The Nature Conservancy
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Maryland/DC Chapter
425 Barlow Place, Ste. 100
Bethesda, MD 20814

Tel (301) 897-8570
Fax (301) 897-0858
nature.org

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Via electronic and first-class mail

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: Application#17-WQC-02, Lower Susquehanna River and Upper Chesapeake Bay, Use I and II Waters

Dear Mr. Ghigiarelli,

The Nature Conservancy (the Conservancy) submits these comments in response to the Maryland Department of the Environment's (MDE or Department) "Public Notice of the Proposed Relicensing of the Conowingo Hydroelectric Project Application for Water Quality Certification" (Notice issued on October 13, 2017, as updated by the Department at the December 5, 2017 public hearing).

These comments are organized as follows: Section I provides an overview of the project's performance relative to hydropower projects globally; Section II outlines our recommended conditions for Water Quality Certification; Section III provides information regarding the feasibility of recommended conditions; and Section IV concludes our comments.

I. The Conowingo Project Contributes to Impacts on Water Quality and Designated Beneficial Uses on the Susquehanna and Chesapeake Bay.

We recognize that the Susquehanna River and Chesapeake Bay are complex ecosystems with multiple sources of ecological impacts, upstream and downstream. In that context, our recommendations focus on the *incremental* impacts of Conowingo dam on these systems as they may affect state Water Quality Standards (WQS) over the term of the requested license.

The Conservancy has global expertise on hydropower and river conservation, working in dozens of countries, including the U.S., Mexico, Gabon, Columbia, China, and in the Balkans region. We work with governments, industry, NGOs and development banks to assess and support hydropower investments that provide low-carbon energy production, while sustaining the many vital services that rivers provide for people and nature.

We share the following summary to put into context our understanding of Conowingo dam's environmental performance relative to existing environmental performance criteria, guidance, thresholds and comparable privately-owned hydropower dams. The capacity (MW) of this dam is in the top 2% of privately-owned, federally licensed conventional hydropower facilities in the U.S.[1]

1. **The Conowingo project would not be built today** – When constructed, almost a century ago, we did not fully understand the environmental and social impacts of damming a river for hydropower production. Today, clear guidance emphasizes avoiding siting dams near the mouths of major coastal tributaries where they serve as a barrier for accessing key spawning habitats[2] and disrupt the patterns of timing and transport of streamflow[3] and sediment from an entire basin to its estuary.[4]

2. **The Conowingo project appears to be low-performing under the International Hydropower Sustainability Assessment Protocol (Protocol) environmental criteria[5]** – The Protocol is an internationally accredited assessment and disclosure practice that can be used at any stage of hydropower development to assess a project's sustainability. Conowingo dam would qualify for review under the 'operational stage,' criteria including environmental and social issues management (pp 172); biodiversity and invasive species (pp 199), water quality (pp 205); and downstream flow regimes (pp 205). The protocol has a gradational scoring approach with the highest score (5) indicating best practices and a mid-range score (3) indicating basic good practice. Based on the narrative guidance for each of the above criteria coupled with our understanding of the unmitigated impacts of current and proposed operations, we estimate Conowingo dam is operating at a 1 or 2 (below basic good practice). This does not constitute a formal assessment and we encourage the Department to independently review the narrative criteria in the Protocol (specific pages are referenced above).

3. **Project operations are inconsistent with U.S. Environmental Protection Agency (EPA) and U.S. Geologic Survey's (USGS) Technical Report: Protecting Aquatic Life from Effects of Hydrologic Alteration[6]** – The report provides scientific and technical support for states and Tribes to advance the protection of aquatic life from the adverse effects of hydrologic alteration in streams and rivers. It is emphasized that criteria for minimum flows alone are not sufficient for maintaining ecosystem integrity and implementation should recognize critical linkages between daily, seasonal and intra-annual variability and aquatic life-history stages, including magnitude, frequency,

[1] https://www.ferc.gov/industries/hydropower/gen-info/licensing.asp.
[2] Opperman et al. 2015. The power of rivers: finding balance between energy and conservation in hydropower development. The Nature Conservancy: Washington, D.C.; Opperman et al. 2017. The power of rivers: a business case, how system scale planning and management of hydropower can yield economic, financial and environmental benefits. The Nature Conservancy: Washington, D.C.
[3] Nilsson et al. 2005. Fragmentation and flow regulation of the world's largest river systems. Science, 308:405-408
[4] Kondolf et al. 2014. Sustainable sediment management in reservoirs and regulated rivers: experience from five continents. Earth's future 2(5):256-280
[5] International Hydropower Association 2010. Hydropower Sustainability Assessment Protocol. http://www.hydrosustainability.org/IHAHydro4Life/media/PDFs/Protocol/hydropower-sustainability-assessment-protocol_web.pdf.
[6] Novak et al. 2017. Final EPA-USGS Technical Report: Protecting Aquatic Life from Hydrologic Alteration: USGS Scientific Investigations Report 2016-5164, EPA Report 822-R-156-007, 156 p. https://www.epa.gov/sites/production/files/2016-12/documents/final-aquatic-life-hydrologic-alteration-report.pdf.

duration, timing and rate of change. Exelon's existing and proposed operations do not include these recommended critical linkages.

4. **The Conowingo Project significantly exceeds key indicators for sub-daily hydrologic alteration and flashiness**[7] – As the ratio between generation flows (high) and minimum flows increases, specialized species are often replaced by more generalist species. In a European study of 5th to 7th order rivers (Susquehanna is 8th order), rivers with less than a 2:1 ratio had an unmeasured impact, > 5:1 had a 50% loss in biomass and > 10:1 had a 95% loss in biomass. For Conowingo dam, this ratio ranges from 8:1 (Spring) to 20:1 (Summer, Fall and Winter). In addition, looking at key indicators for flashiness, Conowingo exceeded all thresholds and when compared to an upstream reference gage, exceeded them by 300% (number of reversals) to 2,500% (maximum hourly fall rate) (Exhibit A, Attachment 2, Table 2).

5. **FERC hydropower licenses for peaking dams in a similar size class and environmental setting have required more protective environmental measures**– As mentioned above, Conowingo dam is among the largest privately licensed dams in the country, and one of the few that occurs near the mouth of a coastal tributary, critical for diadromous fish migration and spawning. One of the few comparable projects in size and setting is the Skagit River Hydroelectric Project, Washington (FERC No. 553). The licensed operation of this project includes (a) instantaneous minimum flows, (b) dry and wet-year differentiation, (c) limit down-ramping to specific rates and times, (d) limit maximum average daily flows during spawning periods, (e) restriction of down-ramping amplitude, (f) monitoring and evaluation of the performance of the habitat models and (g) conduct field monitoring of migratory fish as determined by an interagency Committee.[8] While much smaller than Conowingo, Piney Hydroelectric Project, Pennsylvania (FERC No. 309), is a peaking hydropower facility that is operated in a run-of-river mode during spring spawning (April 1-May 31), as detailed in Pennsylvania Department of Environmental Protection's 401 WQC.

II. Recommended Conditions for Water Quality Standards

Under Clean Water Act section 401, Exelon must obtain water quality certification from the Department that the discharge from the Conowingo Project will comply with applicable state water quality standards.[9] In its "Application for a Maryland Water Quality Certificate for the Conowingo Hydroelectric Project" (Application), Exelon argues that its relicensing studies show "the Project, as proposed, is consistent with Maryland water quality standards." Application, p. 2.

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[7] Moog 1993. Quantification of daily peak hydropower effects on aquatic fauna and management to minimize environmental impacts. Regulated Rivers: Research & Management, 8(1-2):5-14; Poff et al. 1997. The natural flow regime. BioScience, 47(11):769-784; Bevelheimer et al. 2015. Characterizing sub-daily flow regimes: implications of hydrologic resolution on ecohydrology studies. Richer Research and Applications, 31(7):867-879; Jones and Petreman 2014. Environmental influences on fish migration in a hydropeaking river. River Research and Applications, 31(9):1109-1118; *See* Exhibit A- Attachment 2.

[8] Skagit River Hydroelectric Project. FERC No. 553. Revised Fisheries Settlement Agreement. Revised January 2011.

[9] 33 U.S.C. § 1341(a)(1); *see also* Md. Code Regs. 26.08.02.10.

The Conservancy agrees that the protection, mitigation and enhancement (PM&E) measures proposed in the Application will nominally enhance baseline conditions. However, as stated in our August 23, 2017 written comments (Exhibit A) and testimony at the public hearing, Exelon's proposed measures are inadequate to mitigate the Project's significant effects on environmental resources in the lower Susquehanna River and Upper Chesapeake Bay. Of particular concern are the proposed operations and facilities' design as they affect the physical, chemical and biological integrity of the Lower Susquehanna and Upper Chesapeake Bay. Specifically:

- The **unmitigated impact of reservoir design, storage and releases on designated uses** including: Growth and propagation of fish, other aquatic life and wildlife (year-round); Seasonal migratory fish spawning and nursery use (2/1-5/31); Seasonal Shallow-Water Submerged Aquatic Vegetation (4/1-10/30); and Open-water fish and shellfish (year-round); and

- The **unmitigated impact of reservoir design, storage and releases on the timing and quality of sediment and nutrient loads** stored in, and released from, the dam to the lower Susquehanna River and Upper Chesapeake Bay, which impede the achievement of designated uses (referenced above) and the Chesapeake Bay TMDL.

Therefore, we recommend the following conditions and actions to provide reasonable assurance that the reservoir operation and the retention and release of fill material in the waters of the Susquehanna River by Conowingo Dam, and other project activities, will not violate applicable Water Quality Standards over the term of the license. We summarize our recommended conditions in Table 1, and provide detailed explanation in the following pages.

Table 1. Overview of Proposed Conditions

Unmitigated Impact	Affected WQS	Proposed Condition or Recommendation	Page
1. Dam releases on downstream habitat	All Designated Uses referenced above & Chesapeake Bay TMDL	1.a. Proposed flow schedule	3
		1.b. Implementation and adaptive management	5
2. Migratory fish passage	Seasonal migratory fish spawning and nursery use	2. Adoption of settlement agreement	14
3. Sediment & Water Quality	All Designated Uses referenced above & Chesapeake Bay TMDL	3.a. Mitigation for excess nutrients 3.b. Mitigation for lack of coarse sediments 3.c. Completing the record and adaptive management	14
4. Uncertainty & Transparency	All Water Quality Standards	4. Certificate term and data accessibility	15

A. Operational flow releases from Conowingo dam

i. **<u>Designated uses for fish, aquatic life and wildlife.</u>**

As described in Exhibit A, existing dam operations have had a significant impact on the downstream ecosystem. Best available information, including hydraulic habitat data, biological surveys, and expert opinion, show that existing operations (Table 2, Exhibit A; Exhibit B, and Figure 1) are inadequate to support designated uses including: the growth and propagation of fish, other aquatic life and wildlife (year-round); seasonal migratory fish spawning and nursery use (2/1-5/31); seasonal shallow-water submerged aquatic vegetation (4/1-10/30); and open-water fish and shellfish (year-round). Table 2 summarizes these effects. In addition, recent studies (*see* Exhibit A, p. 12) suggest that low-flow conditions exacerbated by existing dam operations could play a role in regulating downstream export of bio-available phosphorus, further impeding the achievement of designated uses (referenced above) and the Chesapeake Bay TMDL.

ii. **<u>Proposed Condition 1.a</u>**

We recommend the Department condition any water quality certification on the flow measures described in Table 3 to mitigate incremental impacts of dam operations and support the attainment of designated uses. These recommended flow measures were supported by multiple state and federal agencies and organizations. They were included as recommended license conditions by the U.S. Fish and Wildlife Service as part of its fish and wildlife recommendations under authority of the Federal Power Act section 10(j), and endorsed by the EPA as a recommendation that should be adopted as a license condition (Exhibit B).[10] They were also recommended by the Susquehanna River Basin Commission.

As described further, below (Section III. iv. Rationale for Recommended Flow Conditions), the Conservancy, in consultation with resource agencies and other stakeholders developed ecological performance goals and used best available data, including habitat models and literature, to identify an operational alternative that would support the continued generation of economically viable, low carbon energy, while restoring the ecological and ecosystem service values of the river. The proposed condition uses the information learned from the operational scenario analysis to identify the combination of alternatives that is most likely to meet both objectives. It is based on a detailed analysis of hydrology, operations and habitat availability.

In addition, this proposed condition takes into account settlement discussions between the agencies/stakeholders and Exelon. To be clear, it is a negotiated proposal that reflects significant compromise. Consistent with the findings of our scenario analysis and relevant literature review, the proposed condition includes three components (a) a two-tiered monthly minimum flow requirement to meet persistent habitat goals for fish migration, spawning, and egg and larval development at those times of greater water availability (streamflows are above normal) and lower cost to the applicant; (b) a maximum flow during the spawning and rearing season for fish, mussels, macroinvertebrates, reptiles and amphibians

[10] Letter from John R. Pomponio (EPA) to Kimberly D. Bose (FERC) (Sept. 29, 2014), Enclosure 1, p. 4 (Exhibit B).

and SAV to support persistent habitat and restore recruitment; and (c) up- and down-ramping rates to improve the availability of aquatic habitat and reduce stranding during peaking events.

We recommend that the Water Quality Certification require implementation of the schedule for releases of water from the dam to the lower Susquehanna River (Table 3) to meet the ecological objectives outlined in Table 4. As discussed below, we recommend the flow measures be adaptively managed to ensure the Project meets the ecological objectives over the license term. As described previously, these operational components (tiered minimum flows, maximum generation flows and rates of change) are common among modern FERC hydropower licenses for peaking facilities in this size class on major coastal tributaries affecting migratory fisheries.

Table 2. Summary of existing dam operations and resulting ecological conditions

<table>
<tr><th colspan="2">Season</th><th>Min. (cfs)</th><th>Summary

Existing Ecological Conditions Attributed to Dam Operations</th></tr>
<tr><td rowspan="3">Winter</td><td>Dec</td><td>3,500</td><td rowspan="13">Diadromous and resident fish. Diadromous fish populations have been significantly reduced (American shad, river herring, striped bass, American eel, Atlantic and Shortnose sturgeon), and in some cases eliminated. Effective migration, spawning and rearing is not currently supported below the dam and overwintering habitat for juveniles and adults is highly unstable.[11] Fish stranding and mortality occur in all months in response to peaking operations. During the study year, 6% of American shad (1,400) were stranded during migration and it is estimated that 420,000 migratory and resident fish may have been stranded over the course of the study year.[11]

Macroinvertebrate community. The community below the dam is characterized as hydrologically impaired and dominated by taxa tolerant of poor habitat conditions and of species adapted to hydrologic alteration. [11]

Freshwater mussels. Populations below the dam are not viable. Recruitment of juveniles is not occurring and the age distribution is shifting toward end of the expected life span for some species. [11]

Reptiles and amphibians (including map turtle). Unstable spring basking habitats and poor winter hibernation habitats. Nesting beaches not being replenished with coarse substrates. [11]

Submerged Aquatic Vegetation. Largely absent on the Lower River below the dam. [11]

Salinity and Dissolved Oxygen to the Upper Bay. The incremental impacts of reservoir operations, in reservoir biogeochemistry and releases to the lower river and upper Bay are estimated to be small (1 to 3 percent over baseline conditions), but significant to Bay resources.[12]</td></tr>
<tr><td>Jan</td><td>3,500</td></tr>
<tr><td>Feb</td><td>3,500</td></tr>
<tr><td rowspan="4">Spring</td><td>Mar</td><td>3,500</td></tr>
<tr><td>Apr</td><td>10,000</td></tr>
<tr><td>May</td><td>7,500</td></tr>
<tr><td>June</td><td>5,000</td></tr>
<tr><td rowspan="2">Summer</td><td>July</td><td>5,000</td></tr>
<tr><td>Aug</td><td>5,000</td></tr>
<tr><td rowspan="3">Fall</td><td>Sept</td><td>5,000; 3,500</td></tr>
<tr><td>Oct</td><td>3,500</td></tr>
<tr><td>Nov</td><td>3,500</td></tr>
</table>

[11] *See* Exhibit A and its attachments for additional explanation.
[12] *See* Exhibit A,p. 12.

Table 3. The Nature Conservancy's Proposed Flow Schedule for Conowingo Dam

<table>
<tr><th rowspan="2">Month</th><th colspan="2">Minimum Flows (cfs)</th><th rowspan="2">Max. Down Ramping (cfs/hr)</th><th rowspan="2">Max. Up Ramping (cfs/hr)</th><th rowspan="2">Max. Flow (cfs)</th></tr>
<tr><th>Above normal
> Monthly Q50</th><th>Below normal
< Monthly Q50</th></tr>
<tr><td>Dec</td><td colspan="2">11,000</td><td rowspan="3">20,000</td><td rowspan="3">40,000</td><td rowspan="3"></td></tr>
<tr><td>Jan</td><td colspan="2">11,000</td></tr>
<tr><td>Feb</td><td colspan="2">12,500</td></tr>
<tr><td>Mar</td><td>30,000</td><td>24,000</td><td rowspan="4">20,000</td><td rowspan="4">40,000</td><td rowspan="4">May and
June: 65,000</td></tr>
<tr><td>Apr</td><td>35,000</td><td>29,000</td></tr>
<tr><td>May</td><td>25,500</td><td>17,500</td></tr>
<tr><td>June</td><td>14,000</td><td>10,000</td></tr>
<tr><td>July</td><td>8,500</td><td>5,500</td><td rowspan="3">10,000 if
< 30,000 cfs;
20,000 if
< 86,000 cfs</td><td rowspan="3">40,000</td><td rowspan="3">65,000</td></tr>
<tr><td>Aug</td><td>6,000</td><td>4,500</td></tr>
<tr><td>Sept</td><td>5,500</td><td>3,500</td></tr>
<tr><td>Oct</td><td>6,000</td><td>4,500</td><td rowspan="2">20,000</td><td rowspan="2">40,000</td><td rowspan="2"></td></tr>
<tr><td>Nov</td><td>11,000</td><td>6,000</td></tr>
</table>

iii. **Proposed Condition 1.b. Implementation and Adaptive Management**

We recommend the Department require adaptive management and specific procedures for implementation for condition 1.a. We outline procedures for implementation below.

USGS gage 01576000 Susquehanna River at Marietta, Pennsylvania plus intervening drainage shall be used to estimate inflow to Conowingo Pond. USGS gage 01576000 Susquehanna River at Conowingo, Maryland shall be used to estimate outflow from Conowingo Dam.

Monthly minimum flows are specified based on inflow conditions measured at USGS gage 01576000 Susquehanna River at Marietta, Pennsylvania. Long-term monthly median flows are used to designate appropriate minimum flows for March through November. For December, January, and February, required minimum flow is based on monthly Q92[13]. For other months, required minimum flow for above normal (Marietta flow greater than monthly Q50) and below normal conditions is based on monthly Q75 and P92, respectively. Conditions should be monitored, and modified as necessary, on a weekly basis.

[13] Monthly Qx refers to the streamflow that was met or exceeded, 'x' percent of the time during that month, over the period of record. For example, if the monthly Q92 for July is 5,000 cfs, that means that 92 percent of the time over the period of record, daily discharge in July was greater than or equal to 5,000 cfs.

Inflow is always greater than required minimum flow for above normal conditions. For below normal conditions, if Conowingo Pond level is equal to or less than 104.7 feet, minimum flow should equal inflow or required minimum flow, whichever is less.

Flow provided through the fish passage facilities would be counted toward the minimum flow requirements specified herein.

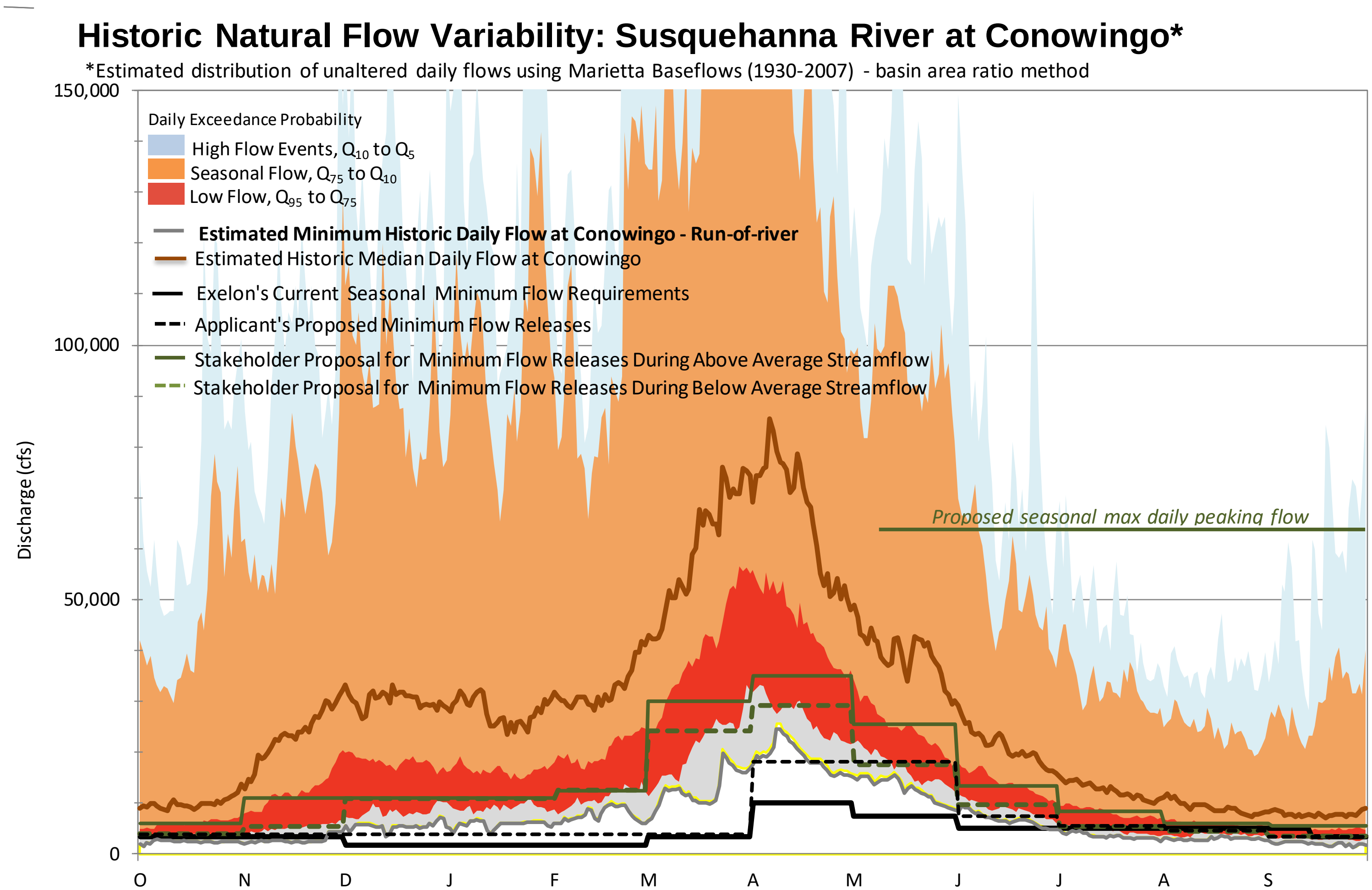
Conowingo Dam leakage is estimated to be 800 cfs. While not counted towards minimum flow requirements under existing conditions, the Conservancy's flow proposal includes 800 cfs estimated dam leakage as part of minimum flows. This eliminates the need for the current waiver process required to credit leakage toward minimum flow requirements during low flow conditions.

Meeting maximum pond level requirements should take priority over meeting the maximum flow limit. When inflow plus Muddy Run generation flow exceeds 65,000 cfs and Conowingo Pond is full, operations should maintain pond level. When inflow plus Muddy Run generation flow exceeds 65,000 cfs and Conowingo Pond is not full, excess flow can be used to build additional storage for generation. This helps avoid impacts to Muddy Run operations and Conowingo flood operations.

Adaptive Management. In order to ensure that implementation of the flow schedule, in combination with other PM&E measures, is improving river habitat conditions to attain designated uses, we recommend that the Department establish an inter-organizational Aquatic Habitat Restoration Plan Committee to provide coordinated technical review regarding the effectiveness of implementation in achieving designated beneficial uses, and recommendations for modifications in the event required measures are inadequate to achieve such uses.

The Department should specify the range of adjustments that can be made under the adaptive management program without need for further hearing. MDE shall, with this Committee's recommendation, also specify procedures (including schedule) for evaluation, monitoring requirements, adjustments, etc.

Data and summary reports should be made publicly available and electronically accessible. Information gathered will be used to inform changes to minimum flow releases, maximum generation flows and ramping rates to ensure operations provide reasonable assurance of supporting the designated uses of the river.



Designated Uses	
	Growth and Propagation of Fish (not trout), other Aquatic Life and Wildlife
	Migratory Fish Spawning, Nursery Use
	Seasonal Shallow Water Submerged Aquatic Vegetation
	Open-water Fish and Shellfish

Figure 1. TNC recommended flow schedule as compared to the existing schedule, Exelon's proposal and underlying designated uses.

iv. Rationale for Recommended Flow Conditions

Given the existing and significant adverse impacts of Conowingo dam's peaking operations on the lower Susquehanna ecosystem, several agencies and organizations[14] have coordinated over the relicensing process to develop fundamental ecological objectives for flow restoration (Table 4, Column I). The Conservancy and stakeholders used information published in the Initial Study Reports, scientific literature, and obtained through interagency consultation to develop several alternative operating scenarios that would likely achieve these ecological objectives consistent with applicable water quality standards,[15] and to identify measurable habitat goals and thresholds (Table 4, Column II and Exhibit A, Attachment 2) that could be used to evaluate success. As is common practice in the development of flow schedules to meet the regulatory requirements for peaking hydropower projects, hydraulic habitat models and persistent habitat measures[16] were used to compare the relative performance between scenarios across species and life stages– and serve as a proxy for population response models.

Table 4. Summary of key ecological objectives and measures below Conowingo[17]

Fundamental Ecological Objectives for Flow Restoration	Metrics and Measures
1. **Diadromous fish**. Support safe and effective migration, spawning, egg and larval development and overwintering.	• Provide at least 50% of maximum persistent habitat for spawning and egg and larval development. • Target 70% maximum weighted usable area across mobile species and life stages.[18] • Avoid fish stranding during migration and spawning. • Provide suitable near- and far-field attraction flows for migrating fish to support lift entry. • Provide suitable habitat for American eel and juvenile shad outmigration.

[14] Susquehanna River Basin Commission, Maryland Department of Natural Resources, Maryland Department of the Environment, Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, US Fish and Wildlife Service, National Oceanic and Atmospheric Administration, American Rivers, The Chesapeake Bay Foundation and The Nature Conservancy.
[15] *See* Md. Code Regs. 26.08.02.02B(1)(d) - (2)(a)).
[16] In these proceedings, 'persistent habitat,' is the habitat that remains available throughout peaking cycles for species and life stages with low mobility. Please see testimony by instream flow habitat expert Claire Stalnaker (Exhibit A) for further information on the importance of using this metric to assess the performance at peaking hydroelectric dams.
[17] *See* Exhibit A, Attachment 2 for detailed description of habitat suitability thresholds and supporting references.
[18] As referenced in Exhibit A, Attachment 3, in assessing habitat availability below a peaking hydroelectric dam, maximum weighted usable area is an inadequate stand-alone metric, therefore results should be interpreted with caution and within the context of habitat that remains available over the broader flow schedule. Habitat duration analysis (e.g. effective habitat or persistent habitat) is necessary to accurately predict suitable fish habitat in a peaking reach.

2.	**Resident fish and macroinvertebrates.** Restore native assemblages of macroinvertebrates and fish and productivity by restoring habitat (persistent habitat and maximum weighted usable area) for spawning, egg and larval development and over-wintering.	• Provide at least 50% of maximum persistent habitat for species and life stages with low mobility. • Target 70% maximum weighted usable area across mobile species and life stages. • Avoid stranding related mortality in all seasons.
3.	**Freshwater mussels.** Restore recruitment of freshwater mussels by maintaining suitable habitat for spawning (including host-fish habitat), brooding and juvenile development.	• Provide at least 50% of available mussel habitat with suitable shear stress at high flows.[19] • Provide suitable habitat for host-fish during spawning. • Provide suitable overwinter habitat for brooding mussels.
4.	**State & Federally Endangered species.** Restore population viability.	• Increase stability and suitability (depth and velocity) of seasonal habitats for map turtles (basking, reproduction and hibernation) and sturgeons (migration, spawning and egg and larval development).
5.	**Submerged and emergent aquatic vegetation.** Restore SAV beds by increasing the stability and availability of shallow-water habitats.	• Increase the stability and availability of shallow-water habitats (persistent shallow habitats).
6.	**Salinity and Dissolved Oxygen in the Upper Bay.** Maintain suitable salinity and DO gradients under low flow conditions in the Upper Bay.	• Modeled relationship between extreme storm and drought events, reservoir biogeochemistry and water quality criteria in the lower river and upper bay.

Flow alternatives reflect a broad range of scenarios, from baseline (current) to run-of-river operations, and include iterations of increases to minimum flow releases, seasonal maximum flow releases, and rates of change. Alternatives were analyzed explicitly to identify those scenarios that would improve the probability of meeting fundamental ecological objectives, while maintaining a viable low-carbon hydroelectric project. The alternatives analyses included the following key findings (Table 5; Exhibit A, Attachment 2):

- **Cost and electricity generation.** All alternative operational scenarios resulted in a net gain of total electricity, but a net loss in revenue. This is due to the energy required for pumped storage (Muddy Run) and the timing and current pricing associated with meeting peak energy demands.

- **Best ecological performance.** Run of river maximized the habitat benefits across species and life stages and performed best against all ecological objectives. It also had the highest costs – an estimated 6% of annual revenues (Figure 2).

[19] *See* Exhibit A, Attachment 2, App. 1. Higher flows limit mussel habitat availability. Study 3.16 developed an empirically-based habitat suitability curve. When discharge is less than 65,000 cfs, 50% of total current habitat is available.

- **Lowest ecological performance.** The baseline scenario (current flows) had the lowest ecological performance (Exhibit A, Attachment 1-App1) and did not meet ecological objectives for fish, mussels, macroinvertebrates, threatened and endangered species or SAV.

- **Minimum flows.** All alternatives with a monthly Q92[20] minimum failed to consistently meet the ecological objectives for habitat for fish or macroinvertebrates. Minimum flows higher than the Q92 were required to meet ecological objectives.

- **Seasonal maximum flows (spawning season).**
  - Only the alternatives with a seasonal maximum flow provided sufficient suitable mussel habitat.
  - All alternatives with a paired maximum and minimum flow, met persistent habitat goals for diadromous fish spawning and egg and larval development.

- **Ramping rates (or Rate of Change (ROC))**.
  - Ramping rates improved the percent of time that habitat goals were met in wet and dry years. In addition, the moderate down-ramping rate (20,000 cfs/hour when discharge is > 30,000 cfs) and 10,000 cfs/hour when discharge is < 30,000 cfs) was predicted to reduce the risk of stranding by not reducing wetted width by more distance than swimming ability, on an hourly basis.

- **Meeting environmental and economic objectives.**
  - Three alternatives failed to meet ecological objectives including the baseline, a scenario with a minimum release of monthly Q92 and maximum seasonal generation of 86,000 cfs, and a scenario with a minimum release of monthly Q92 and a minimally restricted rate of change.
  - Alternatives that met some to most ecological objectives are estimated to cost 1 to 3 percent of annual revenue.
  - The alternative that met or exceeded all measures (run-of-river) is estimated to cost 6% of annual revenue.

If the existing flow schedule were adopted in the new license, we would expect the ecological conditions articulated in Tables 2 and 5 to persist. Similarly, relative to the historic streamflows and hydraulic habitat availability for the lower Susquehanna, the Applicant's proposed changes to the flow schedule vary minimally from existing operations (Figure 1). Therefore, it is reasonable to expect that the Applicant's proposal will cause the adverse effects under existing operations on fish and aquatic life (observed, measured and modeled), to persist over the new license term.

[20] Monthly Qx refers to the streamflow that was met or exceeded, 'x' percent of the time during that month, over the period of record. For example, if the monthly Q92 for July is 5,000 cfs, that means that 92 percent of the time over the period of record, daily discharge in July was greater than or equal to 5,000 cfs.

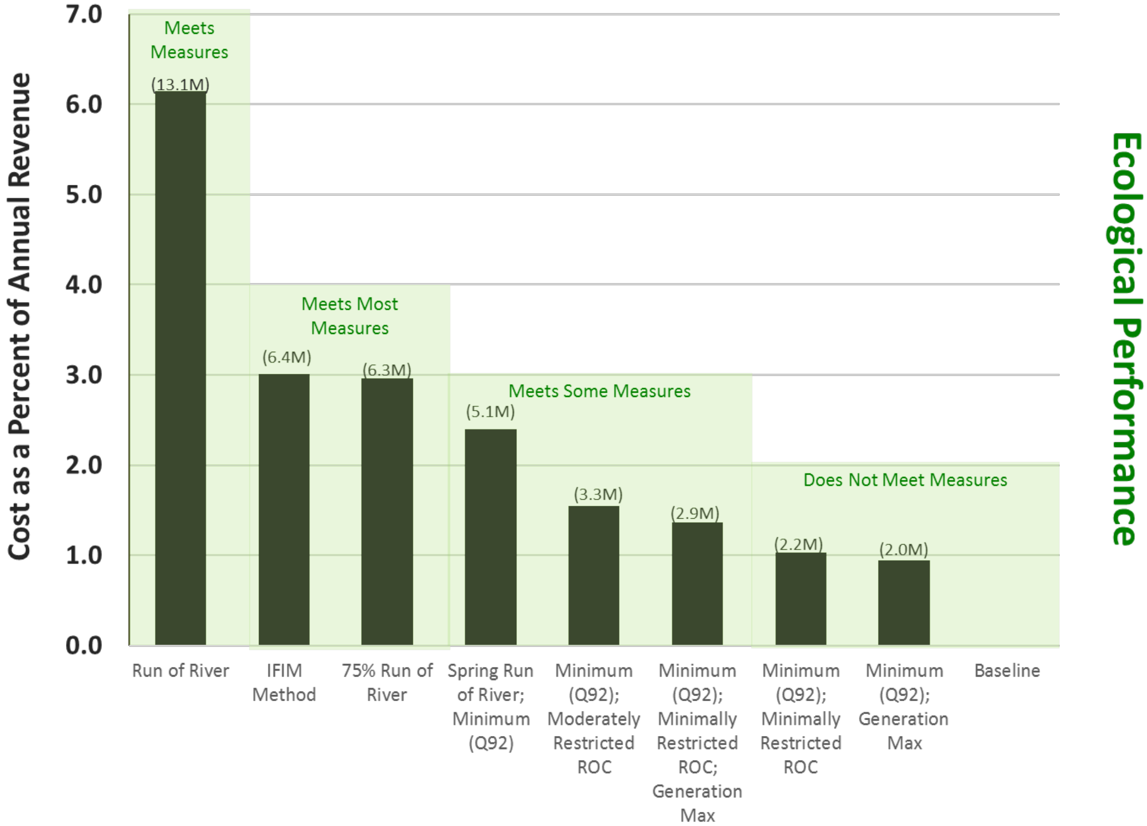


Figure 2. A comparative summary of operational scenarios including cost of the scenario as a percent of current annual revenues (Final License Application) and ecological performance (Exhibit A, Att. 2).

Table 5. Percent of habitat available[21] across scenarios including Existing Operation (baseline), Applicant's Proposed Operation, the Conservancy's Proposed Operation, and Run of River scenario. Cells shaded in yellow are less than the objective threshold and cells shaded in green meet or exceed the ecosystem objective threshold (objective thresholds defined in Table 4).

Period	Target Species & life stage	Existing Operations	Applicant's Proposed Operations	The Conservancy's Proposed Operations		Run of River
				below normal	above normal	
March	Shortnose sturgeon juveniles	56	61	96.7	100	96.7
	Shortnose sturgeon adults	56	61	96.7	100	96.7
	*River herring spawning**	*4*	*5*	*7*	*10*	*20*
	Far-field attraction flows for fish migration[22]					
	Smallmouth bass adults	73	77	96	90	58.7
	*Trichoptera**	*6*	*5*	*20*	*25*	*60*
April	*American shad spawning**	*7*	*30*	*47*	*52*	*98*
	*American shad fry**	*20*	*27*	*39*	*50*	*96*
	*Striped bass spawning**	*10*	*34*	*55*	*63*	*96*
	*Striped bass fry**	*7*	*34*	*67*	*72*	*99*
	*Shortnose sturgeon spawning**	*26*	*47*	*67*	*70*	*94*
	*Shortnose strugeon fry**	*16*	*21*	*27*	*30*	*82*
	*River herring spawning**	*5*	*5*	*7*	*8*	*20*
	Far-field attraction flows for fish migration					
	Reduced risk of fish stranding	No	No	Yes		Yes
May	*American shad spawning**	*2*	*25*	*37*	*56*	*67*
	*American shad fry**	*14*	*27*	*52*	*66*	*80*
	*Striped bass spawning**	*4*	*33*	*59*	*79*	*85*
	*Striped bass fry**	*4*	*24*	*35*	*60*	*69*
	*Shortnose sturgeon spawning**	*14*	*51*	*50*	*64*	*69*
	*Shortnose strugeon fry**	*11*	*21*	*34*	*50*	*96*
	*River herring spawning**	*5*	*5*	*8*	*10*	*43*
	Reduced risk of fish stranding	No	No	Yes		Yes
June	*American shad fry**	10	14	29	49	70
	American shad juvenile	94	98	100	100	100
	*Striped bass fry**	1	3	13	35	45
	Striped bass juvenile	58	68	75	83	83
	*Smallmouth bass spawning**	2	2	7	9	60
	Smallmouth bass adults	82	93	98	100	99
	Increase suitable mussel habitat (scour threshold)	No change	No change	Yes	Yes	Yes
	*Trichoptera**	*5*	*9*	*23*	*27*	*96*

[21] This comparison relies on look-up tables from Study 3.16. In order to get a better understanding of the habitat availability below a peaking plant the scenarios should be modeled and a duration analysis should be compared.
[22] Far-field attraction flows provide migratory cues for diadromous fish downstream from the dam. These flows were recommended by the U.S. Fish and Wildlife Service as providing the necessary cue and documented in their 10(j) recommendation.

Table 5. Continued

Period	Target Species & life stage	Existing Operations	Applicant's Proposed Operations	The Conservancy's Proposed Operations below normal	The Conservancy's Proposed Operations above normal	Run of River
July	*American shad fry**	10	10	15	20	52
	American shad juvenile	94	94	94	99	99
	Striped bass juvenile	59	59	59	70	75
	*Smallmouth bass fry**	5	5	9	10	73
	Smallmouth bass adults	82	82	82	95	98
	Increase suitable mussel habitat (scour threshold)	No change	No change	Yes	Yes	Yes
	*Trichoptera**	*7*	*7*	*13*	*20*	*96*
August	American shad juvenile	94	90	90	96	98
	Striped bass juvenile	58	53	53	60	75
	Smallmouth bass juvenile	99	100	100		96
	Smallmouth bass adults	82	75	75	87	93
	Increase suitable mussel habitat (scour threshold)	No	No change	Yes	Yes	Yes
	*Trichoptera**	*6*	*5*	*13*	*18*	*92*
Sept	American shad juvenile	87 to 94	87	87	94	100
	Striped bass juvenile	50 to 58	50	50	58	75
	Smallmouth bass juvenile	99 to 100	99	99	100	91
	Smallmouth bass adults	72 to 82	72	72	82	98
	Increase suitable mussel habitat (scour threshold)	No	No change	Yes	Yes	Yes
	*Trichoptera**	5 to 7	5	13	20	99
Oct-Nov	American shad juvenile	87	90	92	99	97
	Striped bass juvenile	49	52	56	75	89 to 95
	Smallmouth bass juvenile	99	100	89	100	60 to 64
	Smallmouth bass adults	74	76	76	98	95 to 100
	Increase suitable mussel habitat (scour threshold)	No	No change	Yes	Yes	Yes
	*Trichoptera**	*5 to 7*	*5*	*13*	*15*	*81*
	Suitable depth of map turtle hibernacula	No	No	Yes		Yes
Dec-Feb	Shortnose sturgeon juveniles	56	61	82	87	97
	Shortnose sturgeon adults	56	61	82	87	97
	Smallmouth bass juveniles	99	100	91		64
	Smallmouth bass adults	73	77	98	99	95
	Overwintering adult Striped bass	18	20	45	50	91
	Reduced risk of fish stranding	No	No	Yes		Yes
	Increase overwintering habitat for brooding mussels	No	No	Yes		Yes
	Increase availability of suitable aquatic hibernacula	No	Minimal	Yes		Yes
	*Trichoptera**	*5*	*5*	*12*	*15*	*50 to 80*

B. Migratory Fish Passage

i. Designated uses for seasonal migratory fish spawning and nursery use (2/1-5/31)

As outlined in Exhibit A, and relevant filings, we believe project operations have had a significant impact on diadromous fish migration and spawning in the Susquehanna River over the current license term.

As described in the Application (*see* pp. 36-38), Exelon made several commitments in the Conowingo Hydroelectric Project Settlement (April 21, 2016) (Fish Passage Settlement Agreement) to improve migratory fish passage in an effort to operate in a manner that supports the fish passage goals established in Amendment 3 of the Interstate Fishery Management Plan and the 2010 SRAFRC Migratory Fish Management and Restoration Plan.

In additions to Proposed Condition 1a, we believe these commitments will be fundamental to ensuring the facility is operated in a way that supports the designated use for seasonal migratory fish spawning by ensuring safe and effective up- and downstream migration throughout the project area.[23] In addition, as outlined in Exhibit A (*see* pp. 5), we have outstanding concerns.

ii. Proposed Condition 2

We recommend that the Department incorporate the Fish Passage Settlement Agreement in its Water Quality Certification conditions. As the state water quality agency, it is important for MDE to have the ability to independently enforce the measures in the agreement that are necessary to comply with water quality standards.

In order to ensure that investments include best practicable control technology currently available,[24] we recommend the certification be conditioned to revisit the expected population size and adjusted passage efficiency calculations in 2030 (*see* Proposed Condition 4), and, if populations remain lower, investigate whether it is reasonable to revisit an express limitation on the use of trap and transport to meet passage efficiency goals during the second half of the license term, so as not to delay durable investments in structural and operational improvements to the dam.

C. Sediment and Water Quality

i. Designated uses for fish, wildlife and aquatic life

As documented in the Final License Application and Exhibit A, the Project has incremental and measurable impacts on sediment and water quality conditions in the Lower Susquehanna River and Upper Chesapeake Bay, affecting compliance with applicable state water quality standards and the Chesapeake Bay TMDL. These impacts are caused by

[23] *See* Md. Code Regs. 26.08.02.02.B(1)(d) - (2)(a)).
[24] *See* Md. Code Regs. 26.08.01.02.D.

- increased frequency of scour events that mobilize sediment and associated nutrients stored in the reservoir and decreased potential for deposition;[25]
- artificially low flow conditions in warm, summer months that potentially increase bioavailability of nutrients;[26] and
- near 100% retention of coarse sediments,[27] which causes habitat substrate starvation and degradation downstream of the dam[28]

In addition to altering the amount and timing of nutrients, the record indicates that living resources are negatively affected by the lack of coarse substrate in the project area below Conowingo dam. This lack of coarse substrate, which results from the presence and operation of Conowingo dam, has and will continue to have significant implications for the amount of quality habitat available to priority species, such as American shad, river herring, Shortnose and Atlantic sturgeon, map turtle, freshwater mussels, submerged aquatic vegetation and potentially habitats further downstream into the Chesapeake Bay.

ii. <u>Proposed Condition 3a</u>

We recommend that the Department incorporate a condition that requires mitigation for the incremental addition of nutrients caused by reservoir storage and release (during both low- and high-flow conditions) on water quality in the Lower Susquehanna River and Upper Chesapeake Bay, so that these waterbodies are in attainment with Maryland's Water Quality Standards and the Chesapeake Bay TMDL. We recommend that the Department, in coordination with the Chesapeake Bay Program and its partners, calculate the amount of nutrient mitigation required considering: a) available information in the record, including studies of scour during high flows and release of phosphorus under low flow conditions from the reservoir, b) the most recent watershed models (i.e., Phase 6 of the Chesapeake Bay Watershed Model), and c) the effects of climate change on the frequency of scour events. Our colleagues at the Chesapeake Bay Foundation have proposed an approach to estimate this mitigation in their comments.

As described in Appendix A, the record indicates there is limited feasibility to accomplish proposed mitigation through direct reservoir management, including dredging. We therefore recommend that MDE enable the required mitigation to be accomplished on the basis of cost-effectiveness as performed throughout the Susquehanna River watershed, including prioritizing those efforts that provide a permanent reduction of excess nutrients.

iii. <u>Proposed Condition 3b</u>

We recommend that the Department incorporate a condition requiring mitigation for the loss of coarse sediments (i.e., sand, gravel and cobble) within the project area downstream of Conowingo dam

[25] Hirsch, R.M., 2012. Flux of Nitrogen, Phosphorus, 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 Reservoir Sedimentation on Water Quality Scientific Investigations. Reston, VA.
[26] Friedl, G. and A. Wüest, 2002. Disrupting Biogeochemical Cycles - Consequences of Damming. Aquatic Sciences 64:55–65.
[27] URS Corporation and G. and S. Engineers, 2011. SEDIMENT INTRODUCTION AND TRANSPORT STUDY RSP 3.15 CONOWINGO HYDROELECTRIC PROJECT FERC PROJECT NUMBER 405.
[28] Auel, C., S. Kobayashi, T. Sumi, and Y. Takemon, 2017. Effects of Sediment Bypass Tunnels on Sediment Grain Size Distribution and Benthic Habitats. 13th International Symposium on River Sedimentation: 825–832.

and to the Chesapeake Bay; these measures should be sufficient to achieve the related fundamental ecological objectives outlined in Table 3.

iv. Proposed condition 3.c.

We recommend the Department incorporate a condition which designates a monitoring and adaptive management approach to proposed conditions 3a and 3b, as described below.

Monitoring programs should be designed to evaluate areas where the record is incomplete, including but not limited to outstanding questions about the relationship between reservoir operations, sediment storage, release and related water quality:

1. **Bathymetric surveys** following major storm events (i.e., greater than 175K cfs or a return interval of one to two years[29] and consistent with current estimated minimum scour threshold[30]) to characterize active scour and deposition zones within the reservoir system and its response to extreme weather events.

2. **Bathymetric surveys** conducted annually to estimate delivered loads and to provide additional information for tracking long-term trends in watershed sediment yield and also of the reservoir every five years, and after major scour events (> 275,000 cfs) to characterize the integrated impacts of upstream sediment contributions and internal reservoir depositional and scouring patterns.

3. Strategically designed **sediment studies** linked to water quality measurements at the Conowingo gauge to better understand sediment turnover within the reservoir and release to downstream waters.

4. **Water quality surveys** in the reservoir during warm conditions (when the average monthly high temperature is greater than 23°C) and during low flow conditions (less than 20,000 cfs) to better understand anaerobic conditions in the reservoir and associated release of nutrients. Further, this program should evaluate whether proposed condition 1a (i.e., the flow schedule) can ameliorate the potential for anaerobic conditions in the reservoir and associated release of nutrients. [31]

We also recommend that the Department establish an inter-organizational Water Quality Committee to provide appropriate review, coordination and direction regarding the effectiveness of implementation in achieving designated beneficial uses, while maintaining the economic viability of the Project. The Department shall, with this Committee's recommendation, also specify the frequency of evaluation, monitoring and reporting requirements, adjustments, etc. Given the proposed 40-year time

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[29] Gomez and Sullivan, 2011. Sediment Introduction and Transport Study RSP3.15 Conowingo Hydroelectric Project Report. FERC Project Number 405.

[30] Hirsch, R.M. 2012, Flux of Nitrogen, Phosphorus, and Suspended Sediment from the Susquehanna River Basin to the Chesapeake Bay during Tropical Storm Lee, September 2011, as an Indicator of the Effects on Reservoir Sedimentation on Water Quality.

[31] *See* the following studies documenting the dynamics of reservoir chemistry, including nutrient release under low flow conditions: Edwards, R.E., 2006. Comprehensive Analysis of the Sediments behind Hydroelectric Dams of the Lower Susquehanna River, Report 239; Friedl, G. and A. Wüest, 2002. Disrupting Biogeochemical Cycles - Consequences of Damming. Aquatic Sciences 64:55–65; Cornwell, unpublished data, presented to CBP at https://www.chesapeakebay.net/channel_files/23394/cornwell_jan_2015_modeling.pdf.

frame of the license, we recommend that the Department provide an opportunity to revisit the adopted mitigation strategies on a regular basis (e.g., every five years) and to adjust those strategies accordingly, based on increasingly refined understanding of watershed and reservoir sediment dynamics likely to evolve during those intervals.

D. Certificate Term

While the Department may support issuance of a 46-year FERC license for the Conowingo Project, the FERC licenses for the Holtwood Hydroelectric Facility, Safe Harbor Hydroelectric Facility and the 401 Certificate for Muddy Run Pumped Storage Facility will expire or be revised much sooner, in 2030. Given that these other projects are hydrologically linked to the Conowingo Project, and cumulatively affect water quality and resources in the lower Susquehanna and Chesapeake Bay, we recommend that the Conowingo Water Quality Certification also be conditioned on review and reopener in 2030, as appropriate, to coordinate and update project operations and mitigation measures with other projects as necessary to protect water quality.

III. Feasibility of proposed conditions and economic viability of the project

Understanding that the proposed conditions have potentially substantial financial costs, the Conservancy and Chesapeake Bay Foundation commissioned an economic analysis to assess 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, "An Economic Analysis of the Conowingo Hydroelectric Generating Station," is submitted as Exhibit C.

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. The analysis used publicly available information (proprietary data was not available), including river flow information and market data to develop estimates for electricity generation and associated market revenues for a variety of operational scenarios. Estimates for the total revenues 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 study also identified the opportunity for additional revenue to be generated should Conowingo apply for and be granted access to renewable energy markets. In some cases, access to these markets for hydropower, requires meeting environmental performance criteria. The study found that renewable energy markets could offset a significant amount of the costs of proposed mitigation.

In addition, we understand that operations at Conowingo affect pumped storage potential and associated revenues for Muddy Run. Figure 2 (Section III iv.) compares the costs of various operational scenarios at both Muddy Run and Conowingo to annual revenues for both Projects. Implementation of The Conservancy's recommendations is expected to cost less than 2% of annual revenues as filed in the Final License Application.

IV. <u>Conclusion</u>

The Conservancy thanks the Department for the opportunity to comment on the Application. We request that the Department consider the recommendations and new information provided herein, and grant the requests for further procedures as described in Exhibit A. We support and incorporate by reference the substantive comments of the Chesapeake Bay Foundations.

We reserve the right to supplement these comments as new or additional information that is relevant to the proposed certification becomes available. We look forward to participating in future public processes and otherwise assisting the Department in the development of the record for this proceeding. To this end, we renew our request that MDE publish the draft water quality certification for public review and comment.

Respectfully submitted,

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Mark Bryer

Director, Chesapeake Bay Program

Attachments

Exhibit A. August 23, 2017 Comments

Exhibit B. EPA September 29, 2014 Letter to FERC

Exhibit C. “An Economic Analysis of the Conowingo Hydroelectric Generating Station”

Exhibit A

WATER AND POWER LAW GROUP PC
2140 SHATTUCK AVENUE, STE. 801
BERKELEY, CA 94704-1229
(510) 296-5588
(866) 407-8073 (E-FAX)

August 23, 2017

Via electronic and first-class mail

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

Dear Mr. Ghigiarelli,

The Water and Power Law Group PC submits these comments on behalf of The Nature Conservancy (the Conservancy) in response to the Maryland Department of the Environment's (MDE or Department) "Public Notice of the Proposed Relicensing of the Conowingo Hydroelectric Project Application for Water Quality Certification" (Notice) issued on July 10, 2017. We thank the Department for extending the comment deadline to August 23, 2017.

These comments are organized as follows: Section I describes the Conservancy's significant interests in ensuring that the Conowingo Project complies with applicable water quality standards for the lower Susquehanna River and Chesapeake Bay; Section II describes our concerns regarding the project's impacts on sediment and nutrient loads into Chesapeake Bay, and on designated uses for fish, aquatic life, and wildlife; Section III states our recommendations for further procedures on Exelon's application prior to hearing; and Section IV provides concluding remarks.

I. The Conservancy Is an Interested Party.

The Conservancy is a private, non-profit 501(c)3 organization with membership and operations throughout the Susquehanna River and Chesapeake Bay Watersheds and around the globe. The Conservancy's mission is to conserve the lands and waters on which all life depends. It is a science-based organization that works with partners to identify and implement solutions to complex conservation problems. It has over one million members world-wide.

As the United States' largest estuary, the Chesapeake Bay is an iconic feature that provides important ecological services along with employment, food, and recreation for millions of people. It also serves as a home for more than 3,600 species and is a crucial nursery for many fish and birds that migrate up and down the Atlantic coast and beyond. The health of the

Chesapeake is directly connected to the Susquehanna River, its largest tributary and the largest river on the East Coast of the United States. In addition to its ecological role, the Susquehanna River provides a critical source of drinking water to millions, unparalleled recreational opportunities, and power generation for the Mid-Atlantic region. Due to their enormous economic and ecological values, the Susquehanna River and the Chesapeake Bay are conservation priorities for the Conservancy.

Beyond restoration of these important places, the Conservancy is working globally to ensure a sustainable path to a low-carbon energy future. Our goals for the certification proceeding include the support of low-carbon electricity while: (1) restoring self-sustaining migratory fish populations by improving access to historic habitats above the Conowingo dam; (2) restoring habitat below the dam to restore populations of fish, mussels, turtles, submerged aquatic vegetation (SAV), and other aquatic life; and (3) improving water quality and sediment transport patterns in the Lower River and Upper Chesapeake Bay.

