Attachment D

Conowingo Hydroelectric Project
(FERC Project No. 405)

Fishway Effectiveness Monitoring Plan
("FEMP")

CONOWINGO HYDROELECTRIC PROJECT
FERC PROJECT NUMBER 405

FISHWAY EFFECTIVENESS MONITORING PLAN

Prepared for:

Exelon.

Prepared by:

Normandeau Associates, Inc.

GOMEZ AND SULLIVAN ENGINEERS

September 2021

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

Conowingo Project, Project	Conowingo Hydroelectric Project
CWECF	Conowingo West Eel Collection Facility
EFL	East Fish Lift
EPAG	Eel Passage Advisory Group
Exelon	Exelon Generation Company, LLC
FEMP	Fishway Effectiveness Monitoring Plan
FERC	Federal Energy Regulatory Commission
MDE	Maryland Department of the Environment
PADEP	Pennsylvania Department of Environmental Protection
USFWS, the Service	United States Fish and Wildlife Service
WFL	West Fish Lift

1 INTRODUCTION

Exelon Generation Company, LLC (Exelon) is the licensee for the 570.15-megawatt Conowingo Hydroelectric Project (Conowingo Project or Project) (Federal Energy Regulatory Commission (FERC) Project No. 405). The Project is located on the Susquehanna River in Pennsylvania and Maryland. Conowingo Dam is located at river mile 10 in Maryland connecting Cecil and Harford counties, as is the lowermost six miles of the Project reservoir, Conowingo Pond. The remaining eight miles of Conowingo Pond are located in Pennsylvania, within York and Lancaster counties.

Exelon filed a Final License Application with FERC on August 30, 2012. Subsequent to filing the Final License Application, Exelon reached a negotiated resolution of fish passage issues at the Project with the United States Fish and Wildlife Service (USFWS). The negotiated agreement between Exelon and the USFWS are reflected in the U.S. Department of the Interior Modified Fishway Prescription for the Conowingo Hydroelectric Project No. 405 (filed June 8, 2016) and has been incorporated into the Project's FERC License issued March 19, 2021 as Appendix 1. As discussed herein, the new FERC License requires Exelon to, among other things, prepare a Fishway Effectiveness Monitoring Plan (FEMP).

This FEMP outlines the process and schedule by which passage effectiveness of American Shad (*Alosa sapidissima*), river herring (collectively, *Alosa aestivalis* and *Alosa pseudoharengus*), and American Eel (*Anguilla rostrata*) will be evaluated over the term of the new license at the Project.

1.1 Project Fish Passage Facilities

The Project contains two fish lifts located at Conowingo Dam, known as the West Fish Lift (WFL) and East Fish Lift (EFL) (Figure 1.1-1). The primary purpose of both lifts is to support trap and transport and volitional passage of American Shad and river herring, though other species use the lifts as well. As part of the FERC License, Exelon will implement substantial modifications to the existing fish lift facilities, along with a tiered approach to future improvements if passage effectiveness is not deemed sufficient based on various studies outlined in this FEMP.

Additionally, the Conowingo West Eel Collection Facility (CWECF) is operated at the Project in the vicinity of the WFL. The facility is designed to capture American Eel for subsequent transport to upstream release locations. The Conowingo East Eel Collection Facility will be constructed in the EFL stilling basin after required modifications to the EFL are complete. As part of both the Conowingo FERC license and consistent with the Muddy Run Pumped Storage Project FERC license, Exelon is evaluating potential locations for an additional eel collection facility on the east side of Conowingo Dam.

1.2 Regulatory Background

The Project's FERC License Article 401 *Commission Approval, Reporting, and Filing of Amendments* also refers to the FEMP as follows:

> *a) Requirement to File Plans for Commission Approval*
>
> *Various conditions of this license found in U.S. Department of the Interior's (Interior's) section 18 prescription (Appendix 1) require the licensee to prepare plans in consultation with other entities for approval by Interior (U.S. Fish and Wildlife Service [FWS]) and*

implement specific measures without prior Commission approval. Each such plan must also be submitted to the Commission for approval. These plans are listed below.

Interior Condition[a]	***Description***	***Due Date***
12.4	*Fishway Operation and Maintenance Plan Updates*	*January 31, annually*
12.7.1	*Fishway Effectiveness Monitoring Plan*	*Within 6 months of license issuance*

a. The conditions shown in this table were filed by Interior on June 8, 2016, and are attached to the license order as Appendix 1.

b. Exelon filed an Initial Fishway Operation and Maintenance Plan on September 29, 2017, and an updated plan on February 2, 2021. The plan is required by Article 413.

The licensee must include with each plan filed with the Commission documentation that the licensee has received approval from FWS, as appropriate.

The Commission reserves the right to make changes to any plan submitted. Upon Commission approval, a plan will become a requirement of the license, and the licensee must implement the plan or changes in project operation or facilities, including any changes required by the Commission.

b) Requirement to File Reports

Certain conditions found in Interior's section 18 prescription (Appendix 1) require the licensee to file reports with other entities. Because these reports relate to compliance with the requirements of this license, each such report must also be submitted to the Commission. These reports are listed in the following table:

Interior Condition[a]	***Description***	***Due Date***
12.7.1	*Upstream Fishway Effectiveness Monitoring Report*	*By December 31, annually[b]*
12.7.1	*Downstream Fishway Effectiveness Monitoring Report*	*By August 31, annually[b]*
12.7.3	*Upstream American Eel Effectiveness Testing Report*	*By December 31, annually[b]*

a. The conditions shown in this table were filed by Interior on June 8, 2016, and are attached to this order as Appendix 1.

b. As defined in condition 12.5.4 of Interior's section 18 prescription, fish passage efficiency testing will begin in the fifth year after license issuance.

The licensee must submit to the Commission documentation of any consultation, and copies of any comments and recommendations made by any consulted entity in connection with each report. The Commission reserves the right to require changes to project operation or facilities based on information contained in the report and any other available information.

c) Requirement to File Amendment Applications

Certain conditions of Interior's section 18 prescription (Appendix 1) contemplate unspecified long-term changes to project operation or facilities based on the results of studies or monitoring. Such changes may not be implemented until the licensee has filed an application to amend the license and the Commission has approved the application. In any amendment request, the licensee must identify related project requirements and request corresponding amendments or extensions of time as needed to maintain consistency among requirements.

The Project's FERC License, Appendix I, Section 12.7.1 outlines the development of a FEMP. This section states:

The Licensee shall develop a Fishway Effectiveness Monitoring Plan (FEMP) in consultation and with the approval of the Service, and will submit the FEMP to the FERC for approval within 6 months of license issuance. The FEMP will contain the plans for the studies described in Sections 12.7.2 through 12.7.5. If the Service requests a modification of the FEMP, the Licensee shall file a written response with the Service within 30 days and send a copy of the response to FERC and resource agencies. Any modifications to the FEMP by the Licensee will require approval by the Service and, if necessary, FERC prior to implementation.

The section also outlines the reporting and consultation requirements for this FEMP and associated studies as:

The Licensee shall submit yearly interim study reports to the Service and FERC following the conclusion of each study year. The interim and final reports for upstream passage studies will be submitted to the Service by December 31st of each study year. The interim and final reports for downstream passage studies will be submitted to the Service by August 1 following each study year. The final study report will include results for each life stage and type of study conducted with a determination of the Licensee's success or failure in achieving the passage efficiency criteria established in Section 12.2. In conjunction with submitting the final study report(s), the Licensee shall also provide electronic copies of all data collected from studies to the Service.

1.3 Passage Criteria

The License establishes upstream and downstream passage efficiency criteria for the Project (Table 1.3-1). The License defines upstream fish passage efficiency as the proportion of the fish in the Project tailwaters that successfully move through the fishway and continue upstream migrations, calculated as a percentage. The Project tailwaters at Conowingo are defined as the area downstream of Conowingo Dam located between the dam and the downstream end of Rowland Island. Upstream passage will be deemed successful for, 1: fish that are passed into Conowingo Pond by the Conowingo East fish lift exit trough and move upstream, and 2: fish that enter a fish lift are placed into a transport tank, and are successfully transported upstream of Conowingo Dam.

Downstream fish survival efficiency is the proportion of the fish that approach the upstream side of the Project and survive as they pass the Project and continue downstream migrations. The License incorporates USFWS numeric targets.

Table 1.3-1: Fish Passage and Survival Efficiency Criteria for the Conowingo Project

Species	Life Stage	Passage	Numeric Criteria
American Shad	Adult	Upstream	85% Adjusted Efficiency[1]
	Adult	Downstream	80% Survival Efficiency
	Juvenile	Downstream	95% Survival Efficiency
River Herring	Adult	Upstream	Not Developed
	Adult	Downstream	80% Survival Efficiency
	Juvenile	Downstream	95% Survival Efficiency
American Eel	Juvenile	Upstream	Not Developed
	Adult	Downstream	85% Survival Efficiency

1.4 Monitoring Schedule

The general monitoring schedule is outlined in Table 1.4-1.[2] Additional details regarding monitoring schedules are described under the studies for each species in their respective sections of this document. The License requires that proposed amendments to the schedule be submitted in writing to the USFWS, for subsequent approval by the USFWS and FERC.

[1] Adjusted Efficiency is the calculated fish passage efficiency that accounts for the biological benefit of fish trapped and transported from the Conowingo Project to areas upstream of other main stem dams. This calculated efficiency gives credit towards efficiency targets for the number of fish that are trapped and transported. Formulae for calculating Adjusted Efficiency were developed by USFWS and are included in Appendix B of the FERC License Appendix 1 and are presented in this report as Appendix A.

[2] Exelon will communicate regularly with resource agencies regarding the monitoring schedule and any necessary revisions.

