**UNITED STATES OF AMERICA**
**FEDERAL ENERGY REGULATORY COMMISSION**

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| **In the Matter of**<br><br>**Exelon Generation Company LLC**<br>**Conowingo Hydroelectric Project** | **P-405-106**<br>**P-405-121** |

**CHESAPEAKE BAY FOUNDATION, INC.'S COMMENTS ON OFFER OF SETTLEMENT**

Pursuant to the Commission's Rules of Practice and Procedure, *see* 18 C.F.R. § 385.602(f), the Chesapeake Bay Foundation, Inc. ("CBF"), hereby submits these comments to the Federal Energy Regulatory Commission ("the Commission") on the "Joint Offer of Settlement and Explanatory Statement filed with the Commission by Exelon Generation Company, LLC and the Maryland Department of the Environment," dated October 29, 2019, eLibrary No. 20191029-5119 (the "Settlement Offer").

The record before the Commission does not demonstrate that the Settlement Offer as a whole is adequate to mitigate the impacts to downstream water quality impacts resulting from the operation of the Conowingo Hydroelectric Project (the "Project" or "Conowingo Dam"). CBF requests that the Commission reject the Settlement Offer and conduct further proceedings as there is a genuine issue of fact regarding the water quality impacts from the Project, which the terns of the Settlement Offer do not address or mitigate in a meaningful or legally adequate way.

CBF is the largest independent non-profit organization dedicated solely to restoring and protecting the Chesapeake Bay and its tributary rivers. For over 50 years, CBF has worked to improve water quality by reducing the amount of pollution discharged to the Chesapeake Bay and its tributaries. CBF is headquartered in Annapolis, Maryland on the shore of the Chesapeake

Bay. CBF also has offices in Harrisburg, Pennsylvania; Richmond and Virginia Beach, Virginia; and Washington, DC. CBF has long been involved in the relicensing and water quality certification process for the Project. CBF intervened in the Final License Application Proceeding in 2013 and submitted comments to the Commission on the draft Environmental Impact Statement in September of 2014.[1] CBF also submitted extensive comments to Maryland Department of the Environment ("MDE") during the Water Quality Certification process for the Project.[2] CBF then intervened in support of the State of Maryland in the series of lawsuits Exelon filed challenging the issuance of the Water Quality Certification. CBF is invested in the Conowingo Dam relicensing process because of the impacts the operation of the dam has to downstream water quality, CBF programming, and our members' interests.[3]

## FACTUAL BACKGROUND

### I. The Chesapeake Bay and CBF's Restoration Efforts

The Chesapeake Bay ("the Bay") is the United States' largest and most biologically diverse estuary, home to more than 3,600 species of plants, fish and animals.[4] The Bay watershed encompasses 64,000 square miles from Cooperstown, New York to Virginia Beach, Virginia.[5] Portions of the watershed are found in Delaware, Maryland, New York, Pennsylvania, Virginia, Washington, D.C., and West Virginia.[6] The Susquehanna River is one of the five major

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[1] Motion to Intervene of Chesapeake Bay Foundation, Inc., (Aug. 20, 2013), FERC e-Library No. 20130820-5013; *See* Letter from Kim Coble, Chesapeake Bay Foundation, to Secretary Kimberly Bose, Federal Energy Regulatory Commission (Sept. 29, 2014), FERC e-Library No. 20140929-5106.
[2] *See* Letters from Alison Prost, Chesapeake Bay Foundation, to Elder Ghigiarelli, Jr., Maryland Department of the Environment, (Aug. 23, 2017) and (Jan. 16, 2018) (attached as Exhibits "A" and "B," respectively).
[3] At the time of filing, 532 CBF members and e-subscribers had signed a petition supporting these comments.
[4] Chesapeake Bay Program, *Facts and Figures,* https://www.chesapeakebay.net/discover/factslast visited Jan. 15, 2020).
[5] Chesapeake Bay Foundation, *More than Just the Bay,* https://www.cbf.org/about-the-bay/more-than-just-the-bay/ (last visited Jan. 15, 2020).
[6] *Id.*

tributaries of the Chesapeake Bay.[7] The Susquehanna River contributes about 50% of the freshwater discharged to the Chesapeake Bay and, in a normal flow year, about 25% of the sediment load and the greatest quantity of nutrients from non-tidal areas (nearly 66% of the nitrogen and 40% of the phosphorus transported to the Bay from the major river basins which contribute almost 90% of the freshwater).[8]

High levels of nutrients and sediment enter the water from agricultural operations, urban and suburban stormwater runoff, wastewater facilities, air pollution, and other sources.[9] These pollutants cause algae blooms that block sunlight that is needed for underwater grasses and smother aquatic life on the bottom, and as the algae decay, consume oxygen and create "dead zones" where fish and shellfish cannot survive.[10] Sediment runoff causes significant impairment of some streams and rivers within areas of the Bay watershed by clouding the waters, which harms underwater grasses, fish, and shellfish.[11] Through its various programs, campaigns, and initiatives designed to protect and restore the quality of the Bay and its tributaries by reducing the sediment and nutrients discharged to the Bay, CBF seeks to restore and maintain sustainable populations of crabs, fish, and oysters; and a clean and healthy ecosystem for our children and grandchildren.[12] The Conowingo Dam's operation directly impacts CBF's restoration efforts in the upper Chesapeake Bay.

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[7] Chesapeake Bay Foundation, *The Susquehanna River*, https://www.cbf.org/about-the-bay/more-than-just-the-bay/susquehanna-river/ (last visited Jan. 15, 2020).

[8] Robert M. Hirsch, U.S. Geological Survey, Scientific Investigations Report 2012-5185, *Flux of Nitrogen, Phosphorous, and Suspended Sediment from the Susquehanna River Basin to the Chesapeake Bay during Tropical Storm Lee, September 2011, as an Indicator of the Effects of a Reservoir Sedimentation on Water Quality* 2–4 (2012), https://pubs.usgs.gov/sir/2012/5185/pdf/sir2012-5185-508.pdf.

[9] Chesapeake Bay Foundation, *Dead Zones*, https://www.cbf.org/issues/dead-zones/ (last visited Jan. 15, 2020).

[10] *Id.*

[11] Chesapeake Bay Program, *Bay 101 – Sediment*, https://www.chesapeakebay.net/discover/bay-101/bay_101_sediment (last visited Jan. 15, 2020).

[12] Chesapeake Bay Foundation, *How We Save the Bay*, https://www.cbf.org/how-we-save-the-bay/ (last visited Jan. 15, 2020).

## II. The Conowingo Dam and Impacts to Downstream Water Quality

The Conowingo Dam sits on the Lower Susquehanna River, approximately ten miles upstream of its confluence with the Chesapeake Bay. The Project has been in operation since 1928 and has fundamentally altered the relationship of the Susquehanna River to the Chesapeake Bay. For more detail on the relationship between the Dam and water quality, please see CBF's comments to MDE on the Water Quality Certification from August 23, 2017 and January 16, 2018, incorporated by reference and attached as Exhibits A and B.

The Conowingo Dam alters the form and timing of pollutants entering the Bay, which impacts downstream water quality standards. During heavy rain events, sediment and nutrients are scoured from behind the dam, contributing pollution to downstream waters that negatively impacts water quality. The Lower Susquehanna River Watershed Assessment ("LSRWA") evaluated the impact of scouring events on downstream water quality, including effects on the attainment of the dissolved oxygen water quality standard. The study determined that scour events contribute to downstream non-attainment of dissolved oxygen, and the deposited material may contribute negatively to water quality impacts for years.[13] The study concluded that scoured loads of sediment, on average, represented about 20% of the total loads that enter the Bay during storm events. This percentage increases with storm size. More severe storms are predicted in this region due to climate change.[14]

Recent model simulations of the effects of climate change on infill in the Conowingo Reservoir, or "Pool," indicate that by 2050 outputs of nutrient and sediment from the Project will *exceed* inputs, meaning the Dam itself will become a *source* of these pollutants (Figure 1) within

[13] *Lower Susquehanna River Watershed Assessment, Maryland and Pennsylvania* 100 (March 7, 2016), available at https://dnr.maryland.gov/waters/bay/Pages/LSRWA/Final-Report.aspx (last accessed Jan. 16, 2020).
[14] *Id.* at 79.

the new license term.[15] In turn, these additional pollutants will have effects on downstream water quality, specifically the attainment of dissolved oxygen standards.

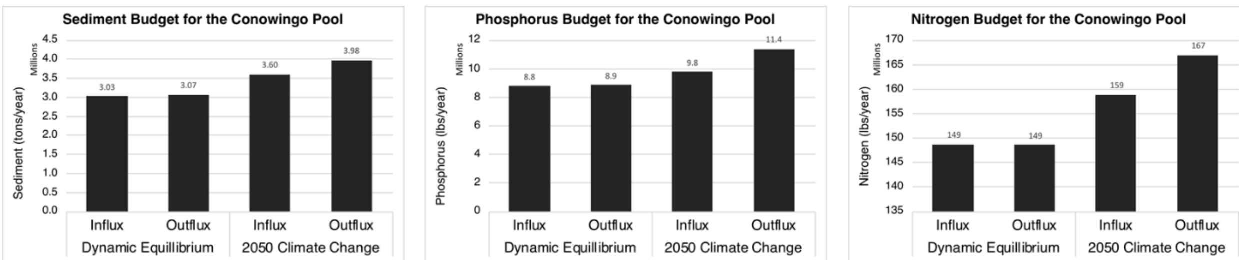


**Figure 1.** Figures show (a) Sediment, (b) Phosphorus, and (c) Nitrogen budgets for the Conowingo pool. Each figure has a set two scenarios – (1) Conowingo in dynamic equilibrium under 1991-2000 average hydrology, (2) Conowingo's response under 2050 hydrology. And for both scenarios influx (input) and outflux (output) are shown.[16]

The State of Maryland developed a water quality certification for the Conowingo Dam, pursuant to its authority under Section 401 of the Clean Water Act that identified and attempted to mitigate the impacts of the Dam. The State of Maryland determined that the Conowingo Dam adversely impacts water quality in Maryland. Specifically, the State of Maryland found that

> Although the Dam has in the past trapped and stored sediment and nutrients and served as a barrier to downstream transport to the Bay, the Reservoir is now full, as no efforts have been undertaken over the life of the Project, such as routine dredging, to maintain any trapping functions. *As a result*, sediments and nutrients move downstream, and during large storm events, significant amounts of trapped sediment and nutrients are scoured from [] behind the Dam and discharged downstream. By releasing significant amounts of sediment and nutrients *through scouring during storm events*, the Dam has altered the nature, timing, and delivery method of these materials with *adverse consequences for the Lower River and the Bay*. Nutrients discharged as a result of the in-filled state of the Reservoir *adversely impact DO levels* and thus aquatic life in the DO Non-Attainment Areas.[17]

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[15] Bhatt, Gopal, Q. Zhang, L. Linker, and G. Shenk. *Conowingo Infill and Climate change Impacts on the Chesapeake Bay Water Quality and TMDL* (in preparation).
[16] *Id.*
[17] Maryland Department of the Environment, Clean Water Act Section 401 Certification For the Conowingo Hydroelectric Project, FERC Project No. P-405/ MDE WSA Application No. 17-WQC-02, at 12 (April 27, 2018) (emphasis added).

Fundamentally, the Water Quality Certification found that the "discharge from the Project impacts water quality in the River below the Dam *and in the Bay*."[18] As discussed more below, none of these impacts are sufficiently addressed in the Settlement Offer.

## LEGAL BACKGROUND

### I. Water Quality Certification and the Clean Water Act

Section 401 of the Clean Water Act vests in states the authority and responsibility to ensure that federal projects will not negatively harm state water quality. A federal agency cannot issue a permit or license to conduct any activity that may result in the discharge of pollutants to navigable waters until a state certifies that the activity does not violate state water quality standards or limitations.[19] The federal license must comply with applicable water quality standards, effluent limitations, and the provisions governing TMDLs.[20] Each state undergoes a public notice-and-comment process to develop and issue a water quality certification. Once issued, the water quality certification is then incorporated into the federal license or permit and must include any conditions or requirements set by the state to protect water quality. Such was the case here prior to Exelon's various legal challenges which resulted in this Settlement Offer.

### II. Hydropower Settlement Agreements under the Federal Power Act

The Commission is authorized to approve settlement agreements for hydropower licenses pursuant to Federal Power Act.[21] The statute dictates that before authorizing a license for a hydropower project, the Commission must determine that any licensed project is:

[18] *Id.* at 8 (emphasis added).
[19] 33 U.S.C. § 1341(a)(1).
[20] 33 U.S.C. § 1341(a)(1) requiring a water quality certification to ensure any discharge "will comply with the applicable provisions of sections 301, 302, 303 [TMDLs], 306, and 307 of this Act."
[21] 16 U.S.C. §§ 791a et seq.

> best adapted to a comprehensive plan for improving or developing a waterway or waters for the use or benefit of interstate or foreign commerce, for the improvement and utilization of waterpower development, for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning ground and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in section 4(e).[22]

Section 4(e) of the Federal Power Act requires:

> The Commission, in addition to the power and development purposes for which licenses are issued, *shall give equal consideration* to the purposes of energy conservation, the protection, mitigation of damages to, and enhancement of, fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality.[23]

Thus, as the Commission reviews settlement agreements, the Commission must consider not just the wishes of the settling parties, but the greater public interest, and whether the settlement proposal meets the comprehensive development, environmental and equal consideration standards of the Federal Power Act.[24]

The Commission issued a 2006 policy statement articulating certain guiding principles it considers when evaluating the legality of a proposed settlement. Pertinent to this Settlement Offer, and discussed in more detail in these comments, are the following principles:

- Measures must be based on substantial evidence in the record of the licensing proceedings
- Measures must be consistent with the law and enforceable. In particular, measures must be within the Commission's jurisdiction
- A relationship must be established between a proposed measure and project effects or purposes
- Measures should be as narrow as possible, with specific measures preferred over general measures

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[22] 16 U.S.C. § 803(a)(1).
[23] 16 U.S.C. § 797(e).
[24] 16 U.S.C. § 803(a)(1); *see* Federal Energy Regulatory Commission, *Policy Statement on Hydropower Licensing Settlements*, Dck. No. PL06-5-000, at 2, ¶4 (Sept. 21, 2006) (hereinafter, "FERC Policy Statement").

- Actions required under measures should occur physically/ geographically as close as possible to the project

- Measures must reserve the Commission's compliance authority, as well as its authority to review and modify as necessary proposed resource or activity plans. [25]

The Settlement Offer fails to meet these principles and is not in the public interest as it does not adequately address the water quality impacts of the operation of the Conowingo Dam on the Chesapeake Bay.

## DISCUSSION

The Settlement Offer proposed by the State of Maryland and Exelon should be rejected because the provisions in the Settlement Offer purporting to address water quality impacts occur as unenforceable off-license provisions in a separate settlement agreement (the "Agreement"). If the Commission approves the Settlement Offer, the terms related to water quality impacts should be made part of the license terms and strengthened consistent with our comments below. Simply put, the Commission cannot accept the Settlement Offer as presented by the State of Maryland and Exelon as it violates the Federal Power Act and the Clean Water Act.

### I. THE SETTLEMENT OFFER DOES NOT ADDRESS THE WATER QUALITY IMPACTS OF THE CONOWINGO DAM SUFFICIENTLY FOR THE COMMISSION TO ISSUE THE LICENSE.

#### A. The State of Maryland effectively abdicates its duty to protect downstream water quality from hydropower projects.

The State of Maryland has a duty to protect state water quality, and nothing in the Settlement Offer accomplishes that goal. The State of Maryland proposes to waive its water quality certification authority—the strongest power bestowed to a state under the Clean Water Act to protect water quality. The State of Maryland also proposes to waive its future ability to

[25] FERC Policy Statement, at 5, ¶12.

issue or amend the National Pollutant Discharge Elimination System permit for the Project under certain circumstances, an authorization not at issue in the licensing process. Nothing in the Settlement Offer addresses the water quality impacts of Conowingo Dam with the sufficiency necessary for the Commission to issue the operating license.

*i. Section 401 Water Quality Certification*

The Clean Water Act requires states to certify that federally licensed projects such as hydropower dams will not harm downstream water quality before the Commission can grant a license to operate. Specifically, section 401 requires that any federally licensed facility whose operation results in a discharge into state navigable waters obtain a certification that it "will comply with the applicable provisions of sections 1311, 1312, 1313, 1316, and 1317" of the Clean Water Act.[26] It also requires that all conditions "necessary to assure" compliance with those provisions become conditions in the license for the facility.[27] Such is not the case here.

None of the Proposed License Articles contain conditions or limitations on the operation of the Project to mitigate the impacts of the discharge of pollutants. In the Agreement, the State of Maryland proposes to waive its water quality certification authority, after already engaging in an extensive public comment period and issuing a water quality certification with conditions aimed to protect water quality from the impacts of Conowingo Dam. Instead, Maryland proposes to address the extensive and well-documented water quality impacts from the operation of the Conowingo Dam in off-license provisions of the Agreement. This approach violates the Clean Water Act and sets bad precedent for hydropower licensing given that hydropower projects like Conowingo Dam have immense impacts on natural resources and water quality. Here, MDE

[26] 33 U.S.C. § 1341(a)(1).
[27] 33 U.S.C. § 1341(d).

established an administrative record to support issuing a water quality certification for the Project only to propose waiving it at this late stage.

