Office of
Energy
Projects

March 2015

FERC/FEIS-0255F

FINAL MULTI-PROJECT ENVIRONMENTAL IMPACT STATEMENT FOR HYDROPOWER LICENSES

Susquehanna River Hydroelectric Projects

York Haven Project—FERC Project No. 1888-030–Pennsylvania

Muddy Run Project—FERC Project No. 2355-018–Pennsylvania

Conowingo Project—FERC Project No. 405-106–Maryland/Pennsylvania

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
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FEDERAL ENERGY REGULATORY COMMISSION

WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

To the Agency or Individual Addressed:

Reference: Final Environmental Impact Statement

Attached is the final environmental impact statement (EIS) for the York Haven, Muddy Run, and Conowingo Projects, collectively referred to as the Susquehanna River Projects (Nos. 1888-030, 2355-018, and 405-106), located on the Susquehanna River in York, Dauphin, and Lancaster Counties in Pennsylvania and Cecil and Harford Counties in Maryland.

This final EIS documents the view of governmental agencies, non-governmental organizations, affected Indian tribes, the public, the license applicants, and Federal Energy Regulatory Commission (Commission or FERC) staff. It contains staff evaluations of the applicants' proposals and the alternatives for relicensing each of the Susquehanna River Projects.

Before the Commission makes a licensing decision, it will take into account all concerns relevant to the public interest. The final EIS will be part of the record from which the Commission will make its decision. The final EIS was sent to the U.S. Environmental Protection Agency and made available to the public on or about March 11, 2015.

Copies of the final EIS are available for review in the Commission's Public Reference Branch, Room 2A, located at 888 First Street, N.E., Washington, D.C. 20426. The final EIS also may be viewed on the Internet at www.ferc.gov/docs-filing/elibrary.asp. Please call (202) 502-8222 for assistance.

Attachment: Final Environmental Impact Statement

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COVER SHEET

a.	**Title:**	**Relicensing the York Haven, Muddy Run, and Conowingo Projects, FERC Project Nos. 1888-030, 2355-018, and 405-106**
b.	Subject:	Final Environmental Impact Statement
c.	Lead Agency:	Federal Energy Regulatory Commission
d.	Abstract:	The existing projects are located on the Susquehanna River in York, Dauphin, and Lancaster Counties in Pennsylvania, and Cecil and Harford Counties in Maryland. Each project has one development, and together they span about 55 river miles from the mouth of the Susquehanna River to upstream of the York Haven impoundment. The York Haven Power Company, LLC (York Haven Power), executed a Settlement Agreement pertaining to relicensing the York Haven Project among York Haven Power, U.S. Fish and Wildlife Service, the Commonwealth of Pennsylvania, Pennsylvania Fish and Boat Commission, Maryland Department of Natural Resources, and the Susquehanna River Basin Commission. The Settlement Agreement resolved all outstanding issues pertaining to project relicensing. Exelon Generation Company, LLC's Muddy Run and Conowingo Projects are located on the Susquehanna River in Lancaster and York Counties, Pennsylvania, and Cecil and Harford Counties, Maryland. Conowingo Pond acts as the lower reservoir for the Muddy Run Project. The three projects do not occupy any federal lands. The staff's recommendation is to relicense the three projects as proposed, with certain modifications and additional measures recommended by the agencies and staff.
e.	Contact:	Emily Carter Federal Energy Regulatory Commission Office of Energy Projects 888 First Street, N.E. Washington, D.C. 20426 (202) 502-6512

f. Transmittal: This final environmental impact statement to relicense the York Haven, Muddy Run, and Conowingo hydroelectric projects is being made available to the public on or about March 11, 2015, as required by the National Environmental Policy Act of 1969 and the Commission's regulations implementing the National Environmental Policy Act (18 CFR, Part 380).[1]

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[1] National Environmental Policy Act of 1969, amended (Pub. L. 91-190. 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, §4(b), September 13, 1982).

FOREWORD

The Federal Energy Regulatory Commission (Commission), pursuant to the Federal Power Act (FPA)[2] and the U.S. Department of Energy Organization Act[3] is authorized to issue licenses for up to 50 years for the construction and operation of non-federal hydroelectric development subject to its jurisdiction, on the necessary conditions:

> That the project…shall be such as in the judgment of the Commission will be 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 referred to in section 4(e)…[4]

The Commission may require such other conditions not inconsistent with the FPA as may be found necessary to provide for the various public interests to be served by the project.[5] Compliance with such conditions during the licensing period is required. The Commission's Rules of Practice and Procedure allow any person objecting to a licensee's compliance or noncompliance with such conditions to file a complaint noting the basis for such objection for the Commission's consideration.[6]

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[2] 16 U.S.C. §791(a)-825r, as amended by the Electric Consumers Protection Act of 1986, Public Law 99-495 (1986), the Energy Policy Act of 1992, Public Law 102-486 (1992), and the Energy Policy Act of 2005, Pub. L. 109-58 (2005).

[3] Public Law 95-91, 91 Stat. 556 (1977).

[4] 16 U.S.C. § 803(a).

[5] 16 U.S.C. § 803(g).

[6] 18 C.F.R. § 385.206 (2014).

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ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
Advisory Council	Advisory Council on Historic Preservation
AOI	areas of interest
APE	area of potential effects
ASMFC	Atlantic States Marine Fisheries Commission
BMP	best management practice
CDP	census-designated place
certification	water quality certification
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commission or FERC	Federal Energy Regulatory Commission
Conowingo Project	Conowingo Hydroelectric Project
Corps	U.S. Army Corps of Engineers
CPUE	catch-per-unit-effort
CZMA	Coastal Zone Management Act
dB	decibels
dbh	diameter at breast height
DO	dissolved oxygen
DPS	distinct population segment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
Exelon	Exelon Generation Company, LLC
ºF	degrees Fahrenheit
FEMP	Fish passage effectiveness monitoring plan
FPA	Federal Power Act
FPMP	fish passage monitoring plan
FPOP	fish passage operating procedures
FWS	U.S. Fish and Wildlife Service
HPMP	Historic Properties Management Plan
Interior	U.S. Department of the Interior
IVM	Integrated Vegetation Management
kV	kilovolt
LSRWA	Lower Susquehanna River Watershed Assessment
Maryland DOE or MDE	Maryland Department of the Environment
Maryland DNR	Maryland Department of Natural Resources
mgd	million gallons per day
mg/L	milligrams per liter
Muddy Run Project	Muddy Run Pumped Storage Project
MW	megawatt
MWh	megawatt-hour

MWUA	maximum weighted usable area
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge and Elimination System
NTU	nephelometric turbidity unit
PA	Programmatic Agreement
Park Service	National Park Service
PBAPS	Peach Bottom Atomic Power Station
Pennsylvania DEP	Pennsylvania Department of Environmental Protection
Pennsylvania FBC	Pennsylvania Fish and Boat Commission
Pennsylvania DCNR	Pennsylvania Department of Conservation and Natural Resources
PPL BI	PPL Brunner Island LLC
ppt	parts per thousand
RM	river mile
RSP	Revised Study Plan
SAV	submerged aquatic vegetation
SD1	Scoping Document 1
Settling Parties	York Haven Power, FWS, Pennsylvania FBC, Maryland DNR, and SRBC
SHPO	State Historic Preservation Officer
SMP	Shoreline Management Plan
SOLS	Stewards of the Lower Susquehanna
SPM	surplus production method
SRAFRC	Susquehanna River Anadromous Fish Restoration Cooperative
SRBC	Susquehanna River Basin Commission
Susquehanna River Projects	York Haven, Muddy Run, and Conowingo Projects
TMDL	Total Maximum Daily Load
USGS	U.S. Geological Survey
WMA	Wildlife Management Area
York Haven Power	York Haven Power Company, LLC

EXECUTIVE SUMMARY

The Federal Energy Regulatory Commission (Commission or FERC) staff is reviewing applications to continue operating (relicense) three hydropower projects located on the lower Susquehanna River (the Susquehanna River Projects): the 19.62-megawatt (MW) York Haven Hydroelectric Project (York Haven Project); the 800.25-MW Muddy Run Pumped Storage Project (Muddy Run Project); and the 574.54-MW Conowingo Hydroelectric Project (Conowingo Project).[7]

Proposed Actions

On August 30, 2012, York Haven Power Company, LLC (York Haven Power) filed an application for a new license to continue operating the existing York Haven Project. On January 30, 2014, York Haven Power filed an Offer of Settlement. In the accompanying Explanatory Statement, York Haven Power states that the Settlement Agreement represents a complete resolution among the Settling Parties of all issues pending in the proceeding.[8] The York Haven Project is located on the Susquehanna River at river mile (RM) 55 in the borough of York, in York, Dauphin, and Lancaster Counties, Pennsylvania. The project does not occupy federal land.

On August 29, 2012, and August 31, 2012, respectively, Exelon Generation Company, LLC (Exelon) filed applications for new licenses to continue operating the Muddy Run Project and the Conowingo Project. The Muddy Run and Conowingo Projects are located on the Susquehanna River at RM 22 and RM 10, respectively, in Lancaster and York Counties, Pennsylvania, and Cecil and Harford Counties, Maryland. Conowingo Pond, the reservoir for the Conowingo Project, acts as the lower reservoir for the Muddy Run Project. The Muddy Run Project also includes an upper reservoir for pumped storage operation. Neither project occupies federal land.

Project Descriptions

York Haven Project

The York Haven Project principal structures consist of (from east to west) the east channel dam, a main dam, a headrace wall, a powerhouse, and a forebay bulkhead wall. The east channel dam extends 928 feet from the east shore of Three Mile Island to the

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[7] The authorized capacity for the Muddy Run Project is taken from the original license issued September 21, 1964, and the authorized capacity for the Conowingo Project is taken from a Commission Order issued March 3, 2010.

[8] The Settling Parties are York Haven Power, the U.S. Fish and Wildlife Service, the Pennsylvania Fish and Boat Commission, the Maryland Department of Natural Resources, and the Susquehanna River Basin Commission.

east bank of the river, and has an average height of 9 feet. The main dam extends 4,970 feet from the west shore of Three Mile Island diagonally across the main channel of the river to the north end of the headrace wall. The main dam has a maximum height at its crest of 18 feet and an average height of 10 feet. The headrace wall extends 3,000 feet from the south end of the main dam to the north end of the powerhouse. A stone masonry forebay bulkhead wall extends west from the south end of the powerhouse to a transformer building, perpendicular to the shoreline. From the transformer building, the forebay bulkhead wall extends north to the west bank of the river. A trash sluice gate and associated spillway are located adjacent to the southern end of the powerhouse at the eastern end of the forebay wall.