Table 1.4-1: Fish Passage Effectiveness Monitoring Study Schedule

Species	Life Stage	Direction	Purpose	Timing	Duration
American Shad	Adult	Upstream	Trap and Transport Mortality Study	4th year after license issuance	1 year
	Adult	Upstream	Initial Efficiency Test	5th passage season after license issuance	3 years
	Adult	Upstream	Post-Modification Efficiency Tests	1st passage season immediately following modifications	3 years
	Adult	Upstream	Periodic Efficiency Tests	Every 5th year after a previous study determines project adjusted efficiency ≥ 85%	2 years[3]
	Adult	Downstream	Route Selection	2027	2 years
	Adult	Downstream	Survival	2027	1 year
	Juvenile	Downstream	Route Selection	2027	2 years
	Juvenile	Downstream	Survival	2027	1 year
River Herring	Adult	Upstream	Initial Efficiency Test	5th passage season after license issuance	3 years
	Adult	Upstream	Post-Modification Efficiency Tests	1st passage season immediately following modifications	3 years
	Adult	Downstream	Route Selection	2027	2 years
	Adult	Downstream	Survival	2027	1 year
	Juvenile	Downstream	Route Selection	2027	2 years
	Juvenile	Downstream	Survival	2027	1 year
American Eel	Juvenile	Upstream	Upstream Effectiveness Testing	1st year after license issuance, and/or after any modifications to the operation or physical structure[4]	1 year

[3] The Periodic Efficiency Tests will consist of a two-year American Shad tagging study, unless Exelon elects, with USFWS concurrence, to conduct an additional one year of study.

[4] The USFWS and Exelon have agreed that no effective technology is available to enable such testing; Exelon will reconsider conducting an upstream efficiency study on juvenile American eel at the west-side eel facility if appropriate technology becomes available.

Species	Life Stage	Direction	Purpose	Timing	Duration
	Adult	Downstream	Basin-Wide Monitoring and Funds	When USFWS determines that sufficient numbers of downstream migrants are present in the upper watershed (2021)	3 years
	Adult	Downstream	Route Selection, Delay, and Mortality	When USFWS determines that sufficient numbers of downstream migrants are present in the upper watershed (Start date no earlier than 2022 and no later than 2024)	To be determined[5]

[5] The duration of the route selection, delay, and mortality study is to be determined in consultation with the Eel Passage Advisory Group (EPAG) as outlined in Section 4.3.

EXELON GENERATION COMPANY, LLC

N

CONOWINGO HYDROELECTRIC PROJECT
PROJECT NO. 405
Fishway Effectiveness Monitoring Plan

0 500 1,000 2,000
Feet

Figure 1.1-1:
Project Overview

Path: X:\GISMaps\project_maps\FEMP\Figure_1_1_1.mxd

2 ANNUAL MEETING

Exelon will meet with the USFWS and the Susquehanna River Anadromous Fish Restoration Cooperative annually to discuss this FEMP, along with the Fishway Operation and Maintenance Plan. This Annual Meeting will occur no later than January 31 each year unless Exelon and the USFWS agree on a different date. The purpose of the meeting will be to discuss the fish passage results from the previous year, review regulatory requirements for fish lift and American Eel passage operations, and discuss any upcoming modification or testing Exelon proposes for the upcoming fish passage season.

3 UPSTREAM PASSAGE

3.1 American Shad Trap and Transport Mortality Study

3.1.1 Background

Exelon will trap American Shad at the Conowingo Project and transport them to areas upstream, providing increased access to spawning habitats upstream of York Haven Dam. The USFWS recognizes the benefits of the trap and transport program and will give credit towards the calculation of the efficiency criterion for upstream passage of shad at the Conowingo Project. This credit calculation requires an estimate of mortality associated with the trap and transport program.

3.1.2 Regulatory Article Text

The Project's FERC License, Appendix 1, Section 12.7.2.1 outlines requirements for evaluation of mortality associated with trap and transport operations for American Shad at the Conowingo Project. The article states:

> *In the 4th year after license issuance, the Licensee shall work with the Service and other resource agencies to develop a one-year study to estimate the mortality of fish which are trapped and transported to areas upstream of York Haven Dam. Such a study will include assessment of immediate mortality (mortality occurring during transport) as well as delayed mortality (mortality occurring during some time period after release). The results of the study will be used to modify, as necessary, the mortality input utilized in the trap and truck credit. The Service's proposed methodology for this study is included in Appendix C; however the Licensee and the Service have not agreed upon a final methodology and final study design is expected to take place post-licensing.*

3.1.3 Methods and Study Plan Development

To assess trap and transport mortality of adult American Shad collected at Conowingo Dam and transported upstream, a treatment and control study, similar to that of Millard *et al*. (2005) is proposed, as requested by the USFWS. The study will incorporate treatment groups and associated control groups that control for mortality associated with handling stress, with replicates occurring each week of the spawning run (4 to 8 weeks, depending on the length of the season).

Exelon will submit a study plan in draft form to the USFWS and other resources agencies in the fourth year after license issuance. The details of the study plan will be presented at a meeting with the agencies, where Exelon and the agencies will come to an agreement on the final methodology. Based on the comments received and agreements reached at the meeting, the study plan will be modified by Exelon and submitted to FERC for approval within six months of study initiation.

3.1.4 Monitoring Schedule

The trap and transport mortality study plan development will be completed by March 2025. The study will then begin in 2026, and the study duration will span the length of the upstream passage season of American Shad that year.

3.1.5 Reporting and Consultation

Exelon will submit the final study reports to the USFWS, the other members of the Eel Passage Advisory Group (EPAG), and the Maryland Department of the Environment (MDE), as well as FERC by December 31 of the study year (2026). Results will be discussed with the agencies at the subsequent Annual Meeting as described in Section 2. Electronic copies of all data collected from this study will be provided to the USFWS.

3.2 American Shad Passage Efficiency Testing

3.2.1 Background

The License target efficiency for upstream passage of adult American Shad at the Project is 85% of the individuals that enter the Project tailwaters by passing the downstream tip of Rowland Island. Additionally, credit toward achieving this passage efficiency can be applied by trapping fish at the Project and transporting them upstream of York Haven Dam.

Exelon has agreed to make substantial changes to the facility at the Project to improve passage of American Shad and other species, along with implementation of a trap and transport program. Upstream passage for adult shad at the Project will be evaluated as outlined in this plan, per the regulatory requirements.

3.2.2 Regulatory Article Text

The Project's FERC License, Appendix 1, Section 12.7.2 outlines requirements for the Initial Efficiency Test, Post-Modification Efficiency Tests, and Periodic Efficiency Tests for Upstream Passage of American Shad and river herring. The section states:

> *The Initial Efficiency Test and any Post-Modification Efficiency Tests will consist of a three-year fish tagging and monitoring study of American Shad and river herring using radio telemetry, or other best tracking technology. The Periodic Efficiency Tests will consist of a two-year American Shad tagging study using the same techniques unless the Licensee elects, with Service concurrence, to conduct an additional one year of study. The Initial Efficiency Test will begin in the 5th passage season after license issuance. The Post-Modification Efficiency Test will begin in the first fish passage season immediately following any required modification implemented from the tiers. The Periodic Efficiency Test will be conducted on every 5th year after a previous study determines that the Adjusted Efficiency of the project is achieving 85 percent passage efficiency for American Shad. Early Periodic Efficiency Tests may be delayed by up to two years to coincide with the schedule for tests at Muddy Run agreed upon in the 2015 Settlement Agreement between the Service and the Licensee.*
>
> *These studies will use sufficient numbers of test fish to account for drop-back and other fish loss. These fish will be collected from a downstream location, and be representative of the migrating population as a whole. Specific details of the telemetry studies such as sample sizes, collection of and release location of tagged American Shad and river herring, arrangement of telemetry receivers, and appropriate statistical analyses shall be developed by the Licensee in conjunction with the Service and other resource agencies. The Licensee shall submit final study plans to the Service and FERC for review and approval prior to initiating any study.*

3.2.3 Methods and Study Plan Development

Upstream passage of adult American Shad will be evaluated each study period using tagged shad captured from the Susquehanna River downstream of the Project. Details of the study, including sample sizes, collection methods, release location, arrangement of telemetry receivers, and statistical analyses will be developed in a study plan, which will be submitted in draft form to the USFWS and other resources agencies. The details of the study plan will be presented at a meeting with the agencies, where Exelon and the agencies will come to an agreement on the number and types of tags, along with receiver locations. Based on the comments received and agreements reached at the meeting, the study plan will be modified by Exelon and submitted to FERC for approval within six months of study initiation.

3.2.4 Monitoring Schedule

Monitoring of upstream passage for adult American Shad at the Project will follow an adaptive approach, with the purpose of monitoring varying depending on whether passage at the Project meets the passage criteria requirements and whether modifications to fish passage are necessary (Figure 3.2.4-1). The respective timelines for each is described in each of their respective subsections below.

