without any mention of the status of the named Respondent as distinct from itself. For NRG Energy, in 2019 total operating revenues were almost $10 billion, and net income was over $4.4 billion. As of September 30, 2020, NRG Energy held $697 million in cash and cash equivalents. The current market capitalization for NRG Energy is approximately $10.1 billion. And even the full amount of my economic benefit result plus the entire compliance costs advocated by Petitioners over the next ten years would represent only about two percent of the present value of NRG Energy's annual cash flow from operations projected out ten years.

- For civil penalties to achieve financial deterrence, their value must exceed the economic benefit that companies realize by delaying and/or avoiding adequate pollution control. Because not all violations are detected, prosecuted, and ultimately penalized, to achieve adequate deterrence, a civil penalty should also be adjusted by probability of detection, prosecution, and ultimate payment, as explained in further detail in my report. This is necessary to achieve the Board's goal to, "deter further violations by the respondent and to otherwise aid in enhancing voluntary compliance with this Act by the respondent and other persons similarly subject to the Act." (415 ILCS 5/42 (from Ch. 111 ½, par. 1042), Sec. 42. Civil penalties, (h)(4))

I reserve the right to supplement and revise the opinions contained herein as new or additional information becomes available to me. Note that as I am an economist – not an attorney – my report does not provide any independent expert opinion in this case on liability or other legal issues.

2. Basis for Opinion: Professional Expertise and Materials Considered

My opinion is based broadly on my expertise in financial economic analysis, as further detailed in the Curriculum Vitae included as Attachment A to this report. I hold both undergraduate and graduate degrees with a focus on economics in various contexts. I have been qualified numerous times as an expert witness on various economics matters in U.S. District Court trials and hearings, Administrative Court hearings of the U.S. Environmental Protection Agency ("EPA"), and state courts trials.

My experience with financial analysis of civil penalty issues dates back to 1992, encompassing expert witness casework, computer model development, training of state and federal agency staff, as well as involvement in federal agency public comment, stakeholder input, and peer review processes.

More specifically, regarding the analysis of financial gain / economic benefit, I have been involved with the periodic revisions and modifications to the U.S. EPA BEN economic benefit computer model since 1992, first as an employee of Industrial Economics, Incorporated ("IEc"), then since April 2006 and into 2017 as a subcontractor to IEc. Both federal and state environmental enforcement staff use the BEN model to develop their economic benefit results for penalty determinations. As compared to the case-specific economic benefit analysis that I have performed for this report, the BEN model performs essentially the same calculations from a conceptual viewpoint, but in a more routine and somewhat more constrained manner, so as to be amenable to financial laypersons.

In 1998, I managed IEc's development (under contract to EPA) of an entirely new version of the model for the Windows operating system (which was based largely upon the spreadsheet that I typically used for my case-specific economic benefit calculations). Since then, and into 2017, I continued to work on all aspects of IEc's support to EPA on the BEN model, encompassing researching relevant tax code changes, implementing new features, supervising a helpline that assists EPA and state environmental agencies, managing academic peer reviews, assisting in public comment processes and outside reviews, developing training course materials, and even typing in individual formulas. I have also created foreign versions of the BEN model for Canada, Chile, and El Salvador. And I have published articles on the subject matter (both concerning the BEN model, and related economic benefit issues).

Specifically for this case, I have:

- Reviewed the Amended Complaint in this case (filed January 14, 2015), the Interim Opinion and Order of the Board (issued June 20, 2019), and the Order of the Board (issued February 6, 2020).

- Reviewed the Illinois statutes 415 ILCS 5/33 (from Ch. 111 ½, par. 1033) Sec. 33. Board orders and 415 ILCS 5/42 (from Ch. 111 ½, par. 1042) Sec. 42. Civil penalties.

- Reviewed Respondent's answers to the third set of interrogatories and responses to the fifth set of document requests (dated June 2, 2020).
- Reviewed the transcript for the deposition of David Callen (taken December 2, 2020).
- Reviewed the expert report by James R. Kunkel, Ph.D., P.E., dated July 1, 2015.
- Reviewed a single-page document produced for discovery, providing a list of officers for Midwest Generation, LLC (MWG13-15_79474), and another single-page document produced by Petitioners' counsel listing those officers' respective positions with NRG Energy, Inc.
- Reviewed financial statements for Midwest Generation, LLC provided through discovery in this case.
- Discussed certain aspects of the case with Petitioners' counsel.
- Conducted independent research for various economic inputs, e.g., interest rates, tax rates, inflation-related cost indices, capital structure, and stock prices (as cited specifically throughout my report).

Further details on my background and experience follow the main body of this report in the form of my Curriculum Vitae as Attachment A, which also includes a list of my publications and public presentations going back at least ten years plus a list of the cases in which I have testified going back at least four years.

3. Basis for Opinion: Financial Gain / Economic Benefit

This section on financial gain / economic benefit covers the following topics:

a. Case-specific background that gives rise to the potential for economic benefit;

b. General concepts and adjustments for the probability of detection, prosecution and penalty payment;

c. Financial economic methodology for the time value of money and present value adjustments;

d. Financial economic methodology for the underlying basis of the rate used for the present value adjustments;

e. Financial economic methodology for the calculations and resulting values of the rate used for the present value adjustments;

f. Case-specific economic benefit inputs and calculation components for the delay and avoidance of control measures; and,

g. Case-specific economic benefit results.

a. Case-Specific Background

According to the Interim Opinion and Order of the Board issued on June 20, 2019, whose findings below were affirmed by the subsequent Order of the Board issued on February 6, 2020:

> After partially granting and partially denying MWG's motion to dismiss, the Board held 10 days of hearings. In today's order, the Board finds that the 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. Specifically, the Board finds that MWG violated Section 12(a) of the Act at all four Stations. 415 ILCS 5/12(a) (2016). The Board finds that MWG caused or allowed discharge of coal ash constituents into groundwater at all four Stations, thereby causing exceedances of the Board's Class I antimony (Joliet 29, Will County), arsenic (Powerton, Will County), boron (Powerton, Will County, and Waukegan), sulfate (Joliet 29, Powerton, Will County, and Waukegan) and TDS (Joliet 29, Powerton, Will County, and Waukegan) GQS during 2010-2017, violating Sections 620.115, 620.301(a), and 620.405 of the Board's regulations (35 Ill. Adm. Code 620.115, 620.301(a), 620.405). 415 ILCS 5/12(a) (2016).).

> The Board also finds that MWG violated Section 12(a) of the Act at all four Stations by causing or allowing discharge of contaminants into groundwater causing water pollution. Specifically, the Board finds that MWG exceeded the statewide 90th percentile levels for sulfate and boron at all four Stations between 2010 and 2017. 415 ILCS 5/12(a)(2016). The Board, however, finds no violation of Section 12(a) of the Act at Joliet 29, Powerton, and Will County during the performance of corrective actions in October 2013 under the GMZs established at those three Stations.
>
> The Board finds that MWG also violated Section 12(d) of the Act at Powerton Station by depositing coal ash cinders directly upon the land, thereby creating a water pollution hazard. 415 ILCS 5/12(d) (2016). The Board, however, finds that the Environmental Groups did not establish violations of Section 12(d) of the Act at Joliet 29, Will County, or Waukegan Stations.
>
> Lastly, the Board finds that 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. The Board finds that MWG did not take measures to remove it or prevent its leaking of contaminants into the groundwaters.
>
> The Board finds the record is insufficient to determine the appropriate relief in this proceeding. Therefore, the Board directs the hearing officer to hold additional hearings to determine the appropriate relief. (pp. 1-2)

My analysis therefore starts with the Order of the Board regarding the violations combined with Petitioner's position as to what remedies and associated costs would have been necessary in the past and will be necessary in the near future to clean up the coal ash.

My methodology for determining Respondent's financial gain from failing to begin these remedies in a timely manner is explained in detail in the sections that follow below along with their integrated tables. In brief though, I calculate the net present value of the necessary remedy measures, after adjusting for inflation and taxes, with all cash flows adjusted to a common date using the weighted-average cost of capital.

b. General Concepts and Probability Adjustments

When companies like Respondent in this case delay and/or avoid undertaking measures that would prevent noncompliance with environmental requirements, an economic benefit can occur from such delay and/or avoidance. By postponing such measures, companies can realize a benefit from delaying investing in capital equipment and/or incurring other costs, from delaying or avoiding business interruption losses necessitated by upgrades for compliance, and/or from avoiding the payment of certain necessary ongoing costs. Economic benefit is simply a term for the financial gains that accrue through such delayed and/or avoided expenditures. Funds not spent on environmental compliance are available for financially productive economic activities or, alternatively, the costs associated with obtaining additional funds for environmental compliance are avoided.[1]

Economic benefit is hence the amount by which companies (such as Respondent in this case) are financially better off as a result of not having complied with environmental requirements in a timely manner. Economic benefit is "no fault" in nature: companies need not have deliberately chosen to delay compliance (for financial or any other reasons) – or in fact even have been aware of the noncompliance – to have accrued the economic benefit of noncompliance.

The economic benefit figure should represent the amount of money to render a company indifferent between compliance versus noncompliance. Ideally, for penalty-setting purposes the economic benefit result should be adjusted for the probability of detection, prosecution, and ultimate payment. That is, if Respondent in this case knew that for every similar violation the probability of ultimately paying a penalty that recaptured economic benefit was only 25 percent (i.e., one-fourth), then the economic benefit result would have to be multiplied by a factor of four for penalty-setting purposes. As the probability of detection-prosecution-payment declines, then the amount of money proportionately increases that would make a Respondent indifferent between compliance versus noncompliance.

This aspect of penalty setting is so compelling that it was raised by a peer review panel of U.S. EPA-convened academic experts in *An Advisory of the Illegal Competitive Advantage (ICA) Economic Benefit (EB) Advisory Panel of the EPA Science Advisory Board*[2] even though the charge questions were entirely unrelated to this aspect. (I am intimately familiar with the charge questions, as I managed under contract to EPA the "White Paper" document that the panel was reviewing.)

[1] The concept that the true cost of any action can be measured by the value of the alternative that must be forgone is known in economics as the concept of "opportunity cost."

[2] The advisory report, dated September 7, 2005, is available for downloading at: https://tinyurl.com/SABICAEB

The Science Advisory Board ("SAB") Advisory noted in part that:

> It should be emphasized that what is sought here is an approximate estimate of the general probability of detection, not a highly elaborate calculation tailored to all the specific details of the particular violation. This could well be handled in a practical manner by identifying a small number of different types of violation, each associated with a generic estimate of the probability of detection. (p. 30)

The SAB Advisory goes on to recommend (at p. 31) that, "[...] EPA begin to study the feasibility of formalizing these concepts and providing more explicit guidance on how to calculate penalties that take into account both the harm and probability of detection." The footnote to this sentence reads:

> One public commenter (Fuhrman, 2004 and 2004a) questioned whether EPA had the legal authority to consider probability in setting penalties. But as noted in Section 3.2 above, deterrence has long been one of the objectives of EPA penalty policy. And the **probability of detection and imposition of a penalty is a key factor in the deterrent power of a penalty policy**. [emphasis added]

The general principle can be illustrated via a simple analogy with parking tickets. When I was in graduate school, at first I was not able to obtain a parking permit for any nearby university-owned parking facilities. I often parked on the adjacent city streets, often illegally in metered spaces that were intended to be limited to only a certain time period.[3]

What fine should the municipal parking authority have levied to deter my illegal parking? First, at a minimum, the fine should have been set equal to the going rate at nearby commercial parking facilities. Suppose that was $15 at the time. But I recall now from my experience back then that I received a parking ticket for only about half the days that I parked illegally. Therefore, the parking ticket would need to be $30 in order to establish financial indifference. And an additional sum would have been necessary not just to render me financially indifferent between parking illegally versus paying for commercial parking, but to also actually deter me from such illegal parking.

If a civil penalty fails to recover at least the economic benefit, then a Respondent will retain a gain from failing to undertake measures that were necessary to prevent noncompliance. Because of the precedent of this retained gain, a Respondent and similarly situated companies may see an economic advantage in similar noncompliance. Hence any such insufficiently high penalty would fail to deter potential future violations, whether at the facility at issue in this case, or at other facilities owned by Respondent's ultimate parent company or by competitors.

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[3] Just so that the record is clear, I paid all my parking tickets promptly and in full.

Economic benefit does not represent compensation to a Petitioner as in a typical "damages" calculation for a tort case, but instead is the minimum amount that a Respondent must pay as a civil penalty so as to return that Respondent to the financial position it would have been in had it complied in a timely manner. Therefore, were the economic benefit not to be fully disgorged in the form of a civil penalty payment, then the residual financial gain could be construed as representing an unfair competitive business advantage to the Respondent.

A civil penalty insufficient to disgorge the entire amount of the probability-adjusted economic benefit figure would fail to make a Respondent financially indifferent between compliance versus noncompliance. As noted earlier, such indifference is the first step in achieving financial deterrence, which would additionally require an even higher penalty over and above the disgorgement of the economic benefit. For example, if the economic benefit were $1,000 and the civil penalty only $700, the Respondent would have a $300 incentive to violate the law. By contrast, if the civil penalty were exactly $1,000, the Respondent would come out even, and have no incentive either to comply or not comply. Alternatively, if the penalty were $1,500, the Respondent would have a $500 incentive to comply. Note that all of these examples implicitly assume a 100-percent probability of detection, prosecution, and payment. As previously explained, as the probability of detection-prosecution-payment declines, then the amount of money proportionately increases that would make the Respondent indifferent between compliance versus noncompliance.

In the environmental regulatory enforcement context, even rough estimates of these probabilities are difficult to obtain.[4] Therefore, for purposes of this report, I am unable to assess any probability-adjusted economic benefit component for a civil penalty, and do not apply any such probability-based multiplier factor to my economic benefit results. Hence, were my economic benefit results to be used as the basis for a civil penalty without any further adjustments, this would implicitly assume a 100-percent probability of detection-prosecution-payment for these types of violations, even though such an absolute certainty does not actually exist. Thus, the Board would need to apply some multiplier in order to achieve its goal to, "deter further violations by the respondent and to otherwise aid in enhancing voluntary compliance with this Act by the respondent and other persons similarly subject to the Act." (415 ILCS 5/42 (from Ch. 111 ½, par. 1042), Sec. 42. Civil penalties, (h)(4))

c. Financial Economic Methodology: Time Value of Money and Present Values

The economic benefit calculation incorporates the concept of the "time value of money." For example, in simple terms, a dollar yesterday is worth more than a dollar today, because one had investment opportunities for yesterday's dollar. Thus, the further in the past that the dollar was obtained, the more it is worth in "present-value" terms. The greater the time value of money (i.e.,

[4] See U.S. EPA Office of Inspector General, *EPA Performance Measures Do Not Effectively Track Compliance Outcomes* (December 15, 2005), available at: https://www.epa.gov/office-inspector-general/report-epa-performance-measures-do-not-effectively-track-compliance

the greater the "discount" or "compounding" rate), the more value past costs have in present-value terms.