The Final Environmental Impact Statement succinctly identified a primary water quality issue posed by the dam, stating that "sediment trapping in Conowingo Pond has reached a state of dynamic equilibrium, where, on balance, the full sediment load (*and the associated nutrient load*) is carried by the river through the reservoir to the Chesapeake Bay."[28] The Settlement Offer makes *no mention* of the fact that the operation of Conowingo Dam contributes to the scouring of pollution from behind the dam during heavy rain events. This was initially the water quality issue that necessitated the Water Quality Certification in dispute between Exelon and the State of Maryland, and neither party has acknowledged this issue in the terms of the Agreement or the Proposed License Articles for the Project. In addition, as noted above, by 2050, within the term of the Project's new license, the Conowingo Dam will be a *source* of nutrients and sediments to downstream waters. Instead of acknowledging and directly addressing these facts, the State of Maryland proposes to waive the Water Quality Certification—the one mechanism the state has to address downstream water quality impacts from the Dam. This flies in the face of the purpose of Section 401 of the Clean Water Act. The Commission should not accept an offer of settlement in which a state abdicates its duty to protect water quality harmed by the operation of a hydroelectric project subject to the Commission's jurisdiction.

*ii. NPDES permits and other pollution reduction provisions*

In a further unnecessary move, the State of Maryland agrees in the off-license Agreement to not impose on Exelon "any additional nutrient or sediment-related measures or nutrient or sediment funding requirements associated with nutrients or sediment *originating from sources*

[28] Federal Energy Regulatory Commission, *Final Multi-Project Environmental Impact Statement for Hydropower Licenses, Susquehanna River Hydroelectric Projects* at 75 (Mar. 2015) (emphasis added).

*outside the Project*" as part of "any NPDES permit or state discharge permit for the Dam, any modification of the New License throughout its Term, [or] any new CWA Section 401 water quality certification issued in connection with a federal permit requirement for any construction related to the FERC Relicensing Proceeding, or any similar proceedings." (emphasis added)[29] As such, the Agreement provides that the State of Maryland may not assert at any point during the license period that Exelon become responsible for addressing pollutants "originating from outside the Project."[30] The phrase "originating from sources outside the Project" ought to be explicitly defined in the Agreement, as this language curtails the State of Maryland's authority under the Clean Water Act and State law. Rather, only the term "Project" is defined as having "the meaning in the recitals of this Agreement."[31] The failure to clearly define the entire phrase will lead to disputes as to Exelon's responsibility for pollutants it discharges from the pool behind the Dam through its operation. The Commission should not approve a settlement with undefined terms of importance to future Dam operation and Clean Water Act permitting. The Agreement should be revised to define the phrase so that it excludes material trapped behind the Dam; material that would not be there and pose a threat to water quality but for operation of the Project. Exelon has become responsible for this material and its impacts by virtue of how it operates the Project.

The practical effect of this provision, as currently drafted, is that the State of Maryland will effectively waive its ability to issue a NPDES permit, or modify the Dam's existing NPDES permit, in any way that would require Exelon to reduce the amount of pollution coming through the dam as a discharge under the Clean Water Act. Hydropower dams have been held to be a

[29] Agreement, section 3.6(a) (emphasis added).
[30] *Id.*, section 3.6(a)(2).
[31] *Id.*, 1.1.

point source, and therefore are susceptible to regulation under the NPDES permitting system.[32] As established by the LSRWA, during a scour event, the Conowingo Dam releases pulses of pollutants that had been trapped behind the Dam. This release could constitute a discharge of a pollutant into a navigable body of water, as the Dam would no longer simply pass the same water through but add pollutants to downstream water.[33] It is inappropriate for the State of Maryland to waive its NPDES permitting responsibility through a settlement agreement when it is highly probable that Conowingo Dam will discharge pollutants during the lifetime of the license.[34] Furthermore, the State of Maryland's ability authority to waive the requirements for a NPDES permit for the Project is circumscribed by the Clean Water Act, as the prohibition against discharging pollutants into navigable waters is self-executing.[35]

### B. The Settlement Offer Does Not Meet the Requirements of the Federal Power Act to Give Equal Consideration to the Environmental Effects of Conowingo Dam.

As stated above, the water quality impacts of the Conowingo Dam should not be relegated to off-license provisions in the Agreement but should have been addressed through the Water Quality Certification process under the Clean Water Act and added to the License terms. Waiver aside, the Settlement Offer fails to meet the requirements of section 4(e) of the Federal Power Act because the water quality impact mitigation measures are not included in Proposed License Articles, despite a clear nexus between the Project's operation and downstream water quality impacts as demonstrated in the record.[36] The State of Maryland and Exelon cannot address water quality impacts through off-license agreements to simply transfer payments to the

[32] *S.D. Warren Co. v. Maine Board of Environmental Protection,* 547 U.S. 370 (2006) (finding that a dam's alteration of water movement and flow fell under the Clean Water Act's definition of pollution and discharge).
[33] *South Fla. Water Management Dist. v. Miccosukee Tribe*, 541 U.S. 95 (2004).
[34] *See* Fig. 1, *supra.*
[35] *See National Wildlife Federation v. Consumers Power Co.*, 862 F.2d 580, 582 (6th Cir. 1988) (citing *United States v. Frezzo Brothers, Inc.*, 602 F.2d 1123, 1127 (3rd Cir. 1979)).
[36] *See supra* pp. 3-5.

Maryland Clean Water Fund, which is structured to be used whenever and wherever the State wishes – indeed, even in a way entirely disconnected from the matter of, and impacts from, the Conowingo Dam. This issue needs to be addressed directly in the terms of the License through the incorporation of the Water Quality Certification in the License, or in the provisions of the License itself which govern the operation of the Project. Furthermore, specific, proportional, and related mitigation needs to be applied in specific, related geographies, under specific timelines.

The Commission is obligated to give equal consideration to the environmental quality impacts associated with its approval of a hydropower license, which includes the downstream water quality impacts of the Conowingo Dam.[37] There are significant water quality issues associated with the operation of the Conowingo Dam that the Commission has identified in the FEIS, the state of Maryland identified in the Water Quality Certification, and stakeholders have raised again and again. The State of Maryland and Exelon have completely ignored the water quality impacts of the Conowingo Dam in this Settlement Offer and have not articulated how any of the measures in it address water quality with sufficient specificity for the Commission to approve the Settlement Offer under the Federal Power Act.

As stated in the 2006 Policy Statement, the Commission expects settlement agreements to describe how the proposals relate to project effects or project purposes in order to determine whether to license the facility under section 10 of the Federal Power Act. It is easier for the Commission to determine if the license comports with section 10 when a settlement agreement calls for "specific measures (rather than a general expenditure of funds), [… and] if the settling parties document how the measures are tied to project effects or purpose." [38] Further, in order to approve a settlement agreement and issue a license under the Federal Power Act, the

[37] 16 U.S.C. § 797(e).
[38] FERC Policy Statement, at 7.

Commission's decision must be supported by substantial evidence. This means that to support a license condition proposed in a settlement agreement, the parities must "develop a factual record that provides substantial evidence to support the proposed condition, and demonstrate[] how the condition is related to project purposes or to project effects."[39] The Settlement Offer accomplishes none of these requirements.

First, the approach in the Agreement to address water quality is through general expenditures of funds, not specific measures. The provisions in the Agreement to address water quality consist exclusively of payments to the Maryland Clean Water Fund, with no specification of how the money is to be spent in order to improve water quality. For example, the Agreement states that Exelon will pay State of Maryland approximately $11.3 million dollars over the course of the license for "financial support for other water quality improvement projects, including forest buffers and agricultural projects such as cover crops."[40] This funding provision is vague. Neither party has articulated where the money would be spent, how much would be spent on specific projects, when the projects would occur, or how those projects would address the water quality impacts caused by operation of the Conowingo Dam. The Commission should require the State of Maryland and Exelon to articulate with a higher degree of specificity what the "other water quality improvement projects" would entail, where they would be implemented, how those measures proportionally relate to the Project's impact, and when they would take place.

Second, measures proposed in a settlement agreement must be tied to the Project's effect, and by proposing to address water quality in off-license provisions, the State of Maryland and Exelon have not developed a settlement agreement that adequately explains how the measures

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[39] *Id.*, at 3.
[40] Agreement at 20 (section C.4 – Funding for Other Water Quality Projects).

are tied to the Project's impacts. Nearly all of the measures related to mitigating water quality impacts are imprecise proposals to expend money, with no demarcation of how the funds will be spent. More significantly, the terms of Agreement do not explain or quantify what the *benefit* of these measures will be *to downstream water quality*, meaning the Settlement Agreement does not describe the relationship between the measures and the water quality impacts of the Project.[41] For example, one of the proposed projects in the Agreement is building a mussel hatchery upstream of the Conowingo Dam. Nothing in the Agreement quantifies the effectiveness or probability of success of mussel restoration in reducing pollution and mitigating the impacts of the Dam on downstream water quality. This provision is therefore not supported by substantial evidence on the record.

The remaining water quality provisions are even less specific than the mussel restoration plan and provide no quantification of the restoration benefits on downstream water quality via pollution reduction. The Agreement makes no effort to quantify the pollution reduction impacts of the "other water quality improvement projects," which is equally troubling considering the tools available to quantify BMP effectiveness based on landscape position, as utilized by the Chesapeake Bay Program and in Maryland's Bay Restoration Fund expenditures.[42] At a minimum, the State of Maryland and Exelon needed to estimate the pollution reduction benefits of various water quality improvement projects, and directly link the impact of the operation of the Conowingo Dam to those mitigation measures. The parties did not, which left the public questioning what "other water quality improvement projects" would be installed with the

[41] Policy Statement, at 7 (citing *Virginia Electric Power Company*, 110 FERC ¶ 61,241 at P11) (the Commission is "troubled by settlements which require measures, such as general funds to be used for unspecified measures, that are *not tied to either project impacts or purposes*.").
[42] *See, e.g.,* U.S. EPA, Chesapeake Bay Program, Chesapeake Assessment Scenario Tool, accessible at cast.chesapeakebay.net

proposed funding, and unable to comment on (1) whether those projects *could* mitigate the downstream impacts of the Dam; or (2) whether the amount of the mitigation funding would be sufficient to do so. Again, these provisions are not supported by substantial evidence on the record, making it impossible for the Commission, or the public, to evaluate whether the provisions are adequately mitigating the impact of the Conowingo Dam on downstream water quality. Indeed, the financial terms are belied by the record, and the initial determination to issue a Water Quality Certificate with a mitigation fund at approximately one-and-one-half orders of magnitude greater than that stated in the Settlement Offer.

Finally, prior decisions make clear that the Commission is "troubled by settlements which require measures, such as general funds to be used for unspecified measures, that are *not tied to either project impacts or purposes*."[43] Conowingo Dam presents known water quality issues – the Dam now discharges more pollution into the Bay as storm intensity increases,[44] and will, during the license term, begin producing more pollution than is entering its pool.[45] *Nothing* in the Settlement Offer addresses the water quality impacts of the Conowingo Dam with any specificity, and the water quality provisions are all addressed in off-license provisions. This means that if approved, Exelon will have a license to operate a hydroelectric dam with documented downstream water quality impacts, for 50 years, without ever having to address these impacts. The Commission should not approve such a settlement or grant such a license.

It is not legally sufficient for the State of Maryland and Exelon to only address these water quality impacts through vague provisions in the off-license section of the Settlement Offer. The Federal Power Act requires the Commission to give equal consideration to the

[43] *Virginia Electric Power Company*, 110 FERC ¶ 61,241 at P11.
[44] Lower Susquehanna River Watershed Assessment, *supra* n. 12 and n. 13.
[45] See Bhat, et al. n. 14.

environmental impacts of a hydropower project before licensing it. If the Commission issues a license for the Project with the License Articles as proposed by the State of Maryland and Exelon, the Commission will not have given equal consideration to the water quality impacts of the Conowingo Dam because those terms are expressly missing from the license. Equally troubling is the fact that the off-license provisions of the Agreement exist solely as contract terms between Exelon and Maryland and would not be made a part of the License Articles as currently proposed. As a result, the Commission has no authority to enforce those terms as a condition of the Project's operation. Downstream citizens are similarly hamstrung since the State of Maryland has proposed to waive its water quality certification authority and is requesting the Commission to issue a license with no specific and measurable provisions to address water quality.

As stated above, the limitations and requirements of a section 401 water quality certification shall become conditions on any federally licensed project.[46] The Commission's own regulations make such conditions enforceable by the public, in providing that "[a]ny person may file a complaint seeking Commission action against any other person alleged to be in contravention or violation of any statute, rule, order, or other law administered by the Commission, or for any other alleged wrong over which the Commission may have jurisdiction."[47] Under the terms of the Settlement Offer and Agreement, however, many of Exelon's commitments would not become components conditions of the License for the Project, and would not be enforceable by citizens affected by its operation. As established by the evidence in the record, the operation of the Dam significantly affects downstream water quality,

[46] 33 U.S.C. § 1341(d).
[47] 18 C.F.R. § 385.206.

and this must be acknowledged and addressed in the terms of the Settlement Offer, Agreement, and License to operate the Project.

## II. CONTESTED ISSUES OF FACT RELATED TO THE SETTLEMENT OFFER.

CBF contests the Settlement Offer as there is a genuine issue of material fact related to the downstream water quality impacts of the operation of the Conowingo Dam. Heavy rainfall events lead to scour events where pollutants are released from behind the Dam.

As noted earlier, modeling estimates of the effects of climate change by scientists at the Chesapeake Bay Program show that by 2050, Conowingo Dam will be releasing more pollutants than the pollutants coming downstream from various sources further up the Susquehanna River. Model estimates indicate that at that point, sediment, phosphorus, and nitrogen outputs are greater than inputs – by approximately 9%, 15%, and 5% respectively.[48] Nothing in the Settlement Offer addresses those water quality impacts, therefore the Commission should reject its terms.

The LSRWA evaluated the impact of scoured sediment and nutrients on downstream water quality, and concluded that the nutrients associated with scoured sediments from behind Conowingo Dam cause impacts to the upper Chesapeake Bay ecosystem, as the nutrients become biologically available and lead to lower dissolved oxygen.[49] The study concluded that the "concentration of dissolved oxygen (DO) available to the Bay's aquatic life is *diminished by Conowingo Reservoir scour events*."[50] A more recent study synthesized insights from field observations and additional modeling conducted to evaluate the potential impacts of the infilling

[48] *See supra* Figure 1

[49] Lower Susquehanna River Watershed Assessment at 158.

[50] *Id.* (emphasis added).

of Conowingo Dam on downstream waters and reaffirmed the effects of scour on downstream water quality.[51] For example, bottom sediments scoured to a depth of 10 cm would result in a contribution of half of the total phosphorus load delivered during Tropical Storm Lee and 12% of the total nitrogen input. The study authors also acknowledge the impacts of this scour on downstream dissolved oxygen standards. Nothing in the Settlement Offer acknowledges this impact or aims to address the impact of scour events on downstream water quality.

The LSRWA also evaluated the percentage of scoured material that enters the Bay after large storm events. This study concluded that approximately 20% of the sediment load entering the Bay during Tropical Storm Lee was scoured sediment from behind the Dam.[52] The study modelled the scour contribution for large storm events—up to 800,000 cubic feet per second of water flowing through the dam—and determined that the average contribution of sediment from scour was 30%.[53] The study indicated that "as flow increases the bed sediment scour load becomes an increasingly higher proportion of the total sediment load."[54] This means that as the region experiences bigger storms, which will occur due to climate change, the percentage of sediment scoured from behind the Conowingo Dam will increase, and the nutrients associated with that sediment will decrease downstream dissolved oxygen. Again, the Settlement Offer does not address this impact in the proposed License Articles. What scant measures are proposed for water quality impacts are not sufficiently tied to the Project impacts for the Commission to conclude that the proposals will in fact mitigate the impacts to downstream dissolved oxygen

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[51] Palinka, Cindy, J. Testa, J. Cornwell, M. Li, and L. Sanford, *Influences of a River Dam on Delivery and Fate of Sediments and Particulate Nutrients to the Adjacent Estuary: Case Study of Conowingo Dam and the Chesapeake Bay* (Nov. 5, 2019).
[52] Lower Susquehanna River Watershed Assessment at 79.
[53] *Id.* at 78.
[54] *Id.*

caused by scour events. Additionally, as discussed above, during the term of the License, the Conowingo Dam will itself become a source of pollutants due to climate change.[55] None of these reasonably foreseeable water quality impacts are addressed in the Settlement Offer. All of this evidence creates a significant issue of material fact that not addressed in the terms of the Settlement Offer.

**CONCLUSION**

For all the foregoing reasons, CBF urges the Commission to reject the proposed Settlement Offer and convene a technical conference pursuant to Rule of Practice and Procedure 601, 18 C.F.R. § 385.601, or such other appropriate evidentiary hearing or proceeding necessary to address the disputed or unresolved issues identified herein.

Respectfully submitted,

*/s/ Paul W. Smail*
Paul W. Smail
Brittany E. Wright
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Dated: January 17, 2020

*Counsel for Chesapeake Bay Foundation, Inc.*

[55] Bhatt, et al., *supra*.

## CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document by electronic mail, or by first-class mail if no e-mail address is provided, upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated: January 17, 2020

*/s/ Paul W. Smail*
Paul W. Smail
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# EXHIBIT A

**Chesapeake Bay Foundation Comments on Conowingo Dam**
**Water Quality Certification, Application #17-WQC-02**
**August 23, 2017**

CHESAPEAKE BAY FOUNDATION
*Saving a National Treasure*



Via electronic and first class mail

August 23, 2017

Elder Ghigiarelli, Jr.
Deputy Program Administrator, Wetlands and Waterways Program
Water management Administration,
Maryland Department of the Environment
1800 Washington Boulevard, Suite 430, Baltimore, MD 21230
elder.ghigiarelli@maryland.gov.

**Re: <u>Application #17-WQC-02, Lower Susquehanna River and Upper Chesapeake Bay, Use I & 2 Waters</u>**

**Dear Mr. Ghigiarelli,**

Chesapeake Bay Foundation provides these comments in response to the Maryland Department of the Environment's Public Notice of the Proposed Relicensing of the Conowingo Hydroelectric Project Application for Water Quality Certification (Notice) issued on July 10, 2017. CBF represents over 200,000 members throughout the watershed interested and directly affected by the decision to grant water quality certification to Exelon for a project that will persist over the next 50 years or more. Moreover, we conduct environmental education programs in the Lower Susquehanna and Susquehanna Flats regions, support advocacy and on the ground restoration projects designed to enhance water clarity to the Susquehanna Flats that contribute to the persistence and expansion of submerged aquatic vegetation, a crucial habitat for the bay's blue crabs and many other species.