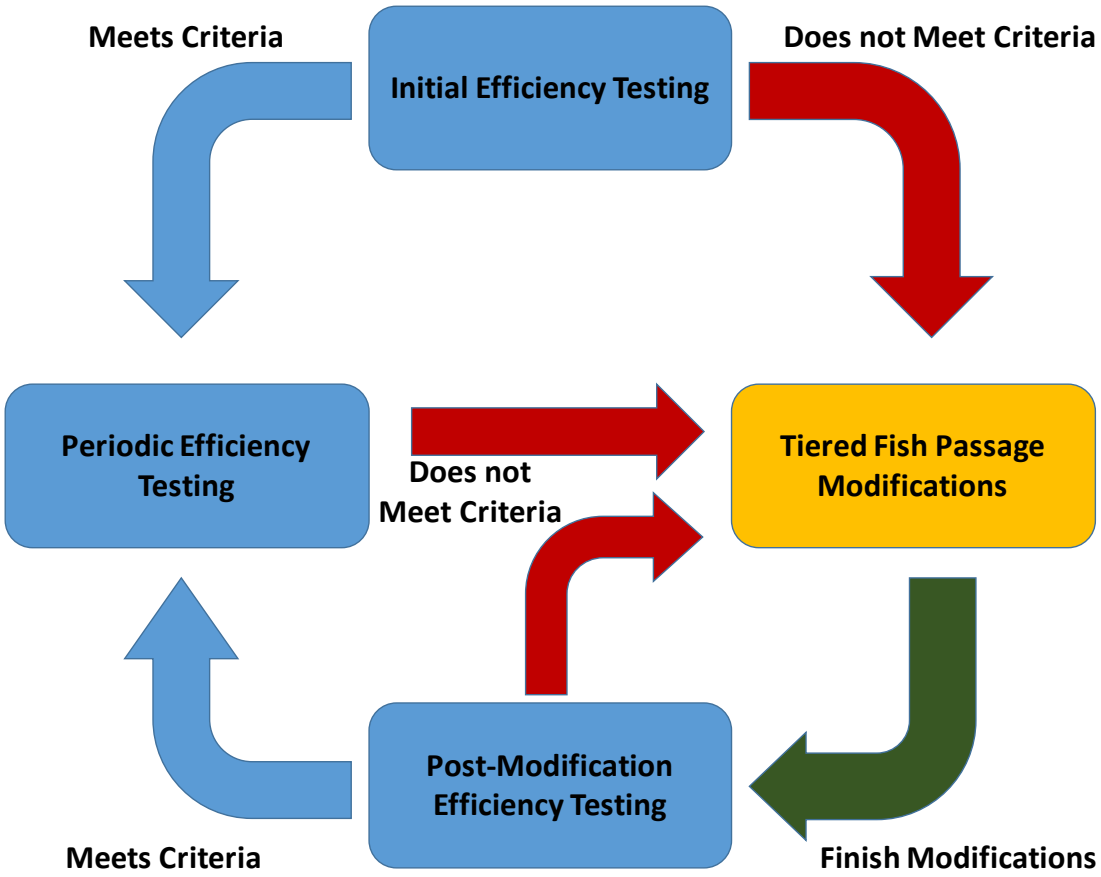

Figure 3.2.4-1: General Process of the Adaptive Efficiency Testing Schedule for American Shad

3.2.4.1 Initial Efficiency Testing

The License requires Exelon to implement substantial modifications to the existing fish passage facilities within three years of license issuance. Initial efficiency testing of the improved fishways will begin during the fifth passage season after license issuance and will consist of three passage seasons of monitoring.

3.2.4.2 Periodic Efficiency Testing

If the Project achieves 85% upstream passage efficiency of adult American Shad, including the Trap and Transport Credit adjustment[6], Exelon will continue to operate the facilities without further modification and will perform periodic efficiency testing starting on the fifth passage season after initial efficiency testing is completed (2033)[7]. Each periodic test will incorporate two consecutive passage seasons of monitoring.[8] Periodic tests will be initiated every fifth passage season after the previous periodic efficiency test or any post-modification efficiency tests determine that passage at the Project meets the upstream passage criteria.

3.2.4.3 Post-Modification Efficiency Testing

Post-modification efficiency testing will commence during the first passage season following any required modification to fish passage implemented at the Project. Each post-modification efficiency test will incorporate three passage seasons. If the Project achieves the adjusted 85% upstream passage efficiency of adult American Shad, then periodic efficiency testing will be initiated. If passage based on post-modification efficiency tests does not meet the criteria, then additional modifications will be completed based on the tiered agreement between Exelon and the USFWS, which would then be followed by additional post-modification testing.

3.2.5 Reporting and Consultation

Exelon will submit interim and final study reports to the USFWS, the other members of EPAG, and MDE, as well as FERC by December 31 following the conclusion of each study year. Results will be discussed with the agencies at the subsequent Annual Meeting as described in Section 2. Electronic copies of all data collected from these studies will be provided to the USFWS.

3.3 River Herring Passage Efficiency Testing

3.3.1 Background

No numeric criteria have been developed for upstream migrating adult river herring to date. However, Exelon has agreed to make substantial changes to the facility at the Project, which is anticipated to improve

[6] Per the FERC License, Appendix 1, Section 12.7.2.1, Exelon Licensee will receive additional credit toward the upstream passage efficiency criterion for adult American Shad that are trapped and transported upstream of York Haven Dam. This credit recognizes the benefits to the species by giving credit towards the calculation of whether the efficiency criterion for upstream shad passage is met, due to the value to restoration of avoiding the passage of impediments at the upstream hydroelectric projects.

[7] Early periodic efficiency tests may be delayed by up to two years to coincide with the schedule for tests at Muddy Run agreed upon in the 2015 Settlement Agreement between the Service and Exelon.

[8] The Periodic Efficiency Tests will consist of a two-year American Shad tagging study, unless Exelon elects, with USFWS concurrence, to conduct an additional one year of study.

passage of river herring. Upstream passage for river herring at the Project will be evaluated as outlined in this plan, per the applicable License requirements.

3.3.2 Regulatory Article Text

The Project's FERC License, Appendix 1, Section 12.7.2 outlines requirements for the Initial Efficiency Test, Post-Modification Efficiency Tests, and Periodic Efficiency Tests for Upstream Passage of American Shad and river herring. The article states:

> *The Initial Efficiency Test and any Post-Modification Efficiency Tests will consist of a three-year fish tagging and monitoring study of American Shad and river herring using radio telemetry, or other best tracking technology. The Periodic Efficiency Tests will consist of a two-year American Shad tagging study using the same techniques unless the Licensee elects, with Service concurrence, to conduct an additional one year of study. The Initial Efficiency Test will begin in the 5th passage season after license issuance. The Post-Modification Efficiency Test will begin in the first fish passage season immediately following any required modification implemented from the tiers. The Periodic Efficiency Test will be conducted on every 5th year after a previous study determines that the Adjusted Efficiency of the project is achieving 85 percent passage efficiency for American Shad. Early Periodic Efficiency Tests may be delayed by up to two years to coincide with the schedule for tests at Muddy Run agreed upon in the 2015 Settlement Agreement between the Service and the Licensee.*
>
> *These studies will use sufficient numbers of test fish to account for drop-back and other fish loss. These fish will be collected from a downstream location, and be representative of the migrating population as a whole. Specific details of the telemetry studies such as sample sizes, collection of and release location of tagged American Shad and river herring, arrangement of telemetry receivers, and appropriate statistical analyses shall be developed by the Licensee in conjunction with the Service and other resource agencies. The Licensee shall submit final study plans to the Service and FERC for review and approval prior to initiating any study.*

3.3.3 Methods and Study Plan Development

Upstream passage of adult river herring will be evaluated each study period using tagged herring captured from the Susquehanna River downstream of the Project. Details of the study, including sample sizes, collection methods, release location, arrangement of telemetry receivers, and statistical analyses will be developed in a study plan, which will be submitted in draft form to the USFWS and other resources agencies in the year preceding study initiation. The details of the study plan will be presented at a meeting with the agencies, where Exelon and the agencies will come to an agreement on the number and types of tags, along with receiver locations. Based on the comments received and agreements reached at the meeting, the study plan will be modified by Exelon and submitted to FERC for approval within six months of study initiation.

3.3.4 Monitoring Schedule

Monitoring of upstream passage for adult river herring at the Project will follow an adaptive approach, with the purpose of monitoring varying depending on whether passage at the Project meets the passage criteria requirements and whether modifications to fish passage are necessary. The respective timelines for each purpose of monitoring is described in each of their respective subsections below.

3.3.4.1 Initial Efficiency Testing

Exelon will be implementing substantial modifications to the existing fish passage facilities within three years of license issuance (2024). Initial efficiency testing of the improved fishways will begin during the fifth passage season (2026) after license issuance and will consist of three passage seasons of monitoring.

3.3.4.2 Post-Modification Efficiency Testing

Post-modification efficiency testing will commence during the first passage season following any required modification to fish passage implemented at the Project. Each post-modification efficiency test will incorporate three passage seasons. If passage based on post-modification efficiency tests is not deemed sufficient, then additional modifications will be completed based on the tiered agreement between Exelon and the USFWS, which would then be followed by additional post-modification testing.

3.3.5 Reporting and Consultation

Exelon will submit interim and final study reports to the USFWS, the other members of EPAG, and MDE, as well as FERC by December 31 following the conclusion of each study year. Results will be discussed with the agencies at the subsequent Annual Meeting as described in Section 2. Electronic copies of all data collected from these studies will be provided to the USFWS.

3.4 Upstream American Eel Passage Effectiveness Testing

3.4.1 Background

The USFWS operated an eel ramp in the vicinity of the WFL from 2008 to 2016. In May 2017, Exelon installed and began operation of a new eel ramp as the CWECF. Under Article 414, the CWECF will operate as a trap and transport facility through 2035. The CWECF contains one collection tank. The juvenile eel ladder is constructed of an aluminum cable tray with landscape fabric climbing substrate (Enkamat 7010) attached to the tray bottom. The facility is designed so that eels ascend the riprap between the tailwater surface and the entrance of the ramp. This portion of the riprap is wetted from the attraction flow exiting the eel ramp and the overflow tank down to the tailwater level. Once eels ascend the rip-rap portion, they enter the eel ramp and can ascend to the collection tank. The ramp is covered from the top down to near the entrance to protect juvenile eels from predation when ascending. A large 60% shade cloth is installed below the entrance to help protect juvenile eels between the tailrace and the entrance of the ramp. The facility provides attraction flow to the eel ramp and for use within the collection tank. There are three holding tanks. The CWECF has operated from May 1 through September 15 each year since 2017. In 2021, it is scheduled to operate May 1 until mean daily water temperature, as determined by hourly readings at Exelon's monitoring station 643 (located 0.6 mile downstream of Conowingo Dam), is 10 degrees Celsius or less for three consecutive days (expected to occur in mid-November). Eels that are collected at the facility are transported to upstream locations in the Susquehanna River watershed.