In addition to its organizational interests, the Conservancy represents individual members who use and enjoy the Susquehanna River and Chesapeake Bay for water supply, recreation, including fishing and boating, and their livelihoods.

The Conservancy, particularly its Pennsylvania and Maryland/DC Chapters and Chesapeake Bay Program, has interests that will be directly affected by the outcome of the Department's decision on Exelon Generation Corporation's (Exelon) application for Clean Water Act (CWA) section 401 certification for the Conowingo Project (Application #17-WQC-02). The Conservancy is also a party to the related hydropower relicensing before the Federal Energy Regulatory Commission (FERC).

II. <u>Exelon's Application Does Not Yet Demonstrate that the Proposed Project Will Comply with Water Quality Standards</u>.

The Conservancy agrees that the proposed protection, mitigation, and enhancement (PM&E) measures proposed in Exelon's Application for a Maryland Water Quality Certificate for the Conowingo Hydroelectric Project (hereafter, Application), will nominally enhance baseline conditions. However, we find the proposed measures are inadequate to mitigate the Conowingo Project's (Project's) known and significant effects on environmental resources in the lower Susquehanna River and Upper Chesapeake Bay.

The CWA and Maryland law require more than minimum protection. CWA section 101(a)[1] declares: "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

In furtherance of this goal, CWA section 401(a)(1), 33 U.S.C. §1341(a)(1), provides:

> Any applicant for a Federal license or permit to conduct any activity . . . which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency

[1] 33 U.S.C. § 1251(a).

> a certification from the State in which the discharge originates or will originate . . . that any such discharge will comply with the applicable provisions of sections 1311, 1312, 1313, 1316, and 1317 of this title.[2]

Thus, the certification must assure that the Conowingo Project will comply with state water quality standards for the term of any new FERC license.[3] State water quality standards consist of designated uses, the water quality criteria necessary to protect such uses, and the anti-degradation standard.[4] Thus, "a project that does not comply with a designated use of the water does not comply with the applicable water quality standards."[5]

The certification must also assure compliance with the Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment (Chesapeake Bay TMDL), which was approved under CWA section 303(d).[6] Under the Chesapeake Bay TMDL, MDE is required to demonstrate that it is making "sufficient progress" toward meeting the TMDL allocations through implementation of Watershed Implementation Plan (WIP) and other actions. If sufficient progress cannot be shown, MDE may be required to undertake additional actions to achieve the required nitrogen, phosphorus, and sediment load reductions that MDE has determined are necessary to protect designated beneficial uses.[7]

In the sections below, we describe why the Application does not provide a reasonable assurance of compliance with applicable state water quality standards, including the Chesapeake Bay TMDL. More detailed explanation is provided in the Attachments.

Of particular concern are the current and proposed design and operations as they affect the physical, chemical, and biological integrity of the Lower Susquehanna and Upper Chesapeake Bay. Specifically:

- The **unmitigated impact of reservoir design and releases to support designated uses** including: Growth and propagation of fish, other aquatic life and wildlife (year-round); Seasonal migratory fish spawning and nursery use (2/1-5/31); Seasonal Shallow-Water Submerged Aquatic Vegetation (4/1-10/30); and Open-water fish and shellfish (year-round); and

- The **unmitigated impact of reservoir storage and releases on the timing and quality of sediment and nutrient loads stored** in the reservoir above the dam, which are released to the lower Susquehanna River and Upper Chesapeake Bay.

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[2] 33 U.S.C. § 1341(a)(1); *see also* Maryland ADC § 26.08.02.10.A(1).
[3] *See id. See also* Maryland ADC §§ 26.08.02.01 ("To protect surface water quality, this State shall adopt water quality standards to: (1) Protect public health or welfare; (2) Enhance the quality of water; (3) Protect aquatic resources; and (4) Serve the purposes of the Federal Act."), 26.08.02.02 (Designated Uses), 26.08.02.04 (Anti-Degradation Policy).
[4] 33 U.S.C. § 1313(c)(2)(A); 40 C.F.R. §§ 131.10 – 131.12; *PUD No. 1 of Jefferson County v. Washington Dept. of Ecology*, 511 U.S. 700, 715 (1994).
[5] *PUD No. 1 of Jefferson County v. Washington Dept. of Ecology*, 511 U.S. at 715.
[6] 33 U.S.C. § 1313(d).
[7] *See* Chesapeake Bay TMDL, pp. 7-11 – 7-12.

A. Impacts on the designated uses for fish, aquatic life, and wildlife

As stated above, the Conservancy is concerned that Exelon's Application does not accurately describe project impacts to designated uses of project waters, which include but are not limited to: Growth and Propagation of Fish (not trout), Other Aquatic Life and Wildlife; Leisure Activities Involving Fishing; Seasonal Migratory Fish Spawning and Nursery Use; and Seasonal Shallow-Water Submerged Aquatic Vegetation Use.[8] It also does not propose PM&E measures that would mitigate impacts on these uses.

1. Migratory fish passage

Conowingo dam blocks 98% of historic migratory spawning habitat on the Susquehanna River for fish including American shad, river herring, and American eel.[9] Efforts to pass migrating fish through the existing lifts have largely failed, with American shad passage remaining at less than 1 percent of population restoration goals (Figure 1). Regional stocks of native diadromous species remain relicts, well below sustainable thresholds.[10] In addition to the ecological benefits of restoration, it is estimated that a restored stock of American shad on the Susquehanna River could produce 500,000 angler days valued at $25 to $37 million annually.[11]

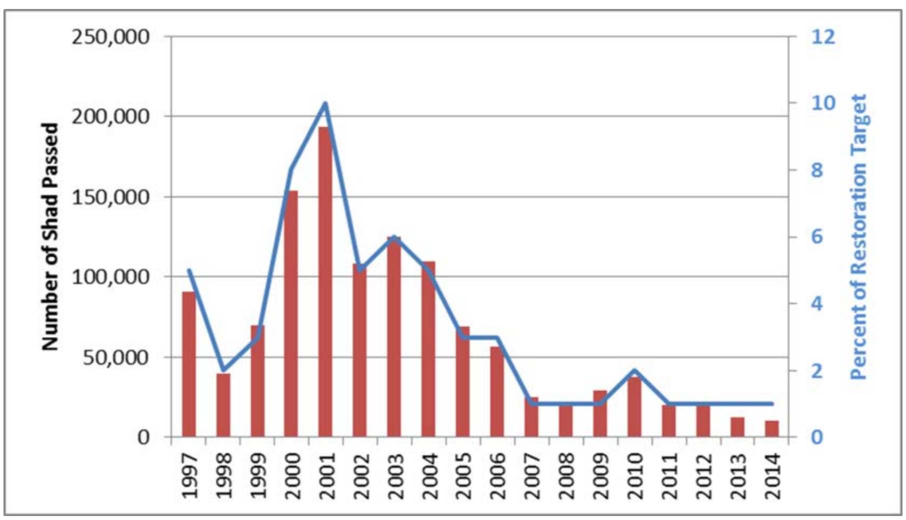

Figure 1. Annual number of shad passed at Conowingo dam as a percent of the SRAFRC restoration target.

[8] Code of Maryland Regs. § 26.08.02.02.B(4).
[9] Snyder, B. 2005. The Susquehanna River Fish Assemblage: Survey, Composition and Changes. *American Fisheries Society Symposium* 45:451-470.
[10] Brown, J., K. Limburg, J. Waldman, K. Stephenson, E. Glenn, F. Juanes and A. Jordan. 2013. Fish and Hydropower on the U.S. Atlantic coast. Conservation Letters (2013):1-7.
[11] Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC). 2010. Migratory Fish Management and Restoration Plan for the Susquehanna River Basin. November 15, 2010.

As described in the Application (*see* pp. 36-38), Exelon made several commitments in the Conowingo Hydroelectric Project Settlement (April 21, 2016) (Fish Passage Agreement)[12] to improve migratory fish passage in an effort to operate in a manner that supports the fish passage goals established in Amendment 3 of the Interstate Fishery Management Plan and the 2010 SRAFRC Migratory Fish Management and Restoration Plan.

The Conservancy participated in the negotiations that led to the Fish Passage Agreement. To ensure reasonable protection of designated uses related to migratory fish and avoid inconsistent license requirements, the Conservancy requests that the Department incorporate the terms and conditions of the Fish Passage Agreement into their certification conditions as appropriate. We are particularly concerned that the Application omits the following three components of the Fish Passage Agreement that we believe are critical to restoring fish passage at the Project: (1) the inclusion of design criteria that reflect science-based goals to restore self-sustaining populations of shad, river herring and American eel to the Susquehanna River Basin; (2) the incorporation of performance-based standards for passage efficiency as opposed to technological standards to meet the design criteria; and (3) the inclusion of an adaptive management framework if performance standards are not met.

Although we participated in the negotiations, we declined to sign the Fish Passage Agreement for two reasons. First, we are concerned that the Agreement does not expressly limit use of trap-and-transport, at any point in the proposed 50-year license, in favor of increasing volitional passage. Second, we are concerned by the Agreement's definition and use of "adjusted passage efficiency" to trigger structural and operational investments. Specifically, under trap-and-transport, passage efficiency values are credited (or adjusted) at a greater rate than volitional passage. This adjustment is predicted to inflate passage efficiency values (to be greater than 100% under moderate population growth scenarios), which could result in a delay or complete deferral of operational and/or structural investments over the term of the license. These reasons are described in detail in Attachment 1.

We request that MDE address these outstanding issues and their implications on the protection of designated uses on the Susquehanna River and Upper Chesapeake Bay in its review of the Application and in the development of any certification conditions.

2. Migratory cues and fish stranding

Project operations adversely impact native diadromous fish populations by interrupting migratory cues, lengthening migration times, and stranding fish during ramping events.

The Application (*see* p. 22) states, "regardless of project discharge, tagged adult American shad migrated upstream to the Dam with little observable difficulty." We disagree with this conclusion. In our review of Revised Study Plan 3.5[13] and related telemetry data, we

[12] eLibrary no. 20160512-5272 (May 12, 2016).
[13] Normandeau Associates, Inc. 2011. Upstream Fish Passage Effectiveness Study RSP 3.5. Conowingo Hydroelectric Project. FERC Project Number 405. Prepared for Exelon Corporation.

found that after entering the tail race, it took American shad an average of 11 days to successfully enter the fish lift. Given typical swimming speeds, this distance should take only hours to migrate, and less than an hour at burst speeds. Peaking operations of up to 86,000 cfs create velocities at the fish lifts that exceed 6 ft./s and the maximum burst swim speeds of migratory fish. In addition, telemetry data revealed that fish enter the east fish lift disproportionately under certain operational scenarios. The operation of Unit 11 negatively impacts entry to the east fish lift, and successful entries were dominated by operating a combination of Units 2, 5, and 7.[14] It has been demonstrated that delay of upstream migration associated with hydropower operations has been detrimental to the spawning and survival of diadromous fish.[15]

In addition to delaying migration, peaking operations at the Project cause fish stranding. Specifically, current operations allow the dam to change from peaking flows of 86,000 cfs to minimum flows (3,000 – 10,000 cfs), or by up to 9 feet, in an hour. The Application, states that "very low numbers of American shad, river herring and white perch were documented" (*see* p. 22), and goes on to conclude that while, "implementing an alternative flow regime could reduce this source of mortality, FERC concluded that the results of Exelon's stranding surveys indicate that the magnitude of this benefit would be minor" (*id.* at p. 23).

Based on our review of the stranding studies, we strongly disagree and find that stranding impacts are significant on diadromous fish populations. Current project operations result in fish stranding and mortality in all months, both as a direct result of dewatering and indirectly from thermal stress and increased predation. During the 2011 spawning migration, it is estimated that 1,400 American shad and more than 500 river herring were stranded due to peaking operations (Attachment 2, Appendix1: Table 4 and Figure 14). Further, total stranding is likely underestimated due to confounding factors of predation in isolated pools and issues of pool access during the FERC studies.[16]

We ask MDE to consider these outstanding issues and their implications to designated uses on the Susquehanna River in its review of the Application.

3. <u>Downstream Aquatic Habitat</u>

The Application proposes minimum flow conditions (*see* pp. 34). In our opinion, the weight of evidence in FERC's administrative record shows these flows will not mitigate the impacts of the Project's regulation of flow on resources of the lower Susquehanna River. For context, the proposed minimum flow releases would be lower than the historic minimum daily flows for most of the year and would be orders of magnitude lower than typical average flows

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http://mde.maryland.gov/programs/water/WetlandsandWaterways/Documents/ExelonMD/WQCApplication0517_pp1869-1969.pdf.
[14] Pugh, D. 2013. Independent review of American shad radio-telemetry data.
[15] Casto-Santos and Letcher 2010.
[16] Normandeau Associates, Inc. 2012. Final Study Report: Downstream Flow Ramping and Stranding Study RSP 3.8. Conowingo Hydroelectric Project. FERC Project No. 405:
http://mde.maryland.gov/programs/water/WetlandsandWaterways/Documents/ExelonMD/FERC/Conowingo-FRSP-3.08.pdf

throughout the year (Figure 2). More simply put, minimum flow releases would be lower than drought conditions for much of the year.

We strongly disagree with the Applicant's statement that this measure will, "adequately impact the Project's regulation of flow on the Susquehanna River, and protect suitable habitats and key natural processes (Application, p. 35)." The discussion below summarizes the basis for this disagreement, with a detailed report outlining ecological impacts of Project operations included in Attachment 2, Appendix1.

First, we disagree with the scientific basis for the Application's findings on flow regime impacts. Exelon bases its findings of benefit on an invalid method to estimate aquatic habitat availability at a peaking facility (*see* Application p. 27, Table 1). The result is a gross overestimate of available habitat. Our scientific objections to this method and their related habitat estimates are corroborated by an attached expert testimony from Dr. Stalnaker (*see* Attachment 3) and other relevant filings (*see* Attachments 2 and 4). Dr. Stalnaker developed the Instream Flow Incremental Method and has played a key role in the development of instream flow science over the last 30 years. As explained by Dr. Stalnaker, the minimum flow approach and methods used by Exelon are based on science of the 1970's and 1980's. In his opinion, this approach is now regarded as "outdated and ecologically unsound."

Best available data, models, and literature in the record continue to show that existing and proposed project operations have significant adverse impacts on the quality and availability of habitat for native diadromous fish migration, spawning and rearing, including American shad, river herring (Federal Species of Concern), striped bass, Atlantic (Federally-listed Endangered) and shortnose sturgeon (Federally-listed Endangered); freshwater mussels; map turtles (State-listed Endangered); submerged aquatic vegetation; and macroinvertebrates (Attachments 2 and 4). As shown in Table 1 below, in most cases, the proposed operations will support less than 1/3 of maximum available persistent habitat for migratory fish spawning and rearing.

Figure 2. The Applicant's minimum flow alternative (dashed black line) proposes releases that would be lower than historic minimum flows (yellow line) for most of the year and orders of magnitude lower than median flows (brown line) year-round.

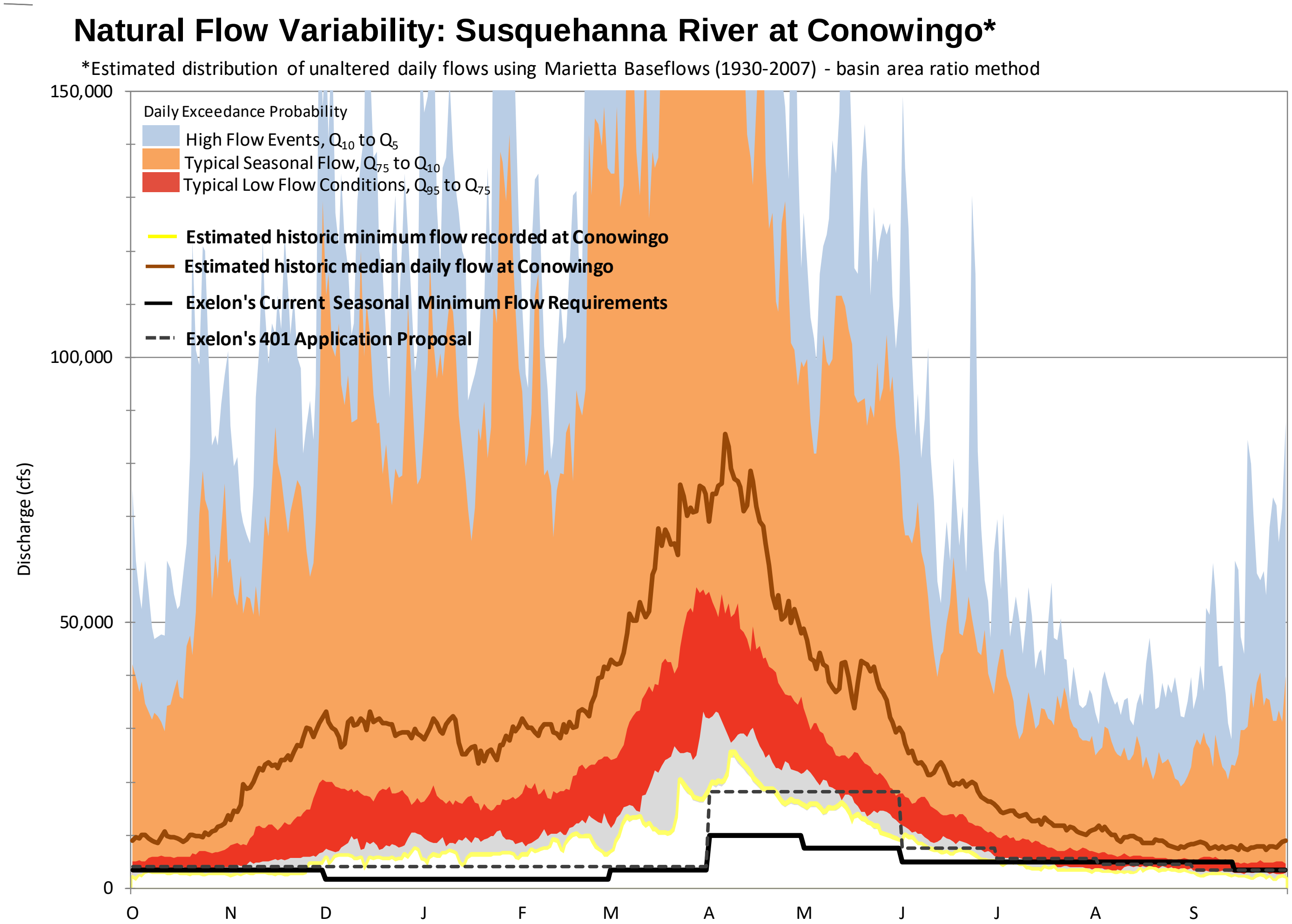

Table 1. Estimated percent of maximum available persistent habitat available for critical life stages with low mobility under proposed PM&E measures (Application pp. 34).

Target life stages	Percentage of Maximum Available Persistent Quality Habitat under Proposed Operations[17]
American shad spawning	35 %
American shad fry	14 to 27 %
Striped bass spawning	33 %
Striped bass fry	3 to 24 %
Shortnose sturgeon spawning	50 %
Shortnose sturgeon fry	21 %
River herring spawning	4 to 5 %
Smallmouth bass spawning	2 %
Smallmouth bass fry	5 %
Trichoptera	5 to 9 %

The Conservancy, in consultation with resource agencies and other non-governmental organizations,[18] developed ecological performance goals and a preferred operational alternative that supports the continued generation of low-cost, low carbon energy, while better balancing the ecological and ecosystem service values of the river (Attachment 2). This proposal was supported by multiple organizations and submitted by the U.S. Fish and Wildlife Service as part of its fish and wildlife recommendations under authority of Federal Power Act section 10(j).[19]

In summary, the Conservancy does not agree with the Application's statement that Exelon's proposed "flow condition adequately balance[s] both environmental and economic interests" (*see* Application, p. 7). The existing and proposed flow regime has, and is likely to continue to adversely affect submerged and emergent aquatic vegetation and the propagation of fish, shellfish and wildlife and aquatic habitat downstream on the Susquehanna River and Upper Bay downstream of Conowingo dam (*see* Attachment 2, Appendix1: pp 6-13).

We ask MDE to address these outstanding issues and their implications on the protection of designated uses on the Susquehanna River and Upper Chesapeake Bay in its review of the Application and in the development of any certification conditions.

[17] Estimated using minimum flows proposed in the Application, paired with maximum generation flows (86,000 cfs) and comparing to RSP 3.16 Appendix G, persistent habitat look up tables.
[18] Susquehanna River Basin Commission, Maryland Department of Natural Resources, Maryland Department of the Environment, Pennsylvania Department of Environmental Protection, U.S. Fish and Wildlife Service, American Rivers.
[19] 16 U.S.C. § 803(j).

4. Federal and State Listed T&E Species

Northern map turtle. As acknowledged in the Application (*see* p. 31), the Northern Map Turtle, listed as endangered in the state of Maryland, occurs in the Project boundary. The occurrences on the Susquehanna River below Conowingo dam are the largest remaining population in the state, with only a couple of additional occurrences being documented on local tributaries. The Application makes no statement of effect on the Northern Map Turtle, nor does it propose PM&E measures for their protection.

Project operations have been shown to adversely impact map turtle habitats important for reproduction, adult and juvenile growth and hibernation. Generation flows inundate basking habitats (*see* Attachment 2 – Appendix 1, Figures 3-4), which has reduced basking activity by an estimated 50 percent.[20] Basking is critical to juvenile and adult growth and reproductive development (rate and quality of egg-shelling).[21] Conowingo's peaking has also been shown to hinder short- and long term movements[22] and proposed minimum flows during winter months are not sufficient to maintain suitable habitat conditions at key hibernacula (Attachment 2,App.1, Figure 20).

Shortnose and Atlantic sturgeon. The Application (*see* pp. 31-32) states that both species have historically occurred in the project area, but, "continued operation of the Project would not be likely to adversely affect either" (*id.*, p. 32). The Application and referenced Final Environmental Impact Statement (FEIS) provide no basis for its conclusion (*see* Attachment 4 (TNC's comments on FEIS)). We disagree that continued operation of the Project as Exelon proposes would not be likely to adversely affect these species.

As outlined in the Final Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*) (1998) (pp. 49-50), "in all but one of the northeast rivers supporting sturgeon populations…, the first dam on the river marks the upstream limit of the shortnose sturgeon population's range. In all of these rivers, shortnose sturgeon spawning sites occur just below the dams, leaving all life stages vulnerable to perturbations of natural river conditions (e.g. volume, flow, velocity) caused by the dam's operation." The Conowingo dam on the Susquehanna River is not the exception.

As detailed in Table 1 above, proposed minimum flows are expected to provide less than 50% of maximum available spawning habitat for Shortnose sturgeon and less than 25% of available habitat for Shortnose sturgeon fry development. As Atlantic sturgeon use similar spawning habitat, effects are expected to be similar. Further, as sturgeon require gravels to

[20] Richards, T.M. and R.A. Seigel 2009. Habitat use of Northern Map Turtles (Gratemys geographica) in an altered system, the Susquehanna River, Maryland (USA). Presentation at the 2009 Ecological Society of America.; Richards-Dimitrie, T.M. 2011. Spatial ecology and diet of Maryland endangered northern Map Turtles (Graptemys geographica) in an altered river system: Implications for conservation and management. Graduate Thesis. Department of Biological Sciences, Towson University, Towson, MD.
[21] Ernst, C.H. and J.E. Lovich. Turgles of the United States and Canada. 2nd Edition, Johns Hopkins University Press, Baltimore; , Vogt, R.C. 1980. Natural history of the map turtles Graptemys pseudogeographica and Graptemys ouachitensis in Wisconsin. Tulane Studies in Zoology and Botany 22:17-48.
[22] Richards and Seigel 2009 & 2011

spawn, and reservoir storage has trapped spawning substrate above the dam, this likely underestimates total habitat loss as a result of the ongoing, and proposed future operations of the dam. While this reach of the river was not listed as critical habitat for the Atlantic sturgeon Chesapeake Bay DPS, sturgeon have occurred on the reach of river affected by the Project, and changes in project operations could nonetheless benefit Atlantic sturgeon. Particularly in drier years when the salinity gradient moves upstream and into the tributaries.[23]

B. Impacts on the timing and quality of sediment and nutrient loads to the Susquehanna River and Chesapeake Bay

The Application states that, “relatively little sediment is introduced from Project lands” (*see* pp. 19). While we agree with that statement, and recognize that the Upper Susquehanna as well as other major tributaries of the Chesapeake Bay contribute a far greater proportion of excess nutrients and sediment loads, the record shows that the Project nonetheless has an incremental and measurable effect on water quality conditions in the Lower Susquehanna River and Upper Chesapeake Bay, and that this contribution may impact MDE’s compliance with the Chesapeake Bay TMDL.[24]

Proposed PM&E measures in the Application only address shoreline erosion and do not propose mitigation to reduce or avoid the impacts of (1) the direct and indirect water quality impacts of scour events that mobilize sediment stored in the Applicant’s reservoir or (2) the influence in low flow conditions, during warm late summer months, in increasing the bioavailability of nutrients.

In recent decades, increasing nutrient concentrations below Conowingo Dam contrast trends observed above the reservoir system.[25] This has highlighted an urgent need to better understand how the reservoir system affects water quality.

The 2015 Lower Susquehanna River Watershed Assessment (LSRWA) specifically assessed the impact of scouring events (capable of mobilizing sediment stored in Conowingo pond), on downstream water quality. The study found negative effects on nutrient loading, dissolved oxygen (DO), water clarity and chlorophyll a concentrations, including an increase in

[23] Niklitschek, E.J and D.H. Secor. 2005. Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science 64 (2005) 135-148.
[24] 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. Li, 2017. UMCES Comprehensive Proposal: The impacts of Conowingo particulates on the Chesapeake Bay; Lower Susquehanna River Watershed Assessment, Maryland and Pennsylvania, May 2015 Final. Found at: http://dnr.maryland.gov/waters/bay/Pages/LSRWA/Final-Report.aspx.
[25] Hirsch, R.M. 2012. Flux of nitrogen, phosphorus 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 reservoir sedimentation on water quality: U.S. Geological Survey Scientific Investigations Report 2012-5185. U.S. Geological Survey, Reston, VA; Zhang, Q. D.C. Brady and W.P. Ball. 2013. Long-term seasonal trends of nitrogen, phosphorus and suspended sediment load from the non-tidal Susquehanna River Basin to Chesapeake Bay. Sci Total Environment 452-453:208-221.

frequency of non-attainment of DO standards.[26] The LSRWA also found that the effects on these constituents are more severe if the event occurs during the summer and that the impacts can last for years.

The recently released 2017 University of Maryland Center for Environmental Science (UMCES) studies confirm and add to the understanding of the incremental effects on loading. Specifically, they provide a better understanding of the potential release of bio-available nutrients (phosphorus and nitrogen (in the form of ammonia)) to the upper and mid-Bay.

While recent studies have improved our ability to characterize the incremental effect of Conowingo Pond on sediment and nutrient dynamics as they concern the Bay TMDL, a few key questions remain:

1. <u>How do low flow conditions in the reservoir, especially during dry years and warm summer months, affect the bioavailability of phosphorus</u>?

Water quality trends suggest that excess phosphorus loads continue to increase and present a major challenge to achieving the Chesapeake Bay TMDL; the source of excess phosphorus, however, remains uncertain.[27] Cornwell (et al. 2017) notes that the study years (2015 and 2016) occurred under average and above average hydrologic conditions. During the study period, bottom water conditions remained aerobic. Previous observations in the reservoir suggest that bottom water hypoxia has occurred in the past. Low flow conditions could play a role in regulating downstream export of bio-available phosphorus and other contaminants of concern, especially during dry years and warm summer months when low oxygen conditions typically occur, *see* Section 2, *infra.* [28] Any mitigation program, should continue to design and implement research that refines our understanding of reservoir dynamics.

2. <u>How does the volume, type and timing of scour event affect the relative contribution of total load and the bioavailability of nutrients from the event – including extreme events as a result of climate change</u>?

Existing observations of storm events show that the relative contribution of material scoured from Conowingo Pond as compared to the upstream watershed contribution varies with the type of event (e.g. 2011 Sept. Tropical Storm Lee compared to a Jan. 1996 snowmelt event). The LSWRA study found that the effects on these constituents are more severe if the event occurs during the summer.

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[26] LSWRA 2015
[27] Metson, G.S., J. Lin, J.A. Harrison, and J.E. Compton, 2017. Linking Terrestrial Phosphorus Inputs to Riverine Export across the United States. Water Research 124:177–191.
[28] Cornwell et al. 2017; Doig, L.E., R.L. North, J.J. Hudson, C. Hewlett, K.E. Lindenschmidt, K. Liber. 2016. Phosphorus release from sediments in a river-valley reservoir in the northern Great Plains of North America. Hydrobiologia. Doi: 10.1007/s10750-0162977-2)

Routine bathymetry surveys, which the Applicant has already committed to provide every five years, will be critical to characterizing the integrated impacts of upstream sediment contributions and internal reservoir depositional and scouring patterns. In addition to surveys every five years, it will be critical to add surveys after major scour events (> 275,000 cfs). This information is critical to understanding the role of the Conowingo Reservoir in regulating downstream water quality. As highlighted by Cornwell and others, reservoir sediment chemistry, including internal phosphorus and nitrogen transformations, also should also be evaluated to fully understand impacts and inform an adaptive reservoir sediment management plan to be consistent with Bay TMDL goals, over the term of the certificate.

3. <u>How does downstream coarse sediment starvation affect water quality regulators (e.g. mussels, emergent vegetation and submerged aquatic vegetation)</u>?

In addition to changing the timing and quality of inputs, Conowingo Dam traps a large portion of coarse sediments, resulting in downstream 'starvation,' of sands and gravels critical for aquatic habitat. The loss of habitat-forming gravels in combination with daily peaking, has resulted in a loss of recruitment for communities that require these habitats, including mussels, SAV, EAV and gravel spawners (Attachment 2). Only a small percentage of fine particles, are trapped. The latter tend to settle across the Upper Chesapeake Bay. In addition to having a direct impact on these communities, the Project indirectly impacts the regulating services that these communities once provided in improving water clarity, buffering extreme temperatures and dissolved oxygen.[29]

4. <u>What are the most feasible, best practicable technologies (BPT) or interventions to mitigate the Project's incremental impact (direct, indirect and cumulative) on achieving the Chesapeake Bay TMDL</u>?

Currently, there is no comparison of effectiveness or feasibility across the BPTs. The Conowingo Project's incremental impacts to the attainment of water quality standards and related designated uses should be mitigated through a multi-pronged, holistic and cost-effective solution that considers the range of interventions including upstream floodplain and river corridor restoration, innovative reservoir operations, and active sediment management.

Recent studies suggest that dredging is not likely to provide a cost-effective approach to sediment management and Bay restoration (LSRWA 2015).[30] If dredging is pursued, targeted dredging should be considered as previous studies indicate discrete areas of sediment deposition and scouring occur within the reservoir. Inactive areas where trapping capacity can be best restored, however, also may hold historically contaminated sediments and release additional pollutions (Cornwell et al. 2017). The Department should consider these tradeoffs.

In summary, the record shows that the Project has an incremental and measurable contribution to sediment and nutrient loading in the Lower Susquehanna River and Upper

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[29] Vaughn, C.C. 2017. Ecosystem services provided by freshwater mussels. *Hydrobiologia*, 1-13.
[30] LSWRA 2015

Chesapeake Bay, and that this contribution may impact MDE's compliance with the Chesapeake Bay TMDL.[31] We recognize that the Upper Susquehanna as well as other major tributaries of the Chesapeake Bay contribute a far greater proportion of excess nutrients and sediment loads. We ask MDE to address the incremental impact of Project operations on meeting the goals of the Bay TMDL in its review of the Application and in the development of any certification conditions including the development of an adaptive management plan to address remaining questions.

III. The Conservancy Recommends Additional Procedures Prior to Hearing.

The Conservancy requests that the Department undertake the following procedures prior to scheduling hearing.

First, we request that the Department undertake the additional information gathering and analysis requested herein prior to developing a draft water quality certification. The Department should assess the ecological benefits of the proposed flow regime using models developed for the proceeding. Similarly, the new information learned in the UMCES sediment studies should be used upon finalizing the defined impact of Project operations, and Exelon should be directed to propose mitigation for their impacts.

Second, we request that the Department issue a draft water quality certification for public comment before convening a public hearing, proposed for this fall, and issuing a final certification.

Third, we request the Department provide a preliminary list of disputed issues of facts of law for which it intends to request evidence. The Conservancy reserves the right to request to present evidence at the hearing depending on the list of disputed issues of facts and law.

Fourth, we request to be added to both the interested parties and the service list to receive copies of all future filings by Exelon and others. Notices should be sent to:

Tara Moberg
The Nature Conservancy
2101 N Front Street
Harrisburg, PA 17101
tmoberg@tnc.org

Mark Bryer
The Nature Conservancy
425 Barlow Place, Suite 100
Bethesda, MD 20814
mbryer@tnc.org

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[31] Sanford et al. 2017; Cornwell et al 2017; LSRWA 2015.

Richard Roos-Collins
Julie Gantenbein
Water and Power Law Group PC
2140 Shattuck Ave., Suite 801
Berkeley, CA 94704
(510) 296-5588
rrcollins@waterpowerlaw.com
jgantenbein@waterpowerlaw.com

IV. **Conclusion**

The Conservancy thanks the Department for the opportunity to comment on the Application. We request that the Department consider the new information provided herein, and grant the requests for further procedures. We support and incorporate by reference the substantive comments of the Chesapeake Bay Foundation and the Susquehanna River Basin Commission. We reserve the right to supplement these comments as new or additional information that is relevant to the proposed certification becomes available. We look forward to participating in public meeting and otherwise assisting the Department in the development of the record for this proceeding.

Respectfully submitted,

Allison Vogt

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Allison Vogt
Deputy State Director
Maryland/DC Chapter
The Nature Conservancy
425 Barlow Place, Suite 100
Bethesda, MD 20814

____
Tara Moberg
North America Hydropower
Coordinator
The Nature Conservancy
2101 N Front St, Bldg 1, Ste. 200
Harrisburg, PA 17102

Richard Roos-Collins
Julie Gantenbein
Water and Power Law Group PC
2140 Shattuck Ave, Ste. 801
Berkeley, CA 94704
(510) 296-5588

Attachments

Attachment 1. June 2016 Comments by The Nature Conservancy on Offer of Settlement for Fish Passage (Conowingo Project, P-405) TNC comments on fish passage settlement agreement

Attachment 2. January 2014 The Nature Conservancy's Motion to Intervene, Recommended Alternatives for Environmental Analysis and Preliminary Terms and Conditions;

> **Att2 - Appendix 1**: TNC Summary Report on Estimated Impacts to Ecological Resources and Restoration Goals

Attachment 3. Expert testimony by Dr. Claire Stalnaker.

Attachment 4. April 2015 Comments by The Nature Conservancy on Final Environmental Impact Statement for Susquehanna River Hydroelectric Projects

Attachment 1

The Nature Conservancy.
Protecting nature. Preserving life.

June 1, 2016

Via eFiling

The Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20246

Re: Comments by The Nature Conservancy on the Offer of Settlement (Conowingo Project, P-405)

Dear Secretary Bose:

The Nature Conservancy (Conservancy) provides comments in response to Exelon Generation Company, LLC's (Exelon) "Offer of Settlement and Explanatory Statement" (Settlement Offer) to settle remaining issues between Exelon and the U.S. Department of Interior regarding the appropriate terms of the fishway prescription for the Conowingo Project relicensing.[1] We note that these comments are limited to the Settlement Offer, and do not address other issues – *e.g.*, fish stranding, operational effects on downstream aquatic habitat, or project effects on sedimentation and water quality in the lower Susquehanna River and Chesapeake Bay – that remain unresolved.

The Conservancy is a party to this relicensing, and participated in the negotiations that led to the Settlement Offer, but did not sign the Settlement Agreement that is the basis for the offer, for reasons discussed below. Although we did not sign, the Conservancy is generally supportive of the terms of the Settlement Agreement. Conowingo dam blocks 98% of historic migratory spawning habitat for fish including American shad, river herring, and American eel. Presently less than one percent of the population restoration goals have been met. Restoration of large historic runs like that in the Susquehanna is fundamental to meeting coast-wide population restoration goals.

We support the Settlement Agreement's inclusion of design criteria and populations that reflect the goal of restoring self-sustaining populations of millions of shad, river herring, and American eel to the Susquehanna Basin (*see* Settlement Offer, Attachment 1, § 12.1.1). The Agreement's establishment of a quantitative goal for restoring these populations is consistent

[1] eLibrary no. 20160512-5272 (May 12, 2016).

with the regional, science-based comprehensive plan from the Susquehanna River Anadromous Fish Restoration Cooperative (SRFRAC 2010).

We support the Agreement's incorporation of performance-based standards for both upstream and downstream passage efficiency as a means to measure whether the alternative is on track for population restoration. This measure is also consistent with the comprehensive SRFRAC plan.

We also support the adaptive management framework, which requires iteratively testing passage efficiency, and prescribes tiered alternatives to correct any deficiencies or limitations identified by the tests. The framework identifies a range of alternative corrective actions, from preferential turbine operation to existing lift modification and new lift construction.

The Conservancy declined to sign the settlement for two, related reasons. First, while we support trap-and-transport as an interim mitigation tool that may aid in jumpstarting population growth while fish passage modifications are being made at Conowingo and the upstream dams (York Haven and Holtwood), we believe the long-term use of this tool does not meet the design population goal of self-sustaining populations. We are concerned that the Agreement does not expressly limit use of trap-and-transport in favor of increasing volitional passage over the proposed 50-year term of the license.

Second, we are concerned about the Agreement's definition and use of "adjusted passage efficiency" to trigger structural and operational modifications to the fishways. The trap-and-transport credit calculation provides credit toward meeting the 85% upstream passage efficiency by adjusting the total passage efficiency based on a proposed formula that incorporates a multiplier for bypassing upstream dams. Currently, upstream passage efficiency at Conowingo dam is between 35 and 40%. As a result of the proposed credit calculation, the operator could maintain this passage efficiency (35-40%) and receive up to a 72% credit for trap and transport, resulting in an adjusted passage efficiency that is greater than 100%, if and until migrating populations exceed 500,000 fish (Attachment 1, Table 1). Based on our understanding of the proposed methodology, the value of the trap and transport credit diminishes to account for less than 40% of the adjusted upstream efficiency if and when populations exceed 500,000 and upstream dams exceed 75% passage efficiency (Attachment 1, Tables 1-6). Because the threshold for structural and operational modifications under the adaptive management tiers are only triggered when the adjusted passage efficiency is less than 85%, the reliance on trap-and-truck to achieve that efficiency rate may delay implementation of structural and operational modifications for the first half of the license term, or longer, depending on population growth and performance of upstream dams. We recommend that any license term based on the Settlement Offer use the term "adjusted passage efficiency," to describe the measured efficiency plus the trap and transport credit, rather than "upstream passage efficiency," which is the defined term used in the Settlement Agreement.

Although the Conservancy did not sign the Settlement Agreement, we remain committed to achieving the goal of restoring self-sustaining populations of millions of shad, river herring, and American eel to the Susquehanna Basin. As an organization we have considerable expertise in restoration of degraded ecosystems through adaptive management. We request that, under Federal Power Act section 10(a)(1), the Commission name the Conservancy as one of the entities that will be consulted in the implementation of the fishway measures. The Conservancy is willing to make a commitment to allocate sufficient staff time and other resources over the course of any license term to participate in the implementation of the fishway measures. We will undertake further discussion with Exelon and the Department of Interior's Fish and Wildlife Service regarding this request, and we will file an appropriate further pleading.

We thank the Commission for this opportunity to provide comments.

Dated: June 1, 2016

Respectfully submitted,

Mark Bryer
Director, Chesapeake Bay Program
The Nature Conservancy
5410 Grosvenor Lane, Suite 100
Bethesda, MD 20814
301-897-8570
mbryer@tnc.org

DECLARATION OF SERVICE

Exelon Corporation, Conowingo Project (P-405)

I, Julie Gantenbein, declare that I today served the attached "Comments by The Nature Conservancy on the Offer of Settlement," by electronic mail, or by first-class mail if no e-mail address is provided, to each person on the official service list compiled by the Secretary in this proceeding.

Dated: June 1, 2016

By: ____________________________

Julie Gantenbein
WATER AND POWER LAW GROUP PC
2140 Shattuck Ave., Suite 801
Berkeley, CA 94704-1229
Phone: (510) 296-5591
Fax: (866) 407-8073
office@waterpowerlaw.com

Attachment 1

Attachment 1

Attachment 1. Relationship between population size, Conowingo passage efficiency, performance of upstream dams and adjusted efficiency (trap and transport credit)

Table 1. Relationship between population size, upstream passage efficiency of 37% and adjusted passage efficiency (credit) when upstream dams are passing 25% and 85% (denominator of .225).

Migrating Population that Reaches Rowland Island in Year X (#)	Number of Fish Passed (Pi) over 1 year with **37% Upstream Passage Efficiency (#)**	80% Trap and transport up to 100K (#)	Trap and Transport Volitional Equivalent with .225 denominator (#)	Volitional Upstream (#)	Adjusted Total Volitional (#)	**Adjusted Overall Efficiency (%)**	**Potential Contribution of T&T Credit to Passage Efficiency (%)**
10,000	3,700	2,960	12,366	740	13,106	**131**	**72**
50,000	18,500	14,800	61,831	3,700	65,531	**131**	**72**
100,000	37,000	29,600	123,662	7,400	131,062	**131**	**72**
150,000	55,500	44,400	185,493	11,100	196,593	**131**	**72**
200,000	74,000	59,200	247,324	14,800	262,124	**131**	**72**
250,000	92,500	74,000	309,156	18,500	327,656	**131**	**72**
300,000	111,000	88,800	370,987	22,200	393,187	**131**	**72**
350,000	129,500	100,000	417,778	29,500	447,278	**128**	**71**
400,000	148,000	100,000	417,778	48,000	465,778	**116**	**68**
450,000	166,500	100,000	417,778	66,500	484,278	**108**	**66**
500,000	185,000	100,000	417,778	85,000	502,778	**101**	**63**
750,000	277,500	100,000	417,778	177,500	595,278	79	53
1,000,000	370,000	100,000	417,778	270,000	687,778	69	46
2,000,000	740,000	100,000	417,778	640,000	1,057,778	53	30
3,000,000	1,110,000	100,000	417,778	1,010,000	1,427,778	48	22
4,000,000	1,480,000	100,000	417,778	1,380,000	1,797,778	45	18
5,000,000	1,850,000	100,000	417,778	1,750,000	2,167,778	43	15
6,000,000	2,220,000	100,000	417,778	2,120,000	2,537,778	42	13
7,000,000	2,590,000	100,000	417,778	2,490,000	2,907,778	42	11
8,000,000	2,960,000	100,000	417,778	2,860,000	3,277,778	41	10

Table 2. Relationship between population size, upstream passage efficiency of 55% and adjusted passage efficiency (credit) when upstream dams are passing 25% and 85% (denominator of .225).

Migrating Population that Reaches Rowland Island in Year X (#)	Number of Fish Passed (Pi) over 1 year with **55% Upstream Passage Efficiency (#)**	80% Trap and transport up to 100K (#)	Trap and Transport Volitional Equivalent with .225 denominator (#)	Volitional Upstream (#)	Adjusted Total Volitional (#)	**Adjusted Overall Efficiency (%)**	**Potential Contribution of T&T Credit to Passage Efficiency (%)**
10,000	5,500	4,400	18,382	1,100	19,482	**194.8**	**72**
50,000	27,500	22,000	91,911	5,500	97,411	**194.8**	**72**
100,000	55,000	44,000	183,822	11,000	194,822	**194.8**	**72**
150,000	82,500	66,000	275,733	16,500	292,233	**194.8**	**72**
200,000	110,000	88,000	367,644	22,000	389,644	**194.8**	**72**
250,000	137,500	110,000	459,556	27,500	487,056	**194.8**	**72**
300,000	165,000	132,000	551,467	33,000	584,467	**194.8**	**72**
350,000	192,500	100,000	417,778	92,500	510,278	**145.8**	**62**
400,000	220,000	100,000	417,778	120,000	537,778	**134.4**	**59**
450,000	247,500	100,000	417,778	147,500	565,278	**125.6**	**56**
500,000	275,000	100,000	417,778	175,000	592,778	**118.6**	**54**
1,000,000	550,000	100,000	417,778	450,000	867,778	**86.8**	**37**
2,000,000	1,100,000	100,000	417,778	1,000,000	1,417,778	70.9	22
3,000,000	1,650,000	100,000	417,778	1,550,000	1,967,778	65.6	16
4,000,000	2,200,000	100,000	417,778	2,100,000	2,517,778	62.9	13
5,000,000	2,750,000	100,000	417,778	2,650,000	3,067,778	61.4	10
6,000,000	3,300,000	100,000	417,778	3,200,000	3,617,778	60.3	9
7,000,000	3,850,000	100,000	417,778	3,750,000	4,167,778	59.5	8
8,000,000	4,400,000	100,000	417,778	4,300,000	4,717,778	59.0	7

Table 3. Relationship between population size, upstream passage efficiency of 37% and adjusted passage efficiency (credit) when upstream dams are passing 60% and 80% (denominator of .297).

Migrating Population that Reaches Rowland Island in Year X (#)	Number of Fish Passed (Pi) over 1 year with **37% Upstream Passage Efficiency (#)**	80% Trap and transport up to 100K (#)	Trap and Transport Volitional Equivalent with .297 denominator (#)	Volitional Upstream (#)	Adjusted Total Volitional (#)	**Adjusted Overall Efficiency (%)**	**Potential Contribution of T&T Credit to Passage Efficiency (%)**
10,000	3,700	2,960	9,368	740	10,108	**101**	**63**
50,000	18,500	14,800	46,842	3,700	50,542	**101**	**63**
100,000	37,000	29,600	93,684	7,400	101,084	**101**	**63**
150,000	55,500	44,400	140,525	11,100	151,625	**101**	**63**
200,000	74,000	59,200	187,367	14,800	202,167	**101**	**63**
250,000	92,500	74,000	234,209	18,500	252,709	**101**	**63**
300,000	111,000	88,800	281,051	22,200	303,251	**101**	**63**
350,000	129,500	100,000	316,498	29,500	345,998	**99**	**63**
400,000	148,000	100,000	316,498	48,000	364,498	**91**	**59**
450,000	166,500	100,000	316,498	66,500	382,998	**85**	**57**
500,000	185,000	100,000	316,498	85,000	401,498	80	54
1,000,000	370,000	100,000	316,498	270,000	586,498	59	37
2,000,000	740,000	100,000	316,498	640,000	956,498	48	23
3,000,000	1,110,000	100,000	316,498	1,010,000	1,326,498	44	16
4,000,000	1,480,000	100,000	316,498	1,380,000	1,696,498	42	13
5,000,000	1,850,000	100,000	316,498	1,750,000	2,066,498	41	10
6,000,000	2,220,000	100,000	316,498	2,120,000	2,436,498	41	9
7,000,000	2,590,000	100,000	316,498	2,490,000	2,806,498	40	8
8,000,000	2,960,000	100,000	316,498	2,860,000	3,176,498	40	7

Table 4. Relationship between population size, upstream passage efficiency of 55% and adjusted passage efficiency (credit) when upstream dams are passing 60% and 80% (denominator of .297).

Migrating Population that Reaches Rowland Island in Year X (#)	Number of Fish Passed (Pi) over 1 year with **55% Upstream Passage Efficiency (#)**	80% Trap and transport up to 100K (#)	Trap and Transport Volitional Equivalent with .297 denominator (#)	Volitional Upstream (#)	Adjusted Total Volitional (#)	**Adjusted Overall Efficiency (%)**	**Potential Contribution of T&T Credit to Passage Efficiency (%)**
10,000	5,500	4,400	13,926	1,100	15,026	**150.3**	**63**
50,000	27,500	22,000	69,630	5,500	75,130	**150.3**	**63**
100,000	55,000	44,000	139,259	11,000	150,259	**150.3**	**63**
150,000	82,500	66,000	208,889	16,500	225,389	**150.3**	**63**
200,000	110,000	88,000	278,519	22,000	300,519	**150.3**	**63**
250,000	137,500	110,000	348,148	27,500	375,648	**150.3**	**63**
300,000	165,000	132,000	417,778	33,000	450,778	**150.3**	**63**
350,000	192,500	100,000	316,498	92,500	408,998	**116.9**	**53**
400,000	220,000	100,000	316,498	120,000	436,498	**109.1**	**50**
450,000	247,500	100,000	316,498	147,500	463,998	**103.1**	**47**
500,000	275,000	100,000	316,498	175,000	491,498	**98.3**	**44**
750,000	412,500	100,000	316,498	312,500	628,998	83.9	34
1,000,000	550,000	100,000	316,498	450,000	766,498	76.6	28
2,000,000	1,100,000	100,000	316,498	1,000,000	1,316,498	65.8	16
3,000,000	1,650,000	100,000	316,498	1,550,000	1,866,498	62.2	12
4,000,000	2,200,000	100,000	316,498	2,100,000	2,416,498	60.4	9
5,000,000	2,750,000	100,000	316,498	2,650,000	2,966,498	59.3	7
6,000,000	3,300,000	100,000	316,498	3,200,000	3,516,498	58.6	6
7,000,000	3,850,000	100,000	316,498	3,750,000	4,066,498	58.1	5
8,000,000	4,400,000	100,000	316,498	4,300,000	4,616,498	57.7	5

Table 5. Relationship between population size, upstream passage efficiency of 37% and adjusted passage efficiency (credit) when upstream dams are passing 75% (denominator of .428).

Migrating Population that Reaches Rowland Island in Year X (#)	Number of Fish Passed (Pi) over 1 year with **37% Upstream Passage Efficiency (#)**	80% Trap and transport up to 100K (#)	Trap and Transport Volitional Equivalent with .428 denominator (#)	Volitional Upstream (#)	Adjusted Total Volitional (#)	**Adjusted Passage Efficiency (%)**	**Potential Contribution of T&T Credit to Passage Efficiency (%)**
10,000	3,700	2,960	6,593	740	7,333	73	50
50,000	18,500	14,800	32,967	3,700	36,667	73	50
100,000	37,000	29,600	65,934	7,400	73,334	73	50
150,000	55,500	44,400	98,900	11,100	110,000	73	50
200,000	74,000	59,200	131,867	14,800	146,667	73	50
250,000	92,500	74,000	164,834	18,500	183,334	73	50
300,000	111,000	88,800	197,801	22,200	220,001	73	50
350,000	129,500	100,000	222,749	29,500	252,249	72	49
400,000	148,000	100,000	222,749	48,000	270,749	68	45
450,000	166,500	100,000	222,749	66,500	289,249	64	42
500,000	185,000	100,000	222,749	85,000	307,749	62	40
1,000,000	370,000	100,000	222,749	270,000	492,749	49	25
2,000,000	740,000	100,000	222,749	640,000	862,749	43	14
3,000,000	1,110,000	100,000	222,749	1,010,000	1,232,749	41	10
4,000,000	1,480,000	100,000	222,749	1,380,000	1,602,749	40	8
5,000,000	1,850,000	100,000	222,749	1,750,000	1,972,749	39	6
6,000,000	2,220,000	100,000	222,749	2,120,000	2,342,749	39	5
7,000,000	2,590,000	100,000	222,749	2,490,000	2,712,749	39	5
8,000,000	2,960,000	100,000	222,749	2,860,000	3,082,749	39	4

Table 6. Relationship between population size, upstream passage efficiency of 55% and adjusted passage efficiency (credit) when upstream dams are passing 75% (denominator of .428).

Migrating Population that Reaches Rowland Island in Year X (#)	Number of Fish Passed (Pi) over 1 year with **55% Upstream Passage Efficiency (#)**	80% Trap and transport up to 100K (#)	Trap and Transport Volitional Equivalent with .428 denominator (#)	Volitional Upstream (#)	Adjusted Total Volitional (#)	**Adjusted Passage Efficiency (%)**	**Potential Contribution of T&T Credit to Passage Efficiency (%)**
10,000	5,500	4,400	9,801	1,100	10,901	**109.0**	**66**
50,000	27,500	22,000	49,005	5,500	54,505	**109.0**	**66**
100,000	55,000	44,000	98,009	11,000	109,009	**109.0**	**66**
150,000	82,500	66,000	147,014	16,500	163,514	**109.0**	**66**
200,000	110,000	88,000	196,019	22,000	218,019	**109.0**	**66**
250,000	137,500	100,000	222,749	37,500	260,249	**104.1**	**64**
300,000	165,000	100,000	222,749	65,000	287,749	**95.9**	**61**
350,000	192,500	100,000	222,749	92,500	315,249	**90.1**	**59**
400,000	220,000	100,000	222,749	120,000	342,749	**85.7**	**57**
450,000	247,500	100,000	222,749	147,500	370,249	82.3	55
500,000	275,000	100,000	222,749	175,000	397,749	79.5	53
1,000,000	550,000	100,000	222,749	450,000	672,749	67.3	45
2,000,000	1,100,000	100,000	222,749	1,000,000	1,222,749	61.1	39
3,000,000	1,650,000	100,000	222,749	1,550,000	1,772,749	59.1	37
4,000,000	2,200,000	100,000	222,749	2,100,000	2,322,749	58.1	36
5,000,000	2,750,000	100,000	222,749	2,650,000	2,872,749	57.5	36
6,000,000	3,300,000	100,000	222,749	3,200,000	3,422,749	57.0	35
7,000,000	3,850,000	100,000	222,749	3,750,000	3,972,749	56.8	35
8,000,000	4,400,000	100,000	222,749	4,300,000	4,522,749	56.5	35

Attachment 2

Attachment 2

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Exelon Generation Company, LLC Conowingo Hydroelectric Project	)	P-405-106
Muddy Run Hydroelectric Project	)	P-2355-018
York Haven Power Company, LLC York Haven Hydroelectric Project	)	P-1888-030

THE NATURE CONSERVANCY'S MOTION TO INTERVENE, RECOMMENDED ALTERNATIVES FOR ENVIRONMENTAL ANALYSIS, AND PRELIMINARY TERMS AND CONDITIONS

Pursuant to 18 C.F.R. § 385.214, The Nature Conservancy moves to intervene in the relicensing of Exelon Generation Company's Conowingo and Muddy Run Hydroelectric Projects and York Haven Power Company's York Haven Hydroelectric Project, all located on the Susquehanna River. Pursuant to 18 C.F.R. § 5.23(a) and the "Notice Granting Extension of Time and Intent to Prepare an Environmental Impact Statement,"[1] the Conservancy also requests that Office of Energy Projects (OEP) Staff develop and study specific alternatives in the Environmental Impact Statement it is preparing for these relicensings.