Thank you for the opportunity to comment on the application for a Water Quality Certification ("WQC") under Section 401(a)(1) of the Clean Water Act for the Conowingo Hydroelectric Project, FERC Project Number 405 ("Conowingo Dam" or "the Dam"). The Chesapeake Bay Foundation (CBF) is committed to fully implementing the Chesapeake Bay Total Maximum Daily Load ("TMDL"), or the Chesapeake Bay Blueprint, to reduce pollution levels by 25 percent for nitrogen, 24 percent for phosphorus, and 20 percent in sediment pollution, Bay-wide[1] by 2025 to make the Bay once more a productive estuary safe for swimming and fishing. This effort requires all six states in the Bay watershed, as well as the District of Columbia, to reduce pollution from every source. CBF recognizes that the Conowingo Dam has played a crucial role in curtailing the sediment pollution that travels down the Susquehanna River and eventually reaches the Bay. However, over time, the Dam's ability to trap pollution has diminished due to sediment build up behind the dam. As discussed below, studies have also shown that the Dam itself has the ability to impact water quality. Therefore, the state of Maryland must ensure that impacts of Conowingo Dam's

[1] U.S Environmental Protection Agency, CHESAPEAKE BAY TMDL, ES-1 (Dec. 2010), *available at* https://www.epa.gov/sites/production/files/2014-12/documents/bay_tmdl_executive_summary_final_12.29.10_final_1.pdf

operations on downstream water quality are addressed and mitigated as part of the new operating permit. This is why CBF has formally intervened as a party to the Federal Energy Regulatory Commission (FERC) relicensing of the Dam, and submits the following comments regarding the impacts of the Dam on Maryland's water quality. CBF also requests inclusion on the "interested persons" and "service" lists to receive timely notice of all applications, public notices, information and studies, and decisions regarding the Conowingo Dam.

We have focused our comments on the WQC on effects relative to achievement of the water quality standards (i.e., dissolved oxygen, water clarity, chlorophyll a) associated with the Chesapeake Bay TMDL for nutrients and sediment.[2] We defer the general scientific basis for defining project Project impacts from flow regulation, impeding fish passage and trapping coarse sands and gravel on from flow regulation, impeding fish passage and trapping coarse sands and gravels on habitat and designated uses incorporating by reference the more detailed discussion submitted by The Nature Conservancy.

Under the Clean Water Act and applicable Maryland state laws and regulations, a federal permit or license to conduct any activity that may result in any discharge to navigable waters may not be issued unless the state certifies that the activity does not violate State water quality standards or limitations.[3] It is fully within the state's authority to impose more stringent water quality standards than those set by the federal Act,[4] and any WQC must comply with all applicable provisions of the Clean Water Act, including the provisions governing TMDLs.[5] Finally, it is well-established that the alteration of water, including the alteration of movement, flow, circulation, or chemical composition, is included in the Clean Water Act's definition of pollution and is within a State's legitimate interests when considering a WQC.[6] To that end, we disagree with Exelon's contention that the Conowingo project, as proposed, is consistent with applicable Maryland Water Quality Standards. While it is true that the origin of the sediment and nutrients from behind the Dam is mostly from upstream of Conowingo, the Dam does alter the form of these sediments and nutrients and the timing by which they enter the Chesapeake Bay.[7] [8] For example, the Dam changes the grain

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[2] https://www.epa.gov/chesapeake-bay-tmdl
[3] 33 USCS §1341; COMAR 26.08.02.10.
[4] 33 USCS §1370.
[5] 33 USCS 1341(1)(a) requiring a WQC to ensure any discharge "will comply with the applicable provisions of sections 301, 302, 303 [TMDLs], 306, and 307 of this Act…"
[6] *See, e.g., S.D. Warren Co. v. Maine Board of Environmental Protection,* 547 US 370 (2006) (finding that a dam's alteration of water movement and flow fell under the Clean Water Act's definitions of pollution and discharge).
[7] Lawrence P. Sanford, Stephanie Barletta, UNCES Horn Point Laboratory, Cambridge, MD, Grace Massey, Kelsey Fall, Virginia Institute of Marine Science, Gloucester Point, VA. The Impacts of Conowingo Particulates on the Chesapeake Bay: Suspended Particle Size, Settling and Transport. UMCES Contribution TS-705-17. Final Report to Exelon Generation and Gomez and Sullivan, July 2017.
[8] Cornwell, J., M. Owens, H. Perez, and Z. Vulgaropulos. 2017. The Impact of Conowingo Particulates on the Chesapeake Bay: Assessing the Biogeochemistry of Nitrogen and Phosphorus in

size profile of downstream sediments, preferentially passing finer sediments that tend to stay in suspension longer, with potential negative effects on downstream water clarity and underwater grasses. Coarser materials are preferentially retained by the Dam, again with negative downstream impacts as these materials are needed to build and protect desirable habitats, like islands and shorelines, for fish spawning and rearing, mussels and Submerged Aquatic Vegetation, for fish spawning and rearing, mussels and Submerged Aquatic Vegetation. In addition, scouring events caused by high flows mean more nutrients and sediments will flow downstream than are attributed to upstream sources. These are all incremental impacts directly, indirectly, or cumulatively caused by Conowingo Dam's impoundment and artificial release of the Susquehanna River.

Of particular relevance to the WQC are the findings of the Lower Susquehanna River Watershed Assessment[9] (LSRWA). The LSRWA evaluated the impact of scouring events on downstream water quality, namely additional loads of nutrients, as well as effects on dissolved oxygen (DO), water clarity, and chlorophyll a concentrations. These findings were reviewed and confirmed at a more recent workshop sponsored by the Chesapeake Bay Program Scientific and Technical Advisory Committee. [10] As detailed below, modeling results indicate detectable negative effects on these water quality parameters and these effects are more severe if the scour event occurs during the summer. Results also suggest that nutrients from scour events deposit downstream and may contribute to negative water quality impacts for years, though these effects diminish over time.

The study included the coupling of multi-dimensional hydrodynamic and eutrophication models that included estimates of sediment transport for multiple grain sizes and of diagenetic processes in bottom sediments. Both of these features were deemed important in estimating the effect of reservoir scour on downstream water quality. These models were used to run several different scenarios; probably the most relevant to downstream impacts are scenarios 4 through 6 (see Table 4-9 in the Lower Susquehanna River Watershed Assessment report).

Scenario 4 assumed that the Watershed Implementation Plans (WIPs) were not in effect, the reservoirs had all reached dynamic equilibrium and there is a winter scour event. Results of this scenario indicated a scour event would add 7,800 tons of particulate (organic) nitrogen and 2,600 tons of particulate phosphorus, in addition to watershed loads, over a 4-day period.

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Reservoirs and the Chesapeake Bay. UMCES Contribution TS-703-17. Final Report to Exelon Generation and Gomez and Sullivan. July 28, 2017.

[9] Lower Susquehanna River Watershed Assessment, Maryland and Pennsylvania, May 2015 Final. Found at: http://dnr.maryland.gov/waters/bay/Pages/LSRWA/Final-Report.aspx

[10] Linker, L., R. Hirsch, W. Ball, J. Testa, K. Boomer, C. Cerco, L. Sanford, J. Cornwell, L. Currey, C. Friedrichs, R. Dixon. 2016. Conowingo Reservoir Infill and Its Influence on Chesapeake Bay Water Quality. STAC Publication Number 16-004, Edgewater, MD. 51 pp. Found at: http://www.chesapeake.org/pubs/356_Linker2016.pdf

Scenario 5 assumed the WIPs are in full effect, the reservoirs have reached dynamic equilibrium and there is a winter scour event. Additional loads were estimated to be the same as Scenario 4, indicating the amount scoured is not affected by WIP implementation.

Scenario 6 assumes the WIPs are in full effect, the reservoirs are trapping at current condition and there is a scour event that occurs during summer, fall or winter. Additional loads of phosphorus and nitrogen were estimated to be as high as 14,300 tons of nitrogen and 3,180 tons of phosphorus, but these include watershed and scour loads.

It should be noted the additional loads associated with lost capacity and increased scouring are not quantified or offset by any sector under the Chesapeake Bay Blueprint[11] The applicant for the WQC should be held responsible for mitigating loads associated with these scour events, as again, they are proximately caused by the Dam's operation itself.

The water quality effects of these scour events, including effects on water quality standards attainment were also quantified. Scenarios 4 – 6 all indicated increased chlorophyll a concentrations downstream as well as decreases in water clarity. A June storm event had the most impact on water quality, stimulating higher chlorophyll concentrations and decreases in water clarity that extended up to 37 miles downstream of the dam and persisting throughout the summer.
In terms of attainment of the dissolved oxygen standards, the study examined, for each of the 92 TMDL segments and applicable water quality standard, the percent of time and volume that a given water quality criterion (i.e., DO, chlorophyll, water clarity) was outside an allowed exceedance. Attaining DO standards in the volume-time integral represented by deep-channel water from June to September is a main driver of the Bay TMDL.

Scenario 4 indicates that a reservoir scour event occurring in the winter places an additional 1 percent of the volume-time integral outside of DO standards in segments CB4MH (in the mainstem of the Bay) and PATMH (the mesohaline part of the Patapsco River). Scenario 5 indicates an increase of 1% nonattainment in segments CB4MH, EASMH (the Eastern Bay), and CHSMH (the lower part of the Chester River). Scenario 6 indicated that a June high-flow storm event has the most detrimental influence on deep channel DO followed by a storm of the same magnitude in January, and then October. The June event scenario had an estimated increase in deep-channel DO nonattainment of 1%, 4%, 8%, and 3% in segments CB3MH (in the mainstem of the Bay, north of CB4MH), CB4MH, CHSMH, and EASMH, respectively when compared to the No Storm Scenario. The January storm condition had an estimated increase in deep-channel DO nonattainment of 1%, 1%, 2%, and 2% in segments CB3MH, CB4MH, CHSMH, and EASMH, respectively, when compared to the No Storm Scenario.

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[11] U.S. Environmental Protection Agency Chesapeake Bay Program Office, *Lower Susquehanna River Assessment Appendix D: Estimated Influence of Conowingo Infill on the Chesapeake Bay Water Quality*. Spetember 25, 2014. Page 31-32 (finding that TMDL allocations may need adjustment when Conowingo Dam is found to have reached dynamic equilibrium, and identifying further research and analysis needs in order to "advance considerably the understanding of the influence Conowingo Reservoir infill has on Chesapeake water quality").

For the October high-flow event, the estimated deep-channel DO saw increased nonattainment of 2% and 1% in CHSMH and SEVMH (Severn River), respectively, compared to the No Storm Scenario.
Although these percentages may seem small, Clean Water Act regulatory requirements prohibit any increase in nutrient loads that causes diminishment of water quality standard achievement.[12]

More recently, Exelon agreed to fund additional studies at the request of the State of Maryland that, among other things, would lead to better understanding of the form, fate, and effects of nutrients that are scoured from behind the Dam. These studies, conducted by the University of Maryland Center for Environmental Studies (UMCES), were to be used in conjunction with those from the LSRWA to determine the extent and magnitude of downstream water quality impacts. Final reports from these studies were not available for stakeholders to review when the Department initiated public comment for the water quality certification process.

CBF requested an extension to the public comment period based on the missing information, and the UMCES studies were released on July 28, 2017 within the extended comment period. Of particular relevance is the work by Cornwell et al. [13] One key finding is that much of the phosphorus released during scour is, initially, in a form that is not bioavailable (due to binding with iron). However, some particles do settle in the mid-Bay and others will eventually be transported there. Under conditions in the mid-Bay, particularly anoxia, this phosphorus can become available for uptake by phytoplankton and, therefore, can contribute to eutrophic conditions, including depressed DO.

An unexpected result from Cornwell et al. 2017 is the finding of a substantial amount of adsorbed ammonium in sediments in the Conowingo Pond, at concentrations exceeding those in similar sediments downstream. This ammonia could be mobilized during scour events (or during dredging) adding nitrogen loads to downstream waters. Both these findings regarding increased mobilization of nutrients during scour events affirm the findings of the LSRWA study regarding increases in the nonattainment of the DO standard in some segments downstream.

The Maryland Department of the Environment (MDE) should include these findings in their water quality certification. Specifically, we recommend that additional modeling scenarios, similar to those conducted as part of the LSRWA study, be run with the new information from the UMCES study about the fate, transport, form, and concentrations of nutrients and sediments from the Conowingo Reservoir, to assess the impact on water quality standards attainment. In addition, we believe MDE should also consider projected effects of climate

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[12] 40 CFR §122.4.

[13] Cornwell, J., M. Owens, H. Perez, and Z. Vulgaropulos. 2017. The Impact of Conowingo Particulates on the Chesapeake Bay: Assessing the Biogeochemistry of Nitrogen and Phosphorus in Reservoirs and the Chesapeake Bay. UMCES Contribution TS-703-17. Final Report to Exelon Generation and Gomez and Sullivan. July 28, 2017.

change on the water quality response, given the long-term duration of the permit. Of particular interest is the projected increase in the frequency and intensity of storms, as these will mean more scour events, and higher temperatures that could affect DO. [14] The Chesapeake Bay Program is currently working to include climate change into its models and MDE could leverage this ongoing work for this evaluation. The scenarios should include critical conditions such as severe storms during the summer as this is when impacts are likely to be the greatest. The uncertainties of impact noted above are surely sufficient to seek adequate scientific resolution prior to issuing a WQC, and the studies sought are reasonably implemented modeling runs, not the multi-year work of the previous research.
In its application, Exelon does not propose any mitigation for its downstream water quality impacts. They cite the LSRWA findings, but ignore those that specifically address impacts to downstream water quality. As described above, operation of the Conowingo Dam alters the form of nutrients and the timing by which they enter the Chesapeake Bay and these changes cause incremental effects on DO and the achievement of water quality standards. Consequently, appropriate mitigation measures should be required as a condition for a new license to Exelon for the operation at Conowingo Dam in order to provide reasonable protection to Maryland waters.

As part of the WQC process under the Clean Water Act, Maryland is responsible for setting forth any effluent limitations or any other conditions or limitations and monitoring requirements that may be necessary to assure compliance with the Act and the Chesapeake Bay TMDL.[15] Federal regulations explicitly prohibit issuing such certifications where the conditions of the permit do not provide for compliance with water quality standards or where conditions cannot ensure compliance with applicable water quality requirements of affected states.[16] As has been demonstrated, scour events result in violation of downstream water standards and the WQC must ensure that there are sufficient offsets to mitigate these impacts.

These measures could include financial assistance for nutrient reduction projects upstream of the Dam, in Maryland, Pennsylvania, and New York such as agricultural practices, wastewater treatment plant upgrades, green infrastructure, and restoration of the system's "natural filters" such as propagation of freshwater mussels in fresh water and oyster restoration downstream. Such mitigation efforts should result in pollution reductions that are

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[14] Johnson, Z., M. Bennett, L. Linker, S. Julius, R. Najjar, M. Mitchell, D. Montali, R. Dixon. 2016. The Development of Climate Projections for Use in Chesapeake Bay Program Assessments. STAC Publication Number 16-006, Edgewater, MD 52 pp. Available here: http://www.chesapeake.org/pubs/360_Johnson2016.pdf

[15] 33 USCS §1341(d) ("Any certification provided under this section shall set forth any effluent limitations and other limitations, and monitoring requirements necessary to assure that any applicant for a Federal license or permit will comply with any applicable effluent limitations and other limitations, under section 301 or 302 of this Act [33 USCS § 1311 or 1312], standard of performance under section 306 of this Act [33 USCS § 1316], or prohibition, effluent standard, or pretreatment standard under section 307 of this Act [33 USCS § 1317], and with any other appropriate requirement of State law set forth in such certification, and shall become a condition on any Federal license or permit subject to the provisions of this section").

[16] 40 CFR §122.4.

equivalent to the maximum amounts of nutrients estimated to be associated with sediments scoured from behind the Dam and any additional pollution produced as a result of the Dam's presence and operation. CBF remains skeptical of dredging as a viable option to mitigate these water quality impacts, but if this activity is pursued, MDE must consider the potential water quality effects of adsorbed ammonia in Conowingo Pond that would be released during dredging. [17]

Finally, CBF realizes that a public hearing will be held as part of the water quality certification process. We feel that incorporating the findings of the UMCES study and suggested additional model runs should occur prior to such a hearing and that the Department should propose a draft water quality certification for public review that incorporates appropriate mitigation measures to offset the additional nutrient loads, prior to, and to be discussed at that hearing.

Again, we thank you for the opportunity to comment on this important state action.

Sincerely,

Sincerely,

Alison Prost
Maryland Executive Director

[17] Cornwell, J., M. Owens, H. Perez, and Z. Vulgaropulos. 2017. The Impact of Conowingo Particulates on the Chesapeake Bay: Assessing the Biogeochemistry of Nitrogen and Phosphorus in Reservoirs and the Chesapeake Bay. UMCES Contribution TS-703-17. Final Report to Exelon Generation and Gomez and Sullivan. July 28, 2017.

# EXHIBIT B

**Chesapeake Bay Foundation Comments on Conowingo Dam Water Quality Certification, Application #17-WQC-02**
**January 16, 2018**

CHESAPEAKE BAY FOUNDATION
*Saving a National Treasure*



January 16, 2018

Elder Ghigiarelli, Jr.
Deputy Program Administrator, Wetlands and Waterways Program
Water management Administration,
Maryland Department of the Environment
1800 Washington Boulevard, Suite 430, Baltimore, MD 21230

VIA Email: elder.ghigiarelli@maryland.gov

**Re: Application #17-WQC-02, Lower Susquehanna River and Upper Chesapeake Bay, Use I & 2 Waters**

**Dear Mr. Ghigiarelli,**

Thank you again for the opportunity to provide comments on the above-referenced Water Quality Certification (WQC) application. Please refer to our initial letter dated August 23, 2017 and oral comments of Chesapeake Bay Foundation Maryland Executive Director Alison Prost made during the public hearing on December 5, 2017 as a basis for this supplemental written comment.