With the Muddy Run Pumped Storage Project FERC License, the EPAG, was established to inform implementation of Exelon's Eel Passage Plan, as indicated in the Pennsylvania Department of Environmental Protection (PADEP) 401 Water Quality Certification. The EPAG is chaired by Exelon and composed of a representative from each of the following: PADEP, Pennsylvania Fish and Boat Commission, USFWS, the Maryland Department of Natural Resources, and the Susquehanna River Basin

Commission. Representatives from New York State's Department of Environmental Conservation have also participated. Each designated representative is knowledgeable of American Eel, the Susquehanna River, as well as ongoing fisheries and other related resource programs being implemented in the Lower Susquehanna River (*e.g.*, American Shad restoration). The EPAG has been actively engaged in American Eel passage measures downstream of Conowingo, including approvals of the design of the American Eel passage facility near the WFL, and is familiar with issues associated with juvenile American Eel monitoring. Monthly remote meetings with EPAG and the Maryland Department of the Environment will be the primary means by which Exelon will consult with the resource agencies regarding this study.

3.4.2 Regulatory Article Text

> *12.7.3 Upstream American Eel Effectiveness Testing*
>
> *Unless the Service and the Licensee agree that no effective technology is available to enable such testing, the Licensee shall conduct an upstream efficiency study on juvenile American eel at the WFL facility in the year immediately following license issuance. The study will determine the American eel upstream passage efficiency of the eelway throughout the upstream migration season. The study will consist of two components, including determining attraction efficiency to the facility and passage efficiency of the facility once an eel enters the structure. Efficiency studies will be repeated following any modifications to the operation or physical structure to evaluate the relative success of the modifications. The Licensee shall provide an annual report on the efficiency study to the Service by December 31 of the study year.*

3.4.3 Upstream American Eel Effectiveness Testing - Methods and Study Plan Development

Exelon has investigated the technology available to conduct this upstream American Eel effectiveness testing. Passive integrated transponder tags are a proven technology for several species of fish; however, American Eel investigations utilizing passive integrated transponder tags have not been successfully completed with eels smaller than 150 mm. At the CWECF, collected eels range in size from 70 mm to 180 mm with an average length of 120 mm. Tagging only eels measuring greater than 150 mm would not be representative of the eels collected at the CWECF and would provide information relative to only a small portion of those eels collected at the CWECF.

The use of various dyes such as Bismarck Brown or Rose Bengal have been used to determine entrainment of juvenile alosines on the Connecticut River, but these fish were counted after being collected in specialized gear and inspected using standard white light. Most eel movement occurs at night and eels avoid bright light, so a red light would be required. Unfortunately, the red light would make it very difficult to detect the subtle color of the dye on the marked eels, potentially biasing the results.

Attempts to place a known number of unmarked eels at the bottom of an eel ramp to determine the percentage of eels that successfully ascend the ramp has yielded mixed results. One of the issues with conducting this type of study is that the ramp must be shut down (turning off the attraction flow) to clear the substrate of all eels prior to placing the unmarked eels at the base of the ramp.

Exelon would prefer to assess attraction efficiency and ramp efficiency using a single proven technology. Exelon has concluded that suitable technology to conduct this combined study is not currently available. However, Exelon will draft a study plan for the ramp efficiency portion of the test, only. The draft study

plan will be provided to resource agencies and will only be implemented following approval of the Exelon's Eel Passage and Restoration Plan.

Exelon will also continue to work with USFWS upon any modifications to the operation or physical structure to evaluate combined attraction flow and passage efficiency should technology become available later in the license term to do such a study. This process will include discussions during annual fish passage meetings between Exelon, USFWS, and other resource agencies to continually assess the current available technology and the feasibility of the implementing upstream American Eel effectiveness testing.

Following the 2019 site inspection, USFWS requested that Exelon complete an assessment of the spray bar that is positioned at the top of the CWECF eel ladder. Exelon used a red-light camera to record video of juvenile eel passing over the top of the ladder into the facility's collection tank during the 2020 passage season. The video was analyzed to assess how eels responded to the spray at the top of the ladder. Samples of the video and assessment results were shared with USFWS and other EPAG members. Although a large portion of the eels traversed the apex and dropped into the collection tank with little hesitation, approximately 25% were observed that hesitated, dropped back from the apex, or travelled laterally across the apex before successfully dropping into the collection tank.

Exelon will be conducting an additional evaluation of the spray bar at the Conowingo eel facility in September 2021, which will supplement the findings of the 2020 spray bar assessment. Methods were discussed with USFWS and other resource agencies during a remote meeting on August 18, 2021 and a written study plan will be provided to resource agencies as well as a written summary of evaluation results after the study's completion.

3.4.4 Monitoring Schedule

At this time, technology is not available for conducting a combined study to investigate attraction efficiency to the facility and passage efficiency of the facility once an eel enters the ramp. Accordingly, testing will be postponed indefinitely until the Exelon and USFWS, the other members of EPAG, and Maryland Department of Environment determine that effective technology is available. The availability of effective technology will be monitored and discussed at monthly meetings and the Annual Meeting with EPAG and the Maryland Department of the Environment. However, Exelon will draft a study plan for the ramp passage efficiency portion of the test, only, and conduct the study following approval of the Exelon's Eel Passage and Restoration Plan (anticipated in 2022).

Efficiency studies will be repeated following any modifications to the operation or physical structure to evaluate the relative success of the modifications, pending effective technology to do so.

Draft study plans for efficiency studies will be provided to the resource agencies by December 31 of the year preceding the study

3.4.5 Reporting and Consultation

When the study is performed, Exelon will submit a study report to USFWS, the other members of EPAG, and Maryland Department of the Environment as well as FERC by December 31 of the study year.

4 DOWNSTREAM PASSAGE

4.1 American Shad and River Herring Route of Passage Study

4.1.1 Background

Downstream passage effectiveness at the Conowingo Project depends on route selection and the survival associated with each route. Adult American Shad and river herring passed upstream of the Project during the upstream passage season need to survive emigration through the Project to remain in the population with the potential for repeat spawning during following years. Additionally, juvenile shad and river herring that are spawned upstream need to successfully migrate through the Project to the ocean, where they will mature before returning to spawn. The required passage criteria for downstream passage at the Project is 80% survival efficiency for adult shad and river herring, and 95% survival efficiency for juvenile shad and river herring (Table 1.3-1). Determining potential preferred routes by emigrating fish would be used to inform overall survival efficiency calculations.

4.1.2 Regulatory Article Text

> *12.7.4 Downstream Adult and Juvenile American Shad and River Herring Effectiveness Testing*
>
> *The Licensee shall conduct downstream passage effectiveness studies of American Shad and river herring in 2027 in coordination with the Service. As part of the Conowingo FEMP for downstream passage, the Licensee will evaluate both juvenile and adult life stages using a study protocol developed cooperatively with the Service to include a Conowingo Pond route of passage study. A route of passage study will be conducted to determine the routes chosen by downstream migrating fish through the Project under various generation conditions to determine if there are preferred routes of passage at the dam. The route of passage study will be conducted for 2 years to account for inter-annual variation in flow conditions. The Licensee will have the option to extend the route of passage study for an additional year.*

4.1.3 Methods and Study Plan Development

Downstream passage of adult and juvenile American Shad and river herring will be evaluated each study period using tagged fish captured from the Susquehanna River. Details of the study, including sample sizes, collection methods, release location, arrangement of telemetry receivers, and statistical analyses will be developed in a study plan, which will be submitted in draft form to the USFWS and other resources agencies. Tagging juvenile American Shad and river herring is challenging due to the small size of the fish. In addition, these fish are very sensitive to stress, handling, holding, and transport. Appropriate techniques and methods will be considered during study design to address these challenges. The details of the study plan will be presented at a meeting with the agencies, where Exelon will obtain verbal and written comments. Based on the comments received, the study plan will be modified by Exelon and submitted to the FERC for approval within six months of study initiation.

4.1.4 Monitoring Schedule

Route selection data collection for adult and juvenile American Shad and river herring will be performed over two passage seasons in 2027 and 2028. If Exelon deems necessary based on its own discretion, the study will be extended an additional year to assess route selection in 2029.

4.1.5 Reporting and Consultation

The interim and final reports for the downstream route of passage studies for adult and juvenile American Shad and river herring will be submitted to the USFWS, the other members of EPAG, and MDE by August 1 and FERC by August 31 following each study year. The final study report will incorporate results from the turbine passage survival study to describe success or failure in achieving the passage efficiency criteria. Results will be discussed with the agencies at the subsequent Annual Meeting as described in Section 2. Electronic copies of all data collected from these studies will be provided to the USFWS.

4.2 American Shad and River Herring Turbine Survival Study

4.2.1 Background

Adult American Shad and river herring passed upstream of the Project during the upstream passage season need to survive emigration through the Project to remain in the population with the potential for repeat spawning during following years. Additionally, juvenile shad and river herring that are spawned upstream need to successfully migrate through the Project to the ocean, where they will mature before returning to spawn. The required passage criteria for downstream passage at the Project is 80% survival efficiency for adult shad and river herring, and 95% survival efficiency for juvenile shad and river herring (Table 1.3-1). Three turbine survival studies of American Shad have been conducted previously (one study of adult shad conducted in 2012; two studies using juvenile shad in 1993 and 2011). The adult shad study conducted in 2012 resulted in immediate survival rates of 86.3% and 93.0% for the Kaplan and Francis turbines, respectively. In 1993, the observed immediate survival for juvenile shad passing through a Kaplan turbine was 94.9% while the immediate survival of juvenile shad observed passing through a Francis turbine in 2011 was 89.9%.