This filing is organized as follows. *Section I* provides the Conservancy's Motion to Intervene; *Section II* states the legal basis for the Conservancy's comments and recommended alternatives for the Conowingo Project that OEP should analyze in the Environmental Impact Statement (EIS). On factual issues, we rely on the Final License Application (FLA) for the Conowingo Project and other documents as cited. *Section III* states the Conservancy's preliminary terms and conditions for the new Conowingo license and provides explanation. *Section IV* proposes further procedures to assist in the resolution of the disputed issues of law and fact in these coordinated proceedings.

I.
THE NATURE CONSERVANCY'S MOTION TO INTERVENE

A. Description of The Nature Conservancy

The Nature Conservancy (the Conservancy) is a private, non-profit 501(c)3 organization with membership and operations throughout the Susquehanna River and Chesapeake Bay

[1] eLibrary no. 20130830-3004 (Aug. 30, 2013).

watersheds and around the globe. The Conservancy's mission is to conserve the lands and waters on which all life depends. The Conservancy is a science-based organization that works with partners to identify and implement solutions to complex conservation problems; it has over one million members world-wide. Since its inception in 1951, the Conservancy has protected more than 120 million acres of land, 5,000 miles of streams, and has 150 active marine conservation projects.

B. Description of The Nature Conservancy's Interests

As the United States' largest estuary, the Chesapeake Bay is an iconic feature that provides important ecological services along with employment, food, and recreation for millions of people. It also serves as a home for more than 3,600 species and is a crucial nursery for many fish and birds that migrate up and down the Atlantic coast and beyond.

The health of the Chesapeake is directly connected to the Susquehanna River, its largest tributary and the largest river on the East Coast of the United States. In addition to its ecological role, the Susquehanna River provides a critical source of drinking water to millions, unparalleled recreational opportunities, and power generation for the Mid-Atlantic region.

Because of their enormous economic and ecological values, the Susquehanna River and the Chesapeake Bay are conservation priorities for The Nature Conservancy. Through its Pennsylvania and Maryland Chapters and Chesapeake Bay Program, The Nature Conservancy has interests that will be directly affected by the outcome of the relicensing of the Conowingo, Muddy Run, and York Haven Projects.

These interests include protecting and enhancing the ecosystem processes that support freshwater and estuarine species and habitats of the Susquehanna River and the upper Chesapeake Bay. Efforts to restore and protect a more natural hydrologic regime, sediment regime, and connectivity of migratory fish habitat in the Susquehanna River are a key component of the Conservancy's conservation work. Modifications to the infrastructure and operation of the hydropower facilities on the Lower Susquehanna – including improvements to fish passage and modifying releases to restore critical flows – will benefit priority species and habitats.

The Nature Conservancy has developed global expertise in environmental flow science and management, including creating tools and techniques to assess human influence on water flow and associated ecosystem impacts (Richter et al. 1997, Postel and Richter 2003, Poff et al. 2007, Poff et al. 2010). These assessments have provided important information to develop collaborative solutions that resolve potential incompatibilities between human and ecosystem needs, as well as to design and implement adaptive management plans to improve water management on large river systems including the Savannah, the Willamette, the Rivanna and the Upper Colorado (Bowler et al. 2006, Richter et al. 2006, Gregory et al. 2007, Wilding and Poff 2008). As a result of our expertise in environmental flows and our interest in the health of the Susquehanna River and the Chesapeake Bay, the Conservancy has developed assessments that directly inform these proceedings. For example, the Conservancy filed "Ecosystem Flow

Recommendations for the Susquehanna River Basin," with its comments on the Draft License Application (DePhilip et al. 2010).

For these reasons, the Commission should grant the Conservancy's Motion to Intervene.

II. BASIS FOR THE NATURE CONSERVANCY'S REQUEST FOR CONSIDERATION OF SPECIFIC ALTERNATIVES

A. The Commission Must Ensure the New License is Best Adapted for All Beneficial Uses of the Susquehanna River.

FPA section 10(a)(1), 16 U.S.C. § 803(a)(1), requires that any license be, in FERC's judgment, "best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water-power development, for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes . . . ."

The statute "requires the Commission to consider *all* beneficial public uses when it grants a license." *Confederated Tribes and Bands of Yakima Indian Nation v. FERC*, 746 F.2d 466, 471 (1984) (emphasis added). This requirement applies equally to new licenses. FERC is to "make the same inquiries on relicensing as on initial licensing." *Id.* at 470. FPA section 15(a)(2), 16 U.S.C. § 808(a)(2), expressly requires that "[a]ny new license issued under this section shall be issued to the applicant having the final proposal which the Commission determines is best adapted to serve the public interest …."

The FLA is not proposing any changes to Project operations (FLA at B-4). It does propose to construct a permanent trap and transport facility for the upstream and downstream passage of American Eel. However, most of its proposed environmental measures focus on development and implementation of various resource management plans, e.g., Shoreline Management Plan. *Id.* at E-26 – E-28.

The Conservancy agrees that these measures will enhance baseline conditions. However, they are inadequate to mitigate the project's significant effects on environmental resources in the lower Susquehanna River and Upper Chesapeake Bay.

DePhilip et al. (2010) documented the need to protect the timing, magnitude, frequency and rate of change of high, seasonal and low flow components in order to support the ecosystem needs of the Susquehanna River mainstem (Att 1: Figure 1). Current operations significantly impact in-stream flows and downstream habitat by the combination of (1) decreasing daily minimum flows during storage and increasing the duration of low flows during dry conditions,

(2) increasing daily maximum flows during generation, and (3) increasing the rate and frequency of rise of fall events (Att 1, Table 4-Column III).

More specifically, minimum flow releases (0 to 10,000 cfs) are less than the minimum recorded daily flow during the winter and spring months. In addition, releases are 60 to 100% lower than the historic monthly median flows during fall, winter and spring (Att 1: Figure 2, Table 1).

Maximum generation releases (86,000 cfs) range from 8 to 25 times greater than minimum flow releases, depending on the month (Att 1: Table 1). Daily maximum generation releases are equivalent to seasonal flood pulses. In July and August, generation releases, are greater than the maximum recorded daily flow (Att 1: Figure 2, Table 1).

There is no limit to the rate of rise or fall between minimum releases and maximum generation releases, therefore the river can fluctuate by as much as 86,000 cfs/hour, equating up to a 9 foot change in depth, or from typical dry conditions to flood conditions (Att 1: Tables1-2, Figures 3-4).

The maximum hourly rise rate is 12 times or 1,200% greater than an upstream reference gage and the maximum hourly fall rate is 25 times or 2,542% greater than an upstream reference gage. The frequency of flow fluctuations is 341% greater than an upstream reference gage (Att1: Table 2).

FPA section 15(a)(2) requires that "any new license … shall be issued to the applicant having the final proposal which the Commission determines is best adapted to serve the public interest." 16 U.S.C. § 808(a)(2). This echoes the requirement under FPA section 10(a)(1) that FERC show, based on a thorough study of alternatives, that the new license is best adapted to a comprehensive plan of development for the Susquehanna River for all beneficial uses over the term of the license. *See Scenic Hudson*, 354 F.2d 608, 612 (2d Cir. 1965); *Green Island Power Auth. v. FERC*, 577 F.3d 148, 168 (2d Cir. 2009). Based on the existing record, the Conservancy does not believe that Exelon's preferred licensing alternative, with only modest environmental measures as stated in the FLA, is best adapted to serve the public interest.

Further, we support the Susquehanna River Basin Commission's (SRBC) comments and explanations regarding the adequacy of the existing record.

B. The Commission Must Consider the Extent to Which the Project under the New License Will Be Consistent with the Comprehensive Plans of State and Federal Agencies.

In making its best adapted determination under FPA section 10(a)(1), the Commission must consider "[t]he extent to which the project is consistent with … comprehensive plan[s] for improving, developing or conserving a waterway or waterways affected by the project" developed by other agencies. 16 U.S.C. § 803(a)(2).

In its comments on the DLA, the Nature Conservancy requested that Exelon demonstrate how its proposed PM&E measures would be consistent with the specific goals and objectives in the relevant comprehensive plans. *See* The Nature Conservancy, "Comments on the Draft License Applications for Conowingo and Muddy Run Projects (P-405 and P-2355)," eLibrary no. 20120709-5134 (July 9, 2012), p. 7. In response, Exelon provided some additional discussion of comprehensive plans in the FLA. FLA at E-374 – E-384. However, this discussion is still too cursory for OEP Staff to base findings of consistency under FPA section 10(a)(2) on it.

For example, the FLA states that "[t]he continued operation of the Project will not have a significant impact on the shad and river herring population of the Susquehanna River, and is therefore consistent with" Amendment 3 of the Interstate Fishery Management Plan for shad and river herring (Feb. 2010). FLA at E-377. However, it does not describe how the proposed measures will comply with the overall goal to "[p]rotect, enhance, and restore Atlantic coast migratory stocks and critical habitat of American shad in order to achieve levels of spawning stock biomass that are sustainable, can produce a harvestable surplus, and are robust enough to withstand unforeseen threats." Atlantic States Marine Fisheries Commission, "Amendment 3 to the Interstate Fishery Management Plan for Shad and River herring (American Shad Management) (Feb. 2010), p. iv. It does not describe how continuation of project operations will mitigate the impact of the project's instream flow regulation on these fish. *See id.* at vi.

In another example, the FLA finds that the project "will not impact the recovery plan for the shortnose sturgeon, and is therefore consistent with this management plan." FLA at E-379. However, it does not discuss how the proposed measures, which do not include any changes in project operation for sturgeon, will mitigate the continuing adverse effects of the dam on shortnose sturgeon, which are significant:

> Hydroelectric dams may affect shortnose sturgeon by restricting habitat, altering river flows or temperatures necessary for successful spawning and/or migration, and causing mortalities to fish that become entrained in turbines. In all but one of the northeast rivers supporting sturgeon populations …, the first dam on the river marks the upstream limit of the shortnose sturgeon population's range (Kynard 1997). In all of these rivers, shortnose sturgeon spawning sites occur just below the dams, leaving all life stages vulnerable to perturbations of natural river conditions (e.g., volume, flow velocity) caused by the dam's operation.

NMFS, "Final Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*) (1998), pp. 49-50. The FLA does not describe how the proposed measures are consistent with the recovery objective to "[m]itigate/eliminate impact of adverse anthropogenic actions on shortnose sturgeon population segments." *Id.* at 61.

The FLA also finds that the project "is consistent with the management objectives associated with hydropower development on the Susquehanna River, and is therefore consistent with the" Susquehanna River Basin Commission's "Comprehensive Plan for Management and Development of the Water Resources of the Susquehanna River Basin" (Dec. 2008). FLA at E-380. Again, the FLA offers no explanation in support of this conclusion. Further, it does not discuss whether or how the project is consistent with the plan's other goals and objectives that are not strictly related to hydropower. For example, the FLA does not discuss how the project is consistent with the stated goal for sustainable water development, which is "[t]o regulate and plan for water resources development in a manner that maintains economic viability, protects instream users, and ensures ecological diversity; and meets immediate and future needs of the people of the basin for domestic, municipal, commercial, agricultural and industrial water supply and recreational activities." Susquehanna River Basin Comprehensive Plan at 45. It does not describe whether and how the project is consistent with similar goals for protection of water quality (*id.* at 52), flood protection (*id.* at 60), ecosystem restoration (*id.* at 64), and Chesapeake Bay restoration and maintenance (*id.* at 68).

C. The Commission Must Consider Reasonable Alternatives to the Applicants' Preferred Alternatives.

As stated above, the Commission has a substantive obligation under FPA section 10(a)(1) to undertake a thorough study of alternatives as the basis for its finding that a new license is best adapted to a comprehensive plan of development. *See Scenic Hudson,* 354 F.2d at 612; *Green Island*, 577 F.3d at 168.

FERC is also subject to parallel, procedural obligations to study alternatives under the National Environmental Policy Act.

NEPA section 102(2)(C) requires that the FEIS provide a "detailed statement" on the following:

> (i) the environmental impact of the proposed action,
>
> (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
>
> (iii) *alternatives to the proposed action,*
>
> (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
>
> (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

42 U.S.C. § 4332(2)(C). The EIS requirement "provides evidence that the mandated decision making process has in fact taken place and, most importantly, allows those removed from the

initial process to evaluate and balance the factors on their own." *Calvert Cliffs' Coordinating Committee, Inc. v. U.S. Atomic Energy Commission*, 449 F.2d 1109, 1114 (D.C. Cir. 1971).

NEPA section 102(2)(E) imposes an independent, and broader obligation than the EIS requirement to evaluate alternatives; it requires that the Commission "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E); *Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1229 (9th Cir. 1988).

> The goal of the statute is to ensure "that federal agencies infuse in project planning a thorough consideration of environmental values." *Conner*, 836 F.2d at 1532. The consideration of alternatives requirement furthers that goal by guaranteeing that agency decisionmakers "[have] before [them] and take [ ] into proper account all possible approaches to a particular project (*including total abandonment of the project*) which would alter the environmental impact and the cost-benefit balance." *Calvert Cliffs' Coordinating Committee, Inc. v. United States Atomic Energy Commission*, 449 F.2d 1109, 1114 (D.C.Cir.1971) (emphasis added).

Bob Marshall Alliance v. Hodel, 852 F.2d at 1228. Further,

> NEPA's requirement that alternatives be studied, developed, and described both guides the substance of environmental decisionmaking and provides evidence that the mandated decisionmaking process has actually taken place. *Id.* Informed and meaningful consideration of alternatives-including the no action alternative-is thus an integral part of the statutory scheme.

Id.

Under the Council for Environmental Quality's (CEQ) rules, the presentation of alternatives

> is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (§ 1502.15) and the Environmental Consequences (§ 1502.16), it should present the environmental impacts of the proposal and the alternatives *in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public*. In this section agencies shall:
>
> ...
>
> (b) *Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits*.

40 C.F.R. § 1502.14 (emphasis added).

Further, an EIS must provide a comparable level of analysis of the Staff Alternative and other alternatives that are not preferred.

> 5b. Q. Is the analysis of the "proposed action" in an EIS to be treated differently from the analysis of alternatives?
>
> A. The degree of analysis devoted to each alternative in the EIS is to be substantially similar to that devoted to the "proposed action." Section 1502.14 is titled "Alternatives including the proposed action" to reflect such comparable treatment. Section 1502.14(b) specifically requires "substantial treatment" in the EIS of each alternative including the proposed action. This regulation does not dictate an amount of information to be provided, but rather, prescribes a level of treatment, which may in turn require varying amounts of information, to enable a reviewer to evaluate and compare alternatives.

CEQ, Forty Questions, *supra*, Question 5b.

We request that OEP provide this level of analysis for the alternatives the Conservancy identifies below so as to present a clear basis for evaluation not only for OEP Staff, but also other stakeholders.

D. <u>The EIS Should Evaluate Specific Alternatives that are Better Adapted to Other Agencies' Comprehensive Plans of Development for the Susquehanna River</u>.

The information and study results in the record, in addition to the analyses referenced herein, show that the Conowingo Project has adverse effects on ecological resources and processes in the Lower Susquehanna River and Upper Chesapeake Bay.

We start by noting that Study 3.11, as approved in the February 4, 2010 Final Study Plan Determination (FSPD), required that Exelon model alternative flow management scenarios, including run-of-river operations, and compare these to its baseline operations proposal. The purpose of this modeling, as stated by Exelon, was to develop "a comprehensive flow management plan for the lower Susquehanna River that minimizes environmental and hydrologic impacts, while maintaining the viability of energy generation and water supply uses." Exelon was required to provide the results of its modeling in its study reports. However, the Final Study Report for RSP 3.11 only contains three of nine operational scenarios submitted by the stakeholders. Further the report does not include an adequate basis for comparison between alternatives presented. Pursuant to the Study Plan Determination, we expect the results from the operational alternatives analysis, including hydrologic data, habitat analyses, and energy analyses (Muddy Run and Conowingo power generation and revenue loss compared to the baseline) will be filed in the public record and considered as best available information in OEP's evaluation in the EIS.

The Conservancy, in consultation with resource agencies and other non-governmental organizations,[2] developed ecological goals that could be achieved in whole or in part by the new license (Att 1: Table 4-Columns I and II, Figure 5). These goals include a focus on physical, chemical and biological habitat on the Lower River from Conowingo dam to Spencer Island and from Spencer Island to the Upper Chesapeake Bay. Using information published in the FLA, literature and inter-agency and organizational consultation, and pursuant to the study plan requirement for 3.11 Hydrologic Study of the Lower Susquehanna River, several alternative operating scenarios were developed to support ecosystem goals (Att1: Table 5).

Stakeholders estimated the ecological performance of each alternative operational scenario using a combination of habitat based metrics including (1) persistent habitat, (2) weighted usable area (WUA), (3) shear stress, and (4) hydraulic variables (local depth, wetted area, velocity) (Att1: Table 4-Column IV). Because Project operations cause rapid and significant sub-daily fluctuations to instream habitat (depth, wetted width, velocity and shear stress), instantaneous measures of habitat (e.g., WUA), used alone, provide an inadequate basis of comparison for operational alternatives (Stalnaker 1992).

Instead, availability of habitat under peaking operations should be compared among alternatives using units of persistent habitat, especially for species and life stages characterized as immobile or having low mobility (Stalnaker 1992, Freeman et al. 2001, Maloney et al. 2012, Gomez and Sullivan 2013). Persistent habitat is defined as the amount of habitat that remains functionally connected over a biologically relevant time period. Persistent habitat was calculated pursuant to study plan requirements and is available for several taxa life stages (Att 1: Table 4-Column IV). We recommend OEP use this metric in combination with those described previously as a basis of comparison for alternatives in the EIS. The specific methods to calculate these metrics are included in Attachment 1.

It is important to note that all estimates of maximum habitat (instantaneous and persistent) as defined currently in the FLA are *underestimates* that do not reflect the influence of the Project on the availability of coarse substrate. Therefore, these metrics are used with caution, and are most useful for comparative purposes as opposed to providing absolute values.

Using this information, and the direction of the comprehensive management plans described above, the stakeholders drafted quantitative goals using best available information and professional judgment for target species, physical and chemical processes, and assumptions that increases in available habitat will result in increased abundance of affected target species (Att 1: Table 4). For each scenario we reviewed ecosystem performance during each season and under dry, average and wet hydrologic conditions. Based on the results from this preliminary analysis we identified two operational alternatives that bracket a range of mitigation opportunities under

[2] Susquehanna River Basin Commission, Maryland Department of Natural Resources, Maryland Department of the Environment, Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, US Fish and Wildlife Service, National Marine Fisheries Service, and The Nature Conservancy.

the new license with the potential to meet performance goals. We specifically request that OEP consider the two following operational alternatives in the EIS.

Ecosystem Restoration Alternative. We recommend that OEP include the run-of-river scenario (SRBC Run 007) as a basis for comparison in the EIS. This scenario provides opportunities for peaking generation at the Muddy Run Project, but limits peaking operations at Conowingo. It requires, on an hourly basis, passing the daily average flow at Marietta plus intervening inflow between Marietta and Conowingo (Att 1: Table 5). From our preliminary analysis, the run-of-river scenario provided maximum habitat benefits and minimizes operational risk over the term of a proposed license for threatened and endangered species, species of concern, and species with declining stocks, as compared to all operating scenarios modeled (Att 1: Figures 4-11, 13-16, 23-43). This scenario will allow OEP to bracket a reasonable range of alternatives by identifying the months and hydrologic conditions under which run-of-river or percent run-of-river operations may meet the project's purpose and need. Further, it provided the greatest net energy production of all alternatives, including the baseline scenario. However, because this energy production did not occur during peak demand, it was predicted to result in a net loss of profit.

Ecosystem Enhancement Alternative. We also recommend that OEP consider the operational alternative outlined in Table 1 in the EIS. This alternative was developed based on analysis of the ecological performance of several operating scenarios under different seasons and hydrologic conditions (Att 1, p. 14). While the ecosystem benefits are less than the Ecosystem Restoration Scenario, based on preliminary analysis, we believe this alternative would achieve performance goals while allowing for peaking operations at both Muddy Run and Conowingo Projects

Table 1. Proposed operational alternative for analysis in OEP's EIS[3].

Month	**Min. Flows (cfs)**		**Max. Down Ramping (cfs/hr)**	**Max. Up Ramping (cfs/hr)**	**Max. Generation Flow (cfs)**
	$Q_{Marietta}$ > Monthly P50	**$Q_{Marietta}$ < Monthly P50**			
December	11,000		20,000	40,000	Same as current
January	11,000				
February	12,500				
March	30,000	24,000	20,000	40,000	May and June: 65,000
April	35,000	29,000			
May	25,500	17,500			
June	14,000	10,000			
July	8,500	5,500	10,000 if Q < 30,000 20,000 if Q < 86,000	40,000	65,000
August	6,000	4,500			
September	5,500	3,500			
October	6,000		20,000	40,000	Same as current
November	11,000				

The numerical values in Attachment 1 are estimates, based on professional judgment and preliminary modeling assessments, of habitat amount and quality needed for consistency with existing comprehensive plans. The Conservancy recommends OEP staff use these values as a starting point to evaluate alternative operations and their performance against the metrics described above and using the methodology described in Attachment 1. Additionally, we recommend that any additional alternatives for analysis evaluate: 1) minimum flows, 2) maximum flows, and 3) ramping rates between low flows and generation, as all have significant and different effects on instantaneous and persistent habitat for priority species.

The Conservancy proposes license terms in Section III, *infra*, for OEP's evaluation in the EIS that it believes, based on the current relicensing record, may best achieve these goals.

[3] The relicensing stakeholders' flow management alternatives recognize that fish passage flows take priority over flow through the turbines during the fish passage season and that flow through the fish passage facilities would count toward the minimum flow requirements.

III.
THE CONSERVANCY'S PRELIMINARY TERMS AND CONDITIONS FOR NEW LICENSE FOR EXELON'S CONOWINGO PROJECT.

The ILP permits stakeholders to submit terms and conditions for projects undergoing re-licensing. The Nature Conservancy does so in this section, subject to two caveats. First, the record is still being developed. Ongoing studies, especially related to sediment and its impacts on the water quality of the Susquehanna River and Chesapeake Bay, will potentially provide significant and new information to this proceeding. Second, ongoing negotiations between the licensee and stakeholders may result in modifications to certain terms and conditions.

As such, we have not settled on final recommendations for license conditions, but we recommend OEP analyze the following alternatives in the EIS to address the effects described above in Section II.D and explained further below. We will timely notify OEP of any modifications to these preliminary recommendations based on information disclosed in the EIS, ongoing studies, or negotiated resolution of disputed issues.

Preliminary License Condition 1. Fish Passage. *Licensee shall provide passage to migratory fish through structural and operational modifications so as to achieve the following:*

a. Commensurate with the goal of the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) Migratory Fish Management and Restoration Plan for the Susquehanna River Basin to, 'Restore self-sustaining robust and productive stocks of migratory fish capable of producing sustainable fisheries to the Susquehanna River Basin throughout their historic ranges…" (SRAFRC 2010):

1. *Upstream passage efficiency of at least 85% for adult American shad and river herring, with at least 8o% of shad and river herring passed within 36 hours of crossing the head of Rowland Island*
2. *Downstream passage efficiency and survival rates for adult American shad and river herring of at least 80%.*
3. *Downstream passage efficiency and survival rates for juvenile American shad and river herring of at least 95%.*
4. *Upstream passage efficiency for American eels consistent with January 2013 SRAFRC American Eel Restoration Plan for the Susquehanna River Basin.*
5. *Downstream passage efficiency and survival rates for adult American eel (silver eels) of at least 85% survival for silver eels*

In addition to passage performance standards, TNC recommends that the Commission require Exelon to a) operate volitional upstream passage for American shad at both east and west fish lifts, and b) provide for interim trap-and-truck fish passage until such time as both fish lifts are operational and meeting the performance standards described above.

Explanation. Diadromous fish in the Susquehanna River, including American shad, river herring, American eel, Striped bass, and Atlantic and Shortnose sturgeon, once represented valuable commercial and recreational fisheries. In particular, American shad were one of the region's most valuable commodities for commerce and daily living through the 1800's. In the Susquehanna basin, the migratory cycle of these diadromous fish has been impinged by anthropogenic activities, primarily the construction of the four dams on the lower Susquehanna River, including Conowingo dam. The dams disconnect the Lower River and migratory fish from an estimated 98% of their formerly available habitat in the basin (Snyder 2005).

Recognizing the critical role of re-connecting migratory habitats to restoring depleted stocks of diadromous fish, in 1988 and 1989, stakeholders on the river signed settlement agreements with provisions for addressing fish passage at Conowingo dam. The east fish lift became operational in 1997. In 2010 a restoration plan was developed setting goals for diadromous fish restoration in the river basin including 2 million American shad and 5 million river herring. Presently, regional stocks of all diadromous species remain relicts, well below sustainable thresholds (Brown et al. 2013). Current American shad passage on the Lower River remains less than 1% of the restoration goal, which has called into debate the alternative of mainstem dam removal to restore diadromous fisheries (Brown et al. 2013).

Exelon's FLA does not demonstrate that its proposed fish passage measures are consistent with the goals and objectives of relevant comprehensive plans, including Amendment 3 of the Interstate Fishery Management Plan, the 2010 SRAFRC Migratory Fish Management and Restoration Plan, and the SRBC's 2008 Comprehensive Plan for Management and Development of the Water Resources of the Susquehanna River Basin. We recommend a license condition based on the quantitative objectives outlined in the 2010 SRAFRC Migratory Fish Management and Restoration Plan's Objective A: Tasks 1-5.

Alternatives to Exelon's proposed fish passage measures and fishway design proposal are needed to ensure the new license is best adapted for all beneficial uses of the Susquehanna River and should be considered by OEP in the EIS pursuant to NEPA. In addition to the ecological benefits of restoration, it is estimated that a restored stock of American shad on the Susquehanna River could produce 500,000 angler days valued at $25 to $37 million annually (SRAFRC 2010).

Preliminary License Condition 2. Instream Flows. *Licensee shall release flows sufficient to achieve the following within the project area downstream of Conowingo dam:*

Based on best available information, the flow schedule provided in Table 1, supra, is one combination of operational change to meet the following ecosystem goals:

- *i. Restore persistent habitat and maximum weighted usable area (MWUA)for the spawning, migration and egg and larval development of diadromous and resident fish and for macroinvertebrates*
    1. *Provide at least 50% of historic maximum persistent habitat and minimize the amount of time that <25% of historic maximum persistent habitat is available*

2. *Target 70% of MWUA across species and life stages (Table 4, Column I)*

ii. *Increase the probability of lift entry for American shad, river herring and American eel*

iii. *Eliminate stranding related mortality of adult and juvenile fish*

iv. *Provide at least 50% of available mussel habitat with suitable shear stress*

v. *Increase stability and suitability of basking and hibernation habitats for map turtles*

vi. *Increase suitability for SAV and emergent vegetation establishment*

Explanation. As described in Section II.A, *supra*, Exelon's existing and proposed operations of the Conowingo Project significantly impact in-stream flows and habitat on the Lower River and may influence salinity and DO in the Upper Bay by the combination of (1) significantly decreasing daily minimum flows during storage, and increasing the duration of low flows during dry conditions; (2) significantly increasing daily maximum flows during generation; and (3) significantly increasing the rate of rise and rate of fall, with the river transitioning from extreme low flows to high flows within a one to two hour period (Att 1, Figures 1-3, Tables 1-3, Table 4-Column III).

Project operations adversely impact all native diadromous fish populations by interrupting migratory cues and lengthening migration times, stranding fish during ramping events and by significantly reducing suitable hydraulic habitat. Based on telemetry data from RSP 3.5, it took migrating American shad an average of 11 days between first entering the tailrace and successfully entering the fish lift. Delay of upstream migration associated with hydropower operations has been shown to impose bioenergetics costs that are detrimental to the spawning and survival of diadromous fish (Castro-Santos and Letcher 2010).

Exelon's operation of Conowingo dam has also significantly reduced downstream hydraulic habitat for diadromous fish migration and spawning and egg and larval development, by an estimated 75 to 95%[4]. Further, current project operations result in fish stranding and mortality in all months, both as a direct result of dewatering and indirectly from thermal stress and increased predation. During the 2011 spawning migration, an estimated 1,400 American shad (about 6 % that passed that year) and more than 500 river herring were stranded as a result of hydropower operations (Att1: Table 4-Column III, Figure 14). It is estimated that 420,000 fish may have been stranded over the course of the year. Mortality from stranding was highest during the spring and summer months.

Project operations adversely impact the mussel community composition and abundance below Conowingo dam. Under current operations the population is not viable. Recruitment of juveniles is not occurring and the age distribution of the current population is nearing expected life span for some species due to the combination of high flow related shear stress on adult and juvenile life stages and unsuitable conditions for host-fish (Att1: Table 4-Column III, Figure 13).

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[4] Comparison between persistent habitat available under baseline and run-of-river operations.

Study 3.1.6, Figure 4.3-3 shows that when generation releases increase above 60,000 cfs, there is a loss of more than 50% of suitable habitat due to shear stress forces. Further it is estimated that current operations have reduced persistent habitat for host fish by 70 to 80% (Att1: Table 4-Column III).

Project operations adversely impact map turtles, an endangered species in the state of Maryland, and other native reptiles and amphibians by impacting habitats for reproduction, adult and juvenile growth and hibernation. Generation flows inundate basking habitats which are critical to adult reproductive growth (Att1: Table 4-Column III). This has reduced basking activity by an estimated 50% (Richards and Seigel 2009, Att 1: Figures 2-3, Figures 20-21). Further, peaking flows impair short- and long term movements (Richards and Seigel 2009). During hibernation, specifically the winter months, minimum releases are not sufficient to maintain suitable habitat conditions at key hibernacula (Att1: Figure 22).

Project operations adversely impact Submerged Aquatic Vegetation (SAV) communities, which are now largely absent on the lower river due to elimination of coarse-grained sediments and turbulent conditions resulting from hydropower operations.

Project operations adversely impact the macroinvertebrate community below Conowingo dam. Study 3.18 concluded that the assemblage below the dam was dominated by taxa tolerant of poor habitat conditions and of species adapted to hydrologic alteration. Further, important taxa including mayflies, stoneflies and crayfish are underrepresented or absent below the dam. These taxa are present upstream of the dam (below Safe Harbor), where sensitive taxa composed a higher proportion of the community.

Exelon's proposed project operations are inconsistent with the goals and objectives of relevant comprehensive plans over the term of the requested license, including the NMFS 1998 Final Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*), Amendment 3 of the Interstate Fishery Management Plan, the SRBC 2008 Comprehensive Plan for Management and Development of the Water Resources of the Susquehanna River Basin, and the 2010 SRAFRC Migratory Fish Management and Restoration Plan, Objective B-Task 2: "Assess and mitigate the impacts of hydroelectric projects and their operation on migratory fish spawning and rearing habitat within the project area immediately downstream and upstream of the project."

Preliminary License Condition 3. Sediment Transport. *Licensee shall mitigate for loss of coarse sediments (i.e., sand, gravel, and cobble) within the project area downstream of Conowingo dam and to the Chesapeake Bay.*

Explanation. The record is still being developed with regards to the magnitude of habitat impacts from sediment regime changes behind Conowingo dam, as well as specific alternatives to mitigate these impacts. However, the record (as demonstrated in Exelon's FLA) is clear that living resources are negatively affected by the lack of coarse substrate in the project area below Conowingo dam. This lack of substrate, which results from the presence and operation of Conowingo dam, has and will continue to have significant implications for the *amount* of quality habitat available to priority species, such as American Shad, river herring, Shortnose and Atlantic sturgeon, map turtle, freshwater mussels, SAV, and potentially to habitats further downstream into the Chesapeake Bay.

The FLA does not propose any environmental measures to mitigate for this impact of continuing operations. It does not demonstrate consistency with SRBC's Comprehensive Plan for Management and Development of the Water Resources of the Susquehanna River Basin, specifically for ecosystem restoration (*id.* at 64), and Chesapeake Bay restoration and maintenance (*id.* at 68). Accordingly, we request that OEP staff develop and consider alternatives that mitigate the effects on living resources to meet these goals.

Preliminary License Condition 4. Compliance with Water Quality Standards. *Licensee shall ensure that ongoing project operations do not result in violation of water quality standards or non-attainment of water quality criteria established for the Susquehanna River or the Chesapeake Bay, including consistency with the Chesapeake Bay TMDL.*

Explanation. The record is still being developed with regards to the water quality and habitat impacts from sediment regime changes behind Conowingo dam, as well as specific alternatives to mitigate these impacts. However, initial studies (e.g., Hirsch 2012) indicate that new conditions within the project area may result in new effects from discharges of sediment and associated nutrients resulting from the presence of Conowingo dam and its operations. Further, an assessment led by the U.S. Army Corps of Engineers (*available at* http://mddnr.chesapeakebay.net/LSRWA/index.cfm) is ongoing and will provide information critical to this license application. As the record is developed, we request that OEP staff develop and consider alternatives that mitigate the effects on living resources to meet these goals.

Preliminary License Condition 5. Adaptive Management Plan. *Licensee shall develop an adaptive management plan to ensure ongoing operations of the project are not in conflict with comprehensive management plans prepared by other agencies under FPA section 10(a)(2). The adaptive management plan shall be prepared in consultation with relevant resource agencies and interested stakeholders, and include the following: measurable objectives for the project's performance based on objectives contained in the comprehensive plans, deadlines for meeting measurable objectives, specific procedures for reopener if the measurable objectives are not met on time; and procedures for affirmative coordination between the Licensee, resource agencies that administer the comprehensive plans, and interested stakeholders.*

Explanation. TNC recommends that Exelon prepare an adaptive management plan that coordinates post-licensing monitoring and adaptive management measures as necessary to ensure license conditions are meeting previously established measurable objectives and otherwise performing as forecasted over the term of the new license. TNC further recommends that such plan include specific provisions for reopener in the event the project is not meeting measurable objectives as intended, rather than reliance on the general reopener clause contained in Standard License Article 15, Form L-3 (October 1975), which FERC has interpreted restrictively.

IV.
FURTHER PROCEDURES

There are a number of disputed factual issues remaining that are material to how the Commission will condition the new licenses for these projects. For this reason we request the following procedures to help narrow or resolve the remaining disputes.

A. Technical Conference

Pursuant to 18 C.F.R. § 385.601, The Conservancy requests that OEP convene a Technical Conference once NREA comments and replies have been submitted, in an effort to identify, discuss, and resolve any differences in analytical data or method that underlie such disputed conditions. For example, the FLA uses the metric of instantaneous WUA for predicting aquatic species' response to current operations. The Conservancy advocates use of a more reliable, and available, metric, persistent habitat for this project, where instream flows can vary by a factor of between 8 and 25 on a sub-daily basis. It would be useful to have a technical conference to discuss the comparative merits of these two methods for evaluating alternative project operations.

The Conservancy recommends against the Commission's standard practice of relying exclusively on paper hearing. However, if OEP elects to proceed in this manner, Exelon, as the applicant for a discretionary permit, has the burden of proof on any disputed issue. 5 U.S.C § 556(d).

B. Continued Coordination of Several Proceedings

The Conservancy strongly supports the continued coordination of the Conowingo, Muddy Run, and York Haven relicensing proceedings. Many disputed issues are common to these proceedings. Further, effective mitigation of the cumulative impacts of these projects may require coordinated measures in the three new licenses.

C. Disclosure in the Environmental Impact Statement.

The Conservancy understands that the Commission has discretion as to how it balances the competing beneficial uses of the Susquehanna River. However, its final licensing decision must state legal and factual findings and the basis therefor. 5 U.S.C. § 557(c). Its factual findings must be based on substantial evidence. 16 U.S.C. § 825*l*(b).

The Commission typically relies on the EIS prepared by OEP as the factual basis for its findings of fact, sometimes incorporating OEP's findings in the EIS directly into the final decision issuing new license. For this reason we request that the EIS state the specific basis for

OEP's findings. This request is consistent with the Commission's obligations under the FPA and Administrative Procedures Act.

The Commission must have and state a rational basis for choosing among competing methods or evidence. *Farmers Union Central Exchange v. FERC*, 734 F.2d 1486 (D.C. Cir. 1984). The Commission must exercise independent judgment and may not assume that evidence submitted by the applicant or any other party is adequate as the basis for its decision. 40 C.F.R. § 1502.14(a); *Scenic Hudson*, 354 F.2d at 620-621. Any scientific evidence on which the Commission relies must be consistent with scientific method, reliable, and probative. Fed. Rules Evid. 702; *Daubert v. Merrell Dow Pharmaceuticals*, 113 S.Ct. 2786 (1993). More generally, in any finding based on the record, the Commission must identify the facts on which it relies, explain why these facts are reliable and relevant, and then demonstrate how the facts support its decision. *See* 5 U.S.C. §§ 556, 557, 706(2); *Motor Vehicle Manufacturers Association v. State Farm Insurance*, 463 U.S. 29 (1983); *Burlington Truck Lines v. United States*, 371 U.S. 156 (1962). OEP must include specific citations to evidence relied upon for its findings, and explanation as to why such evidence is reliable and relevant, and then demonstrate how the facts support its decision.

D. Request to Accept the Chesapeake TMDL as a Comprehensive Plan.

As stated in Section II.B, *supra*, under FPA section 10(a)(2) the Commission is required to consider the extent to which a new license is consistent with a comprehensive plan for improving, developing, or conserving a waterway affected by a project. The Conservancy requests that the Commission add the Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus, and Sediment (Dec. 29, 2010)[5] (Chesapeake Bay TMDL) to the list of comprehensive plans for the states of Pennsylvania and Maryland.

The TMDL is relevant to these relicensings because it includes pollution limits for the Susquehanna River, which is a tributary to the Bay:

> About half of the Bay's water volume consists of saltwater from the Atlantic Ocean. The other half is freshwater that drains into the Bay from its 64,000-square-mile watershed (Figure 2-1). Ninety percent of the freshwater is delivered from five major rivers: the Susquehanna (which is responsible for about 50 percent), Potomac, James, Rappahannock, and York rivers.

Id. at 2-1.

In addition, the TMDL relies on assumptions regarding the sediment trapping capacity of Conowingo and upstream dams:

[5] The Chesapeake Bay TMDL is available at http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/tmdlexec.html.

> The dams along the lower Susquehanna River are a significant factor influencing nitrogen, phosphorus, and sediment loads to the Bay because they retain large quantities of sediment and phosphorus, and some nitrogen, in their reservoirs (Appendix T). The three major dams along the lower Susquehanna River are the Safe Harbor Dam, Holtwood Dam, and Conowingo dam. In developing the TMDL, EPA considered the impact of these dams on the pollutant loads to the Bay and how those loads will change when the dams no longer function to trap nitrogen, phosphorus, and sediment.
>
> …
>
> For the purposes of the Chesapeake Bay TMDL, EPA and the partners assumed the current trapping efficiencies will continue. If future monitoring shows that trapping efficiencies are reduced, Pennsylvania, New York, and Maryland's respective 2-year milestone delivered loads could be adjusted accordingly. Therefore it is imperative that those jurisdictions work together to develop an implementation strategy for addressing the sediment, nitrogen, and phosphorus behind the Conowingo dam through their respective WIPs, so that they are prepared if the trapping efficiencies decrease.

Id. at 10-8.

In Order No. 481-A, the Commission stated that it will consider a plan under Section 10(a)(2) if the plan is:

(1) prepared by an agency established by Federal law that has the authority to prepare such a plan, or by a state agency authorized to conduct such planning pursuant to state law;

(2) a comprehensive study of one or more of the beneficial uses of a waterway or waterways;

(3) articulates the standards applied, the data relied upon, and the methodology used; and

(4) is filed with the Secretary of the Commission.

The Chesapeake Bay TMDL meets these criteria.

Pursuant to Clean Water Act section 303(d), 33 U.S.C. § 1313(d), the U.S. Environmental Protection Agency (EPA), and Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia – all of which have jurisdiction over waters tributary to the Bay – developed the Chesapeake Bay TMDL.

The TMDL includes a comprehensive study of measures necessary to protect water quality standards, including designated beneficial uses, in the Bay:

> The TMDL – the largest ever developed by EPA – identifies the necessary pollution reductions of nitrogen, phosphorus and sediment across Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia and sets pollution limits necessary to meet applicable water quality standards in the Bay and its tidal rivers and embayments.… These pollution limits are further divided by jurisdiction and major river basin based on state-of-the-art modeling tools, extensive monitoring data, peer-reviewed science and close interaction with jurisdiction partners.

Chesapeake Bay TMDL at ES-1. The TMDL highlights five designated beneficial uses of the Bay that reflect "the habitats of an array of recreationally, commercially, and ecologically important species and biological communities" that the TMDL is intended to protect. *Id.* at 3-4. Implementation of the TMDL will likely benefit the ecologically important species and biological communities in the lower Susquehanna River as well.

The TMDL articulates the standards applied and documents the scientific methodology used to establish the pollution limits and measures to achieve the limits. *Id.* at Sections 5-8. The TMDL also includes programs for implementation and adaptive management that are intended to ensure accountability for achieving the TMDL objectives.

> The TMDL is designed to ensure that all pollution control measures needed to fully restore the Bay and its tidal rivers are in place by 2025, with at least 60 percent of the actions completed by 2017. The TMDL is supported by rigorous accountability measures to ensure cleanup commitments are met, including short-and long-term benchmarks, a tracking and accountability system for jurisdiction activities, and federal contingency actions that can be employed if necessary to spur progress.

Id.

The Conservancy is filing a hard copy of the Chesapeake Bay TMDL concurrently with the Secretary of the Commission.

E. <u>Request for Additional Studies/Analysis</u>

As stated above, the EIS will likely serve as the factual basis for the Commission's licensing decision. However, the Conservancy is concerned that OEP does not yet have substantial evidence to support findings regarding the environmental effects of Exelon's proposed new license or the feasibility of alternatives. More specifically, the environmental effects of evolving sediment-storage processes behind Conowingo are not currently part of the record (Hirsch 2012).

As stated above, Exelon, as the license applicant has the burden of proof in this relicensing. 5 U.S.C. § 556(d). OEP has the necessary authority to request that Exelon provide information and complete studies necessary for OEP to prepare the EIS and for the Commission to make its licensing decision. We request that OEP use this authority to complete the record.

V.
CONCLUSION

The Nature Conservancy respectfully requests that the OEP Staff grant this Motion to Intervene, and develop and consider the alternatives requested by the Conservancy.

Dated: January 31, 2014

Respectfully submitted,

Mark Bryer
Director, Chesapeake Bay Program
The Nature Conservancy
5410 Grosvenor Lane, Suite 100
Bethesda, MD 20814
301-897-8570
mbryer@tnc.org

Tara Moberg
Freshwater Scientist
The Nature Conservancy
2101 N Front Street, Building 1
Harrisburg, PA 17102
717-232-6001 ext 229
tmoberg@tnc.org

Richard Roos-Collins
Julie Gantenbein
Nicholas Niiro
Water and Power Law Group PC
2140 Shattuck Ave., Ste. 801
Berkeley, CA 94704
510-296-5588
rrcollins@waterpowerlaw.com
jgantenbein@waterpowerlaw.com
nniiro@waterpowerlaw.com

Attachment 2

DECLARATION OF SERVICE

Exelon Generation Company, LLC's Conowingo (P-405) and Muddy Run Hydroelectric Projects (P-2355) and York Haven Power Company, LLC's York Haven Hydroelectric Project (P-1888)

I, Nicholas Niiro, declare that I today served the attached "The Nature Conservancy's Motion to Intervene, Recommended Alternatives For Environmental Analysis, and Preliminary Terms and Conditions" by electronic mail, or by first-class mail if no e-mail address is provided, to each person on the official service list compiled by the Secretary in this proceeding.

Dated: January 31, 2014

By:

Nicholas Niiro
WATER AND POWER LAW GROUP PC
2140 Shattuck Ave., Suite 801
Berkeley, CA 94704-1229
Phone: (510) 296-5591
Fax: (866) 407-8073
nniiro@waterpowerlaw.com

Attachment 1. Preliminary Analysis of Conowingo Hydropower Operational Alternatives to Support Lower Susquehanna River and Upper Chesapeake Bay Ecosystem Restoration Goals

Summary Objective

The focus of this summary is to bracket the estimated impacts of baseline operations of the Conowingo dam and Muddy Run Projects on the Lower Susquehanna River and Upper Chesapeake Bay flow regime and related biological and physical processes. This discussion is followed by an outline of ecological goals and metrics for alternative future operating scenarios to improve downstream habitat to support fish, mussels, reptiles, submerged aquatic vegetation and flow mediated water quality conditions. We give an overview of the estimated performance of the baseline, run-of-river, and alternative operating scenarios related to ecological goals and summarize findings and recommendations. We do not have access to the operations or habitat models. Therefore this summary and findings do not represent multi-objective optimization. Rather, we present an identification of components of alternative operating scenarios that meet ecological objectives and should be considered in future alternatives.

Importance of the natural flow regime

A river's flow regime is considered a "master variable" structuring physical and biotic components of aquatic ecosystems (Power et al. 1995, Poff et al. 1997). Patterns of river flow determine physical habitat in rivers and on floodplains and influence organic matter and nutrient availability, water temperature, and water quality (Stanford et al. 1996, Bunn and Arthington 2002, Whiting 2002). Five critical components of a natural flow regime, including magnitude of discharge, frequency of occurrence, duration, timing, and rate of change of flows, maintain aquatic biodiversity and ecosystem processes (Poff et al. 1997, Arthington et al. 2006). Life history strategies of aquatic and riparian species have evolved in response to natural flow regimes in the species' native rivers and streams (Poff et al. 1997, Bunn and Arthington 2002). Changes in components of the natural flow regime, including both low and high flows, may result in loss of aquatic biodiversity, changes in aquatic food webs, and reductions in fish species and abundance (Power et al. 1995a, Power et al. 1995b, Wootton et al. 1996). DePhilip (et al. 2010) documented the need to protect low, seasonal and high flows throughout the year in order to support ecosystem needs for the large river habitats including the mainstem Susquehanna river (Figure 1).

Changes to the flow regime from Conowingo reservoir operations

Under current and proposed project operations:

- minimum flow releases (0 to 10,000 cfs) are less than the lowest recorded daily minimum flow for the months of December through June and are 60 to 100% lower than the historic monthly median flows from October through June (Figure 2, Table 1);
- daily maximum generation releases (86,000 cfs) are equivalent to seasonal flood pulses during all months, with the exception of March and April, and are greater than the historic maximum daily flows during July and August (Figure 2, Table 1);
- depending on the month, maximum generation flows are between 8 and 25 times greater than minimum flows (Table 1);
- there is no limit to the rate of rise or fall between minimum releases and maximum generation releases so the river can fluctuate by as much as 86,000 cfs/hour, equating up to a 9 foot change in depth, or from typical dry conditions to flood conditions (Tables1-2, Figures 3-4);

- the maximum hourly rise rate is 12 times or 1,200% greater than an upstream reference gage and the maximum hourly fall rate is 25 times or 2,542% greater than an upstream reference gage (Table 2); and
- The frequency of flow fluctuations is 341% greater than an upstream reference gage (Table 2).

Table 1. Comparison between current operations and a minimally altered flow regime.

Month	Baseline Minimum Flows	Relationship to historic monthly exceedance probability	Estimated historic monthly median (% deviation of operations)	Relationship of Max generation flows (86,000 cfs) to historic monthly exceedance probability
December	0 cfs 3,500 cfs	< historic min < historic min	28,257 (-88 to -100%)	December Q10
January	0 cfs 3,500 cfs	< historic min < historic min	32,220 (-89% to -100%)	January Q12
February	0 cfs 3,500 cfs	< historic min < historic min	62,875 (-94% to -100%)	February Q12
March	3,500 cfs	< historic min	65,430 (-94%)	March Q32
April	10,000 cfs	< historic min	39,519 (-74%)	April Q32
May	7,500 cfs	< historic min	20,958 (-64%)	May Q13
June	5,000 cfs	< historic min	12,721 (-60%)	June Q3
July	5,000 cfs	July Q92	9,103 (-45%)	> historic max
August	5,000 cfs	Aug Q86	7,940 (-37%)	> historic max
September	5,000 cfs 3,500 cfs	Sept Q77 Sept Q92	10,198 (-51% to -66%)	September Q2
October	3,500 cfs	Oct Q97	24087 (-85%)	October Q5
November	3,500 cfs	Nov Q99	31281 (-88%)	November Q11

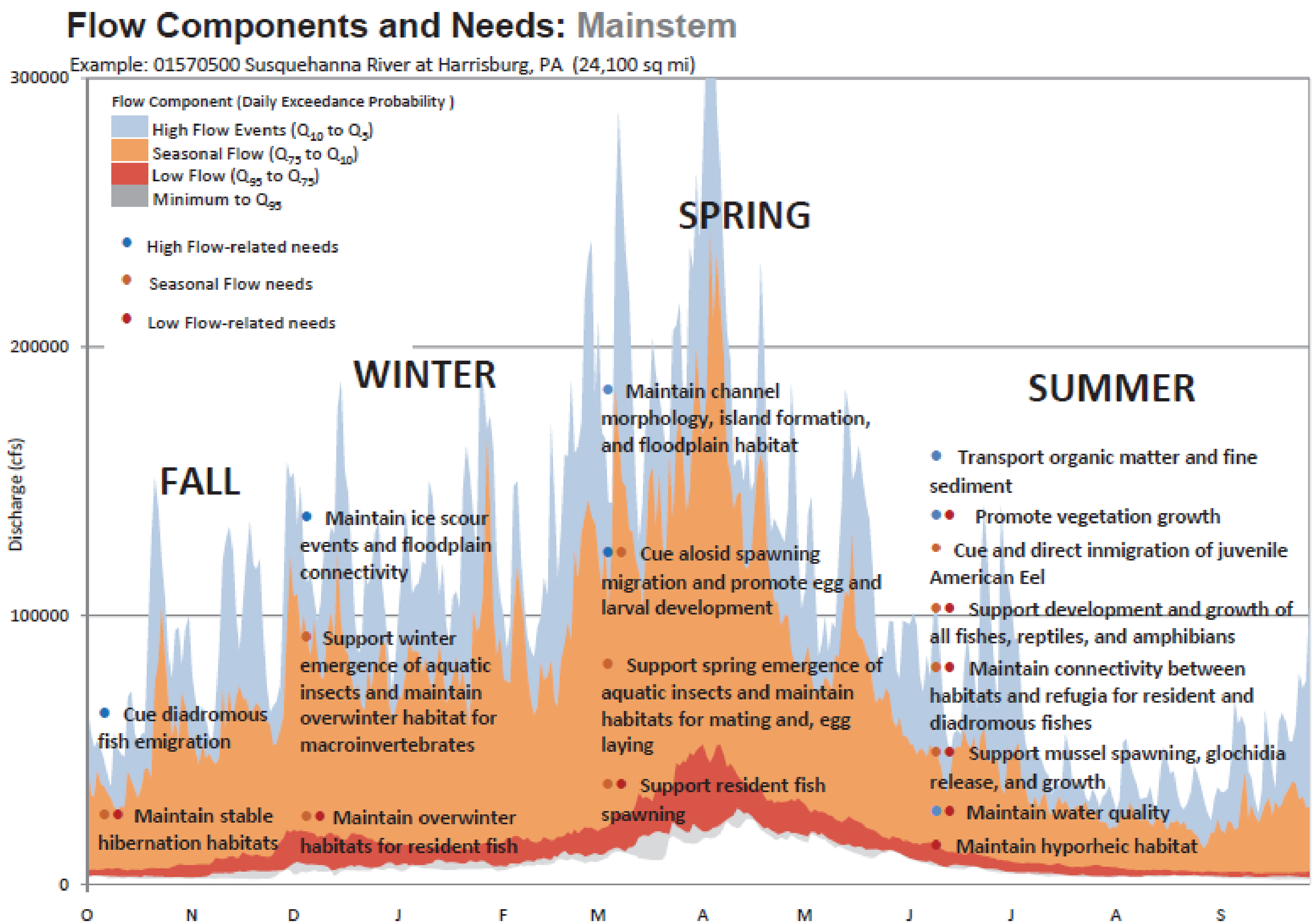

Figure 1: An illustration of seasonal ecosystem flow needs related to high, seasonal and low flows for the Susquehanna River mainstem DePhilip et al. (2010)

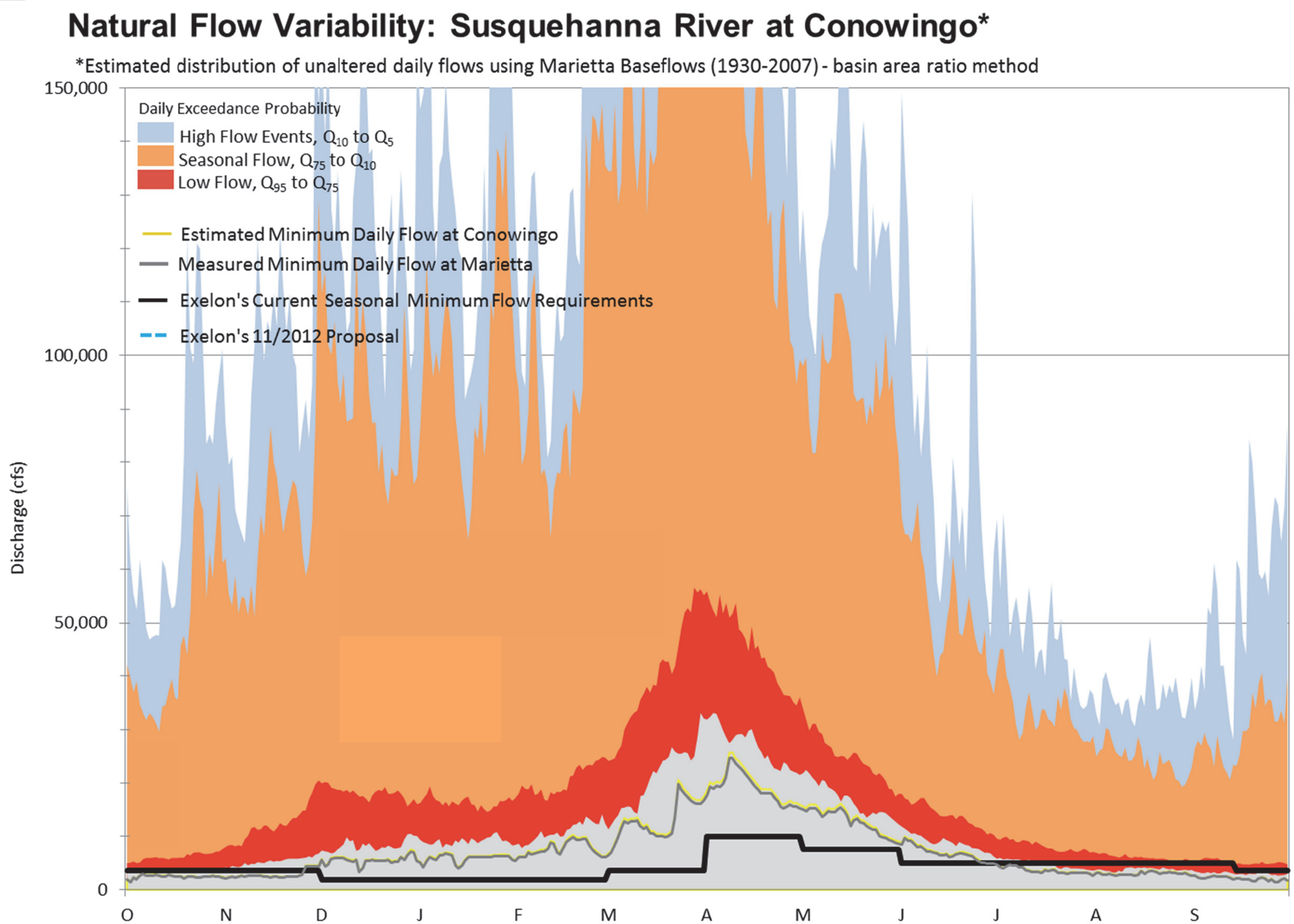

Figure 2: Minimum flow releases under current and proposed operations compared to historic daily distribution of low (red), seasonal (orange) and high (blue) flows on the Susquehanna River at Conowingo.