York Haven's impoundment, Lake Frederic, is 3.5 miles long with 29 miles of shoreline within the project boundary, including the shoreline of the islands in Lake Frederic. At the normal water surface elevation of 277.86 feet, Lake Frederic has a surface area of 2,218 acres and 9,600 acre-feet of gross storage capacity. The impoundment provides approximately 22.5 feet of net head for power generation purposes.[9]

The brick and stone masonry powerhouse is integral with the dam and includes 20 turbine-generator units and appurtenant equipment. Water flowing through the turbines is discharged into the tailrace immediately downstream of the dam.

There are no primary transmission lines included as part of the project because it interconnects with the 115-kilovolt (kV) electric grid at a substation located immediately downstream of the project's forebay wall.

The project includes an east channel upstream fish passage facility located at the western end of east channel dam, which has been operational since April 2000.

The project also includes 10 recreation facilities that York Haven Power owns and operates: the Historic Canal Lock, East Shore Boat Launch, Goosehorn Island Picnic Area, Shelley Island Recreation Area, Goodling Island Picnic Area, Beshore Island Recreation Area, Battery Island Recreation Area, Cly Shore recreational lot sites, York Haven Power Plant Recreation Area, and a Canoe Portage trail.

The project is operated in a run-of-river mode and maintains a normal pool elevation of 277.86 feet under low to moderate inflow conditions, defined as less than 17,000 cubic feet per second (cfs). Under low-flow conditions, York Haven Power has the ability to draw down the impoundment by up to 1.10 feet, which generally occurs for purposes of dam maintenance. During periods of moderate to high inflow conditions of greater than 17,000 cfs, the project turbines cannot control water levels and the impoundment elevation varies above its normal pool elevation depending on the

[9] Unless otherwise noted, all elevations are referenced to National Geodetic Vertical Datum of 1929.

magnitude of river flow. Under these conditions, water overtops the main dam, east channel dam, and headrace walls when their crest elevations are exceeded.

Muddy Run Project

The Muddy Run Project impoundment structures consist of four dams (main dam, intake channel dam, east dike, and the Recreation Lake dam) and two reservoirs (upper reservoir and the Recreation Lake). The 4,800-foot-long, 260-foot-high main dam is a zoned earth embankment with an impervious core. The 3,200-foot-long, 35-foot-high intake channel dam is an earthfill embankment with a concrete cap layer along the intake side of the embankment. The 800-foot-long and 12-foot-high east dike is a zoned earth and rock-fill embankment. The 750-foot-long and 90-foot-high Recreation Lake dam is a zoned earth and rock-fill embankment.

Total storage in the 900-acre Muddy Run reservoir (upper reservoir) is about 56,731 acre-feet, and the total usable storage is 33,894 acre-feet at the maximum pool elevation of 520 feet. The maximum pool elevation is about 411 feet above the normal elevation of Conowingo Pond (lower reservoir), which has a surface area of 8,500 acres and design storage of 310,000 acre-feet at the normal full pool elevation of 109.2 feet. The upper reservoir includes an emergency spillway that is a non-gated concrete ogee-type structure 200 feet long, 20 feet high, with a crest elevation of 521 feet. The spillway directs spill flows into a vegetated natural ravine, although the spillway has never been used since the project was constructed.

A separate pool, designated as the Recreation Lake, is located adjacent to the upper reservoir. The pool is used for recreation purposes and is not used for water storage for power production purposes. The Recreation Lake includes a spillway consisting of a rock-cut channel approximately 140 feet wide with a crest elevation of 520 feet.

The power intake facilities at the west end of the upper reservoir consist of four cylinder gates with trashracks in a cylindrical tower, and each intake supplies two units. Each intake leads to a horizontal power tunnel, which divides into two sections. The power tunnel sections transition to penstocks that lead to the eight reversible pump-turbine units in the powerhouse. The powerhouse is located along the shore of the Susquehanna River. The powerhouse houses eight Francis turbines each equipped with a 100-MW generator. The turbines have a total discharge capacity from the powerhouse of 32,000 cfs. The total powerhouse pumping capability is 28,000 cfs. Water flowing through the turbines is discharged via draft tubes into the Susquehanna River adjacent to the powerhouse. The pump-turbine units are equipped with trashracks between the draft tube outlet and the river. Electricity generated at the project is transmitted by two individual 220-kV transmission lines extending from the project switching station approximately 4.25 miles to the Peach Bottom Atomic Power Station North Substation located in York County.

The project also includes three recreation areas: Muddy Run Park, owned by Exelon and operated by a vendor; Wissler's Run Park, owned and operated by Exelon; and Muddy Run Wildlife Management Area, owned by Exelon and leased to and managed by the Pennsylvania Game Commission.

The Muddy Run Project is a pumped storage hydroelectric facility. Water is pumped at night (typically) from the lower reservoir (Conowingo Pond) to the upper reservoir that has 33,894 acre-feet of active storage available for pumped storage operation. Water is then released from the upper reservoir through the powerhouse units to the Susquehanna River (Conowingo Pond). Typically, pumping occurs during low-load periods when energy costs are low (nights and weekends), while generation occurs during high-load periods.

Conowingo Project

The Conowingo Project principal structures consist of a concrete gravity dam with a 1,190-foot-long non-overflow gravity section, a 2,385-foot-long ogee-shaped spillway section, a 1,105-foot-long intake-powerhouse section, and a 127-foot-long abutment section. The spillway consists of a 2,250-foot-long section with a crest elevation of 86.0 feet, and a 135-foot-long section with a crest elevation of 99.2 feet. The spillway is fitted with 50 Stoney-type crest gates and two regulating gates. Each Stoney crest gate is 22.5 feet high by 38 feet wide and has a discharge capacity of 16,000 cfs at a reservoir elevation of 109.2 feet. The two regulating gates are 10 feet high by 38 feet wide and have a discharge capacity of 4,000 cfs per gate at a reservoir elevation of 109.2 feet. The dam includes two fish lifts: a west fish lift and a newer east fish lift.

Conowingo dam impounds the Conowingo reservoir (Conowingo Pond) which extends 14 miles upstream from the dam. The total design storage capacity of the 8,500-acre reservoir is approximately 310,000 acre-feet at the normal full pool elevation of 109.2 feet. The normal tailwater elevation is approximately 20.5 feet. The impoundment provides approximately 89 feet of gross head for power generation purposes.

The powerhouse is integral with the dam and houses 13 turbine-generator units, associated draft tubes, and transformer bays. Water flowing through the turbines is discharged via the draft tubes into a tailrace immediately downstream of the dam. There are no primary transmission lines associated with the project as power from the project is transmitted directly from the switchyard to the grid.

The project includes 15 recreation facilities and public access areas owned by Exelon: Lock 13, Lock 15, Muddy Creek Boat Launch, Cold Cabin Boat Launch, Dorsey Park, Line Bridge, Broad Creek Public Landing, Glen Cove Marina, Conowingo Swimming Pool and Visitor's Center, Peach Bottom Marina, Conowingo Creek Boat Launch, Funk's Pond, Conowingo Dam Overlook, Fisherman's Park/Shures Landing, and Octoraro Creek Access. Exelon operates seven of these facilities and leases the other eight to local and state entities or commercial operators.

The Conowingo Project is a peaking facility that uses reservoir storage to generate during peak electricity demand periods. The current Conowingo Project license allows for Conowingo Pond to fluctuate up to 9 feet daily between elevation 101.2 and 110.2 feet.

Proposed Facilities

York Haven Project

York Haven Power proposes to construct a new nature-like fishway[10] at the project for upstream and downstream fish passage. The installation would require modifications to the north end of the dam. No other major modifications are proposed to project facilities.

Muddy Run Project

Exelon is not proposing any major modifications to the Muddy Run Project; however, it proposes minor improvements at the project's recreation facilities.

Conowingo Project

Exelon proposes to construct an eel trapping facility on the western shore of the Susquehanna River downstream of Conowingo dam and a similar facility on Octoraro Creek, which enters the Susquehanna River approximately 4,500 feet downstream of Conowingo dam on the eastern shore. No other major modifications to project facilities are proposed at the Conowingo Project; however, minor improvements are proposed for the project's recreation facilities.

Proposed Environmental Measures

York Haven Project

Under the terms of the Settlement Agreement, and in addition to the fishway noted above, York Haven Power proposes the following environmental measures at the York Haven Project:

- Develop an erosion and sediment control plan for construction of the nature-like fishway.
- Continue to operate and maintain the existing east channel fishway as the primary means for upstream fish passage until the proposed nature-like fishway is completed.
- Continue an existing downstream juvenile American shad passage protocol that calls for the operation of units 1-6 (Kaplan and propeller units) to be

[10] A nature-like fishway is a fishway that is designed to appear and operate similar to a natural riffle, with a gradually sloping channel interspersed with rock weirs and pools. These fishways are typically suitable for a wide range of species.

first online and last offline during the juvenile shad downstream migration period (which typically is from October 1 through November 30), and opening the forebay sluice gate at specific times for downstream fish passage. If river flows exceed the capacity of units 1-6, unit 14 would be operated, and if flows exceed the capacities of units 1-6 and 14, units 7-13 and 15-30 would be operated in ascending order.

- Provide a year-round, continuous, minimum flow from the project of 1,000 cfs and an average daily minimum flow of 2,500 cfs, or inflow, whichever is less, to protect and enhance aquatic resources downstream of the project.
- Continue to operate the project in a run-of-river mode when inflow to the project is less than 3,000 cfs.
- Pass about 370 cfs through the forebay sluice gate for 1 or 2 hours in the morning during weekdays if river flows exceed the sum of: (1) the turbine hydraulic capacity; (2) flows through the nature-like fishway, once constructed; (3) flows through the east channel; and (4) flows (if any) over the main dam from May 1 through June 30, to facilitate downstream passage of post-spawning adult American shad; and any day that river flow exceeds the combined hydraulic capacity during the fall American shad emigration period, to facilitate downstream passage of juvenile American shad.
- Pass about 370 cfs through the forebay sluice gate between the hours of 5 p.m. and 11 p.m. during the entire fall juvenile American shad passage period to facilitate the downstream passage of juvenile American shad.
- Develop designs within 4 years of license issuance for: (1) removal of obstructions in or deepening of the downstream plunge pool for the forebay sluice gate, and (2) a chute structure to convey flows beyond the roadway on the downstream side of the stone masonry forebay bulkhead wall to protect outmigrating juvenile and adult American shad passing into the downstream plunge pool.
- Cooperate with resource agencies and other interested parties to conduct a lower Susquehanna River downstream eel migration study that would include monitoring silver eels at the project and providing $25,000 to support the study.
- Conduct a site-specific silver eel route of passage study and a survival study at the project, including the potential for providing $50,000 to resource agencies for collection and tagging of silver eels at upstream locations.