Conowingo Dam and the deep pond created by the dam, change the form and timing of pollutant discharges to downstream waters including the Lower Susquehanna River and Chesapeake Bay mainstem [1]. Therefore, the Chesapeake Bay Foundation believes the dam's continued operation is itself directly and proximately responsible for some of the pollution coming through the Dam – especially that which occurs during high-flow storm and scour events – and that these additional loads contribute to the violation of downstream water quality standards.

Furthermore, though we recognize that the Conowingo Dam has, historically, played a role in reducing the sediment and associated nutrients from the Susquehanna River that reach the Bay – some have called it the "Bay's biggest best management practice (BMP)"- we also note that the accumulating sediments and associated nutrients that reached the Conowingo Reservoir were not managed by Exelon. Because of Exelon's failure to address sediment accumulation, the Bay jurisdictions are faced with needing to reduce additional pollutant loads to achieve the sediment, phosphorus and nitrogen allocations of the Chesapeake Bay Total Maximum Daily Load (TMDL).

**Negative Effects on Attainment of Downstream Water Quality Standards Must be Mitigated**
The most recent estimates of the additional load reductions that are needed to achieve downstream water quality standards and account for the lost trapping capacity of Conowingo, that includes the effect of scouring events, is roughly 6 million pounds of nitrogen and 0.26 pounds of phosphorus. [2] Exelon needs to play a role in achieving these additional reductions.

[1] Linker, L., R. Hirsch, W. Ball, J. Testa, K. Boomer, C. Cerco, L. Sanford, J. Cornwell, L. Currey, C. Friedrichs, R. Dixon. 2016. Conowingo Reservoir Infill and Its Influence on Chesapeake Bay Water Quality. STAC Publication Number 16-004, Edgewater, MD. 51 pp. Found at: http://www.chesapeake.org/pubs/356_Linker2016.pdf

[2] https://www.chesapeakebay.net/channel_files/25782/wqgit_dec_4-5_2017_mpa_policy_decisions_briefing_presentation_story_board-12.3.17_jsadd.pdf slide 351

As detailed in our August 23, 2017 letter, the Lower Susquehanna River Watershed Assessment (LSRWA) study[3] evaluated the impact of scouring events on downstream water quality including effects on attainment of the dissolved oxygen (DO) water quality standard. Results indicate scour events cause increases in non-attainment of the DO standards in some downstream segments. For example, a scour event occurring in June had an estimated increase in deep-channel DO nonattainment of 1%, 4%, 8%, and 3% in segments CB3MH, CB4MH, CHSMH, and EASMH, respectively when compared to the No Storm Scenario. Results also suggest that nutrients from scour events deposit downstream and may contribute to negative water quality impacts for years.

As part of the WQC process under the Clean Water Act, Maryland is responsible for setting forth any effluent limitations or any other conditions or limitations and monitoring requirements that may be necessary to assure compliance with the Act and the Chesapeake Bay TMDL. As has been demonstrated, scour events result in violation of downstream water standards and the WQC must ensure that there are sufficient pollutant offsets to mitigate these impacts. **Therefore, Exelon should be held responsible for their contribution to the impacts on downstream water quality**.

Consequently, we recommend that MDE run scenarios similar to those that were conducted as part of the LSRWA study, but with the Phase 6 model. In addition, given the long-term duration of the proposed permit, we recommend these scenarios consider the effects of climate change that includes increases in the size of storm events and the frequency of their occurrence, both of which will lead to increased pollution and more scour events. The Chesapeake Bay Program has quantitative estimates for expected effects of climate change by 2050. These input parameters should be used in the updated modeling scenarios.

With these results in hand, we recommend the following approach to estimate the amount of phosphorus and nitrogen load reductions necessary to mitigate for these impacts. We caution, however, that the numbers used below are for illustrative purposes since they are based on the "old" Chesapeake Watershed Model (Phase 5.3.2), not the "newer" version (Phase 6) that includes many refinements, including updated modeling inputs for the Conowingo. As noted above, increases in non-attainment due to scour events range from 1% - 8%. The LSRWA estimated that to offset a 1 percent increase in Deep-Channel DO nonattainment would require a reduction of about 2.4 million pounds of nitrogen and 0.27 million pounds of phosphorus (p.95). So, for example, to offset a 4% increase in nonattainment in CB4MH would require nitrogen (N) reduction of 9.6 million pounds and 1.08 million pounds of phosphorus (P). These load reductions, however, are not solely Exelon's responsibility as they result from nutrients that originate upstream of the Dam during storms as well as those that are scoured from behind the Dam.

Results of the LSRWA (p. 79) indicate that, on average, scoured loads of sediments represented about 20% of the total loads that enter the Bay from storm events. We note that this proportion is likely conservative. This percentage increases with the size of the storm and more severe storms are likely in the future due to climate change. In addition, a study by the Lower Susquehanna Riverkeeper suggested that scour may have been underestimated by the LSRWA study.[4]

Under this scenario, Exelon would be responsible for achieving 20% of the 9.6 million pounds of N or **2.4 million pounds** and 20% of the 1.08 million pounds of P or **0.27 million pounds**. Again, these numbers are for illustration, but represent a logical, scientifically-based approach for estimating mitigation requirements for Exelon.

The most efficient and permanent practices are those that plant trees because of the land conversion factor and permanence on the landscape once complete. If impervious surfaces are converted to forest, the most

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[3] Lower Susquehanna River Watershed Assessment, Maryland and Pennsylvania, May 2015 Final. Found at: http://dnr.maryland.gov/waters/bay/Pages/LSRWA/Final-Report.aspx

[4] LSRWA Modeling Review Final Report, Prepared for Earth Justice and Lower Susquehanna Riverkeeper by Paul Frank, P.E., August 25, 2017

efficient load reduction, then 207,253 acres would be needed for nitrogen and 148,351 acres for phosphorus. While less efficient, there's more opportunity to convert turf or highly erodible ag lands to forest. That scenario would require 287,735 acres for the nitrogen offset and 613,636 acres for the phosphorus offset. Using these two scenarios and the BMP cost per acre range of these practices from $150 to $300 per acre as reasonable boundaries for cost, the total offset would range between $22.2 Million and $184 Million. These calculations are derived from two Chesapeake Bay Program Draft reports and current Chesapeake Assessment Scenario Tool (CAST) BMP cost spreadsheets.[5]

If these land conversions are made early in the license term, the benefits will propagate through time as annual load reductions. Conversely, if offset contributions were applied to annual practices such as cover crops, the load reduction efficiency is much less and the benefit will cease at the end of the license term. CBF would discourage a cost-based offset approach that does not take permanence of load reduction into account.

A Chesapeake Stormwater Network report [6] is instructive for looking at opportunity. The top 4 counties in turf acreage in Pennsylvania (Lancaster, York, Dauphin and Luzerne) contain 350,413 acres of turf. If we are to consider that certain counties in Maryland also contribute loads to CB4MH and adjacent segments, we could include an additional 306,621 acres of opportunity from Harford, Baltimore and Anne Arundel Counties. Of course, the phasing of payments into an account for these BMPs and application of optimization tools for N and P effectiveness should also be encouraged.

CBF suggests an appropriate mechanism to manage the mitigation contribution of Exelon to the Chesapeake Bay Program Partnership effort and its distribution should be through a special account held for this purpose. This would allow the leveraging of additional private and public investments to offset loads attributed to the Conowingo Dam infill and lost capacity estimated by the Phase 6 Chesapeake Bay Model[7]. CBF would prefer that disbursements to this account be made annually through the timeframe of any approved Chesapeake Bay Partnership plan to address additional reductions due to Conowingo Dam infill.

At this time, given the extreme costs, risk of resuspension of adsorbed ammonia and limited utility in replacing lost sediment storage capacity, CBF is not recommending dredging of the Conowingo pond as a mitigation measure. Perhaps within an adaptive management framework as discussed below, the technology and markets will in the future be developed sufficiently for an innovative or beneficial use of dredged sediments from the pond to be cost-effective while protecting downstream water quality, but that is yet to be determined. In addition, the lack of a remedy for bypassing beneficial coarse sediment identified by some stakeholders is likely contributing to habitat degradation in the segment downstream of the dam to the mouth of the river. Future iterations of a sediment management plan that might include dredging of a sediment trap at the appropriate location within the reservoir should take into account the

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[5] Urban Tree Canopy Expansion and Urban Forestry Planting BMPs, DRAFT Fact Sheet, Chesapeake Bay Program
https://www.chesapeakebay.net/channel_files/23644/attach_c._utc_fact_sheet_draft_for_feedback.pdf

A Guide for Forestry Practices in the Chesapeake TMDL Phase III WIPs, Prepared by the Forestry Workgroup, Chesapeake Bay Program Office, DRAFT July 31, 2017
https://www.chesapeakebay.net/channel_files/24878/draft_forestry_bmp_info_packet_for_wip_iii.pdf

[6] The Grass Crop of the Chesapeake Bay Watershed, Technical Bulleting #8: The Clipping Point, Chesapeake Stormwater Network, April 1, 2010
http://chesapeakestormwater.net/2009/06/the-grass-crop-of-the-chesapeake-bay-watershed/

[7] Allocation of Conowingo Infil Nutrient and Sediment Loads: Comparing Cost Effectiveness in Different Phosphorus Load Allocation Scenarios Among Jurisdictional Partners, Chesapeake Bay Program, Revised 6/27/17
https://www.chesapeakebay.net/channel_files/24809/conowingocostofphosreductions_20170622_2.pdf

potential for separation and beneficial use of coarse sediments downstream, rather than sediments being sold for commercial purposes.

**Downstream Beneficial Uses Need to be restored**

As outlined by our Nature Conservancy colleagues, the Susquehanna River Basin Commission (SRBC), and others, Conowingo Dam's daily peaking operations have had a significant and unmitigated impact on the ecosystem of the lower River and Upper Chesapeake Bay. Modifying current operations to restore habitat quality and availability below the dam will be necessary to achieve designated uses under the requested license term. Dam operations impact aquatic resources of the non-tidal and tidal segments of the river[8] and impacts may extend as far south as oyster aquaculture operations near Rock Hall.[9]

MDE must consider requiring Exelon to modify existing operations to provide meaningful restoration to downstream aquatic habitat for diadromous and resident fish, bivalves, macroinvertebrates, submerged aquatic vegetation and water quality. As documented in biological surveys and hydraulic habitat models, these communities are currently in fair to poor condition, or absent, below Conowingo Dam. CBF supports the proposed initial flow schedule shared by TNC and SRBC and an adaptive management plan, to manage flows to accommodate the myriad of designated uses of downstream segments and the economies on which they depend. To that end, CBF incorporates by reference the comments submitted by TNC to the extent they do not conflict with our own.

Evidence from TNC and CBF's submitted economic study by E3 suggest both the aforementioned nutrient load mitigation and operational changes are financially feasible while still maintaining profitability for Exelon.

**Economic Study**

An analysis was conducted by Energy + Environmental Economics, Inc. (E3) to estimate the range of market revenues for Conowingo Hydroelectric Dam, assuming it remains a merchant generator in the Mid-Atlantic electricity market, in order to inform how much economic "headroom" (i.e. "excess" profits available after a reasonable return on investment) exist to mitigate the Dam's incremental environmental and ecological impacts on the Bay.[10] A copy of the study is attached to this comment letter.

For its analysis, E3 used publicly available information, including: historical river flows and monthly Conowingo generation data (the latter from SNL Energy); historic hourly flow and monthly generation data for a representative base case, and two additional operational/hourly flow scenarios from the Susquehanna River Basin Commission; market and price data from regional electricity transmission organization PJM; and financial information (market revenues and projections of capital and operating costs for Conowingo) from Exelon's 2011 and 2013 Conowingo relicensing filings with the Federal Energy Regulatory Commission.

To arrive at an unlevered internal rate of return (IRR), E3 researched fully merchant projects, and chose 10 percent as a reasonable target IRR, within a range shown from independent power producers. E3 examined average seasonal prices and dispatch for the dam, and the differences among the scenarios for

[8] The Nature Conservancy's August 23rd letter and associated filings.

[9] Since the public hearing, CBF has learned that freshwater flows from dam operations may even create prolonged freshets which could impair the designated uses of EASMH for oyster aquaculture operations as far south as Rock Hall (Scott Budden Orchard Point Oysters, personal communication).

[10] Energy + Environmental Economics, Inc., "An Economic Analysis of the Conowingo Hydroelectric Generating Station," August 2017. It should be noted that some of these calculations are necessarily estimates, as Exelon does not make available proprietary data. In addition, compensation to Exelon through renewable energy markets was not explicitly assessed, although it could add value and revenues. It should also be noted that revenues for the dam have declined in recent years due to the suppression of energy market prices in PJM, and that the dam's total generation does vary significantly from year to year, which can change revenue estimates. Muddy Run's operations and economics were not included in this analysis, as the intent was to focus solely on Conowingo dam's operations and incremental economics.

average hourly prices and output by season. It then calculated total revenues for the base case and the two alternative scenarios and performed a *proforma* analysis to calculate the unlevered IRR and the annual headroom available, with the resulting headroom ranging from a low of $27.1M to a high of $44.1M.

**Draft Conditions**
In light of these recommendations, the WQC should at a minimum include the following or similar conditions:

1) Given the direct and proximate relationship between the operation of Conowingo Dam and deep pool, and the fact that the form and timing of nutrient pollution discharged through the Dam during certain storm events is altered by both residence and scour, and the fact that known accumulating sediments went unmanaged by Exelon for decades, and given that the result is a certain level of nonattainment of specific Maryland water quality standards in some segments of the deep channel below the dam which persist over a period of time, Exelon Corporation shall provide sufficient mitigation for the addition of such pollution. Such mitigation shall generally be accomplished in concert with that being undertaken or contributed to by the Chesapeake Bay Program partnership, as outlined by the Principals' Staff Committee of the Chesapeake Bay Program.[11]
2) An average amount of increase in several Chesapeake Bay downstream segment(s)' nonattainment of dissolved oxygen standards, due to storm events at the dam, should be calculated with the Phase 6 watershed model and include future effects of climate change expected by 2050. Exelon's responsibility for contributing to this nonattainment should be based on up to date estimates of the contribution of scour during storm events to non-attainment. Then as illustrated above this number should be translated to annual pounds of nitrogen and phosphorus and cost estimates to achieve these reductions.
3) Such mitigation shall be annually deposited into an account to be managed and directed by a neutral third-party funds administrator into grants for the purpose of reducing sediment and nutrient inputs into the Susquehanna by upstream land uses such as agriculture. The locations, specific grantees, and best management practices so supported shall be chosen by the fund manager for their benefit/cost-efficiency and relative ease of implementation. The account shall be used to collect and distribute both public sector and private investments to offset pollution loads attributable to the Conowingo Dam infill and lost capacity estimated by the Phase 6 Chesapeake Bay Model.
4) Exelon shall manage flow so as to restore downstream beneficial uses which have been and continue to be heavily impacted by the current highly unnatural flow regime utilized at the dam. Changes required include implementation of the proposed initial flow schedule shared by TNC and SRBC and implementing an adaptive management plan to ensure that operational changes result in meaningful restoration of diadromous fish, mussels, SAV and related aquatic communities and downstream water quality conditions, to achieve designated uses.

A recommended adaptive management condition follows below.

**Adaptive Management Condition**
Since the current FERC operating license will be in place for the next 37 years, and since various conditions are very likely to change over that timeframe (e.g., modeled or monitored pollution flows and downstream impacts, the frequency and severity of adverse weather events due to climate change, changing nutrient and sediment pollution management practices and technologies, data on fish/habitat, and the financials of dam management) this Water Quality Certification should have a mechanism or framework for adaptive management. The following constitutes our outline of that framework.

1) In addition to meeting the WQC's conditions for flow and habitat, fish passage, and water quality, set out in this WQC, financial resources provided as mitigation by Exelon shall also be used to contribute

[11]https://www.chesapeakebay.net/channel_files/25523/draft_conowingo_wip_framework_december_19_to_psc.pdf

to ongoing monitoring and research so that such WQC conditions may be amended, as changes in modeled or monitored pollutant flows, the frequency and severity of adverse weather events due to climate change, and changing nutrient and sediment pollution management practices and technologies occur, and as new information about nutrient changes in the pond, downstream impacts, and healthy fisheries is developed over the life of the operating license.

2) Every seven years until the operating license expires or is reissued for this facility in 2055, there shall be convened by Maryland Department of the Environment (MDE) or its successor agency a combined expert and stakeholder panel to consider the changes in flows, pollution loads, downstream impacts, fish and habitat data, and technology noted above, as such information is collected from monitoring and modeling, or new studies or circumstances provide new relevant operating, financial, environmental, or technical information. A potential turning point for such information may be 2030 to consider the effects of any flow changes affected by other licenses such as Muddy Run upstream. The panel will meet and make recommendations for altering any of the conditions specified in this Certificate according to its best professional judgement.

   The expert and stakeholder panel shall be comprised of such regional NGO, state agency, federal agency, and academic experts, as well as interested stakeholders and Exelon's representatives, with demonstrated expertise and continuing interest in water quality and the Chesapeake Bay Total Maximum Daily Load (TMDL), climate change, best management practices for point and nonpoint source pollution control, fish passage, flow management and habitat, and hydropower management, as MDE shall appoint at each seven-year increment.

3) At each seven-year increment, MDE shall consider the recommendations of the expert and stakeholder panel, and after public notice and hearing, shall make whatever changes to the WQC's conditions it deems necessary and appropriate. Such changes shall be in effect until the next seven-year evaluation.

Again, the Chesapeake Bay Foundation and its 240,0000 members throughout the watershed are depending on a prudent and swift decision on firm water quality certification conditions by MDE so that development of the Phase III Watershed Implementation Plans for completing the Bay TMDL and any additional TMDL for implementing the Conowingo Watershed Plan will ensure that Maryland's Water Quality Standards and Designated Uses of the Lower Susquehanna and Chesapeake Bay are met once again.