Table 2. (Zimmerman and Bryer 2009) Thresholds for six metrics of flow variability, above which flows may be considered flashy ("flashiness thresholds"), and the mean number of days per year that these flashiness thresholds were exceeded at the Marietta and Conowingo stream gages (for water years 1998-2007). Flashiness thresholds are in parentheses after each metric.

Site	**Mean number of days per year above flashiness threshold**					
	Richards-Baker flashiness index (0.06)	Ratio of flow fluctuations to total daily discharge (0.005)	Coefficient of diel variation (0.08)	Number of reversals (5/day)	Max hourly rise rate (1000cfs)	Max hourly fall rate (1000cfs)
Marietta	0	39.8	36.6	42.0	19.3	9.5
Conowingo	202.9	255.9 (+543%)	294.6 (+704%)	185.4 (+341%)	251.2 (+1201%)	251.5 (+2542%)

Figure 3. Lower River Conditions under minimum flows

Figure 4. Lower River **c**onditions under maximum flows

Summary of estimated impacts of baseline hydropower operations on the Lower River and Upper Bay Ecosystem

- **Diadromous fish** populations have been significantly reduced (American shad, river herring, striped bass, Atlantic and Shortnose sturgeon).
  - Project operations adversely impact all native diadromous fish populations by interrupting migratory cues and lengthening migration times, stranding fish during ramping events and by significantly reducing suitable hydraulic habitat. Based on telemetry data from RSP 3.5, it took migrating American shad an average of 11 days between first entering the tailrace and successfully entering the fish lift. Delay of upstream migration associated with hydropower operations has been shown to impose bioenergetics costs that are detrimental to the spawning and survival of diadromous fish (Castro-Santos and Letcher 2010).
  - Downstream habitat for migration, spawning and egg and larval development, has been significantly reduced by 75 to 95%[1]
- Hydropower operations result in **fish stranding and mortality** in all months, both as a direct result of dewatering the varial zone and indirectly from thermal stress and increased piscivorous and avian predation. During the 2011 spawning migration, an estimated 1,400 American shad (about 6 % that passed that year) and more than 500 river herring were stranded as a result of hydropower operations (Att1: Table 4-Column III). It is estimated that 420,000 fish may have been stranded over the course of the year. Mortality from stranding was highest during the spring and summer months.
- Operations have negatively impacted **freshwater mussel populations** on the lower river. Under current operations the population is not viable. Recruitment of juveniles is not occurring and the age distribution is shifting toward end of the expected life span for some species due to the combination of (1) high flow related shear stress during peaking generation (2) elimination of coarse grained bedload (3) unsuitable conditions for host-fish.
- **Macroinvertebrate community** is characterized as hydrologically impaired. Study 3.18 concluded that the assemblage below the dam was dominated by taxa tolerant of poor habitat conditions and of species adapted to hydrologic alteration. Further, important taxa including mayflies, stoneflies and crayfish are underrepresented or absent below the dam. These taxa are present upstream of the dam (below Safe Harbor), where sensitive taxa composed a higher proportion of the community.
- Project operations adversely impact **map turtles**, an endangered species in the state of Maryland, and other native reptiles and amphibians by impacting habitats for reproduction, adult and juvenile growth and hibernation. Generation flows inundate basking habitats which are critical to adult reproductive growth (Table 4-Column III). This has reduced basking activity by an estimated 50% (Richards and Seigel 2009, Figures 3-4). Further, peaking flows hinder short- and long term movements (Richards and Seigel 2009). During hibernation, specifically the winter

[1] Comparison between persistent habitat available under baseline and run-of-river operations.

months, minimum releases are not sufficient to maintain suitable habitat conditions at key hibernacula (Figure 20).

- Project operations adversely impact **Submerged Aquatic Vegetation (SAV)** communities, which are now largely absent on the lower river due to elimination of coarse-grained sediments and turbulent conditions resulting from hydropower operations.

- The lower river and upper bay are **coarse sediment-starved** with bedload gravels and sands being trapped above Conowingo dam. This has resulted in reduced maintenance of channel habitats, islands, and river edges. This has and will continue to have significant implications for the *amount* of quality habitat available to priority species, such as American Shad, river herring Shortnose and Atlantic sturgeon, map turtle, freshwater mussels, SAV and potentially to habitats further downstream into the Chesapeake Bay.

Restoration goals for instream habitat and physical and chemical processes in the Lower River and Upper Chesapeake Bay

Several agencies and organizations[2] coordinated to develop ecological goals for the Lower River ecosystem. This includes goals for physical, chemical and biological habitat on the Lower River from Conowingo dam to Spencer Island and from Spencer Island to the Upper Chesapeake Bay. This document focuses on the goals and methods used to quantify habitat improvement for multiple species and life stages including fish, mussels, aquatic insects and reptiles on the modeled reach. Each habitat improvement goal is articulated in terms of one or more species or life stage and, is estimated with best available habitat metrics (Table 4-Column IV). Using information published in the ISR's, literature and interagency and organizational consultation, more than 10 alternative operating scenarios were developed to identify operational alternatives that mitigate significant impacts of project operations on downstream ecological values (Table 5). Scenarios were developed to meet the following goals:

- **Diadromous and Resident Fish and Macroinvertebrates**. Restore persistent habitat and maximum weighted usable area for the spawning, migration and egg and larval development of diadromous and resident fish and for macroinvertebrates
    - Provide at least 50% of historic maximum persistent ***habitat for spawning and migration, egg and larval development***. In addition, minimize the amount of time that < 25% maximum persistent habitat is available.
    - Target 70% of maximum weighted usable area for ***juvenile and adult fish growth***.

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[2] Susquehanna River Basin Commission, Maryland Department of Natural Resources, Maryland Department of the Environment, Pennsylvania Department of Environmental Protection, Pennsylvania Fish and Boat Commission, US Fish and Wildlife Service, National Oceanic and Atmospheric Administration, and The Nature Conservancy

- Increase probability of ***successful lift entry and up and downstream migration*** for American shad, river herring and American eel. This includes elver traps and ramps.
- ***Reduce the risk of stranding related mortality*** and stress in all seasons

- **Freshwater Mussels.**
  - Provide 50% of mussel habitat below the high flow shear stress threshold to support ***habitat for adult growth, spawning and juvenile establishment***.
  - Provide ***suitable habitat for host-fish*** during glochidia transfer

- **Map turtles.**
  - Increase persistence of ***basking habitat for juvenile and adult growth*** and access to nesting habitat
  - Increase ***stability and suitability of hibernation habitat***

- **Submerged and Emergent Aquatic Vegetation.**
  - Increase persistent habitats for emergent and submerged aquatic vegetation

- **Salinty and Dissolved Oxygen in the Upper Bay.**
  - Avoid impacts to salinity and dissolved oxygen gradients under low flow conditions in the Upper Bay

Table 4: Summary of ecological goals, targets, impact from current operations and metrics for ecosystem performance to compare alternative operating scenarios

Season	**Column I**	**Column II**	**Column III**				**Column IV**
	Ecological Goals of Future Operations	**Ecological Targets**	**Impact from Current Operations**	**Max**	**Min**	**Ramp**	**Metrics**
Spring **March, April, May, June**	Increase in persistent and usable habitat for **diadromous fish migration and spawning** providing at least 50% of historic persistent habitat and 70% of MWUA.	• American shad • River herring • Striped bass • Shortnose and Atlantic Sturgeon	Estimated loss of 75 to 95% of persistent spawning and migration habitat (Figures 6 -9, 23-25 and 32-41).	X	X	X	• IFIM persistence • IFIM WUA
	Increase in persistent and usable habitat for **egg and larval development of diadromous fish** providing at least 50% of historic persistent habitat and target 70% of MWUA	• American shad • River herring • Striped bass • Shortnose and Atlantic Sturgeon	Estimated loss of 70 to 95% of persistent spawning and migration habitat (Figures 10 -12 and 27-30).	X	X	X	• IFIM persistence • IFIM WUA
	Increase in persistent and usable habitat for **freshwater mussel and host-fish interaction**, specifically for mussels with diadromous host fish to provide at least 50% of historic persistent habitat and 50 to 90% of	• Alewife floater • Eastern Elliptio	Estimated loss of 70 to 80% of persistent habitat for host fish[3] Less than 50% of available habitat with suitable shear stress (Figure 13).	X X	X	X	• Shear stress • Host-fish IFIM persistence

[3] This may underestimate loss, depending on the current overlap between existing mussel populations and persistent diadromous fish habitat. Persistent habitat for adult fish was not modeled in ISR's

	MWUA						
	Reduce **stress and mortality from stranding** of diadromous and resident fish	• American shad • River herring • Striped bass • All resident fish	In 2011 migration and spawning season, estimated stranding of 1,485 migrating shad and 562 migrating river herring[4] (Figure 14).		X	X	• Estimate loss from baseline scenario using seasonal stranding analysis
	Increase accessibility and efficiency of fish lifts, including elver traps and ramps	• American eel • American shad • River herring	Avg. 11 days to navigate tailrace to and through lift[5] Peaking flows (86K cfs) twice as high as range of most probable entry during telemetry studies (25 to 30K cfs)[6].	X	X	X	• Estimates from radio-telemetry study
	Increase extent of SAV and emergent beds	• SAV and emergent vegetation establishment	Habitat models for SAV are not available at this time.	X	X		
Summer **July, August, Sept**	Increase in persistent and usable **habitat for fish spawning and adult growth** providing at least 50% of historic persistent habitat and 50 to 90% of MWUA	• American eel (yellow) Smallmouth bass • White perch • Yellow perch	Estimated loss of 50 to 80% persistent spawning habitat (Figure 17, Figure 26, and Figures 41-43).	X	X		• IFIM persistence • IFIM WUA

[4] Estimated by extrapolating the RSP documentation of measured stranding during four sample events. Total stranding during these events was likely underestimated due to confounding factors of piscivorous and avian predation in isolated pools and pool access.
[5] Castro-Santos and Letcher 2010
[6] Pugh, D. 2013. Independent review of American Shad Radio-telemetry data

	Mitigate loss of habitat for **egg, larval and juvenile fish development**	• American shad • River herring • Striped bass • Shortnose and Atlantic Sturgeon • Smallmouth bass	Estimated loss of 17 to 90% persistent habitat (Figures 13-16).	X	X		• IFIM persistence (E&L) • IFIM WUA (juvenile)
	Mitigate loss of habitat for **mussel growth, spawning, glochidia transfer and juvenile mussel establishment**	• Alewife floater • Eastern Elliptio • Lampmussels and tidewater mucket	Figure 13	X			• Shear stress • Host fish IFIM WUA
	Mitigate for loss of **stranded adult and juvenile fish**	• Draft list identified in stranding study	Figure 14	X		X	• Estimate loss from baseline scenario using seasonal stranding analysis; rate of change
	Mitigate loss of **basking and access to nesting habitat** for reptiles and amphibians	• Map turtle	Basking activity has been reduced by at least 50% under peaking operations[7](Figure 18). Peak generation hinders movement– turtles take shelter behind logs and rocks[8]	X		X	• Estimate loss from occurrence data, hydraulic habitat maps and Towson research
Fall **October,**	Mitigate loss of habitat for **diadromous fish outmigration**	• American eel • Juvenile shad	WUA curve	•	•	•	• IFIM WUA

[7] Basking hours are critical for adult reproductive growth and have been reduced significantly below Conowingo reservoir (Richards and Seigal 2012)
[8] Richards and Siegel 2009

November	Mitigate loss of habitat for **juvenile fish development**	• American eel • American shad • River herring • Striped bass • Shortnose and Atlantic Sturgeon • Smallmouth bass • White perch • Yellow perch	WUA curve	•	•	•	• IFIM WUA
	Mitigate for loss of **stranded adult and juvenile fish**	• Draft list identified in stranding study	Figure 14	•	•	•	• Estimate loss from baseline scenario using seasonal stranding analysis; rate of change
	Mitigate loss of habitat for **mussel growth, spawning and brooding**	• Alewife floater • Eastern Ellipito	Less than 50% of available habitat with suitable shear stress (Figure 13).	•	•	•	• Sheer stress
Winter **December, January, February**	Increase **habitat for outmigrating and overwintering juvenile and adult diadromous** fish	• American eels (yellow eels) • Juvenile shad • Striped bass • Shortnose and Atlantic sturgeon •	WUA curve	X	X	X	• IFIM WUA
	Increase **habitat for resident fish during a time** when they have low energy reserves	• Smallmouth bass • White perch • Yellow perch	WUA curve	X	X	X	• IFIM WUA

	Increase **reproductive habitat for freshwater mussels during spawning and brooding**	• Alewife floater • Eastern Elliptio	Freshwater mussel population is not viable	X	X		• Shear stress
	Mitigate for loss of persistent habitat for macroinvertebrates	• Caddis	Figures 19 and 30.		X		• IFIM persistence
	Mitigate instability of map turtle hibernacula	• Map turtle	Figure 22		X		• Estimate using hydraulic habitat data and known hibernation locations on the reach

Evaluation of ecosystem performance of alternative operating scenarios for Conowingo Reservoir

The ecological performance of the baseline, run-of-river and each alternative operational scenario was estimated using a combination of habitat based metrics including (1) persistent habitat, (2) Weighted Usable Area (WUA), (3) shear stress and (4) hydraulic variables. Methods for using these variables are outlined below.

Use and limitations of available hydraulic and habitat models

Under study RSP 3.16 for the Conowingo Hydroelectric Project, a two-dimensional (depth-averaged) hydraulic and habitat model (River2D) was developed for the reach of the lower Susquehanna River from the downstream face of Conowingo Dam to the downstream end of Spencer Island, approximately a 4.5 mile reach. The study aimed to develop relationships between flow and aquatic habitat conditions for multiple species and life stages that occur on this reach. The model was calibrated for flows from 2,000 to 182,500 cfs, but was not run above 86,000 cfs (maximum generation at Conowingo Dam). For each species and life stage represented, Habitat Suitability Indices (HSI) were developed related to depth, velocity and/or substrate. Sources used to develop HSI curves for each species and life stage are documented in Study 3.16. Using the HSI curves, and the model's hydraulic outputs, habitat for each species and life stage was estimated using weighted usable area, persistent habitat and shear stress.

There are two major limitations to available habitat models:

- First, for those species and life stages requiring gravel (all but striped bass), the estimate of total habitat available is an underestimate due to the geomorphic influences of operations. Specifically, downstream coarse sediments have been reduced by the combination of trapping of bedload materials behind the dam and downstream scour from increased high flow magnitude and frequency. A better understanding of the magnitude of these influences should come from pending studies.
- A second limitation in the hydraulic and associated habitat models is the estimation of available habitat for several species using four habitat guilds (shallow-slow, shallow-fast, deep-slow and deep-fast). While habitat guilds provide an estimate of available habitat, species-specific HSI curves and associated habitat models provide more accurate estimates. In order to address this concern, we reviewed the habitat guild results and based on consultation with the agencies, decided to (1) use the shortnose sturgeon habitat model as a surrogate to estimate Atlantic Sturgeon habitat over all life stages and (2) did not include species' life stages assigned to shallow-slow and shallow-fast habitat guilds because the conditions under which the model predicted these habitats are maximized occurred less than 1% of the time over the period of record.

Persistent Habitat

With rapid sub-daily fluctuations in stream flow, habitat improvement goals for the reach are defined, for all immobile species and life stages, in terms of available persistent habitat (Stalnaker 1992, Freeman et al. 2001, Maloney et al. 2012). This definition is the area of quality habitat (HSI> .5) that persists as flows transition between minimum flow releases and generation releases. To compare the relative performance of alternative operational scenarios, it is important to summarized available persistent habitat over three timescales under each operational scenario; (1) which operational scenarios maximize daily persistent habitat for each species/life stage over the period of record (2) how much persistent habitat is available during critical life stages in dry, average and wet years and (3) on a sub-daily basis, which rate-of-change scenarios increase persistent habitat

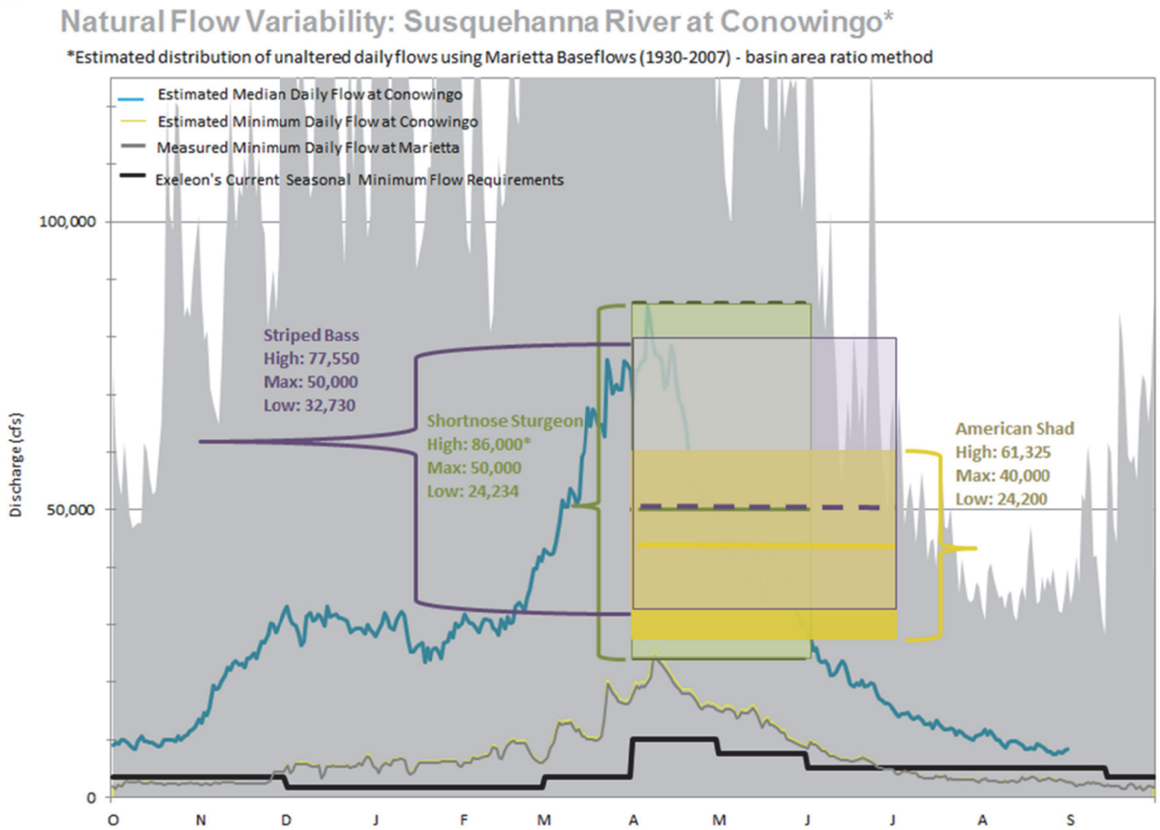
First, for each immobile species and life stage identified in Table 4, we summarized daily persistent habitat available for the period of record. Under each operational scenario, daily persistent habitat for each immobile life stage was generated using the daily minimum and daily maximum flow for each day over the period of record and interpolating the area of habitat that persisted between the two flow conditions. We then summarized the total number of days over the period of record that persistent quality habitat was within 75% of maximum for the relevant months of each immobile species life stage, between 50 and 75%, 25 and 75% and < 25% (Figures 23-31). From this analysis, we found that the run-of-river scenario maximized the number of days within 75% of the maximum persistent habitat and minimized the number of days when <25% of maximum persistent habitat was available. The baseline scenario (current operations) had the highest number of days, or highest proportion of time that persistent habitat availability was < 25% (Figures 23-31).

In addition to summarizing available persistent habitat over the period of record, we selected representative dry, average, and wet conditions to compare consecutive days of persistent habitat available for immobile life stages. Dry, average and wet conditions were defined on a monthly basis using percentiles based on conditions at the Marietta gage based on the modeled operations period. We summarized habitat area that persisted over a 14-day and a 1-month period for each scenario (Figures 32 - 43) under these conditions. As expected, operational scenarios perform differently depending on year type. Similarly, we also reviewed habitat persistence within a day to compare availablity during up- and down-ramping scenarios. The run-of-river scenario maximized hourly habitat persistence, followed by the scenario with variable ramping rates (based on the previous hourly discharge).

Weighted Usable Area

For mobile species and life stages without data on habitat persistence (adult and juvenile growth) we used an instantaneous habitat metric, percent of maximum weighted usable area (MWUA), to draft alternative operating scenarios (Gomez and Sullivan 2013). For each month, we used periodicity information to identify relevant species and life stages and compare MWUA across species and life stages to identify a minimum flow that would provide 70 to 90% MWUA across the majority of target species and no less than 50% MWUA for all species. For example, in Figure 5 MWUA for striped bass, shortnose sturgeon and American shad migration and spawning occurs between 40,000 and 50,000 cfs. The range of flows within 90% of MWUA for striped bass is from 77,550 cfs and 32,730 cfs (purple box).

Figure 5. Common habitat ranges of 90% MWUA for Striped bass, Shortnose sturgeon and American Shad migration and spawning.



Shear Stress

During spawning and glochidia transfer, an increase in high flow events may mobilize the bedload, increasing shear stress and scour of mussel beds. Shear stress influences the suitability of juvenile settlement and colonization (Hardison and Layzer 2001, Morales et al. 2006, Holland-Bartels 1990, Layzer and Madizon 1995). Vaughn and Taylor (1999) also documented that increases in high flow frequency and magnitude were a factor in reducing mussel species diversity and abundance.

As reported in Study 3.16, higher flows limit mussel habitat availability. A plot of catch per unit effort (CPUE) compared to shear stress at incremental discharges, showed the sample stations with the highest CPUE had relatively low shear stress values (Figure 4.3.3-2, Study 3.16). A habitat curve was created predicting percent of wetted area above and below the high flow shear stress threshold based on discharge (2,000 to 86,000 cfs). High flow shear stress curves were developed for the lower river below Conowingo at incremental flows. When discharge is less than 65,000 cfs, 50% of total current habitat is available. We developed scenarios that limit the maximum generation to 65,000 cfs during critical months of spawning and/or glochidia transfer for alewife floater, eastern elliptio, lampussels and tidewater mucket. Because total current habitat is limited by the lack of coarse substrates below the dam, this is an underestimate of historically available habitat.

Depth/Velocity maps for species and life stages not included in habitat mapping

For those species or life stages that were not included in life stage specific habitat mapping, we overlay ISR data on channel depth and velocity under various discharges to estimate suitability for a species' life stage. For example, for map turtle hibernation, we took known river bed hibernacula, overlain by current minimum flows during the hibernation period to determine whether known hibernation locations remained at a suitable depth (1m). The depth over hibernacula provided by current minimum flows was unsuitable to support hibernation, therefore we developed scenarios with more suitable minimum flows during the hibernation period.

Integration across habitat goals and metrics

The distribution of benefits are typically reversed for species and life stages that prefer drier conditions, with those species benefitting most under dry conditions and least under wet conditions. We cross referenced draft minimum and maximum flow recommendations for each month with the Weighted Usable Area for each mobile species and life stage to develop recommendations that increase both persistent and instananeous (WUA) habitat across our targets as compared to the baseline.

Table 5. First round of alternative operating scenarios developed by stakeholders. All streamflow values are reported in cubic feet per second. The number in parantheses, e.g. (005) refers to the identification number used in the modeling process. 'Daily Max' refers to a cap on maximum generation flows. ROC refers to whether there is a rate-of-change component to current operations. Within ROC, the number of steps refers to the number of tiers of ramping based on the previous hour's releases.

Monthly Min	Baseline	Q92	ROR		IFIM	Q92_Cap_ROC	Spring ROR	75% of inflow Plus Peak
	(005)	(006)	(007)		(008)	(204)	(205)	(206)
Jan	1,750	10,948	Marietta + intervening	28,257	4,011	10,900	10,900	0.75*(Marietta
Feb	1,750	12,513	Marietta + intervening	32,220	4,011	12,500	12,500	0.75*(Marietta
Mar	3,500	24,087	Marietta + intervening	61,408	24,000	24,100	Marietta flow + intervening	0.75*(Marietta
Apr	10,000	29,300	Marietta + intervening	65,837	24,000	29,300		0.75*(Marietta
May	7,500	17,100	Marietta + intervening	39,492	24,000	17,100		0.75*(Marietta
Jun 1-15	5,000	9,687	Marietta + intervening	20,735	24,000	9,700		0.75*(Marietta
Jun 16-30			Marietta + intervening					0.75*(Marietta
Jul	5,000	5,370	Marietta + intervening	12,721	14,068	5,300	9,700	0.75*(Marietta
Aug	5,000	4,286	Marietta + intervening	9,103	14,068	4,300	5,300	0.75*(Marietta
Sept. 1-15	5,000	3,545	Marietta + intervening	7,940	14,068	3,500	4,300	0.75*(Marietta
Sept. 15-30	3,500	3,545	Marietta + intervening		4,011	3,500	3,500	0.75*(Marietta
Oct	3,500	4,181	Marietta + intervening	10,198	4,011	4,200	4,200	0.75*(Marietta
Nov	3,500	6,142	Marietta + intervening	24,087	4,011	6,100	6,100	0.75*(Marietta
Dec	1,750	10,531	Marietta + intervening	31,281	4,011	10,500	10,500	0.75*(Marietta
Daily Max	N	N	NA		65 K	65 K	N	N
ROC	N		NA		Y - 1 step, 20K	Y - 3 step	Y - 3 step	N

Findings and Recommended Components of a Future Operating Scenario

Through the preliminary analysis of alternative operational scenarios we gained a better understanding of the relationship between generation revenues and ecological goals in different seasons and under wet, average and dry hydrologic conditions. A few key findings include:

- During years with dry summer conditions, relatively little habitat value was gained under alternative scenarios that required higher minimum releases as compared to the baseline scenario. Further, higher minimum releases under these dry summer conditions resulted in failure to meet minimum flow requirements with downstream flows dropping to 800 cfs (leakage), more often. Those scenarios that required a minimum release of Q92 (SRBC 204) during dry summer conditions were able to sustain minimum releases through these conditions.

    - Therefore, we'd recommend that any alternative scenario include tiered minimum flow requirements in summer (July, August and September), allowing lower minimum flow requirements during dry conditions (SRBC 204), and higher minimum flow requirements as hydrologic conditions allow (SRBC 208 < x > SRBC 204).

- The largest gains in meeting ecological goals occurred during Spring months in all alternative scenarios (Figure 6-12, 23-29 and 32-40). This is a biologically active period with several target species' life stages with limited mobility (fish spawning, egg and larval development, mussel spawning and glochidia transfer). This is also a time of year when high river flows have allowed for more frequent peaking opportunities and higher revenues. During the Spring months, minimum flow releases under the baseline scenario are less than the estimated historic minimum daily flow (Table 1, Figure 2).

    - In order to balance hydropower opportunities with the non-power values of the river, we recommend that any alternative scenario include higher minimum flow requirements during the Spring months. Minimum flows should be high enough to meet spring ecosystem goals (Table 4). While higher minimum flow releases impact revenues, this financial burden could be minimized by using a tiered schedule that takes advantage of availability of habitat under different hydrologic conditions. In years that flows are above average minimum flows could be high enough to meet spring ecosystem goals (SRBC 008 > x < SRBC 007). In years that flows are below average, minimum flows could be reduced to meet a portion of the spring ecosystem goals (SRBC 204).

    - The run-of-river scenario provided significant habitat benefits during these months. However, the revenue losses under the run-of-river scenario were high. We would recommend an alternative operating scenario that considers run-of-river under above average conditions during a portion of the migration period once temperature cues for Alosid migration and spawning are met downstream.

- During fall and winter months, ecosystem performance was also high under alternative operating scenarios as compared to the baseline. While less biologically active, life stages during these months require more habitat than baseline operations provide (for map turtle hibernation, mussel brooding, American eel and shad outmigration and thermal buffering). During the fall and winter months, minimum releases under baseline operations are either less than the estimated historic minimum daily flow, or equal to drought flow conditions.

  - During winter months, we'd recommend minimum flow releases equivalent or greater than SRBC 204.

- Maximum generation is currently 86,000 cfs. In June and July, this is greater than the historic daily maximum flow. From June – December, maximum generation is equivalent to historic seasonal flood flows. This means that the lower river transitions from drought flows to flood flows on a daily basis for most of the year. This has a significant influence on the availability of persistent habitat and shear stress conditions.
  - During the biologically active months for species and life stages with limited mobility (fish spawning, egg and larval development, mussel glochidia transfer and juvenile deposition), we recommend a maximum peaking generation of 65,000 cfs. This, in combination with increased minimum flows, increases habitat persistence and increases the area of mussel habitat with acceptable shear stress. This would not apply to flood events, when river flows exceed typical generation flows.

- There is currently no limit to the transition between minimum flow releases and maximum generation releases. Most often this transition occurs over a 2 hour period, resulting in significant stress to aquatic species including stranding and mortality of fish and difficulty migrating to flow refugia.

  - All times of year, we recommend a flow conditional downramping rate to no more than 10,000 cfs/hr when flows are less than 30,000 cfs, and no more than 20,000 cfs per hour when flows are between 30,000 cfs and 86,000 cfs. We estimated downramping rates that would decrease the probability of stranding by calculating the distance from edge of wetted perimeter at Qx to the resulting edge of wetted perimeter at Qy and comparing that to swim speeds. This estimate assumes directional movement during downramping, therefore the effectiveness of a downramping rate at preventing stranding and mortality would have to be monitored and adaptively managed.

- All alternative operational scenarios resulting in a net gain of total electricity generated but a net loss in revenue. This is due to the energy required for pump storage (Muddy Run) but the timing and pricing associated with meeting peak energy demands.

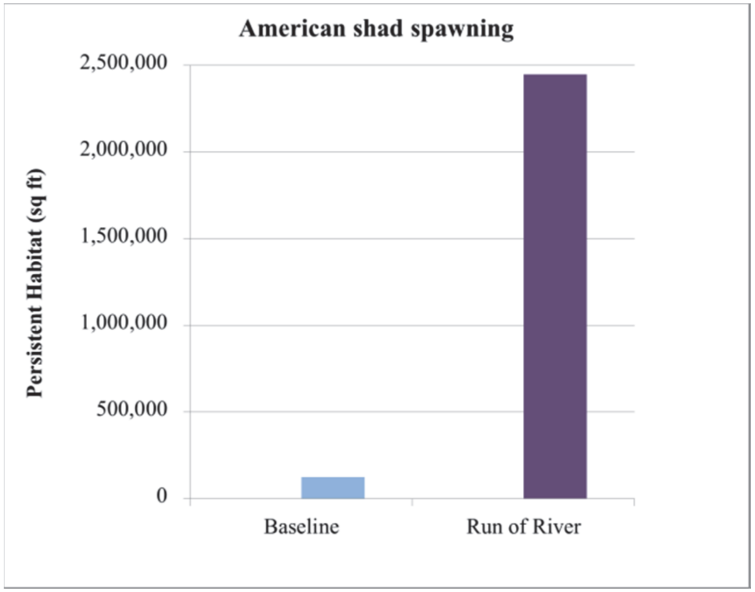
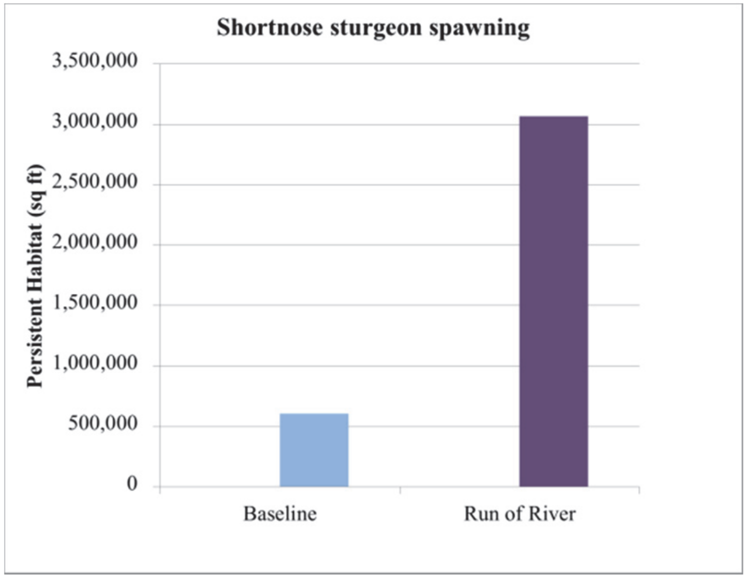


Figure 6.



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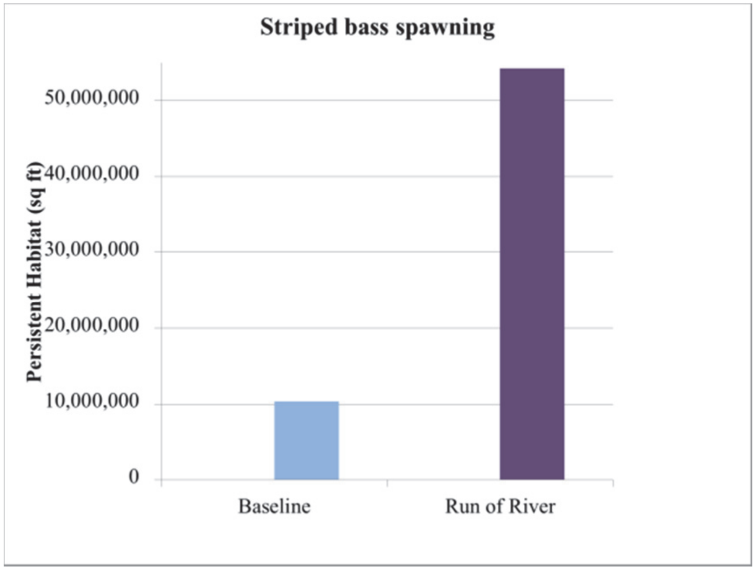

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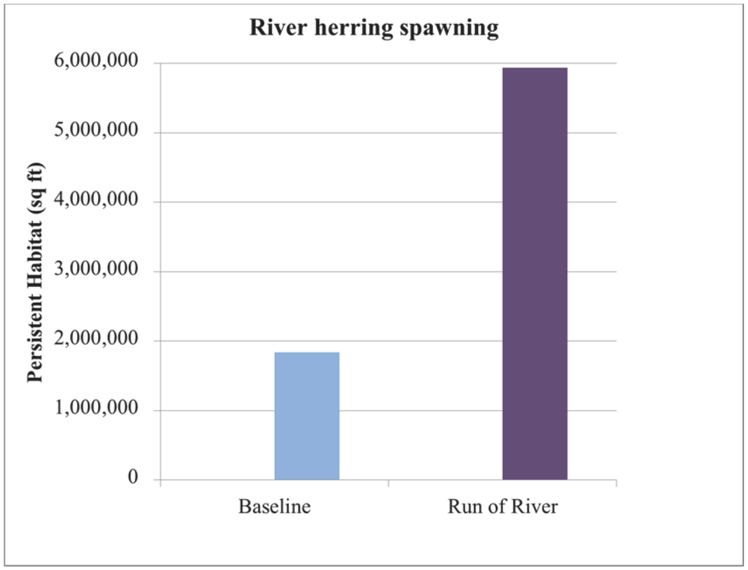

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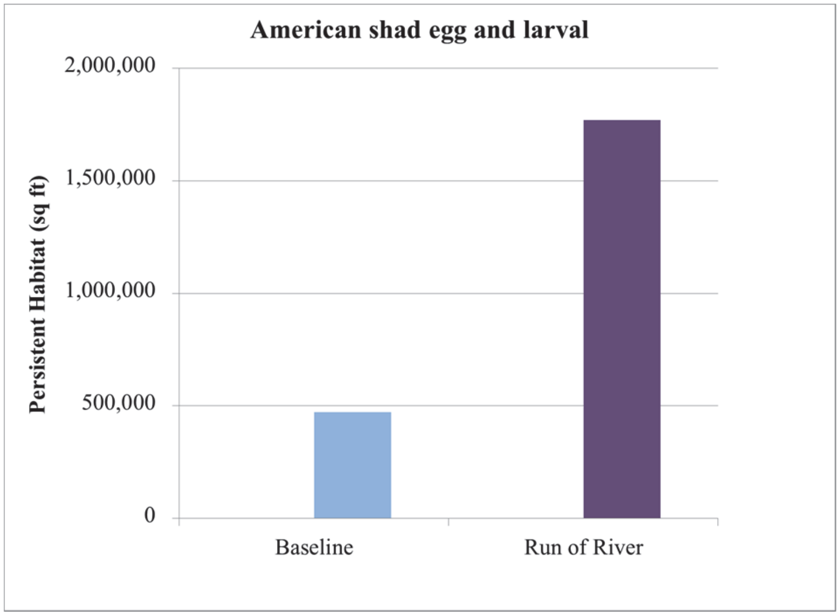

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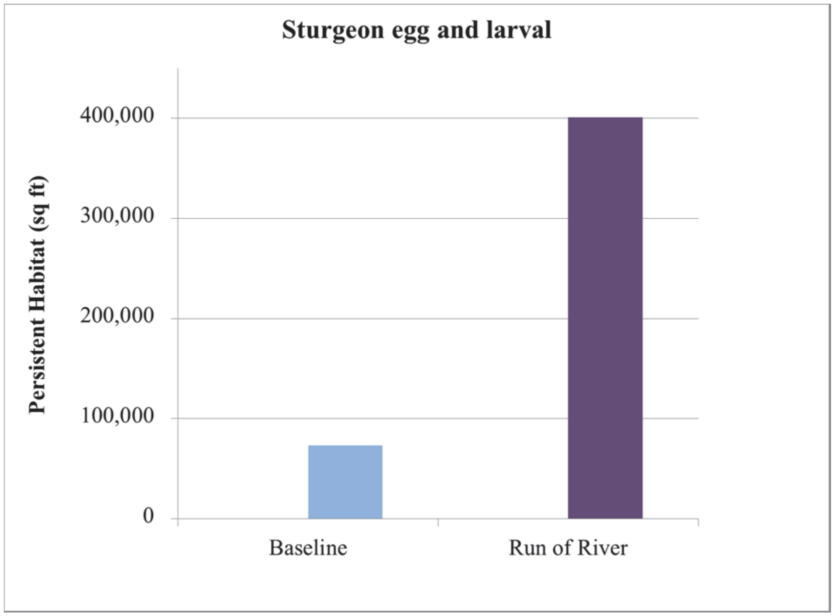

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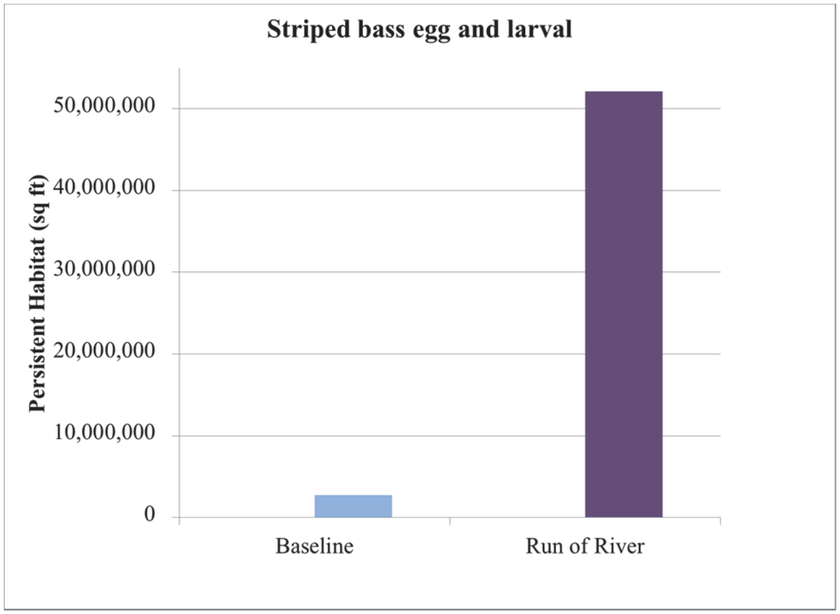


Figure 12.

Figures 6-12. Relative comparison of estimated available habitat between baseline and run of river operations. **Important note -**for those species and life stages requiring gravel (all but striped bass), the estimate of total habitat available is an underestimate due to the geomorphic influences of operations. Specifically, downstream gravels have been reduced by the combination of trapping of bedload materials behind the dam and downstream scour from increased high flow magnitude and frequency. A better understanding of the magnitude of these influences will come from pending studies.

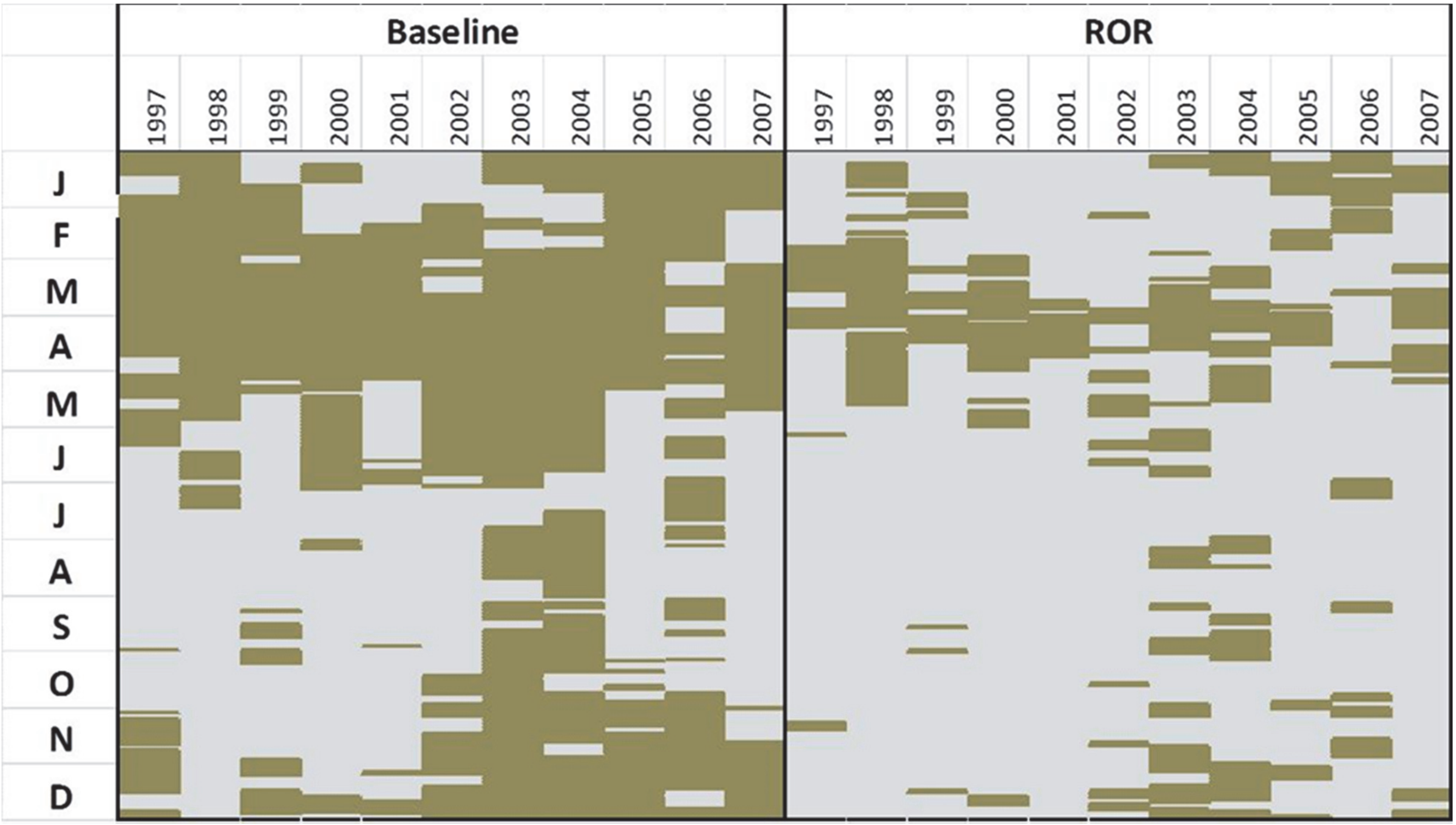
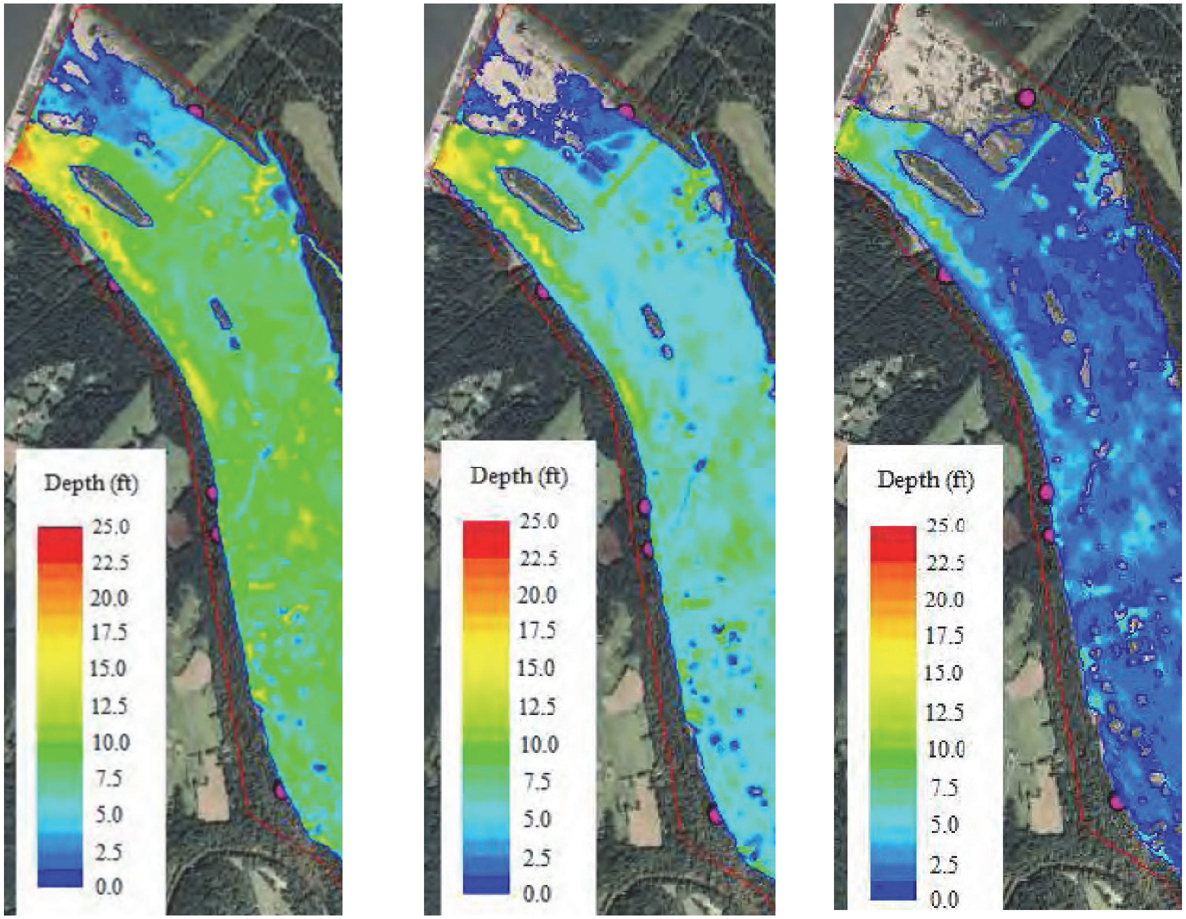


Figure 13. Example of frequency and duration of events when shear stress exceeds goals for suitable mussel habitat (> 50% of habitat available) comparing the baseline and run-of-river scenarios.



80,000 cfs   40,000 cfs   3,500 cfs

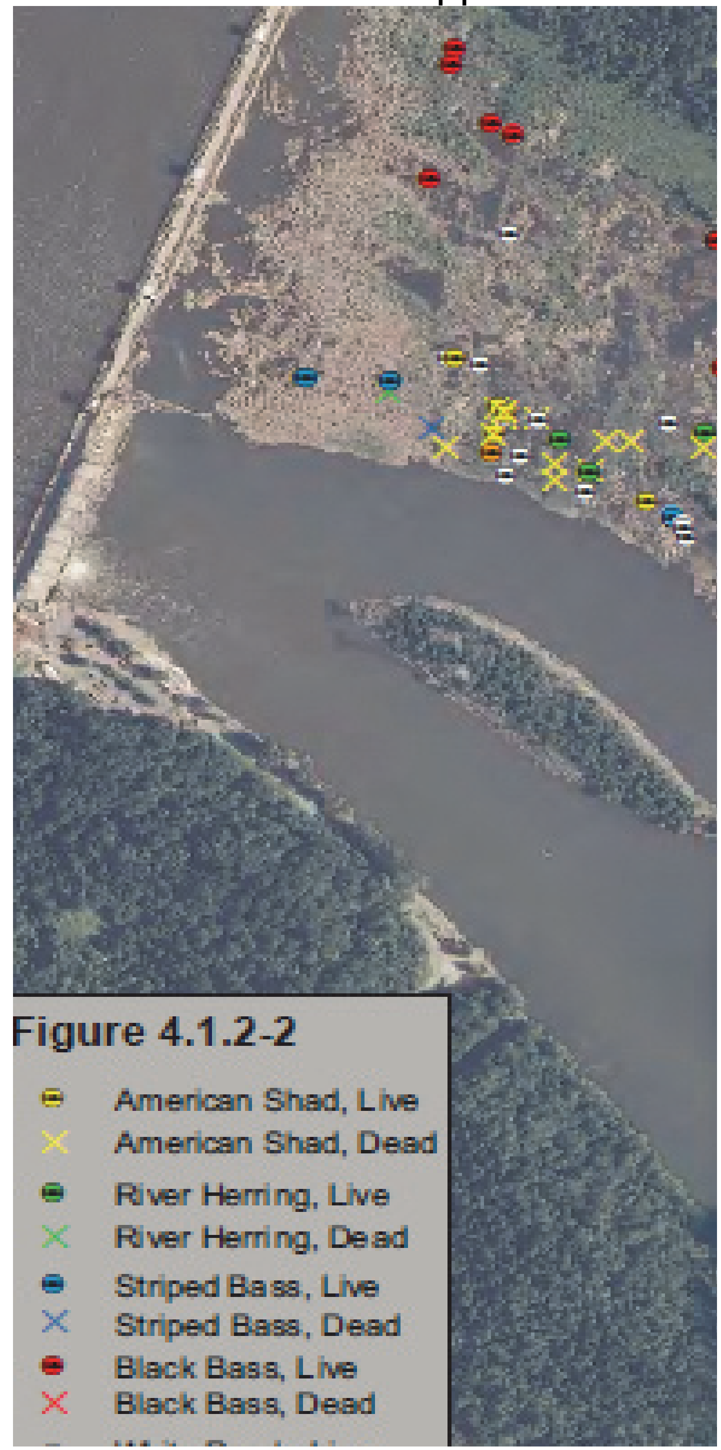
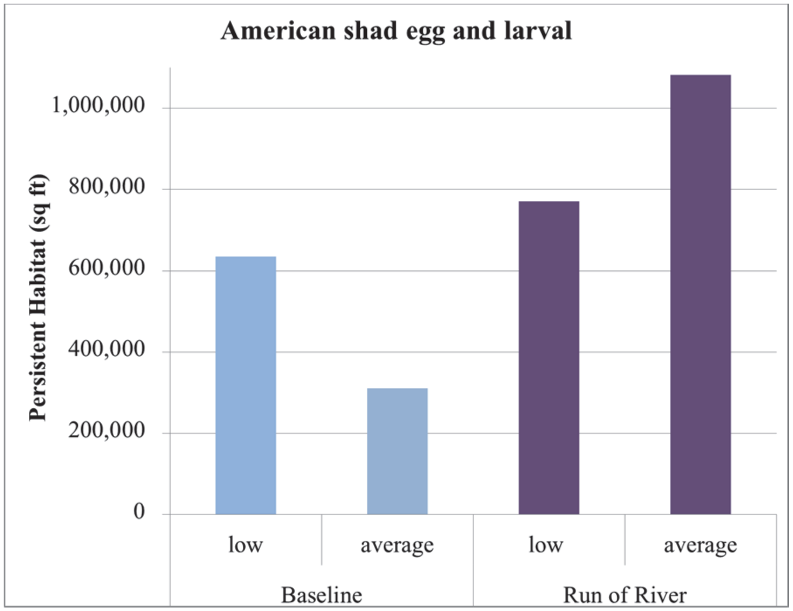


Figure 14. Comparison of depth and wetted area between minimum flow releases and maximum generation releases and a map of stranded and dead fish surveyed during 2011 study surveys. When releases are reduced to current minimum flows, fish become stranded in pools, increasing the probability of mortality from predation or poor water quality conditions.