- Conduct a downstream eel passage improvement study if downstream eel passage goals are not achieved with provisions for subsequent monitoring and adjustments.
- Prior to construction of the proposed nature-like fishway:
  - Provide a minimum flow of 2,000 cfs at the east channel dam and a spillage flow of 4,000 cfs at the main dam during the American shad upstream passage season when the east channel fishway is in operation.
  - After the American shad upstream passage season until the end of the resident fish passage season, maintain a minimum flow of 400 cfs in the east channel downstream from the east channel fishway during the period that the east channel fishway is operated to allow upstream passage of resident fish species, per a June 2010 Consent Order and Agreement between York Haven Power and the Pennsylvania Department of Environmental Protection (Pennsylvania DEP).
  - Conduct vegetation surveys, wetlands delineations, invasive species surveys, rare species surveys, bog turtle habitat assessments, and bald eagle surveys in the area of the nature-like fishway.[11]
- After construction of the nature-like fishway:
  - Conduct American shad upstream passage effectiveness studies using radio telemetry beginning the second year of the nature-like fishway operation. If the project area passage success criterion is not achieved, York Haven Power would implement corrective measures, followed by two additional years of radio telemetry studies to confirm achievement of the project area passage success criterion.
  - Conduct a juvenile American shad headrace turbine avoidance study.
  - If the juvenile American shad headrace turbine avoidance goals are not achieved, implement measures that would enhance the effectiveness of downstream passage and conduct a supplemental juvenile American shad headrace turbine avoidance study within 2 years of implementing the measures.
  - Provide an average daily minimum flow in the east channel below the east channel dam of 267 cfs year round to protect aquatic resources in

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[11] These proposed measures, which are cited in the explanatory statement accompanying the Offer of Settlement, would be implemented prior to the construction of the nature-like fishway.

the east channel and provide a minimum passage flow for fish ascending the east channel and using the east channel fishway.

- Provide a minimum of 5 percent of the river flow through the nature-like fishway during the American shad upstream passage season such that when inflows to the project are between 5,000 and 150,000 cfs, total flow through the nature-like fishway ranges from about 1,000 to 7,500 cfs, depending on inflow.
- Outside of the American shad upstream passage season, provide a minimum flow of 200 cfs through the nature-like fishway when the river elevation is at the crest of the main dam.
- When flows exceed the hydraulic capacity of all available generating units, and to the extent controllable by York Haven Power, manage flows to maximize flow over the main dam and the nature-like fishway to provide attraction flow to the vicinity of and from the nature-like fishway to maximize fishway effectiveness.

- To prevent a buildup of debris that could affect project and fish passage operations, remove non-natural debris from the forebay and sluice remaining natural debris downstream, after notifying the downstream PPL Brunner Island Station.
- Contribute $25,000 per year to the York County Conservation District or such other entity identified by the Pennsylvania DEP for the purposes of debris removal in the lower Susquehanna River watershed.

In addition to the measures specified in the Settlement Agreement, York Haven Power also proposes the following:

- Maintain existing project recreation facilities, and consult with the resource agencies on recreation resources and management strategies every 10 years after the effective date of any new license.
- Continue the current permitting program for the approximately 300 recreational lots located within the project boundary, but terminate permits and remove lots from the program if structures are abandoned by the lessee, or when existing structures become damaged and are not replaced by conforming structures.
- Implement the Historic Properties Management Plan (HPMP) filed with the Commission on December 28, 2012, to manage project effects on properties eligible for listing on the National Register of Historic Places (National Register).

Muddy Run Project

Exelon proposes the following environmental measures at the Muddy Run Project:

- Develop a dissolved oxygen (DO) monitoring plan no earlier than November 1, 2027, with measures designed to ensure that the project does not violate DO standards.
- Develop fish passage operating procedures (FPOP) for minimizing delay and potential fish entrainment during upstream and downstream fish passage past the project tailrace during generating and pumping cycles.
- Develop a plan and schedule for a radio telemetry study or equivalent Tier II study of American shad passage and behavior within the Muddy Run Project boundary if resource agencies determine that operation of the Muddy Run Project is causing the Holtwood Project to fail to meet the Tier I upstream American shad target specified in the water quality certification for the Holtwood Project.
- Develop a downstream eel passage plan to ensure the safe and timely passage of eels past the Muddy Run Project.
- Implement the American Eel Passage Plan[12] filed with the license application for an eel trap and truck program to trap, hold, and transport American eels from the Conowingo Project and Octoraro Creek to designated points in the Susquehanna River watershed until at least 2030, and then either continue the trap and truck program or construct a volitional eel passage facility at Conowingo dam.[13]
- Implement the Bald Eagle Management Plan filed with the license application to minimize impacts on bald eagles and their habitat within the project boundary in accordance with recommendations from *the National Bald Eagle Management Guidelines* (FWS, 2007a) and state agency guidance.
- Implement the Bog Turtle Management Plan filed with the license application to minimize impacts on bog turtles and that includes: (1) the restriction of mowing in the wetland documented to support bog

[12] Exelon filed an Eel Management Plan with its final license application. In the water quality certification for the Muddy Run Project, the Pennsylvania Department of Environmental Protection called this plan an American Eel Passage Plan, and we use this title throughout the EIS.

[13] Exelon proposes this as a measure for the Muddy Run Project; however, because the Conowingo Project currently blocks the upstream passage of American eel on the Susquehanna River, upstream passage measures would be provided at the Conowingo Project.

turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) limits on public access to the wetland without advertising the reason.

- Once every 10 years through the term of the license, evaluate all state and federal endangered and threatened species that may be present within the project boundary, and if the evaluation identifies the presence, critical habitat, or critical dependence of endangered species, propose and implement a protection plan for each species.
- Provide annual grants of up to $450,000 total to be split between the Lancaster County and York County Conservation Districts through 2030 for the implementation of agricultural pasture and barnyard best management practices (BMPs) to control sediment loading into the Susquehanna River.
- Provide $50,000 annually through 2030 to the Pennsylvania Fish and Boat Commission (Pennsylvania FBC) for habitat improvement projects, including removal of small dams.
- Implement the Recreation Management Plan filed with the license application that includes the following improvements to project recreation facilities at the Muddy Run Park and Campgrounds: an improved launching ramp and barrier-free dock; shoreline erosion measures; an improved retaining wall; electric upgrades; expanded playground area near the Visitor's Center; and construction of a 2,000-square-foot water spray park near the entrance to Muddy Run Park, along with paving resurfacing.
- Implement the Shoreline Management Plan (SMP) filed with the license application that includes measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, and use of project lands and BMPs for controlling sediment introduction.
- Implement the osprey management policy described in Exelon's proposed SMP.
- Prepare a cultural resources management plan if cultural materials are identified during project-related ground-disturbing activities.
- Within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become final, provide the version of

the Lower Susquehanna OASIS model to the Susquehanna River Basin Commission (SRBC) as per a letter agreement dated November 19, 2013.[14]

Conowingo Project

Exelon proposes to continue the following environmental measures:

- Operate the project with a normal daily range of operation of Conowingo Pond between elevations 101.2 and 110.2 feet, with a minimum elevation of 107.2 feet on weekends between Memorial Day and Labor Day, to meet recreational needs.
- Provide minimum downstream flow releases from the project as follows:
  - March 1 – March 31: 3,500 cfs or natural inflow,[15] whichever is less;
  - April 1 – April 30: 10,000 cfs or natural inflow, whichever is less;
  - May 1 – May 31: 7,500 cfs or natural inflow, whichever is less;
  - June 1 – September 14: 5,000 cfs or natural inflow, whichever is less;
  - September 15 – November 30: 3,500 cfs or natural inflow, whichever is less; and
  - December 1 – February 28: 3,500 cfs intermittent (maximum six hours off followed by equal amount on).
- Enhance DO at the project using the turbine venting systems on Units 1 through 7 and the aerating runners on Units 2 and 5, and continuously monitor DO levels from May 1 through October 1 at the Station 643 location about 0.6 mile downstream of Conowingo dam.
- Operate the east fish lift to pass American shad, river herring, and other migratory fishes, and the west fish lift for American shad egg collection and other research purposes.
- Manage debris to include clamming (with three gantry cranes with grapple attachments) to remove submerged debris from the area upstream of the powerhouse intakes and floating surficial debris in front of the powerhouse

[14] On November 19, 2013, Exelon sent a letter agreement to SRBC stating that it would provide SRBC with a version of the OASIS model as we describe. SRBC signed the letter agreement on November 21, 2013, and that agreement is appendix 2 in the water quality certification for the Muddy Run Project.

[15] As measured at the upstream U.S. Geological Survey (USGS) Marietta gage (No. 01576000).

intakes, and sponsoring community-based clean-ups in the pond and downstream of the dam.

- Maintain the project's public recreation facilities.

Exelon proposes the following new environmental measures:

- Implement the Sediment Management Plan filed with the license application that identifies benchmarks and thresholds for actions to address sediment issues that may affect project operation.
- Conduct a bathymetric survey of Conowingo Pond every 5 years to monitor sediment transport and depositional patterns.
- Implement a preventive maintenance program for the east fish lift to extend the useful life of the facility over the next license term.
- Use the project turbines as the route for downstream passage of American shad and river herring.
- Construct a permanent trap and transport facility for the upstream passage of American eel, consisting of an eel ramp and collection facility on the west bank of the Conowingo tailrace and a similar facility on the east side of the river on Octoraro Creek.
- After 2030, construct volitional eel passage facilities on the west and east banks that consist of full eel ramps with resting pools.
- Implement the Bald Eagle Management Plan filed with the license application to minimize impacts on bald eagles and their habitat within the project boundary in accordance with recommendations from the *National Bald Eagle Management Guidelines* (FWS, 2007a) and state agency guidance.
- Implement the Recreation Management Plan filed with the application that provides for improvements to 13 project recreation facilities, including directional signage to facilities and canoe portages, expanded parking, barrier-free boat trailer parking spaces, fencing, shoreline stabilization, new or repaired boat ramps, picnic tables, portable restrooms, and other amenities.
- Implement the SMP filed with the license application that includes measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, BMPs for controlling sediment introduction from lands within the project boundary, and use of project lands.

- Implement the osprey management policy described in Exelon's proposed SMP.
- Implement the HPMP filed with the license application for the management of archaeological and historic resources, including: (1) a schedule and methodology for completing any additional recommended studies and implementing monitoring measures; (2) management measures for identified historic properties including Conowingo dam and powerhouse; (3) protection of any historic properties threatened by project-related activities, including project operation, shoreline and aquatic recreation, shoreline development, routine project maintenance, and other project activities or operations; and (4) public outreach, education, and signage for the purpose of reducing looting and vandalism of sites.

Project Boundary Revisions

York Haven Project

York Haven Power proposes to add 1.9 acres to the total York Haven Project boundary acreage to encompass the project's existing East Shore Boat Launch and Canal Lock recreation area.