To calculate economic benefit, I use standard financial cash flow and net present value analysis techniques, based on modern and generally accepted financial principles. Such an approach is the underpinning of any capital budgeting exercise, and is the standard approach by which alternative investments should be judged according to any financial economics or corporate finance text. This is the same approach that the U.S. EPA's BEN economic benefit computer model employs.[5] This is also the same approach that I employ when testifying, whether on behalf of U.S. EPA, the U.S. Department of Justice ("DOJ"), state environmental enforcement agencies and attorneys general, or citizen litigators.

In a typical case, first I calculate:

(a) the "on-time" costs for compliance measures that would have been necessary had a Respondent undertaken them at an earlier point in time so as to prevent and/or mitigate the violations that are alleged to actually have occurred, i.e., a retrospective assessment; and,

(b) the "delay" costs for compliance measures that a Respondent has incurred or can be expected to incur to stop the violations at issue in the case, i.e., a more recent historical assessment or even an entirely prospective assessment.

These calculations incorporate adjustments for inflation over the intervening years from when the costs are currently estimated to when they would have been incurred at the times of both the "on-time" and "delay" compliance scenarios.

I then adjust for the tax deductions available for these costs. Next, I calculate the present value of the costs, or "cash flows" (using a rate whose basis and values are discussed in detail in the next two subsections of this report). Finally, I subtract the present value of the "delayed" compliance from the present value of the "on-time" compliance to determine the economic benefit that the violator has gained. Any recurring costs are entirely avoided over the period of

[5] The BEN model has been the subject of three academic peer reviews convened by EPA (in 1988, 1991, and 2003), along with a review by the federal Office of Management and Budget (in 2005), plus two rounds of public notice and comment in the *Federal Register* (extending from 1996 into 2005). Furthermore, economic benefit issues that go beyond the BEN model were the subject of yet another academic peer review convened by EPA, under the auspices of its Science Advisory Board (in 2005), as previously cited. As I explained under Section 2 of this report ("Basis for Opinion: Professional Expertise and Materials Considered"), I have provided support to EPA for all of seven of these reviews and processes, with the exception of the first two in 1988 and 1991 (which I quote from in the following subsection of my report). The files for these reviews (with the exception of the OMB Review, which produced no documentation), are available at: http://tinyurl.com/BENreviews

noncompliance, so their after-tax net present value is part of the "on-time" scenario, but not the "delay" scenario. Overall, for this case, the comparisons between "on-time" versus "delayed" compliance are complicated by many factors, but the underlying principle is unchanged.

d. Financial Economic Methodology: Rate for Present Value Adjustments, Basis

I perform all of my present value adjustments at a rate that reflects my results for the weighted-average cost of capital ("WACC"). The WACC represents the cost of a company's debt and equity weighted by the value of each source of financing. The debt cost of capital is based upon the after-tax interest rate on company debt. (Interest payments on debt may be deducted from taxable income.) The equity cost of capital is based upon the Capital Asset Pricing Model ("CAPM"), which states that investors will demand a return from a risky investment that is equal to the return on a risk-free investment plus an additional return to compensate for the additional risk taken on by the investor.[6]

As I opined in my expert report accompanying my sworn affidavit *In the matter of Titan Wheel Corporation of Iowa*:

> A company must on average earn a rate of return necessary to repay its debt capital holders (e.g., banks, bondholders) and satisfy its equity capital owners (e.g., partners, stock holders). While companies often earn rates in excess of their cost of capital, companies that do not on average earn at least their cost of capital will not survive (i.e., their lenders will not receive their principal and/or interest payments, and their owners will be dissatisfied with their returns). The cost of capital therefore represents the minimum expected return a company can earn on average on monies not invested in pollution control, or, viewed alternatively, represents the avoided costs of financing pollution control investments. Thus, a company should make its business decisions by adjusting cash flows to present values at its cost of capital, and my economic benefit approach follows the internal analysis a company will normally perform.

The EPA Administrative Law Judge adopted my economic benefit figure in the May 4, 2001 Initial Decision. The above passage was then favorably quoted in both the June 6, 2002 Final Decision of the Environmental Appeals Board (p. 56) and the November 10, 2003 Order on Cross

[6] Although other methodologies exist for estimating the equity cost of capital, the CAPM is the most widely used in the field of financial economics. The CAPM's development also played a major role in the awarding of the Nobel Prize in economics to one of the three 1990 winners, Harry Markowitz. (Another 1990 winner, Merton Miller, served in the 1988 peer review of EPA's BEN economic benefit computer model.)

Motions for Summary Judgment by the U.S. District Court for the Southern District of Iowa, Central Division (p. 60), both of which confirmed my economic benefit methodology and results.[7]

> And in a subsequent U.S. District Court opinion, the Court ruled:
>
> On the whole, the Court finds the approach of the Shefftz Report to be reasonable and consistent with case law. *See, e.g., Smithfield Foods*, 191 F.3d at 530 (approving of district court's application of the WACC).[8]

> In another subsequent U.S. District Court opinion, the Court ruled:
>
> Further, the Court finds Shefftz's report in this case highly credible because it employs an accepted methodology--known as the Weighted Average Cost of Capital or "WACC"--to determine the present value of Magar's noncompliance over a given period of time. *See, e.g., id.; United States v. Smithfield Foods, Inc.*, 972 F.Supp. 338, 348-49 (E.D. Va. 1997).[9]

Table 1, on the following page, provides a list of court opinions that have adopted my own WACC-based economic benefit calculations for penalty-setting purposes.

[7] See (respectively): *In the matter of Titan Wheel Corp. of Iowa*, 10 E.A.D. 526, 563-65 (2002); and, *Titan Wheel Corp. v. United States Envtl. Prot. Agency*, 291 F. Supp. 2d 899, 930-33 (D. Iowa 2003) (affirmed by 8th Circuit).

[8] See: *Idaho Conservation League v. Atlanta Gold Corp.*, 879 F. Supp. 2d 1148, 1166-68 (D. Idaho 2012). Note that in the Smithfield case (i.e., cited in the Atlanta Gold decision), I testified in deposition regarding the use of the WACC.

[9] See: *Idaho Conservation League v. Magar E. Magar, d/b/a Syringa Mobile Home Park*, LEXIS 18326 (D. Idaho 2015).

Table 1

COURT DECISIONS THAT HAVE ADOPTED MY WACC-BASED ECONOMIC BENEFIT CALCULATIONS FOR PENALTY-SETTING PURPOSES

Plaintiff or Complainant	Defendant or Respondent	Court	Date: Testimony (or report)	Date: Decision	Excerpt(s)
U.S. Environmental Protection Agency	EK Associates, L.P., d/b/a EKCO/GLACO, and EK Management	U.S. EPA Administrative Court	14-Aug-97	15-Jun-98	"The economic benefit finding regarding the Section 52.741(e)(1) violation is based upon the testimony of Jonathan Shefftz, a Senior Associate with Industrial Economics, Inc."
U.S. Environmental Protection Agency	Titan Wheel Corporation of Iowa	U.S. EPA Administrative Court	24-Nov-99	4-May-01	"EPA used an expert, Mr. Jonathan Shefftz, to help calculate the present value of the economic benefit."
U.S. Environmental Protection Agency	Titan Wheel Corporation of Iowa	U.S. EPA Administrative Court, Environ. Appeals Bd	24-Nov-99	6-Jun-02	"Applying the WACC method, the Region's expert, Jonathan S. Shefftz, concluded that Titan received an economic benefit of $20,599 for the violations in the three counts discussed above. The ALJ found that this determination was supported by the record."
U.S. Environmental Protection Agency	Titan Wheel Corporation of Iowa	U.S. District Court, Southern District of Iowa, Central Division	24-Nov-99	20-Nov-03	"After considering Titan's challenge to the application of the WACC method and examining the cases cited by Titan, the EAB found the challenge was without merit. […] The EAB examined the EPA's chosen method and found the expert's analysis and calculations to be appropriate."
State of Ohio	The Shelly Holding Company et al.	Franklin County Municipal Court	16-Oct-08	3-Sep-09	[Of the total $350,123.52 penalty, $229,093.52 -- or nearly two-thirds -- was directly attributable to Mr. Shefftz's economic benefit calculations. See in particular pp. 17, 49, 88, and 100.]
U.S. Environmental Protection Agency	Valimet, Inc.	U.S. EPA Administrative Court	10-Dec-08	30-Jun-09	"There is no question that the penalty thus far calculated significantly exceeds Complainant's modification to Mr. Shefftz' initial calculation of an economic benefit, "up to" $135,000, and thus serves as a sufficient deterrent to any future violation by Respondent and to any other potential violators."
United States of America	James and Nancy Oliver d/b/a Safety Waste Incineration	U.S District Court, Alaska	25-Mar-09	24-Jun-09	"Testimony which estimates the economic benefit to the Olivers was given by the United States' expert witness, Jonathan Shefftz. Mr. Shefftz's testimony would conservatively support a finding of economic benefit of not less than $57,000, plus an unliquidated benefit from deferred maintenance costs plus, $403 per month for each month payment of the penalty were delayed beyond March 31, 2009."
Idaho Conservation League	Atlanta Gold Corporation	U.S. District Court, Idaho	26-Apr-12	19-Jul-12	"On the whole, the Court finds the approach of the Shefftz Report to be reasonable and consistent with case law. See, e.g., Smithfield Foods, 191 F.3d at 530 (approving of district court's application of the WACC)."
Idaho Conservation League	Magar E. Magar, d/b/a Syringa Mobile Home Park	U.S. District Court, Idaho	14-Jul-14	13-Feb-15	"Further, the Court finds Shefftz's report in this case highly credible because it employs an accepted methodology--known as the Weighted Average Cost of Capital or "WACC"--to determine the present value of Magar's noncompliance over a given period of time. See, e.g., id.; United States v. Smithfield Foods, Inc., 972 F.Supp. 338, 348-49 (E.D. Va. 1997)."
Environment Texas Citizen Lobby, Inc. and Sierra Club	ExxonMobil Corporation, et al.	U.S. District Court, Southern District of Texas	14-Feb-14	26-Apr-17	"The Court previously found Shefftz's methodology reliable. […] Accordingly, the Court finds Exxon received an economic benefit of $14,249,940 from the delayed implementation of the improvement projects."
U.S. Environmental Protection Agency	Taotao USA, Inc., Taotao Group Co., Ltd., and Jinyun County Xiangyuan Industry Co., Ltd.	U.S. EPA Administrative Court	19-Oct-17	7-Aug-18	"From those numbers, and factoring in exchange rates, Mr. Shefftz determined that there existed an economic benefit of $104,942 for Counts 1-4 and $114,357 for Counts 5-10 for a total of $219,299. [...] Therefore, I find Respondents obtained an economic benefit from their violations in the amount of $219,299."

In general, a cost of capital calculation can be tailored to a particular line of business whose riskiness varies from that of the overall firm, but such a calculation is not specific to the context of environmental violations. As James C. Van Horne, A. P. Giannini Professor of Finance at Stanford University's Graduate School of Business, commented in his 1991 peer review of the U.S. Environmental Protection Agency BEN economic benefit computer model:

> Environmental cash flows have about the same risk as projects overall in a division or in a company; they are necessary to stay in business. Given this assumption, the overall required rate of return is based on both debt and equity costs, the same mix as used to finance investment projects in general.

Note that this 1991 peer review was a follow-on to an earlier 1988 U.S. EPA sponsored academic peer review of the BEN model. In the 1988 academic peer review, Deems Buell and Marc Blaustein, from Temple, Barker & Sloane (TBS), Inc., the EPA contractor facilitating the peer review, summarized the position of the three peer reviewers as follows:

> The most defensible and conservative escalation rate is the corporate borrowing rate, although a reasonable argument supports the use of WACC. [...] the WACC is the firm's overall borrowing rate and the return it most likely received on money from the government "loan" if the capital was invested in the firm's typical projects during the noncompliance period.

This was confirmed by Charles Upton; then Associate Professor, Graduate School of Management, Rutgers University (now Professor Emeritus of Economics, College of Business Administration, Kent State University), in a letter in which he stated, "The approach which TBS has outlined in their August 22 memorandum is a reasonable approach to the problem, and one which I support." Dr. Upton was also providing comments on behalf of Merton Miller of the University of Chicago, who would later win the Nobel Prize in Economics. The third peer reviewer, Stewart Myers; then Professor of Finance (now Emeritus), Sloan School of Management, Massachusetts Institute of Technology, wrote, "I believe Mr. Blaustein's memo puts forth a reasonable approach to the discounting issues it addresses."

e. Financial Economic Methodology: Rate for Present Value Adjustments, Results

For the rate that I apply to my present value adjustments, I use an estimate of the firm-wide WACC for NRG Energy, Inc., the ultimate parent company of Respondent Midwest Generation, LLC, incorporating company-specific data. Table 2 and its accompanying supplemental tables (i.e., Table 2a, 2b, and 2c), on the following pages, provide my WACC calculations in this case.

Table 2 for each year (as identified in column 1) is divided into two main sections: columns "b" through "g" calculate both the cost and capital structure weight for debt financing, and columns "h" through "n" calculate both the cost and capital structure weight for equity financing. The penultimate column, "o", calculates the weighted average of debt and equity financing. Finally, column "p" for each year calculates the average WACC from that year all the way through the final year in the Table 2, i.e., 2020.

The debt section for each year starts in column "b" with a pre-tax interest rate: the weighted-average interest rate on long-term debt as calculated from NRG's financial statements (as shown in Table 2a). The following three columns, "c" through "e", provide the highest statutory marginal corporate income tax rates: state, federal, and combined (reflecting the deductibility of state income taxes from federal taxable income). The combined rate is then applied to the interest rate to derive in column "f" the after-tax cost of debt (since interest payments are deductible from taxable income). Finally, the debt weight in column "g" is the portion of the total capital structure that comprises debt financing (i.e., as opposed to equity): the debt proportion out of total financing as calculated for NRG (based upon the detailed data in Table 2b).

The equity section is an application of the Capital Asset Pricing Model ("CAPM"). As previously explained, CAPM states that investors will demand a return from a risky investment that is equal to the return on a risk-free investment plus an additional return to compensate for the additional risk taken on by the investor. Matching up with this conceptual model, the equity section starts in column "h" with the interest rate on long-term U.S. Treasury securities as a proxy for the return on a risk-free investment. Columns "i" and "j" then provide a measure of systematic/un-diversifiable risk, i.e., how much more volatile the investment returns are compared to the market as a whole. A beta value of exactly 1.00 would mean that the investment is no more or less risky than the market as a whole. By contrast, a beta value of 1.50 would mean that the investment is 50-percent riskier than the market as a whole. And a beta value of 0.50 would mean that the investment is only half as risky than the market as a whole.

I calculate the raw unadjusted beta in column "i" as the statistical covariance of monthly returns for NRG and the S&P 500 market index, divided by the variance of that same S&P 500 market index (with the detailed data in Table 2c). Then, based on the common financial analysis

practice of adjusting betas toward the average, I add two-thirds of my calculated beta to a constant one-third value to derive an adjusted beta in column "j".[10]

Column "k" provides the long-horizon risk premium: the difference of returns on the overall stock market versus long-term U.S. Treasury interest rates, averaged from 1926 through the year prior to the year each row. Column "l" calculates the company-specific risk premium as the product of the beta and the long-horizon risk premium. This value is added to the long-term U.S. Treasury security interest rate to derive the equity cost in column "m". Then column "n", the equity weight, is simply the difference of 100 percent minus the previously provided debt weight.