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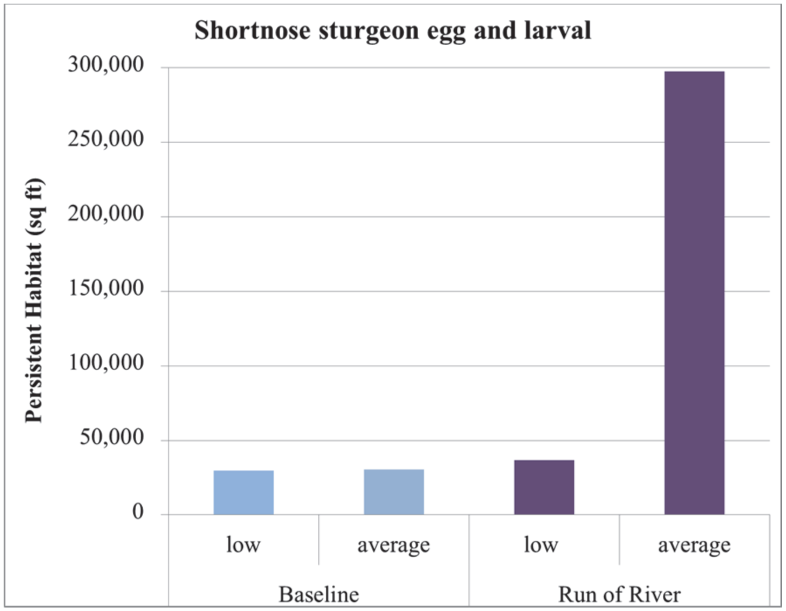

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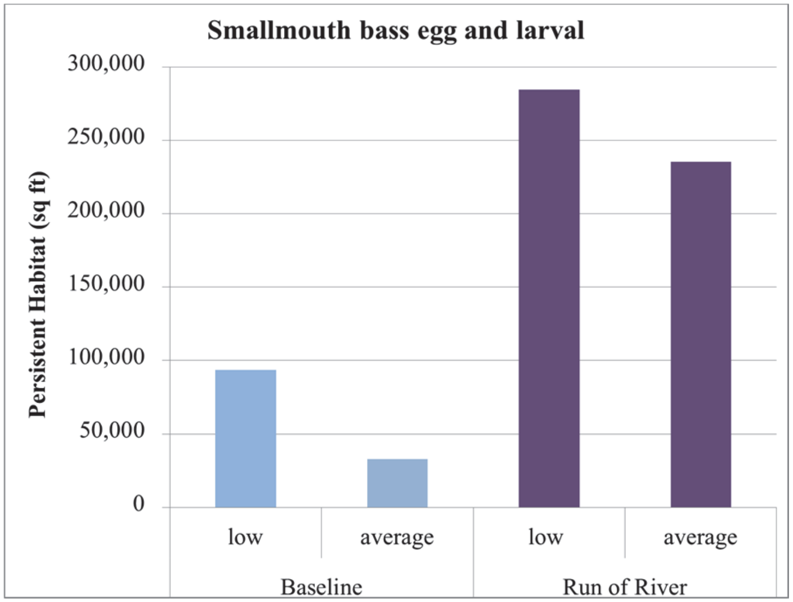

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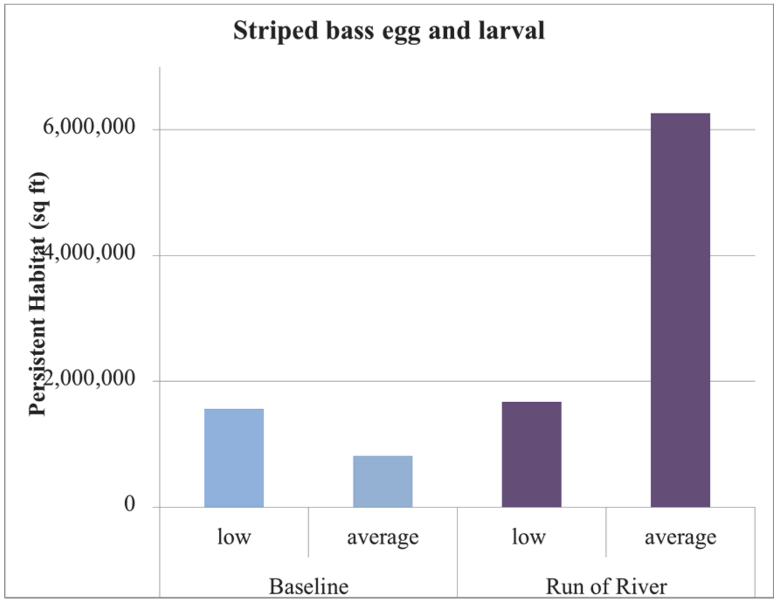

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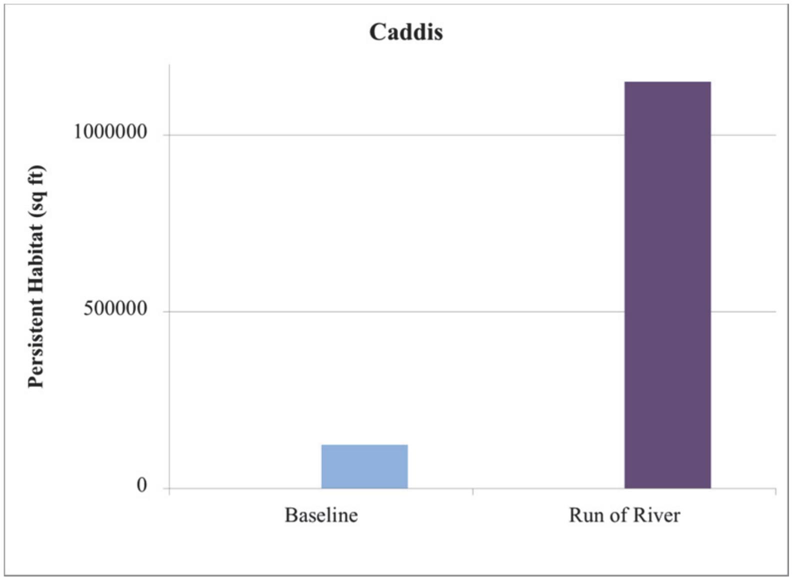
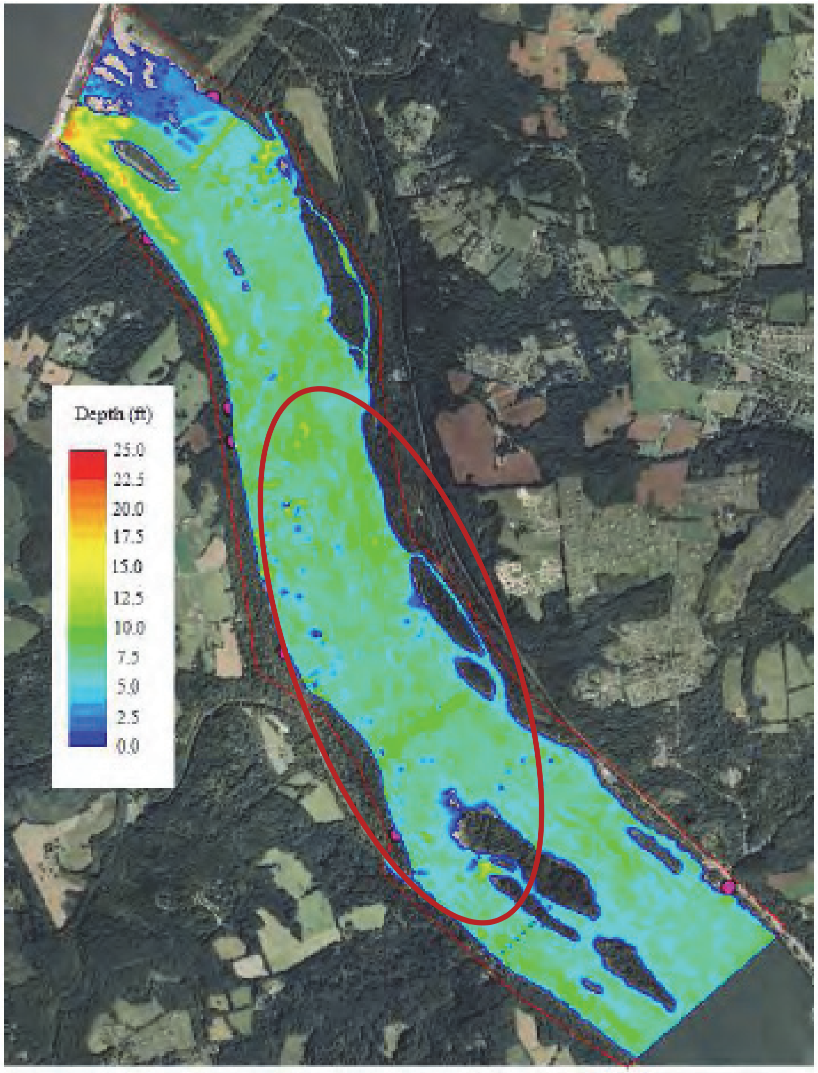


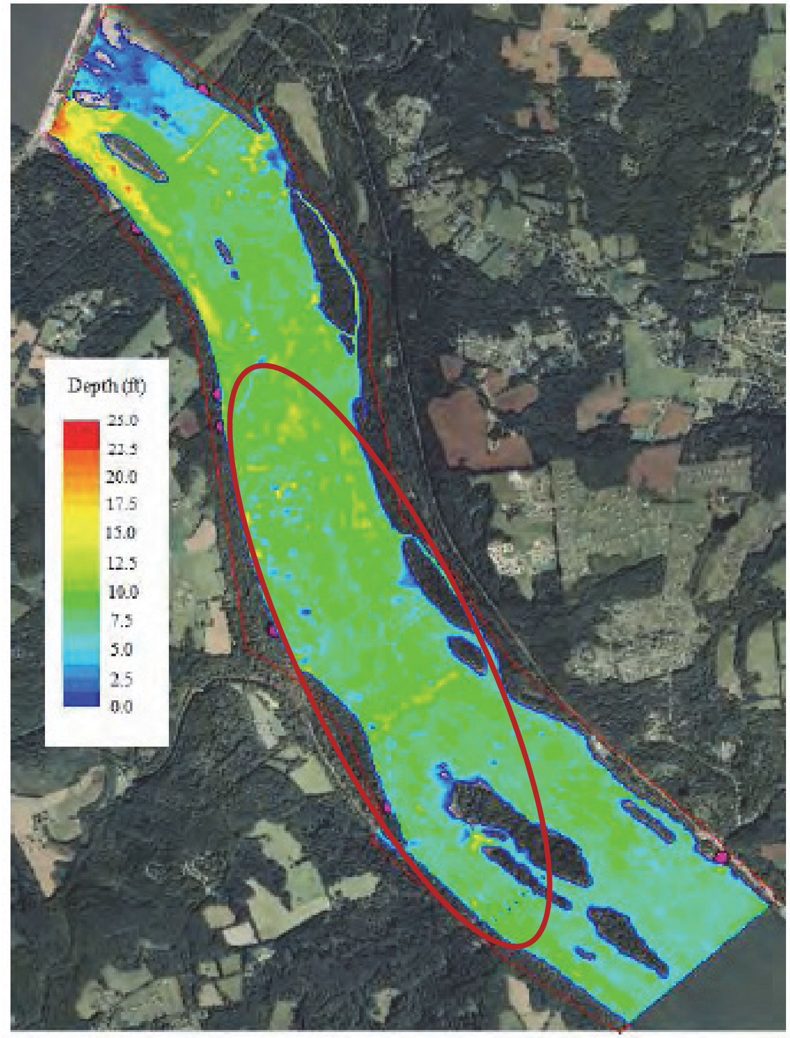
Figure 19.

Figures 15-19. Relative comparison of estimated available habitat between baseline and run of river operations. **Important note** -for those species and life stages requiring gravel (all but striped bass), the estimate of total habitat available is an underestimate due to the geomorphic influences of operations. Specifically, downstream gravels have been reduced by the combination of trapping of bedload materials behind the dam and downstream scour from increased high flow magnitude and frequency. A better understanding of the magnitude of these influences will come from pending studies.



60,000 CFS

Figure 20.



86,000 CFS

Figure 21.

Figures 20-21. Comparison of mid-river basking habitats (dark blue) available under moderate flows and maximum generation flows (86,000 cfs). In response to this loss of habitat, basking time for map turtles has been reduced by and estimated 50%. This has implications for successful adult and juvenile growth and reproductive success (Pers comm Siegel 2013).

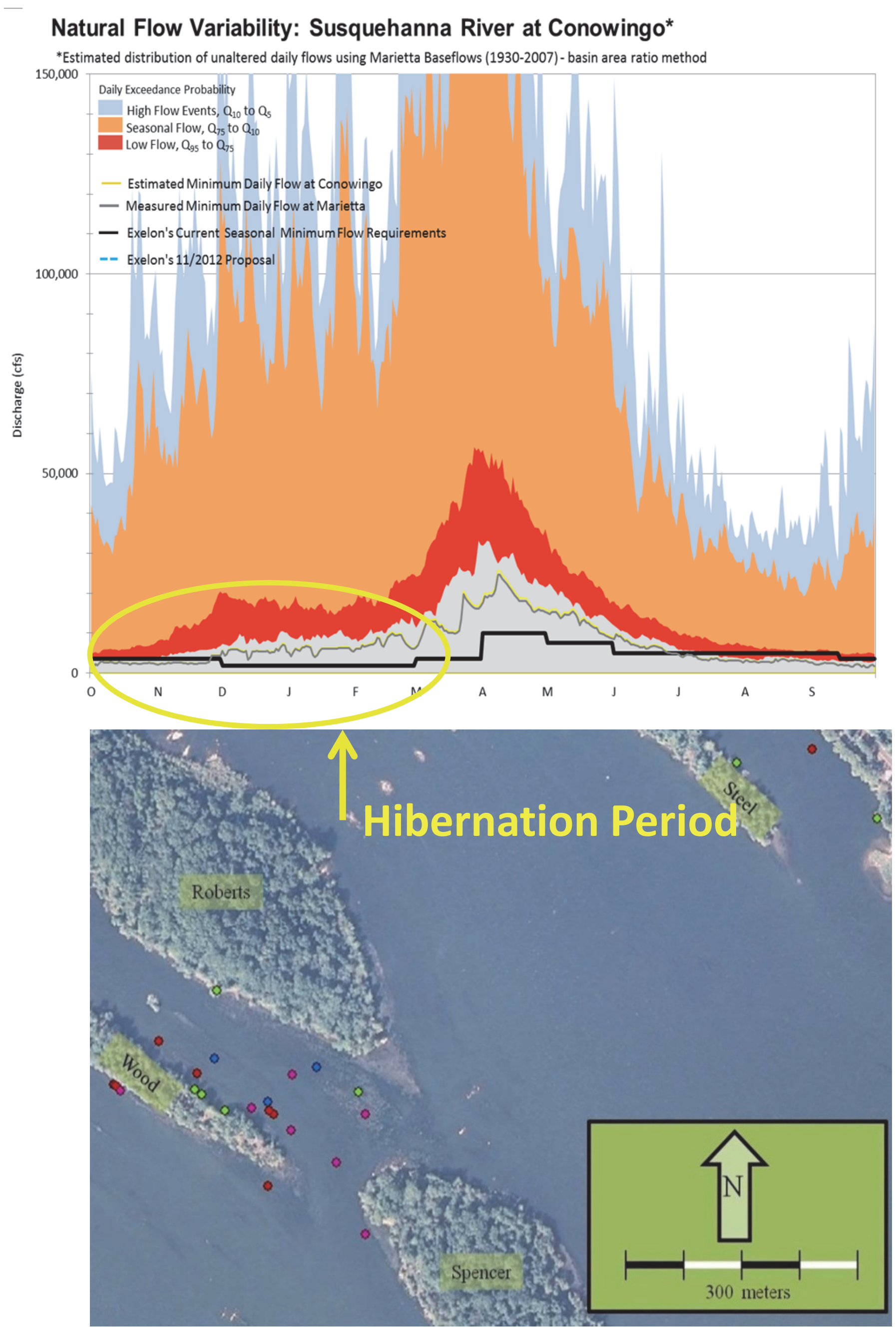
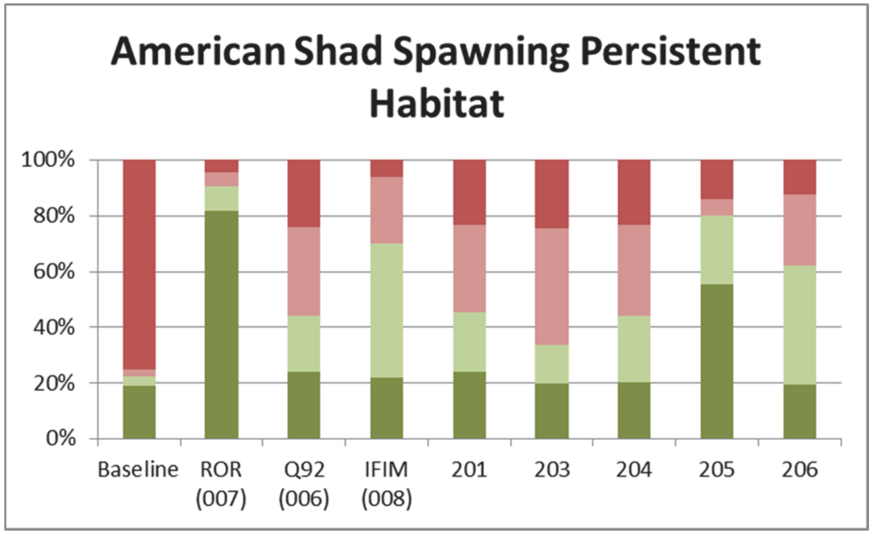


Figure 22. Current minimum flow releases during the map turtle hibernation period are lower than the minimum recorded daily flow. During hibernation, map turtles are on the river bottom and have limited ability to move to avoid adverse habitat conditions. Water levels should be relatively stable with a minimum depth of 1m.



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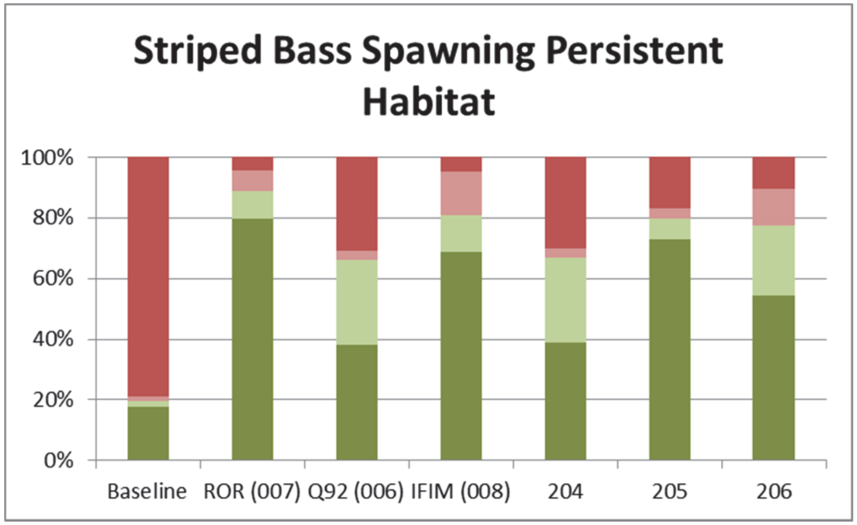

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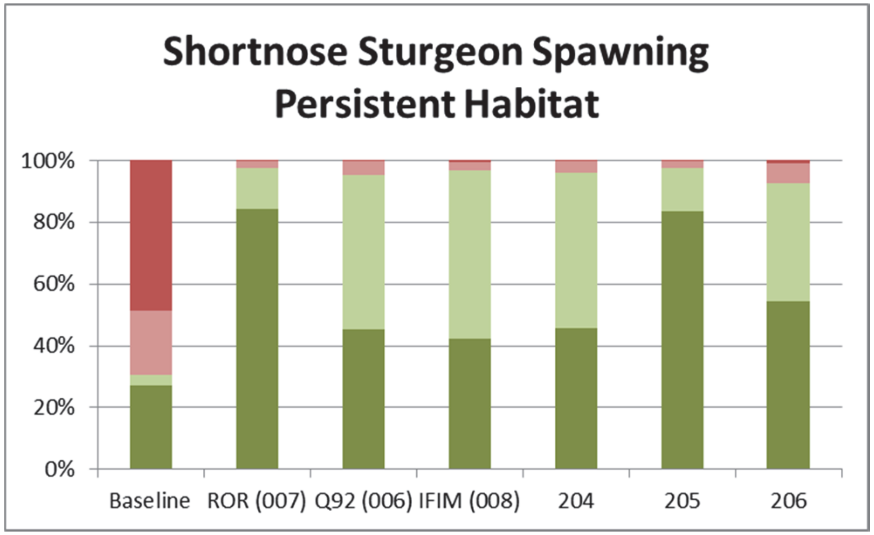

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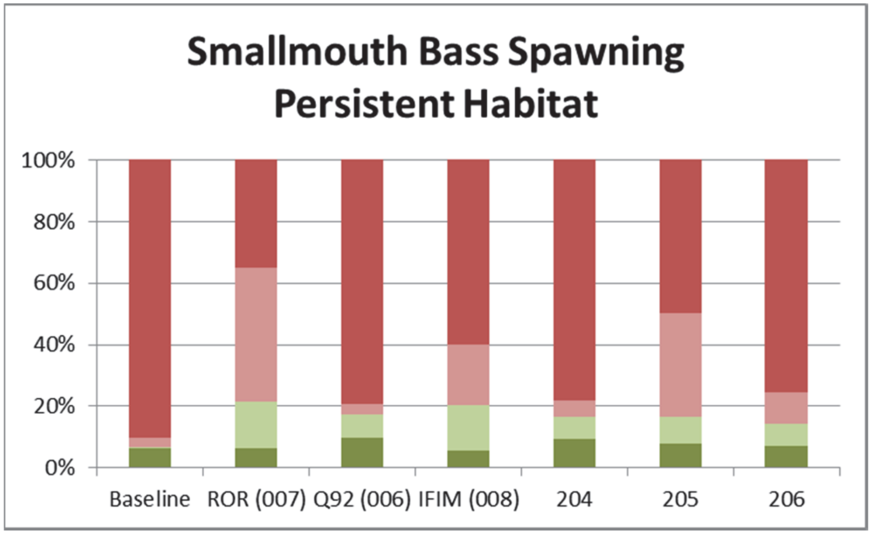

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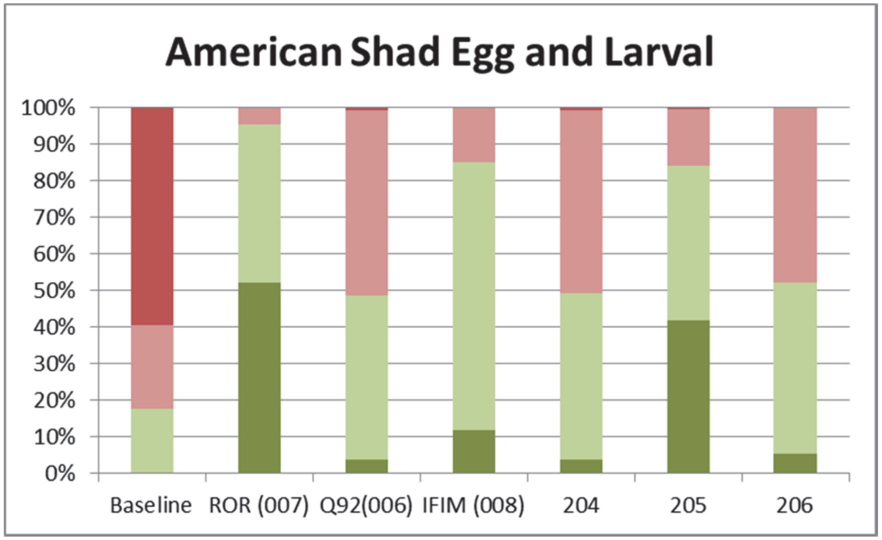

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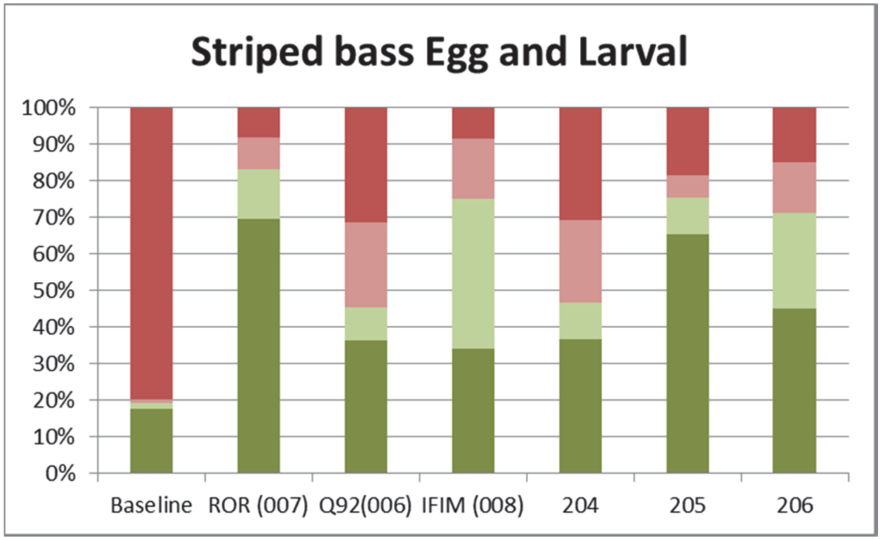

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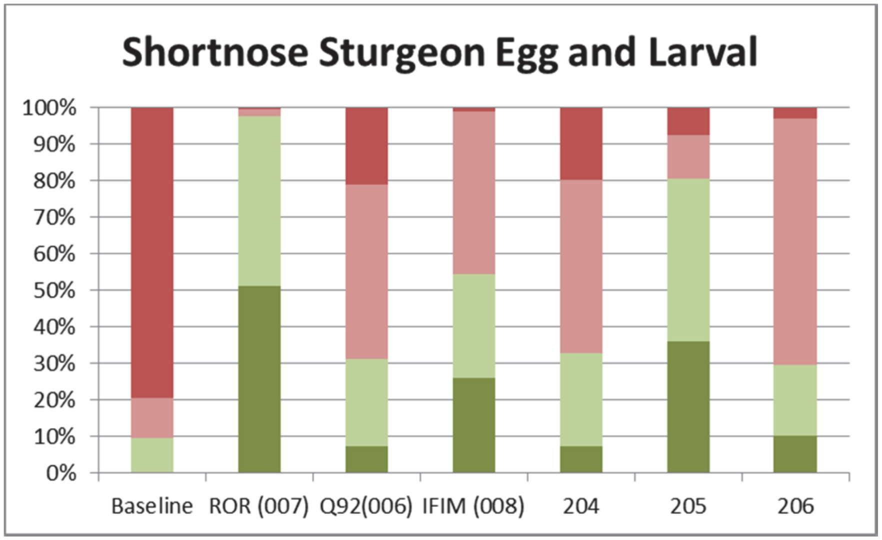

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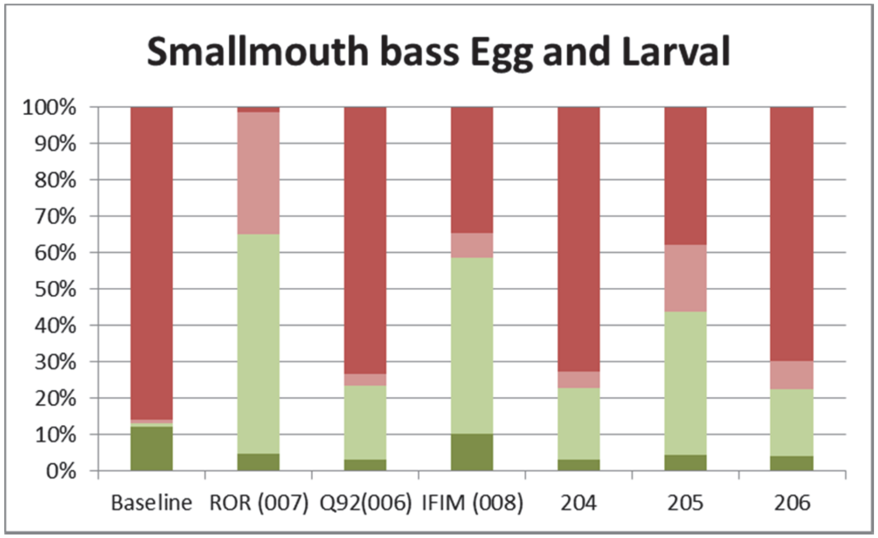


Figure 30.

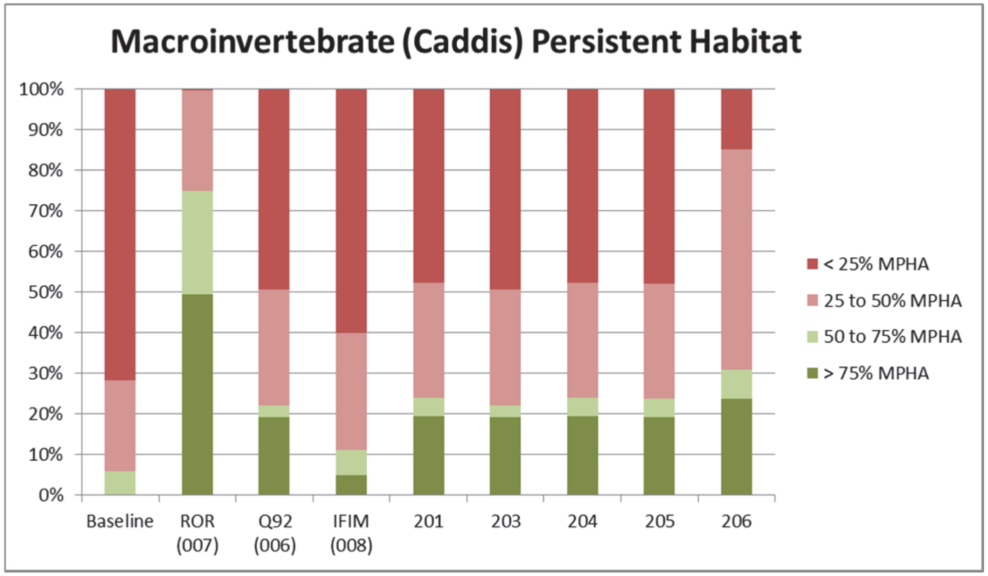
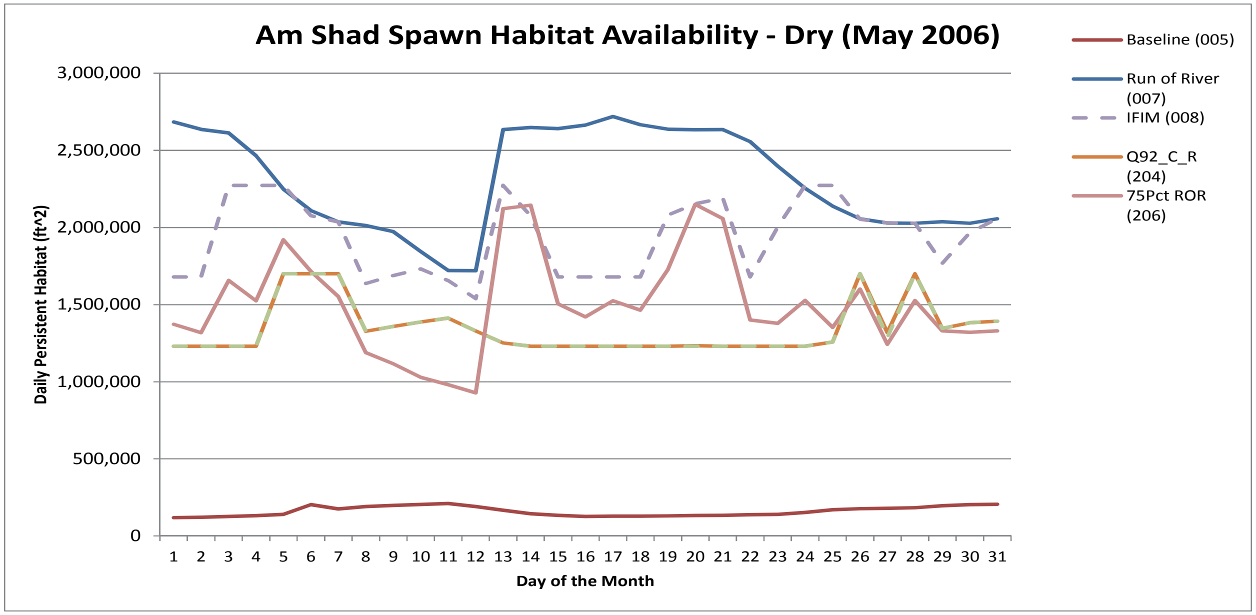


Figure 30.

Figures 23-31. Percent of total Maximum Persistent Habitat Available (MPHA) under alternative operating scenarios including baseline operations and run of river. Dark green represents the proportion of time at least 75% of MPHA is available, light green between 50 and 75% MPHA, pink between 25 and 50% MPHA and red less than 25% MPHA.



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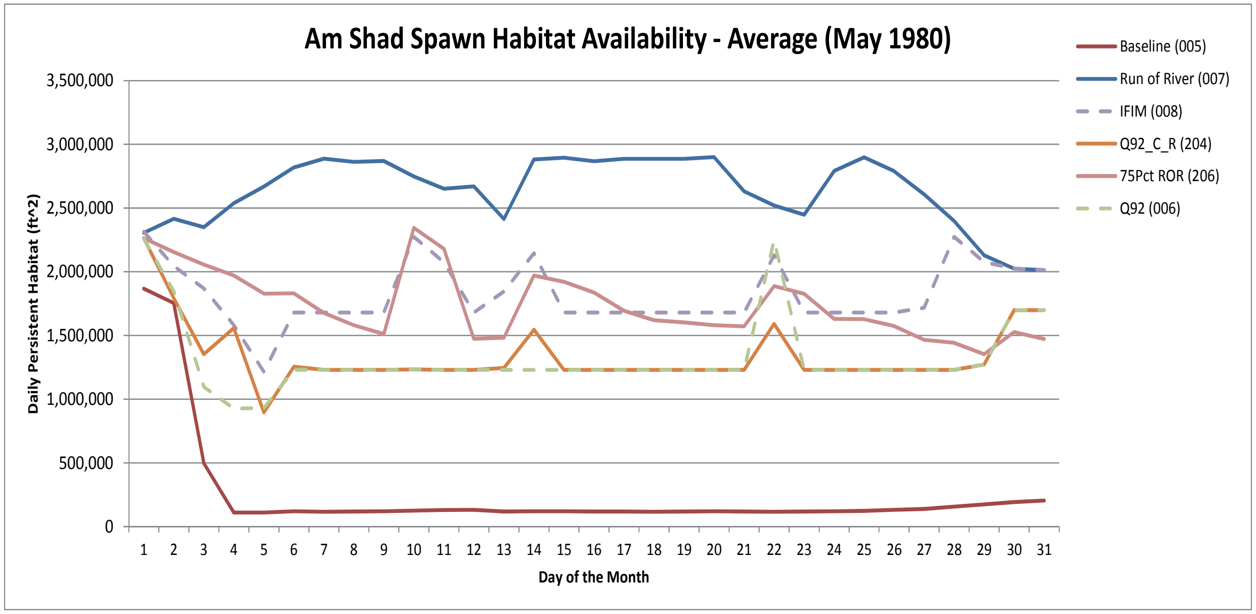


Figure 33.

Figures 32-41. A comparison of available persistent habitat under alternative operating scenarios. The **blue line represents run-of-river** and the **red line represents the baseline operations.** Available habitat is compared between operational alternatives for diadromous and resident fish under representative dry, average and wet conditions. The description for additional scenarios displayed is included in Table 5.

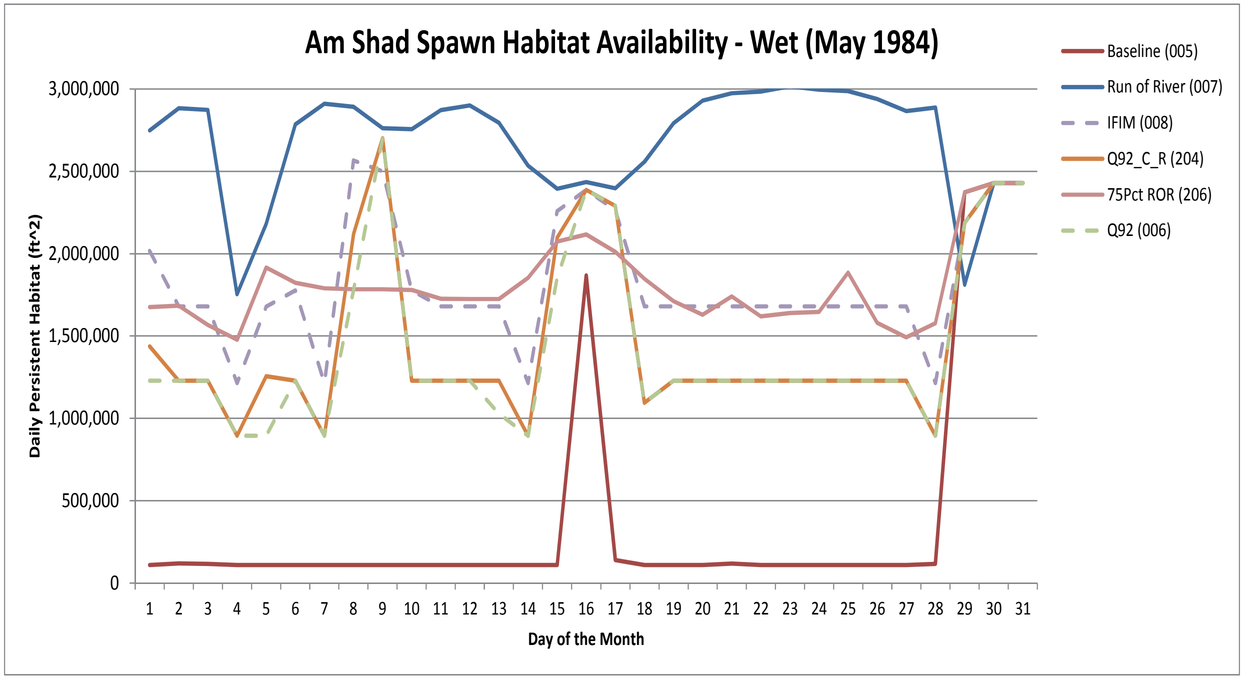


Figure 34.

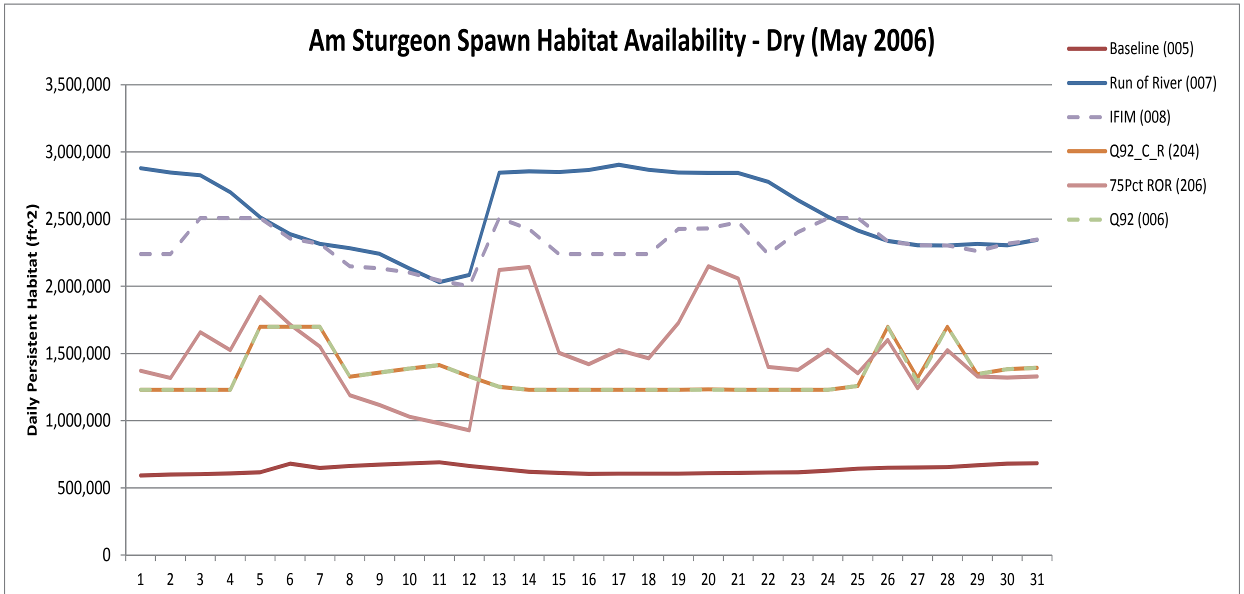
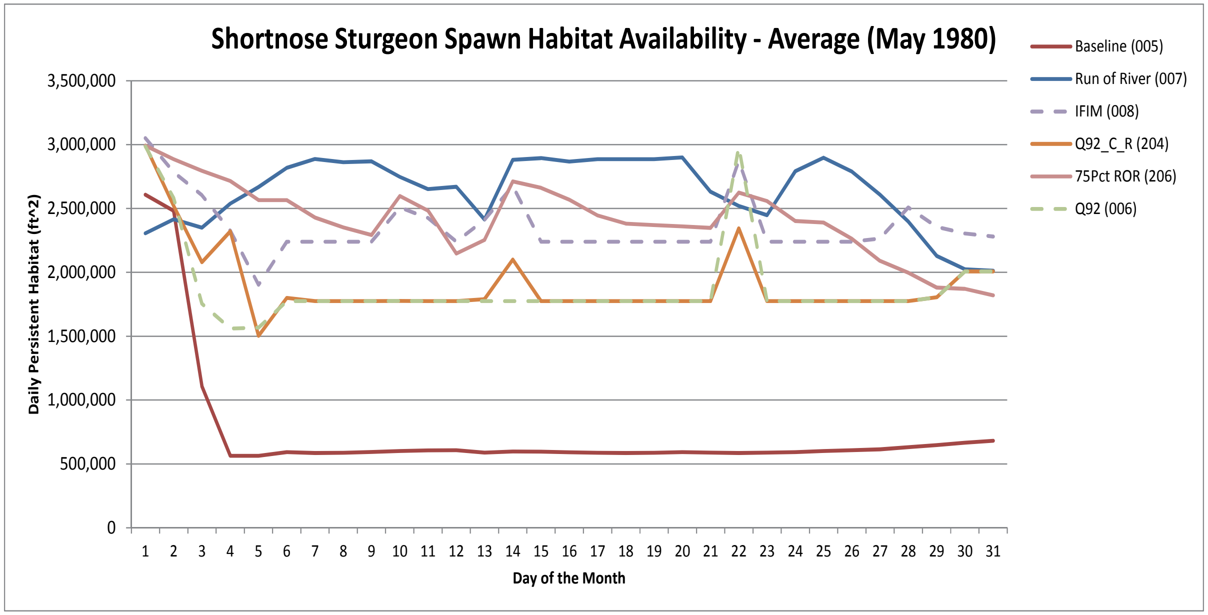


Figure 35.



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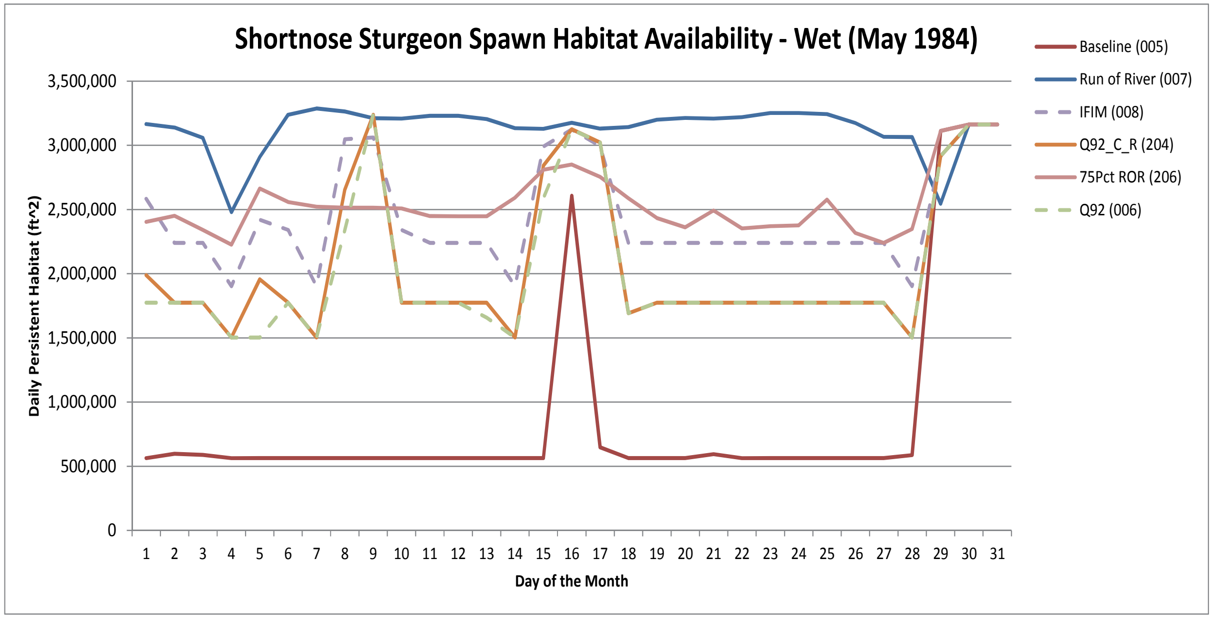


Figure 37.

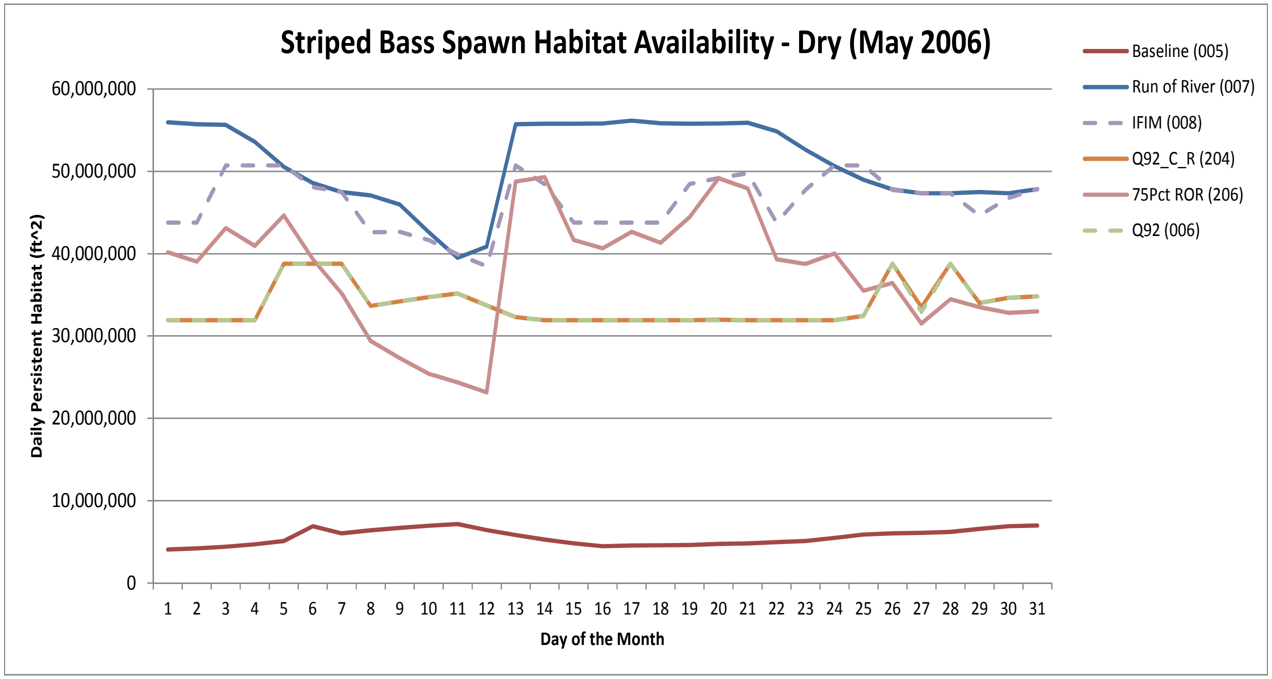
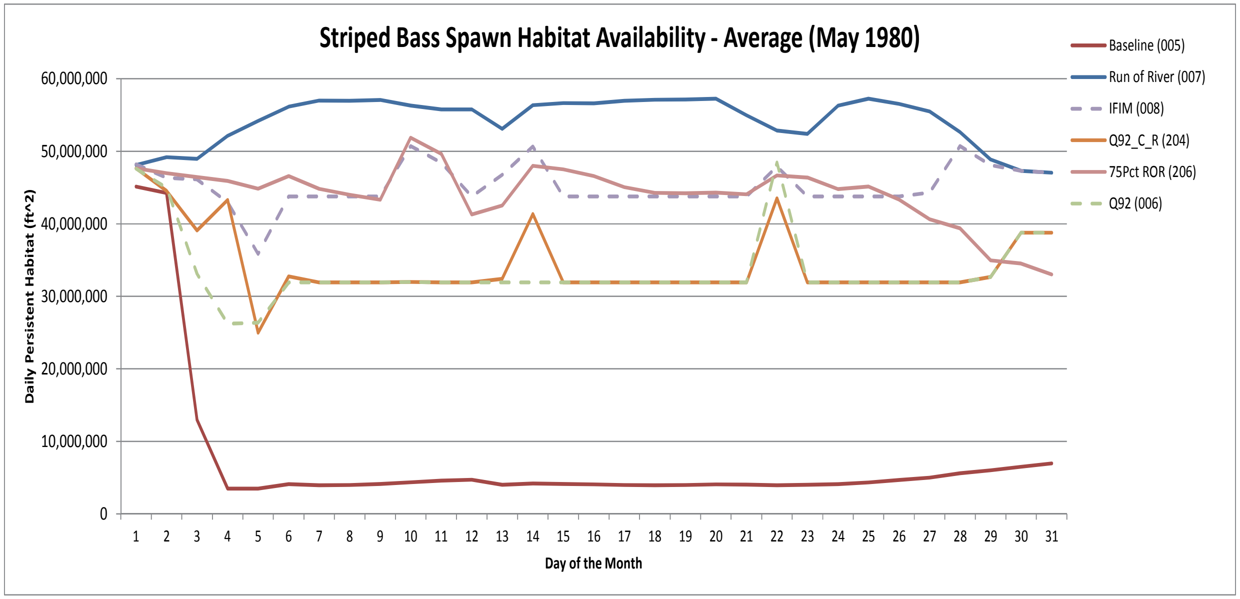


Figure 38.