Conowingo Project

Exelon proposes to modify the Conowingo Project boundary by removing lands that are not necessary for operation and maintenance of the project or for public recreation or protection of environmental resources. These lands include: 0.06 acre of land not owned by Exelon in the upper reaches of Conowingo Pond; 34.4 acres along the Susquehanna River shoreline at the Muddy Run Project (to minimize the overlap of project lands between the two projects); lands from upper Broad Creek and from the Susquehanna River downstream of Rowland Island that were originally included for construction of the project, including 205.6 acres on upper Broad Creek, a tributary to Conowingo Pond; and 1,758.7 acres of the Susquehanna River and shoreline downstream of Conowingo dam. The Lower Susquehanna Heritage Greenway, Deer Creek Access, Lapidum Boat Launch, and McLhinney Park are non-project recreation sites located on a thin ribbon of land along the west bank of the Susquehanna River downstream of Conowingo dam. This area was included in past licenses so as to incorporate the railroad that was used to shuttle material to the dam during initial construction. The proposed project boundary contains 9,919 acres, including 8,850 acres of project waters and 1,069 acres of land above the normal high water elevation in Lancaster and York Counties, Pennsylvania, and Harford and Cecil Counties, Maryland. Exelon would negotiate leases with existing recreation facility operators for the continued operation of those facilities located on lands owned by Exelon, but no longer within the project boundary. Exelon would also negotiate a new lease with Maryland Department of Natural Resources (Maryland DNR) for the continued protection and use of the co-located Lower

Susquehanna Greenway Trail and Mason-Dixon Trail on Exelon-owned lands outside of the project boundary. The former lease expired in August 2014.

Alternatives Considered

In addition to the applicants' proposals, as outlined above, this final environmental impact statement considers the following alternatives: (1) the applicants' proposals with staff-recommended modifications (staff alternative), (2) a staff alternative with mandatory conditions,[16] and (3) a no-action alternative.

Staff Alternative

Under the staff alternative, the projects would be operated as proposed by York Haven Power and Exelon with the modifications and additional staff-recommended measures described below for each project:

York Haven Project

- Develop a Recreation Management Plan that provides for York Haven's proposed maintenance of its existing recreation facilities with additional provisions to update the plan every 12 years consistent with every other 6-year Form 80 reporting period deadline, continuation of the licensing program for approximately 300 recreational lots within the project boundary, and implementation of revisions to the program to allow for the termination of permits and removal of lots from the program if structures are abandoned by the lessee, or when existing structures become damaged and are not replaced by conforming structures.
- Develop an SMP that includes specific measures and policies related to shoreline management at the project and a provision to update the plan every 10 years.
- Modify York Haven's proposed HPMP with the following additional provisions: (a) request access to sites on private lands within the project boundary if project effects are identified during shoreline monitoring activities, assess these effects, and evaluate the affected sites for listing on the National Register of Historic Places (National Register); (b) develop a plan and schedule to survey and record archaeological sites on York Haven-owned fee lands within the project boundary and evaluate them for their National Register eligibility to ensure that any effects on sites owned by York Haven Power are fully considered in accordance with section 106;

[16] This alternative only applies to the York Haven and Muddy Run projects, where mandatory conditions were filed. No mandatory conditions have been filed for the Conowingo Project.

(c) include two additional sites (36YO300, 36YO334) in the monitoring schedule, or clarification regarding why they were excluded; and
(d) include the National Park Service (Park Service) as a consulting party.

Muddy Run Project

- Visit the U.S. Fish and Wildlife Service's (FWS) Chesapeake Bay Field Office and the Pennsylvania Field Office websites prior to any ground disturbance, and follow the bog turtle and bald eagle guidelines.
- Modify the restrictions for mowing areas C, D, and F in Exelon's proposed Bog Turtle Management Plan to state, "avoid mowing between April and October to avoid turtle's active period."
- Modify Exelon's proposed Recreation Management Plan to include recreation use monitoring and plan updates every 12 years in concert with every other 6-year Form 80 reporting deadline.
- Modify Exelon's proposed SMP to include a provision to update the plan every 10 years.
- Develop an HPMP that provides for the management of historic properties and unevaluated cultural resources within the project's area of potential effects (APE) and includes: (a) a plan for further archaeological investigations of additional areas of interest (AOIs) and other potentially affected areas within the APE as recommended in the Phase IB report: (b) a detailed discussion of the three sites (36LA67, 36LA103, 36LA368) identified during Phase IA cultural resources surveys and two additional sites (36LA70, 36LA47) located outside of the project boundary that could be affected by the project; (c) requirements for National Register evaluation of affected sites in consultation with the Pennsylvania State Historic Preservation Officer (SHPO); (d) requirements for formal National Register evaluation of the Muddy Run Project; (e) documentation of all consultation with the Delaware Nation and Onondaga Nation; and (f) designation of the Park Service as a consulting party.

Although required by the water quality certification issued by Pennsylvania DEP for the Muddy Run Project, the staff alternative does not include Exelon's proposals to implement provisions of the Muddy Run American Eel Passage Plan at the Conowingo Project, including an eel trap and truck program, and to provide annual grants of $450,000 to be split between the York County and Lancaster County conservation districts and $50,000 to Pennsylvania FBC to compensate for the entrainment of resident fish, and to improve fish habitat by removal of dams elsewhere in Pennsylvania. The Commission cannot require a condition in the Muddy Run license (eel passage) for actions to take place as part of another licensed project. However, we are recommending that the Conowingo Project license include essentially the same measures as those in the

Muddy Run American Eel Passage Plan at the Conowingo Project. For the annual grants, providing compensatory funds is inconsistent with the Commission's guidelines on environmental measures.[17] The staff alternative also does not include the water quality certification requirement that Exelon provide a copy of the OASIS model to SRBC. We are not recommending this as a requirement of any license issued because it is not a specific measure for protection or enhancement of environmental resources, and instead appears to be a transfer of information to SRBC. Finally, the staff alternative does not recommend Exelon's proposal to evaluate all state and federal endangered or threatened species that may be present within the project boundary once every 10 years through the term of the license. The Commission typically includes in its licenses a standard license article with a fish and wildlife reopener provision that could be used to require changes to project facilities upon Commission motion or as recommended by the appropriate federal and state fish and wildlife agencies after notice and opportunity for hearing. This standard reopener provision retains authority for the Commission to implement any measures that may be needed to protect threatened or endangered species or other fish and wildlife resources over the term of any license issued for the project.

<u>Conowingo Project</u>

- Modify Exelon's proposed Sediment Management Plan to include periodic dredging at the Conowingo Creek, Peters Creek (Peach Bottom Marina), and Broad Creek boat ramps, where sediments have been accumulating, to improve and maintain recreational boating access; include metrics (magnitude or frequency of sediment loading storm events) that would trigger action to protect boating access between the 5 year monitoring interval; and include with the results of each bathymetric survey an analysis of any change in sediment deposition or scour in the pond from the previous survey(s).
- Modify Exelon's proposed minimum flow regime to enhance minimum flows from December through February, by eliminating periods with no minimum flow, and by increasing the minimum flow during the first 2 weeks of June, summarized as follows:
  - September 15 – March 31: 3,500 cfs or natural inflow (measured at the U.S. Geological Survey Marietta gage No. 0157600), whichever is less;
  - April 1 – April 30: 10,000 cfs or natural inflow, whichever is less;
  - May 1 – June 15: 7,500 cfs or natural flow, whichever is less;
  - June 16 – September 14: 5,000 cfs or natural inflow, whichever is less.

[17] *See* Policy Statement on Hydropower Licensing Settlements, issued September 21, 2006.

- Implement measures designed to improve upstream fish passage through modification to the existing west and east fish lifts, including: (a) replacing the existing hopper at the west fish lift with a 1,500 gallon hopper; (b) improving the west fish lift sorting and loading process to facilitate trap and truck operations, and implementing a trap and truck program for American shad; (c) conducting a feasibility study for adding attraction flow at the west fish lift and if feasible and beneficial, installing additional flow capacity; (d) restoring the original design for the 900-cfs attraction flow in the east fish lift; (e) adding a second 3,300-gallon hopper to the east fish lift in the space provided for in the original design, and upgrading the electrical and mechanical equipment to allow for a 15-minute lift cycle; and (f) if 2 years of effectiveness studies, after restoration of the 900-cfs attraction flow, show poor attraction at the east fish lift, conducting a feasibility study for modifying the locations of entrances A and B, and implementing the modifications, if feasible.
- Modify Exelon's proposed Bald Eagle Management Plan to include measures to minimize recreation-related disturbance in proximity to roosting or foraging eagles.
- Develop a northern map turtle protection plan to minimize project impacts on map turtles through monitoring, habitat management, and nest site protection.
- Develop a waterfowl nesting protection plan to identify waterfowl nesting habitat that is routinely flooded by project peaking operations during the breeding season, and where feasible, establish mitigation measures to minimize impacts on waterfowl nests.
- Develop a bog turtle management plan, in consultation with FWS and Maryland DNR, to minimize impacts on bog turtles and that includes: (1) the restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) limits on public access to the wetland without advertising the reason.
- Modify Exelon's proposed Recreation Management Plan to include recreation use monitoring and plan updates every 12 years in concert with every other 6-year Form 80 reporting deadline; inclusion of the Park Service as a consulting party; a provision to provide angler access to the catwalk on a limited basis and security measures in place that address the vulnerability of the facility and the safety of the users of the catwalk; a cross reference to the Sediment Management Plan to provide periodic dredging of tributary boat access areas; and development and implementation of a debris management program in consultation with

Pennsylvania FBC, Maryland DNR, and Susquehanna River Boaters Association that includes: (1) debris management goals, (2) BMPs for debris management on Exelon-owned lands to minimize additional inputs into the pond, (3) methods of debris management (e.g., clamming in front of dam and by skimmer boat), (4) timeframes for when debris would be collected and frequency of skimmer boat and clamming operations, (5) size criteria specification, (6) removal of stored debris procedures, (7) tracking procedures, and (8) a hotline for boaters to directly link with Exelon staff.