Each year's annual rate is the sum of the products of the respective costs and weights, i.e., debt cost times debt weight plus equity cost times equity weight. The final column then averages each year's annual rate through the final year in Table 2, i.e., 2020.

The previously referenced tables supplemental to Table 2 are as follows:

- Table 2a provides the amounts and interest rates on NRG's long-term debt, copied from each year's 10-K filing (or 10-Q for the third quarter of 2020), from which a weighted-average interest rate is calculated in Table 2 (column "b").

- Table 2b provides NRG's capital structure information, i.e., total liabilities (at year-end, or the end of the third quarter for 2020), equity shares outstanding (same reporting basis), closing stock price (averaged throughout the year from the monthly values in Table 2c), and calculated debt financing proportion of total capital.

- Table 2c provides the data used to calculate the beta values (in column 9 of Table 2), based on monthly closing prices for NRG and the S&P 500 market index, and their respective monthly returns.

[10] Numerous studies have observed the tendencies of company equity betas to converge toward the market as a whole over time, i.e., betas below 1.00 trend up, whereas betas above 1.00 trend down. Therefore, for the purposes of applying the Capital Asset Pricing Model to the calculation of a company's cost of equity beta, many analysts use not the "raw" equity beta (i.e., the covariance of monthly returns for the company and the overall market, divided by the variance of the overall market), but instead an adjusted beta. Many such adjustment algorithms are exceedingly complex, subjective, or even proprietary. By contrast, for simplicity, consistency, and transparency across my casework, I apply an adjustment that is commonly used, and that has its origins in a paper by Marshall E. Blume, "Betas and Their Regression Tendencies," *The Journal of Finance*, Vol. 30, No. 3 (June 1975).

Table 2

NRG COMPANY-SPECIFIC WEIGHTED-AVERAGE COST OF CAPITAL

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
					After-		Long-Term			Long	Company				Avg
	Cost of	Marginal Tax Rate:			Tax	Debt	Treasury	Equity Beta:		Horizon	Risk	Equity	Equity	Annual	thru:
Year	Debt	IL	U.S.	Combine	Cost	Weight	Notes	Raw	Adj.	Risk Prem	Premium	Cost	Weight	Rate	2020
2011	6.15%	9.50%	35.0%	41.18%	3.62%	80.42%	3.62%	0.7231	0.8154	6.7%	5.5%	9.1%	19.6%	4.7%	4.8%
2012	6.51%	9.50%	35.0%	41.18%	3.83%	86.38%	2.54%	0.5322	0.6882	6.6%	4.5%	7.1%	13.6%	4.3%	4.8%
2013	5.69%	9.50%	35.0%	41.18%	3.35%	75.38%	3.12%	0.5940	0.7293	6.7%	4.9%	8.0%	24.6%	4.5%	4.9%
2014	5.42%	9.50%	35.0%	41.18%	3.19%	74.98%	3.07%	0.8633	0.9089	6.96%	6.3%	9.4%	25.0%	4.7%	4.9%
2015	5.40%	7.75%	35.0%	40.04%	3.24%	81.73%	2.55%	0.8870	0.9246	7.00%	6.5%	9.0%	18.3%	4.3%	4.9%
2016	5.46%	7.75%	35.0%	40.04%	3.27%	87.32%	2.22%	1.2352	1.1568	6.90%	8.0%	10.2%	12.7%	4.2%	5.1%
2017	4.72%	8.63%	35.0%	40.61%	2.80%	76.53%	2.65%	1.3083	1.2055	6.94%	8.4%	11.0%	23.5%	4.7%	5.3%
2018	5.44%	9.50%	21.0%	28.51%	3.89%	54.74%	3.02%	0.7227	0.8151	7.07%	5.8%	8.8%	45.3%	6.1%	5.5%
2019	5.45%	9.50%	21.0%	28.51%	3.89%	52.39%	2.40%	0.3022	0.5348	6.91%	3.7%	6.1%	47.6%	4.9%	5.2%
2020	5.47%	9.50%	21.0%	28.51%	3.91%	56.27%	1.35%	0.8290	0.8860	6.91%	6.1%	7.5%	43.7%	5.5%	5.5%

Notes:

(a)	Year for calculation.
(b)	Table 2a for interest rate data from NRG 10-K SEC filings, except at September 30 for 2020 from 10-Q SEC filing.
(c)	Marginal tax rates, corporate income, State of IL; Federation of Tax Administrators.
(d)	Marginal tax rates, corporate income, U.S. Federal; Federation of Tax Administrators.
(e)	Marginal tax rates, combined State and Federal (reflecting deductibility of state taxes from federal taxable income).
(f)	Calculated as: (b) * {100%-(e)}. [Adjusts for tax-deductibility of interest payments.]
(g)	See Table 2b for capital structure data and calculations.
(h)	20-yr securities; Federal Reserve Statistical Release H.15. [Risk-free rate proxy in Capital Asset Pricing Model (CAPM)].
(i)	Measures risk relative to overall market; calculated from monthly returns for NRG v. S&P 500 (Yahoo Finance data for three most recent years); see Table 2b for detailed data.
(j)	Calculated as: 2/3 * (i) + 1/3. [Blume adjustment.]
(k)	Difference of average returns between stock market vs. Treasuries, 1926 - prior year (2020 set equal to 2019); Duff & Phelps.
(l)	Calculated as: (j) * (k).
(m)	Calculated as: (h) + (l). [Reflects risk-free rate of return plus the company risk premium.]
(n)	Calculated as: 100% - (g). [Reflects: total financing - debt = equity financing.]
(o)	Calculated as: (f) * (g) + (m) * (n). [Reflects: (debt cost x debt wt) + (equity cost x equity weight).]
(p)	Cumulative average from each year through 2020.

Table 2a: NRG COMPANY-SPECIFIC INTEREST RATES

Annual average of 3-month LIBOR:				*0.85%*	*2.33%*	*2.30%*	*1.26%*	*0.74%*	*0.32%*	*0.23%*	*0.27%*	*0.43%*	*0.34%*
Rates		Libor	Total	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
	7.625%		7.625%					398	1,039	1,130	1,130	1,200	1,200
	7.625%		7.625%								800	800	800
	8.500%		8.500%								602	693	691
	8.250%		8.250%						1,058	1,063	1,062	1,100	1,100
	7.875%		7.875%					207	1,128	1,128	1,128	1,128	1,200
	7.375%		7.375%										1,090
	6.250%		6.250%				992	992	1,100	1,100			
	6.625%		6.625%					869	936	990	990	990	
	6.250%		6.250%			733	733	733	904	1,000			
	7.250%		7.250%	1,000	1,000	1,000	1,000	1,000					
	6.625%		6.625%	1,230	1,230	1,230	1,250	1,250					
	5.750%		5.750%	821	821	821	870						
	5.250%		5.250%	733	733								
	2.750%		2.750%	575	575	575							
	3.750%		3.750%	600	600								
	4.450%		4.450%	500	500								
	1.750%	2.33%	4.080%		83								
	3.000%	0.34%	3.340%										1,588
	3.000%	0.34%	3.340%									1,573	
2.000%	3.000%	0.27%	2.770%								2,002		
	2.000%	0.23%	2.230%							1,983			
	2.000%	0.32%	2.320%						1,964				
	2.750%	0.74%	3.490%					1,882					
	2.250%	1.26%	3.510%				1,872						
	1.750%	2.30%	4.050%			1,698							
5.375%	6.000%		5.688%								247	247	
	5.875%		5.875%								59	59	59
	4.750%		4.750%								67	28	
	6.000%		6.000%										57
4.750%	6.000%		5.375%							406			
4.125%	6.000%		5.063%	466	466	466	465	455	455				
	7.625%		7.625%									617	
	7.875%		7.875%								782	800	
	9.500%		9.500%								780	801	
	9.875%		9.875%								621	631	
	8.500%		8.500%								503	509	
	9.125%		9.125%								435	437	
7.875%	9.875%		8.875%					1,911	1,956	2,133			
8.500%	9.125%		8.813%					745	752	929			
	5.375%		5.375%				500	500	500	500			148
1.126%	3.991%		2.559%										290
1.116%	4.195%		2.656%										314
1.381%	4.256%		2.819%										270
	1.070%	0.34%	1.410%										190
2.730%	3.256%		2.993%										181
2.250%	2.750%	0.34%	2.840%										159
5.950%	7.310%		6.630%										151
	2.500%	0.34%	2.840%										75
	3.500%	0.34%	3.840%										17
	3.500%	0.34%	3.840%										42
	2.010%	0.34%	2.350%										61
	2.500%	0.34%	2.840%										27
	5.000%		5.000%				350	350					
	2.750%	0.32%	3.070%						306				
	3.500%		3.500%				345	335	330	326			
	3.250%		3.250%				288	271	266				
	2.500%	1.26%	3.760%				55						
2.500%	2.750%	0.34%	2.965%									390	
2.750%	3.000%	0.27%	3.145%								473		
1.750%	1.875%	0.23%	2.043%							464			
	1.750%	0.32%	2.070%						418				
	1.750%	0.74%	2.490%					370					
	1.875%	1.26%	3.135%				318						
0.611%	2.683%		1.647%									786	
0.611%	3.579%		2.095%								1,104		
2.339%	3.775%		3.057%				746	771	793	815			
	4.680%		4.680%				194	199					
2.250%	2.750%	0.34%	2.840%									350	
2.250%	2.750%	0.27%	2.770%								512		
2.500%	2.875%	0.23%	2.918%							506			
	1.625%	0.32%	1.945%						485				
	1.625%	0.74%	2.365%					443					
	1.750%	1.26%	3.010%				400						
2.395%	3.256%		2.826%									640	
2.395%	3.633%		3.014%				818	849	879	898	878		
	5.430%		5.430%			86	89						
1.116%	4.256%		2.686%								1,575		
0.437%	4.256%		2.347%							1,187			
2.285%	4.256%		3.271%				1,073	1,113	1,149				
	1.625%	1.26%	2.885%				427						
2.500%	2.625%	0.34%	2.903%									72	
	2.625%	0.27%	2.895%								69		
	1.070%	0.34%	1.410%									173	
	1.070%	0.27%	1.340%								154		
	1.070%	0.23%	1.300%							100			
	1.070%	0.32%	1.390%						72				
5.950%	7.310%		6.630%								127	137	
5.950%	7.250%		6.600%					96	108	121			
3.550%	5.950%		4.750%				83						
	3.550%		3.550%				125	125					
5.696%	7.015%		6.356%				926	965	1,002	1,036			
	2.000%	0.23%	2.230%							300			
	2.000%	0.23%	2.230%							191			
2.250%	2.500%	0.27%	2.645%								221		
1.750%	2.500%	0.23%	2.355%							163			
	1.750%	0.32%	2.070%						154				
	1.750%	0.74%	2.490%					145					
	1.750%	1.26%	3.010%				135						
2.500%	5.650%	0.27%	4.345%								78		
	2.010%	0.34%	2.350%									46	
	2.250%	0.34%	2.590%									66	
	2.250%	0.27%	2.520%								63		
2.500%	5.150%	0.27%	4.095%								80		
2.000%	2.625%	0.27%	2.583%								58		
	1.625%	0.23%	1.855%							391			
	1.625%	0.32%	1.945%						351				
	1.625%	0.74%	2.365%					310					
	1.625%	1.26%	2.885%				267						
	2.750%	0.23%	2.980%							196			
	2.750%	0.32%	3.070%						189				
	2.750%	0.74%	3.490%					178					
	3.000%	1.26%	4.260%				163						
	1.625%	0.23%	1.855%							192			
	1.625%	0.32%	1.945%						181				
	1.875%	0.32%	2.195%						104				
	1.625%	0.74%	2.365%					172					
	1.625%	1.26%	2.885%				162						
	3.125%	0.23%	3.355%							110			
	2.250%	0.32%	2.570%						98				
	2.250%	0.74%	2.990%					76					
	3.125%	0.32%	3.445%						103				
	1.750%	0.74%	2.490%					163					
	1.750%	1.26%	3.010%				151						
	2.650%	0.74%	3.390%					287					
	2.625%	1.26%	3.885%				278						
	4.390%		4.390%			48	152	218					
weighted-average interest rate:				5.47%	5.45%	5.44%	4.72%	5.46%	5.40%	5.42%	5.69%	6.51%	6.15%

Table 2b

NRG COMPANY-SPECIFIC CAPITAL STRUCTURE DATA AND CALCULATIONS

(q)	(r)	(s)	(t)	(u)
	Total	Shares	Average	Debt:
	Liabilities	Outstanding	Closing	Total
Year	(millions)	(millions)	Stock Price	Capital
2011	$18,892	241	19.09	80%
2012	$24,465	234	16.49	86%
2013	$23,184	323	23.44	75%
2014	$28,480	339	28.03	75%
2015	$27,117	329	18.43	82%
2016	$26,190	316	12.03	87%
2017	$21,272	317	20.58	77%
2018	$11,843	308	31.79	55%
2019	$10,853	264	37.36	52%
2020	$10,291	247	32.38	56%

Notes:

(q)	Year for data or calculations.
(r)	NRG total liabilities reported at year-end from 10-K SEC filings, except at September 30 for 2020 from 10-Q SEC filing.
(s)	NRG weighted-average shares outstanding, diluted, for the year from 10-K SEC filings, except for the first nine months of 2020 from 10-Q SEC filing.
(t)	Average closing stock price; calculated from Table 2c.
(u)	Debt as % of total capital, calculated as: (r) / { (r) + (s) * (t) }