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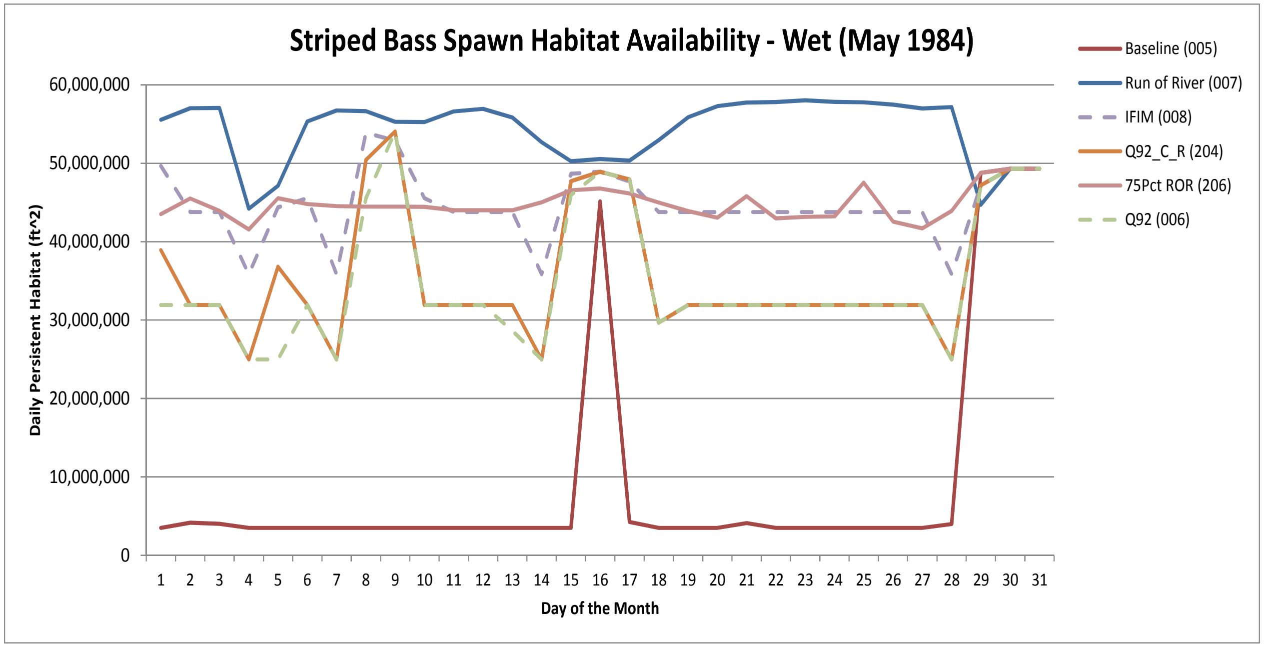
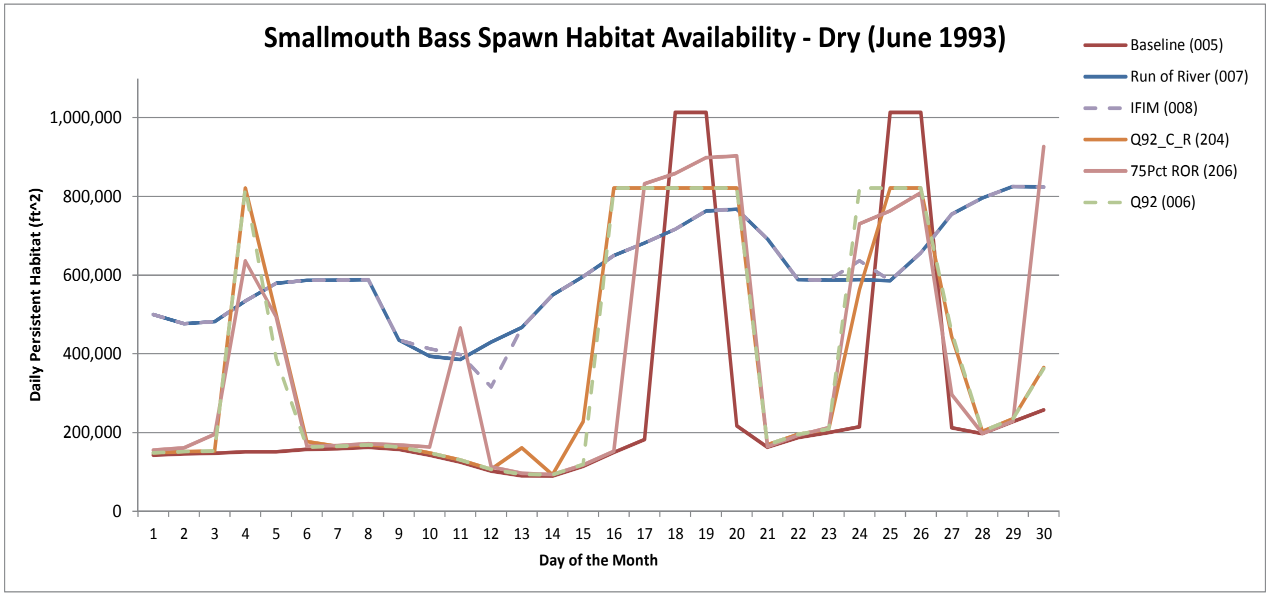


Figure 40.



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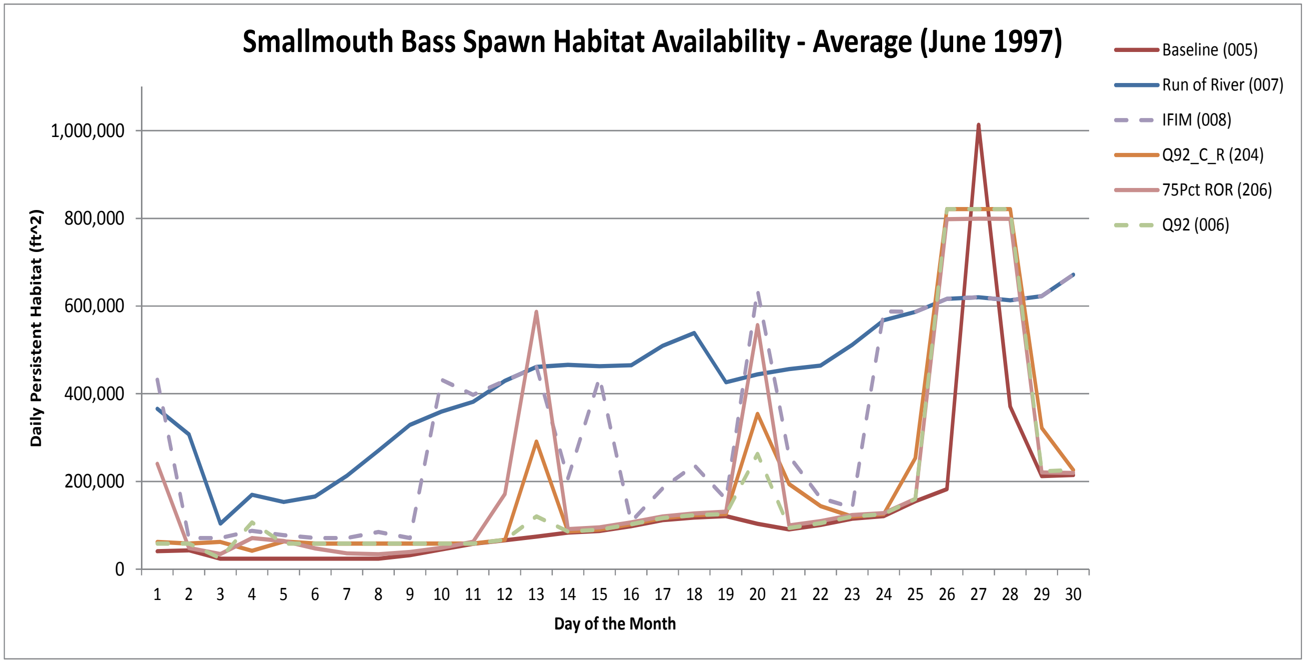

Figure 42.

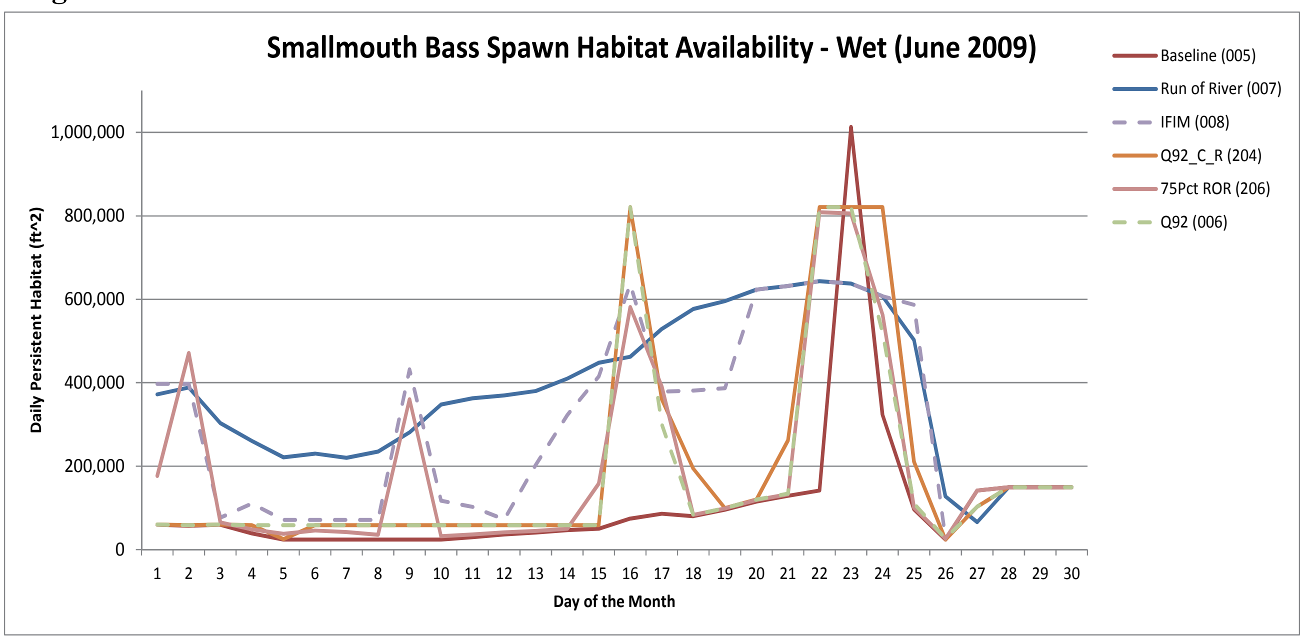

Figure 43.

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Document Content(s)

Attachment 2 - Appendix 1

Attachment 3

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Exelon Generation Company, LLC	)	
Conowingo Hydroelectric Project	)	P-405-106
	)	
Muddy Run Hydroelectric Project	)	P-2355-018
	)	
York Haven Power Company, LLC	)	P-1888-030
York Haven Hydroelectric Project	)	

THE NATURE CONSERVANCY'S SUPPLEMENTAL COMMENTS ON DRAFT MULTI-PROJECT ENVIRONMENTAL IMPACT STATEMENT FOR HYDROPOWER LICENSES, SUSQUEHANNA RIVER HYDROELECTRIC PROJECTS

The Nature Conservancy (the Conservancy) provides these supplemental comments on the instream flow analyses included in the "Draft Multi-Project Environmental Impact Statement for Hydropower Licenses" (DEIS), prepared by the Federal Energy Regulatory Commission, Office of Energy Projects (OEP), and dated July 2014.[1]

In a letter to Clean Chesapeake Coalition, OEP Staff stated that it intended "to issue a final EIS on February 25, 2015." It clarified that it was adhering to the schedule published on December 19, 2013. This clarification came notwithstanding the fact that Exelon recently withdrew its application for water quality certification under Section 401 of the Clean Water Act and committed to help fund a multi-year sediment study that will provide additional information that the Maryland Department of the Environment (MDE) has said is necessary to process Exelon's application for water quality certification. We understand this to mean that it is unlikely that MDE will issue a water quality certification (or waiver), which is a prerequisite to the Commission's issuance of a new license, within the next two years.

Given that issuance of a water quality certification is not anticipated for more than a year, we request that OEP Staff take additional time to complete analyses necessary to evaluate the effects of proposed and alternative instream flow schedules on the beneficial uses listed in Federal Power Act section 10(a)(1), 16 U.S.C. § 803(a)(1), as requested in our initial comments on the DEIS. To this end we are providing a declaration prepared by Dr. Clair Stalnaker, one of the founders of the Instream Flow Incremental Method (IFIM) and leading experts in its application, on the adequacy of the instream flow analyses undertaken in this proceeding to date. *See* Attachment 1.

[1] eLibrary no. 20140730-4001.

Dr. Stalnaker makes several recommendations for additional steps needed to complete the analysis of the Conowingo Project's flow-related effects on aquatic habitat, including:

(1) Complete the comparative analyses, as requested by The Nature Conservancy and other stakeholders and apparently intended by Exelon's Study 3.11, and document this analysis in the FEIS. Attachment 1, ¶¶ 36-38.

(2) Specifically focus on dual flow analyses examining the quantitative differences among suggested alternative project operation flow patterns and reporting those differences over representative wet, normal, and dry hydrologic conditions. Attachment 1, ¶¶ 47-51.

(3) Use a decision-support framework to determine which combinations of base flow and generation flows best address the goals of enhanced habitat and survival for recovery involving improved recruitment for aquatic species of concern while still achieving reasonable levels of hydroelectric generation and project profits. A typical negotiated settlement for a peaking hydropower project includes different operating rules for seasons within each type of water year. In the case of critical species life stages, peaking may even be curtailed for a period of days in particular seasons for a particular water year type. For example, Piney Dam (FERC No. 309) is required to cease hydro-peaking and operate in a strict run-of-river mode during spring fish spawning. Attachment 1, ¶¶ 52-54.

We respectfully request that OEP undertake further analysis of the proposed and alternative flows schedules on aquatic habitat consistent with Dr. Stalnaker's recommendations prior to publishing the FEIS. We believe this further analysis is necessary to satisfy the Commission's obligations under the Federal Power Act and National Environmental Policy Act to conduct a rigorous study of licensing alternatives based on a complete record.[2] We believe this analysis is also necessary to demonstrate consistency between the preferred alternative and the comprehensive plans of State and Federal Agencies pursuant to FPA Section 10(a), including:

- Susquehanna River Basin Commission, "Comprehensive Plan for Management and Development of the Water Resources of the Susquehanna River Basin" (2013);
- Susquehanna River Anadromous Fish Restoration Cooperative, "Migratory Fish Management and Restoration Plan for the Susquehanna River Basin" (2010);
- NMFS, Final Recovery Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*) (1998); and
- Amendment 3 of the Interstate Fishery Management Plan for shad and river herring (Feb. 2010).

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[2] *See Scenic Hudson v. FPC,* 354 F.2d 608 (2d Cir. 1965); *Environmental Defense Fund v. U.S. Army Corps of Engineers*, 492 F.2d 1123 (5th Cir. 1974).

The Nature Conservancy will make Dr. Stalnaker available to OEP Staff if they have any questions regarding his recommendations or analysis supporting those recommendations. The Conservancy thanks OEP Staff for considering this request.

Dated: February 6, 2015

Respectfully submitted,

Julie Gantenbein

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Richard Roos-Collins
Julie Gantenbein
Nicholas Niiro
Water and Power Law Group PC
2140 Shattuck Ave., Ste. 801
Berkeley, CA 94704
(510) 296-5588
rrcollins@waterpowerlaw.com
jgantenbein@waterpowerlaw.com
nniiro@waterpowerlaw.com

Attorneys for THE NATURE CONSERVANCY

Mark Bryer
Director, Chesapeake Bay Program
The Nature Conservancy
5410 Grosvenor Lane, Suite 100
Bethesda, MD 20814
(301) 897-8570
mbryer@tnc.org

Tara Moberg
Freshwater Scientist
The Nature Conservancy
2101 N Front Street, Building 1
Harrisburg, PA 17102
(717) 232-6001 ext 229
tmoberg@tnc.org

Attachment 3

DECLARATION OF SERVICE

Exelon Generation Company, LLC's Conowingo (P-405) and Muddy Run Hydroelectric Projects (P-2355) and York Haven Power Company, LLC's York Haven Hydroelectric Project (P-1888)

I, Nicholas Niiro, declare that I today served the attached "The Nature Conservancy's Supplemental Comments On Draft Multi-Project Environmental Impact Statement For Hydropower Licenses, Susquehanna River Hydroelectric Projects" by electronic mail, or by first-class mail if no e-mail address is provided, to each person on the official service lists compiled by the Secretary in these proceedings.

Dated: February 6, 2015

By:

Nicholas Niiro
WATER AND POWER LAW GROUP PC
2140 Shattuck Ave., Suite 801
Berkeley, CA 94704-1229
Phone: (510) 296-5591
Fax: (866) 407-8073
nniiro@waterpowerlaw.com

Attachment 1

DECLARATION OF DR. CLAIR B. STALNAKER

1. I, Clair B. Stalnaker, Ph.D., provide this expert report on behalf of The Nature Conservancy in the concurrent relicensings of Exelon Corporation's Muddy Run Pumped Storage and Conowingo Hydroelectric Projects before the Federal Energy Regulatory Commission (FERC). The Nature Conservancy requested that I analyze and provide my opinion regarding the proper application of the Instream Flow Incremental Methodology (IFIM) to the relicensing of the Conowingo Project to quantitatively evaluate the proposed action's and alternatives' flow-based impacts on aquatic habitat.

2. The Nature Conservancy has requested that FERC direct Exelon to complete spatial and temporal analyses of aquatic riverine habitats. This analysis would form the basis for evaluating alternative project operations and determining which alternative(s) are best suited to achieving the dual goals of Project Profitability from hydroelectric generation *and* Environmental Enhancement of degraded aquatic resources. I understand that the study plan was to provide data to be used with the IFIM analytical procedures necessary for comparative aquatic habitat based analyses of proposed alternative Project operations. However, the study is incomplete. As supervisor of the U.S. Fish and Wildlife Service/U.S. Geological Survey research and development group that developed IFIM and conducted training over three decades, I conclude that the information requested by the Conservancy is necessary for comparing alternative project operations on aquatic resources.

I.
QUALIFICATIONS

3. I have played a key role in the development of instream flow science for over 30 years. I organized and served as leader of the Cooperative Instream Flow Service Groups (and various subsequent titles) under the U.S. Fish and Wildlife Service. This program brought together an interagency group of multidisciplinary scientists for the purpose of advancing state-of-the-art science and elevating the field of instream flow to national and international prominence. The primary focus of this group has been to develop a holistic view of river science addressing the major components of instream flow management, namely hydrology, geomorphology, water quality, aquatic biology and connectivity, and promoting instream flow regimes (incorporating intra- and inter-annual variability). I retired as a Senior Scientist with the U.S. Geological Survey where I served as Chief of the River Systems Management Section, Midcontinent Ecological Center, Fort Collins, Colorado. I earlier served as Assistant Professor of Fisheries and Wildlife Science and Adjunct Professor of Civil Engineering, Utah State University, Logan Utah, as well as Adjunct Professor in the Departments of Earth Resources and Fisheries and Wildlife, Colorado State University.

4. I have served on national and international technical committees, task forces and review boards, and have authored numerous publications focusing on the instream flow aspects of water allocation and river management. I served for the National Research Council (NRC) on the Water, Science and Technology Board Committee on Western Water Management and the NRC Board on Environmental Studies and Toxicology on the Klamath River Basin. In October

2008, I was recognized by the international Instream Flow Council with their Lifetime Achievement Award.

5. My curriculum vitae is Attachment 1.1 to this report.

6. In preparing this report I have reviewed the following documents specifically relevant to these proceedings:

- Instream Flow Habitat Study Report, Appendix G (Persistent Habitat Tables), eLibrary no. 20120831-5048 (Aug. 2012);
- The Nature Conservancy, "Motion to Intervene," eLibrary no. 20140131-5199 (Jan. 31, 2014);
- Draft Environmental Impact Statement for the Susquehanna River Hydroelectric Projects: York Haven Hydroelectric Project (P-1888-030), Muddy Run Pumped Storage Project (P-2355-018), and the Conowingo Hydroelectric Project (P-405-106), eLibrary no. 20140730-4001 (July 30, 2014); and
- The Nature Conservancy, "DEIS Comments," eLibrary no. 20140929-5354 (Sept. 29, 2014).

I supplemented the information provided in these documents with other literature as cited below and listed in the References section.

II.
RECOMMENDATIONS

I make the following recommendations for next steps to complete the analysis of flow effects on aquatic habitat in this relicensing:

(1) Complete the comparative analyses, as requested by The Nature Conservancy and other stakeholders and apparently intended by Exelon's Study 3.11, and document this analysis in the FEIS.

(2) Specifically focus on dual flow analyses examining the quantitative differences among suggested alternative project operation flow patterns and reporting those differences over representative wet, normal and dry hydrologic conditions.

(3) Use a decision-support framework to determine which combinations of base flow and generation flows best address the goals of enhanced habitat and survival for recovery involving improved recruitment for aquatic species of concern while still achieving reasonable levels of hydroelectric generation and project profits. A typical negotiated settlement for a peaking hydropower project includes different operating rules for seasons within each type of water year. In the case of critical species life stages, peaking may even be curtailed for a period of days in

particular seasons for a particular water year type. For example, Piney Dam (FERC No. 309) is required to cease hydro-peaking and operate in a strict run-of-river mode during spring fish spawning.

The following sections provide background on the IFIM and explain the basis for these recommendations.

III.
IFIM BASELINES AND OBJECTIVES

7. IFIM studies have a long association with licensing and re-licensing of hydroelectric projects. An IFIM Training manual (IF 402, unpublished) was prepared for State and Federal agency staff responsible for reviewing hydroelectric projects. This training manual was designed to specifically address the FERC Revisions to the Federal Power Act, Hydroelectric Re-licensing Regulations Under the Federal Power Act (18 CFR Parts 4 and 16, May 17, 1989). Several IFIM training courses and numerous IFIM applications to hydro projects have been completed since.

8. I understand that the FERC-approved study plan required Exelon to conduct an Instream Flow Assessment below Conowingo Dam. The goal of the study was to determine the relationship between flow and habitat conditions in the river. Exelon undertook aquatic species habitat studies as part of its Study 3.16. These habitat studies can provide the site-specific data necessary for conducting a comprehensive IFIM-based comparative analysis of alternatives, but, as explained below, those studies alone do not provide the data necessary for a comprehensive IFIM analysis, or comparable analysis.

A. Baselines

9. IFIM analyses provide quantitative data for direct comparison of proposed and alternative water management operations against project baseline flow patterns. The project baseline is initially presented as a hydrologic time series representing existing conditions (actual gage records of hydrology as the project has operated since construction), not pre-project conditions requiring speculation about the status of resources prior to construction.

10. The Nature Conservancy, with the support of other resource agencies, has requested that FERC evaluate a run-of-river of river alternative. The run-of-river hydrologic time series is better considered as a second baseline from which to evaluate the effects of proposed alternative flow schedules.

11. These two sets of baseline hydrology time series are created and then transformed to habitat time series. Because the Conowingo Project is a daily peaking hydropower facility, and in some seasons peaks twice per day, habitat time series should be estimated using a metric for persistence. These baselines then serve as reference time series for comparisons among proposed alternative operation schemes. Comparisons to these baselines simultaneously quantify the degree of deviation of hydroelectric generation potential from present operations along with the degree of movement toward positive environmental

enhancement (if any) for each proposed alternative. All comparisons should address the spatial and temporal patterns of suitable habitats for selected aquatic species and/or species guilds.

B. Representative Years

12. Stratification of water years into wet, normal and dry strata is necessary for understanding the dynamic nature of riverine aquatic species and to maintain intra- and inter-annual stream flow and habitat variability essential for healthy aquatic environments. These analyses require a unique set of hydrologic and habitat time series for each alternative operating scenario that may be proposed by resource agencies and stakeholders.

13. It is useful to incorporate Indicators of Hydrologic Alteration (IHA) analyses to assess the natural range of variability of daily discharge within water year strata. There should be less variation in flow among calendar year weeks and months for all annual hydrographs placed within a water year strata than is seen for the same calendar weeks and months across water year strata. The usable locations for spawning within the river channel may be quite different between wet and dry years, perhaps even different between dry and extremely dry years, and are significantly different between different peaking regimes that are based on different base flows. Because IHA can only analyze daily data, the natural range of sub-daily variability, within water year strata, should be assessed using relevant metrics (Bevelhimer et al. 2013).

14. It is the variation within representative water strata that determines timing of spawning, duration of egg incubation and emergence of fry. The simulation of available suitable habitats by water year strata facilitates comparison of alternatives and preparation of decision support displays (*see* Section V).

C. Fundamental Objectives

15. Where protection, enhancement, or recovery of aquatic species of concern is recognized as a *fundamental resource management objective*, as it is in this proceeding, the in-river life stages and periodicity of each species should be compared to corresponding hydrology and suitable persistent habitat time series representing historical conditions available across all water year conditions. Baseline habitat conditions when compared alongside best available historical fish population data[1] assist in identifying "habitat bottlenecks."[2] Such analyses look for correlations between occurrence of "habitat bottlenecks" during past years and any evidence of significantly low population numbers for species of concern (from creel census, age and growth studies, periodic sampling, year-class strength for given years, etc.). *See* Stalnaker, et al.,1994.

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[1] Simple examination of recent hydrology time series translated to habitat time series representing the life stage periodicity of the species of concern can reveal "good years" and "bad years." Specific years when simulated habitat conditions are extremely low and other years when habitat conditions are above average can often be related to generic observations and professional opinions from fishermen and resource agency representatives as relatively poor or good years for certain species. There nearly always is some information available even if no formal "fish population data" has been collected.

[2] These are characterized by extremely low occurrences of suitable habitat present when spawning, fry or juvenile life stages are present.

16. Subsequently, an IFIM impact study compares simulated baseline habitat conditions with simulated hydrology and habitat for proposed alternative project operations. Comparisons of simulated habitat time series for each alternative project operation scenario against baseline habitat time series assist in identifying which alternative(s) may significantly enhance, or further depress, recognized habitat limitations (habitat bottlenecks).

17. A comprehensive IFIM impact analysis will illustrate (and quantify) the comparison of potential impacts (positive or negative) from proposed project operations having different *fundamental objectives. Fundamental objectives* are the most important objectives that represent the core values of the resource agencies, stakeholders and project decision-makers.

18. Given the negative impacts from past project operations and contemporary societal goals for recovery of species of special concern, the resource agencies involved in this relicensing have stated that their *fundamental objectives* for this relicensing are to significantly reduce the frequency and magnitude of habitat bottlenecks from present project operations for species of concern. In contrast, Exelon's *fundamental objectives* may be to optimize hydroelectric generation and maximize profits. The IFIM analyses, when completed as intended, can be quite useful to FERC in selecting an alternative(s) that best achieves a balance between these opposing *fundamental objectives*.

D. <u>Suitable Habitats as Means Objectives</u>

19. Proposed flow schedules and simulated suitable habitats are *means objectives* not to be confused with the *fundamental objectives*. Once *fundamental objectives* have been defined, the *means objectives*, or approach, are defined in a manner that assures all *fundamental objectives* can be addressed using the same flow and habitat currency. Within IFIM impact analyses the proposed alternatives produce unique flow regimes that are transformed to suitable habitat time series that serve as the *means objectives. Means objectives* are the objectives that, if achieved, will presumably support the quantitative analyses required to assess and predict the project's effect on each stakeholder's *fundamental objectives.*

20. Proposed alternatives flow schedules are *means objectives* and should not to be treated simply as "minimum flows," but must be transformed to flow and habitat time series simulating the flow changes to the baseline hydrology time series.

21. The three flow based alternatives identified in Section 2.0 of the DEIS[3] are still *means objectives* that, as such, have no documented basis in aquatic ecology of the river system. They seem to have some habitat basis, but this has not been demonstrated, therefore *they are simply proposed flows. They should be treated as alternatives and transformed to habitat time series for comparison through the IFIM modeling process.*

[3] DEIS, pp. 33-34, 44-48, 53-55.

E. <u>IFIM is NOT a "Minimum Flow" Method</u>

22. The IFIM modeling process has always been focused on the timing and extent of limiting habitat events that determine success for riverine life stages of aquatic species. Habitat time series provide the basis for comparative analyses.

23. Initial development emphasis was placed on fish population response to habitat imposed limitations often referred to as "habitat bottlenecks" (Bovee, 1982; Stalnaker, 1994; Stalnaker et al., 1994; Stalnaker et al., 1996; Bovee et al., 1998). "Effective habitat analyses" was initially presented as a *quasi*- population model. "Effective habitat analyses allow the manager to determine if there are associations between weak or strong year-classes and patterns of year-class-strength, calculated growth histories, or any other anecdotal information on population status" (Bovee, et al., 1998).

24. The point being that IFIM is not a "minimum flow" method, rather it is a process for comparing alternative water management project operations and their effects on both the spatial and temporal aspects of aquatic habitats. It is best used as an environmental analysis tool.

IV.
<u>Habitat Time Series Analyses</u>

A. <u>Steps to Developing the Analyses</u>

25. There are a series of important steps required to develop time and space sensitive habitat time series analyses. I describe each step below because, based on my review of the DEIS where some of these steps were abrogated or skipped, there appears to be some confusion. I also provide my opinion on whether the appropriate steps have been completed based on the documents I reviewed in preparation for this declaration and consultation with The Nature Conservancy Staff.

26. <u>Step 1</u>. The first step is to develop species-specific Habitat Suitability Criteria (HSC) for species and life stages of fish and aquatic organisms and conduct time series of usable habitats for biologically relevant time periods. Criteria are based on observed physical phenomena that may be a factor in fish preference (*e.g.*, depth, velocity, substrate, embeddedness, cover, proximity to cover, groundwater influence, turbidity). When study efforts are unable to develop robust site-specific data, HSC can be developed using the best available information and selected in consultation with the stakeholders. This step was completed through Study 3.16.

27. <u>Step 2</u>. Apply a mainstem open-water flow routing model that estimates water surface elevations, discharge and mean water velocities longitudinally along sampled habitat river sites. This step was completed through Study 3.11.

28. <u>Step 3</u>. Produce hydrologic time series for baseline and proposed alternative Project operation flow schedules. *This step is incomplete. Alternative operational flow schedules have not been published*.

29. Step 4. Develop integrated hydraulic/habitat models using species specific life stage periodicity and habitat criteria (HSC). This step was completed through Study 3.16.

30. Step 5. Produce habitat time series for baseline conditions and determine time and duration of habitat bottle necks for species of concern. Determine when habitat bottlenecks may occur and at what life stage and season, with particular attention to specific calendar years exhibiting good and poor year-class strength for species of concern. This step is incomplete. I understand there is limited data on which to determine the link between habitat and year class strength to identify bottlenecks. Regardless of the lack of formal study results, there is often some evidence of "poor years" for certain species. Reconstructed habitat time series for those years as compared to other years in the historical time series may be an adequate basis for a finding that "habitat bottlenecks" have acted on specific life stages during those years. IFIM analyses use professional opinion based on knowledge of specific species and simulated habitat conditions over recent history.

31. Step 6. Stratify baseline hydrology into sets of annual hydrographs representing different types of water year conditions (*e.g.*, extremely wet, wet, normal, dry, extremely dry). Identify the degree (timing, magnitude and duration) that habitat bottlenecks may or may not appear within stratified water year types. This step is incomplete.

32. Step 7. Compare proposed alternative operational flow scenarios against historic baselines as hydrologic time series. Also, compare representative annual hydrographs for extremely wet, normal, dry, and extremely dry hydrologic strata (also consider warm and cool climatic year types if water temperature is a major component of total usable habitat analysis). This step is incomplete. An example of this approach is included in The Nature Conservancy, "Motion to Intervene," Attachment 1, pp. 32-36.

33. Step 8. Transform hydrological time series to habitat time series. This step is incomplete.

34. Step 9. Compare proposed alternative project flow schedules. This step is incomplete.

35. Step 10. Select alternative(s) that best achieves compromise between opposing goals of environmental enhancements and maximizing Project hydroelectric generation and profits. This step is incomplete.

36. Step 11. Determine if conditions other than suitable hydraulic habitat may override suitable habitat analysis conclusions. This step is incomplete.

37. Naturally flow and habitat conditions are quite dynamic across time, and species have evolved to cope with these different magnitudes, frequencies, durations and rates of change. The spatial and temporal occurrence of habitat bottlenecks is quite different for different obligate riverine species. Habitat limitations may only be observed during low flow years for some species, only during high flow years for other species and may seldom occur for other more

generalists species. Therefore stratification of analyses and display of comparative availability of persistent habitat by water year type is important. This step is incomplete.

38. Step 12. Prepare a Decision Support Framework capable of conducting a variety of post-processing comparative analyses that focus on comparison and contrast of fundamental objectives for all parties. This comparison uses the common output of habitat metrics (the means objectives), estimated from habitat time series, effective habitat, persistence of suitable habitat over peaking cycles and other models. It is appropriate to use tabular and visual display by water year strata for all comparisons. This step is incomplete.

39. Step 13. Negotiate unique project operating rules for the different water year types. This often identifies the best compromise for balancing environmental and project management goals. This step is incomplete.

B. Effective Habitat, Persistent Habitat and Binary Criteria

40. An effective habitat time series is a modified version of a habitat time series designed to help address the problem of non-uniform effects of available suitable habitat for different aquatic species life stages. This approach was incorporated into IFIM as "quasi-population analyses" termed effective habitat analyses (*see* Bovee, 1982, pp. 100-120; in Bovee et al., 1998, pp. 98-101).

41. The effective habitat time series is a simplified fish population model based on the concept of habitat ratios. The persistence of suitable spawning, incubation and fry habitats as time series is designed to address the special case of unstable habitat conditions below peaking hydroelectric projects. This analysis quantifies the area of wetted stream bed that is suitable for spawning and subsequently remains suitable during the egg incubation period as determined throughout the generation cycle below peaking hydroelectric projects (Stalnaker, 1992; Bovee et al., 1998). The foundational data for this analysis was included in Appendix G (Persistent Habitat Tables), eLibrary no. 20120831-5048 (Aug. 2012), but was not transferred to habitat time series to compare alternatives for Study 3.11 or in the DEIS.

42. Typical impact analyses involving a hydro-peaking project where there are many aquatic organisms of interest will involve multiple comparisons and numerous time series. In such situations the weighted usable area (WUA) index is difficult to interpret. Consequently, *IFIM analyses involving peaking hydro projects are best evaluated by focusing on usable and unusable habitat as defined by binary habitat criteria*. This simpler and more readily understood habitat index greatly facilitates a common understanding among project managers, agency staff and other stakeholders.

43. Thomas and Bovee (1993) converted HSC based composite suitability indexes to binary format, with the optimum range for a variable defined as having a composite suitability index greater than 0.85 and usable habitat defined as having a composite suitability value between 0.2 and 0.85. Suitable microhabitat is then defined as the full range of conditions in which the species life stage was observed. Unsuitable microhabitat is defined as all microhabitat values outside the suitable range.

44. Another way to visualize these habitat categories is as areas of the wetted stream bed that provide optimal, marginal or unusable microhabitat conditions. *Since habitat time series is the currency of IFIM and serves as the basis for comparing baseline conditions with proposed project operating schedules, the use of binary composite suitability indexes and testing of model output represents the state-of-the-art and should become the state-of-the-practice*.

> "For statistical reasons of model testing and for ease in conducting *habitat time series* and *effective habitat analysis***,** resorting to this simpler classification of model output should perhaps become the norm" (Locke et al., 2008).

45. Similarly the Norwegians have adopted the convention of suitable, indifferent, unsuitable, and dry (high points that become islands at low flows) presented as color coded 2 dimensional figures, where suitable habitat is blue and unsuitable habitat is red, while the indifferent habitat is yellow and dry areas are clear (Alfredsen et al., 2004; Heggenes et al. 1994). They have found during their studies of Atlantic salmon and brown trout that the "Niche differences were most pronounced with respect to what types of habitat were *not* used: salmon were much more tolerant for high mean water velocities and deeper stream areas." *This highlights the fact that the area under the wetted surface of a stream that is unusable can be quite large, especially during hydropeaking. From the resource perspective negotiations of project operating rules should strive to keep the proportion of unusable area to highly suitable area (optimum) as low as possible*.

46. When proposed project operating flow schedules are to be evaluated, the change in the amount of optimal habitat present for a species life stage at critical times versus the amount of unusable stream area is the most informative metric. Likewise, it is undesirable to see an increase in the amount of marginal habitat at the expense of optimal habitat as a result of proposed project operations. Preventing the total amount of stream area that is *unusable* for specific life stages from being severely increased over baseline levels due to alternative project operation schedules is a common IFIM strategy for protection and recovery of species of concern.

C. <u>Dual Flow Habitat Analyses</u>

47. The idea of dual flow habitat is best understood by contrasting the large difference between the base and generation flows. These dual flows – the daily minimum and maximum – determine the suitability of habitat for aquatic organisms below peaking hydro projects. Again, the foundational data for the dual flow habitat analysis was included in Study 3.11, Appendix G (Persistent Habitat Tables), but was not transferred to habitat time series to compare alternatives for Study 3.11 or in the DEIS.

48. Rapid, frequent, and large magnitude changes in streamflow are common below peaking hydro projects. The discharge and habitat conditions for each square meter of stream bed may change dramatically throughout the peaking cycle. Mobile organisms, such as adult fishes, can move from one area to another to maintain position over areas of suitable habitat conditions.

49. In contrast organisms with restricted mobility, such as mussels and fish fry and juvenile fishes, may be displaced from suitable habitat areas of low velocity when flows increase. Those fish "species that dig redds, build nests, broadcast eggs to substrate or vegetation can be at risk due to rapid flow fluctuations. Likewise species whose young depend on stationary, reliable rearing habitats can be decimated by rapid changes in flow" (Stalnaker, 1992). Only those areas that remain suitable over the entire peaking cycle are considered as suitable for immobile organisms. Typically, during the peaking cycle, a large proportion of the stream bed that may have suitable habitat conditions for immobile organisms during base flow conditions becomes unsuitable as the flows increase. Consequently, the less mobile organisms are either stranded or swept downstream resulting in high mortalities.

50. The objective of dual flow analyses is to determine the effect of different combinations of generation and base flows on different aquatic organisms. This is referred to as "persistent habitat" by The Nature Conservancy in their comments. The "persistent habitat" is the amount of suitable habitat that persists as flow transitions from base flow conditions through generation releases. This persistent habitat metric is quite different (typically much lower) from minimum WUA, average WUA or other static habitat metrics calculated for the duration of the peaking cycle.

51. Negotiating unique project operating rules for the different water year conditions (*see* "Representative Years," *supra*) often identifies the best compromise for balancing environmental and Project management goals. For peaking hydro operations this often means that the base flow upon which peaking is allowed will vary across water years. In the case of recovery for critical species life stages, peaking may even be curtailed for a period of days in particular seasons for a particular water year type(s). Consequently, a typical negotiated settlement for a peaking hydro project includes different operating rules for seasons within each type of water year. IFIM study based negotiated operating rules for weeks, months or seasons within each water year class can be identified as **conditions to be included** in a project license.

V.
DECISION SUPPORT SYSTEM

52. Every process should include a decision support system for illustrating complex analyses contrasting alternative project operation scenarios. A well-defined support system will include a linked set of quantitative models (hydrologic, water temperature, hydraulic/fish habitat, fish population/production) and a Graphic Information System that provides the connection between project operations and ecological effects.

53. Resource agencies, project managers and stakeholders must understand and buy into the chain of analyses within the analytical system and use it as an integrative tool for comparing alternatives, informing management decisions, and assessing progress toward achieving *fundamental objectives*. HSCs, composite suitability indexes, and habitat time series are only *means objectives* (building blocks) that lead to the *fundamental objectives* and potential fish population response as consequence of river flow management. In this proceeding, a few of the *means objectives* have been completed (HSCs, dual flow habitat analysis), but they have not

been used to develop a chain of analyses to comparatively assess performance of alternatives in achieving *fundamental objectives*. Therefore the decision support system is incomplete.

54. A basic understanding of the modeling system and buy-in by stakeholders is critical. Understanding and accepting the uses and limitations of computer based flow to habitat to fish population response is a difficult task for non-modelers and takes time to develop a thorough understanding of the process. Describing the many technical tasks that feed into the process is important for stakeholder understanding. Stakeholders are naturally wary of computer models: trust is gained over time as stakeholders gain understanding and experience with the support system. Confidence and acceptance among all parties (including technical members) comes from many iterations of the linked models in the support system. Through a series of "scenario exercises" stakeholders become more involved and supportive.

VI.
MINIMUM FLOWS AND PERCENTAGE OF WUA

55. I am concerned that the analyses performed to date for this proceeding do not show a full understanding of the importance of habitat variability across time for obligate species. As described below, PHABSIM is not IFIM.

56. "Many people confuse IFIM with the Physical HABitat SIMulation System (PHABSIM). Where IFIM is a general problem solving approach employing systems analysis techniques, PHABSIM is but one specific model designed to calculate an index to the amount of suitable hydraulic habitat available for different life stages at different flow levels. PHABSIM has two major analytical components: stream hydraulics and life stage-specific habitat requirements (Stalnaker et al., 1994).

57. "Practitioners must remember that the habitat suitability criteria are "input" to the habitat model and are not the output" (Annear et al., 2004). "A common practice has evolved among some practitioners for prescribing an instream flow standard by recommending the maximum habitat value from the weighted usable area or discharge graph for a single life stage of a single species or by some aggregation technique of the maximum values from among several species and life stage plots" (Annear et al., 2004). Another common practice is to prescribe a minimum flow standard as some percentage of the peak (*e.g.*, 90%) value from a flow versus habitat graph. This may be useful where local policy dictates that "minimum flow" is the accepted instream flow standard. This is referred to as Standard Setting. Standard Setting is defined as "a streamflow policy or technique that uses a single, fixed rule to establish minimum flow requirements" (Annear et al., 2004).

58. Standard setting of minimum flow is not appropriate for environmental impact studies where alternative water project operations are compared.

59. IFIM was developed to replace the simple but static minimum flow methods practiced during the mid to late 20th century and to specifically address the more comprehensive environmental impact analyses necessary to evaluate alternative water management flow release

schemes. Unfortunately, some have used output from but one model (PHABSIM) within the suite of IFIM models to perpetuate “minimum flow” prescriptions.

60. IFIM is designed to assist natural resource and water management agencies in comparing the relative merits of prosed instream flow management schemes for operating water projects (such as hydro project licensing). The use of habitat time series, coupled with life-history habitat requirements and periodicity is the proper approach when using IFIM to evaluate peaking hydro facilities. The amount of intra- and inter-annual flow and habitat variability present under baseline conditions and the magnitude of any deviations that may occur under alternative Project operations becomes the focus of these impact studies.

61. “There is an extensive ecological literature on habitat-selection modeling, which indicates that simple selection of flow recommendations from a static set of WUA versus flow curves is not considered a credible approach…” (National Research Council, 2008). The National Research Council (NRC, 2008) has devoted several chapters to modeling and river management (Formulating and Applying Models in Ecosystem Management, Instream Flow Study, and Applying Science to Management).

62. The dynamic effects of varying levels of hydraulic habitat on biological processes, including competition, bioenergetics, predation, disease, and the recruitment of juveniles into the population, must be considered (Bartholow, et al., 1993). “Ecological and biological processes occur over variable scales of time and space, so an instream flow prescription should provide an appropriate level of spatial and temporal variability, to preserve the complexity of these processes” (NRC, 2008).

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Attachment 3

Attachment 1.1

CURRICULUM VITAE

Clair B Stalnaker

Address:
Telephone # (970)568-9298; cell (970) 372-8932
Email: clair_stalnaker@cowisp.net
Mailing Address:
5413 East County Road 58
Fort Collins, CO 80524

Professional Experience:

2000-present: Retired Senior Scientist, serving as consultant and expert witness.

1998-1999: Senior Scientist, Midwest Ecological Science Center, U.S. Geological Survey, Fort Collins, CO

1993 - 1998: Leader, River Systems Management Section, Midcontinent Ecological Science Center, U.S. Geological Survey, Fort Collins, Colorado

1990 – 1993: Chief, Riverine and Wetland Ecosystem Branch, National Ecology Research Center, FWS, Fort Collins, Colorado

1985 - 1999: Adjunct Professor of Environmental Engineering, Utah State University, Logan, Utah

1986 - 1990: Chief, Aquatic Systems Branch, National Ecology Research Center, FWS, Fort Collins, Colorado

1977 - 1999: Adjunct Professor, Dept. of Fisheries and Wildlife, Colorado State University, Fort Collins, Colorado

1976 - 1986: Leader, Instream Flow and Aquatic Systems Group, Water Energy and Land Use Team, FWS, Fort Collins, Colorado

1976: Fishery Research Biologist, Western Water Allocation Program, Office of Biological Services, U.S. Fish and Wildlife Service, Logan, Utah

1975 - 1976: Fishery Research Specialist, Division of Federal Assistance and Endangered Species, U.S. Fish and Wildlife Service, Region 6, Denver, Colorado

1966 - 1975: Assistant Unit Leader, Utah Cooperative Fishery Research Unit, FWS, Logan, Utah

1966 - 1975: Assistant Professor, Utah State University, Logan, Utah

Education:

Universities

1960 West Virginia University
BS in Forestry and Wildlife Mgt.

1966 North Carolina State University
PhD in Animal Ecology, Physiology and Genetics

Professional Societies

A.A.A.S., American Fisheries Society, Bonneville Chapter of A.F.S. (1973-74, two years executive committee member and chairman of resolutions committee; 1974-75 President Elect; 1975-76 Chapter President and executive committee member of the Western Division American Fishery Society), The Wildlife Society, and American Society of Naturalists.

Scholarly Societies

Gamma Sigma Delta - National Honor Society of Agriculture
Alpha Zeta - National Honorary Fraternity of Agriculture (Chapter Secretary and President)
Xi Sigma Pi - National Honor Society of Forestry (Chapter Secretary-Treasurer)
Phi Epsilon Phi - Honorary Botanical Fraternity
Tau Alpha Sigma - Honorary Wildlife Fraternity (Chapter President)
Sigma Xi

Appointments

Member five person Science Advisory Board, Trinity River Restoration Program, U.S. Department of Interior. 2002-present.

Member, six person National Review Panel, Department of Energy, Water and Power Program. Review of research projects being conducted by the DOE. National Laboratories. 2010 and 2011.

Adjunct Professor, Department of Civil and Environmental Engineering, Utah State University, Logan, Utah, 1985-1999.

Adjunct Professor, Departments of Fisheries and Wildlife, and Earth Resources Colorado State University, Fort Collins, Colorado, 1977-1999.

Member, Committee on Hydrology, Ecology, and Fishes of the Klamath River. National Research Council, Board on Environmental Studies and Toxicology, Water Science and Technology Board, Division on Earth and Life Sciences. Washington, D.C. 2006–2008.

Member, Science Advisory Board, Trinity River Restoration Program, Trinity Management Council, Weaverville, California, 2004-present.

Honorary Life Member, Instream Flow Council, Elected 2003. Awarded the Instream Flow Council's Lifetime Achievement Award in 2008.

Member, Science Advisory Committee, Upper Gila River Fluvial Geomorphology Study to Restore Habitat, U. S. Bureau of Reclamation, Graham County, Arizona, San Carlos/Safford/Duncan Watershed Group, Arizona, 1999-2004.

Member, Research Review Committee, CalFed, 2005.

Member, Research Review Committee, CalFed, 2002.

Chair, Research Review Committee, CalFed, 2000.

Member, Scientific Review Panel, New Zealand Foundation for Research, Science & Technology, 1997.

Member, Technical Advisory Committee, Joint Electric Power Research Institute and Pacific Gas and Electric Co. Research study on fish habitat/hydro power interactions, 1985-1998.

Member, Technical Advisory Committee, Joint BIA, Salish and Kootenai Tribes, Fishery/water study on the Flathead Reservation, Montana, 1987-1989

Member, Advisory Steering Committee, National Instream Flow Program Assessment,Joint State - Federal Aid assessment of the status of instream flow programs in all States and the seven regions of the Fish and Wildlife Service, 1994-1997.

Member, Technical Advisory Committee, Joint FWS N.Y. Department Environmental Conservation and Niagara Mohawk Power Co. research study on effects of hydropeaking on downstream fisheries, 1986-1990

Member Committee on Western Water Management Changes, National Research Council, Water Science and Technology Board, 1989-1992

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1975.Stalnaker, C.B., G.T. Klar, J. C. Braman, Y-H. J. Kao and T.M. Farley. Biochemical genetic analysis. Report NMFS Project 1-87-R. 34 p.

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1974.Stalnaker, C.B. Biochemical adaptations among subspecies of rainbow and cutthroat trout. Proceedings: Seminar on Fish Genetics, USFWS Fish Genetics Lab, Beulah, Wyoming. June 1974.

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Attachment 4

Attachment 4

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

	)	
Exelon Generation Company, LLC	)	
Conowingo Hydroelectric Project	)	P-405-106
	)	
Muddy Run Hydroelectric Project	)	P-2355-018
	)	
York Haven Power Company, LLC	)	P-1888-030
York Haven Hydroelectric Project	)	
	)	

THE NATURE CONSERVANCY'S COMMENTS ON FINAL MULTI-PROJECT ENVIRONMENTAL IMPACT STATEMENT FOR HYDROPOWER LICENSES, SUSQUEHANNA RIVER HYDROELECTRIC PROJECTS

The Nature Conservancy (the Conservancy) provides comments in response to the "Final Multi-Project Environmental Impact Statement for Hydropower Licenses" (FEIS), prepared by the Federal Energy Regulatory Commission, Office of Energy Projects (OEP), and dated March 2015.[1] We provide these comments by the April 20, 2015 deadline published in the Federal Register.[2] The Nature Conservancy is a party to these proceedings, having filed a timely Motion to Intervene.[3]

These comments focus on OEP's analysis of Conowingo Project flow releases, specifically *Section 3.3.2 Water Resources: Downstream Flow Releases*. The Conservancy thanks OEP for considering its comments on the Draft Environmental Impact Statement (DEIS) submitted in September,[4] and supplemented in January[5] with expert testimony provided by Dr. Clair Stalnaker. In those comments, the Conservancy made several recommendations for additional steps necessary to complete the analysis of the Conowingo Project's flow-related effects on aquatic resources. Unfortunately, the revisions in the FEIS that were intended to address deficiencies in the DEIS instead perpetuate inappropriate analytical methods and result in significant misinformation. This misinformation is material to OEP's findings of impact and

[1] eLibrary no. 20150311-4005.

[2] Environmental Impact Statements; Notice of Availability, 80 Fed. Reg. 15001 (Mar. 20, 2015).

[3] *See* "The Nature Conservancy's Motion to Intervene, Recommended Alternatives for Environmental Analysis, and Preliminary Terms and Conditions," eLibrary no. 20140131-5199 (Jan. 31, 2014) (TNC MOI). The TNC MOI includes a complete description of the Conservancy and its interests in these proceedings.

[4] eLibrary no. 20140929-5234 (TNC DEIS Comments).

[5] eLibrary no. 20150206-5219 (TNC Supplemental DEIS Comments).

recommendations for new license articles. We include a Second Expert Report by Dr. Stalnaker in support of these comments on the FEIS. *See* Attachment 1.

Contrary to OEP's revised analysis, the best available data, models and literature in the record continue to show that existing project operations have significant adverse impacts on (1) populations and the quality and availability of habitat for native diadromous fish migration, spawning and rearing, including American shad, river herring (Federal Species of Concern), striped bass, Atlantic (Federally-listed Endangered) and shortnose sturgeon (Federally-listed Endangered); (2) freshwater mussels; (3) map turtles (State-listed Endangered); (4) submerged aquatic vegetation; and (5) macroinvertebrates.[6]

OEP should revise the analysis of instream flow alternatives in the FEIS consistent with the recommendations made by Dr. Stalnaker in his First and Second Expert Reports prior to license issuance so that the Commission has a correct and complete administrative record as the basis for its licensing decision, as required by FPA sections 10(a)(1)[7] and 313(b).[8] The Conservancy requests that OEP accomplish this in a supplement to the FEIS.[9]

These comments also briefly address issues the Conservancy raised related to fish passage and stranding, water quality, sediment transport, and Endangered Species Act (ESA)-listed species where the FEIS does not adequately resolve those issues. The Conservancy continues to support the DEIS comments filed by the United States Fish and Wildlife Service (USFWS), the United States Environmental Protection Agency (USEPA), National Marine Fisheries Service (NMFS), Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Environmental Protection (PADEP), Susquehanna River Basin Commission (SRBC), the Maryland Department of Natural Resources (MD DNR), and American Rivers, and is concerned that the FEIS is not responsive to many of those comments. In particular, the Conservancy is concerned that OEP's responses (*see* FEIS, Appendix H) to comments and

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6 *See id.* at 14-15.

7 16 U.S.C. § 803(a)(1).

8 16 U.S.C. § 825*l*(b).

9 The Council for Environmental Quality's (CEQ) regulations for implementing National Environmental Policy Act (NEPA) provide that agencies:

> (1) Shall prepare supplements to either draft or final environmental impact statements if:
> (i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or
> (ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.
> (2) May also prepare supplements when the agency determines that the purposes of the Act will be furthered by doing so.

40 C.F.R. § 1502.9.

recommendations made regarding flow release alternatives (including minimum flows, maximum flows and rate of change), fish passage and stranding, sediment transport, and endangered sturgeon, rely on significant misinformation.

The Conservancy reserves the right to supplement these comments as the administrative record is further developed through additional investigation by Exelon, the relicensing parties, or OEP Staff. For example, additional information may be entered into the record as a result of proceedings related to Federal Power Act (FPA) section 18 prescription, Clean Water Act (CWA) section 401 water quality certification, and Endangered Species Act (ESA) section 7 consultation.

II.
SPECIFIC COMMENTS

A. The FEIS Does Not Give Full Consideration to Feasible Alternatives.

Sections 2.0 and 4.0 of the FEIS are limited to the same three alternatives identified in the DEIS: No Action, Exelon's Proposal, and Staff Alternative. Exelon's Proposal and the Staff Alternative propose substantially the same project release schedule as the No Action Alternative. OEP rejected the Conservancy's request that it consider the Agency-NGO Flow Alternative[10] as a complete alternative in Section 2.0 and 4.0. It claims that it "fully analyze[d] American Rivers and The Nature Conservancy's recommendations in this final EIS," despite not treating them as stand-alone alternatives."[11]

The Conservancy disputes that the FEIS's consideration of three variants of the same operational proposal satisfies the Commission's obligation under FPA section 10(a)(1)[12] and NEPA section 102(2)(E)[13] to undertake a thorough study of feasible alternatives. The Conservancy also disputes that the FEIS's disparate treatment of the Agency-NGO Flow Alternative is adequate under NEPA. Under NEPA section 102(C)(iii), an EIS must include a "detailed statement" on alternatives to the proposed action.[14] According to the CEQ's regulations implementing NEPA:

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[10] In its MOI the Conservancy proposed an operational alternative for evaluation in the FEIS. *See* TNC MOI, p. 11. The Conservancy stated that its preferred operational alternative might change based on further development of the record. *Id.* This alternative was supported by several other entities, including USFWS, USEPA, and American Rivers. The biological objectives for this alternative were supported by SRBC, Maryland Department of the Environment, NMFS, USFWS, and American Rivers. The FEIS refers to this alternative as the "TNC Flow Regime," but it should more accurately be referred to as the "Agency-NGO Flow Alternative."