- Modify Exelon's proposed SMP with the addition of a provision to update the plan every 10 years.
- Modify Exelon's proposed HPMP to include the following additional provisions: (a) a revised APE with the narrow strip of land in the current project boundary extending downstream from Spencer Island along the west side of the river to Havre de Grace, Maryland; (b) a discussion of all 48 sites and 27 historic structures identified to date within the project APE or an explanation of why they are not considered; (c) correction to identify the Susquehanna and Tidewater Canal and Columbia & Port Deposit Railroad eligible for listing; (d) requirements to inventory any lands within the revised APE, evaluate identified cultural resources for eligibility, and address potential effects before sale or transfer of those lands; (e) a requirement to make good faith effort to obtain access to private property to conduct studies if project effects on cultural resources on private lands are identified; (f) a revised list of project activities involving the Conowingo Project that can be completed without Maryland SHPO review; (g) a process for assessing project-related ground-disturbing activities to determine whether or not archaeological sites would be affected, particularly in areas that have not had archaeological surveys; (h) requirements to ensure confidentiality of cultural resources location information during implementation of public outreach programs; (i) a description of project-related activities that would require consultation with the Delaware Nation and the Onondaga Nation in accordance with section 106 of the National Historic Preservation Act, and documentation of all consultation with the Delaware Nation and Onondaga Nation; and (j) the inclusion of the Park Service as a consulting party.

Staff Alternative with Mandatory Conditions (York Haven and Muddy Run Projects)

We recognize that the Commission is required to include valid water quality certification conditions and section 18 fishway prescriptions in any licenses issued for the projects. The staff alternative with mandatory conditions would include the respective staff-recommended measures along with the mandatory conditions that we did not include in the staff alternative.

For the York Haven Project, this alternative would include the staff alternative with one additional measure: contributing $25,000 per year to the York County Conservation District or such other entity identified by Pennsylvania DEP for the purposes of debris removal in the lower Susquehanna River watershed. The staff alternative does not include this measure, because providing compensatory funds is inconsistent with the Commission's guidelines on environmental measures, and this measure may not have a direct nexus to the project in that debris removal may occur in areas not affected by project operations.

For the Muddy Run Project, this alternative would include the staff alternative with four additional measures: (1) implement the Eel Management Plan filed with the license application for the eel trap and truck program to trap, hold, and transport American eels from the Conowingo Project to designated points in the Susquehanna River watershed until at least 2030, and then either continue the trap and truck program or construct a volitional eel passage facility at Conowingo dam; (2) provide the version of the Lower Susquehanna River OASIS Model to SRBC within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become final, as provided in the *Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRBC*; (3) provide annual grants up to $450,000 total to be split between the Lancaster County and York County Conservation Districts through 2030, for the implementation of agricultural pasture and barnyard BMPs to control sediment loading to the Susquehanna River; and (4) provide $50,000 annually to Pennsylvania FBC to perform habitat improvement projects including the removal of small dams.

Incorporation of these mandatory conditions into new licenses for the York Haven and Muddy Run Projects would not cause us to modify or eliminate any of the environmental measures that we include in the staff alternative.

No-Action Alternative

Under the no-action alternative, each project would continue to operate under the terms and conditions of the existing licenses, and no new environmental protection, mitigation, or enhancement measures would be implemented.

Public Involvement and Areas of Concern

Before filing the license applications for the Susquehanna River Projects, York Haven Power and Exelon conducted pre-filing consultation under the integrated licensing process. The intent of the Commission's pre-filing process is to initiate public involvement early in the project planning process and to encourage citizens, government entities, Indian tribes, and other interested entities to identify and resolve issues prior to a license application being formally filed with the Commission. During pre-filing, Commission staff conducted scoping to determine what issues and alternatives should be addressed. Scoping documents (SD1s) were distributed to interested agencies and others on July 24, 2009, for the York Haven Project, and on May 11, 2009, for the Muddy Run and Conowingo Projects. In addition, scoping meetings were held on

August 26 and 27, 2009, for the York Haven Project; June 10, 2009, for the Muddy Run Project; and June 11 and 12, 2009, for the Conowingo Project to request comments on the projects. Revised scoping documents, addressing the comments received, were issued on November 13, 2009, for the York Haven Project, and on August 24, 2009, for the Muddy Run and Conowingo Projects.

The primary issues associated with relicensing the projects are sedimentation effects on aquatic resources downstream of Conowingo dam, including the Chesapeake Bay; instream flows downstream of Conowingo dam; the effects of project operations on water quality; effective fish passage for American shad, American eel, and other diadromous species; protection of sensitive plant and wildlife species including the bald eagle, osprey, bog turtle, and northern map turtle; and enhancements to recreation opportunities and facilities.

Staff Alternative

Geology and Soils – Continued run-of-river operation of the York Haven Project would have minimal effect on shoreline erosion in Lake Frederic. Development of the proposed erosion and sediment control plan prior to ground-disturbing activities associated with construction of the nature-like fishway would ensure BMPs are in place to minimize erosion and sedimentation.

Shoreline erosion effects from the operation of the Muddy Run and Conowingo Projects are also considered minimal, and implementing erosion control measures proposed by Exelon in the SMPs would help minimize adverse effects on water quality in the respective reservoirs.

Exelon's proposed Conowingo Sediment Management Plan would identify action benchmarks and thresholds at the powerhouse intakes to address sedimentation-related issues as they might affect project operation. Exelon's proposed bathymetric surveys in Conowingo Pond at 5-year intervals would allow for verification of predictions from the Lower Susquehanna River Watershed Assessment (LSRWA) study (U.S. Army Corps of Engineers and Maryland Department of the Environment, 2014) and identify appropriate management actions. A final Sediment Management Plan that includes detailed benchmarks for dredging, a schedule, and commitment to dredging three boating access areas affected by sedimentation in Conowingo Pond as soon as the benchmark sediment depths are reached would maintain recreation access.

Aquatic Resources – Continued operation of the York Haven, Muddy Run, and Conowingo Projects would have minimal effects on water quality in the lower Susquehanna River, and Exelon's continued DO monitoring at the Muddy Run and Conowingo Projects would ensure that DO is maintained at levels that are consistent with current state standards.

Establishing a modified minimum flow regime at Conowingo that would enhance Exelon's minimum flows from December through February and in the first 2 weeks of

June would allow continued operation of the Muddy Run and Conowingo Projects while improving downstream aquatic habitat.

Constructing and operating the nature-like fishway at York Haven, improving the fish lifts at the Conowingo Project, and implementing American eel passage measures at the three projects would enhance upstream fish migration and maintain required downstream survival of diadromous fish species in the lower Susquehanna River.

Interior filed preliminary fishway prescriptions for the York Haven and Muddy Run Projects (see appendices D and E to this final EIS). At York Haven, the prescription is consistent with the Settlement Agreement, requiring the nature-like fishway and downstream passage measures. At Muddy Run, the prescription requires an FPOP for minimizing delay and potential fish entrainment, and an upstream eel passage program from the downstream Conowingo Project. At Conowingo, Interior reserves its authority to later prescribe fishways during the term of the license, although it describes an alternative (alternative G) that it may or may not adopt, that would require major renovations to the existing east and west fish lifts, and implementation of upstream eel passage at the project. The staff alternative includes measures consistent with Interior's fishway prescriptions for York Haven and Muddy Run, with the exception of the Muddy Run requirements for eel passage, which cannot be included in another project's license (Conowingo). In addition, while the final fishway prescriptions would become a requirement of any licenses issued, staff recommends an alternative at Conowingo that would provide substantial improvements to the fish passage facilities at the project and would involve renovations to the existing east and west fish lifts, but at a lower cost and more appropriate scale than alternative G, considering the current size of the American shad run.

<u>Terrestrial Resources</u> – Raptors, including state sensitive species such as bald eagle and osprey, and waterfowl occur on the projects' lands and waters, and these species could be affected by project operation, maintenance activities, and use of project recreation facilities. Implementing Exelon's Bald Eagle Management Plan, as proposed for the Muddy Run Project, and with the staff modifications for the plan at the Conowingo Project to include measures to minimize recreation-related disturbance in proximity to roosting or foraging eagles, would ensure that bald eagle nesting, roosting, and foraging areas are protected within the Muddy Run and Conowingo project boundaries.

Exelon's proposed osprey management policies at the Muddy Run and Conowingo Projects would benefit ospreys by implementing BMPs and protection measures to minimize effects on osprey nesting within the project boundary.

A waterfowl nesting protection plan at the Conowingo Project, as recommended by Interior would identify waterfowl nesting habitat that is routinely flooded by project peaking operations during the breeding season, and where feasible, establish mitigation measures to minimize impacts on waterfowl nests.

A northern map turtle protection plan would minimize project impacts on map turtles, through monitoring, habitat management, and nest site protection, as described in Towson University's 2014 final map turtle report.

Threatened and Endangered Species – Six federally listed species are known to occur in the general vicinity of one or more of the projects: shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus),* bog turtle (*Glyptemys* [*Clemmys*] *muhlenbergii*), Indiana bat (*Myotis sodalis*), Delmarva Peninsula fox squirrel (*Sciurus niger cinereus*), and swamp pink (*Helonias bullata*). In addition, the northern long-eared bat (*Myotis septentrionalis*) is proposed for listing under the Endangered Species Act.

The York Haven and Muddy Run Projects would have no effect on either shortnose or Atlantic sturgeon because neither species has been collected or passed via the Conowingo fish lifts since they began operation in 1972. While there is suitable habitat downstream of Conowingo for both species, only occasional individual shortnose sturgeon have been reported from the river below the dam, and there is no recent evidence of the occurrence of Atlantic sturgeon in the lower Susquehanna River. Therefore, continued operation of the Conowingo Project would not likely adversely affect shortnose or Atlantic sturgeon.

Bog turtles have been confirmed near the Muddy Run and Conowingo Projects. Bog turtles are not known to occur at the York Haven Project. Implementing Exelon's Bog Turtle Management Plan for the Muddy Run Project with FWS' recommended modified mowing restrictions for mowing areas C, D, and F and implementing Interior's recommended bog turtle management plan at the Conowingo Project, including habitat management at any confirmed breeding locations and other practices to protect the existing population and improve bog turtle habitat, would eliminate the likelihood of any adverse effects on bog turtles and their habitat due to project maintenance or recreation. Therefore, we conclude that relicensing the York Haven, Muddy Run, and Conowingo Projects would not be likely to adversely affect the bog turtle.

Potential Indiana and northern long-eared bat habitat may exist within the three project areas, along the riparian forested edges of the river and reservoirs, and forested edges along transmission line rights-of-way and recreational areas. Neither York Haven Power nor Exelon propose any activities that would result in more than a minimal amount of tree clearing. At the Muddy Run Project, continued routine vegetation management practices, such as trimming and herbicide application, would be unlikely to affect trees large enough to provide roosting habitat. Therefore, the York Haven, Muddy Run, and Conowingo Projects would not be likely to adversely affect the Indiana bat and would not be likely to jeopardize the continued existence of the northern long-eared bat.

Swamp pink have been previously documented in Cecil and Harford Counties where the Conowingo Project is located but are not known to occur in those project areas according to FWS' Information, Planning, and Conservation System website. Therefore, the York Haven and Muddy Run Projects would have no effect on the swamp pink.

The three projects would have no effect on the Delmarva Peninsula fox squirrel. Although it was noted in SD1 as occurring in the vicinity of the Muddy Run and Conowingo Projects, it is not known to exist in the project area.