Sincerely,

Alison H. Prost, Esq.,
Maryland Executive Director
Interim Vice President of Environmental Protection and Restoration
Chesapeake Bay Foundation

# Executive Summary

## An Economic Analysis of the Conowingo Hydroelectric Generating Stations

### Prepared for: Water Power Law Group


An analysis was conducted by Energy and Environmental Economics, Inc. (E3) to estimate the range of market revenues for Conowingo Hydropower Dam, assuming it remains a merchant generator in the Mid-Atlantic electricity market, in order to inform how much economic headroom (i.e., excess profits) exists to mitigate the incremental impacts of the Dam's continued operation on ecological resources of the Susquehanna River and Chesapeake Bay. The analysis focused on identifying market revenue estimates for the project, costs associated with owning and operating the project, how benefits and costs change under different operational scenarios and how much economic headroom is potentially available.

E3 used publicly available information including river flow information and market data from PJM, the regional electricity transmission organization in the Mid-Atlantic, to develop estimates for electricity generation and associated market revenues for a variety of operational scenarios. E3 estimated economic headroom through financial *proforma* modeling.

Estimates for the total revenues for Conowingo range between $115 million to $121 million annually. Estimates for available headroom---after a 10% rate of return--- ranged from $27 million to $44 million annually depending on the operational scenario and climate conditions, as well as the range of revenue estimates. These values translate to a present value capital investment that could be used towards mitigation efforts of at least $268 million (real 2008 $).

The estimates of revenues and headroom, did not include the following sensitivities. First, compensation through renewable energy markets, for example a Renewable Energy Credit (REC) payment that the project could potentially be eligible for if it were able to get certified as an eligible resource, was not explicitly assessed. This additional value stream could potentially increase the revenues Conowingo could earn over the term of their requested license. Based on preliminary estimates, the REC payment necessary to offset revenue losses is within range of REC market values. Secondly, it is likely that revenues for Conowingo have declined in recent years due to the suppression of energy market prices in PJM. In addition, the total generation from Conowingo seems to vary significantly from year to year, which may change the revenue estimates for the project. Finally, this analysis does not include the operations or economics of Muddy Run pumped storage, rather it focused on the incremental economics of Conowingo dam. The operations and combined economics of the projects were filed with FERC.

# An Economic Analysis of the Conowingo Hydroelectric Generating Station

## Prepared for: Water Power Law Group

**Final: August 8th, 2017**

**Attorney-Client Work Product, Privileged and Confidential**

Energy+Environmental Economics

# An Economic Analysis of the Conowingo Hydroelectric Generating Station

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# 1 Background

Energy and Environmental Economics, Inc. (E3) was retained by the Water and Power Law Group PC ("WPLG" or "client") to perform an economic analysis of the Conowingo Hydroelectric Generating Station ("Conowingo" or "Project"), which is wholly owned and operated by Exelon Corporation. The project is a 570 MW hydroelectric peaking plant located on the Susquehanna River in northern Maryland.[1]

The purpose of this analysis is to provide an estimation of the range of market revenues for Conowingo assuming it remains a merchant generator in the PJM market[2]. This analysis has been performed to help WPLG, The Nature Conservancy and the Chesapeake Bay Foundation develop a more informed strategy associated with Exelon's relicensing process for the Project with the Federal Energy Regulatory Commission (FERC) and Maryland regulatory agencies. Ultimately, the economic valuation can be used to inform how much economic headroom exists to support Exelon's investment in mitigating its effects on ecological resources of the Susquehanna River and Chesapeake Bay.

We address the following questions with this report:

- What are the market revenue estimates for the project?
- What are the costs associated with owning and operating the project?
- How do these benefits and costs change under different operational scenarios?
- How much headroom is potentially available for mitigation efforts in the Susquehanna River and Chesapeake Bay?

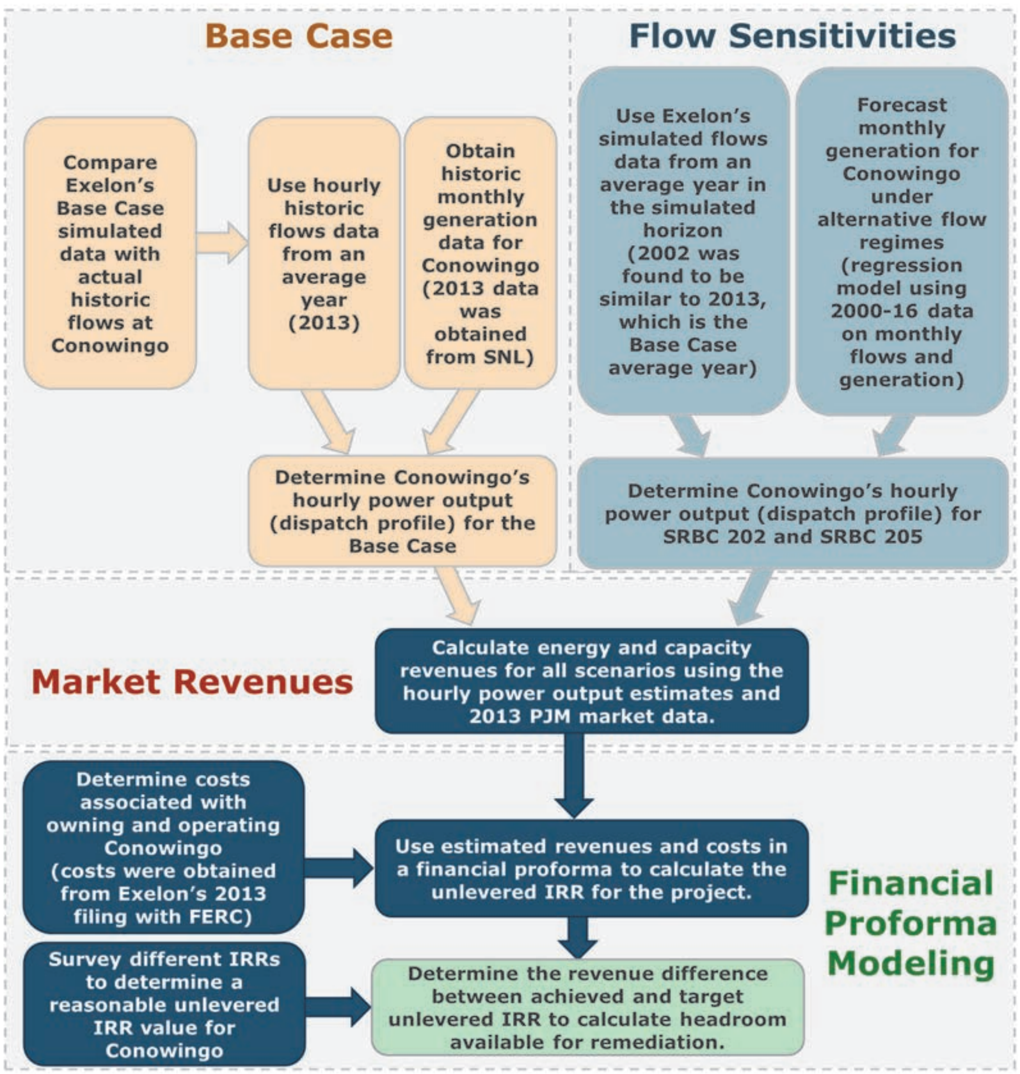
[1] More details can be found on Exelon's website: **http://www.exeloncorp.com/locations/power-plants/conowingo-hydroelectric-generating-station**

[2] PJM Interconnection is a regional transmission organization (RTO) responsible for maintaining wholesale electricity markets for energy, capacity and ancillary services in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. More details can be found here: **http://www.pjm.com/about-pjm/who-we-are.aspx**

# 2 Analysis Approach

The inputs and methodology used in the analysis are described in detail in sections 2.1 and 2.2 respectively. For the analysis, E3 used available flows and PJM market data, and developed estimates for hourly Conowingo generation and associated market revenues for the Base Case as well as the flow scenarios. An overview of the analysis is shown in Figure 1.

Figure 1: Analysis overview for the Base Case as well as the flow scenarios.



## 2.1 Input Data, Assumptions and Limitations

### 2.1.1 INPUTS

In order to identify which year to use for the Base Case, E3 analyzed PJM market prices, USGS flows at Conowingo, and historic generation levels for the project. Table 1 shows the values for the parameters used to identify an 'average' year for the Base Case. Even though annual average flows at Conowingo are closer to the period average in 2010 and 2014, E3 picked 2013 as an average year due to the annual average day ahead LMP and total annual generation at Conowingo being close to the period average.

**Table 1: Base Case Selection - 2013 flows, prices, and generation approximate the average values in the 2010-2016 period.**

| Year | Annual Average Day Ahead LMP[3] ($/MWh) | Annual Average Flows (cfs) | Total Annual Generation (MWh) |
|---|---|---|---|
| 2010 | 49 | 35,528 | 1,645,359 |
| 2011 | 45 | 72,090 | 2,518,452 |
| 2012 | 33 | 31,697 | 1,639,132 |
| 2013 | 38 | 33,351 | 1,699,398 |
| 2014 | 52 | 34,927 | 1,594,647 |
| 2015 | 32 | 30,909 | 1,597,488 |
| 2016 | 23 | 27,295 | 1,369,003 |
| Average 2010-16 | 39 | 37,971 | 1,723,354 |

Table 2 summarizes the data used for the analysis, and the corresponding sources, for the Base Case and the two sensitivity scenarios.

[3] (LMP) Locational marginal pricing

**Table 2: Key data inputs and a description of data sources.**

| Key Inputs | Base Case | SRBC 202 | SRBC 205 |
|---|---|---|---|
| **Flows:** Flows at Conowingo | Historic hourly flows for 2013 from United States Geological Survey (USGS) | 2002 SRBC 202 hourly flows simulated by Exelon (provided to E3 by the Nature Conservancy) | 2002 SRBC 205 hourly flows simulated by Exelon (provided to E3 by the Nature Conservancy) |
| **Power Production:** Monthly generation | Historic 2013 monthly generation data obtained from SNL Energy | Forecasted from 2002 cumulative monthly flows simulated by Exelon for SRBC 202 | Forecasted from 2002 cumulative monthly flows simulated by Exelon for SRBC 205 |
| **Generation profile:** Hourly power production | Calculated by E3 using hourly to monthly flow ratios to allocate 2013 historic monthly generation | Calculated by E3 using hourly to monthly flow ratios to allocate forecasted 2002 SRBC 202 monthly generation | Calculated by E3 using hourly to monthly flow ratios to allocate forecasted 2002 SRBC 205 monthly generation |
| **Market data**: PJM energy and capacity market data | 2013 historic PJM market data used across all flow scenarios<br>- Hourly energy prices<br>- Seasonal capacity prices | | |

### 2.1.2 ASSUMPTIONS AND LIMITATIONS.

It is important to note that Exelon operates Conowingo and Muddy Run, which is a pumped hydro storage facility upstream of Conowingo, as a coordinated facility. Conowingo pond provides the after bay for generation at Muddy Run. For the purpose of this analysis, E3 has focused on Conowingo only, and assumed Muddy Run's impacts on Conowingo operations are captured in historic operations data, as well as Exelon's simulated data for the alternative flow regimes (SRBC 202 and SRBC 205).

In addition, energy prices and flow regimes for a Base Year (2013) were assumed to be constant for the study horizon. Changes to either would change the valuation results, but the examination of those sensitivities is outside of the scope of the analysis.

## 2.2 Methodology Description

In order to address the four study questions, E3 utilized a combination of publicly available data published market and hydro flow data, and generation data developed by Exelon and provided by The Nature Conservancy. E3 analyzed three scenarios, described in more detail below.

E3's methodology included the following steps for each scenario:

1. Determining flows at Conowingo
2. Developing Conowingo dispatch profile
3. Estimating market revenues
4. Estimating target and achieved unlevered IRR
5. Calculating annual and upfront capital available for mitigation

These steps are described in detail below.

### 2.2.1 STEP 1: DETERMINING FLOWS AT CONOWINGO

#### *2.2.1.1 Overview of Operational Scenarios*

For this study, the economics of Conowingo dam were estimated using three operational scenarios; the base case scenario and two potential future scenarios that were developed and proposed by stakeholders through the FERC re-licensing process.[4] A description of each scenario is included in Table 3 and the operational parameters for each scenario are included in Appendix 5.2. The scenarios are approximations based on best available data, therefore each has limitations in its ability to simulate future conditions.

[4] TNC MOI 2015.

| Scenario Name | | Description |
|---|---|---|
| The Base Case | | Current operations with primary goal of maximizing revenue. This does not include moderate increases to minimum flow releases proposed by Exelon in their recent CWA 401 application. |
| Alternative Flow Regimes | SRBC 202 | Potential future operations to restore up to 50% of maximum available habitat. Includes higher minimum releases, a capped maximum generation flow during key spawning and reproductive months and a guided rate of change. |
| | SRBC 205 | Potential future operations, similar to SRBC 202, but include run-of-river operations during spring to improve migratory fish habitat. It is hypothesized that this level of mitigation may make the facility eligible for compensation under renewable energy markets.[5] |

The Base Case was developed using data from a year representative of average PJM market prices, average Conowingo flows, and average annual power generation at the dam. The client was also interested in understanding the impact of alternative flow regimes at Conowingo on the revenues, and consequently the available headroom. The alternative flow regimes analyzed were SRBC 202 and SRBC 205. SRBC 202 is an alternative flow regime proposed by a group of stakeholders in the relicensing proceeding of Conowingo in Maryland, provided to E3 by The Nature Conservancy. Base Case Flows: Benchmarking Exelon's simulated flows

[5] It is noted that this is hypothetical. In order to be eligible for RPS in Pennsylvania, the facility requires Low Impact Hydropower Institute certification. LIHI certification requires the applicant to meet eight criteria including ecological flows and fish passage.

For the Base Case, E3 compared historic flows data from an average year obtained from the United States Geological Survey (USGS) website to Exelon's Base Case hydro simulation. With this verification analysis, E3 confirmed that currently, Exelon operates Conowingo in a manner consistent with its Base Case hydro flow simulation.[6]. For the verification analysis E3 compared the hourly USGS flows to Exelon's simulated hourly flows for the Base Case. The datasets had overlap for the October 2007 to December 2007 period.

**Figure 2: Benchmarking hourly average Exelon and USGS flows at Conowingo – October 2007 to December 2007.**

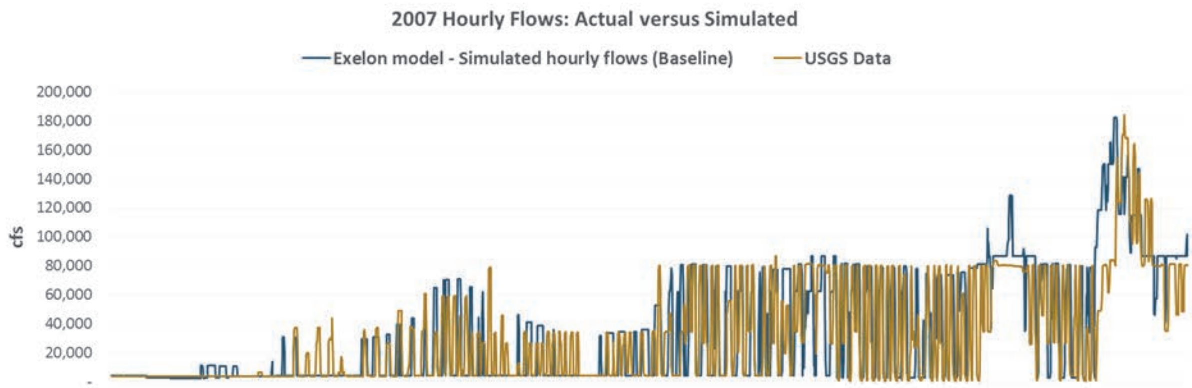
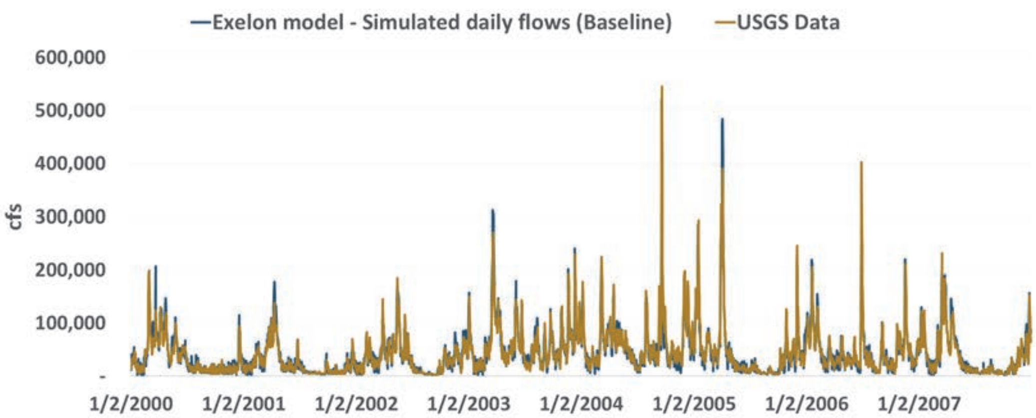