[11] *Id.* at H-8.

[12] 16 U.S.C. § 803(a)(1); *Scenic Hudson v. FPC*, 354 F.2d 608, 617-18 (2d Cir. 1965); *Green Island Power Authority v. FERC,* 577 F.3d 148, 168 (2d Cir. 2009).

[13] 42 U.S.C. § 4332(2)(E); *Environmental Defense Fund v. U.S. Army Corps of Engineers*, 492 F.2d 1123, 1135 (5th Cir. 1974).

[14] 42 U.S.C. § 4332(2)(C)(iii).

> This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (§ 1502.15) and the Environmental Consequences (§ 1502.16), *it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public.*[15]

The omission of the Agency-NGO Flow Alternative from Section 2.0, where each action alternative is clearly described, and Section 4.0, which is the basis for OEP's benefit-cost analysis, prevents a clear comparison of that alternative to the other operational alternatives and is an abuse of the Commission's discretion under the FPA and NEPA and regulations implementing those statutes.

B. <u>The FEIS Does Not Support OEP's Finding that the Flow Regime Included in the Staff Alternative Will Achieve Biological Objectives</u>.

In the FEIS, OEP finds that the Staff Alternative will achieve the fundamental, flow-dependent objectives established by the Conservancy and resource agencies, to an extent comparable to the Agency-NGO Flow Alternative.[16] OEP's use of the objectives to compare the Staff Alternative to the Agency-NGO Flow Alternative indicates OEP's acceptance of those objectives as a statement of the desired future condition of these resources. However, the instream flow analysis in the FEIS does not support OEP's finding that the two alternatives would achieve those objectives to a comparable extent. Thus, OEP's rejection of the Agency-NGO Flow Alternative under FPA sections 10(a) and 10(j),[17] is not supported by substantial evidence as required by FPA section 313(b).

We explain below why the analysis OEP used to determine the Staff Alternative would achieve the biological objectives is not scientifically defensible.

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[15] 40 C.F.R. § 1502.14.

[16] FEIS, p. 416.

[17] 16 U.S.C. § 803(j). Pursuant to FPA section 10(j), the Department of Interior recommended that Exelon be required to "implement the flow recommendations of The Nature Conservancy unless more restrictive measures are adopted in the Maryland Clean Water Act 401 Water Quality Certification." Department of Interior, "Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Prescriptions," eLibrary no. 20140131-5118 (Jan. 31, 2014), p. 23. In the FEIS, OEP finds that this recommendation "may be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA." FEIS, p. 439. This finding is based on the analysis in section 5.1.3.3 of the FEIS that "the TNC Flow Regime would not provide substantially more aquatic habitat benefits than the staff-recommended flow regime," but would cost more. *Id.* at 439. This analysis is an inadequate basis for OEP's failure to give "due weight to the recommendations, expertise, and statutory responsibilities" of the Department of Interior. 16 U.S.C. § 803(j).

1. <u>The Staff Alternative Recommends Flow Releases that Are Lower than Historic Minimum Flows Are Adequate to Support Aquatic Resources</u>.

The Staff Alternative includes Exelon's proposed flow regime, subject to two adjustments recommended by OEP:

(1) Eliminating the 6-hour periods of zero minimum flow from December through February; and

(2) Increasing the minimum flow from 5,000 to 7,500 cfs during the first 2 weeks in June, to protect the end of the spawning period for shad and striped bass.[18]

Under the Staff Alternative, the recommended flow releases from Conowingo dam to the Lower Susquehanna River would continue to be lower than the historic minimum daily flow from December through June and would be orders of magnitude lower than typical seasonal flows throughout the year. More simply put, the Staff Alternative recommends flow releases that are lower than drought conditions for much of the year *See* Figure 1, *infra.*

As explained by Dr. Stalnaker, the Staff Alternative is representative of "decision-making based on flow statistics and searching for 'minimum flows' (by observing flow/habitat relations generated from average flow conditions)," which is now regarded as "outdated and ecologically unsound."[19]

> Such decision-making represents late 1970's and early 1980's "minimum flow" approaches, a time when obtaining any continuous flow in excess of leakage below large reservoirs was considered progress. The goal then was often to avoid extinction by providing a "minimum flow" that would sustain a minimalist aquatic community and avoid extinction of species. These analytical approaches do **not** represent the modern state-of-the-art science or management practice. Decision-making based on such approaches may not enhance or sustain a complex aquatic community in the Susquehanna River.[20]

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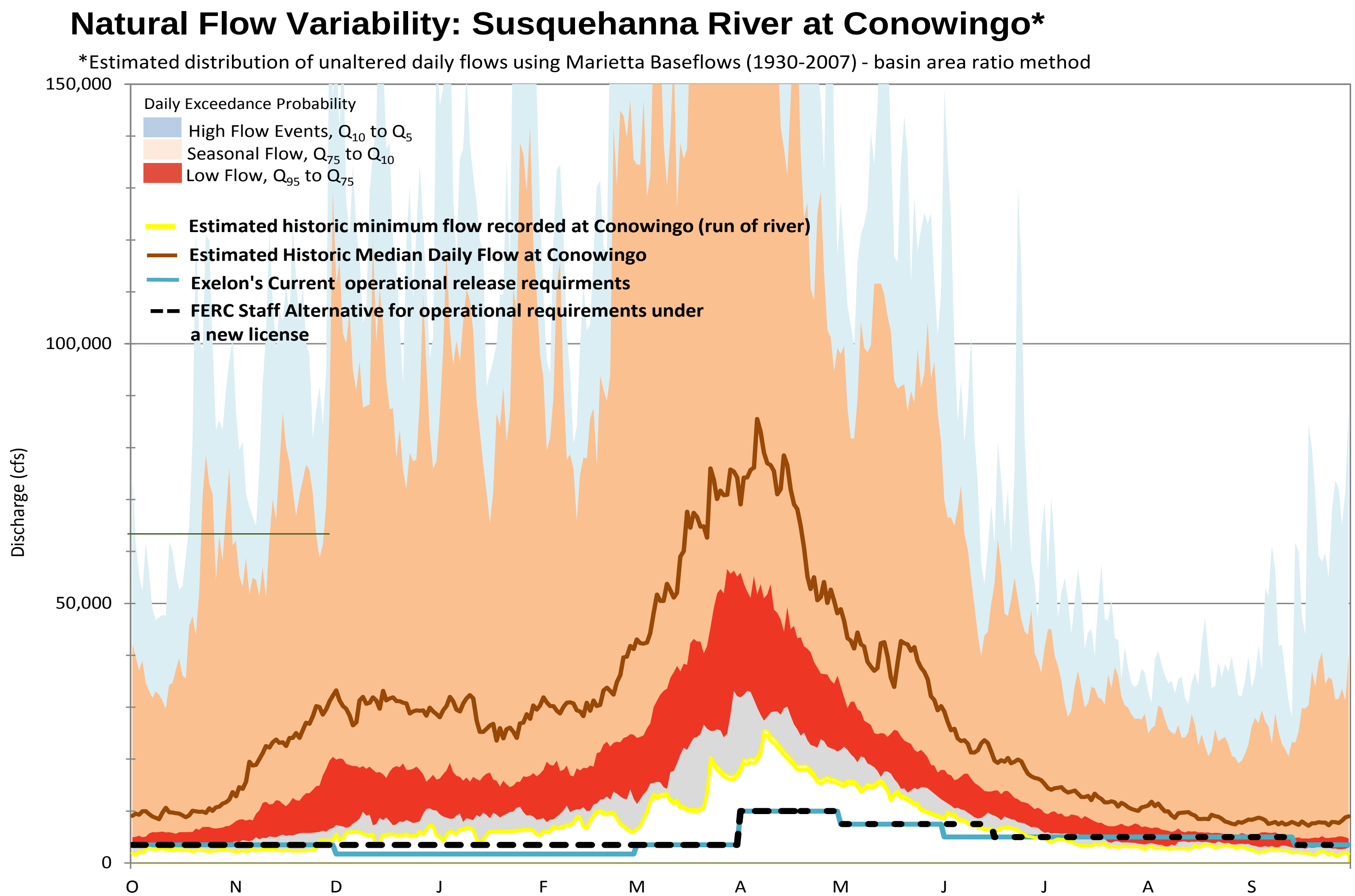
18 FEIS, p. 416.

19 Attachment 1, ¶ 16.

20 *Id.*

Figure 1. The Staff Alternative (black dashed line) Recommends Flow Releases that would be Lower than Historic Minimum Flows (yellow line) for most of the year and orders of magnitude lower than seasonal baseflows (brown line) year round.



The Nature Conservancy's FEIS Comments
Exelon, Conowingo (P-405-106) and Muddy Run Projects (P-2355-018)
York Haven, York Haven Project (P-1888-030)

2. The Comparison of Alternatives Presented in Table 3-21 Is Not Based on a Valid Scientific Method.

In preparing the FEIS, OEP conducted additional analysis of the Staff and Agency-NGO Flow Alternatives. These further analyses are presented in Tables 3-21 and 3-22. Table 3-21 summarizes OEP's "analysis of flow pairs using The Nature Conservancy-recommended minimum and maximum flows, compared to existing flow conditions downstream of Conowingo dam using the monthly 90 percent exceedance flows as the minimum flow, and the 10 percent exceedance flow as the maximum generation flow."[21] According to OEP, Table 3-21 indicates "that the amount of persistent habitat is similar and the ranges in persistent habitat actually overlap for some life stages between the two flow scenarios."[22]

In preparing Table 3-21, OEP used historic average daily flows to represent the persistent habitat available under existing peaking operations. This dataset averages the minimum flow releases and maximum generation releases on a daily basis. As shown in Figure 2, *infra*, the resulting number has little resemblance to "real world," conditions. By averaging peaking operations (the high and low flows), the statistic has no biological relevance. This error in the FEIS is confounded by accumulating daily averages into an exceedance curve.

As Dr. Stalnaker explained:

> The analyses offered by Exelon and FERC are based exclusively on statistics from the hydrological record. These statistical averages are translated into physical habitat values for various aquatic species of interest followed by attempts to select a series of "minimum flows" as a percentage of the maximum weighted usable area (MWUA) obtained from the flow/habitat relationships. These values are calculated from flow statistics representing average flows from across the entire hydrological record and, therefore, **have no biological meaning**. These flow patterns never actually occur during any one year and certainly did not occur every year over the many years of Project operations.[23]

Table 3-21 should be removed from the record and the findings that rely upon it should be re-examined using data and models reviewed and used during the re-licensing study process.

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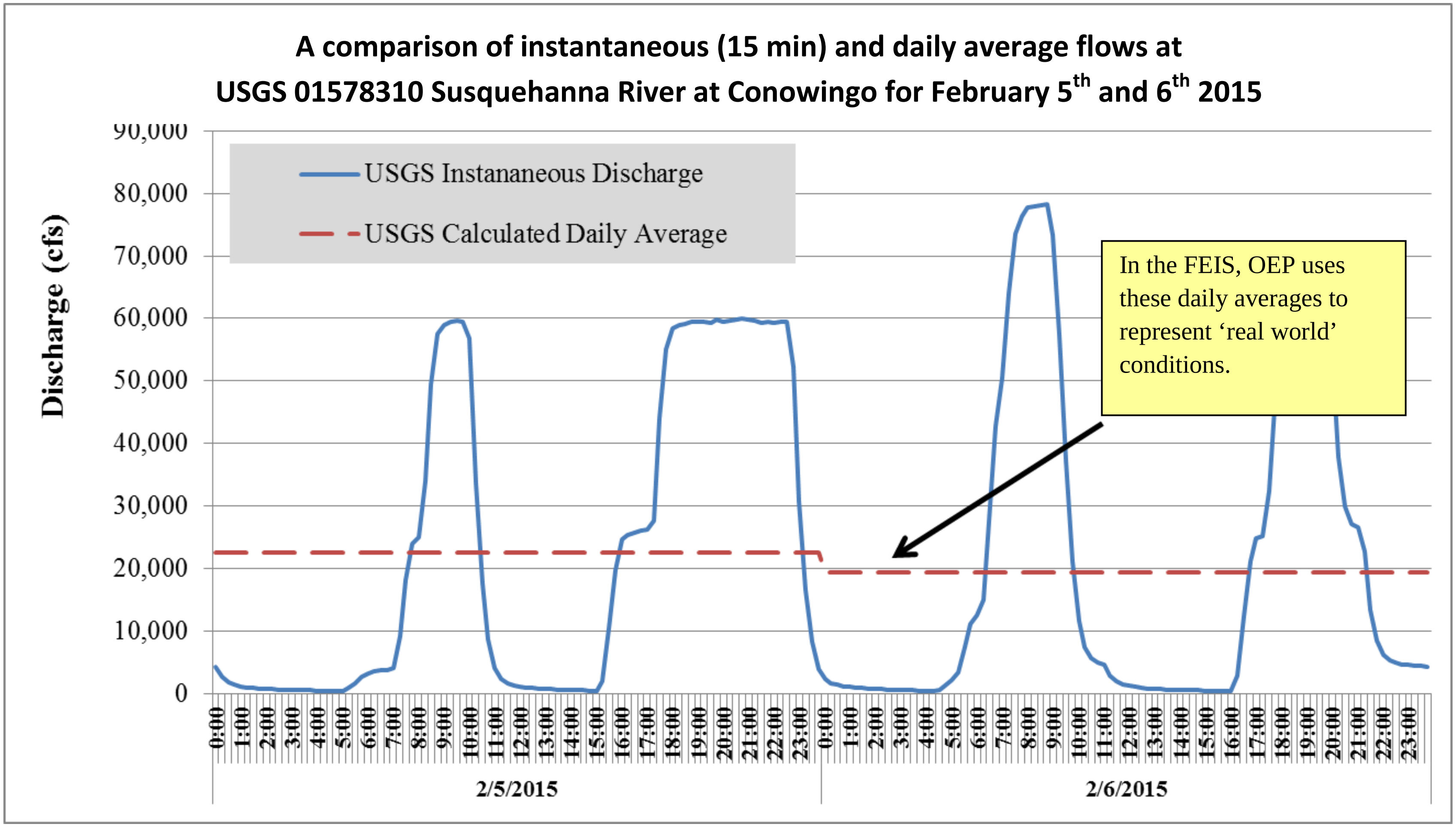
21 FEIS, p. 153.

22 *Id.* at 154.

23 Attachment 1, ¶ 2 (emphasis in original).

Figure 2. In the FEIS OEP uses historic daily average flows (red) to represent persistent habitat availability under current peaking operations at the Conowingo Project. Using data from USGS 01578310 both instantaneous and daily average data from USGS Conowingo, Figure 2 illustrates that this statistic does not represent daily flow and related habitat conditions.



We appreciate OEP's intent in conducting independent analysis of this critical issue. However, it was not necessary for OEP to generate Table 3-21 given that the data needed to accurately conduct the comparison between operational scenarios are available in the existing relicensing studies and models.[24] Much of this data was gathered pursuant to Studies 3.11 and 3.16, which were approved in the Study Plan Determination issued by OEP.[25]

Study 3.11 included the development and comparison of several Agency and NGO stakeholder operational alternatives, including the existing condition and run-of-river.[26] Gomez and Sullivan, as consultants to Exelon, developed a persistent habitat model in accordance with the study plan that was reviewed by interested participants. For each of the operational alternatives, a persistent habitat time series was estimated by using the minimum and maximum daily flows and selecting the appropriate persistent habitat value from the dual flows analysis in Appendix G.

According to Dr. Stalnaker:

> The Instream Flow Study Report, Appendix G indicates that all of the data necessary for the habitat time series based analyses requested here are indeed available. State-of-the-art data collection using River 2D hydraulic modeling for habitat descriptions provides the data necessary for translating hydrological time series to habitat time series. Only additional analyses of the data are required.[27]

The Conservancy reiterates the request made in our MOI and DEIS comments[28] that OEP direct Exelon to disclose the results, including environmental benefit and operational cost, of all Agency and NGO operational alternatives on the record.

The Conservancy submitted preliminary analysis of the Study 3.11 data that was filed in the record in its MOI.[29] Rather than address this information and methodology, OEP inexplicably ignores it in the DEIS and FEIS. The FEIS still does not explain OEP's decision to abandon the persistent habitat model when comparing stakeholder operational scenarios conducted as part of Study 3.11.

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[24] *See* Attachment 1, ¶ 15. Models are a tool used as a best approximation of 'real world' conditions. *See, e.g.*, Attachment 1, ¶¶ 4, 15.

[25] Study Plan Determination, eLibrary no. 20100204-3055, pp. 4-5 (Feb. 4, 2010).

[26] TNC MOI, pp. 8-11.

[27] Attachment 1, ¶ 15.

[28] TNC DEIS Comments, p. 6.

[29] TNC MOI, Attachment 1.

Even under OEP's flawed analysis, the FEIS states that, "the TNC Flow Regime generally shows a higher range of percent of maximum persistent habitat" for most species, with the exception of smallmouth bass."[30] Rather than recommend the Agency-NGO Flow Alternative on this basis, OEP states:

> It is not known, however, whether higher persistent habitat would necessarily result in significant enhancements for these life stages because there is no information to indicate the current "carrying capacity" of habitat in the lower Susquehanna River.[31]

OEP does not explain why the lack of information to definitively understand "carrying capacity" for the lower river is cause to abandon the persistent habitat model. This purported deficiency applies equally to the Maximum Weighted Useable Area (MWUA) method that OEP relies upon. If OEP views the current carrying capacity of habitat in the lower Susquehanna River as material to its evaluation of flow alternatives, then it should undertake to complete the record on this issue. As stated above, under FPA section 10(a)(1), the Commission has an obligation to undertake a thorough evaluation of alternatives based on a complete record.[32]

Based on the historic data and observations that are available, the estimated "carrying capacity" is orders of magnitude higher than current population estimates for target species including striped bass, river herring, American shad, shortnose and Atlantic sturgeon, freshwater mussels, and map turtles (Meehan 1897[33], PADF 1906[34], McCoy and Vogt 1990[35], MDNR 2009[36], SSSRT 2010[37], Walburg 1967[38]).

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[30] FEIS, p. 154.

[31] *Id.*

[32] *Scenic Hudson v. FPC*, 354 F.2d at 617-18.

[33] Meehan, W.E. Report of the Commissioners of Fisheries of the State of Pennsylvania for the year 1900. Official report archived at Benner Spring Research Station, State College, PA. 194 pp.

[34] Pennsylvania Department of Fisheries. 1906. Report of the Department of Fisheries of the Commonwealth of Pennsylvania from December 1, 1904 to November 30, 1905. Harrisburg, PA. 245 pp.

[35] McCoy, C.J. and R.C. Vogt. 1990. *Graptemys Geographica*. Catalog of American Amphibians and Reptiles. 484.4.

[36] Maryland Department of Natural Resources. 1985-2009. Population assessment of American shad in the upper Chesapeake Bay. Job VII, in Restoration of American shad to the Susquehanna River, Annual Progress Reports for 1984-2001, SRFRC, Harrisburg, PA.

[37] Shortnose Sturgeon Status Review Team, 2010. A Biological Assessment of Shortnose Sturgeon (Acipenser brevirostrum). Report to the National Marine Fisheries Service, Northeast Regional Office. 417 pp.

[38] Walburg, C.H. and P.R. Nichols. 1967. Biology and management of American shad and status of the fisheries, Atlantic Coast of the U.S., 1960. USFWS. Special Scientific Report (Fisheries) No. 550:105 pp.

OEP also indicates that the persistent habitat model may not provide reliable results:

> While we agree [habitat persistence analysis] is insightful in helping to understand the effects of flow fluctuations, "persistent habitat" may be difficult to simulate under "real world" conditions using flow pairs, because habitat is constantly changing in the lower Susquehanna River.[39]

OEP does not cite to any authority for this statement. The persistent habitat model uses the hydrologic record with a one-hour timestep, *i.e.*, "real world" conditions, to predict suitable habitat across time. The Conservancy has submitted numerous authorities, including expert testimony from Dr. Stalnaker, a leader in instream flow science, which state that persistent habitat models are a critical tool for analyzing the impacts of variable releases on flow-dependent species below dams.[40] OEP has not disputed this evidence. Further, as stated and illustrated in Figure 2, *supra*, the data OEP used is a completely inaccurate representation of actual conditions below a hydro-peaking facility.

As stated above, OEP should update the instream flow analysis in the FEIS consistent with the recommendations made by Dr. Stalnaker in his First Expert Report, and reiterated in his Second Expert Report. As the Conservancy stated in its supplemental comments to the DEIS, given that the State of Maryland is unlikely to issue a water quality certification pursuant to Clean Water Act section 401[41] within the next 18 months, OEP has time to update its analysis consistent with the following recommendations:

(a) Complete habitat time series based analyses with stratification of water supply into wet, normal and dry representative conditions using historical Project operations. Consider these time series as the Project hydrological baseline. Convert these time series to habitat time series.

(b) Compare habitats provided by alternative flow regimes proposed by Exelon and the agency-NGO stakeholders (including the Conservancy). Summarize comparisons by wet, normal and dry representative water year conditions (how much deviation from Project habitat baselines do each provide?).

(c) Based on these new analyses design **new** flow schedules that are unique to each water supply condition along with operational rules by which flow releases switch from one set of schedules to another once the dry or wet water supply condition is determined to significantly differ from normal water supply conditions. This will

[39] *Id.* at 152.

[40] *See, e.g.*, Attachment 1, ¶¶ 8-12

[41] 33 U.S.C. § 1341.

include three sets of flow schedules (wet, normal and dry) ensuring that both intra- and inter-annual flow and habitat variability is maintained.

(d) Design i**nstantaneous** reservoir release base flow levels for peaking that are unique to seasons within wet, normal and dry water supply conditions. Base flows and peaking flows should be based on actual conditions as simulated for stratified water supply conditions and **not** from averages computed over the entire Project historical flow records.

(e) Strive to design flow schedules that prove some quantitative level of enhancement over baseline habitat values for **all** species and life stages seasonally present. The natural resource agencies' and TNC's goals are to attain a significant level of habitat improvement over existing Project operations.

(f) Ensure that the new licensed releases will provide at least the same quantitative habitat level (habitat maintenance) and some increases (enhancements) to seasonal habitats within representative water supply conditions when compared with simulated historical time series. . . .

(g) After investigating the historical habitat levels provided via Project operations, FERC should prepare recommendations that provide for feasible levels of Project profits **while also providing** some quantified level of physical habitat enhancements for downstream aquatic species and guilds. To be ecologically meaningful the Project release schedules approved in the new license must be **instantaneous** flows and **not** simply daily averages.[42]

3. Table 3-22 Summarizes Maximum Weighted Usable Area Data Not Habitat Persistence Data.

Table 3-22 in the FEIS is described as a "Summary of Exelon's habitat persistence analysis by month . . . ."[43] More specifically, it purportedly "summarizes the flow ranges that provide 70 percent of MWUA for evaluation species and life stages . . . ."[44] According to the FEIS, "Table 3-22 indicates that, overall, the current and proposed Exelon operation generally brackets the range of flows that would provide 70 percent of MWUA for all the evaluation species combined."[45]

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[42] Attachment 1, ¶ 19 (emphasis in original).

[43] FEIS, p. 159.

[44] *Id.* at 155.

[45] *Id.* at 156.

The data presented in Table 3-22 do not represent habitat persistence. The Conservancy requests that OEP remove "persistence" from the table description because the data do not show habitat that is available over time.

The data instead represent MWUA. As described in its previous filings (*see, e.g.*, TNC MOI, Attachment 1), the MWUA statistic is not appropriate for immobile life stages including spawning and fry.

Further, as described in detail in our comments on the DEIS,[46] the data summary row entitled "Flow range for 70% MWUA," should be revised to represent overlapping values – as described in the table title. As published, the values are inaccurate, specifically the ranges are much less than 70% MWUA for several species life stages (*e.g.*, striped bass adult).

Lastly, as described in the Conservancy's MOI, the habitat models for guilds were less accurate and contested when compared to species-specific models.[47] The Conservancy requested that the guild results be removed from the MWUA.[48] The FEIS does not address this request.

C. **The FEIS Does Not Support OEP's Finding that the Agency-NGO Flow Alternative Would Have Major Adverse Effects on Project Economics**.

The FEIS rejects the Agency-NGO Flow Alternative because

> benefits to some species life stages would not justify the effects on project operation and costs. While there would be a small gain in generation at the Conowingo Project (13,116 MWH), which a levelized annual value of $348, 130, there would be a major loss of generation at the Muddy Run Project (146,837 MWh), with a levelized annual lows of $1,989,490, or about 9 percent of the annual generation at the project.[49]

The Conservancy disputes that the record is adequate to show that the benefits to non-developmental uses would not be worth the potential costs. In addition to the ecological benefits of restoration, it is estimated that a restored stock of American shad on the Susquehanna River could produce 500,000 angler days valued at $25 to $37 million annually (SRAFRC 2010). As explained above, OEP's findings regarding the potential benefits to fish and wildlife under the operational alternatives is based on invalid scientific methods and misinformation. In addition, OEP has not yet disclosed the assumptions and methods OEP used in its analysis of the Project's cost-effectiveness under the different operational alternatives. The Conservancy reiterates the

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[46] TNC DEIS Comments, p. 8.

[47] TNC MOI, Attachment 1.

[48] *See id.*

[49] FEIS, pp. 429, 439.

request made in our MOI and DEIS comments that OEP direct Exelon to disclose these results for all Agency-NGO flow alternatives completed under Study 3.11.[50]

D. The FEIS Does Not Support OEP's Recommended Measures for Fish Passage and Stranding.

The FEIS rejects many of the measures the agencies and the Conservancy recommended to address fish passage and stranding at the Conowingo Project in favor of less expensive measures preferred by Staff.[51] The FEIS does not show that the measures proposed by Staff will achieve the fish objectives established by the agencies.

In its DEIS comments, the Conservancy requested that OEP provide substantial evidence in support of its fish passage recommendations and "state the specific basis for [OEP's] finding that any fish passage recommendations are consistent with the applicable comprehensive plans."[52] OEP responds that it is not necessary to articulate how its recommended fish passage measures will achieve specific fish passage goals stated in the comprehensive plans. It states that it reviewed amendment 3 of the Interstate Fishery Management Plan for shad and river herring and found "no inconsistencies between our recommended measures and the plan."[53] It further states:

> As is typical for such interstate plans, the goals, objectives, and recommended measures are generalized . . . Because staff-recommended measures would improve fish passage at the Conowingo and York Haven dams, the shad population in the river would be enhanced, which is the overall objective of the plan for the Susquehanna River.[54]

The Conservancy disputes that this summary response shows that the recommended measures are best adapted to a comprehensive plan of development for the Susquehanna River as it relates to protection of fisheries.

The FEIS references the current biological performance goal for the Susquehanna River as described in SRAFRC (2010):

> Restore self-sustaining, robust, and productive stocks of migratory fish capable of producing sustainable fisheries, to the Susquehanna River Basin throughout their historic

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50 TNC MOI, pp. 8-9; TNC DEIS Comments, pp. 13-14.

51 *Id.* at 429-430, 434-441.

52 TNC DEIS Comments, p. 11.

53 FEIS, p. H-25.

54 *Id.* at H-26.

> ranges in Maryland, Pennsylvania, and New York. The goals are 2 million American shad and 5 million river herring spawning upstream of the York Haven dam.[55]

Rather than describe the basis for its determination that the recommended fish passage measures would specifically contribute to this goal, the FEIS states that determining whether those measures would achieve the goals

> would involve a theoretical modeling of conditions 30 to 50 years into the future. Because such an exercise would be founded on many untested assumptions (which may be debatable among the parties to this proceeding, as would be the results), we conclude that it would provide little useful information for this proceeding.[56]

The Conservancy disagrees that OEP has shown modeling potential future conditions is impossible and continues to support the basis for and recommendations by the USFWS and PFBC. Current American shad passage on the Lower River remains less than 1% of the SRAFRC restoration goal, which has called into debate the alternative of mainstem dam removal to restore diadromous fisheries (Brown et al. 2013).[57]

The Conservancy further disagrees with OEP's finding that fish stranding and mortality induced by down-ramping operations is not having a major adverse effect on target species including American shad and river herring. As documented in the Conservancy's MOI, "[d]uring the 2011 spawning migration, an estimated 1,400 American shad (about 6% that passed that year) and more than 500 river herring were stranded as a result of hydropower operations."[58] The Conservancy continues to support recommendations made by USFWS, NMFS, PFBC, SRBC and American Rivers to mitigate these impacts.

E. <u>The FEIS Does Not Support a Finding that the Project is Not Likely to Adversely Affect ESA-listed Sturgeon</u>.

The FEIS finds:

> While there is suitable habitat downstream of Conowingo for [shortnose and Atlantic sturgeon], only occasional individual shortnose sturgeon have been reported from the river below the dam, and there is no evidence of any recent occurrence of Atlantic sturgeon in the lower Susquehanna River. Therefore, continued operation of the

[55] *Id.* (*quoting* SRAFRC (2010)).

[56] *Id.*

[57] Brown, J.J., K.E. Limburg, J.R. Waldman, K. Stephenson, E.P. Glenn, F. Juanes and A. Jordaan. 2013. Fish and hydropower on the U.S. Atlantic coast: failed fisheries policies from half-way technologies. Conservation Letters, 6: 280–286. doi: 10.1111/conl.12000.

[58] TNC MOI, p. 14.

Conowingo Project would not be likely to adversely affect the shortnose and Atlantic Sturgeon.[59]

It rejects the Conservancy's request that it prepare a biological assessment that describes the Project's impacts on listed sturgeon under proposed and alternative operations because" most of the information that was requested for the biological assessment is already included in the EIS in multiple locations."[60]

Leaving aside any dispute as to form, the Conservancy disagrees that the information included in the FEIS is adequate to support this finding. The Staff Alternative proposes to continue the existing flow schedule, subject to two adjustments proposed by OEP Staff. As stated above, this would perpetuate a flow regime that is lower than the historic minimum daily flow from December through June and would be orders of magnitude lower than typical seasonal flows throughout the year. The information in the record shows that the existing flow schedule is not protective of listed sturgeon.[61]

For the reasons stated in the Conservancy's previous comments, particularly the Expert Reports prepared by Dr. Stalnaker, OEP has not yet complied with its regulatory obligation to "provide the Service with the best scientific and commercial data available or which can be obtained during the consultation for an adequate review of the effects that an action may have upon listed species or critical habitat."[62] Specifically, OEP has not yet completed the dual flow habitat analyses that are necessary to more accurately predict available habitat downstream of Conowingo Dam under the range of proposed and alternative operational flows.[63] OEP has not explained why the dual flow analyses recommended by Dr. Stalnaker cannot be completed in the course of ESA consultation. As stated by Dr. Stalnaker, much of the information needed to conduct the analyses has already been gathered by Studies 3.11 and 3.16, OEP just needs to conduct further analyses.[64]

For these and the reasons stated in our MOI,[65] the Conservancy continues to support NMFS's request that OEP prepare a Biological Assessment to evaluate the effects of the continued operation of Conowingo on shortnose and Atlantic sturgeons, these species are (1)

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59 FEIS, p. 16.

60 *Id.* at H-36.

61 *See* TNC MOI, pp. 14-15; TNC DEIS Comments p. 9.

62 50 C.F.R. § 402.14(d).

63 Attachment 1.

64 *Id.* at ¶ 15.

65 TNC MOI, p. 5.

present in the project area, and (2) affected by dams and flow regulation throughout their range (Kynard 1997,[66] NMFS 2010,[67] Kynard 2012).[68] We further request that the Biological Assessment include the dual flow analyses recommended by Dr. Stalnaker.

F. The FEIS Does Not Support OEP's Finding regarding Sediment Transport.

The FEIS finds:

> Based on the findings of the draft LSRWA study report (Corps and MDE, 2014), we find that changes in Conowingo Project structures and operation are not viable solutions to the sediment transport issue at this time. We consider it premature to conclude that dredging of Conowingo Pond would be an environmentally acceptable solution. Exelon's proposal and other entities' recommendations to use the LSRWA study as a basis for additional analysis of this issue are reasonable. . . .[¶] The ultimate resolution of the issue of environmental health of the Bay would require more than singular actions at the Conowingo Project, and instead would require a basin-wide approach involving many governmental jurisdictions and other entities.[69]

The Conservancy agrees that the ultimate resolution of the environmental health of Chesapeake Bay requires more than just changes at Conowingo Dam. However, the fact that the sediment transport is a cumulative impact does not excuse the Commission from conditioning the new license on specific measures to limit the Conowingo Project's contribution to the impact.

The record (as demonstrated in Exelon's Final License Application) is clear that living resources are negatively affected by the lack of coarse substrate in the project area below Conowingo dam. This lack of substrate, which results from the presence and operation of Conowingo dam, has and will continue to have significant implications for the amount of quality habitat available to priority species, such as American Shad, river herring, Shortnose and Atlantic sturgeon, map turtle, freshwater mussels, submerged aquatic vegetation, and potentially to habitats further downstream into the Chesapeake Bay.[70]

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[66] Kynard, B. 1997. Life history, latitudinal patterns and status of the shortnose sturgeon, Acipenser brevirostrum. Environmental Biology of Fishes. 48:319-334.

[67] Shortnose Sturgeon Status Review Team, 2010. A Biological Assessment of Shortnose Sturgeon (Acipenser brevirostrum). Report to the National Marine Fisheries Service, Northeast Regional Office. 417 pp.

[68] Kynard, B. 2012. Life History and Behavior of Connecticut River Shortnose and other Sturgeons. World Sturgeon Conservation Society: Special Publication 4(2012).

[69] FEIS, pp. 80-81.

[70] TNC MOI, pp. 15-16.

G. The FEIS Does Not Support a Finding of Consistency with Applicable Comprehensive Plans.

In making its best adapted determination under FPA section 10(a)(1), the Commission must consider "[t]he extent to which the project is consistent with . . . comprehensive plan[s] for improving, developing or conserving a waterway or waterways affected by the project" developed by other agencies.[71]

The FEIS states that "[n]o inconsistencies were found" in OEP's review of the 26 comprehensive plans applicable to the Susquehanna River Projects.[72]

The Conservancy objects that this summary finding satisfies the Commission's substantive obligation under FPA section 10(a) to ensure the project is best adapted, or its general obligation to articulate the basis for its findings under Administrative Procedures Act sections 557 and 706(2)(A).[73]

Further, this finding is not supported by substantial evidence in the record, as required by FPA section 313(b). In its comments on the DEIS, the Conservancy submitted evidence that the Staff Alternative for the Conowingo Project was inconsistent with several applicable comprehensive plans. The FEIS does not resolve the inconsistencies identified by the Conservancy.

The FEIS rejects the Conservancy's request that OEP consider the 2010 Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus, and Sediment (Bay TMDL) as a comprehensive plan under FPA section 10(a)(2).[74] It states: "[b]ecause the Bay TMDL was not filed by a state or federal agency that has comprehensive plan authority in the state where the project is located, it could not be considered for addition to the Commission's list of comprehensive plans."[75] OEP cites 18 C.F.R. section 2.19 in support.[76] However, there is no requirement in Section 2.19 that the plan be filed by the agency that prepared it or by another agency with concurrent jurisdiction over the affected resource.[77] The Conservancy objects to OEP's rejection of the plan on this basis. As stated in the Conservancy's DEIS Comments, the Bay TMDL meets all the criteria identified in Section 2.19 for a plan to be considered under FPA

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71 16 U.S.C. § 803(a)(2).

72 FEIS, p. 441.

73 5 U.S.C. §§ 557, 706(2)(A).

74 *Id.* at H-8.

75 *Id.*

76 *Id.*

77 18 C.F.R. § 2.19.

section 10(a)(2). The Conservancy requests that the Bay TMDL be added to the list of plans the Commission will consider under FPA section 10(a)(2).

CONCLUSION

The Nature Conservancy respectfully requests that the OEP address these comments in a supplement to the FEIS prior to issuing the new license.

Dated: April 16, 2015

Respectfully submitted,

Richard Roos-Collins
Julie Gantenbein
Water and Power Law Group PC
2140 Shattuck Ave., Ste. 801
Berkeley, CA 94704
510-296-5588
rrcollins@waterpowerlaw.com
jgantenbein@waterpowerlaw.com

Mark Bryer
Director, Chesapeake Bay Program
The Nature Conservancy
5410 Grosvenor Lane, Suite 100
Bethesda, MD 20814
301-897-8570
mbryer@tnc.org

Tara Moberg
Freshwater Scientist
The Nature Conservancy
2101 N Front Street, Building 1
Harrisburg, PA 17102
717-232-6001 ext. 229
tmoberg@tnc.org

DECLARATION OF SERVICE

Exelon Generation Company, LLC's Conowingo (P-405) and Muddy Run Hydroelectric Projects (P-2355) and York Haven Power Company, LLC's York Haven Hydroelectric Project (P-1888)

I, Jessica Mangaccat, declare that I today served the attached "The Nature Conservancy's Comments On Final Multi-Project Environmental Impact Statement For Hydropower Licenses, Susquehanna River Hydroelectric Projects" by electronic mail, or by first-class mail if no e-mail address is provided, to each person on the official service list compiled by the Secretary in this proceeding.

Dated: April 16, 2015

By: 

Jessica Mangaccat
WATER AND POWER LAW GROUP PC
2140 Shattuck Ave., Suite 801
Berkeley, CA 94704-1229
Phone: 510- 296-5590
Fax: 866-407-8073
jmangaccat@waterpowerlaw.com

Attachment 4

Attachment 1

SECOND EXPERT REPORT OF DR. CLAIR B. STALNAKER

1. I, Clair B. Stalnaker, Ph.D., provide this expert report on behalf of The Nature Conservancy (TNC) in the concurrent relicensings of Exelon Corporation's Muddy Run Pumped Storage and Conowingo Hydroelectric Projects and York Haven's York Haven Project before the Federal Energy Regulatory Commission (FERC). Upon reviewing the "Final Multi-Project Environmental Impact Statement for Hydropower Licenses" (FEIS), prepared by the Federal Energy Regulatory Commission, Office of Energy Projects (OEP) (Mar. 2015), I provide the following comments to supplement my First Expert Report.[1]

2. Unfortunately the FEIS ignores my recommendations for analyses based on stratification of water supply conditions and simulation of time series of flow records covering historical Project operations. The analyses offered by Exelon and FERC are based exclusively on statistics from the hydrological record. These statistical averages are translated into physical habitat values for various aquatic species of interest followed by attempts to select a series of "minimum flows" as a percentage of the maximum weighted usable area (MWUA) obtained from the flow/habitat relationships. These values are calculated from flow statistics representing average flows from across the entire hydrological record and, therefore, **have no biological meaning**. These flow patterns never actually occur during any one year and certainly did not occur every year over the many years of Project operations.

3. The following quotes from Annear et al. (2004) highlight the improper (or, at a minimum, ecologically illogical) use of similar constructed "minimum flows."

> Practitioners should not simply prescribe a minimum instream flow standard by recommending the maximum habitat value from the weighted usable area/discharge graph for a single life stage of a single species. Doing so can result in unrealistic recommendations that damage the credibility of the entire study and the study team.

They go on to say,

> Practitioners who prescribe single, minimum flow values by examining the flow/habitat or flow/temperature relation (e.g., output from PHABSIM or SINTEMP) and present the results as an IFIM analysis are misusing the methodology and fueling the controversy regarding the appropriate tools.

4. The modern approach to the use of physical habitat analyses when comparing alternative operating schedules starts by developing "habitat time series" for the aquatic organisms of interest. This starts with the time series of the hydrological record over the entire period of Project operations **and therefore reflects the actual flow patterns across seasons and years**. This hydrological record is then translated into physical habitat values as the modeled representation of the actual quality and quantity of habitat that may have occurred during the seasons, months, and days within each year of operation. Observation of this modeled

[1] eLibrary no. 20150206-5219.

habitat time series will reveal that different obligate riverine species thrive under very different water supply conditions. This is typical (and expected) for streams having numerous aquatic species, such as the Susquehanna River.

5. Aquatic ecologists would expect some species to thrive under higher physical habitat values during high water years, others to thrive under higher habitat values that occur only during low water years, and still others to have higher habitat values during years of more normal water supply conditions. Furthermore, the more "generalist" species seem to do well across all water year conditions (*e.g.*, high habitat values are present across a wide range of flows found during most all water years), save the most extreme drought and century level or greater floods.

6. This issue has been recognized by OEP in the FEIS section *Alternative Flow Regime*:

> Our analysis of Exelon's instream flow study indicates that several combinations of minimum and maximum flows may improve habitat for some species and life stages, but those flow combinations are not consistent among the evaluation species. Certain flows may improve habitat for some species and life stages, while those same flows would reduce habitat for other species and life stages.[2]

7. The FEIS further states that some species may benefit from a certain flow, while others may not:

> Because the project (or any hydroelectric project) typically provides only one minimum flow on any given day (although the minimum flow may be varied over the season, as now occurs), some species or life stages may benefit from a specific minimum flow, while others may not benefit from the same flow.[3]

As explained below, these statements support the need for the analyses I am recommending to more accurately predict suitable habitat under the range of flows being evaluated.

8. Rapid, frequent, and large magnitude changes in streamflow are common below peaking hydro projects resulting in corresponding rapid changes in available suitable stream habitats (Hughes, R.M., et al. 2005; Young et al., 2011; Cushman, 1985). Such changes are extreme below Conowingo Dam, both in the magnitude of difference between the base flow and peaking flows of the peaking cycle as well as in the up and down rates of change.

9. I stress again that the ratio of unusable to usable habitat (suitable) area under the wetted surface of the river often becomes quite large (ranging from 10/1 to 100/1) during the hydro-peaking cycle and this can be a major limitation for less mobile aquatic organisms, nest

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[2] FEIS, p. 152.

[3] *Id.*, p. 156.

builders and young-of-year. This is discussed in my First Expert Report under section C, "Dual Flow Analyses."

10. Dual flow analysis tracks each small area (termed the habitat cell as simulated from field measurements) throughout each peaking cycle from the base flow to the power peak and quantifies the amount of usable area that persists throughout. This is quite different from simply comparing the averaged usable habitat in a reach that is available at the base flow and at the power peak flow (and further assuming that the difference is the amount that remains usable over the cycle). A limitation of latter approach, is that it can lose sight of the fact that, in complex channels, individual cells can exhibit quite different degrees of usability and even become unusable within the hydro-peaking cycle while showing usability at the two end points.

11. With this limitation in mind, the information in the dual flow tables in Appendix G still provides a more scientifically defensible estimate of habitat availability for immobile life stages below a hydro-peaking facility than simply picking a point on the Weighted Usable Area vs. flow habitat curves. These curves do not account for temporal or spatial usability over recent flow history. These flow/habitat functions are initially used as **input** for developing habitat time series for each species, life stage and guild of interest. Only by examining these habitat time series (independently for each species and guild) can aquatic ecologists determine how the present Project flow releases may have influenced successful life history events. Based on this examination of the reconstructed recent history of habitat usability, the flow patterns that have produced habitat conditions assumed to lead to high success, as well as those leading to depressed or entirely unusable conditions, can be documented for each species and guild.

12. An important scientific point must be made: **defining the base flow upon which power peaking takes place as the daily or hourly average flow is biologically invalid**. Consequently, any flow release schedule intended to provide ecological enhancement below a peaking facility must identify **instantaneous base flows** and the up and down ramping rates. In order to maintain biological integrity across multiple species there should be different rules for seasons within years and for different water supply conditions (wet, normal, dry). These analyses allow for different flow schedules to enhance conditions for **all** species of interest. Contrary to the FEIS's recommendation, there is no single flow schedule that will be good for all species. The analyses summarized above illustrate the fallacy of using averages to represent time dependent events. Thus new flow release schedules should provide for the sub-daily, intra- and inter-annual range of variability that is essential for maintaining healthy aquatic communities.

13. It is important to realize that only after the conversion of actual flow patterns into habitat time series values representing different water supply conditions can the analyst **begin** to compare habitat conditions and develop alternative flow schedules as is required for modern impact analyses.

14. Only after stratifying the hydrologic and corresponding habitat time series into representative years of differing water supply conditions is statistical summarization for comparing alternatives appropriate. This is highlighted in my First Expert Report, *see* ¶¶ 12, 14

under section B, "Representative Years." **Statistics are for summarizing findings after thorough analyses and not as a means for summarizing the flow history prior to habitat analyses!**

15. The Instream Flow Study Report, Appendix G indicates that all of the data necessary for the habitat time series based analyses requested here are indeed available. State-of-the-art data collection using River 2D hydraulic modeling for habitat descriptions provides the data necessary for translating hydrological time series to habitat time series. Only additional analyses of the data are required.

16. The continuation of decision-making based on flow statistics and searching for "minimum flows" (by observing flow/habitat relations generated from average flow conditions) is outdated and ecologically unsound. Such decision-making represents late 1970's and early 1980's "minimum flow" approaches, a time when obtaining any continuous flow in excess of leakage below large reservoirs was considered progress. The goal then was often to avoid extinction by providing a "minimum flow" that would sustain a minimalist aquatic community and avoid extinction of species. These analytical approaches do **not** represent the modern state-of-the-art science or management practice. Decision-making based on such approaches may not enhance or sustain a complex aquatic community in the Susquehanna River. The passage of environmental statutes like the National Environmental Policy Act requires decision-making based on detailed comparative analyses and balancing of competing water uses.

17. The Instream Flow Incremental Method (IFIM) was specifically developed and designed for modern Environmental Impact Studies and guidance documents. The Fish and Wildlife Service provided training at the specific request of FERC management, and numerous FERC staff attended IFIM training during the late 1980's and 1990's.

18. The scientific and commonly accepted ecological view of relicensing is to provide some level of enhancement for downstream aquatic communities that have been suppressed by decades of project operation under existing licenses issued decades ago. Restoration to pristine conditions is not expected **but** some significant and quantitative level of enhancements for the aquatic communities found below FERC licensed Projects is now the expected social norm. Projects that have operated for maximum profits over decades at the expense of obligate aquatic species should no longer be the norm. Reasonable profits (that may approach levels achieved under previous licenses) must be balanced with enhanced downstream biological goals. This is critical for threatened and endangered species.

RECOMMENDATIONS

19. I make the following recommendations consistent with those in my First Expert Report:

(a) Complete habitat time series based analyses with stratification of water supply into wet, normal and dry representative conditions using historical Project operations. Consider these time series as the Project hydrological baseline. Convert these time series to habitat time series.[4]

(b) Compare habitats provided by alternative flow regimes proposed by Exelon and the agency-NGO stakeholders (including TNC). Summarize comparisons by wet, normal and dry representative water year conditions (how much deviation from Project habitat baselines do each provide?).

(c) Based on these new analyses design **new** flow schedules that are unique to each water supply condition along with operational rules by which flow releases switch from one set of schedules to another once the dry or wet water supply condition is determined to significantly differ from normal water supply conditions. This will include three sets of flow schedules (wet, normal and dry) ensuring that both intra- and inter-annual flow and habitat variability is maintained.

(d) Design i**nstantaneous** reservoir release base flow levels for peaking that are unique to seasons within wet, normal and dry water supply conditions. Base flows and peaking flows should be based on actual conditions as simulated for stratified water supply conditions and **not** from averages computed over the entire Project historical flow records.

(e) Strive to design flow schedules that prove some quantitative level of enhancement over baseline habitat values for **all** species and life stages seasonally present. The natural resource agencies' and TNC's goals are to attain a significant level of habitat improvement over existing Project operations.

(f) Ensure that the new licensed releases will provide at least the same quantitative habitat level (habitat maintenance) and some increases (enhancements) to seasonal habitats within representative water supply conditions when compared with simulated historical time series. As Federal stewards of the "water commons" and accompanying aquatic resource, the modern charge to FERC, is

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4 To be more specific, this recommendation would include the following tasks:

(1) Construct time series analyses starting with actual flows released during the time period of the current license. Transform this hydrological record into a habitat time series. These two time series are the baseline conditions for the period of Project operation during the existing license.

(2) Stratify the hydrological record into representations of wet, normal and dry water supply conditions by assigning each hydrological year to one of the strata. Replace this set of annual flow records with their habitat equivalents. This creates three sets (wet, normal and dry) of simulated seasonal habitat values representing the intra-annual variability for habitats for all of the species and guilds of interest. The three strata represent the inter-annual variability. At this point the annual habitat values within each strata may be averaged (daily or weekly averages) if they appear similar, or single water year habitat graphs may be selected to represent the strata when similar. Each species or guild would likely require different decisions (averages or representative years).

achieving a balance among Project objectives and natural resource enhancements. Maintaining habitats at present Project operation levels represents a minimalist approach and does not demonstrate achieving a balance toward environmental enhancements during the new licensing process.

(g) After investigating the historical habitat levels provided via Project operations, FERC should prepare recommendations that provide for feasible levels of Project profits **while also providing** some quantified level of physical habitat enhancements for downstream aquatic species and guilds. To be ecologically meaningful the Project release schedules approved in the new license must be **instantaneous** flows and **not** simply daily averages.

Dated: April 17, 2015

Clair B Stalnaker

Dr. Clair B. Stalnaker

References

Annear, T. et al. 2004. Instream Flows for Riverine Resource Stewardship, revised edition. Instream Flow Council, Cheyenne, Wyoming. 267 pages.

Cushman, P.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. N. Am. J. Fish. Mgt. 5:330-339.

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Young, P.S., J.J. Cech, and L.C. Thompson. 2011. Hydropower-related pulsed-flow impacts on stream fishes: a brief review, conceptual model, knowledge gaps, and research needs. Reviews in Fish Biology and Fisheries.21:713-731.

Document Content(s)

Attachment 4

Exhibit B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

SEP 29 2014

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room 1A
Washington, DC 20426

Subject: Draft Environmental Impact Statement for the York Haven, Muddy Run, Conowingo Projects, Pennsylvania and Maryland, July 2014, (Project Nos. 1888-030, 2355-018, 405-106), CEQ# 20140212

Dear Secretary Bose:

In accordance with Section 102(2) (c) of the National Environmental Policy Act (NEPA), 42 U.S.C. § 4332(2) (c), Section 309 of the Clean Air Act, 42 U.S.C. § 7609, and the Council on Environmental Quality (CEQ) regulations, 40 CFR Parts 1500-1508, the United States Environmental Protection Agency (EPA), has reviewed the Draft Environmental Impact Statement (EIS) for the above-referenced projects and is providing the enclosed comments.

As you are aware, the Draft EIS is for the Federal Energy Regulatory Commission (FERC) relicensing of the three hydroelectric projects located on the lower Susquehanna River (collectively referred to as the Susquehanna River Projects). These projects are: the York Haven Hydroelectric Project, the Muddy Run Pumped Storage Project and the Conowingo Hydroelectric Project (Conowingo). The York Haven Hydroelectric Project, located in the city of York, in York, Dauphin, and Lancaster Counties, Pennsylvania, is owned and operated by the York Haven Power company. The Muddy Run Pumped Storage Project in located in Lancaster and York Counties, Pennsylvania and the Conowingo Hydroelectric Project is located in Cecil and Harford Counties, Maryland; both are owned and operated by Exelon.

The alternatives analyzed in the Draft EIS included:

- The No-Action alternative – all the projects (York Haven, Muddy Run and the Conowingo) would continue to operate under the terms and conditions of the existing licenses, and no new environmental protection, mitigation, or environmental measures would be implemented;

- Applicant's Proposals – the applicant has proposed a number of operational and environmental measures related to the enhancement of fish passage. Noted measures include: for the York Haven Project, the construction of a nature-like fishway and the incorporation of the resource agencies' settlement agreement; and for Conowingo Project, the construction of an eel trap and transport facility on the west side of the tailrace and a similar facility on the east side of the tailrace or in the Octoraro Creek; and

- Staff Alternative (the Preferred Alternative) – the Susquehanna River Projects would include most of the Applicant's Proposals and would also provide for enhancements to recreational, cultural and ecological management plans.

Since 1927, the Susquehanna River Projects have benefitted the area by providing renewable, zero carbon emission hydroelectric power. In addition, the Conowingo Dam has long trapped and stored sediment and associated nutrients within the reservoir behind the Dam, effectively preventing some of these pollutants from entering into the Chesapeake Bay. However, the US Army Corps of Engineers recently conducted the Lower Susquehanna River Watershed Assessment (LSRWA), in coordination the Maryland Department of the Environment, the Susquehanna River Basin Commission and The Nature Conservancy, which is a comprehensive study to fully assess sediment and nutrient flow in the Susquehanna River. The draft LSRWA analyzes the role of the Conowingo Dam as well as the other three dams on the lower Susquehanna River in storing sediment and nutrients. The draft LSRWA further provides analysis and estimated cost ranges for management options to address the accumulation of sediment and nutrients. The draft LSRWA found that the Conowingo Dam has reached effective trapping and long-term storage capacity and that the resultant increases in nitrogen and phosphorus pollutant loads entering the Chesapeake Bay are affecting the health of the Bay ecosystem.

While the Susquehanna River Projects have provided renewable energy to the area, they are not without environmental consequences. The Susquehanna River Projects have significantly altered the aquatic ecology both upstream and downstream of the facilities. Those impacts include conversion from a lotic aquatic ecosystem to a lentic ecosystem, barriers to migratory fish passage, and restriction of the natural sediment and nutrient transport. As a result, the water quality and habitat management of the Chesapeake Bay watershed has evolved to take into account these changes to the river system.