Recreation and Land Use – Continued operation of the York Haven, Muddy Run, and Conowingo Projects would enhance the recreational facilities and benefit recreationists in the region. Implementing a Recreation Management Plan at the York Haven Project that includes a facility inventory with ownership and management responsibilities for each site, as well as measures to provide for periodic monitoring and consultation, would ensure that recreational opportunities are maintained and enhanced.

Revising the York Haven Project boundary to include the entirety of the Lock 15 recreation facility would bring a facility associated with the East Shore boat launch within the project boundary.

Implementing the proposed Recreation Management Plans at the Muddy Run and Conowingo Projects that include measures for maintenance and capital improvement, with staff modifications that include providing angler access to the catwalk at Conowingo and including an expanded debris management program, would ensure that the visitation, facilities, and reservoir surface are monitored and maintained periodically to ensure that the project recreation facilities and reservoir surface continue to meet recreation use and demand at the projects.

Revising the Conowingo project boundary to remove lands that were necessary during construction of the project but are no longer used for project purposes (such as project-related recreation or protection of environmental resources not related to the project) would be consistent with FERC policy that only lands and waters needed for project purposes should be included in the project boundary.

Cultural Resources – Continued operation of the York Haven, Muddy Run, and Conowingo Projects could affect historic properties located within the projects' boundaries. Implementing York Haven Power's and Exelon's HPMPs with the staff-recommended modifications to the plans for the York Haven and Conowingo Projects, and development of an HPMP for the Muddy Run Project would provide for the management and protection of cultural resources and any historic properties associated with the projects.

No-Action Alternative

Under the no-action alternative, the projects would continue to operate under the terms and conditions of the existing licenses, and no new environmental protection, mitigation, or enhancement measures would be implemented.

Conclusions

Based on our analysis, we recommend licensing the projects as proposed by York Haven Power and Exelon with some staff modifications and additional measures. The staff alternative does not include certain mandatory conditions for the York Haven and Muddy Run Projects in a new license as discussed in section 5, *Conclusions and Recommendations*.

In section 4.2, *Comparison of Alternatives*, we estimate the likely cost of alternative power for each of the alternatives identified above. For the York Haven Project, our analysis shows that, during the first year of operation under the proposed action, the project would produce power at a cost that is $336,690 or $2.56/megawatt-hour (MWh) more than the cost of alternative power. Under the staff alternative, the project would produce power at a cost that is $332,650 or $2.52/MWh more than the cost of alternative power. Under the staff alternative with mandatory conditions, the project would produce power at a cost that is $348,900 or $2.65/MWh more than the cost of alternative power.

For the Muddy Run Project, our analysis shows that, during the first year of operation under the proposed action, the project would produce power at a cost that is $50,233,890 or $31.09/MWh less than the cost of alternative power. Under the staff alternative, the project would produce power at a cost that is $50,497,820 or 31.27/MWh less than the cost of alternative power. Under the staff alternative with mandatory conditions, the project would produce power at a cost that is $50,172,280 or 31.07/MWh less than the cost of alternative power.

For the Conowingo Project, our analysis shows that, during the first year of operation under the proposed action, the project would produce power at a cost that is $32,473,180 or $17.81/MWh less than the cost of alternative power. Under the staff alternative, the project would produce power at a cost that is $31,228,810 or $17.15/MWh less than the cost of alternative power. No mandatory conditions have been filed to date for the Conowingo Project, so there is no staff alternative with mandatory conditions for the project.

We chose the staff alternatives as the preferred alternatives for the Susquehanna River Projects because: (1) the York Haven, Muddy Run, and Conowingo Projects would provide a dependable source of electrical energy and ancillary services for the region (131,771 MWh, 1,614,882 MWh, and 1,820,743 MWh annually, respectively); (2) the combined 594.16 MW of electric capacity for the York Haven and Conowingo Projects comes from a renewable resource that does not contribute to atmospheric pollution[18]; and (3) the recommended environmental measures proposed by York Haven

[18] The 800.25 MW of capacity from the Muddy Run Project cannot be considered renewable because power used for pumping may come from non-renewable sources.

Power and Exelon, as modified by staff, would adequately protect and enhance environmental resources affected by the projects. The overall benefits of the staff alternatives would be worth the cost of the proposed and recommended environmental measures.

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1.0 INTRODUCTION

1.1 APPLICATION

On August 30, 2012, York Haven Power Company, LLC (York Haven Power) filed an application for a new license with the Federal Energy Regulatory Commission (Commission or FERC) to continue operating the existing York Haven Project (FERC Project No. 1888).[19] The 19.62-megawatt (MW) project is on the Susquehanna River at river mile (RM)[20] 55 in the borough of York, in York, Dauphin, and Lancaster Counties, Pennsylvania (figure 1-1), and it generates an average of about 132,271 megawatt-hours (MWh) of energy annually. The project does not occupy any federal lands. York Haven Power proposes no new capacity and no new construction; however, it is proposing the construction of a new fishway as part of its proposed environmental measures.

On August 29, 2012, Exelon Generation Company, LLC (Exelon) filed applications for new licenses with the Commission to continue operating the existing Muddy Run Pumped Storage Project (Muddy Run Project) (FERC Project No. 2355)[21] and the existing Conowingo Hydroelectric Project (Conowingo Project).[22] The 800.25-MW Muddy Run and the 574.54-MW Conowingo Projects are located on the Susquehanna River at RM 22 and 10, respectively, in Lancaster and York Counties, Pennsylvania, and Cecil and Harford Counties, Maryland (figure 1-1).[23] Conowingo Pond acts as the lower reservoir for the Muddy Run Project. Neither project occupies any federal lands. The Muddy Run and Conowingo Projects generate an average of about

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[19] The current license for the York Haven Project was issued on August 14, 1980, and expired on September 1, 2014. On September 10, 2014, the Commission issued a notice that York Haven Power is authorized to continue operation of the York Haven Project until such time as the Commission acts on its application for a new license.

[20] The river mile is calculated from the mouth of the Susquehanna River at its confluence with the Chesapeake Bay.

[21] The current license for the Muddy Run Project was issued on September 21, 1964, and expired on August 31, 2014. On September 10, 2014, the Commission issued a notice that Exelon is authorized to continue operation of the Muddy Run Project until such time as the Commission acts on its application for a new license.

[22] The current license for the Conowingo Project was issued on August 14, 1980, and expires on September 1, 2014. On September 10, 2014, the Commission issued a notice that Exelon is authorized to continue operation of the Conowingo Project until such time as the Commission acts on its application for a new license.

[23] The authorized capacity for Muddy Run is from the original license issued September 21, 1964, and the authorized capacity for Conowingo is from the Commission Order issued March 3, 2010.

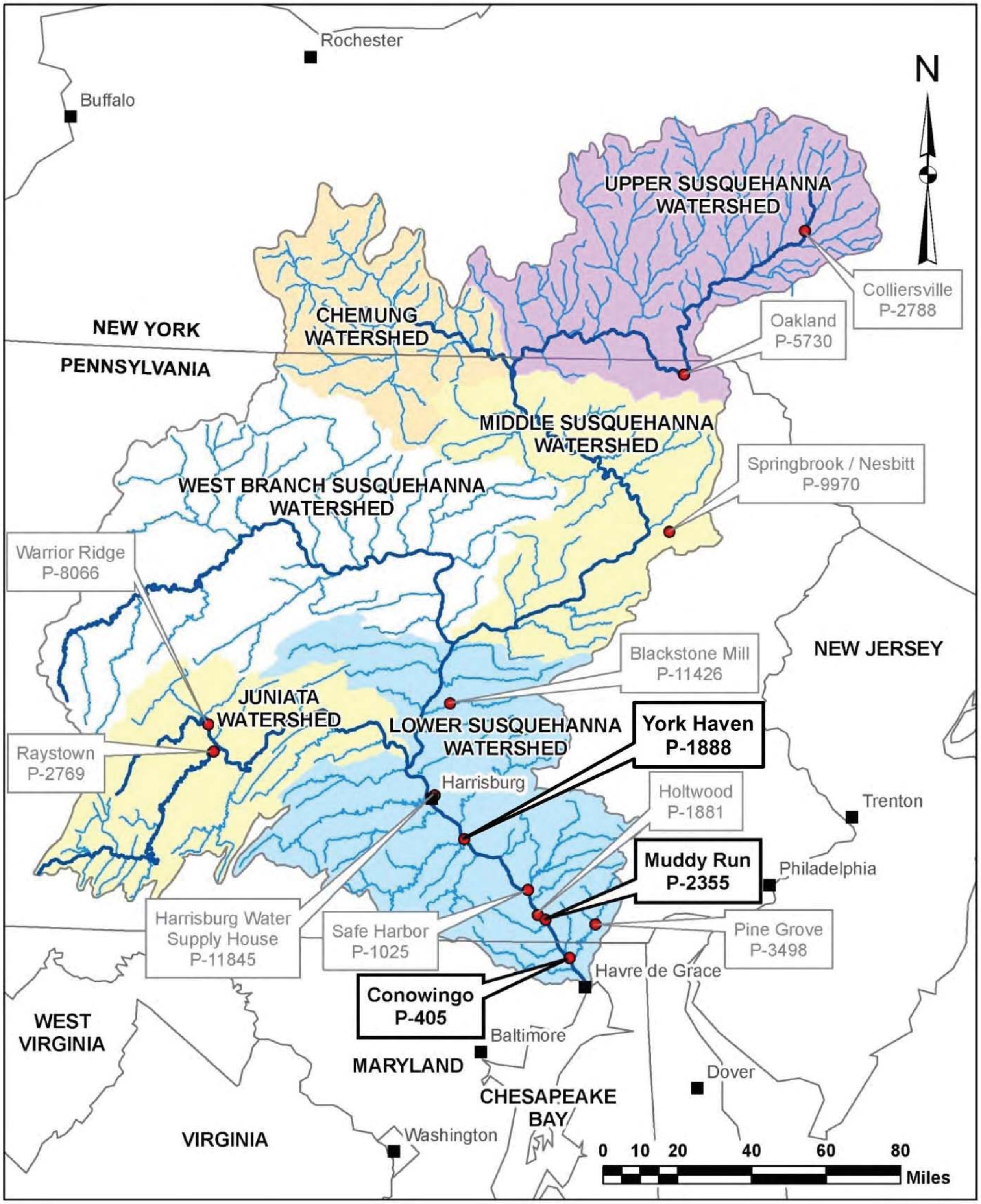

Figure 1-1. Susquehanna River Projects location (Source: FERC, 2009, as modified by staff).

1,615,813 MWh and 1,823,193 MWh of energy annually, respectively. Exelon proposes no new capacity and no new construction at either project.