Table 2c

NRG COMPANY-SPECIFIC EQUITY BETA DATA

	Yahoo Finance data			*calculated values*	
	Close:	Adjusted Close:		Return:	
Date	NRG	NRG	S&P 500	NRG	S&P 500
Jan-09	23.360001	20.252918	825.880005		
Feb-09	18.900000	16.386135	735.090027	-19.09%	-10.99%
Mar-09	17.600000	15.259048	797.869995	-6.88%	8.54%
Apr-09	17.980000	15.588504	872.809998	2.16%	9.39%
May-09	22.500000	19.507301	919.140015	25.14%	5.31%
Jun-09	25.959999	22.507095	919.320007	15.38%	0.02%
Jul-09	27.209999	23.590834	987.479980	4.82%	7.41%
Aug-09	26.850000	23.278721	1020.619995	-1.32%	3.36%
Sep-09	28.190001	24.440491	1057.079956	4.99%	3.57%
Oct-09	22.990000	19.932127	1036.189941	-18.45%	-1.98%
Nov-09	23.940001	20.755772	1095.630005	4.13%	5.74%
Dec-09	23.610001	20.469666	1115.099976	-1.38%	1.78%
Jan-10	24.110001	20.903164	1073.869995	2.12%	-3.70%
Feb-10	21.840000	18.935089	1104.489990	-9.42%	2.85%
Mar-10	20.900000	18.120123	1169.430054	-4.30%	5.88%
Apr-10	24.170000	20.955177	1186.689941	15.65%	1.48%
May-10	23.350000	20.244247	1089.410034	-3.39%	-8.20%
Jun-10	21.209999	18.388884	1030.709961	-9.16%	-5.39%
Jul-10	22.680000	19.663361	1101.599976	6.93%	6.88%
Aug-10	20.320000	17.617258	1049.329956	-10.41%	-4.74%
Sep-10	20.820000	18.050762	1141.199951	2.46%	8.76%
Oct-10	19.910000	17.261795	1183.260010	-4.37%	3.69%
Nov-10	19.379999	16.802290	1180.550049	-2.66%	-0.23%
Dec-10	19.540001	16.941011	1257.640015	0.83%	6.53%
Jan-11	20.750000	17.990072	1286.119995	6.19%	2.26%
Feb-11	19.990000	17.331160	1327.219971	-3.66%	3.20%
Mar-11	21.540001	18.674995	1325.829956	7.75%	-0.10%
Apr-11	24.200001	20.981195	1363.609985	12.35%	2.85%
May-11	24.760000	21.466705	1345.199951	2.31%	-1.35%
Jun-11	24.580000	21.310648	1320.640015	-0.73%	-1.83%
Jul-11	24.520000	21.258623	1292.280029	-0.24%	-2.15%
Aug-11	23.440001	20.322277	1218.890015	-4.40%	-5.68%
Sep-11	21.209999	18.388884	1131.420044	-9.51%	-7.18%
Oct-11	21.420000	18.570953	1253.300049	0.99%	10.77%
Nov-11	19.680000	17.062387	1246.959961	-8.12%	-0.51%
Dec-11	18.120001	15.709883	1257.599976	-7.93%	0.85%
Jan-12	16.879999	14.634814	1312.410034	-6.84%	4.36%
Feb-12	17.100000	14.825553	1365.680054	1.30%	4.06%
Mar-12	15.670000	13.585757	1408.469971	-8.36%	3.13%
Apr-12	17.000000	14.738850	1397.910034	8.49%	-0.75%
May-12	15.320000	13.282308	1310.329956	-9.88%	-6.27%
Jun-12	17.360001	15.050972	1362.160034	13.32%	3.96%
Jul-12	19.820000	17.183771	1379.319946	14.17%	1.26%
Aug-12	21.340000	18.586164	1406.579956	8.16%	1.98%
Sep-12	21.389999	18.629709	1440.670044	0.23%	2.42%
Oct-12	21.559999	18.777775	1412.160034	0.79%	-1.98%
Nov-12	21.100000	18.452829	1416.180054	-1.73%	0.28%
Dec-12	22.990000	20.105717	1426.189941	8.96%	0.71%
Jan-13	24.000000	20.989000	1498.109985	4.39%	5.04%
Feb-13	24.000000	21.068403	1514.680054	0.38%	1.11%
Mar-13	26.490000	23.254250	1569.189941	10.38%	3.60%
Apr-13	27.870001	24.465687	1597.569946	5.21%	1.81%
May-13	25.520000	22.499443	1630.739990	-8.04%	2.08%
Jun-13	26.700001	23.539776	1606.280029	4.62%	-1.50%
Jul-13	26.820000	23.645567	1685.729980	0.45%	4.95%
Aug-13	26.250000	23.245398	1632.969971	-1.69%	-3.13%
Sep-13	27.330000	24.201780	1681.550049	4.11%	2.97%
Oct-13	28.530001	25.264427	1756.540039	4.39%	4.46%
Nov-13	26.459999	23.528122	1805.810059	-6.87%	2.80%
Dec-13	28.719999	25.537706	1848.359985	8.54%	2.36%
Jan-14	27.850000	24.764103	1782.589966	-3.03%	-3.56%
Feb-14	29.070000	25.963507	1859.449951	4.84%	4.31%
Mar-14	31.799999	28.401775	1872.339966	9.39%	0.69%
Apr-14	32.720001	29.223463	1883.949951	2.89%	0.62%
May-14	35.639999	31.967165	1923.569946	9.39%	2.10%
Jun-14	37.200001	33.366402	1960.229980	4.38%	1.91%
Jul-14	30.959999	27.769453	1930.670044	-16.77%	-1.51%
Aug-14	30.780001	27.732727	2003.369995	-0.13%	3.77%
Sep-14	30.480000	27.462431	1972.290039	-0.97%	-1.55%

Oct-14	29.980000	27.610839	2018.050049	-10.66%	-2.32%
Nov-14	31.260000	28.300798	2067.560059	4.77%	2.45%
Dec-14	26.950001	24.398808	2058.899902	-13.79%	-0.42%
Jan-15	24.660000	22.325592	1994.989990	-8.50%	-3.10%
Feb-15	23.980000	21.838631	2104.500000	-2.18%	5.49%
Mar-15	25.190001	22.940578	2067.889893	5.05%	-1.74%
Apr-15	25.240000	22.986111	2085.510010	0.20%	0.85%
May-15	25.200001	23.080362	2107.389893	0.41%	1.05%
Jun-15	22.879999	20.955502	2063.110107	-9.21%	-2.10%
Jul-15	22.450001	20.561670	2103.840088	-1.88%	1.97%
Aug-15	19.920000	18.365520	1972.180054	-10.68%	-6.26%
Sep-15	14.850000	13.691165	1920.030029	-25.45%	-2.64%
Oct-15	12.890000	11.884116	2079.360107	-13.20%	8.30%
Nov-15	12.360000	11.523713	2080.409912	-3.03%	0.05%
Dec-15	11.770000	10.973634	2043.939941	-4.77%	-1.75%
Jan-16	10.640000	9.920090	1940.239990	-9.60%	-5.07%
Feb-16	10.780000	10.200163	1932.229980	2.82%	-0.41%
Mar-16	13.010000	12.310218	2059.739990	20.69%	6.60%
Apr-16	15.100000	14.287797	2065.300049	16.06%	0.27%
May-16	16.379999	15.530054	2096.949951	8.69%	1.53%
Jun-16	14.990000	14.212178	2098.860107	-8.49%	0.09%
Jul-16	13.840000	13.121852	2173.600098	-7.67%	3.56%
Aug-16	12.110000	11.506310	2170.949951	-12.31%	-0.12%
Sep-16	11.210000	10.651175	2168.270020	-7.43%	-0.12%
Oct-16	10.630000	10.100089	2126.149902	-5.17%	-1.94%
Nov-16	11.340000	10.805658	2198.810059	6.99%	3.42%
Dec-16	12.260000	11.682308	2238.830078	8.11%	1.82%
Jan-17	16.540001	15.760633	2278.870117	34.91%	1.79%
Feb-17	16.559999	15.808520	2363.639893	0.30%	3.72%
Mar-17	18.700001	17.851410	2362.719971	12.92%	-0.04%
Apr-17	16.900000	16.133091	2384.199951	-9.63%	0.91%
May-17	16.059999	15.357874	2411.800049	-4.81%	1.16%
Jun-17	17.219999	16.467159	2423.409912	7.22%	0.48%
Jul-17	24.620001	23.543638	2470.300049	42.97%	1.93%
Aug-17	24.910000	23.850039	2471.649902	1.30%	0.05%
Sep-17	25.590000	24.501102	2519.360107	2.73%	1.93%
Oct-17	25.000000	23.936205	2575.260010	-2.31%	2.22%
Nov-17	27.650000	26.505236	2584.840088	10.73%	0.37%
Dec-17	28.480000	27.300873	2673.610107	3.00%	3.43%
Jan-18	26.010000	24.933138	2823.810059	-8.67%	5.62%
Feb-18	25.860001	24.817884	2713.830078	-0.46%	-3.89%
Mar-18	30.530001	29.299694	2640.870117	18.06%	-2.69%
Apr-18	31.000000	29.750751	2648.050049	1.54%	0.27%
May-18	34.230000	32.881893	2705.270020	10.52%	2.16%
Jun-18	30.700001	29.490917	2718.370117	-10.31%	0.48%
Jul-18	31.670000	30.422714	2816.290039	3.16%	3.60%
Aug-18	35.389999	34.029064	2901.520020	11.85%	3.03%
Sep-18	37.400002	35.961773	2913.979980	5.68%	0.43%
Oct-18	36.189999	34.798298	2711.739990	-3.24%	-6.94%
Nov-18	38.430000	36.983212	2760.169922	6.28%	1.79%
Dec-18	39.599998	38.109161	2506.850098	3.04%	-9.18%
Jan-19	40.910000	39.369843	2704.100098	3.31%	7.87%
Feb-19	41.680000	40.140831	2784.489990	1.96%	2.97%
Mar-19	42.480000	40.911289	2834.399902	1.92%	1.79%
Apr-19	41.169998	39.649658	2945.830078	-3.08%	3.93%
May-19	34.040001	32.807041	2752.060059	-17.26%	-6.58%
Jun-19	35.119999	33.847916	2941.760010	3.17%	6.89%
Jul-19	34.139999	32.903416	2980.379883	-2.79%	1.31%
Aug-19	36.400002	35.111832	2926.459961	6.71%	-1.81%
Sep-19	39.599998	38.198586	2976.739990	8.79%	1.72%
Oct-19	40.119999	38.700184	3037.560059	1.31%	2.04%
Nov-19	39.730000	38.352219	3140.979980	-0.90%	3.40%
Dec-19	39.750000	38.371525	3230.780029	0.05%	2.86%
Jan-20	36.889999	35.610706	3225.520020	-7.19%	-0.16%
Feb-20	33.209999	32.319248	2954.219971	-9.24%	-8.41%
Mar-20	27.260000	26.528837	2584.590088	-17.92%	-12.51%
Apr-20	33.529999	32.630661	2912.429932	23.00%	12.68%
May-20	36.049999	35.389565	3044.310059	8.45%	4.53%
Jun-20	32.560001	31.963501	3100.290039	-9.68%	1.84%
Jul-20	33.810001	33.190601	3271.120117	3.84%	5.51%
Aug-20	34.410000	34.081661	3500.310059	2.68%	7.01%
Sep-20	30.740000	30.446678	3363.000000	-10.67%	-3.92%
Oct-20	31.620001	31.318283	3269.959961	2.86%	-2.77%
Nov-20	32.750000	32.750000	3621.629883	4.57%	10.75%
Dec-20	37.549999	37.549999	3756.070068	14.66%	3.71%

f. Case-Specific Economic Benefit Inputs and Calculation Components: Delayed and Avoided Expenditures

In addition to the weighted-average cost of capital to use as the rate for the present value adjustments (as described in the prior subsections and previously displayed in Table 2), my economic benefit calculations for the delayed remedy costs use the following inputs, as shown in Table 3 and Table 4 (on successive pages).

- *Compliance Measures, Cost Estimates, and Estimate Dates:* The remedy cost estimates are taken from the expert repot of James R. Kunkel, Ph.D., P.E., dated July 1, 2015. Specifically, I use the low-end estimates from Table 6 of the expert report. As I am an economist, not an engineer, I have no independent expert opinion on the cost estimates that were prepared in that report. The associated dates for all four sites are all based on information that Petitioners' Counsel provided to me in response to my requests.

- *Expenditure Dates:* Table 3 provides the dates for when the various remedy costs should have been expended and can reasonably be anticipated to be expended eventually, based on a ten-year cleanup schedule at each of the four sites. This schedule is based on information that Petitioners' Counsel provided to me in response to my requests. In general, and with all else being equal, the earlier the date for an expenditure, then the higher its present value. And were I to analyze any annually recurring costs that are entirely avoided over some period of time, then the longer the period between the start and end dates, the higher the economic benefit.

- *Inflation Adjustments and Cost Indices:* The next step is to adjust the compliance cost estimates for inflation from when they are estimated to when they are modeled as occurring. To perform this adjustment, I rely on the same cost indices that I have previously programmed into the U.S. EPA BEN economic benefit computer model, which provides the complete data series and also explanations of their composition.[11]

- *Tax Rates:* For taxation adjustments (i.e., Column "l" and Column "r" in Table 3, and also section "c" in Table 4), I use the highest year-specific combined U.S. federal and Illinois state corporate income tax rates. I follow this approach regardless

[11] In more detail, in Table 3 I use these cost indices to adjust the cost estimates for inflation to the relevant dates in the economic benefit calculations. To perform these inflation adjustments, I use the monthly values from each cost index. I then apply the ratio between the different values to the initial cost estimate.

For example, suppose that as of the month for when an initial cost estimate was developed, a cost index has a value of 100. The initial cost estimate needs to be adjusted to a later date, as of when the cost index reported a value of 110. The initial cost estimate is divided by 100, then multiplied by 110, i.e., a ratio of 110 divided by 100, or 1.1 in this example. The net effect in this simple illustrative example is to increase by initial cost estimate by 10 percent.

of what rates Respondent and its ultimate parent NRG might actually have been paying during the periods being analyzed. The highest marginal rates produce the lowest after-tax value of compliance costs, and therefore the most conservative, downwardly biased economic benefit results. The combined value is provided in the previously presented Table 2, specifically in Column "e", as part of my calculations for the WACC.

- *Capital Investment Depreciation:* Capital investments have historically not been fully deductible for tax purposes during the year in which they are made; instead, a portion has been deducted in each future year until the investment is fully depreciated. The allowed depreciation schedule is usually far shorter than the actual useful life of the capital equipment. My economic benefit calculations are therefore modeled on the modified Accelerated Cost Recovery System ("MACRS") as specified by the U.S. Internal Revenue Service, which entails a double declining balance schedule with conversion to straight line. This is the most rapid depreciation schedule that NRG would likely use (and be legally allowed to use) for tax purposes, and thus is conservative in that it lends a downward bias to the economic benefit calculations.[12] An additional depreciation "bonus" applies to equipment placed in service during certain years.[13] Table 4 (which follows Table 3 at the end of this subsection) provides the detailed derivations and the final depreciation "tax shield" present value factors. My understanding is that the remedy costs proposed by Petitioners would not constitute depreciable capital investments. Therefore, at this time, my calculations do not need to account for depreciation.

- *Capital Investment Replacement:* In addition to the previously described "paper" depreciation, capital investments also wear out and eventually need to be replaced. Therefore, an additional gain accrues in the future since the equipment from noncompliant delayed installation is newer than had it been installed on time. That is, had the compliance occurred on time as it should have, then the installed equipment would have needed to be replaced at an earlier date in the future as compared to when it will eventually have to be replaced under the actual state of the world (i.e., with the historical noncompliance). But to be conservative, I typically omit this element from my calculations, especially given the frequently very long useful lives for the required capital investments.

[12] Depreciation generates positive after-tax cash flows; the nearer these are to the current date, the lower the net present value of the capital equipment.

[13] Specifically, the incorporation of the first-year depreciation bonus models the: Economic Growth and Tax Relief Reconciliation Act of 2001; Economic Stimulus Act of 2008; American Recovery and Reinvestment Act of 2009; Small Business Jobs Act of 2010; Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010; American Taxpayer Relief Act of 2012; Tax Increase Prevention Act Of 2014; Protecting Americans from Tax Hikes Act of 2015; Tax Cuts and Jobs Act of 2017.

- *Penalty Payment Date:* My economic benefit results are present value figures calculated as of January 25, 2021, i.e., the date of this expert report. But the economic benefit will continue to grow after that date until disgorged in the form of a penalty payment. I therefore also provide information in the following section on how this economic benefit should be adjusted forward with the passage of time.