**Figure 3: Benchmarking daily average Exelon and USGS flows at Conowingo – 2000 to 2007.**

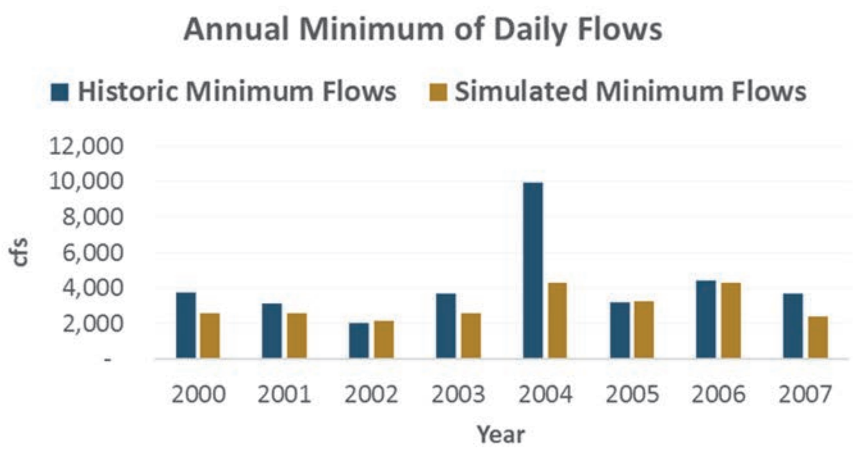


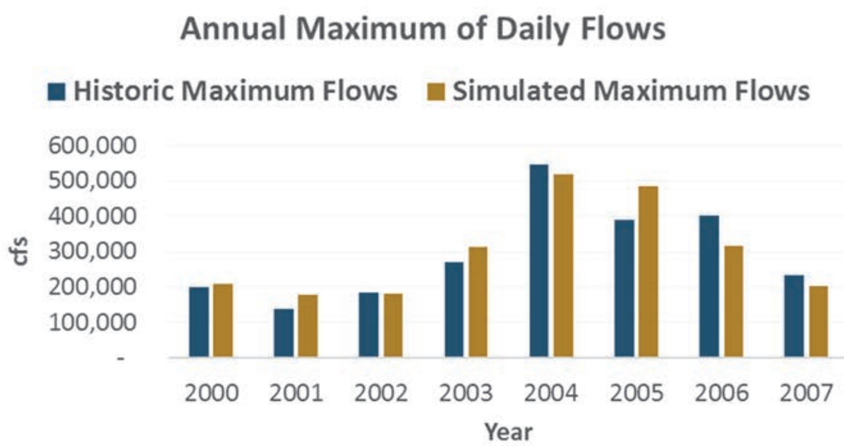

[6] Historical flows data was obtained from USGS: https://waterdata.usgs.gov/usa/nwis/uv?01578310

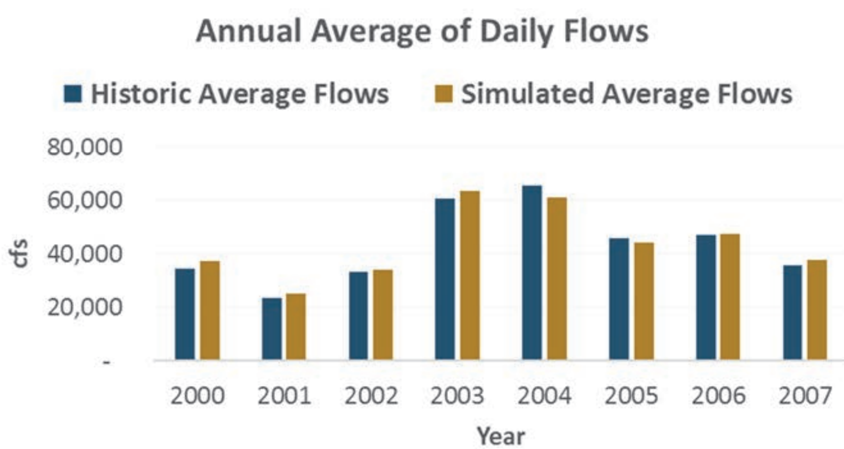
In addition to comparing the flows at the hourly time step, E3 also verified that the historical daily flows were similar to the Base Case daily flows simulated by Exelon. As seen in Figures 2 and 3, Exelon's simulated daily flows in the 2000-2007 timeframe match historically observed data from USGS. Given the similarity in actual and simulated flows, E3 utilized actual flows from 2013 to estimate Conowingo's dispatch profile.

Figure 4 show the comparison between annual minimum, maximum and average flows for the 2000-2007 time horizon.

**Figure 4: Comparison of historic and simulated annual daily minimum, maximum and average Conowingo flows.**






The comparison of hourly flows by month and daily flows by year can be found in Appendix B.

#### *2.2.1.2 Alternative flow scenarios: SRBC 202 and SRBC 205*

For the alternative flow scenarios (SRBC 202 and SRBC 205), E3 used flows data simulated by Exelon,[7] and provided to E3 by The Nature Conservancy. The simulated data was available for the 1967-2007 period. In order to keep the scenario analysis consistent with the Base Case year assumptions, E3 tried to identify a year in the simulation period with flows closely resembling 2013 flows for Conowingo.

[7] The Nature Conservancy provided E3 with data simulated by Exelon for Conowingo flows under different regimes

After comparing the annual minimum, maximum and average flows levels, E3 concluded that year 2002 has similar hydrological conditions at Conowingo to year 2013. E3 also compared the flow duration curves of daily flows, which are the daily flows for the years sorted from the highest to lowest values, for the two years. The comparison is shown in Figure 5.

Table 3 shows the minimum, maximum, average and total flows for the 1980-2007 horizon, and how the values for each of those years compare to the Base Case average year 2013. Figure 3 shows the comparison of the flow duration curves for the year selected from the simulation period (2002) and the Base Case average year (2013).

**Table 3: Comparison of flows in the 1980 – 2007 time horizon to the Base Case average year 2013 (target year shown in green in the table).**

| | Baseline flows | Baseline flows | Baseline flows | Baseline flows | Difference from target year | Difference from target year | Difference from target year | Difference from target year |
|---|---|---|---|---|---|---|---|---|
| | Minimum | Maximum | Average | Total | Minimum | Maximum | Average | Total |
| 2013 | 3,680 | 192,000 | 33,351 | 12,173,220 | - | - | - | - |
| 1980 | 719 | 215,000 | 28,430 | 10,405,422 | (2,961) | 23,000 | (4,921) | (1,767,798) |
| 1981 | 726 | 301,000 | 30,358 | 11,080,514 | (2,954) | 109,000 | (2,994) | (1,092,706) |
| 1982 | 781 | 211,000 | 34,619 | 12,635,852 | (2,899) | 19,000 | 1,267 | 462,632 |
| 1983 | 848 | 357,000 | 41,928 | 15,303,806 | (2,832) | 165,000 | 8,577 | 3,130,586 |
| 1984 | 798 | 470,000 | 49,779 | 18,219,256 | (2,882) | 278,000 | 16,428 | 6,046,036 |
| 1985 | 821 | 165,000 | 30,469 | 11,121,262 | (2,859) | (27,000) | (2,882) | (1,051,958) |
| 1986 | 938 | 361,000 | 41,242 | 15,053,248 | (2,742) | 169,000 | 7,890 | 2,880,028 |
| 1987 | 893 | 236,000 | 32,263 | 11,776,040 | (2,787) | 44,000 | (1,088) | (397,180) |
| 1988 | 2,260 | 184,000 | 27,159 | 9,940,180 | (1,420) | (8,000) | (6,192) | (2,233,040) |
| 1989 | 2,900 | 232,000 | 39,859 | 14,548,460 | (780) | 40,000 | 6,508 | 2,375,240 |
| 1990 | 4,270 | 215,000 | 48,311 | 17,633,450 | 590 | 23,000 | 14,960 | 5,460,230 |
| 1991 | 3,810 | 199,000 | 29,665 | 10,827,810 | 130 | 7,000 | (3,686) | (1,345,410) |
| 1992 | 1,730 | 163,000 | 35,497 | 12,991,830 | (1,950) | (29,000) | 2,146 | 818,610 |
| 1993 | 4,120 | 467,000 | 52,476 | 19,153,600 | 440 | 275,000 | 19,124 | 6,980,380 |
| 1994 | 2,560 | 358,000 | 51,700 | 18,870,530 | (1,120) | 166,000 | 18,349 | 6,697,310 |
| 1995 | 2,770 | 174,000 | 27,972 | 10,209,960 | (910) | (18,000) | (5,379) | (1,963,260) |
| 1996 | 5,270 | 622,000 | 63,467 | 23,228,860 | 1,590 | 430,000 | 30,116 | 11,055,640 |
| 1997 | 3,620 | 118,000 | 29,705 | 10,842,380 | (60) | (74,000) | (3,646) | (1,330,840) |
| 1998 | 1,550 | 332,000 | 41,327 | 15,084,440 | (2,130) | 140,000 | 7,976 | 2,911,220 |
| 1999 | 2,110 | 222,000 | 26,831 | 9,793,150 | (1,570) | 30,000 | (6,521) | (2,380,070) |
| 2000 | 3,760 | 199,000 | 34,350 | 12,572,060 | 80 | 7,000 | 999 | 398,840 |
| 2001 | 3,100 | 138,000 | 23,560 | 8,599,260 | (580) | (54,000) | (9,792) | (3,573,960) |
| 2002 | 1,990 | 185,000 | 33,386 | 12,185,850 | (1,690) | (7,000) | 35 | 12,630 |
| 2003 | 3,680 | 271,000 | 60,681 | 22,148,730 | - | 79,000 | 27,330 | 9,975,510 |
| 2004 | 9,910 | 545,000 | 65,536 | 23,986,310 | 6,230 | 353,000 | 32,185 | 11,813,090 |
| 2005 | 3,200 | 390,000 | 45,805 | 16,718,950 | (480) | 198,000 | 12,454 | 4,545,730 |
| 2006 | 4,400 | 403,000 | 47,075 | 17,182,500 | 720 | 211,000 | 13,724 | 5,009,280 |
| 2007 | 3,660 | 232,000 | 35,618 | 13,000,610 | (20) | 40,000 | 2,267 | 827,390 |

**Figure 5: 2002 and 2013 flow duration curves (log scale).**

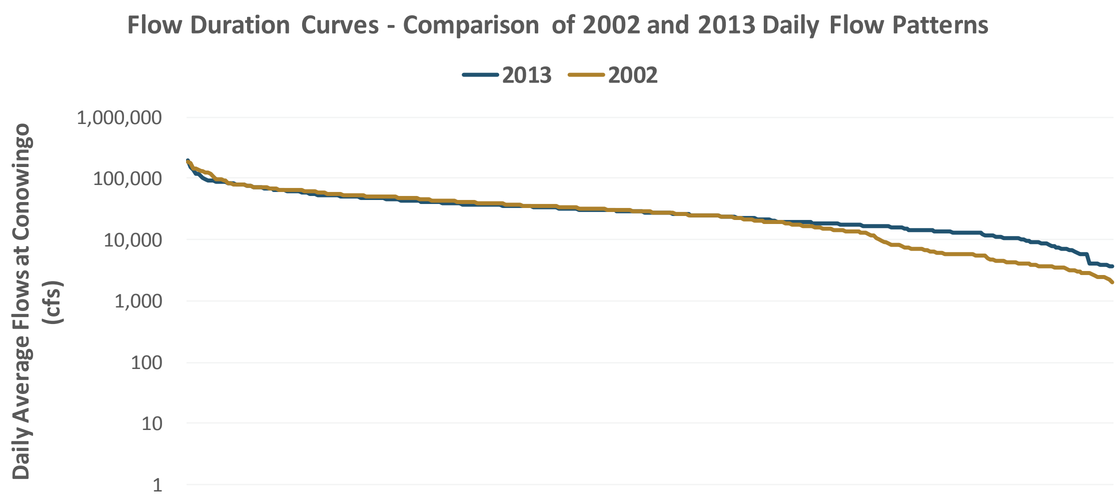


Figure 5 shows that the flows on the lower end are much lower in 2002 than in 2013. However, relative to the other years in the 1980 – 2007 sample, 2002 has mean, minimum, maximum as well as total cumulative flows closest to 2013, which is the Base Case year. All other years have cumulative annual flows, minimum flows and/or maximum flows that are considerably more different from 2013 than 2002 is.

The selection of 2002 as the analysis year for the flow scenarios implies that E3 estimates for total annual generation, as well as corresponding revenues for Conowingo under SRBC 202 and SRBC 205 are likely underestimated.

### 2.2.2 STEP 2: DEVELOPING HOURLY CONOWINGO DISPATCH PROFILE

Once the flows for the Base Case, SRBC 202 and SRBC 205 were obtained, E3 developed generation data associated with these flow regimes. For the Base Case, E3 was able to utilize historic data on Conowingo's monthly power output obtained from SNL energy, given that historic generation at Conowingo is consistent with the Base Case generation profile.[8] For determination of the generation associated with SRBC 202 and SRBC 205, E3 developed a regression model that utilized historic relationships between monthly cumulative flows and monthly power output. Using the regression model, E3 was able to predict what Conowingo's monthly generation would be for the SRBC 202 and SRBC 205 regimes by using Exelon's simulated data for the monthly flows associated with those two operational regimes.[9]

#### *2.2.2.1 Base Case*

E3 obtained monthly generation data from SNL. No hourly generation was available for Conowingo. To estimate power output from flows, E3 used the following formula:

[8] Can be downloaded at: https://www.snl.com/web/client?auth=inherit#powerplant/PP_GenerationChart?ID=2487
[9] Please see Appendix 5.3

**Equation 1: Determining the hourly power output from monthly power generation, hourly flows, and cumulative monthly flows.**

**Hourly power generation = Monthly power generation x (Hourly flows/Monthly flows)**

E3 allocated the total historic monthly generation in 2013 to each hour consistent with how total monthly flows were allocated to the hours of the month. This implies that the relationship between flows and power generation is linear, which is a simplifying assumption made for this analysis.

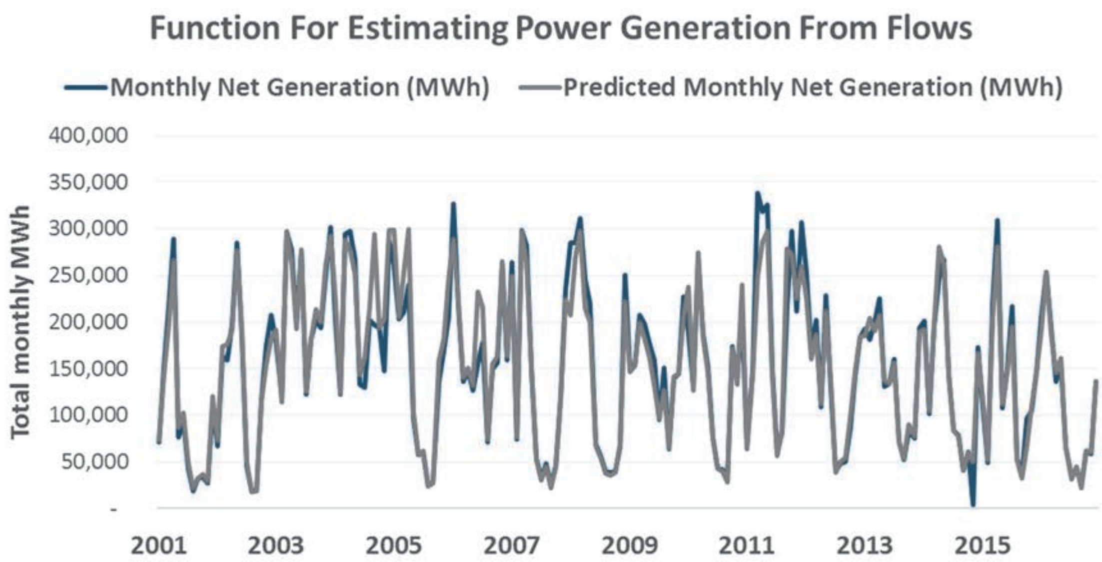
For some hours, using this allocation resulted in power generation that exceeded the project's nameplate capacity. For those hours, the generation was capped at the maximum power output of the project (nameplate capacity), and the difference between the estimated generation and maximum possible generation in each hour was assumed to be compensated at the average annual on-peak energy price.

#### *2.2.2.2 Stakeholder Scenarios (SRBC 202 and SRBC 205)*

E3 could not use historic power generation at Conowingo for analyzing SRBC 202 and SRBC 205 as flow regimes, because current operations at Conowingo are different from those two regimes. To estimate generation for the SRBC 202 and SRBC 205 flow regimes, E3 developed a regression model[10] to establish the relationship between cumulative monthly flows and total monthly generation. E3 used 2001 to 2016 historic monthly flows and generation data to develop the model due to Conowingo historic generation data only being available from 2001[11]. Using the relationship established with this simple model, E3 estimated what the monthly power generation for the 2002 simulated year would be, under the SRBC 202 and SRBC 205 operational regimes, by utilizing the monthly cumulative flows provided by Exelon for the two regimes.

[10] Specifications of the model can be found in the Appendix.
[11] SNL data for monthly generation at Conowingo only begins in 2001.

**Figure 6: Regression model prediction of monthly flows and actual monthly flows for the 2001-2016 time frame.**




E3 compared the estimates from this regression model to Exelon's estimates of the changes in power generation relative to the Base Case for each of these flow scenarios.

For both the sensitivity analyses, E3 used the same methodology for allocating the monthly total generation to create an hourly profile described in Equation 1.

### 2.2.3 STEP 3: ESTIMATING MARKET REVENUES

Using the estimated dispatch profile for the project, E3 calculated the energy market revenues by multiplying the hourly estimated power output for the different flow regimes (Base Case, SRBC 202, and SRBC 205) and the average year's (2013) hourly day-ahead energy market prices.

In addition, E3 calculated the potential capacity revenues in PJM that could be earned by Conowingo by multiplying the project's unforced capacity value (UCAP) by the average year's seasonal capacity prices posted by PJM. These were assumed to be constant across all the flow regimes.

For ancillary services revenues, E3 used the values filed by Exelon in 2013 to develop revenue estimates the project could potentially earn in the ancillary service markets for the Base Case. E3 decreased the Base Case ancillary services revenues proportionally to the decline in energy revenues for the SRBC 202 and SRBC 205 flow regimes.

For SRBC 205, E3 estimated the REC price that would be needed for the lost energy and ancillary service revenues due to more constrained operations to be compensated for through the REC markets, i.e. E3 calculated the REC payment that would be needed per MWh of energy generated to make up for the lost PJM market revenues.