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the York Haven, Muddy Run, and Conowingo Projects (Susquehanna River Projects) is to continue to provide a source of hydroelectric power. Therefore, under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue a license to York Haven Power for the York Haven Project and to Exelon for the Muddy Run and Conowingo Projects and what conditions should be placed on any licenses issued. In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the projects will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, or water supply), the Commission must give equal consideration to the purposes of: (1) energy conservation; (2) the protection of, mitigation of damage to, and enhancement of fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

Issuing new licenses for the Susquehanna River Projects would allow York Haven Power and Exelon to generate electricity at the projects for the term of each new license, making electric power from a renewable resource available to their customers. This multi-project final environmental impact statement (EIS) assesses the effects associated with operation of the projects, alternatives to the proposed projects, and makes recommendations to the Commission on whether to issue a new license, and if so, recommends terms and conditions to become a part of any licenses issued.

In this final EIS, we assess the environmental and economic effects of continuing to operate the projects: (1) as proposed by York Haven Power and Exelon; and (2) with our recommended measures. We also consider the effects of the staff alternative with mandatory conditions and the no-action alternative. Important issues that are addressed include the effects of continued project operation on instream flows, shoreline erosion and sediment transport, water quality, fishery resources and fish passage, terrestrial resources, threatened and endangered species, recreation and land use, and cultural resources.

1.2.2 Need for Power

The Susquehanna River Projects provide hydroelectric generation to meet part of Maryland's and Pennsylvania's power requirements, resource diversity, and capacity needs. The existing York Haven Project has an installed capacity of 19.62 MW and generates approximately 132,271 MWh per year (average 2001-2011). The existing Muddy Run Project has an installed capacity of 800.25 MW and generates approximately 1,615,813 MWh per year (average 1996-2010). The existing Conowingo Project has an installed capacity of 574.54 MW and generates approximately 1,823,193 MWh per year (1996-2010).

The North American Electric Reliability Corporation (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. The projects are located in the Pennsylvania-New Jersey-Maryland region of NERC. According to NERC's 2013 forecast, the summer and winter planning reserve margins (capacity resources in excess of demand) are expected to drop from 32.04 percent in 2014 to 19.73 percent in 2023 and from 42.99 percent in 2014 to 32.87 percent in 2023, respectively (NERC, 2013).

In addition to energy and capacity, the Conowingo and Muddy Run Projects provide ancillary services that benefit the electric grid. The Conowingo Project provides peaking generation, regulation control, and black start capabilities. The Muddy Run Project provides peaking generation, peak load following, spinning reserve, and black start capability, and also is able to use excess baseload energy during pumping operation.

Baseload facilities operate at maximum output. They shut down or reduce power only to perform maintenance or repairs. Baseload facilities typically include coal, fuel oil, nuclear, hydroelectric, geothermal, biomass, and combined cycle natural gas facilities.

Pumped storage facilities can be operated at a generating level that is much lower than baseload facilities and can therefore avoid the need to run a baseload unit at low efficiencies below the minimum load rating of the baseload unit. Pumped storage facilities can also use excess energy provided by baseload units that run continuously at night to pump water to the upper reservoir so that it can be used for generation during daily peak demand periods.

Peaking facilities operate during times of peak electric demand. Conowingo and Muddy Run have the ability to meet peak energy demands by increasing generation needed when water is available. They have the ability to start within minutes, if not seconds, depending upon available water supply. Muddy Run is able to draw from storage in the Muddy Run Project reservoir (the upper reservoir) when needed to provide peak generation, while Conowingo relies on inflows and impoundment storage.

Spinning reserve is the extra generating capacity that is available by increasing the power output of generators that are already connected to the power grid. Facilities like Muddy Run that provide spinning reserve can be on line, synchronized with the electric grid, and quickly add power to the system as needed. Muddy Run can also perform "load following," whereby the output of the facilities is increased or decreased in response to variations in electric demand.

Hydroelectric facilities can also provide frequency and/or voltage regulation benefits to the system. Operating in frequency control mode, they alter their output to keep the system frequency near the required value to avoid system imbalance. Similarly, they can also provide system voltage control.

Black start is the procedure to recover from a total or partial shutdown of the transmission system, such as the blackout that occurred in August 2003, which was the largest ever blackout of the North American power grid. The outage affected an estimated 50 million people and more than 70,000 MW of electrical load in parts of Ohio, Michigan, New York, Pennsylvania, New Jersey, Connecticut, Massachusetts, Vermont, and the Canadian provinces of Ontario and Quebec. Power was successfully restored to most customers within hours, while some areas in the United States did not have power for 2 days, and parts of Ontario experienced rotating blackouts for up to 2 weeks. Conowingo and Muddy Run were some of the first units used to bring the system back on line. These facilities were started individually and gradually brought on line to stabilize the system before the baseload units were brought back on line.

We conclude that power from the projects would help meet a need for power and ancillary services in the Pennsylvania-New Jersey-Maryland region in both the short- and long-term. The projects would provide low-cost power that displaces generation from non-renewable sources. Displacing the operation of non-renewable facilities may avoid some power plant emissions, thus creating environmental benefits.

1.3 STATUTORY AND REGULATORY REQUIREMENTS

Licenses for the Susquehanna River Projects are subject to numerous requirements under the FPA and other applicable statutes. We summarize the major regulatory requirements in table 1-1 and describe them below.

Table 1-1. Major statutory and regulatory requirements for the Susquehanna River Projects.

Requirement	Agency	Status
Section 18 of the FPA (fishway prescriptions)	U.S. Department of the Interior (Interior); National Marine Fisheries Service (NMFS)	Interior filed preliminary fishway prescriptions for the York Haven Project on January 30, 2014, and for the Muddy Run Project on January 31, 2014. Interior filed a reservation of authority for the Conowingo Project on January 31, 2014. NMFS filed reservations of authority for the Muddy Run and Conowingo Projects on January 30, 2014.
Section 10(j) of the FPA	Interior; Pennsylvania Fish and Boat Commission (Pennsylvania FBC)	Interior filed 10(j) recommendations for the York Haven, Muddy Run,

Requirement	Agency	Status
		and Conowingo Projects on January 30 and 31, 2014; Pennsylvania FBC filed 10(j) recommendations for the Conowingo Project on December 11, 2013.
Clean Water Act—water quality certification	Pennsylvania Department of Environmental Protection (Pennsylvania DEP); Maryland Department of the Environment (Maryland DOE)	York Haven Project – Pennsylvania DEP received an application for water quality certification on August 29, 2013; Pennsylvania DEP issued a certification for the York Haven Project on August 19, 2014.
		Muddy Run Project – Exelon applied to Pennsylvania DEP for certification on August 28, 2013; Pennsylvania DEP issued a certification for the Muddy Run Project on June 3, 2014, and filed a clarified version of the certification on December 10, 2014.
		Conowingo Project – Maryland DOE received an application for certification on January 31, 2014; Exelon withdrew its application on December 4, 2014, with plans to refile an application for certification within 90 days of that date. Maryland DOE will have one year to act on the application, although Exelon stated by letter filed December 22, 2014, that it will withdraw and refile the

Requirement	Agency	Status
		application on an annual basis until a sediment study to be conducted by Exelon and Maryland DOE is completed in 2016 or 2017.
Endangered Species Act Consultation	U.S. Fish and Wildlife Service (FWS); NMFS	In letters filed on January 7, 2015, FWS concurred with our not likely to adversely affect determinations for the Indiana bat and the bog turtle for all three projects, with some qualifications;[24] following staff letters issued August 21 and September 3, 2014, NMFS concurred with our no effect determination for shortnose sturgeon and Atlantic sturgeon for the York Haven and Muddy Run Projects, by letter filed September 23, 2014; by letters issued August 21, September 3, and October 23, 2014, we sought concurrence from NMFS on our not likely to adversely affect determination for shortnose sturgeon and Atlantic sturgeon for the Conowingo Project.
Coastal Zone Management Act Consistency	Pennsylvania Coastal Resource Management Program (Pennsylvania CRM Program); Maryland DOE	Pennsylvania CRM Program determined both York Haven and Muddy Run are located outside the state's coastal zone and would not affect coastal resources; Maryland

[24] See sections 1.3.3, *Endangered Species Act*, and 3.3.4, *Threatened and Endangered Species*, for a detailed discussion.

Requirement	Agency	Status
		DOE has until January 30, 2015, to determine consistency.
National Historic Preservation Act	Pennsylvania State Historic Preservation Officer (Pennsylvania SHPO); Maryland SHPO	A Programmatic Agreement is to be executed between the Commission and the SHPOs.

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of Commerce and Interior.

On January 30, 2014, the U.S. Department of the Interior (Interior) timely filed a preliminary fishway prescription for the York Haven Project, including conditions consistent with a Settlement Agreement filed on January 30, 2014 (see section 1.5, *Settlement Agreement*). Interior filed a corrected version of the preliminary fishway prescription on February 7, 2014, requesting that it replace the original filing that contained inadvertent word processing artifacts. These conditions are described under section 2.2, *Applicants' Proposals*, *York Haven Project.*

On January 31, 2014, Interior timely filed a preliminary fishway prescription for the Muddy Run Project, which it modified by letter filed on February 28, 2014. These conditions are described under section 2.2.4, *Modifications to the Applicants' Proposals – Mandatory Conditions.*

On January 31, 2014, Interior requested that a reservation of authority to prescribe fishways under section 18 be included in any license issued for the Conowingo Project.

The National Marine Fisheries Service (NMFS), by letter filed January 30, 2014, requested that a reservation of authority to prescribe fishways under section 18 be included in any license issued for the Muddy Run and Conowingo Projects.

1.3.1.2 Section 10(j) Recommendations

Under section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

Interior timely filed 10(j) recommendations for the York Haven Project on January 30, 2014, and for the Muddy Run Project on January 31, 2014, and the Pennsylvania Fish and Boat Commission (Pennsylvania FBC) and Interior timely filed, on December 11, 2013, and January 31, 2014, respectively, recommendations under section 10(j) for the Conowingo Project. In comments on the draft EIS filed on September 29, 2014, Interior withdrew its 10(j) recommendation to install and operate fishways at the Conowingo Project as described in alternative G of its reservation of authority to prescribe fishways under section 18. These recommendations are summarized in table 5-1, in section 5.3, *Fish and Wildlife Agency Recommendations*. In section 5.3, we discuss how we address the agency recommendations and comply with section 10(j).