4.2.2 Regulatory Article Text

> *12.7.4 Downstream Adult and Juvenile American Shad and River Herring Effectiveness Testing*
>
> *In addition to the route of passage study, a one year separate and discrete passage study for both adult and juvenile American Shad and river herring shall be conducted to estimate survival through the Kaplan and Francis turbines under best gate efficiency. This study will commence in 2027. The effects of barotrauma during turbine passage will be included as part of the turbine survival studies for all life stages when possible. Results of the studies will be used to determine through-Project survival (i.e. via spill, Francis turbines, Kaplan turbines, etc.), and immediate and latent mortality for each route to achieve the passage criteria.*

4.2.3 Methods and Study Plan Development

Downstream turbine survival of adult and juvenile American Shad and river herring will be evaluated each study period (late spring/fall) using the Normandeau HI-Z Turbine tag with juvenile fish captured from the Susquehanna River. Adult shad and herring will be collected from the East Fish Lift and WFL if available. Details of the study, including sample sizes, release and recapture methods, assessment of immediate and latent mortality, and statistical analyses will be developed in a study plan, which will be submitted in draft form to the USFWS and other resources agencies. The details of the study plan will be presented at a meeting with the agencies, where Exelon will obtain verbal and written comments. Based on the comments received, the study plan will be modified by Exelon and submitted to FERC for approval within six months of study initiation.

4.2.4 Monitoring Schedule

The turbine survival study for adult and juvenile American Shad and river herring will be performed during 2027 and will be completed within a single passage season if sufficient numbers of test specimens (particularly juvenile American Shad and juvenile river herring) are available for study use.

4.2.5 Reporting and Consultation

The draft report for the turbine survival studies for adult and juvenile American Shad and river herring will be submitted to the USFWS, the other members of EPAG, and MDE by August 1 and FERC by August 31, 2028, following the 2027 study season. Results will be discussed with the agencies at the subsequent Annual Meeting as described in Section 2. Electronic copies of all data collected from these studies will be provided to the USFWS.

4.3 Downstream American Eel Passage Effectiveness Monitoring

4.3.1 Background

To effectively spawn in the Sargasso Sea, American Eel in the Susquehanna basin upstream of the Project must successfully pass through the Project and emigrate without mortality or considerable injury. The downstream passage criteria for adult American Eel at the Project is 85% survival efficiency. Survival efficiency for the Project can be determined based on a combination of the proportion of fish passing via specific routes, along with survival when passing via each route.

4.3.2 Regulatory Article Text

> *12.7.5 Downstream American Eel Effectiveness Monitoring*
>
> *The Licensee shall conduct or participate in two separate studies on downstream migrating American eel in the Susquehanna River. The studies can be done concurrently or separately, and will be conducted in conjunction with the American eel downstream studies undertaken by the Licensee of the Muddy Run Hydroelectric Project. The Licensee shall initiate studies when the Service determines that sufficient numbers of downstream migrants can be collected in the upper watershed to conduct a valid study.*
>
> *First, the Licensee shall participate in a basin-wide study coordinated by the Service to determine timing of downstream migration of American eels in the Susquehanna River. To*

complete this study, the Licensee shall contribute $75,000 to the Service to collect and tag fish for use in the basin-wide study. Radio telemetry monitoring will be conducted by the Licensee year-round for 3 consecutive years.

In addition to the basin-wide migration timing study, the Licensee will conduct a study at Conowingo Dam to determine migratory delay, route of downstream passage (i.e., via spill, Francis turbines, Kaplan turbines, etc.), and immediate and latent mortality for each route. If a sufficient number of tagged fish encounter the Project, a route of passage study can be done concurrently with the basin-wide downstream migration study using the same tagged eels assuming appropriate tag technology is available to assess latent mortality of those fish during the study.

4.3.3 Methods and Study Plan Development

The degree to which the two studies outlined here can be performed concurrently will be determined by Exelon in consultation with the EPAG. In accordance with the Muddy Run Pumped Storage Project License, within six months of the trigger date for initiation of downstream American Eel passage studies (or a later date as approved by PADEP in writing), Exelon will submit a plan to the EPAG to conduct a downstream passage study. This trigger date shall not occur prior to October 1, 2026 in order for the trapping and transport program to have sufficient time to reestablish a significant eel population.

4.3.3.1 Basin-Wide Migration Study

In 2021, USWFS is scheduled to begin a basin-wide study to determine timing of downstream migration of American Eels in the Susquehanna River. USFWS has developed the study design in coordination with Exelon and other interested parties. The 2021 study effort does not involve efforts from Exelon at Conowingo; therefore, USFWS has requested that Exelon's $75,000 contribution to the USFWS to collect and tag fish for use in a basin-wide study be held for the 2022 season. Additionally, radio telemetry monitoring is scheduled to be conducted by Exelon in the vicinity of the Conowingo Project in 2022 and 2023. Mobile tracking and data analysis for this study will be the responsibility of the USFWS. Annually, the USFWS will share with Exelon all data collected as part of the basin-wide study.

4.3.3.2 Delay, Route Selection, and Mortality Study

Methods for evaluating downstream passage effectiveness of adult American Eel at the Conowingo Dam to determine migratory delay, route of downstream passage (i.e. via spill, Francis turbines, Kaplan turbines, etc.) and immediate and latent mortality for each route will be developed by Exelon in consultation with the EPAG. A subsequent study plan, will be developed by Exelon in consultation with the EPAG.

4.3.4 Monitoring Schedule

According to the 401 Water Quality Certification issued by PADEP at the Muddy Run Pumped Storage Project, the trigger date for initiation of downstream American Eel passage studies will be determined by PADEP in consultation with other resource agencies and shall not occur prior to October 1, 2026 (PADEP, 2014). To the extent possible, Exelon will coordinate the downstream eel passage studies required at the Muddy Run Pumped Storage Project, with the downstream eel passage studies identified above for the Conowingo Project in terms of timing and methodology. The basin-wide migration study monitoring will be performed over three passage seasons (2021-2023). Accordingly, Exelon will complete the

Conowingo delay, route selection, and mortality study in 2026 to align with the Muddy Run Pumped Storage Project eel studies, and also allow time for analysis of results from the USFWS basin-wide study (2021-2023), which will likely inform the planning and methods used in the Muddy Run Pumped Storage Project and Conowingo eel studies.

4.3.5 Reporting and Consultation

Any interim and final reports for the downstream route of passage studies for adult American Eel will be submitted to the USFWS, the other members of EPAG, and MDE by August 1 and FERC by August 31 following each study year. Results will be discussed with the agencies at the subsequent Annual Meeting as described in Section 2. Electronic copies of all data collected from these studies will be provided to the USFWS.

5 REFERENCES

Millard, M.J., J.W. Mohler, A. Kahnle, and A. Cosman. 2005. Mortality associated with catch-and-release angling of striped bass in the Hudson River. North American Journal of Fisheries Management 25: 1533-1541.

Pennsylvania Department of Environmental Protection (PADEP). 2014. Water quality certification for Muddy Run Pumped Storage Project and related mitigation, FERC Project No. P-2355-018. Submitted to the FERC 12/10/2014.

APPENDIX A. CALCULATING ADJUSTED EFFICIENCY WITH TRAP AND TRANSPORT CREDIT

U.S. Department of the Interior Modified Fishway Prescription for the Conowingo Hydroelectric Project No. 405 (filed June 8, 2016)
FERC License Appendix 1
Appendix B. Calculating Trap and Transport Credit

Credit Towards an Overall Efficiency Criterion (85 percent of the fish entering the Conowingo Tailrace)

For a given number of shad trapped and transported we can estimate the number that would need to pass Conowingo Dam via the fish lift to result in the same number of spawners upstream of York Haven Dam. This number is termed "lift equivalents" (L_e) and is calculated as:

[1] $$L_e = (\sum_{i=1}^{n} TT_i) \cdot (1 - TT_m)/D$$

Where TT_i refers to the number trapped and transported each year during a single or multi-year study to measure passage efficiency, and TT_m is the mortality associated with trapping and transporting shad. Harris and Hightower (2011) estimated mortality of trapped and transported shad in the Roanoke River to be 15 percent. However, SRAFRC (1997) gave estimates of mortality for holding shad prior to trap and transport, mortality during the transport, and delayed mortality following release. When all these factors are considered, the overall mortality associated with trap and transport operations was 6 percent, which was used in this model. The denominator (*D*) in equation [1] will be calculated using the maximum efficiency of each of the two upstream dams with the highest passage efficiency over the three year study and the average of these efficiencies. For example, if the highest efficiencies of Holtwood, Safe Harbor, and York Haven Dams over the three year study were 0.60, 0.78, and 0.50, respectively, then the denominator would be calculated as $D = 0.60 \cdot 0.78 \cdot \left(\frac{0.60+0.78}{2}\right) = 0.3229$. It was assumed that other than the mortality associated with trap and transport operations, no other negative impacts on their fitness occurred compared to shad that would migrate via multiple fish passage facilities to areas upstream of York Haven Dam.

The L_e can be added to the observed number that were lifted past Conowingo Dam during the study period to arrive at an adjusted total number that are passed via the fish lift (L_a).

[2] $$L_a = L_e + \sum_{i=1}^{n} L_i$$

where L_i is the observed number lifted in each year.

During a radio telemetry study at Conowingo Dam, an estimate of passage efficiency will be made and given the total number of shad actually passed (lifted and released into Conowingo Pond + trapped and transported upstream), an estimate of the total number of shad downstream of Conowingo Dam during all years of the study can be made.