For this, E3 calculated the expected revenue losses for SRBC 205 relative to the Base Case, and divided them by the expected change in generation. E3 calculated the implied REC price for Exelon to be indifferent between the Base Case and SRBC 205 using both E3 modeled revenue losses and change in generation, as well as those filed by Exelon and provided by The Nature Conservancy.

### 2.2.4 STEP 4: ESTIMATING TARGET AND ACHIEVED UNLEVERED IRR

Using the estimated market revenues, and projections of the capital and operating costs associated with owning and operating of Conowingo filed by Exelon with FERC, E3 calculated the 46-year unlevered Internal Rate of Return (IRR) for the project under different flow regimes. We utilized the unlevered IRR metric because return on equity is driven by the amount of debt in the capital structure.

#### *2.2.4.1 Financing Costs*

E3 developed a financial proforma model to estimate the unlevered after-tax IRR for Conowingo. To estimate annual capital and operating costs, E3 used Exelon's 2011 and 2013 FERC filings, which had values for annual operations and maintenance costs (O&M), property taxes, capital expenditures, relicensing fees, as well as costs associated with any protection, mitigation and enhancement measures (PM&E). The O&M costs (including O&M associated with environmental measures), and property taxes are assumed to be incurred on an annual basis, whereas the estimated acquisition cost is a one time cost. The estimates for costs associated with the 2016

Fish Passage Settlement Agreement are assumed to be reflected in the annual ongoing PM&E capital expenditures. A summary of the costs can be found in Table 4.

E3 calculated the after-tax unlevered IRR using these cost assumptions, and the revenues for each scenario. Exelon acquired Conowingo in 2008, and is requesting a renewed license to operate the asset through 2055. For calculation of the IRRs, E3 assumed that the revenues stayed constant in each scenario for the 2008 – 2055 time frame.

**Table 4: Capital and operating costs from Exelon's 2011 and 2013 FERC filings.**

| Component | Value |
|---|---|
| O&M costs | $16M (escalated at 2%) |
| Property taxes | $3.8M |
| Estimated 2008 acquisition cost | $281.7M |
| Annual ongoing capital expenditures | $15.7M |
| Relicensing costs | $15M |
| PM&E O&M costs | $55M |
| PM&E capital costs | $5.4M |

#### *2.2.4.2 Determining a reasonable target IRR*

E3 compared the unlevered IRR achieved for the different flow regimes to what a reasonable unlevered IRR for the project would be. A reasonable IRR provides Exelon with an unlevered, after-tax return commensurate with the risk it bears owning and operating Conowingo. If Conowingo were fully contracted, the unlevered after-tax IRR should be priced greater than the off-taker's weighted average cost of capital (WACC). For instance, Potomac Electric's WACC is currently

8.01%.[12] However, Conowingo, as a fully merchant project in PJM, bears energy and capacity market risk, so the expected return would need to be higher than 8%.

E3 researched appropriate rates of return for a fully merchant project and found two potentially appropriate benchmarks. The benchmarks were used to estimate an after-tax IRR that would be reasonable for Conowingo, and compensate Exelon appropriately for the risk associated with Conowingo. The California State Board of Equalization's 2017 capitalization rate study, which is used to assess property taxes, recommends IRRs of 11.2% to 12.8%.[13] This range is based on analysis of independent power producers that hold a mix of contracted and merchant generation assets (Calpine, AES, NRG Energy, Dynegy) and diversified electric utilities (Xcel Energy, Duke Energy, NextEra Energy). A Brattle report prepared in 2014 for 2018 online dates recommends an 8% after-tax IRR in PJM.[14]

Given this range, E3 determined 10% to be a reasonable target IRR.

### 2.2.5 STEP 5: CALCULATING ANNUAL AND UPFRONT CAPITAL AVAILABLE FOR REMEDIATION

#### *2.2.5.1 Annual Headroom Available*

E3 utilized the proforma model to determine what level of annual revenues would provide a 10% unlevered IRR for Conowingo. After determining this revenue level, E3 calculated the annual headroom available for remediation to be the difference between these target revenues and Base Case revenues estimated as described in section 2.2.3.

[12] Can be found on Exelon's investor relations webpage: http://www.exeloncorp.com/investor-relations/recent-rate-cases
[13] https://www.boe.ca.gov/proptaxes/pdf/2017capratestudy.pdf
[14] The report can be downloaded at: http://www.brattle.com/system/publications/pdfs/000/005/010/original/Cost_of_New_Entry_Estimates_for_Combustion_Turbine_and_Combined_Cycle_Plants_in_PJM.pdf?1400252453

#### 2.2.5.2 Upfront Capital Available

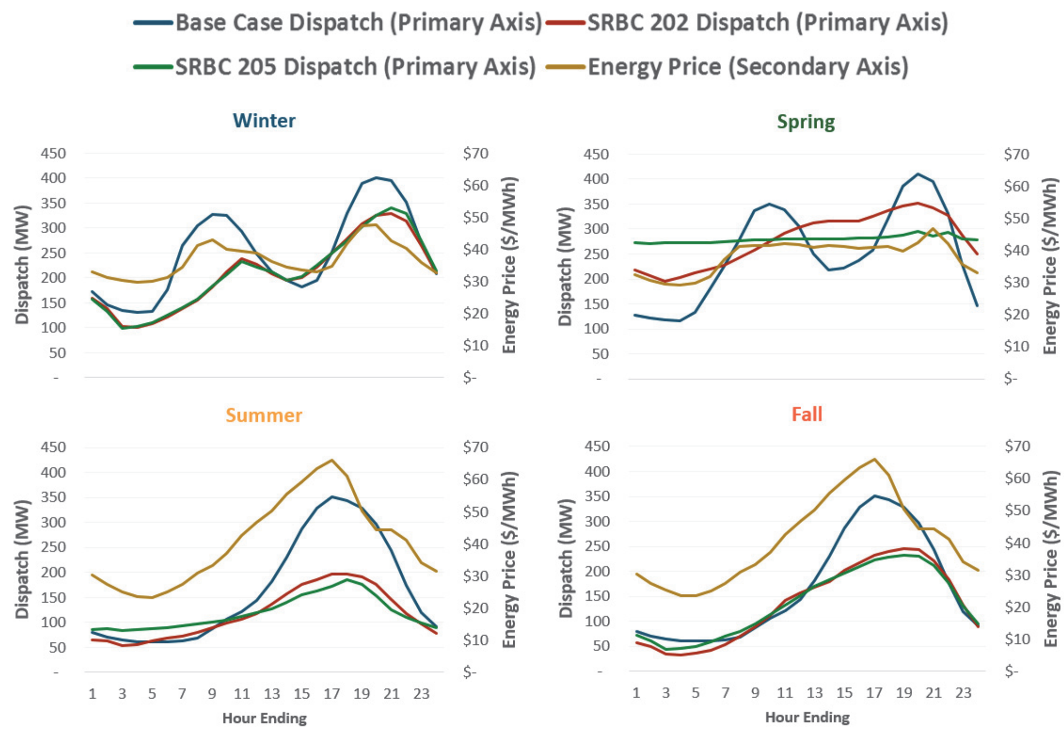
After calculating the annual headroom available for remediation by using the methodology described in section 2.2.5.1, E3 estimated the upfront capital available for remediation as the present value (10%) of the annual headroom stream for the 2008-55 period.

# 3 Results

## 3.1 Conowingo Hourly Dispatch

Using the approach described in section 2.2.2., E3 estimated the operations of Conowingo. In general, the project's dispatch seems to be correlated with energy prices in the Base Case, except in the spring. Under the Base Case, the Project is likely more constrained in its operations in the spring due to higher seasonal run-off. For the stakeholder alternatives (SRBC 202 and SRBC 205), in the spring, the project is constrained in its peaking ability; SRBC 202 includes higher minimum flows, maximum flows and ramping rates and SRBC 205 is instantaneous run-of-river in the Spring.

**Figure 7: 2013 Average seasonal prices and dispatch for Conowingo. Figure represents average of hourly prices and estimated hourly power output for all the months in the season.**



## 3.2 Market Revenues

Using the methodology described in Section 2, E3 calculated the total revenues from Conowingo in the Base Case to be $121 million annually. These estimates are higher than Exelon's 2013 FERC filings by $11.5 million, but in the same overall range, with the exception of capacity market revenues. The breakdown of the different revenue components, and how they compare to Exelon's filing is summarized in Table 5.

For SRBC 202 and SRBC 205, E3 estimated the annual revenues to be $116 million and $115 million respectively. These values do not include the revenues that Conowingo could make by selling into the REC market. E3 calculated the implied REC price, i.e. the value per MWh of Conowingo's generation if it were certified as a REC resource, that would be needed in the SRBC 205 scenario for Exelon to be indifferent between the Base Case operations and the SRBC 205 flow regime. E3 calculated the implied REC price using both E3 modeled revenue losses and change in generation, as well as Exelon's estimates. Exelon's revenue loss estimates include the losses for Muddy Run, and would be lower for Conowingo. Therefore, the implied REC price by using Exelon's filings is likely overestimated if only Conowingo is taken into consideration.

**Table 5: Comparison of E3 estimates and Exelon 2013 filing for different components of PJM market revenues**

| Base Case | | | |
|---|---|---|---|
| Revenue Source | E3 Model Estimates | Exelon 2013 FERC Filing | Difference (E3 Estimates – FERC Filing) |
| Energy | $70M | $68M | $2.6M |
| Capacity[15] | $51M | $42M | $8.7M |

[15] Exelon uses 2013 calendar year to calculate PJM's capacity prices, whereas E3 uses the capacity prices from the 2013-2014 capacity year.

| | | | |
|---|---|---|---|
| Ancillary Services | $0.4M | $0.4M | - |
| Total Revenues ($) | $121M | $110M | $11M |
| Generation (MWh) | 1,699,398 | 1,669,000 | 30,398 |
| Total Revenues ($/MWh) | $71 | $66 | $5 |

Similarly, E3 compared its estimates for the flow scenarios to the values filed in 2013 by Exelon, which are for both Conowingo and Muddy Run, and are therefore likely lower for Conowingo alone. The results are summarized in Table 6.

**Table 6: Comparison of E3 estimates and Exelon's revenue estimates under alternative flow regimes (SRBC 202 and SRBC 205).**

| SRBC 202 | | | |
|---|---|---|---|
| Revenue Source | E3 Model Estimates | Exelon 2013 FERC Filing[16] | Difference (E3 Estimates – FERC Filing) |
| Energy | $64M | | |
| Capacity | $51M | | |
| Ancillary Services | $0.4M | | |
| Total Revenues ($) | $116M | $108M | $8M |
| Generation (MWh) | 1,640,009 | 1,678,000 | (37,991) |

[16] Exelon simulated data has changes in total generation and revenues, but they were not broken out by component.

| | | | |
|---|---|---|---|
| Total Revenues ($/MWh) | $71 | $64 | $6 |
| **SRBC 205** | | | |
| **Revenue Source** | **E3 Model Estimates** | **Exelon 2013 FERC Filing[17]** | **Difference (E3 Estimates – FERC Filing)** |
| Energy | $64M | | |
| Capacity | $51M | | |
| Ancillary Services | $0.4M | | |
| Total Revenues ($) | $115M | $105M | $10M |
| Generation (MWh) | 1,652,373 | 1,701,000 | (48,627) |
| Total Revenues ($/MWh) | $69 | $62 | $8 |

In addition, the REC prices needed for the revenues in the SRBC 205 flow scenario to be the same as the Base Case are summarized in Table 7. Therefore, if Conowingo was able to supplement its revenues with REC prices of $3/MWh - $4.25/MWh, the revenues in the SRBC 205 operational scenario would be identical to the revenues estimated for the Base Case. With these additional REC revenues, Exelon would be indifferent between operating Conowingo consistent with the Base Case, or under the SRBC 205 operational flow regime.

[17] Exelon simulated data has changes in total generation and revenues, but they were not broken out by component.

**Table 7: REC payment needed per MWh of energy generated in SRBC 205 operational scenario by Conowingo to make up for the lost PJM energy and ancillary service market revenues using Exelon's filings as well as E3's modeled estimates.**

| | E3 SRBC 205 | Exelon SRBC 205 |
|---|---|---|
| Total generation (MWh) | 1,652,373 | 1,701,000 |
| Total revenue reduction relative to Base Case ($) | $7,023,091 | $5,100,000 |
| Implied REC price needed ($/MWh) | $4.25 | $3.00 |

## 3.3 Proforma Analysis Results

With the financial proforma analysis, E3 was able to calculate the after-tax unlevered IRRs for Conowingo under different flow regimes. E3 also calculated the after-tax unlevered IRRs implied by Exelon's revenue estimates from the FERC filing. The results of this analysis are shown in Table 8.

**Table 8: Comparison of after-tax unlevered IRRs for the different flow regimes.**

| Scenario | E3 Model Estimates | Calculations Using Exelon's Revenue Estimates |
|---|---|---|
| Base Case | 20.84% | 18.04% |
| SRBC 202 | 19.41% | 17.51% |
| SRBC 205 | 19.19% | 16.82% |

## 3.4 Headroom Calculation Results

As described in section 2.2.5, E3 calculated the annual headroom and upfront capital available for investment in mitigation. The available headroom is lowest for the SRBC 205 regime, due to the overall revenues being lower, however the SRBC 205 operational regime could have access to additional revenues through sale of RECs associated with Conowingo's generation. Based on E3's analysis, the REC payment needed in the SRBC 205 flow scenario is $3/MWh to $4.25/MWh depending on whether Exelon's assumptions on market revenues and annual generation are used or E3's modeled estimates. Across the different flow scenarios, and based on differences in modeling between E3's estimates and Exelon's estimates, the annual available headroom is in the $27 million to $44 million range per year.

Exelon has already modified their Base Case operations to increase minimum flow levels. Therefore, the Base Case, although closest to their current operations, may still overestimate market revenues by assuming a higher level of dispatchability for Conowingo than currently exists due to the 401 Cert application.

**Table 9: Estimate of annual headroom.**

| Annual headroom available ($) | E3 Model Estimates | Calculations Using Exelon's Revenue Estimates |
|---|---|---|
| Base Case | $44.1M | $32.2M |
| SRBC 202 | $37.9M | $30.0M |
| SRBC 205 | $37.0M | $27.1M |

Using the annual headroom stream provided in Table 9, E3 calculated the available upfront capital that could be used for undertaking remediation efforts in the Chesapeake Bay as the present value of the annual headroom discounted at the target 10% after-tax unlevered IRR.

**Table 10: Present value (10%) of annual headroom available in the 2008 to 2055 time horizon.**

| PV of annual headroom available (2008$) | E3 Model Estimates | Calculations Using Exelon's Revenue Estimates |
|---|---|---|
| Base Case | $436.4M | $318.9M |
| SRBC 202 | $375.9M | $297.1M |
| SRBC 205 | $366.9M | $268.4M |

It is important to note that if Conowingo were able to access REC markets and receive a payment of $3/MWh - $4/MWh for its generation in the SRBC 205 operational scenario, the headroom available for SRBC 205 would be the same as the Base Case.

# 4 Conclusions

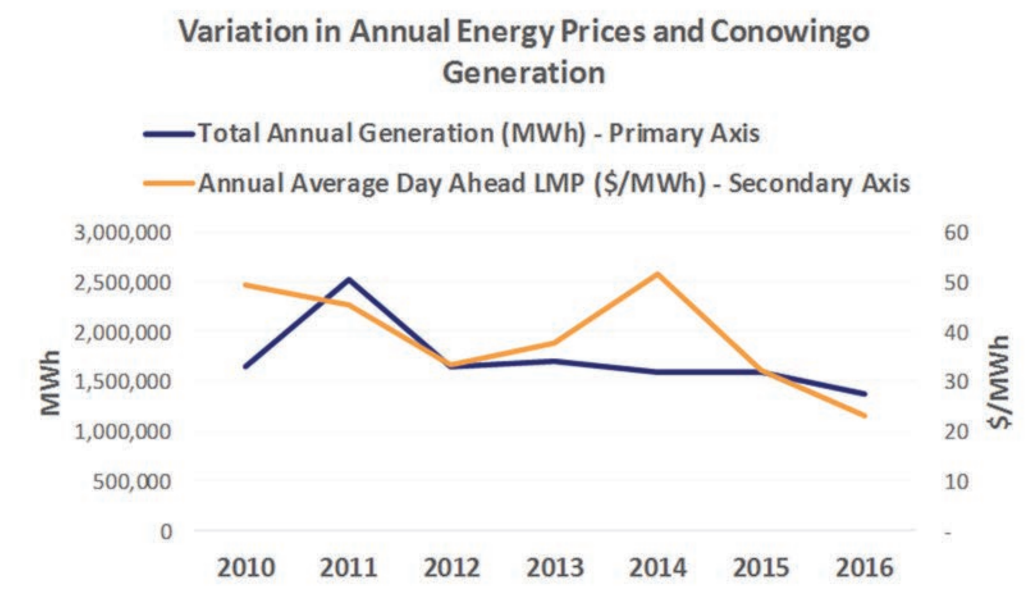
E3's estimates for the total revenues for Conowingo range between $115 million to $121 million depending on the operational scenario. For the Base Case, SRBC 202 and SRBC 205 regimes, E3's calculated revenues were higher than Exelon's model estimates. The difference in revenues primarily stems from the capacity value of the project in PJM in 2013. E3 utilized the seasonal capacity values posted by PJM, whereas Exelon used a calendar year average capacity market price, which was lower. E3 utilized seasonal capacity prices due to PJM posting its capacity market clearing prices seasonally. However, if E3 were to calculate calendar year capacity revenues for the Base Case assuming annual capacity prices, the estimated revenues would be lower and more in line with Exelon's filings. In addition to differences in capacity market revenue estimates, E3's modeled energy market revenues were also higher than Exelon's.