As discussed in EPA's August 6, 2013 letter, the trapping capacity of nutrients and sediment by the Conowingo Dam (along with the York Haven, Safe Harbor and Holtwood Dams) is a significant factor in the delivery of those pollutants to the Chesapeake Bay, which EPA considered in the development of the Bay Total Maximum Daily Load (TMDL). EPA set forth its analysis, the data supporting its conclusions, and assumptions of storage capacity in Section 10.6 (pages 10-7 to 10-8 of the TMDL) and Appendix T to the Bay TMDL, which were attached to the August letter. Because the storage capacity of the Conowingo Dam pond has been reached, new contributions of sediment and associated other pollutants migrating downstream, as well as the sediment scoured from behind the dam, jeopardize attainment of the water quality standards for the Bay. The operators of the Susquehanna River Projects along with other stakeholders in the watershed share responsibility in addressing this issue.

EPA has determined that the Draft EIS does not consider important information such as that provided in the LSWRA and does not identify significant environmental impacts that should be avoided in order to adequately protect the environment. Needed corrective measures, which are not documented within the Draft EIS, may require substantial changes to the preferred alternative or consideration of some other project alternatives. As you know, section 4(e) of the Federal Power Act requires that FERC "shall give equal consideration to the purposes of energy conservation, the protection, mitigation of damage 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." (16 U.S.C. § 797(e)). Unfortunately, the Draft EIS does not seem to provide that equal consideration and address important environmental concerns. Below is a summary of the information not considered and the potential significant impacts, with further details included in the enclosed comments:

- The Draft EIS does not assess current literature for the Susquehanna River system. The evaluation of sediment storage capacity is based on outdated data and should include or address new findings from the LSWRA. Current TMDL assessment data, including for PCBs, flow, and wildlife passage, should be incorporated in the analysis for decision-making.

- The project study area is overly limited (from Harrisburg to the mouth of the Susquehanna River at Havre de Grace, MD); as a result, the Draft EIS does not consider adverse water quality and aquatic life impacts to the greater tidal Chesapeake Bay. Acknowledgement and assessment of these impacts are needed in order to consider the range of options available to address water quality and ecosystem restoration.

- The endangered species management plan, flow management plan, and adaptive management plan as they apply to fish passage should be given stronger weight in the draft EIS to be consistent with the equal consideration provision of the Federal Power Act, Section 4(e). EPA suggests that the recommendations of the US Fish and Wildlife Service and the PA Fish and Boat Commission be included as license conditions, as these commitments and activities are critical to maintaining or restoring ecosystems impacted by the hydropower facilities.

- The Draft EIS does not consider the effects of PCB impairment in the Conowingo Pool and the effect of those PCBs on water quality and natural resources in the Susquehanna River and the Chesapeake Bay.

- The Draft EIS does not consider the effects of climate change on the Susquehanna River and Chesapeake Bay over the course of the decades-long license for the Susquehanna River Projects.

EPA has developed a set of criteria for evaluating and rating Draft Environmental Impact Statements. This rating system provides a basis upon which EPA makes recommendations to the lead agency. EPA's rating system consists of a two-part alphanumeric evaluation. The alpha criterion evaluates the environmental impact of the proposed action. The numeric criterion evaluates the adequacy of the Draft EIS. Based on this rating system, EPA has rated the Draft EIS for the Susquehanna River Projects as an Environmental Objections 2 (EO-2). The EO rating means the review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternatives. The 2 rating indicates that the Draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment. A copy of our rating system is enclosed, and can also be found at: http://www.epa.gov/compliance/nepa/comments/ratings.html. The basis for the EPA rating of an EO-2 is reflected in the enclosed comments.

Detailed comments and recommendations to improve the analysis in the EIS and options to include in the preferred alternative are presented in the technical enclosure. EPA suggests that the additional information needs to be assessed to allow for decision making for the re-licensing of the Susquehanna River Projects.

EPA appreciates the opportunity to provide comments on these important and environmentally significant projects. We would like to schedule a meeting to discuss our comments and concerns with you, and ask that FERC fully consider our comments and provide additional documentation and additional recommended measures in the Final Environmental Impact Statement. If you have any questions, please contact me at 215-814-2702 or have your staff contact Kevin Magerr at (215) 814-5724.

Sincerely,

John R. Pomponio, Director
Environmental Assessment and Innovation Division

Enclosures

Enclosure

EPA Technical Comments on the Draft EIS for the York Haven, Muddy Run, and Conowingo Projects, July 2014 (Project Nos. 1888-030, 2355-018, 405-106) CEQ# 20140212

EPA has determined that FERC's Draft EIS for the relicensing of the York Haven, Muddy Run, and Conowingo Dams (collectively referred to herein as the Susquehanna River Projects) does not consider important information such as the draft Lower Susquehanna River Watershed Assessment (LSRWA) conducted by the US Army Corps of Engineers in coordination the Maryland Department of the Environment, the Susquehanna River Basin Commission and The Nature Conservancy, which is a comprehensive study to fully assess the role of the Susquehanna River Projects in storing sediment and nutrients. The Draft EIS also does not identify significant environmental impacts that should be avoided in order to adequately protect the environment and meet water quality standards. Needed corrective measures, which are not documented within the Draft EIS, may require substantial changes to the preferred alternative or consideration of some other project alternatives. This enclosure provides a detailed description of the information and the potential significant impacts that were not considered in the Draft EIS.

1. The geographic scope of the analysis for the EIS is insufficient and needs to be expanded in the Final EIS.

On page 59 under section 3.2.1 Geographic Scope, the Draft EIS text states that:

> "The geographic scope of the analysis defines the physical limits or boundaries of the proposed action's effects on the resources. Because the proposed action would affect resources differently, the geographic scope for each resource may vary. For the four identified resources, we identified the geographic scope as extending from Harrisburg, Pennsylvania, located upstream of the York Haven Project, downstream to the mouth of the Susquehanna River at Chesapeake Bay. We chose the above geographic bounds because the effects of proposed project operation and potential environmental measures on the identified resources, in combination with other activities in the basin, are limited to these areas."

This text does not reflect a consideration of the LSRWA which reports that the Susquehanna River Projects impact Chesapeake Bay tidal water quality down the length of the mainstem Chesapeake Bay's deep channel to just north of the mouth of the tidal Patuxent River and into the lower Chester Rivers and Eastern Bay. These tidal water quality impacts, assessed as increases in non-attainment of Maryland's water quality standards, are directly attributable to the presence and operation of the Conowingo facility. For further consideration By FERC, EPA will be providing a complete copy of the draft LSRWA report and supporting technical appendices in a separate letter.

EPA requests that FERC extend the geographic scope of the EIS to encompass the mainstem Chesapeake Bay, from where the tidal Susquehanna River enters the Susquehanna Flats down to just north of the mouth of the tidal Patuxent River as well as the lower Chester River and the

Eastern Bay. This geographic area is clearly and legally delineated with Maryland state water quality regulations by the follow set of Chesapeake Bay segments[1]:

- Northern Chesapeake Bay Segment (CB1TF)
- Upper Chesapeake Bay Segment (CB2OH)
- Upper Central Chesapeake Bay Segment (CB3MH)
- Middle Central Chesapeake Bay Segment (CB4MH)
- Lower Chester River Segment (CHSMH)
- Eastern Bay Segment (EASMH)

Due to its limited geographic scope, the Draft EIS is not adequate to fully assess the documented impacts on the Chesapeake Bay and applicable water quality standards.

EPA also notes that, even if FERC modifies the project boundary to remove many acres of land downstream from the Conowingo Dam, the flow of nutrients and sediment down to the Chesapeake Bay will continue regardless, and adverse water quality impacts from those pollutants still should be considered. The project boundary does not change the scientific and geomorphic effect of the Dam on downstream water quality, and does not change the extent of downstream impacts that should be considered in the EIS.

2. The EIS should reflect the current scientific understanding of the Conowingo Dam's trapping capacity and its impacts on Chesapeake Bay water quality.

The Draft EIS for the Susquehanna River Projects is based on old information regarding the sediment storage capacity of the Conowingo Dam and its reservoir. Although the Draft EIS recognizes the LSRWA's existence, it does not consider the LSRWA's findings. Significantly, the Draft EIS does not discuss or recognize the impacts that sediment and associated nutrients scoured from the reservoir behind the Conowingo Dam have on Chesapeake Bay water quality and aquatic life.

As an example, FERC's statement that "Conowingo Pond may be filled sometime between 2023 and 2038 and then would reach a state of dynamic equilibrium in which the net change in sedimentation (deposition during low flows and scour during floods) would remain relatively constant" (see page 68, second paragraph, second sentence) is based on previously reported findings that conflict with the more recent findings of the LSRWA. In our August 6, 2013 letter to FERC in response to FERC's notice of Ready for Environmental Analysis, EPA "strongly recommend[ed]" that FERC "include the results of the Corps study as part of the EIS under the National Environmental Policy Act.".

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[1] These segments are fully documented in the following US EPA publications: U.S. Environmental Protection Agency. 2004. *Chesapeake Bay Program Analytical Segmentation Scheme: Revisions, Decisions and Rationales 1983–2003.* EPA 903-R-04-008. CBP/TRS 268/04. U.S. Environmental Protection Agency, Region 3, Chesapeake Bay Program Office, Annapolis, MD; and USEPA (U.S. Environmental Protection Agency). 2005. *Chesapeake Bay Program Analytical Segmentation Scheme: Revisions, Decisions and Rationales 1983-2003. 2005 Addendum.* EPA 903-R-05-004. CBP/TRS 278-06. U.S. Environmental Protection Agency, Region 3 Chesapeake Bay Program Office, Annapolis, MD.

FERC should revise the analysis presented in the Draft EIS to reflect the findings from the LSRWA, which reflects years of intensive assessments, model simulations, options analyses, and more. Further, FERC should evaluate and incorporate new research, replacing the now outdated cited references (e.g., Langland, 2009) with more recent scientific understandings documented in the LSRWA. Although EPA recognizes that this will require significant revisions to the EIS, it is critical to do so in order to adequately consider the environmental effects of the potential relicensing of the Susquehanna River Projects.

3. FERC should consider mitigation of the Conowingo Dam and Reservoir's contribution to Chesapeake Bay water quality impacts within the Final EIS and Re-licensing.

The LSRWA provides extensive documentation demonstrating the direct connection between the presence and operation of the Conowingo facility, and increases in sediment and associated nutrient pollutant loads to the Chesapeake Bay during storm flow events. EPA requests that FERC reconsider the statement "We find no justification at this time for requiring Exelon to implement measures such as dredging to help control sediment and nutrient loading in the Bay, which would occur in the long term whether or not Conowingo dam was in place" found at the bottom of page 128 to reflect the more recent scientific understandings of the Conowingo Dam and reservoir system and its direct impacts on Chesapeake Bay water quality conditions.

EPA first notes, with approval, that FERC does seem to agree in this statement that sediment and nutrients from behind the Conowingo Dam do make their way to the Chesapeake Bay. However, FERC's point that such pollutant loads "would occur in the long term whether or not Conowingo Dam was in place" does not reflect the reality that for the past almost 90 years, the presence of the Conowingo Dam and reservoir and its, until recently, significant pollutant trapping and storage capacity, have profoundly influenced pollutant reduction choices and solutions. It is acknowledged that the presence of the Conowingo Dam has not precluded improvements to sediment and nutrient controls in the watershed, but water quality and ecosystem management decisions have been based on the existence of the dam with its wide-ranged influence on the Susquehanna system. Without creative management, the current and future condition of the Conowingo sediment pool will result in the facility's contribution to the increased loads of sediment and associated nutrient pollutants to the Chesapeake Bay. Therefore, it is appropriate for the Conowingo facility to be part of the long term solution.

EPA requests FERC to significantly revise the EIS to fully reflect the more recent, documented scientific understanding of the effect of the Conowingo Dam and reservoir on the increasing sediment and associated nutrient pollutant loads to the Chesapeake Bay. Further, EPA requests that FERC recognize the important role the Conowingo facility must now play as part of the long-term solution.

4. The Conowingo Dam Project should include a bog turtle management plan (Section 5.1.3.3, Conowingo Project, Measures Not Recommended).

FERC's rejection of the bog turtle management plan for the Conowingo Dam portion of the project recommended by the Department of the Interior (the US Fish and Wildlife Service (USFWS)) is unreasonable. According to the Draft EIS, FERC rejected that plan because, "although Interior states that bog turtles have been observed close to Conowingo dam and recommends a bog turtle management plan, it has yet to provide evidence to indicate that bog turtles are present within the Conowingo Project boundary, and Exelon states that there is no evidence of bog turtles in the project area. Thus, staff cannot presently determine if bog turtles would be affected by the Conowingo Project." Draft EIS at p. xxxviii; see also Draft EIS at pp. xxxv, 10-11). However, Excelon Corp's own document entitled: "Final Study Report – Study to identify potential habitat of Bog Turtle - RSP 3.9A – Muddy Run Pumped Storage Project. FERC Project Number 2355" (August 2012) stated that "Bog Turtle populations are also known to occur within 5 miles of the Conowingo Dam in adjoining Harford County, Maryland (Morrow et al. 2001)."

Further, as noted above, even if FERC modifies the project boundary to remove many acres of land downstream from the Conowingo Dam, the flow of nutrients and sediment down to the Chesapeake Bay will continue regardless, and these effects – including the effect on the bog turtles and their habitat – should be considered. It is not unreasonable for the facility to implement a bog turtle management plan. An adaptive management process can be used such that if the company completes surveys and documents a lack of habitat and bog turtle presentations then the bog turtle management plan can be revised.

5. The Conowingo Dam Project should include a flow management plan (Section 5.1.3.3, Conowingo Project, Measures Not Recommended).

The adoption by FERC of the flow management plan recommended by the USFWS would serve to address some environmental issues resulting from the Conowingo Dam's modification of flow regime. The Nature Conservancy (TNC) Flow Regime represents the state of the science on the subject of natural flow regimes on aquatic ecosystems and was developed as a cooperative project with state and federal agencies.

EPA strongly supports making the needed changes in flow management at the Conowingo Dam. The Susquehanna Flats and the upper Chesapeake Bay are extremely critical spawning and nursery grounds for a host of recreationally, commercially, and ecologically important fish species that are flow dependent for these important life stages.

6. The Conowingo Dam Project should include upstream fish passage as recommended by the U.S. Department of Interior and the Pennsylvania Fish and Boat Commission (PAFBC) (Section 5.1.3.2, Conowingo Project, Additional Measures Recommended by Staff for Conowingo, Upstream Fish Passage).

EPA supports the installation and operation of the adaptive management approach to upstream fish passage as recommended by the U.S. Department of the Interior and the Pennsylvania Fish and Boat Commission (PAFBC). The goal of the fish passage projects is to allow the successful passage of the American Shad, American Eel and other fish beyond the Conowingo Dam so that they can regain access to historic spawning streams that are currently blocked by the dam structures.

The PAFBC has recommended a reasonable adaptive management approach to determine if modification is required for the fish passage structures. The PAFBC is proposing a series of studies to determine if the American Shad (and other migratory fish) are able to successfully use the existing fish passage structures. EPA considers it reasonable to adopt the proposed PAFBC studies and other studies on evaluating the success of the fish passage structures and using the adaptive management approach to meet the goals. The Draft EIS should address shortcomings of the environmental goal of the successful passage of fish to their historic spawning grounds. The adaptive management process would allow the licensee and the resource agencies to find solutions to identified problems over the life of the license.

EPA recommends that FERC work with the natural resource agencies and Exelon to define successful fish passage and to determine when structural improvements are required at the facilities prior to the issuance of the Final Environmental Impact Statement.

The license under consideration would have an effective life as much 50 years. If the proposed fish passage improvements do not fulfill the goals of the fish passage structures then an alternative would require waiting upwards of 50 years for the next license renewal to address the potential shortcomings of successful fish passage goals. EPA recommends adopting PAFBC's recommendations.

7. EPA recommends adopting a modified version of the PAFBC's recommendation "to transport 1 million eels annually from 2015 to 2030 to sites above the Conowingo and York Haven dams until permanent volitional facilities are operating effectively".

FERC, the resource agencies and Exelon should define "operating effectively" prior to the issuance of the Final EIS. If acceptable numbers of eels and other migratory fish are not able to migrate above the Conowingo and York Haven dam structures then the license should contain provisions to address the issue. Rather than dismissing the recommendation of the PAFBC for transporting eels above the two facilities due to the potential unknown number of eels downstream of the dams, we believe that FERC should work with the resource agencies to require annual population surveys of the eels downstream of the dams and then require that an ecologically significant portion of the downstream population be transported above the dams on an annual basis.

8. The Conowingo Dam Project should include PAFBC's recommendation to reduce stranding of migratory fish (Section 5.1.3.3, Conowingo Project, Measures not Recommended).

EPA supports PAFBC's recommendation to reduce stranding of migratory fish by (1) extending the retaining wall at the east end of the east fish lift or adding boulder fill in that area to prevent generation flow from flooding the spillway pool at high levels of generation, or (2) dredging a channel(s) from the spillway pool area to downstream areas to provide egress for stranded fish. EPA suggests using an adaptive management approach and, if additional information develops over the life of the license timeframe to indicate that fish stranding is a problem, then structural or other appropriate changes should be implemented. The FERC license should provide a definition of unacceptable conditions of fish stranding at the facilities and should require periodic assessments of fish stranding conditions based on discussions with the resource agencies.

9. FERC should consider PCB impairment in the Conowingo Pool in the EIS.

PCB impairment in the Susquehanna River is an ongoing issue that should be considered in FERC's EIS for the Susquehanna River Projects. The State of Maryland listed the waters of the Lower Susquehanna River and the Conowingo Pool as impaired by PCBs in fish tissue in 2002 and 2008. Maryland began work on a PCB TMDL for the Lower Susquehanna River; that work showed that high reductions of PCB loadings would be required from the Conowingo Dam. To develop a PCB TMDL for the Conowingo Pool, more information and data is needed in order to determine if the sources of PCBs are from the bottom sediments of the Conowingo Pool or from upstream of the Conowingo Dam. Maryland has developed a monitoring program to characterize the PCBs in the Conowingo Pool, to determine the extent of the impairment, and to support the model for the PCB TMDL.

Since part of the Conowingo Pool watershed is in Pennsylvania, Maryland has reached out to Pennsylvania to conduct a comprehensive characterization of the Conowingo Pool. Pennsylvania's Draft 2014 303(d) list identifies the mainstem of the Susquehanna River as impaired for PCBs extending 128.07 miles from Sunbury, Pennsylvania at the confluence of the West Branch of the Susquehanna to the Maryland/Pennsylvania border. Maryland and Pennsylvania will work together to monitor PCBs in the Conowingo Pool. Although a complete characterization of PCBs in the Conowingo Pool has not been completed, current information shows that PCB contamination should be considered in future plans regarding the Conowingo Dam and Pool.

10. The Draft EIS should consider how climate change over the life of the license could modify the Susquehanna River Projects' effects on water quality and aquatic life resources.

Although the Draft EIS discusses the climatic and cultural history of the area affected by the Susquehanna River Projects going back to 12,000 B.C. (see Draft EIS at pp. 283-284), it makes no mention or consideration of the potential climatic changes over the course of the decades-long license. Such an omission is unreasonable; in fact, without considering the potential effects of climate change, there can be no assurance that FERC has included adequate measures for protection of threatened and endangered species, migration of fish and eels, recreational use of the water body, and protection of water quality standards (including those of Maryland and Virginia in the Chesapeake Bay mainstem). As noted in EPA's August 6, 2013 letter, the US Climate Change Science Program has found that climate change in the region may result in increased frequency and intensity of storm events further exasperating dam pool scour. (See Our Changing Planet, The U.S. Climate Change Science Program for Fiscal Year 2009, Highlights of Recent Research and Plans for FY 2009). EPA requests that FERC consider the effects of climate change on the Susquehanna River Projects before finalizing the EIS.

RATING THE ENVIRONMENTAL IMPACT OF THE ACTION

- **LO (Lack of Objections)** The review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposed action.
- **EC (Environmental Concerns)** The review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact.
- **EO (Environmental Objections)** The review has identified significant environmental impacts that should be avoided in order to adequately protect the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). The basis for environmental Objections can include situations:
    1. *Where an action might violate or be inconsistent with achievement or maintenance of a national environmental standard;*
    2. *Where the Federal agency violates its own substantive environmental requirements that relate to EPA's areas of jurisdiction or expertise;*
    3. *Where there is a violation of an EPA policy declaration;*
    4. *Where there are no applicable standards or where applicable standards will not be violated but there is potential for significant environmental degradation that could be corrected by project modification or other feasible alternatives; or*
    5. *Where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts.*
- **EU (Environmentally Unsatisfactory)** The review has identified adverse environmental impacts that are of sufficient magnitude that EPA believes the proposed action must not proceed as proposed. The basis for an environmentally unsatisfactory determination consists of identification of environmentally objectionable impacts as defined above and one or more of the following conditions:
    1. *The potential violation of or inconsistency with a national environmental standard is substantive and/or will occur on a long-term basis;*
    2. *There are no applicable standards but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or*
    3. *The potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or to environmental policies.*

RATING THE ADEQUACY OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

- **1 (Adequate)** The draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.
- **2 (Insufficient Information)** The draft EIS does not contain sufficient information to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the proposal. The identified additional information, data, analyses, or discussion should be included in the final EIS.
- **3 (Inadequate)** The draft EIS does not adequately assess the potentially significant environmental impacts of the proposal, or the reviewer has identified new, reasonably available, alternatives, that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant

environmental impacts. The identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. This rating indicates EPA's belief that the draft EIS does not meet the purposes of NEPA and/or the Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS.

Exhibit C

An Economic Analysis of the Conowingo Hydroelectric Generating Station

Prepared for: Water Power Law Group

Final: August 8th, 2017

Energy+Environmental Economics

An Economic Analysis of the Conowingo Hydroelectric Generating Station

Prepared for: Water Power Law Group

Final: August 8th, 2017

Energy and Environmental Economics, Inc.
101 Montgomery Street, Suite 1600
San Francisco, CA 94104
415.391.5100
www.ethree.com

This report is prepared by:

Kiran Chawla, Consultant

Nora Xu, Sr. Associate

Michele Chait, Director

Dr. Nancy Ryan, Partner

Table of Contents

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?

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

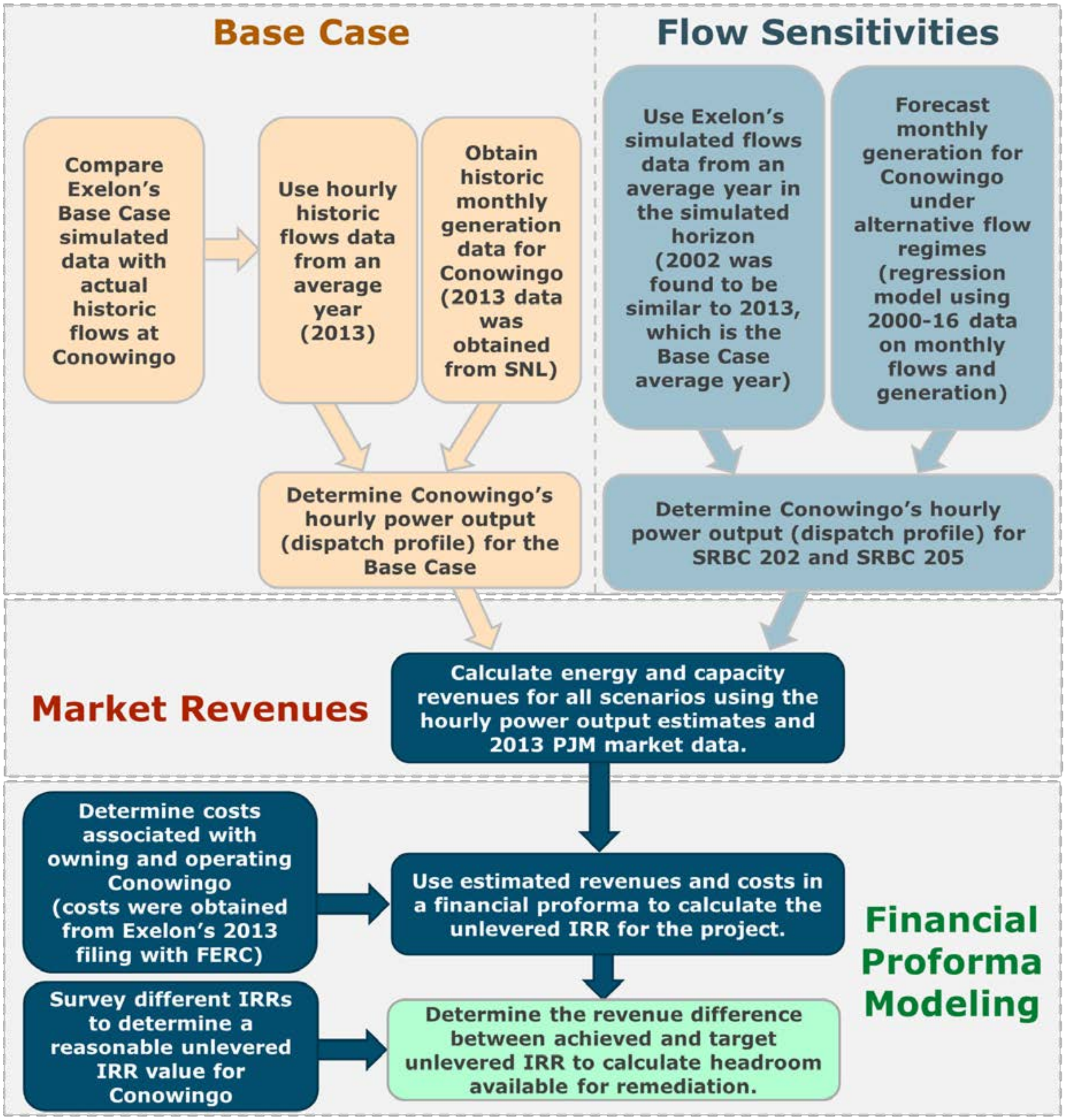
[2] PJM Interconnection is a regional transmission organization (RTO) responsible for maintaining wholesale electricity markets for energy, capacity and ancillary services in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee,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

- How much headroom is potentially available for mitigation efforts in the Susquehanna River and Chesapeake Bay?

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 - Hourly energy prices - 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.

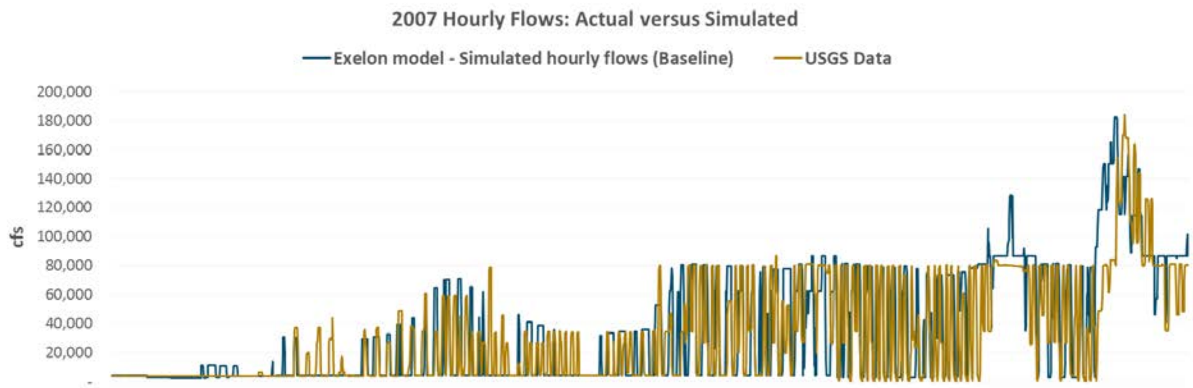
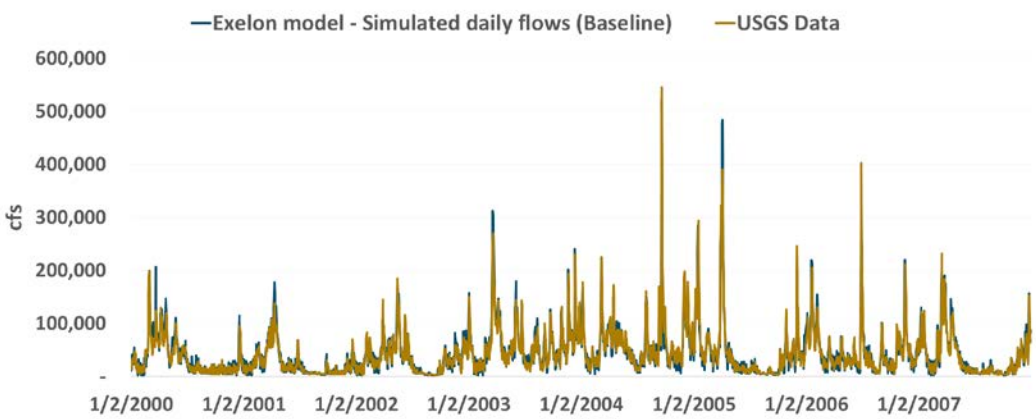


Figure 3: Benchmarking daily average Exelon and USGS flows at Conowingo – 2000 to 2007.

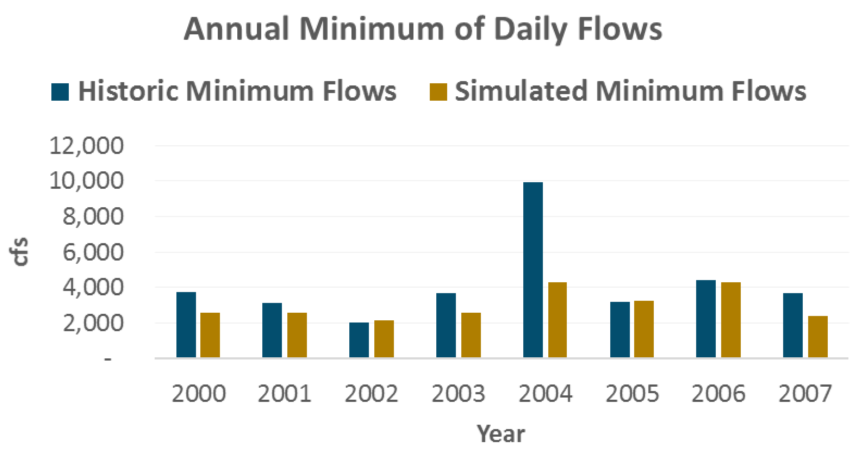


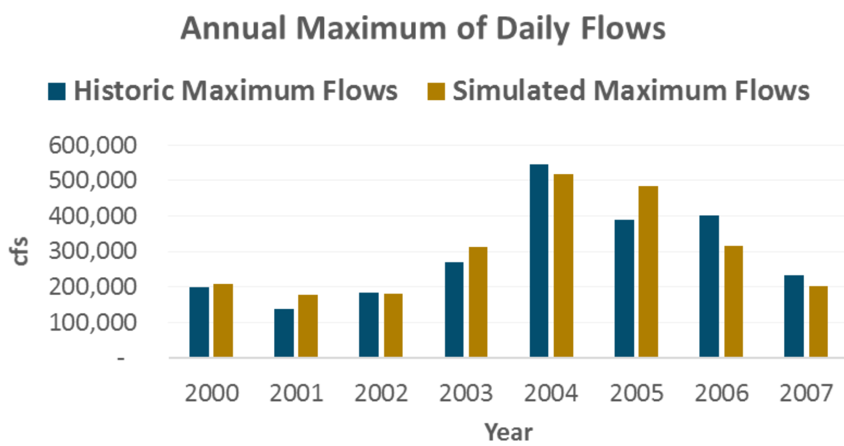
[6] Historical flows data was obtained from USGS: **https://waterdata.usgs.gov/usa/nwis/uv?01578310**

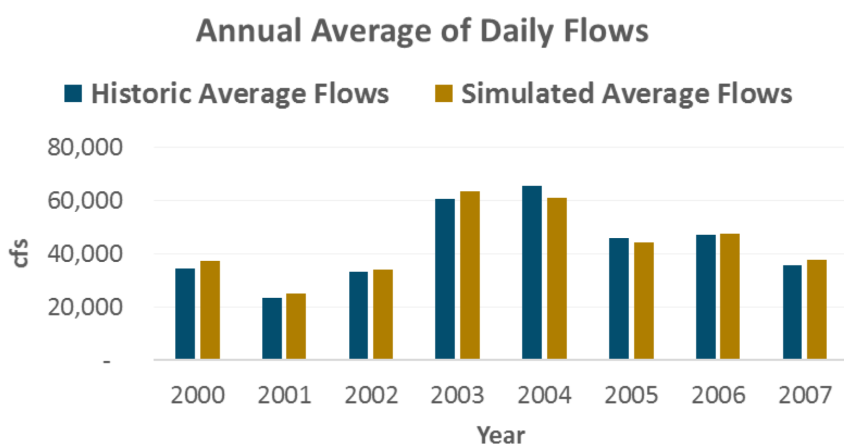
In addition to comparing the flows at the hourly time step, E3 also verified that the historical daily flows were similar to the Base Case daily flows simulated by Exelon. As seen in Figures 2 and 3, Exelon's simulated daily flows in the 2000-2007 timeframe match historically observed data from USGS.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

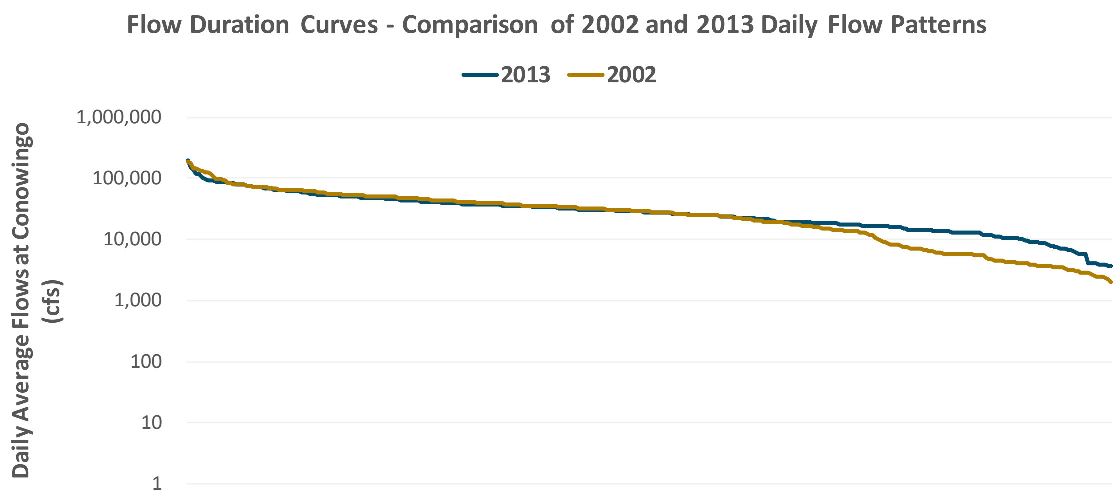


Figure 5 shows that the flows on the lower end are much lower in 2002 than in 2013. However, relative to the other years in the 1980 – 2007 sample, 2002 has mean, minimum, maximum as well as total cumulative flows closest to 2013, which is the Base Case year. All other years have cumulative annual flows, 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] Tara will add the reference to these datasets

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.

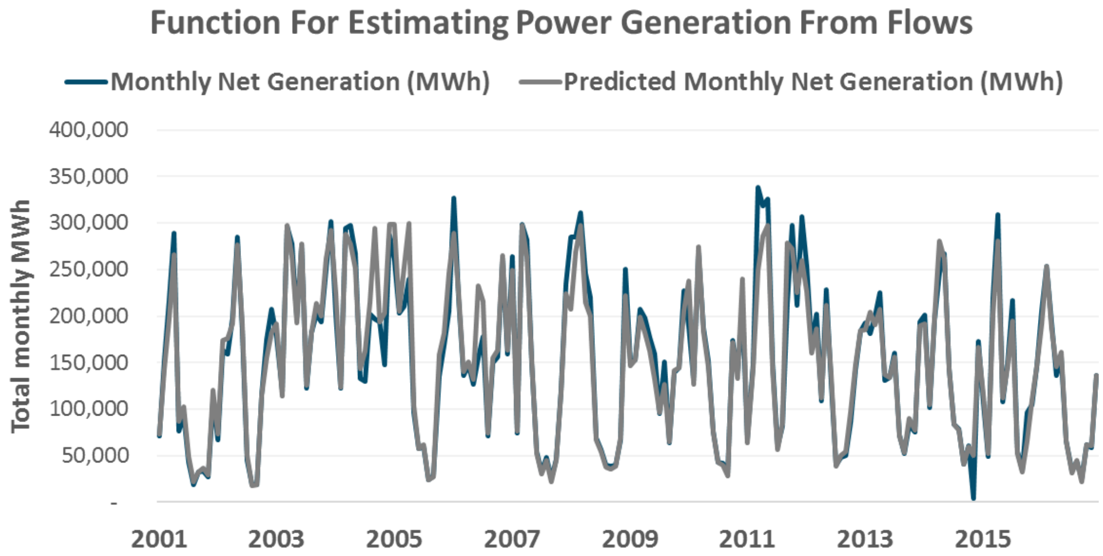
For some hours, using this allocation resulted in power generation that exceeded the project's nameplate capacity. For those hours, the generation was capped at the maximum power output of the project (nameplate capacity), and the difference between the estimated generation and maximum possible generation 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

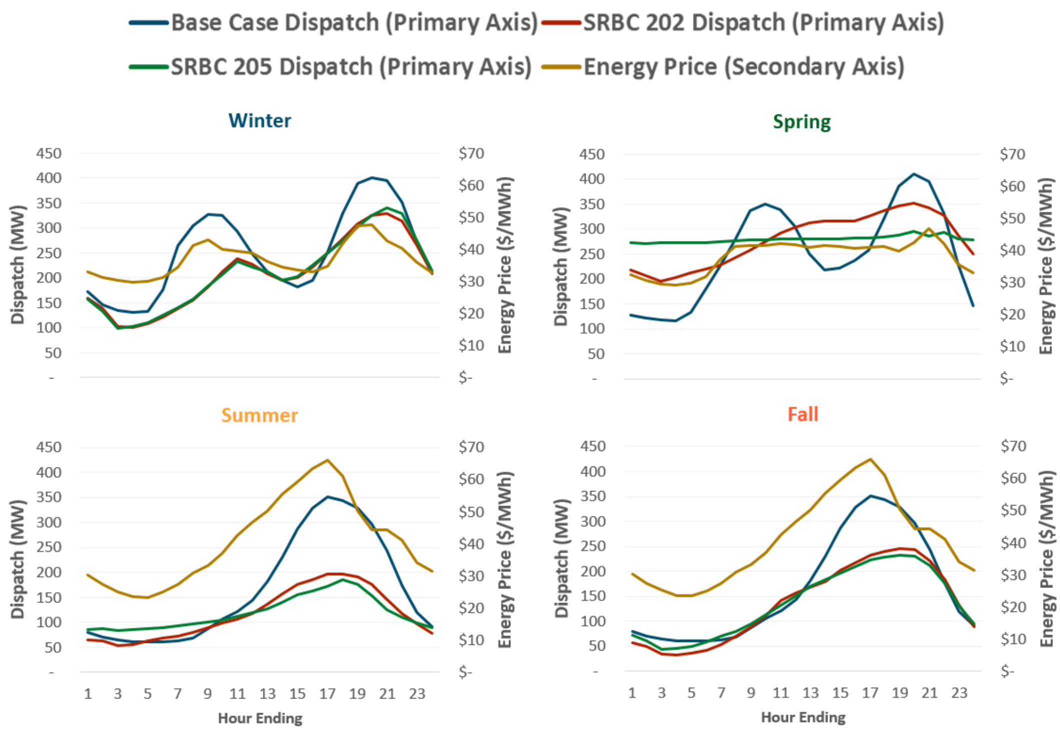
After calculating the annual headroom available for remediation by using the methodology described in section 2.2.5.1, E3 estimated the upfront capital available for remediation as the present value (10%) of the annual headroom stream for the 2008-55 period.

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

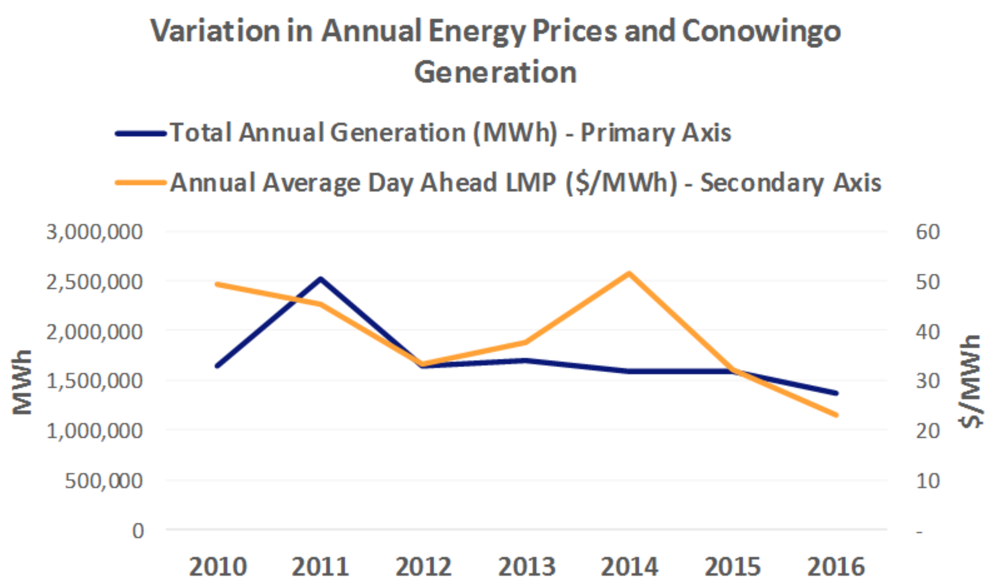
E3's estimates for the total revenues for Conowingo range between $115 million to $121 million depending on the operational scenario. For the Base Case, SRBC 202 and SRBC 205 regimes, E3's calculated revenues were higher than Exelon's model estimates. The difference in revenues primarily stems from the 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.

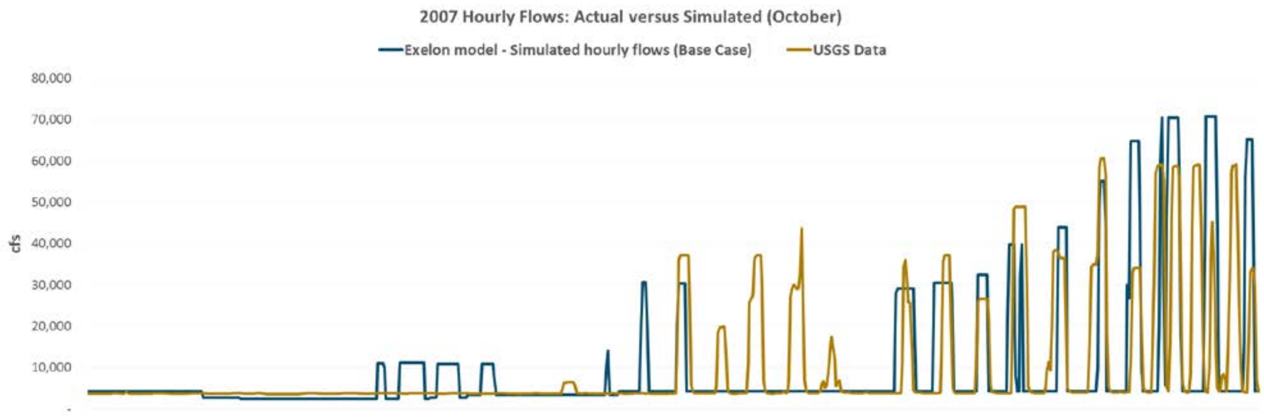


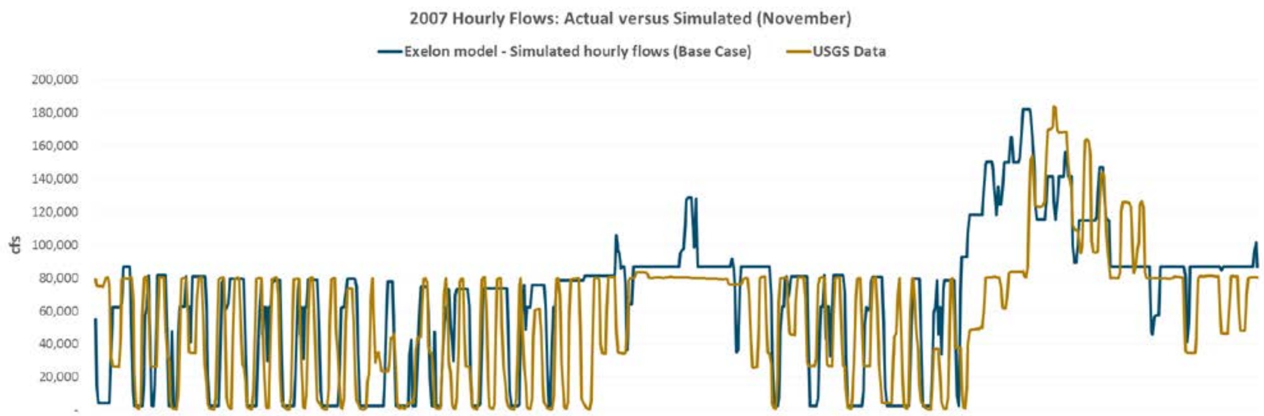
Further analysis would be needed to capture the impact of lower energy prices and changes in power generation on Conowingo's long term revenue forecasts.

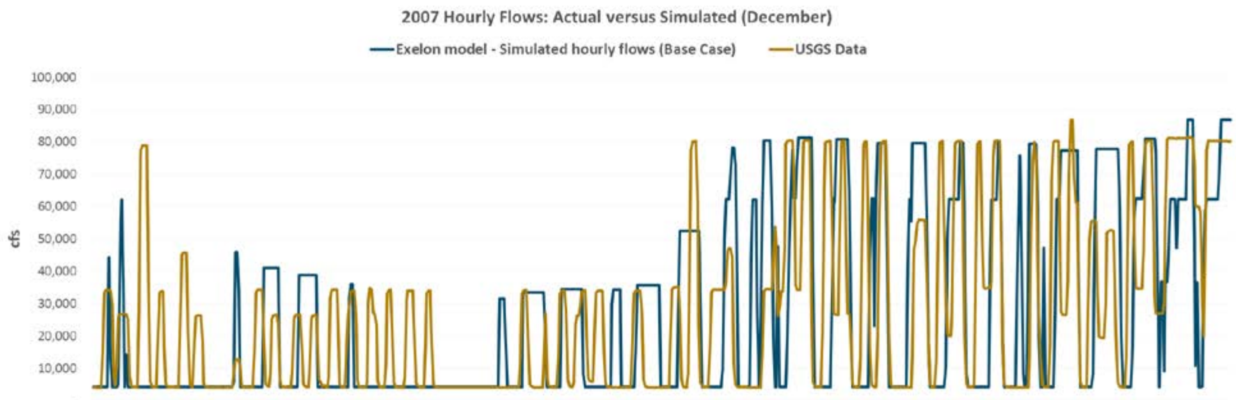
5 Appendix

5.1 Comparison of historic and simulated flows

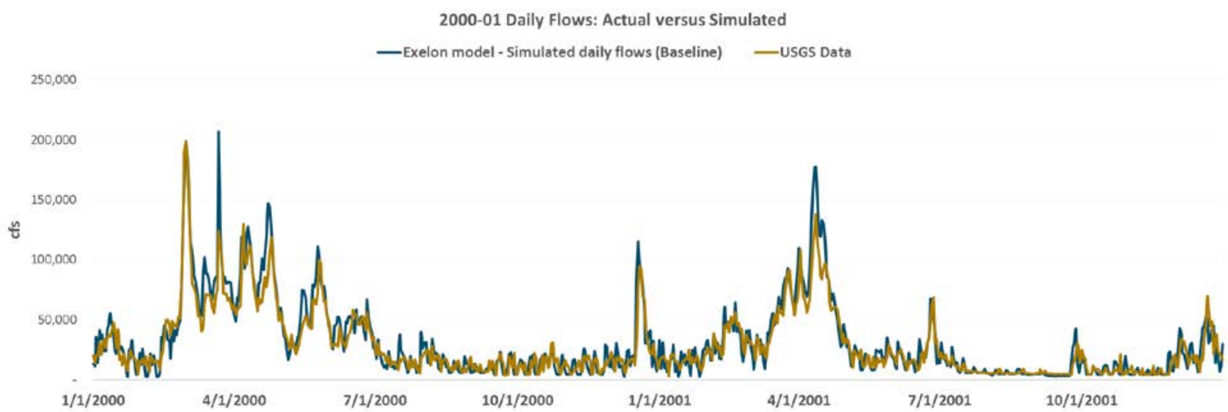
5.1.1 COMPARISON OF HOURLY FLOWS: OCTOBER 2007 – DECEMBER 2007

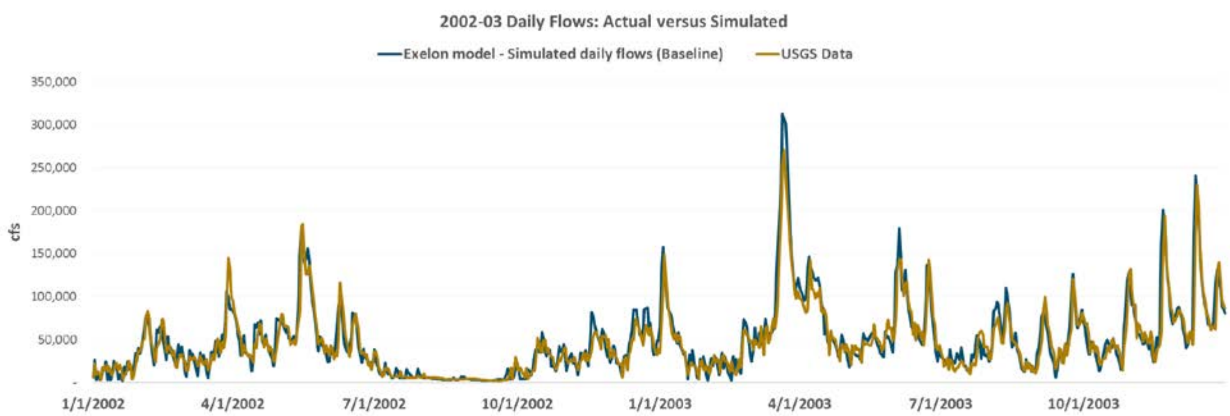


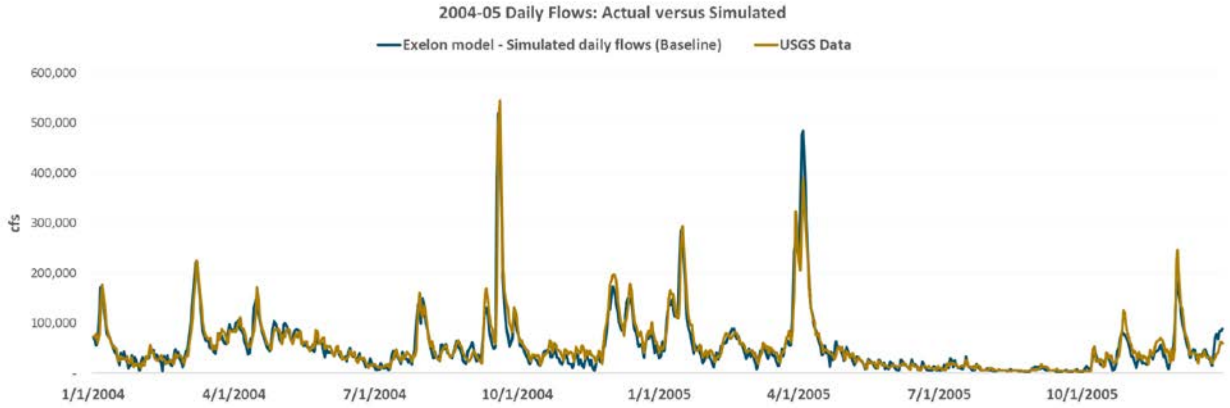


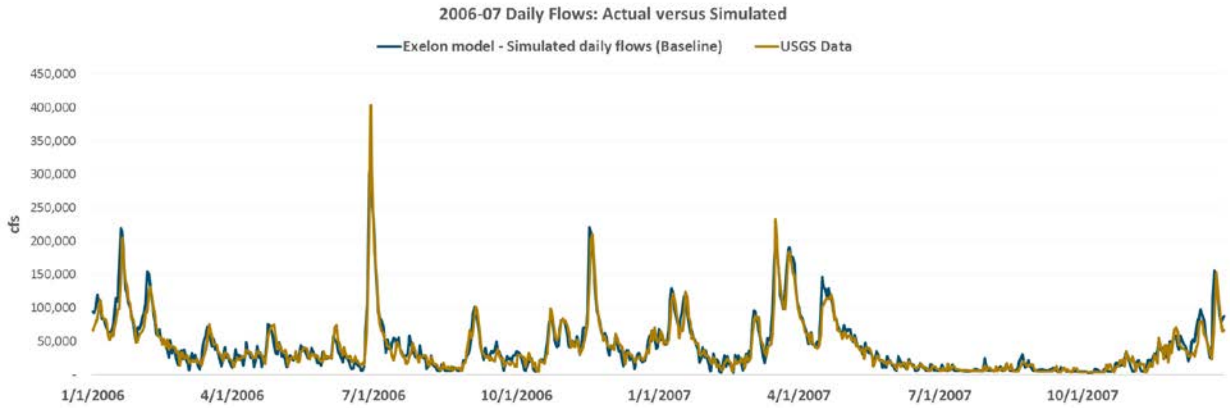


5.1.2 COMPARISON OF DAILY FLOWS: 2001 – 2007









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				
	5/1-5/31	Marietta flow +			
	6/1-6/15	intervening inflow			
	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