[3] $N = (\sum_{i=1}^{n} P_i)/E_o$

where P_i is the total number passed each year and E_o is the estimated passage efficiency during the study. Equation [3] also assumes that no mortality is suffered while attempting to pass Conowingo Dam.

The variance of N can be estimated by the delta method using the estimated variance of E_o.

[4] $Var(N) = [Var(E_o)/E_o^4] \cdot (\sum_{i=1}^{n} P_i)^2$

The adjusted passage efficiency is then the adjusted number that are lifted during the study divided by the total number of shad downstream of Conowingo Dam during all years of the study.

[5] $E_a = L_a/N$

The associated variance from the delta method is:

[6] $Var(E_a) = [Var(N)/N^4] \cdot L_a^2$

The 95 percent confidence interval for $E_a$can be approximated as:

[7] $95\%\ C.I. \approx 1.96 \cdot \sqrt{Var(E_a)}$

If the upper 95% confidence limit is greater than or equal to the efficiency criterion, then the criterion is considered to be met.

APPENDIX B. RESOURCE AGENCY CONSULTATION RECORDS, COMMENTS, AND RESPONSIVENESS MATRIX

APPENDIX B CONTENTS

From: Erin Redding
Sent: Thursday, July 29, 2021 9:29 AM
To: Danucalov, Andrea; Bleistine, Ray; Brett Coakley; Mike.Cox@ERM.com; David Frazier; Eberts, Ron; 'Eyler, Sheila'; 'Henning, Aaron'; denise.keehner@maryland.gov; jesus_morales@fws.gov; Martinek, Michael; 'McCollum, Allyson'; 'McCorkle, Richard'; 'Miller, Jeremy'; 'Minkkinen, Steve'; Heather Nelson -MDE-; Tony Prochaska; 'Sadzinski, Robert'; 'Seaborn, David'; 'Seaman, Shawn'; 'Slowik, Adam'; Kirk Smith; Smith, Fred; 'Steffy, Luanne'; 'Tryninewski, Joshua'; 'Williamson, Scott'
Attachments: 20210729_Fishway_Effectiveness_Monitoring_Plan_Draft.pdf

Hello,

Please see the attached Conowingo Fishway Effectiveness Monitoring Plan Draft for your review. Please send any comments to Andrea Danucalov by August 30, 2021.

Thank you,

Erin Redding (she/her)
Certified Senior Ecologist, ESA
Gomez and Sullivan Engineers, D.P.C.
1961 Wehrle Dr.
Suite 12
Williamsville, NY 14221
eredding@gomezandsullivan.com
I am not *working on Wednesdays.*

From: Eyler, Sheila <sheila_eyler@fws.gov>
Sent: Friday, August 27, 2021 9:36 AM
To: Erin Redding; Danucalov, Andrea; Bleistine, Ray; Brett Coakley; Mike.Cox@ERM.com; David Frazier; Eberts, Ron; 'Henning, Aaron'; denise.keehner@maryland.gov; Morales, Jesus J; Martinek, Michael; 'McCollum, Allyson'; McCorkle, Richard; 'Miller, Jeremy'; Minkkinen, Steve; Heather Nelson -MDE-; Tony Prochaska; 'Sadzinski, Robert'; 'Seaborn, David'; 'Seaman, Shawn'; 'Slowik, Adam'; Kirk Smith; Smith, Fred; lsteffy@srbc.net; Tryninewski, Joshua; 'Williamson, Scott'
Subject: EXTERNAL EMAIL -Re: Conowingo FEMP review
Attachments: Deng et al 2021 A acoustic micro-transmitter enabling tracking of sensitive aquatic species in riverine and estaurine environments.pdf; Mueller et al 2019 Implantation of a new micro acoustic tag in juvenile pacific lamprey and american eel.pdf

Erin/Andrea,

Thank you for providing the draft Conowingo FEMP for FWS review. The document adequately describes the suite of studies and timeline for implementation required under the new FERC license for the project. The study plan details are vague in this document, which is acceptable, as individual study plans for each component will be developed at a later date and in consultation with the agencies.

Specific Comments:
Page 1-1, Section 1.1, paragraph 1: “substantial improvements” should be changed to “substantial modifications” in line 3.

Page 1-3, Section 1.3, paragraph 1: Upstream passage should be deemed successful under two scenarios during the study. First if fish are being passed into Conowingo Pond, those fish need to enter and pass the fishway and move upstream as stated in the FEMP. However, due to the intensive T&T program in the initial years of fish passage at the project, successful upstream passage will also be considered for fish that enter a fish lift and are dumped into a sorting tank for ultimate trucking upstream.

Page 3-4, Section 3.2.4.1: “substantial improvements” should be changed to “substantial modifications” in line 1.

Page 3-5, Section 3.3.4.1: “substantial improvements” should be changed to “substantial modifications” in line 1.

Page 3-7, Section 3.4.2, paragraph 4: Although USFWS agrees that there are shortcomings to current evaluation methods (tagging and dyes) there may be some utility in using them for components of the effectiveness study (i.e. passage efficiency). Also, there are new developments in radio tag technology that may provide tags small enough to be used to assess upstream elver movement (see attached Deng et al. 2021 and Muller et al. 2019) for both evaluating attraction and passage efficiency. The feasibility of implementing upstream American eel effectiveness testing should be reviewed annually between Exelon and the resource agencies until such time as tagging techniques are deemed appropriate for the necessary assessments. The USFWS also supports additional evaluation of the spray bar at the top of the eel ramp as previous video

assessments demonstrated significant fallback rates at the top of the ramp that could be improved with modifying the pathway of water introduction.

If you have any questions about these comments, please feel free to reach out to me. Thank you again for the opportunity to review and provide comments.

Sheila Eyler
U.S. Fish and Wildlife Service
Mid-Atlantic Fish & Wildlife Conservation Office
177 Admiral Cochrane Dr.
Annapolis, MD 21401
717-387-2117

From: Erin Redding <eredding@gomezandsullivan.com>
Sent: Thursday, July 29, 2021 9:29 AM
To: Danucalov, Andrea <Andrea.Danucalov@exeloncorp.com>; Bleistine, Ray <rbleistine@normandeau.com>; Brett Coakley <brett.coakley@maryland.gov>; Mike.Cox@ERM.com <Mike.Cox@ERM.com>; David Frazier <dfrazier@gomezandsullivan.com>; Eberts, Ron <reberts@pa.gov>; Eyler, Sheila <sheila_eyler@fws.gov>; 'Henning, Aaron' <ahenning@srbc.net>; denise.keehner@maryland.gov <denise.keehner@maryland.gov>; Morales, Jesus J <jesus_morales@fws.gov>; Martinek, Michael <mmartinek@normandeau.com>; 'McCollum, Allyson' <amccollum@pa.gov>; McCorkle, Richard <richard_mccorkle@fws.gov>; 'Miller, Jeremy' <jeremmille@pa.gov>; Minkkinen, Steve <steve_minkkinen@fws.gov>; Heather Nelson -MDE- <hnelson@maryland.gov>; Tony Prochaska <tony.prochaska@maryland.gov>; 'Sadzinski, Robert' <bob.sadzinski@maryland.gov>; 'Seaborn, David' <david.seaborn@maryland.gov>; 'Seaman, Shawn' <shawn.seaman@maryland.gov>; 'Slowik, Adam' <aslowik@normandeau.com>; Kirk Smith <ksmith@gomezandsullivan.com>; Smith, Fred <fredp.smith@exeloncorp.com>; lsteffy@srbc.net <lsteffy@srbc.net>; Tryninewski, Joshua <jtryninews@pa.gov>; 'Williamson, Scott' <scwilliams@pa.gov>
Subject: [EXTERNAL]

Hello,

Please see the attached Conowingo Fishway Effectiveness Monitoring Plan Draft for your review. Please send any comments to Andrea Danucalov by August 30, 2021.

Thank you,

Erin Redding (she/her)
Certified Senior Ecologist, ESA
Gomez and Sullivan Engineers, D.P.C.
1961 Wehrle Dr.
Suite 12
Williamsville, NY 14221
eredding@gomezandsullivan.com
I am not *working on Wednesdays.*

PPRP Comments on Exelon's Fishway Effectives Monitoring Plan (FEMP)

PPRP agrees with the Plan purpose:
This FEMP outlines the process and schedule by which passage effectiveness of American Shad (Alosa sapidissima), river herring (collectively, Alosa aestivalis and Alosa pseudoharengus), and American Eel (Anguilla rostrata) will be evaluated over the term of the new license at the Project.

General Comments
There are no specific/defined study plans for any of the studies. The FEMP outlines how each plan will be developed, rather than having plans listed in the response to each study.

USFWS is the only organization that is reviewing and approving. Since this is based on the FERC license, MDE must also review and approve. This should also apply for all data and must be provided to the Resource Agencies not just the Service.

Specific Comments
1.3 states: *... upstream fish passage efficiency as the proportion of the fish in the Project tailwaters that successfully move through the fishway and continue upstream migrations, ...*. Needs to have a caveat for only trucking fish.

1.3 also states: *Downstream fish survival efficiency is the proportion of the fish that approach the upstream side of the Project and survive as they pass the Project and continue downstream migrations.* Define "successful passage criteria", details of how you differentiate between dead/injured fish will need to be defined.

3.1.3 Methods and Study Plan Development
There is no defined study plan in this section but rather states that it will be developed later based upon Millard et al. 2005. The Millard study examined catch and release mortality of striped bass and determined that J-hooks caused greater mortality than circle hooks. The control fish were collected by electrofishing. Other than treatment and control fish, it is unclear how Millard et al. would be a template for this mortality study.

The license article requires that both immediate and delayed mortality be assessed (mortality occurring sometime after release). The draft plan should include an evaluation of post release mortality, which was not a part of the Millard et al. study.