The estimates for available headroom for remediation ranged from $27 million to $44 million annually depending on the flow regimes, access to renewable energy markets, as well as the range of revenue estimates calculated through E3's analysis versus those filed by Exelon. These values translated to a present value capital investment that could be used towards remediation efforts of $268 million (real 2008 $) to $436 million (real 2008 $), depending on the flow regime and whether E3's estimates or Exelon's filing estimates were used.

For the SRBC 205 operations regime, E3 did not include the REC payment that the project would potentially be eligible for if it were able to get certified as a REC eligible resource. This additional value stream could increase the revenues Conowingo could earn, and make Exelon indifferent between the Base Case and SRBC 205 operational regimes. In order for the total revenues for SRBC 205 to be the same as the Base Case, Conowingo would need a REC payment of $3/MWh-$4.25/MWh for its generation, depending on whether E3's modeled estimates or Exelon's filings are used.

It is likely that revenues for Conowingo have declined in recent years due to the suppression of energy market prices in PJM. In addition, the total generation from Conowingo seems to vary significantly from year to year, which may change the revenue estimates for the project. Figure 6 shows the variation in total annual generation at Conowingo as well as the range of energy prices in the 2010 to 2016 horizon.

**Figure 8: 2010 to 2016 variation in Conowingo annual generation and PJM energy market prices.**

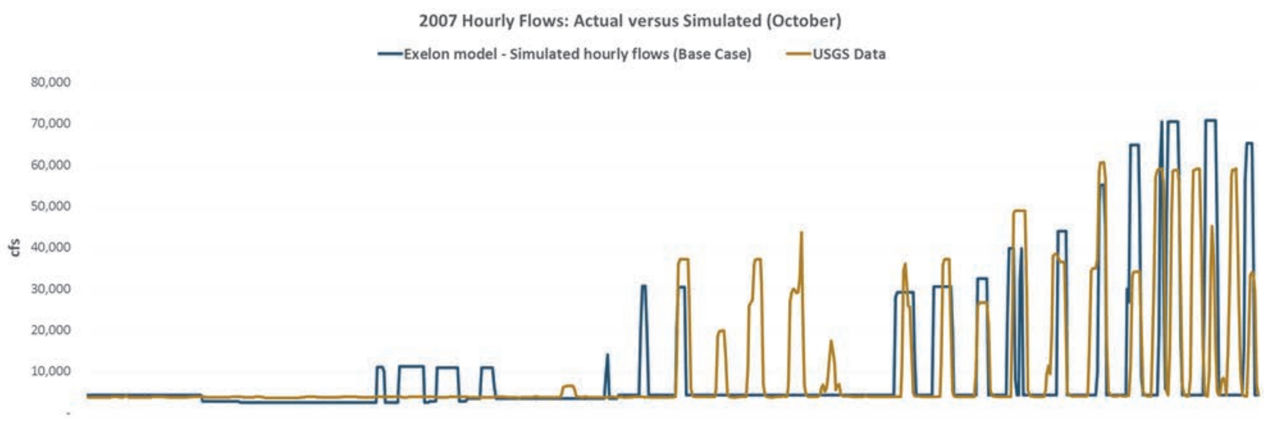


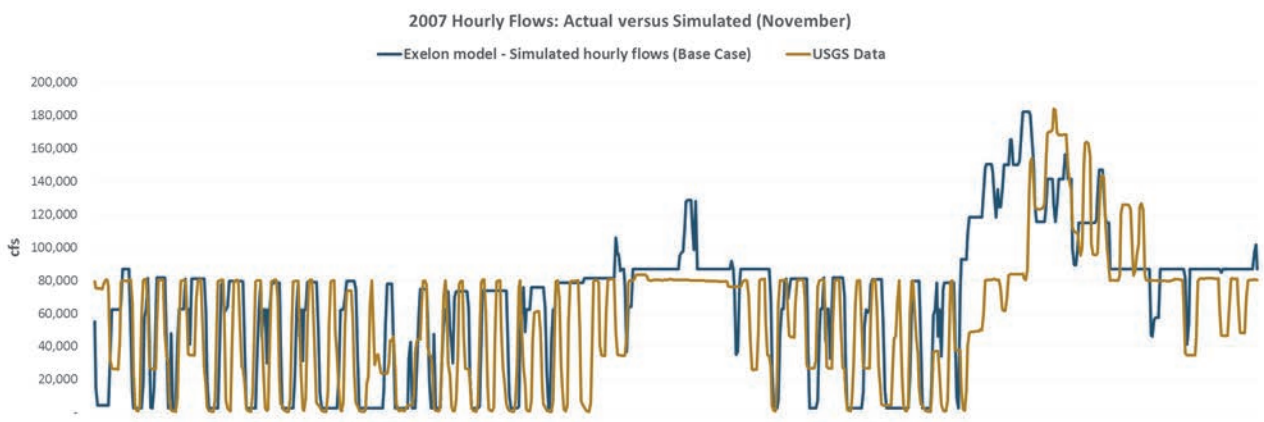

Further analysis would be needed to capture the impact of lower energy prices and changes in power generation on Conowingo's long term revenue forecasts.

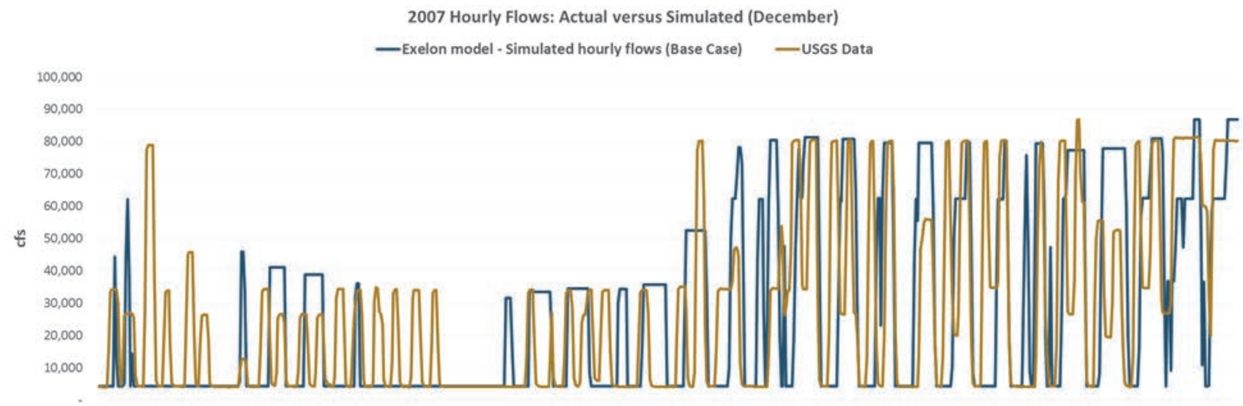
# 5 Appendix

## 5.1 Comparison of historic and simulated flows

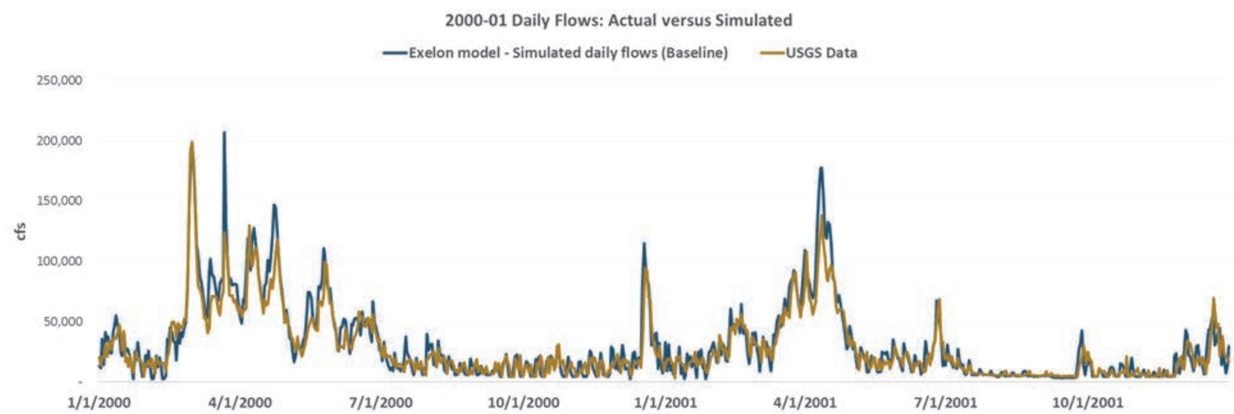
### 5.1.1 COMPARISON OF HOURLY FLOWS: OCTOBER 2007 – DECEMBER 2007

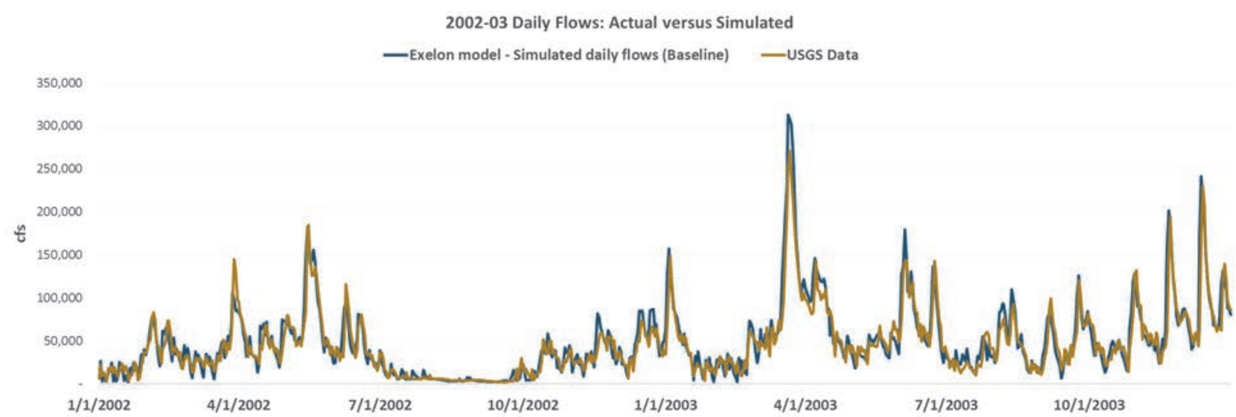


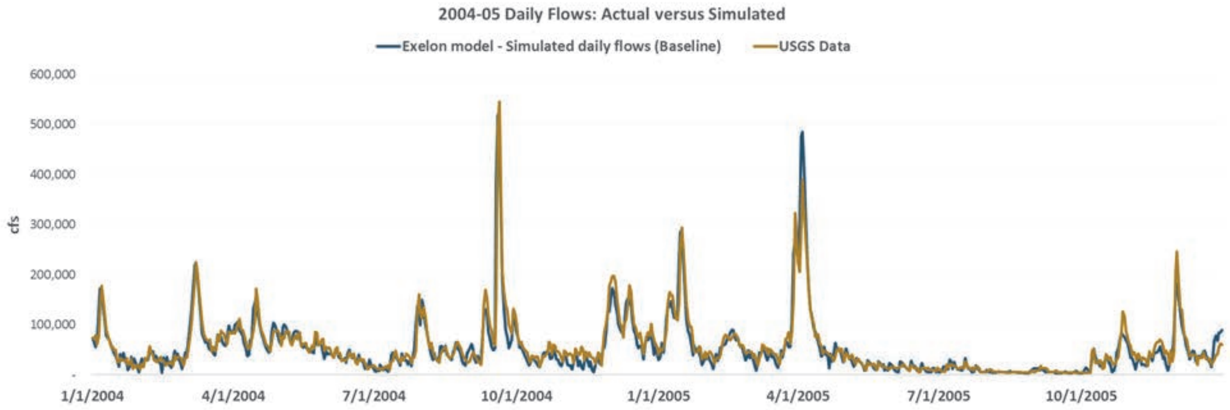



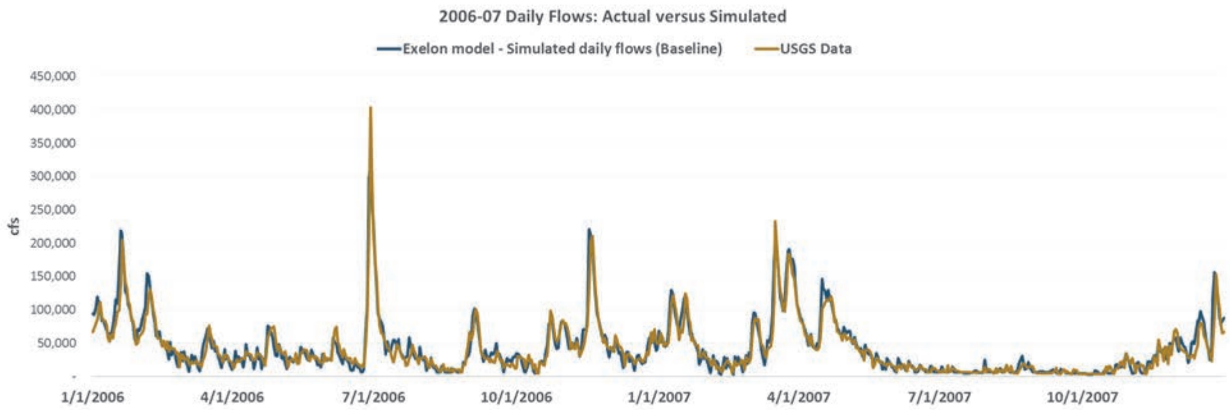



### 5.1.2 COMPARISON OF DAILY FLOWS: 2001 – 2007




2004-05 Daily Flows: Actual versus Simulated
Exelon model - Simulated daily flows (Baseline)
USGS Data
600,000
500,000
400,000
300,000
200,000
100,000
-
cfs
1/1/2004
4/1/2004
7/1/2004
10/1/2004
1/1/2005
4/1/2005
7/1/2005
10/1/2005


2006-07 Daily Flows: Actual versus Simulated
Exelon model - Simulated daily flows (Baseline)
USGS Data
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
cfs
1/1/2006
4/1/2006
7/1/2006
10/1/2006
1/1/2007
4/1/2007
7/1/2007
10/1/2007

## 5.2 Operational parameters for flow scenarios

| Scenario name | Hourly Min Flow (cfs) | | Hourly Max Flow (cfs) | | Hourly Flow Change (cfs/hr) |
|---|---|---|---|---|---|
| Base Case | Jan | 1,750 | | 86,000 cfs | 86,000 cfs |
| | Feb | 1,750 | | | |
| | Mar | 3,500 | | | |
| | Apr | 10,000 | | | |
| | May | 7,500 | | | |
| | Jun | 5,000 | | | |
| | Jul | 5,000 | | | |
| | Aug | 5,000 | | | |
| | Sept. 1-15 | 5,000 | | | |
| | Sept. 15-30 | 3,500 | | | |
| | Oct | 3,500 | | | |
| | Nov | 3,500 | | | |
| | Dec | 1,750 | | | |
| | | | | | |
| SRBC 202 | 1/1-1/31 | 10,900 | 4/1 to 11/30: | 65,000 | 20k |
| | 2/1-2/29 | 12,500 | otherwise: | 86,000 | |
| | 3/1-3/31 | 24,100 | | | |
| | 4/1-4/30 | 29,300 | | | |
| | 5/1-5/31 | 17,100 | | | |
| | 6/1-6/30 | 9,700 | | | |
| | 7/1-7/31 | 5,300 | | | |
| | 8/1-8/31 | 5,000 | | | |
| | 9/1-9/30 | 5,000 | | | |
| | 10/1-10/31 | 4,200 | | | |
| | 11/1-11/30 | 6,100 | | | |
| | 12/1-12/31 | 10,500 | | | |
| | | | | | |
| SRBC 205 | 1/1-1/31 | 10,900 | 4/1 to 11/30: | 65,000 | 5k if flow < 10k cfs |
| | 2/1-2/29 | 12,500 | otherwise: | 86,000 | 10k if flow <30k cfs |
| | 3/1-3/31 | | | | 20k of flow <86k |
| | 4/1-4/30 | Marietta flow + | | | |
| | 5/1-5/31 | intervening inflow | | | |

| | | | |
|---|---|---|---|
| | 6/1-6/15 | | |
| | 6/16-6/30 | 9,700 | |
| | 7/1-7/31 | 5,300 | |
| | 8/1-8/31 | 4,300 | |
| | 9/1-9/30 | 3,500 | |
| | 10/1-10/31 | 4,200 | |
| | 11/1-11/30 | 6,100 | |
| | 12/1-12/31 | 10,500 | |

## 5.3 Regression model for determining relationships between cumulative monthly flows and total monthly generation for Conowingo

SUMMARY OUTPUT

| ***Regression Statistics*** | |
|---|---|
| **Multiple R** | 97% |
| **R Square** | 94% |
| **Adjusted R Square** | 94% |
| **Standard Error** | 20396 |
| **Observations** | 192 |

| **ANOVA** | | | | | |
|---|---|---|---|---|---|
| | ***df*** | ***SS*** | ***MS*** | ***F*** | ***Significance F*** |
| **Regression** | 2 | 1.29316E+12 | 6.46578E+11 | 1554.221331 | 4.5487E-118 |
| **Residual** | 189 | 78626695703 | 416014263 | | |
| **Total** | 191 | 1.37178E+12 | | | |

| | ***Coefficients*** | ***Standard Error*** | ***t Stat*** | ***P-value*** | ***Lower 95%*** | ***Upper 95%*** | ***Lower 95.0%*** | ***Upper 95.0%*** |
|---|---|---|---|---|---|---|---|---|
| **Intercept** | -8.22E+03 | 3.65E+03 | -2.25E+00 | 2.56E-02 | -1.54E+04 | -1.01E+03 | -1.54E+04 | -1.01E+03 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sum of monthly flows** | 7.42E-03 | 1.99E-04 | 3.72E+01 | 6.57E-89 | 7.03E-03 | 7.81E-03 | 7.03E-03 | 7.81E-03 |
| **Sum of monthly flows squared** | -4.48E-11 | 2.14E-12 | -2.09E+01 | 5.48E-51 | -4.90E-11 | -4.05E-11 | -4.90E-11 | -4.05E-11 |