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								**On-Time Compliance Scenario:**						**Delayed Compliance Scenario:**						
Total		Per-Year							Cost	Adjusted	After-	PV	After-		Cost	Adjusted	After-	PV	After-	
Remedy		Cost Estimate:		Cost Index:		Depreciate?	Recurring?		Index	Cost for	Tax	Factor at:	Tax		Index	Cost for	Tax	Factor at:	Tax	**Economic**
Costs		Amount	Date	Choice	Value			Date	Value	Inflation	Value	25-Jan-21	PV	Date	Value	Inflation	Value	25-Jan-21	PV	**Benefit**
(1)	Joliet:	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-11	181.1	$3,099,354	$1,823,040	1.5975	$2,912,301	1-Jan-22	200.1	$3,423,880	$2,447,732	0.9515	$2,329,083	$583,218
(2)	Site-Wide =	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$3,270,494	$1,923,705	1.5260	$2,935,576	1-Jan-23	204.9	$3,506,054	$2,506,478	0.9022	$2,261,452	$674,124
(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	1.4634	$2,837,173	1-Jan-24	209.8	$3,590,053	$2,566,529	0.8555	$2,195,695	$641,478
(4)	NE Landfill =	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$3,323,548	$1,954,911	1.4005	$2,737,770	1-Jan-25	214.7	$3,674,269	$2,626,735	0.8111	$2,130,499	$607,270
(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	1.3371	$2,538,358	1-Jan-26	219.6	$3,758,778	$2,687,150	0.7691	$2,066,614	$471,744
(6)	Pond Areas =	$3,225,998	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$3,075,394	$1,844,006	1.2821	$2,364,211	1-Jan-27	224.7	$3,845,229	$2,748,955	0.7292	$2,004,645	$359,566
(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	1.2309	$2,321,962	1-Jan-28	229.9	$3,933,670	$2,812,180	0.6915	$1,944,534	$377,428
(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	$2,769,514	1-Jan-29	235.1	$4,024,308	$2,876,978	0.6556	$1,886,027	$883,487
(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	1.5975	$15,853,168	1-Jan-22	200.1	$18,637,959	$13,324,277	0.9515	$12,678,410	$3,174,757
(12)	Site-Wide =	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$17,802,998	$10,471,723	1.5260	$15,979,865	1-Jan-23	204.9	$19,085,270	$13,644,060	0.9022	$12,310,259	$3,669,606
(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	1.4634	$15,444,208	1-Jan-24	209.8	$19,542,521	$13,970,948	0.8555	$11,952,310	$3,491,897
(14)	Pond Areas =	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$18,091,796	$10,641,594	1.4005	$14,903,102	1-Jan-25	214.7	$20,000,956	$14,298,683	0.8111	$11,597,414	$3,305,688
(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	1.3371	$13,817,600	1-Jan-26	219.6	$20,460,978	$14,627,553	0.7691	$11,249,655	$2,567,946
(16)	Total =	$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$16,740,967	$10,037,884	1.2821	$12,869,628	1-Jan-27	224.7	$20,931,580	$14,963,987	0.7292	$10,912,324	$1,957,304
(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	1.2309	$12,639,647	1-Jan-28	229.9	$21,413,007	$15,308,159	0.6915	$10,585,108	$2,054,539
(18)		$17,560,780	Jul-15	PPI	188.5	n	n	20-Jan-18	192.6	$17,942,739	$12,827,264	1.1753	$15,075,903	1-Jan-29	235.1	$21,906,398	$15,660,884	0.6556	$10,266,626	$4,809,277
(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	1.5975	$9,588,102	1-Jan-22	200.1	$11,272,363	$8,058,612	0.9515	$7,667,988	$1,920,115
(22)	Site-Wide =	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$10,767,373	$6,333,369	1.5260	$9,664,730	1-Jan-23	204.9	$11,542,900	$8,252,019	0.9022	$7,445,327	$2,219,403
(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	1.4634	$9,340,761	1-Jan-24	209.8	$11,819,448	$8,449,724	0.8555	$7,228,838	$2,111,923
(24)	Pond Areas =	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$10,942,040	$6,436,108	1.4005	$9,013,496	1-Jan-25	214.7	$12,096,713	$8,647,940	0.8111	$7,014,194	$1,999,302
(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	1.3371	$8,356,978	1-Jan-26	219.6	$12,374,937	$8,846,842	0.7691	$6,803,867	$1,553,111
(26)	Total =	$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$10,125,049	$6,070,980	1.2821	$7,783,637	1-Jan-27	224.7	$12,659,561	$9,050,320	0.7292	$6,599,847	$1,183,790
(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	1.2309	$7,644,543	1-Jan-28	229.9	$12,950,730	$9,258,477	0.6915	$6,401,944	$1,242,599
(28)		$10,620,878	Jul-15	PPI	188.5	n	n	20-Jan-18	192.6	$10,851,889	$7,758,016	1.1753	$9,118,008	1-Jan-29	235.1	$13,249,137	$9,471,808	0.6556	$6,209,324	$2,908,683
(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	1.5975	$2,896,201	1-Jan-22	200.1	$3,404,952	$2,434,200	0.9515	$2,316,207	$579,993
(32)	Site-Wide =	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-12	191.1	$3,252,413	$1,913,070	1.5260	$2,919,347	1-Jan-23	204.9	$3,486,670	$2,492,621	0.9022	$2,248,950	$670,397
(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	1.4634	$2,821,488	1-Jan-24	209.8	$3,570,205	$2,552,340	0.8555	$2,183,557	$637,932
(34)	Pond Areas =	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-14	194.2	$3,305,174	$1,944,103	1.4005	$2,722,634	1-Jan-25	214.7	$3,653,956	$2,612,213	0.8111	$2,118,721	$603,913
(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	1.3371	$2,524,325	1-Jan-26	219.6	$3,737,997	$2,672,294	0.7691	$2,055,189	$469,136
(36)	Total =	$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-16	179.7	$3,058,392	$1,833,812	1.2821	$2,351,140	1-Jan-27	224.7	$3,823,971	$2,733,757	0.7292	$1,993,562	$357,578
(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	1.2309	$2,309,125	1-Jan-28	229.9	$3,911,922	$2,796,633	0.6915	$1,933,784	$375,342
(38)		$3,208,163	Jul-15	PPI	188.5	n	n	20-Jan-18	192.6	$3,277,942	$2,343,401	1.1753	$2,754,203	1-Jan-29	235.1	$4,002,060	$2,861,072	0.6556	$1,875,600	$878,602
(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.						

Table 4

DEPRECIATION SCHEDULE TAX SHIELD PRESENT VALUE FACTORS

(a)		Year:	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	
		MACRS:	*14.29%*	*24.49%*	*17.49%*	*12.49%*	*8.93%*	*8.92%*	*8.93%*	*4.460%*	*Bonus:*
(b)	Cost Recovery % Allowed	2011	57.145%	12.245%	8.745%	6.245%	4.465%	4.460%	4.465%	2.230%	*50%*
		2013	57.145%	12.245%	8.745%	6.245%	4.465%	4.460%	4.465%	2.230%	*50%*
		2014	57.145%	12.245%	8.745%	6.245%	4.465%	4.460%	4.465%	2.230%	*50%*
		2015	57.145%	12.245%	8.745%	6.245%	4.465%	4.460%	4.465%	2.230%	*50%*
		2016	57.145%	12.245%	8.745%	6.245%	4.465%	4.460%	4.465%	2.230%	*50%*
		2017	68.299%	9.058%	6.469%	4.620%	3.303%	3.299%	3.303%	1.650%	*63.01%*
		2018	100.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	*100%*
		2019	100.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	*100%*
		2020	100.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	*100%*
(c)	Marginal State and Federal Combined Tax Rate	2011	41.18%	41.18%	41.18%	41.18%	40.04%	40.04%	40.61%	28.51%	
		2013	41.18%	41.18%	40.04%	40.04%	40.61%	28.51%	28.51%	28.51%	
		2014	41.18%	40.04%	40.04%	40.61%	28.51%	28.51%	28.51%	28.51%	
		2015	40.04%	40.04%	40.61%	28.51%	28.51%	28.51%	28.51%	28.51%	
		2016	40.04%	40.61%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	
		2017	40.61%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	
		2018	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	
		2019	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	
		2020	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	28.51%	
(d)	Present Value ("PV") Factor	2011	1.0000	0.9552	0.9124	0.8716	0.8325	0.7952	0.7596	0.7256	
		2013	1.0000	0.9570	0.9158	0.8764	0.8387	0.8026	0.7681	0.7351	
		2014	1.0000	0.9547	0.9115	0.8703	0.8309	0.7932	0.7573	0.7231	***Tax***
		2015	1.0000	0.9588	0.9194	0.8815	0.8452	0.8104	0.7771	0.7451	***Shield***
		2016	1.0000	0.9602	0.9219	0.8852	0.8499	0.8160	0.7835	0.7523	***Present***
		2017	1.0000	0.9548	0.9117	0.8705	0.8312	0.7936	0.7577	0.7235	***Value***
		2018	1.0000	0.9425	0.8882	0.8371	0.7889	0.7435	0.7008	0.6604	***Totals***
		2019	1.0000	0.9529	0.9080	0.8653	0.8245	0.7857	0.7487	0.7134	***Across***
		2020	1.0000	0.9482	0.8990	0.8524	0.8083	0.7664	0.7266	0.6890	***All Yrs:***
(e)	Depreciation Tax Shield Present Value Factor	2011	0.2353	0.0482	0.0329	0.0224	0.0149	0.0142	0.0138	0.0046	***38.62%***
		2013	0.2353	0.0483	0.0321	0.0219	0.0152	0.0102	0.0098	0.0047	***37.74%***
		2014	0.2353	0.0468	0.0319	0.0221	0.0106	0.0101	0.0096	0.0046	***37.10%***
		2015	0.2288	0.0470	0.0326	0.0157	0.0108	0.0103	0.0099	0.0047	***35.99%***
		2016	0.2288	0.0477	0.0230	0.0158	0.0108	0.0104	0.0100	0.0048	***35.12%***
		2017	0.2774	0.0247	0.0168	0.0115	0.0078	0.0075	0.0071	0.0034	***35.61%***
		2018	0.2851	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***28.51%***
		2019	0.2851	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***28.51%***
		2020	0.2851	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***28.51%***

(a) Time period (with half-year convention).

(b) Amount of capital investment allowed to be depreciated, based on Modified Accelerated Cost Recovery System ("MACRS"), with bonus allowed under the Economic Growth and Tax Relief Reconciliation Act of 2001; Economic Stimulus Act of 2008; American Recovery and Reinvestment Act of 2009; Small Business Jobs Act of 2010; Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010; American Taxpayer Relief Act of 2012; Tax Increase Prevention Act Of 2014; and, Protecting Americans from Tax Hikes Act of 2015; Tax Cuts and Jobs Act of 2017.

(c) Marginal combined state and federal tax rate (see Table 2 for the detailed derivation.)

(d) Present value factor, i.e., the value of a future dollar discounted back at the specific year's WACC (see Table 2).

(e) After-tax present value of each tax shield discounted back in time; final column sums all tax shields' present value.

g. Case-Specific Economic Benefit Results

Table 5 below provides a summary of my individual economic benefit calculations. All of my calculations and results should be replicable within a reasonable approximation for any analyst. (The results are very similar to those that would be obtained by running the U.S. EPA BEN economic benefit model.)

Based on my analysis of the remedy cost estimates and associated dates that Petitioners' counsel provided to me in response to my requests, Respondent's economic benefit from failing to implement these measures in a timely manner is approximately $66 million, as shown in column "e" of row 5 in Table 5 below.

Table 5

SUMMARY OF ECONOMIC BENEFIT CALCULATIONS AND RESULTS

All present values calculated at: *25-Jan-2021*

(a)	(b)	(c)	(d)	(e)	(f)
		Present Values:		**Economic**	*Monthly*
	Site	On-Time	Delayed	**Benefit**	*Increase*
(1)	Joliet	$26,588,945	$20,425,268	**$6,163,677**	*$27,397*
(2)	Powerton	$144,737,433	$111,185,339	**$33,552,094**	*$149,136*
(3)	Waukegan	$87,538,173	$67,245,641	**$20,292,532**	*$90,198*
(4)	Will County	$26,441,948	$20,312,347	**$6,129,601**	*$27,245*
(5)	Total Across All Sites	$285,306,500	$219,168,596	**$66,137,904**	*$293,976*

Notes:

(a)	Line number.
(b)	Site.
(c)	Present value, scenario for on-time compliance.
(d)	Present value, scenario for delayed compliance.
(e)	Calculated as: Column "c" - Column "d".
(f)	Column "e" x (1 + most recent annual WACC value from Table 2) ^ (1/12) - column "e".

All of my economic benefit results are present value figures calculated at January 25, 2021, i.e., the date of this expert report. Therefore the economic benefit will continue to grow after this date until Respondent effectively pays back its economic benefit in the form of a civil penalty. Column "f" in Table 5 provides the monthly increase, almost $300,000 across all four sites.

Moreover, as I explained earlier in this report, for civil penalties to achieve financial deterrence, their value must exceed the economic benefit that a Respondent realizes by delaying and/or avoiding adequate pollution control. Because not all violations are detected, prosecuted, and ultimately penalized, to achieve adequate deterrence, a civil penalty should also be adjusted by probability of detection, prosecution, and ultimate payment, as explained in further detail earlier in my report.

4. Basis for Opinion: Economic Impact of Penalty Payment and Compliance Costs

This section on the economic impact from a penalty payment and from the costs of compliance with a Board order covers the following topics:

a. Assessment of financial condition for Midwest Generation, LLC;

b. Relationship of Midwest Generation, LLC to NRG Energy, Inc.;

c. Assessment of financial condition for NRG Energy, Inc.; and,

d. Conclusions for economic impact of penalty payment and compliance costs.

a. Assessment of Financial Condition for Midwest Generation, LLC

The financial statements for Midwest Generation, LLC provided through discovery in this case include the following description under the first note for "Nature of Business":

> Midwest Generation, LLC (the Company) owns or leases interests in five generating facilities in Illinois with net electric generating capacity of 4,319 megawatts (MW) as of December 31, 2019. Midwest Generation provides energy, capacity, ancillary, and other energy services to wholesale customers.

Table 6 below provides a summary of the recent financial results for Midwest Generation, LLC. Operating revenue (Line 1) for each of the three years has been very close to the $636 million average. Net income (Line 3) has averaged $93 million over the three-year period, and net cash provided by operating activities (Line 5) has averaged $132 million. Total assets (Line 4) were valued at $871 million at the end of 2019.

Table 6

RECENT FINANCIAL RESULTS: MIDWEST GENERATION, LLC

(in millions)

		2019	2018	2017
(1)	Operating revenue	$641	$620	$648
(2)	Operating income	$175	$67	$75
(3)	Net income	$165	$54	$61
(4)	Total assets	$871	$893	$1,066
(5)	Net cash provided by operating activities	$108	$145	$142

b. Relationship of Midwest Generation, LLC to NRG Energy, Inc.

The prior examination of the standalone profitability of Midwest Generation, LLC provides only an incomplete picture, as Midwest Generation, LLC is essentially not a standalone entity from either a financial or managerial viewpoint. The previously referenced financial statements also note:

> Midwest Generation, a Delaware limited liability company, is a wholly owned subsidiary of Midwest Generation Holdings II, LLC, both of which are wholly owned indirect subsidiaries of NRG Energy, Inc. (NRG), which is defined as "the Parent."