3.4.1 Consider adding figures and /or photos of the facility being described.

3.4.3 Exelon has stated they cannot do an efficiency testing of the ramp because attempts to do so have resulted in "mixed results". In our review of the published studies below, ramp efficiency was successfully measured. Please clarify your concerns/issues further.

3.4.3 The regulatory text requires two parts to the study: 1) attraction efficiency to the facility, and 2) passage efficiency of the facility once and eel enters the structure.
At present, the first component, attraction efficiency to the facility may not be technically feasible at this time. Determining the efficiency of the eelway certainly is. This has been done on three ladders at the Woronoco project on the Westfield River in Massachusetts (Woronoco 2010 & 2012), at the Lawrence dam on the Merrimack River in Massachusetts (Normandeau 2015), and on the Messalonskee Stream in Maine (Hickey 2012). In all cases, eelway efficiency was determined. At Woronoco the results were 99% in 96 hours at the North Ladder, 93% at the Middle Ladder in 66 hours, and 100% at the South Ladder in 18 hours. At the Lawrence Dam results after 36 hours were 55% and 32%. At the Automatic project on the Messalonskee Stream 97% efficiency was reported on the Enkamat side and 90% efficiency on the Plinko side. No times were reported.

The results above are mixed, two systems worked well and one very poorly. The FEMP states: *Exelon has concluded that suitable technology to conduct this study is not currently available.*

While a methodology for an attraction study may not be available, it is available for a ramp efficiency study. This type of study is relatively simple: enclose a known number of eels at the bottom of the ramp, which has been cleared of eels, and count the number in the capture/holding tank at the top over a fixed period such as 6, 12, 18, 24 etc. hours.

If there is a concern that the eelway to be tested will not be able to pass eels during the test, it is possible to set up a temporary ramp for use during the test.

3.4.3 In 2020, fallback at the top of the ramp was 24% in July and 50% in August. Subsequently no changes to the spray bar were done. Fallback likely affects overall eelway efficiency and should be resolved and re-evaluated as part of the overall eelway efficiency study. Within the FEMP, this assessment seems out of place considering review of assessments/studies are not discussed for other sections of the FEMP.

How ramp overcrowding, as directed in the FERC Order, is going to be determined should be explained.

A draft plan for ramp efficiency should be provided to the agencies by December 31 of the year preceding the study.

3.4.5 Reporting and Conclusions
The study report should be provided to the agencies by December 31 of the study year.

4.1.4 States: "Route selection data collection for adult and juvenile American Shad and river herring will be performed over two passage seasons in 2027 and 2028. If Exelon deems necessary based on its own discretion, the study will be extended an additional year to assess route selection in 2029." Please define what criteria will be followed and what determines if Exelon will extend it to a 3rd year and will this data be used as a metric in determining route selection of the target species?

4.1.5 Reporting and Consultation
The report for each year's study should be provided by the end of April to allow sufficient time for comment and study plan adjustments for the upcoming year's study.

4.2.1 Nowhere else in the FEMP do we discuss past studies. If the FEMP is going to do that here then the FEMP should be consistent throughout.

4.2.3 Methods and Study Plan Development
Adult shad and herring should be collected late in the upstream passage season to better replicate the physical condition of out migrating fish. Sensor Fish should be used to evaluate barotrauma (Advanced Telemetry Systems, ARC 800 Sensor Fish). Sensor Fish measure temperature, pressure, acceleration, and rotation during turbine passage. Nadir pressure is measured to assess the potential for barotrauma related injury to fish and the potential for severe acceleration during turbine passage.

4.2.5 Reporting and Consultation
The draft report should be provided to the agencies by April 30 of the year following the study to allow consultation should a second year of study be required.

4.3.3 Why is the silver eel study not until 2026? Data suggests a sufficient number of silvers are present now in the river (York Haven Dam Mortalities).

Appendix A Calculating T&T Credit – History of this calculation should be given explaining that it was a cooperative estimate between USFWS and Maryland DNR.

References

Hickey, S.J. January 26, 2012. Letter to Mr. Steven Shepard, USFWS. Kennebec Water District Upstream and Downstream Proposal. Pg. 4.

Millard, J.M., J.W. Mohler, A. Kahnle, and A. Cosman. 2008. Mortality associated with catch-and-release angling of striped bass in the Hudson River. N. Am Jour. Fish. Mgt. 25: 1533-1541.

Normandeau. 2015. Assessment of eel pass effectiveness at the Lawrence hydroelectric project (FERC No. 2800), Merrimack River, Lawrence, MA.

Woronoco Hydro. 2010. Report on the 2009 testing of the upstream passage for juvenile American eels phase i – passability testing and site observations. FERC # 2631. Accession No. 20110131-5111.

Woronoco Hydro. 2012. Report on the 2011 testing of the upstream passage of juvenile eels, Phase 1 Passability tests of all eel ladders and repeat of Phase II attractiveness testing and observations –article 404. FERC # 2631. Accession No. 20120229-5139.

Resource Agency Comments and Exelon Responses

Comment	Response
USFWS, Received August 27, 2021	
Specific Comments	
Page 1-1, Section 1.1, paragraph 1: "substantial improvements" should be changed to "substantial modifications" in line 3.	"Substantial improvements" has been changed to "substantial modifications".
Page 1-3, Section 1.3, paragraph 1: Upstream passage should be deemed successful under two scenarios during the study. First if fish are being passed into Conowingo Pond, those fish need to enter and pass the fishway and move upstream as stated in the FEMP. However, due to the intensive T&T program in the initial years of fish passage at the project, successful upstream passage will also be considered for fish that enter a fish lift and are dumped into a sorting tank for ultimate trucking upstream.	These scenarios have been added to Section 1.3, paragraph 1.
Page 3-4, Section 3.2.4.1: "substantial improvements" should be changed to "substantial modifications" in line 1.	"Substantial improvements" has been changed to "substantial modifications".
Page 3-5, Section 3.3.4.1: "substantial improvements" should be changed to "substantial modifications" in line 1.	"Substantial improvements" has been changed to "substantial modifications".
Page 3-7, Section 3.4.2, paragraph 4: Although USFWS agrees that there are shortcomings to current evaluation methods (tagging and dyes) there may be some utility in using them for components of the effectiveness study (i.e. passage efficiency). Also, there are new developments in radio tag technology that may provide tags small enough to be used to assess upstream elver movement (see attached Deng et al. 2021 and Muller et al. 2019) for both evaluating attraction and passage efficiency. The feasibility of implementing upstream American eel effectiveness testing should be reviewed annually between Exelon and the resource agencies until such time as tagging techniques are deemed appropriate for the necessary assessments.	Exelon has reviewed the provided Deng *et al.* 2021 and Muller *et al.* 2019 articles. Exelon agrees to discuss with USFWS, and other resource agencies the feasibility of implementing upstream American eel effectiveness testing during annual fish passage meetings, until such time as tagging techniques are deemed appropriate for the necessary assessments.

The USFWS also supports additional evaluation of the spray bar at the top of the eel ramp as previous video assessments demonstrated significant fallback rates at the top of the ramp that could be improved with modifying the pathway of water introduction.	Exelon will be conducting an additional evaluation of the spray bar at the Conowingo eel ramp in September 2021, which will supplement the findings of the 2020 spray bar assessment. Methods were discussed with USFWS and other resource agencies during a remote meeting on August 18, 2021 and a written study plan will be provided as well as a written summary of evaluation results after the study's completion.
Maryland Department of the Environment & Maryland Department of Natural Resources	
PPRP agrees with the Plan purpose: This FEMP outlines the process and schedule by which passage effectiveness of American Shad (*Alosa sapidissima*), river herring (collectively, *Alosa aestivalis* and *Alosa pseudoharengus*), and American Eel (*Anguilla rostrata*) will be evaluated over the term of the new license at the Project.	This comment is noted.
General Comments	
There are no specific/defined study plans for any of the studies. The FEMP outlines how each plan will be developed, rather than having plans listed in the response to each study.	This comment is noted. FERC License, Appendix 1 and Article 401 require submittal of the FEMP within six months following license issuance. In addition, FERC License, Appendix 1 stipulates when the study plans will be initiated. For instance, Appendix 1, Section 12.7.2.1 Trap and Transport Credit for American Shad states that in the fourth year after license issuance, Exelon will work with the USFWS and other resource agencies to implement a one year study to estimate mortality of fish that are trapped and transported to areas upstream of York Haven Dam. Many of the studies will occur in future years, and technologies related to the tagging and tracking of fish evolve rapidly and may not be currently available. Therefore, Exelon thought it prudent to define specific study methodologies in the year prior to undertaking the actual studies, so that the best technologies available at that time could be employed. Upcoming studies and plans will be discussed monthly and annually with the USFWS and other resource agencies to ensure adequate review of study methodologies and other study related logistics.
USFWS is the only organization that is reviewing and approving. Since this is based on the FERC license, MDE must also review and approve.	This Fishway Effectiveness Monitoring Plan is a requirement of Article 401 and a condition of the US Department of the Interior's Section 18

This should also apply for all data and must be provided to the Resource Agencies not just the Service.	Prescription (License Appendix 1). As such, the USFWS and FERC approval are required. An annual meeting with USFWS and the Susquehanna River Anadromous Fish Restoration Cooperative (including National Marine Fisheries Service, Susquehanna River Basin Commission, New York State Department of Environmental Conservation, Pennsylvania Fish and Boat Commission, and Maryland Department of Natural Resources) will take place to discuss the FEMP. Exelon would expect MDE be participate in this meeting as well. Exelon considers the USFWS as well as MDE, MDNR, PFBC, PADEP, and SRBC consulting parties for the FEMP. These resource agencies were sent a draft plan on July 29, 2021 and invited to review and submit comments to Exelon. All comments received by August 31, 2021 have been considered and included in this consultation record and responsiveness matrix. Exelon will continue to consult with these agencies relative to study planning, execution, and review of the data and results as the various components of the FEMP are implemented during the license term.
Specific Comments	
1.3 states: … upstream fish passage efficiency as the proportion of the fish in the Project tailwaters that successfully move through the fishway and continue upstream migrations, ….. Needs to have a caveat for only trucking fish.	The text in this section has been revised to define successful upstream passage per USFWS' second comment above.
1.3 also states: Downstream fish survival efficiency is the proportion of the fish that approach the upstream side of the Project and survive as they pass the Project and continue downstream migrations. Define "successful passage criteria", details of how you differentiate between dead/injured fish will need to be defined.	The issue of differentiating between live, dead, or injured fish has been a topic of debate in recent studies, particularly when studying downstream adult eel passage. Exelon will continue to work with the resource agencies to define successful passage criteria during the drafting of specific study plans outlined in this document.
3.1.3 Methods and Study Plan Development There is no defined study plan in this section but rather states that it will be developed later based upon Millard et al. 2005. The Millard study examined catch and release mortality of striped bass and determined that J-hooks caused greater mortality than circle hooks. The control fish were collected by electrofishing. Other than treatment and control fish,	USFWS proposed the use Millard *et al*. 2005 in FERC License, Appendix I as a conceptual model to guide development of the trap and transport mortality study. As the draft study plan is developed the overall methodology will be refined and resource agencies will be

it is unclear how Millard et al. would be a template for this mortality study. The license article requires that both immediate and delayed mortality be assessed (mortality occurring sometime after release). The draft plan should include an evaluation of post release mortality, which was not a part of the Millard et al. study.	afforded an opportunity to comment on the eventual approach, which will include assessments of post release mortality.
3.4.1 Consider adding figures and /or photos of the facility being described.	Engineering drawings and photos of the facility are provided in Exelon's Eel Passage and Restoration Plan, which was developed to address FERC License Article 415.
3.4.3 Exelon has stated they cannot do an efficiency testing of the ramp because attempts to do so have resulted in "mixed results". In our review of the published studies below, ramp efficiency was successfully measured. Please clarify your concerns/issues further.	Exelon would prefer to assess attraction efficiency and ramp efficiency using a single proven technology. This technology is not currently available. However, Exelon will draft a study plan for a ramp efficiency test, only. The draft study plan will be provided to resource agencies and will only be implemented following approval of the Conowingo Eel Passage and Restoration Plan (anticipated in 2022).
3.4.3 The regulatory text requires two parts to the study: 1) attraction efficiency to the facility, and 2) passage efficiency of the facility once and eel enters the structure. At present, the first component, attraction efficiency to the facility may not be technically feasible at this time. Determining the efficiency of the eelway certainly is. This has been done on three ladders at the Woronoco project on the Westfield River in Massachusetts (Woronoco 2010 & 2012), at the Lawrence dam on the Merrimack River in Massachusetts (Normandeau 2015), and on the Messalonskee Stream in Maine (Hickey 2012). In all cases, eelway efficiency was determined. At Woronoco the results were 99% in 96 hours at the North Ladder, 93% at the Middle Ladder in 66 hours, and 100% at the South Ladder in 18 hours. At the Lawrence Dam results after 36 hours were 55% and 32%. At the Automatic project on the Messalonskee Stream 97% efficiency was reported on the Enkamat side and 90% efficiency on the Plinko side. No times were reported.	Once an eel enters the facility, it is possible to determine the passage efficiency of the ramp, but there must be an understanding that in order to conduct this evaluation, the ramp will be shut down to clear the ramp of eels and make it inaccessible to eels other than the test specimens. During this evaluation, the ramp will not be collecting or attracting eels from the river. It is also not practicable to set up a temporary ramp for use during the test—questions could arise regarding the effectiveness of the temporary ramp. As stated above, Exelon will draft a study plan for a ramp efficiency test, only, and provide it to resource agencies implement the study following approval of the Conowingo Eel Passage and Restoration Plan (anticipated in 2022).

The results above are mixed, two systems worked well and one very poorly. The FEMP states: Exelon has concluded that suitable technology to conduct this study is not currently available. While a methodology for an attraction study may not be available, it is available for a ramp efficiency study. This type of study is relatively simple: enclose a known number of eels at the bottom of the ramp, which has been cleared of eels, and count the number in the capture/holding tank at the top over a fixed period such as 6, 12, 18, 24 etc. hours. If there is a concern that the eelway to be tested will not be able to pass eels during the test, it is possible to set up a temporary ramp for use during the test.	
3.4.3 In 2020, fallback at the top of the ramp was 24% in July and 50% in August. Subsequently no changes to the spray bar were done. Fallback likely affects overall eelway efficiency and should be resolved and re-evaluated as part of the overall eelway efficiency study. Within the FEMP, this assessment seems out of place considering review of assessments/studies are not discussed for other sections of the FEMP.	Exelon will be conducting an additional evaluation of the spray bar at the Conowingo eel ramp in September 2021, which supplement the findings of the 2020 spray bar assessment. Methods were discussed with USFWS and other resource agencies during a remote meeting on August 18, 2021 and a written study plan will be provided as well as a written summary of evaluation results after the study's completion.
3.4.3 How ramp overcrowding, as directed in the FERC Order, is going to be determined should be explained.	The proposed and existing eel ramps are 18 inches wide. Using the USFWS Fish Passage Engineering Design Criteria (2019) of a maximum capacity of 5,000 eels/day per inch of ramp width, assuming a mean eel size of 150 mm total length, the ramps have a capacity of 90,000 eels/day. During the 10 years of operation, if the number of American Eels attempting to migrate through the CEECF exceeds 90,000 eels per day, based on volumetric estimates, or if densities in the collection tank exceed 10 eels per L, the facility will be modified, or operational protocols adjusted to reduce crowding, in consultation with MDE, USFWS, and EPAG, and following approval from FERC. This is described in the Conowingo Hydroelectric Project Eel Passage and Restoration Plan.

3.4.3 A draft plan for ramp efficiency should be provided to the agencies by December 31 of the year preceding the study.	Exelon will provide draft plans to resource agencies for review and comment by December 31 of the year prior to the study.
3.4.5 Reporting and Conclusions The study report should be provided to the agencies by December 31 of the study year.	The text has been changed to, "When the study is performed, Exelon will submit a study report to USFWS, the other members of EPAG, and Maryland Department of the Environment as well as FERC by December 31 of the study year."
4.1.4 States: "Route selection data collection for adult and juvenile American Shad and river herring will be performed over two passage seasons in 2027 and 2028. If Exelon deems necessary based on its own discretion, the study will be extended an additional year to assess route selection in 2029." Please define what criteria will be followed and what determines if Exelon will extend it to a 3rd year and will this data be used as a metric in determining route selection of the target species?	The option for a third year of study was agreed upon between Exelon and USFWS as part of the Department of the Interior Settlement Agreement to account for atypical operational and environmental conditions that may be encountered during the previous two years of study. Data from all study years will be used, to extent they are scientifically valid, to assess route selection.
4.1.5 Reporting and Consultation The report for each year's study should be provided by the end of April to allow sufficient time for comment and study plan adjustments for the upcoming year's study.	Exelon will provide a draft study report to resource agencies by April 30 following the conclusion of each study year. FERC License Appendix 1, requires interim and final reports for downstream passage studies to be submitted to the USFWS by August 1 following each study year. Article 401 requires interim and final reports for downstream passage studies to be submitted to FERC by August 31 following each study year.
4.2.1 Nowhere else in the FEMP do we discuss past studies. If the FEMP is going to do that here then the FEMP should be consistent throughout.	The past studies provide context to establish the baseline turbine survival conditions at the Project. This is relevant as the future studies contemplated in the FEMP related to turbine survival were meant to be "check-in" studies to confirm that the previous turbine survival estimates remain valid, as changes in operational conditions could impact these estimates.
4.2.3 Methods and Study Plan Development Adult shad and herring should be collected late in the upstream passage season to better replicate the physical condition of out migrating fish. Sensor Fish should be used to evaluate barotrauma (Advanced	Use of Sensor Fish will be considered during study plan development. Normandeau has used Sensor Fish technology in other locations.

Telemetry Systems, ARC 800 Sensor Fish). Sensor Fish measure temperature, pressure, acceleration, and rotation during turbine passage. Nadir pressure is measured to assess the potential for barotrauma related injury to fish and the potential for severe acceleration during turbine passage.	
4.2.5 Reporting and Consultation The draft report should be provided to the agencies by April 30 of the year following the study to allow consultation should a second year of study be required.	Exelon will provide a draft study report to resource agencies by April 30 following the conclusion of each study year. FERC License, Appendix 1, requires interim and final reports for downstream passage studies to be submitted to the USFWS by August 1 following each study year.
4.3.3 Why is the silver eel study not until 2026? Data suggests a sufficient number of silvers are present now in the river (York Haven Dam Mortalities).	The Muddy Run Pumped Storage Project FERC license, which incorporates the project's Pennsylvania Water Quality Certificate, requires that a study of downstream eel passage occur no earlier than October 1, 2026. Exelon intends to conduct the eel studies required by the Muddy Run License and the Conowingo License concurrently. Additionally, this date allows for the conclusion of USFWS' current basin-wide eel passage study (expected duration 2021-2023). Allowing for synthesis of the basin-wide study's findings, which are expected to inform the planning of Exelon's silver eel study.
Appendix A Calculating T&T Credit – History of this calculation should be given explaining that it was a cooperative estimate between USFWS and Maryland DNR.	Text has been added to the footnote that references this Appendix and to the first page of Appendix A to give its source as the FERC License, Appendix 1, U.S. Department of the Interior Modified Fishway Prescription for the Conowingo Hydroelectric Project No. 405 (filed June 8, 2016).