The financial statements for Midwest Generation, LLC explain some aspects of this relationship under the note for Related-Party Transactions, as shown in the following excerpts below (with *italics* emphasis original):

> *Intercompany Cash Management Program* – The Company participates in an intercompany cash management program whereby cash balances at Midwest Generation are transferred to NRG's central concentration accounts to fund working capital and other needs of the respective participants.
>
> *Corporate Allocations* – NRG provides the Company with various management, personnel and other services, which include human resources, regulatory and public affairs, accounting, tax, legal, information systems, treasury, risk management, commercial operations, and asset management. Costs associated with these services have not been allocated to the Company.
>
> *Payroll and Employee Related Costs* – The Company has an arrangement with NRG whereby the Company pays the actual costs incurred by NRG in connection with the provision of employees and related benefits inclusive of pension and post-retirement costs.
>
> *Employee Savings Plan* – The employees of Midwest Generation are eligible to participate in NRG's 401(k) plan.
>
> *Procurement and Marketing Services* – The Company receives services from NRG that include the bidding and dispatch of the generating units (NRG acts as an agent), procurement of fuel and other products, and execution of, including economic hedges to reduce price risk.

Note especially that the costs for "various management, personnel and other services, which include human resources, regulatory and public affairs, accounting, tax, legal, information systems,

treasury, risk management, commercial operations, and asset management" performed by the parent NRG Energy on behalf of its subsidiary Midwest Generation are not charged to the subsidiary.

Many aspects of this relationship are reinforced by the deposition testimony of Mr. David Callen, taken December 2, 2020. For instance, after confirming his status as Chief Accounting Officer at NRG, he also addresses questions about his role at Midwest Generation and other subsidiaries, yet does not even know the details of his own positions:

> Q. Are you currently employed by any other company?
> A. No.
> Q. Are you currently an officer of any company other than NRG?
> A. A large number of our indirect wholly owned subsidiaries, yes.
> Q. For instance, are you currently an officer of Midwest Gen?
> A. I believe I am.
> Q. And what is your -- what is your title?
> A. I think it's just a VP, the vice president.
> Q. Okay. Is there a -- I know sometimes the term vice president will -- you know, will be vice president of operations, vice president of finance. Do you have a fuller title there or is it just vice president?
> A. I just don't recall. I know what you're talking about. I just don't recall.
> Q. Okay. Are you currently on the board of Midwest Gen?
> A. I'm not sure.
> Q. So it's possible that you're on the board, but you don't recall?
> A. Correct
> (p. 16 line 7 through p. 17 line 3)

This is consistent with the material presented in a document produced in discovery for this case (MWG13-15_79474), providing a list of officers for Midwest Generation. In addition to Mr. Callen, all of the other officers have positions with NRG Energy, as shown in Table 7, on the following page. All of the titles in Table 7 are taken directly from the previously referenced discovery document for Midwest Generation, LLC and from the respective officers' publicly available LinkedIn profiles.

Table 7		
OFFICERS FOR MIDWEST GENERATION, LLC AND POSITIONS AT NRG ENERGY		
	Title:	
Name	Midwest Generation LLC	NRG Energy
Lagano, Judith	President	Senior Vice President, Asset Management
Frotte, Gaetan	Vice President & Treasurer	Senior Vice President, Treasurer
Callen, David	Vice President	Chief Accounting Officer
Kranz, Bradley	Vice President	Vice President, Asset Management
Krupa, Edward Christopher	Vice President	Vice President, Tax Planning
Mackey, Glen Edwin	Vice President	Chief Risk Officer
Moser, Christopher S.	Vice President	Head Of Operations
Fry, Deborah R.	Assistant Secretary	Manager, Subsidiary Management

Returning to the deposition testimony of David Callen, despite all the roles that he performs on behalf of Midwest Generation, no attempt is made to financially allocate his services to the financial results of that subsidiary:

> Q. Is any part of your salary recorded as an expense in Midwest Gen's books and records?
> A. No.
> (p. 20 line 23 through p. 21 line 1)

NRG Energy does not maintain any such expense reimbursement scheme even though NRG Energy as the ultimate parent performs even the most basic core financial and managerial functions for Midwest Generation:

> Q. Sure. It might be easier if we sort of talked through that process. Can you just generally -- can you run through the process including the timeline of how a budget is prepared for Midwest Gen each year?
> A. I can talk generically how it's done at NRG, which includes the budget for Midwest Gen.
> (p. 24 lines 14-19)

Moreover, these services are performed by NRG Energy on behalf of its subsidiaries not via any formal agreement or contract, but instead by mere virtue of NRG Energy's ownership of these companies:

> Q. [...]
> Are you aware then -- is there a written policy describing what agreement, what services are provided by NRG to Midwest Gen?
> A. Sorry. There is no document that I know of that describes all the different things that NRG does for the benefit of Midwest Gen. Sorry. I was relating to there could be some procedures. Could be. I just don't know of any --
> Q. Okay.
> A. -- generically how we would record in the books and records the costs related to certain people and what they do. That's all I was getting at. I don't know of anything that was booked specifically to Midwest Gen in the accounts.
> Q. Okay. And sorry. Just to close this line.
> You said you don't know of any written policies specifically to Midwest Gen. Are you aware of a written policy for the method or the scope of services that NRG will provide to its subsidiaries generally?
> MS. NIJMAN: Asked and answered.
> THE WITNESS: There is a broad array of, I just call it services that are done by NRG for all of its indirect subsidiaries.
> I'll give you an example. We do the payroll for everybody across NRG, from NRG. You wouldn't for – it just makes economic sense to do that with one consolidating group at NRG for the benefit of everybody across NRG as opposed to having in every single subsidiary a person or two, depending on how many people you have, to do that service. There are just procedures that you follow when you do that. That's what I'm getting at.
> (p. 55 line 3 through p. 57 line 7)

NRG Energy also closely manages the cash of Midwest Generation, demonstrating that the subsidiary does not even control its own banking operations:

> Q. Okay. Can you describe generally how this cash management program operates?
> MS. NIJMAN: I'm going to object to the form of the question given the statement on the document right in front of you.
> THE WITNESS: Basically this is how NRG manages or operates all the cash across its subsidiaries, consolidates them ultimately into one bank account to manage the relationship with the banks to negotiate the best terms, both in terms of management fees for the bank account as well as any interest rates or interest income.
> BY MR. WANNIER:
> Q. So how is -- who makes the decision to move cash -- to transfer cash balances between Midwest Generation and NRG central concentration accounts?
> MS. NIJMAN: Object to form and misstatement of testimony.
> THE WITNESS: It's -- this is operated by the treasurer of the company and obviously that's dealt with on a daily basis by its team. And with the banks, the banks automate the pooling of the cash into one account.
> (p. 70 lines 2-23)

And as referenced earlier, NRG Energy does not attempt to charge its subsidiaries for these services in semblance of an arms-length relationship transacted at market prices:

> Q. [...]
> [...]
> So when it says "Costs associated with these services have not been allocated to the company," can you describe what that sentence means?
> A. Like my time spent on -- excuse me -- dealing with the accounting for Midwest Gen or my time being here at this deposition on behalf of Midwest Gen isn't charged, for lack of a better term, to Midwest Gen's financial statement -- to Midwest Gen's books and records.
> (p. 73 line 16 through p. 74 line 2)

Furthermore, the decision-making authority for certain thresholds of capital expenditures resides with the ultimate parent company, NRG Energy, not with the named Respondent Midwest Generation, LLC:

> Q. Okay. Is there an NRG policy dictating who is required to approve different levels of capital expenditures?
> A. Yes. NRG has a policy that applies for the most part across all of NRG's direct and indirect subsidiaries.
> Q. And that policy applies -- so Midwest Gen is included in that; it would apply to expenditures at Midwest Gen?
> A. It would apply. That same would apply to Midwest Gen as well.
> Q. Okay. Does that policy have a name?
> A. Broadly speaking, it would be called the delegation of authority policy.
> Q. Okay. And is the delegation of authority policy written down anywhere, to your knowledge?
> A. It is, yes.
> (p. 79 line 17 through p. 80 line 9)

And the same delegation of authority policy would also apply to the environmental context:

> Q. Sure. Let me ask this: Would expenses related to environmental controls fall under the category of capital expenses that are covered by the delegation of authority policy at NRG?
> A. It would be included.
> (p. 81 lines 17-21)

All of the foregoing demonstrates that although Respondent Midwest Generation, LLC is a legally separate entity from its ultimate parent NRG Energy, Inc., the Respondent is so closely intertwined with its ultimate parent NRG Energy as to have no significant independent financial and managerial existence.

c. Assessment of Financial Condition for NRG Energy, Inc.

Following on the previous analysis of the relationship of the named Respondent Midwest Generation, LLC to its ultimate parent, NRG Energy, Inc., Table 7 below provides a selection of key indicators for the recent financial performance of NRG Energy, Inc. As shown in Table 8, NRG's operating revenues were almost $10 billion in 2019 (Line 1). Even with losses in 2016 and 2017, annual net income (Line 3) has averaged $445 million over the entire four-year period. Annual cash flow from operations (Line 5) has averaged over $1.5 billion over the past four years. Annual capital expenditures (Line 6) have averaged over a third of a billion dollars.

Table 8

RECENT FINANCIAL RESULTS: NRG ENERGY INC.

(in millions)

		2019	2018	2017	2016
(1)	Total Operating Revenues	$9,821	$9,478	$9,074	$8,915
(2)	Operating Income (Loss)	$1,290	$982	($741)	$33
(3)	Net Income/(Loss) Attributable to NRG Energy, Inc.	$4,438	$268	($2,153)	($774)
(4)	Total Assets	$12,531	$10,628	$23,355	$30,716
(5)	Cash Flow from Operations	$1,413	$1,377	$1,610	$1,908
(6)	Capital Expenditures	$228	$388	$254	$544
(7)	Cash and Cash equivalents at Year End	$345	$563	$770	$591

In addition to the material presented above in Table 8, as of September 30, 2020, NRG Energy held $697 million in cash and cash equivalents. And a recent estimate of market capitalization for NRG Energy is approximately $10.1 billion.[14]

[14] Closing stock price for NRG Energy, Inc. was $41.40 on January 14, 2021, with approximately 244.22 million shares outstanding, for a product of approximately $10,110,708,000.

d. Conclusions for Economic Impact of Penalty Payment and Compliance Costs

Table 9 below provides the after-tax present values for the costs of compliance with a Board order and for my economic benefit results.

Table 9

SUMMARY OF COMPLIANCE COSTS AND ECONOMIC BENEFIT RESULTS

(in millions)

(a)	(b)	(c)	(d)	(e)
		Injunctive	Economic	
	Site	Relief	Benefit	Total
(1)	Joliet	$20,425,268	$6,163,677	$26,588,945
(2)	Powerton	$111,185,339	$33,552,094	$144,737,433
(3)	Waukegan	$67,245,641	$20,292,532	$87,538,173
(4)	Will County	$20,312,347	$6,129,601	$26,441,948
(5)	Total Across All Sites	$219,168,596	$66,137,904	$285,306,500

Notes:

(a)	Line number.
(b)	Site.
(c)	After-tax present value, summed across site rows from Table 3, column "t".
(d)	Economic benefit, from Table 5, column "e".
(e)	Calculated as: Column "c" + Column "d".

For the economic impact, the named Respondent Midwest Generation, LLC has reported net income averaging $93 million over 2017 through 2019 and has reported net cash provided by operating activities averaging $132 million over the same three-year period.

Yet although the named Respondent Midwest Generation, LLC is a legally separate entity from its ultimate parent NRG Energy, Inc., the Respondent is so closely intertwined with its ultimate parent NRG Energy as to have no significant independent financial and managerial existence. NRG Energy even describes the potential liability from this case in its filings with the U.S. Securities and Exchange Commission ("SEC") without any mention of the status of the named Respondent as distinct from itself.

For NRG Energy, in 2019 total operating revenues were almost $10 billion, and net income was over $4.4 billion. As of September 30, 2020, NRG Energy held $697 million in cash and cash equivalents. The current market capitalization for NRG Energy is approximately $10.1 billion. Annual cash flow from operations for NRG Energy has averaged over $1.5 billion over the past four years, and annual capital expenditures have averaged over a third of a billion dollars.

Table 10 below brings together certain of the previously presented figures and performs some additional calculations.

Table 10

COMPARISON OF ECONOMIC BENEFIT AND COMPLIANCE COSTS WITH PRESENT VALUES OF OPERATING CASH FLOW AND CAPITAL EXPENDITURES

(a)	(b)	(c)	(d)	(e)
Financial	Annual Average	Present Value Over	Economic Benefit +	Ec Ben + Compliance
Statement Item	Over Past Four Years	Next Ten Years	Compliance Costs	As % of PV
Cash Flow from Operations	$1,577,000,000	$11,906,115,693	$285,306,500	2.4%
Capital Expenditures	$353,500,000	$2,668,872,478	$285,306,500	10.7%

Notes:

(a) Financial statement item from Table 8.

(b) Respective annual average over past four years calculated from Table 8.

(c) Calculated using the most recent WACC from Table 2 column "o".

(d) Taken from Table 9 column "e" for total across all sites.

(e) Calculated as column "d" divided by column "c".

Table 10 starts with an item from NRG Energy's financial statements, calculates the annual average of the past four years, and then calculates the present value over the next four years (discounting back to the present at the most recent WACC value from Table 2, but conservatively not allowing for any inflationary increases). Next the total figure is provided from Table 9 for the after-tax present values for the costs of compliance with a Board order and for my economic benefit results. Finally, the present values for the ten-year average of the financial statement item is compared to the economic benefit and compliance costs. As shown in Table 10, in the final column, even the full amount of my economic benefit result plus the entire compliance costs advocated by Petitioners over the next ten years would represent only about two percent of the present value of NRG Energy's annual cash flow from operations projected out ten years. And that full amount would represent only about one-tenth of capital expenditures.

5. Qualifications and Compensation

As previously noted under the section entitled Basis for Opinion, I have separately provided my Curriculum Vitae as this report's Attachment A, which also includes a list of my publications and public presentations going back at least ten years and testimony experience going back at least four years. I receive compensation of $190 per hour for the time that I have spent preparing this report in 2020, and $196 per hour in 2021. For testimony in 2021 I would receive $260 per hour.

I declare under the penalty of perjury that the statements in this report are true and accurate to the best of my knowledge.

Attachment A: Curriculum Vitae

JONATHAN S. SHEFFTZ

d/b/a JShefftz Consulting
14 Moody Field Road
Amherst MA 01002

Mr. Shefftz is an independent consultant who specializes in the application of financial economics to litigation disputes, regulatory enforcement, and public policy decisions. Previously he was a consultant with Industrial Economics, Incorporated ("IEc") from 1992 until 2006 when he moved to western Massachusetts. Mr. Shefftz has extensive experience in settlement and litigation support, and has been qualified as an expert witness in U.S. District Court, a federal agency's Administrative Court, and state courts.

Mr. Shefftz's recent experience includes work in the following areas.

- Calculating the economic damages suffered by companies and individuals from alleged wrongful actions.
- Applying financial economics to civil penalty factors in regulatory enforcement actions.
- Analyzing financial economic issues related to public policy decisions.

Mr. Shefftz has performed this work in a variety of contexts, including expert witness testimony, computer model development, training course delivery, and regulatory review. He has supervised project teams comprising economists, accountants, paralegals, and software developers, as well as worked in parallel with engineers, scientists, lawyers, and lobbyists. His clients have included federal and state governmental agencies, private litigators, and other private-sector entities.

Mr. Shefftz holds a B.A. *magna cum laude* and *Phi Beta Kappa* in Economics and Political Economy from Amherst College, and an M.P.P. degree, with concentrations in Government & Business and Energy & Environmental Policy, from the John F. Kennedy School of Government at Harvard University.

Mr. Shefftz's positions have included Eastern Vice President for the National Association of Forensic Economics, Chair for the Town of Amherst Planning Board, referee for the *Journal of Forensic Economics*, Course Liaison for the "Engineering Economic Decision Making" course at the University of Massachusetts Amherst, Treasurer for the Jewish Community of Amherst, Board of Trustees member for the American Avalanche Association, and Treasurer for the U.S. Ski Mountaineering Association. He is also a member of the Government Finance Officers Association, American Academy of Economic and Financial Experts, and Amherst Area Chamber of Commerce.

Economic Damages

Mr. Shefftz has experience with the following work on economic damages, including expert witness testimony both in deposition and at trial. He has also applied his expertise in unjust enrichment calculation, financial statement analysis, municipal financial assessment, and corporate control / ownership issues to private-party damages cases – this expertise is described in more detail in the "Financial Factors in Regulatory Enforcement" section.

Business Damages
Mr. Shefftz has modeled companies' cash flows under hypothetical "but-for" states of the world versus actual states of the world to calculate business damages in numerous cases. Sample contexts include an engineering firm that lost business to a spin-off competitor, timber companies that alleged a contract breach from implementation of Congressional legislation, a furniture company whose relationship with a joint venture partner was interfered with by a key customer, a fixed base operator prohibited from selling jet fuel by a municipal airport commission, a brownfields remediation firm with an incapacitated key principal, a state-chartered joint underwriting association whose prior servicing carrier incorrectly determined premiums, a dealer who delivered contaminated fuel, a social networking website imperiled by a developer's nondelivery, computer code discarded by a demolition crew, and a sports organization whose apparel licensee breached a contract.

Personal Damages
Mr. Shefftz has assessed lost earnings and household services along with incurred and anticipated medical costs in numerous cases involving wrongful death, personal injury, wrongful termination, estate disputes, credit card interest overcharges, and divorce. Sample contexts include alleged employment discrimination, medical malpractice, workplace injuries, vehicular accidents, retail store accidents, below-market earnings, lead poisoning, professional license revocation, the Servicemembers Civil Relief Act, and an arrest instigated by a former spouse.

Water Contamination
For a real estate development, Mr. Shefftz analyzed the diminution in value by projecting the groundwater contamination-induced delayed schedule versus the original schedule. On a claim to have developed groundwater assets but for contamination, he testified on the municipality's impaired financial condition at the time. On a class action lawsuit by property owners, he evaluated the defense economist's statistical analysis of property values. On other water contamination lawsuits, he has calculated the damages from the need to switch to alternative sources of water, including a desalination plant, whole-house drinking water systems, and a neighboring utility.

Intellectual Property
For defense counsel in a copyright infringement lawsuit, Mr. Shefftz assessed declarations from the plaintiff's expert economist who asserted that a "companion" book would damage the author of the original series of novels. He also assisted counsel with preparation for trial cross examination.

Computer Model Development
For the U.S. Department of Justice Commercial Litigation Branch, Mr. Shefftz developed a standalone computer model for statutorily determined interest under the Contract Disputes Act.

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Financial Factors in Regulatory Enforcement

Mr. Shefftz has experience with the following work on regulatory enforcement actions brought under the Asbestos Hazard Emergency Response Act (AHERA), Clean Air Act (CAA), Clean Water Act (CWA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Emergency Planning and Community Right-to-Know Act (EPCRA), Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Oil Pollution Act (OPA), Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), Spill Prevention, Control and Countermeasure (SPCC) rule, Toxic Substances Control Act (TSCA), Underground Storage Tank (UST) program, as well as various state statutes. Mr. Shefftz has been qualified as an expert witness on numerous occasions in federal, administrative, and state courts. His clients for this work have included the U.S. Environmental Protection Agency (EPA), U.S. Department of Justice (DOJ), private litigators, state Attorneys General, and defense counsel.

Financial Statement Analysis / Ability-to-Pay / Economic Impact / Corporate Control & Ownership
Mr. Shefftz has examined the tax returns, financial statements, and other financial documentation for individuals, businesses, not-for-profits, municipalities, and all four unincorporated organized U.S. territories, to assess the ability to pay for – and/or economic impact of – sought environmental expenditures, e.g., compliance costs, penalty demands, and cleanup/remediation costs. He has reviewed discovery documents and conducted research in many cases to assess the extent to which subsidiaries can rely on their corporate parents for financial support and the extent to which corporate control of subsidiaries goes beyond that exercised by mere ownership.

Financial Gain / Economic Benefit / Unjust Enrichment
Mr. Shefftz has modeled companies' and municipalities' cash flows under hypothetical full and timely compliance states of the world versus actual delayed compliance states of the world to calculate the economic benefit (i.e., financial gain or unjust enrichment) on numerous enforcement actions. As part of this work, he has estimated the weighted-average cost of capital for a wide variety of companies and industries.

Other Financial Factors in Regulatory Enforcement Actions
Mr. Shefftz has performed work on other financial factors in regulatory enforcement actions: the "size of violator" penalty element; the relative weight of different financial indicators for establishing deterrence; and, the adequacy of financing plans to ensure environmental compliance.

Computer Model Development, Training, and Support
Mr. Shefftz has managed the development of the current versions of the BEN, PROJECT, ABEL, INDIPAY, and MUNIPAY computer models that U.S. EPA's Office of Enforcement and Compliance Assurance applies to financial economics issues in enforcement actions. He has prepared the models' help systems and training materials, as well as presented training courses and provided related support for federal and state enforcement staff. Mr. Shefftz has also assisted in several U.S. EPA academic peer reviews and public comment processes for the BEN computer model and related economic benefit recapture issues. Finally, he has created versions of the models for other nations: Canada (BEN), Chile (BEN and ABEL), and El Salvador (BEN).

Public Policy

Cost of Capital Estimation
Mr. Shefftz assessed peer reviewer comments and then revised a draft report on cost of capital estimation for water systems. His work included applying the capital asset pricing model to the commercial drinking water industry and correcting for the earlier draft's assumptions regarding capital structure and industry-level business risk.

Financial Assurance
For a state agency, Mr. Shefftz proposed appropriate inflation forecasts and discount rates, drafted a guidance document, and then developed a stand-alone computer model to calculate the net present value of future remediation costs. For EPA's Office of Solid Waste, he provided recommendations on discounting future cleanup costs; for the Office of Site Remediation and Enforcement, he created a computer model to assess the combined affordability of financial assurance and cleanup costs; for another EPA office, he created a spreadsheet model to calculate the insurance and/or trust fund amounts necessary to provide for post-closure care. For the U.S. Department of the Interior's Office of Surface Mining Reclamation and Enforcement, he reviewed other agencies' approaches and developed a spreadsheet model to calculate initial trust fund amounts and then recalculate subsequent years' annual rebalancings to reflect actual returns and additional future costs. For a not-for-profit, he reviewed draft reports on the potential role of financial assurance in the regulation of hydraulic fracturing (i.e., "fracking").

Joint Cost Allocation
For a study of Bureau of Reclamation rate setting for California's Central Valley Project, Mr. Shefftz researched economically efficient methods for allocating water project costs to user classes.

Proposed Legislation
For an industry association, Mr. Shefftz designed and implemented a survey and analyzed its results to predict the impacts of a proposed national lead tax upon lead consumption and dependent industrial sectors. For a national waste management firm, he analyzed the financial impacts of a proposed state tax on hazardous waste land disposal.

Superfund Impacts
Mr. Shefftz examined the Department of Energy SURE model's predictions of economic impacts from Superfund liability and cost allocation reform. At a Superfund site, he critiqued a small city's claims that a proposed contaminated soil cleanup would lead to widespread economic disruptions.

Legislative Review
For the 1990 Clean Air Act amendments, Mr. Shefftz investigated the potential of fuel oxygenation requirements to cause petroleum refinery closures. For the Safe Drinking Water Act, he reviewed EPA's national-level drinking water affordability criteria, assessed their implications for small water systems' finances, proposed alternative criteria, created databases to predict how many systems would be judged unable to afford drinking water rules, evaluated public comments, and drafted report text to respond to a Congressional charge.

JONATHAN S. SHEFFTZ

Representative Clients

Mr. Shefftz has been retained by the following clients, whether directly as an independent consultant, during his prior employment at Industrial Economics, Incorporated ("IEc"), and/or as an independent consultant via subcontract with IEc.

State Agencies:

California
Connecticut
Illinois
Indiana
Massachusetts
Michigan
New Hampshire
New Mexico
Ohio
Pennsylvania
Texas
Virginia
Washington
Wisconsin

Federal / National Agencies:

U.S. Department of Justice (Civil Division – Commercial Litigation Branch; Environment and Natural Resources Division – Environmental Enforcement Section, Environmental Defense Section)
U.S. Environmental Protection Agency (various Headquarters Offices and Regional Counsels)
U.S. Fish and Wildlife Service (within U.S. Department of Interior)
National Oceanic and Atmospheric Administration (within U.S. Department of Commerce)
Office of Surface Mining Reclamation and Enforcement (within U.S. Department of Interior)
Superintendecia del Medio Ambiente (Chile)
Ministerio de Medio Ambiente y Recursos Naturales (El Salvador)

Industry:

3M Company
Advanced Flow Engineering, Inc.
Bouncing Cranberries LLC
Circle Environmental, Inc.
Country Villa Bay Vista Healthcare Center
CWM Chemical Services, Incorporated
Frasco Fuel Oil
French Heritage, Inc.
Infinity Fluids Corporation
Keystone Automotive Operations, Inc.
Kinder Morgan
National Coating Corporation
Lead Industries Association
MedMal Joint Underwriting Ass'n of RI
Musco Family Olive
Prolerized New England Co., Inc.
Rectrix Aerodome Centers, Inc.
Stebbins-Duffy, Inc.
Taotao USA, Inc.

(In addition to the industry clients listed above, Mr. Shefftz has also performed work on behalf of numerous industry clients and their insurers on economic damages cases, but without any direct interaction with such parties and their insurers or any analytical focus on them.)

JONATHAN S. SHEFFTZ

Representative Clients (continued)

Citizen Groups:

Advocates for the West
Appalachian Mountain Advocates
Biodiversity Conservation Alliance
Center for Biological Diversity
Center for Justice
Clean Air Council
Earthjustice
Ecological Rights Foundation
Environmental Advocates of New York
Environmental Law and Policy Center
Food & Water Watch
Grand Canyon Trust
Hoosier Environmental Council
Inland Empire Waterkeeper
Louisiana Bucket Brigade
Lower Susquehanna Riverkeeper Association
National Parks Conservation Association
Newark Education Workers Caucus
Ohio Valley Environmental Coalition
Orange County Coastkeeper
Our Children's Earth Foundation
PennEnvironment
Puget Soundkeeper Alliance
Respiratory Health Association
St. Bernard Citizens for Environ. Quality
Sierra Club
Suncoast Waterkeeper
Toxics Action Center, Inc.
United States Public Interest Research Group
Waste Action Project
Wild Fish Conservancy
Alabama Environmental Council
Appalachian Voices
Black Warrior Riverkeeper
Center for Comm. Action & Environ. Justice
Citizens Against Ruining the Environment
Conservation Law Foundation
Earthrise Law Center
Environment America Research & Policy
Environmental Integrity Project
Environment Texas Citizen Lobby, Inc.
Frontier Group
Gulf Restoration Network
Idaho Conservation League
Inst. for Governance & Sustainable Develop.
Louisiana Environmental Action Network
National Environmental Law Center
Natural Resources Defense Council
Northwest Environmental Defense Center
Olympic Forest Coalition
Oregon Public Interest Research Group
Pacific Environmental Advocacy Center
Public Justice
RE Sources for Sustainable Communities
Riverkeeper
San Antonio Bay Estuarine Waterkeeper
South River Watershed Alliance, Inc.
Texas Rio Grande Legal Aid, Inc.
Tulane Environmental Law Clinic
Univ. of Denver Environmental Law Clinic
West Virginia Highlands Conservancy
WildEarth Guardians

JONATHAN S. SHEFFTZ

Representative Clients (continued)

Law Firms:

Adler, Cohen, Harvey, Wakeman & Guekguezian
Allyn & Ball, P.C.
Bayh, Connaughton and Malone
Law Offices of Cain, Sherry, Geller & Vachereau
The Law Offices of William Chu
D'Ambrosio Law Offices
Law Offices of John K. Dema, P.C.
Doherty, Wallace, Pillsbury & Murphy
Downey Brand LLP
Frederick, Perales, Allmon & Rockwell, PC
The Garcia Law Firm
Hanson Curran LLP
Henrichsen Siegel Moore, PLLC
Hunsucker Goodstein PC
Kaplan, Massamillo & Andrews, LLC
Law Office of David E. Keller
James E. Kolenich, Esq.
Meryl A. Kukura, Esq.
Lozeau Drury LLP
Mackie Shea O'Brien, PC
Meyers Nave
MFI Law Group PLLC
Motley Rice LLC
Law Office of Michael D. Parker
Pierce Atwood LLP
Plaza Law Group
Reardon Law Office LLC
Ryan & Kuehler PLLC
Ryan Whaley Coldiron Shandy PLLC
The Schreiber Law Firm
Richard Schwartz & Associates, P.A.
Simonds, Winslow, Willis & Abbott
Steve Harvey Law LLC
Todd & Weld LLP
Law Offices of Charles G. Walker
Wilson Elser Moskowitz Edelman & Dicker
Law Office of Jacqueline L. Allen
Arnold & Porter LLP
Bricklin & Newman, LLP
ChasenBoscolo
The Collins Law Firm, P.C.
DeCotiis, FitzPatrick & Cole, LLP
DLA Piper
Donovan Hatem LLP
Dreyer Boyajian LLP
Gallagher & Cavanaugh LLP
David S. Hammer, Esq.
George E. Hays, Esq.
Hogan Lovells US LLP
Kampmeier & Knutsen PLLC
Kasowitz, Benson, Torres & Friedman LLP
Keller Rohrback L.L.P.
Manson Bolves Donaldson Varn
Kenneth Lieberman, Esq.
Lucentini & Lucentini LLP
Marr Law Offices
Meyner and Landis LLP
Morrison Mahoney LLP
Law Office of Jennifer F. Novak
Patton Boggs LLC
Edward M. Pikula, Esq.
Raymond Law Group LLC
Reed Smith LLP
Ryan, Ryan, Johnson & Deluca, LLP
Sasson, Turnbull, Ryan & Hoose
Jon L. Schwartz, Attorney at Law, P.C.
Silverstein, Silverstein & Silverstein P.A.
Smith & Lowney, PLLC
Stoel Rives LLP
Van Ness Feldman LLP
Waltzer Wiygul & Garside LLC
Reed Zars, Esq.

JONATHAN S. SHEFFTZ

Publications and Presentations

Social Security Losses in Personal Injury, paper discussant at Western Economic Association International Annual Conference (Portland OR), 7/1/16.

The "Loss of Chance" Rule in the Various States, paper discussant at Allied Social Sciences Association Annual Conference (Philadelphia PA), 1/4/14.

Foreign Net Discount Rates: The Case of Undocumented Mexican Workers, paper discussant at Western Economic Association International Annual Conference (Seattle WA), 6/30/13.

Evolving Transition Probabilities and Worklives, paper discussant at Allied Social Sciences Association Annual Conference (San Diego CA), 1/5/13.

Commercial Damages Calculations, panelist at Eastern Economic Association Annual Conference (Boston MA), 3/10/12.

Medical Net Discount Rates: 1980 - 2011, paper discussant at Eastern Economic Association Annual Conference (Boston MA), 3/10/12.

The Value of Future Earnings in Perfect Foresight Equilibrium, paper discussant at Allied Social Sciences Association Annual Conference (Denver CO), 1/8/11.

The Role of the Economic Expert in Litigation Directed at Piercing the Corporate Veil, presentation at Fall Forensic Economics Workshop (Durango CO), 10/8/10.

Alternative Perspectives for Breach-Nonbreach Scenario Specifications in Commercial Litigation, paper presentation at Western Economic Association International Annual Conference (Portland OR), 7/1/10.

Sampling Issues in Commercial Damages Cases, paper discussant at Western Economic Association International Annual Conference (Vancouver BC), 7/1/09.

Net Discount Rates: Does Duration Matter?, paper discussant at Eastern Economic Association Annual Conference (Boston MA), 3/7/08

Enforcement Economics: Deterrence, Economic Benefit, & Ability to Pay, presentation at California Environmental Protection Agency State Water Resources Control Board "Enforcenomics" Workshop (Berkeley CA), 1/11/08.

Alternative Focuses for "But-For" Scenario Specification in Commercial Litigation, paper presentation at Western Economic Association International Annual Conference (Seattle WA), 6/30/07

Publications and Presentations (continued)

Expert Witness Role Play, presentation at U.S. EPA 9th Financial Analyst Workshop (Atlanta GA), 5/3/07.

Working with Experts in Environmental Cases: An Expert Economist's Perspective on Expert Testimony, presentation at Public Interest Environmental Law Conference (Eugene OR), 3/2/07.

Alternative Measures and Focuses for Economic Damages Calculations, paper presentation at Eastern Economic Association Annual Conference (New York NY), 2/23/07.

Lost Profit as a Measure of Lost Earning Capacity, panelist at Western Economic Association International Annual Conference (San Francisco CA), 7/7/05

"EPA's Economic Benefit Analysis Policy and Practice," *Natural Resources and Environment*, Fall 2004.

"Taxation Considerations in Economic Damages Calculations," *Litigation Economics Review*, Summer 2004.

Economic Benefit and Wrongful Profits in the Calculation of Penalties for Environmental Violations, presentation to Boston Bar Association Environmental Litigation Committee, 9/23/04.

Business Valuation / Commercial Damages, panelist at Western Economic Association International Annual Conference (Vancouver BC), 7/1/04.

"Wrongful Profits: Setting the Record, and the Concept, Straight," *Environment Reporter*, 1/2/04.

Present Value Sensitivity to Ex Ante vs. Ex Post Perspective, paper presentation at Western Economic Association International Annual Conference (Denver CO), 7/12/03.

Taxation Considerations in Economic Damages Calculations, paper presentation at Eastern Economic Association Annual Conference (New York NY), 2/22/03.

Economic Benefit from Illegal Competitive Advantage and *Complex Economic Benefit Scenarios*, presentation at U.S. EPA 5th Financial Analyst Workshop (Boston MA), 7/26/00.

Economic Benefit in Wetlands Cases: Financial Analysis Issues, presentation at U.S. EPA Wetlands Enforcement Conference (Alexandria VA), 3/22/00.

Economic Benefit, presentation at U.S. EPA 4th Analyst Workshop (Denver CO), 3/10/99.

JONATHAN S. SHEFFTZ

Testimony History

PennEnvironment, Inc., and Clean Air Council v. United States Steel Corporation (USDC WD Penn), deposition 2/10/21 (scheduled).

Sierra Club, Inc. and Conservation Law Foundation, Inc. v. Granite Shore Power LLC et al. (USDC NH), deposition 11/11/20.

Ohio Valley Environmental Coalition and The Sierra Club v. Eagle Natrium LLC (USDC ND West Virginia), deposition 8/19/20.

Gary and Anne Childress, et al. v. JP Morgan Chase & Co., et al. (USDC ED North Carolina), deposition 1/24/19 and affidavit 3/17/20.

Seneca Economics and Environment, LLC v. Manson Bolves Donaldson Varn, P.A. (Florida Circuit Court), affidavit 2/26/20.

Permit application for Plaquemines Liquids Terminal, LLC (Louisiana DEQ), affidavit 1/27/20.

Newark Education Workers Caucus and Natural Resources Defense Council, Inc. v. City of Newark et al. (USDC NJ), courtroom testimony 8/15/19.

Wild Fish Conservancy v. Cooke Aquaculture Pacific, LLC (USDC WD Wash), deposition 8/02/19.

Waste Action Project v. Port of Olympia (USDC WD Wash), deposition 7/17/19.

Toxics Action Center, Inc. and Conservation Law Foundation v. Casella Waste Systems, Inc. and North Country Environmental Services, Inc. (USDC NH), deposition 5/15/19.

Suncoast Waterkeeper, Our Children's Earth Foundation, and Ecological Rights Foundation v. City of Gulfport (USDC MD Fla), deposition 5/7/19.

San Antonio Bay Estuarine Waterkeeper and S. Diane Wilson v. Formosa Plastics Corp., Texas, et al. (USDC SD Tex), deposition 1/16/19.

Infinity Fluids Corporation v. Eemax, testimony at binding arbitration hearing, 12/6/18.

Puget Soundkeeper Alliance v. Seattle Iron & Metals, Corp. (USDC WD Wash), deposition 10/4/18.

Natural Resources Defense Council, Respiratory Health Association, and Sierra Club, Inc. v. Illinois Power Resources, LLC and Illinois Power Resources Generating, LLC (USDC CD Illinois), deposition 6/12/18.

Louisiana Environmental Action Network and Stephanie Anthony v. Exxon Mobil Corp. d/b/a/ ExxonMobil Chemical Co. (USDC MD Louisiana), deposition 10/26/17.

JONATHAN S. SHEFFTZ

Testimony History (continued)

Jeffrey Palmer v. Inn Serve Corporation d/b/a Hampton Inn & Suites, Inn of Daphne, Inc. d/b/a Hampton Inn et al. (Court of Lauderdale County, Mississippi), affidavits 6/2/17 & 10/23/17.

In the Matter of Taotao USA, Inc., Taotao Group Co., Ltd., and Jinyun County Xiangyuan Industry Co., Ltd. (U.S. EPA Administrative Court), deposition 9/26/17, courtroom testimony 10/19/17.

Puget Soundkeeper Alliance v. Louis Dreyfus Commodities LLC et al. (USDC WD Wash), deposition 3/2/16.

Gulf Restoration Network, Louisiana Environmental Action Network, and Sierra Club v. United Bulk Terminals Davant, L.L.C. (USDC ED Louisiana), deposition 5/5/15.

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***DRAFT* 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

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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 it in determining necessary steps to determine an appropriate groundwater remedy based upon regulatory standards established by the Illinois Environmental Protection Agency (IEPA). The Complainants provided reports and analyses from the existing administrative record for me to review, based upon my input of what types of documents would provide the most useful information. Of those documents, the Illinois Pollution Control Board's (Board) opinion regarding 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").

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 Illinois Pollution Control Board (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 or coal combustion residuals ("CCRs") such as fly ash, slag, bottom ash, and cinders. Collectively, those CCRs are commonly called "coal ash."

The Board concluded in its June 29, 2019 Interim Opinion and Order of the Board ("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." 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:

- MWG is liable for groundwater quality and / or open dumping violations of the Act.
- Active and / or historical coal ash disposal and fill areas have contributed to that contamination.
- MWG has not thoroughly investigated contamination at the four stations.
- MWG has used land use and institutional controls in response to groundwater contamination.
- The current record was insufficient "to determine the appropriate relief in this proceeding", and that additional hearings were necessary to determine the appropriate relief.

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 boring. (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. (Opinion at 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, 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).
- 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) but those ELUCs do not 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 2-4 and 2-5). 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 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).

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). 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. An aerial photograph taken in 1973 that illustrates those historical disposal areas is included as **Figure 2**.

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. There are no Environmental Land Use Controls (ELUCs) at Joliet. (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 8). As of 2020, the current coal ash disposal or related treatment ponds included four ponds: the Ash Bypass Basin, Ash Surge Basin, Metal Cleaning Basin, and Service Water Basin located in the immediate vicinity of the Former Ash Basin, as illustrated on **Figure 3**. The Ash Surge Basin and Ash Bypass Basins are currently used to collect bottom ash.

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). 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 Service Water 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 2.30 feet per day based upon the highest aquifer hydraulic conductivity (4.7×10^{-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. MWG acknowledged that the station was subject to the Class I groundwater quality standards, and MWG agreed to re-line the Ash Surge Basin and Ash 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 below 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.

The original disposal area beneath what is now the East and West Basins was unlined. (Opinion at 67). The Board concluded that coal ash was buried around the current 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 replaced with an HDPE liner in 2003 and 2004, respectively. (Opinion at 4 and 64). The liners are not, however, a composite liner that meets the requirements of the CCR Rule that also requires a two-foot layer of soil with a hydraulic conductivity no greater than 1 x 10^{-7} centimeters per second, *in addition to* [emphasis supplied] a HPDE layer. 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.

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 0.6 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) "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 the single groundwater monitoring well used in the comparative analysis of the ASD was drilled into an embankment at least partially constructed of coal ash. (KPRG 2020 Waukegan at 103).

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). 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). 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).

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 sometimes saturated in groundwater. (Opinion at 56). 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 sometimes drilled immediately adjacent to – and sometimes 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 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 in 2013, and Ash Pond 3s was relined in 2009. (Opinion at 52).

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. The Board also concluded that there 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. 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. The Board concluded that GMZs are not a permanent solution for contamination, and no such GMZ exists for the Waukegan station. 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 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. 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. 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,

- Under what conditions the coal ash exists on or near the ground surface relative to groundwater and saturation in the disposal areas, and
- Contaminant migration pathways to human and ecological receptors.

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 the CCAs 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 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.

The ASDs completed by KPRG, are good examples of missed opportunities for MWG to define source(s) of contamination. Also, ASDs performed by KPRG for Powerton, Waukegan, and Will County failed to conclude 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 was careful to only evaluate contaminant potential from the *active* [emphasis supplied] disposal areas and to conclude that other *undefined potential sources* [emphasis supplied] were responsible for the well contamination. KPRG did not conclude that historical coal ash disposal or fill activities might be responsible for groundwater contamination at Powerton and Waukegan – even though it knew that wells were drilled into historic coal ash at both locations. 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 located:

- Within historical coal ash disposal areas at Powerton and Waukegan were drilled into wastes – consistent with KPRG's conclusions,
- Immediately adjacent to and sometimes in coal ash in the ash basins at Will County.
- Within the radius of influence of mounded groundwater that would have flowed radially in a 360-degree direction from unlined surface impoundments where sluicing occurred – resulting in groundwater flowing in the upgradient direction currently interpreted by KPRG.

KPRG has admitted that wells at Powerton were drilled into historical coal ash but has not concluded that any active basin has caused groundwater contamination. The Board concluded that the liners likely leaked, and the basins were re-lined because of that leakage. Next, the 2011 hydrogeologic investigation concluded that groundwater elevation "anomalies" existed around the active basins due to differences in "lithology" or localized areas of "higher recharge." 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). 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**). 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 both) of the 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., 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 regulatory requirements required by the following 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** (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 source 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 and to define the risks to human health, safety, and the environment. 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 an Illinois 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 on 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. Saturated coal ash cannot be closed in-place according to the CCR Rule. Also, disposal units that contain coal ash that is located within five feet of the uppermost aquifer are required to close.

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 the Board, 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), the Comprehensive Environmental Response, Compensation and Liability Act (CERLCA), 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 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 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 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 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 ESA by ENSR – 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. Historical data also demonstrates 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.

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 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.
- Coal ash was found beneath the ash ponds at Powerton and Waukegan, and
- Even though MWG plans to close ash ponds by excavating coal ash from active basins, coal ash will remain beneath and adjacent to those ash ponds – unless MWG also plans to excavate that coal ash.

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 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 program associated with the CCR Rule and the CCAs.

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 CCC 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,
- 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. The nature and extent investigation 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 also 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 also 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, for example, for groundwater 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 removal contaminant sources if historical coal 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

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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
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
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

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
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
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

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
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 Stack Surge Pond	Notice of Intent to Close	Removal	KY
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

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
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
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

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
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
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

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
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
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

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
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
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

Name of Plant or Site	Operator	CCR Unit	Closure Status	Closure Method per CCR Rule Closure Plan (Actual if Closed)	State
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

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

In the Matter of:	)	
	)	
SIERRA CLUB, ENVIRONMENTAL LAW AND POLICY CENTER, PRAIRE RIVERS NETWORK, and CITIZENS AGAINST RUINING THE ENVIRONMENT	)	PCB No-2013-015 (Enforcement – Water)
Complainants,	)	
v.	)	
MIDWEST GENERATION, LLC, Respondents	)	

NOTICE OF SERVICE

To: Don Brown, Clerk of the Board
Illinois Pollution Control Board
100 West Randolph Street
Suite 11-500
Chicago, IL 60601

PLEASE TAKE NOTICE that I have o January 25, 2021, served a true and correct copy of the **Expert Opinion of Mark A. Quarles, P.G.**, and **EXPERT OPINION on Economic Benefit of Noncompliance and Economic Impact of Penalty Payment and Compliance Costs** via electronic mail to the parties listed on the attached service list before 5:00 p.m. Central Time.

Dated: January 25, 2021

Respectfully submitted,

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Interested Parties

CERTIFICATE OF SERVICE

The undersigned, Faith Bugel, an attorney, certifies that a true copy of the foregoing **NOTICE OF SERVICE** was filed electronically on January 25, 2021 with the following:

Don Brown, Clerk of the Board
Illinois Pollution Control Board
100 West Randolph Street
Suite 11-500
Chicago, IL 60601

And that true copies of the **Expert Opinion of Mark A. Quarles, P.G.**, and **EXPERT OPINION on Economic Benefit of Noncompliance and Economic Impact of Penalty Payment and Compliance Costs** were served via electronic mail to the electronic parties on the foregoing service list before 5 p.m. Central Time on January 25, 2021 to the email addresses of the parties' counsel. The entire package is 3 pages.

Respectfully submitted,

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