1.3.2 Clean Water Act

Under section 401 of the Clean Water Act, a license applicant must obtain either certification from the appropriate state water pollution control agency verifying compliance with the Clean Water Act or a waiver of certification by the appropriate agency. Here, the facilities of the York Haven and Muddy Run Projects are located in Pennsylvania and the discharges from these two projects are located in Pennsylvania. The Conowingo Project facilities are located in both Pennsylvania and Maryland, but the discharge occurs in Maryland. Therefore, the Pennsylvania Department of Environmental Protection (Pennsylvania DEP) is the appropriate state water pollution certifying agency to act on York Haven Power's request for the York Haven Project and Exelon's request for the Muddy Run Project. The Maryland Department of the Environment (Maryland DOE) is the appropriate agency to act on Exelon's request for the Conowingo Project.

York Haven Project

On August 29, 2013, York Haven Power applied to Pennsylvania DEP for 401 water quality certification (certification) for the York Haven Project. Pennsylvania DEP received this request on August 29, 2013. Pennsylvania DEP issued certification on August 19, 2014. The conditions included in the water quality certification are consistent with the terms of the Settlement Agreement that is part of York Haven Power's licensing proposal. The certification conditions are included here and further described in section 3.3.2.2, *Water Resources, Environmental Effects*:

- Develop fish passage operating procedures (FPOP) for operation and maintenance of facilities used for passage of migratory and resident fish, with specific operational and maintenance procedures for each fishway at the York Haven Project, and file an annual operating report by December 31 of each year.

- Construct, operate, and maintain a nature-like fishway in the vicinity of the apex of the main dam and Three Mile Island in compliance with design criteria specified in appendices A and B of the water quality certification, with functional design drawings completed by March 31, 2015; section 401, 404, and associated permit applications by July 15, 2015; completion of procurement and construction contracts within 150 days of receiving all governmental approvals; and completion of the fishway (operational) within 3 construction seasons after completion of procurement and construction contracts.
- Operate the nature-like fishway in a "shake-down" mode during the first American shad upstream passage season, followed by 2 to 3 years of telemetry studies in successive years (with caveats) to monitor the effectiveness of the facility, with specific requirements for agency consultations in preparing the nature-like fishway monitoring plan.
- The target upstream passage efficiency for American shad is 75 percent of the upstream-migrating shad passed at the Safe Harbor Project, with specific requirements to investigate why the target efficiency is not met; the target efficiency will be considered met and the telemetry studies may be terminated if the 75 percent efficiency is met for 2 consecutive years, or if 85 percent of the shad that enter the project area pass the York Haven Project via a combination of the nature-like fishway and the east channel fishway; if the target efficiency is not met in two successive seasons, additional studies and corrective measures would be made, followed by an additional 2 years of telemetry studies; if target efficiencies are still not achieved, York Haven Power would propose a plan to mitigate for the low efficiency.
- Downstream adult shad passage would be provided by operation of the nature-like fishway, with a project target survival rate of 80 percent; from May 1 to June 30, also provide spillage flow of 370 cfs over the forebay sluice gate for 1 to 2 hours on weekday mornings, if river flow exceeds the total hydraulic capacity of the project powerhouse, required flows through the nature-like fishway, required flows through the east channel, and required flows over the main dam (if any); if 80 percent survival is not achieved, York Haven Power would propose a plan to mitigate for the low survival.
- Downstream juvenile American shad passage would be provided by an operational protocol that calls for the operation of units 1-6 (Kaplan and propeller units) to be first online and last offline during the juvenile shad downstream migration period (October 1 through November 30), and opening the forebay sluice gate at specific times for downstream fish passage. If river flows exceed the capacity of units 1-6, unit 14 would be

operated, and if flows exceed the capacities of units 1-6 and 14, units 7-13 and 15-30 would be operated in ascending order. Provide about 200 cfs through the nature-like fishway and 370 cfs through the forebay sluice gate between the hours of 5 and 11 p.m. during the entire juvenile American shad passage period, and provide this flow through the forebay sluice gate for 1 to 2 hours on weekday mornings, if river flow exceeds the total hydraulic capacity of the project powerhouse, required flows through the nature-like fishway, required flows through the east channel, and required flows over the main dam (if any).

- The target survival for downstream passage of juvenile shad is 95 percent, to be determined by a route of passage analysis and confirmation that the forebay sluice gate provides for safe passage. The 95 percent survival target would be assumed to be met if 60 percent of tagged juvenile shad released into the headrace exit via the forebay sluice gate during a headrace shad turbine avoidance study, using PIT tag monitoring. The project juvenile shad survival goal would be assumed to be met if the headrace shad turbine avoidance target is met, and York Haven Power makes additional improvements at the forebay sluice gate to ensure safe downstream passage as described below.
- Develop designs within 4 years of license issuance for: (1) removal of obstructions in or deepening of the plunge pool below the forebay sluice gate (adequate depth would be 1 foot for every 4 feet of drop), and (2) a chute structure to convey flows beyond the roadway on the downstream side of the cable alley structure to protect outmigrating juvenile and adult American shad that pass into the downstream plunge pool.
- If the headrace shad turbine avoidance target survival is not met, based on the effectiveness study results, York Haven Power would be required to implement additional measures to improve survival, including: (1) opening the 800-cfs nature-like fishway supplemental flow gate on the same schedule as the forebay sluice gate, (2) suspending the operation of certain Francis units from 5 to 11 p.m. when river flows are between 15,000 and 22,000 cfs during the juvenile shad downstream passage season, up to a total generation loss of 1,000 MWh, and (3) other measures as agreed upon with FWS and Pennsylvania DEP.
- Within 2 years of implementing the above additional measures, York Haven Power would conduct a follow-up headrace shad turbine avoidance study, and if the study shows that the headrace shad turbine avoidance target is met, the additional measures would be required for the duration of the license.
- If by January 1, 2028, the headrace shad turbine avoidance target is not met, and FWS makes a determination that York Haven Power has not met

the project downstream juvenile American shad passage goal, and that additional measures are reasonably required to meet that goal (the additional measures determination), York Haven Power, within 12 months of that determination, would prepare a design and schedule for implementing additional structural and operational measures that are reasonably anticipated to meet the downstream passage goals, which may include a fish guidance system or other appropriate technology. After receipt of all governmental approvals, York Haven Power would implement the approved measures by December 31, 2030. If York Haven Power fails to provide a design and schedule for implementing additional structural and operational measures, Pennsylvania DEP may prescribe such measures. Within 12 months after implementing the additional structural and operational measures, York Haven Power would conduct a follow-up headrace shad turbine avoidance study to determine the number of shad that safely exit the forebay.

- Upstream eel passage would be provided by the proposed nature-like fishway.
- The downstream eel passage survival goal for the project is 85 percent. York Haven Power would cooperate with resource agencies and other interested parties to conduct a lower Susquehanna River downstream eel migration study, to evaluate the active migration of silver eels from stocked tributaries, and would conduct a site-specific silver eel route of passage study at the York Haven Project as described in appendix G of the Settlement Agreement.
- At least 12 months prior to the completion of the nature-like fishway, York Haven Power would prepare a plan and schedule for a site-specific downstream eel study, consisting of the route of passage study described above, and an eel survival study. The site-specific downstream eel study would be conducted after completion of the nature-like fishway. If the results of the study show that existing measures and protocols achieve the downstream eel passage goal, those measures and protocols would continue.
- If the results of the study show that existing measures and protocols do not achieve the downstream eel passage goal, York Haven Power would conduct a downstream eel improvements study to evaluate the feasibility and costs of potential physical and operational modifications to facilitate downstream eel passage, including adjusting nature-like fishway operations, modifying juvenile shad passage facilities, installing a fish guidance system, or replacing turbine runners with more "fish-friendly" runners.

- If the downstream eel improvements study finds that additional measures are feasible and technically sound, York Haven Power would implement those measures, followed by an evaluation of those measures within 12 months. If the downstream eel passage goals are not met, York Haven Power and the resources agencies would meet on an annual basis to determine alternative measures that could be implemented to meet the eel passage goals.
- Resident fish passage would be provided by the continued operation of the east channel fishway and by the nature-like fishway when operational. The east channel fishway would be operational from April 1 to December 15, or until daily river water temperature at the U.S. Geological Survey (USGS) Harrisburg gage is equal to or less than 40 degrees Fahrenheit (°F) for 3 consecutive days.
- Provide a year-round, continuous, minimum flow from the project of 1,000 cfs and an average daily minimum flow of 2,500 cfs, or inflow, whichever is less, to protect and enhance aquatic resources downstream of the project.
- Operate the project in a run-of-river mode when inflow to the project is less than 3,000 cfs, without deliberate impoundment drawdown or storage for purposes of generating electricity in particular time periods.
- Continue to implement the existing debris management program to prevent a buildup of debris that could affect project and fish passage operations, remove non-natural debris from the forebay, and sluice remaining natural debris downstream after notifying the downstream PPL Brunner Island Station.
- Contribute $25,000 per year to the York County Conservation District or such other entity identified by Pennsylvania DEP for the purposes of debris removal in the lower Susquehanna River watershed.

Muddy Run Project

On August 28, 2013, Exelon applied to Pennsylvania DEP for the Muddy Run Project. Pennsylvania DEP issued certification on June 3, 2014, and filed a clarified version of the certification on December 10, 2014. In its reply comments filed on March 18, 2014, Exelon requested that the Commission incorporate the conditions of the draft certification into Exelon's licensing proposal and reflect the conditions as Exelon's preferred alternative in the EIS. By letter filed January 21, 2015, Exelon confirmed that the clarified water quality certification filed by Pennsylvania DEP on December 10, 2014, continues to represent Exelon's licensing proposal for the Muddy Run Project. Therefore, this EIS treats the conditions in the certification as part of Exelon's proposal. The certification conditions are summarized here and described in detail in sections

3.3.1.2, *Geology and Soils, Environmental Effects*, and 3.3.2.2, *Water Resources, Environmental Effects*:

- Develop a dissolved oxygen (DO) monitoring plan no earlier than November 1, 2027, with measures designed to ensure that the project does not violate DO standards.
- Develop FPOP for upstream and downstream fish passage, with specific targets for upstream and downstream passage at the Muddy Run Project, and corrective actions if targets are not met.
- In 2018, develop a plan and schedule, as part of fish passage monitoring, for a radio telemetry study or equivalent Tier II study of American shad passage and behavior within the Muddy Run Project boundary, although no such plan would be required if available data indicate that 75 percent of the shad that pass the downstream Conowingo Project also pass through the Holtwood Project fish passage facilities (Tier I requirement), and that 50 percent of the shad that pass the Conowingo Project pass the Holtwood Project within 5 days (Tier II requirement). The Tier II study, if required, would determine the percentage of shad that enter the Muddy Run Project area at the northern tip of Sicily Island and exit the Muddy Run Project area at the southern tip of Deepwater Island. The radio transmitters would be inserted into shad at the Conowingo Project or other locations approved by Pennsylvania DEP. At the end of the four-year study period, or such longer time as established by the Pennsylvania DEP, if the results indicate that, as a result of Muddy Run operations, less than 88 percent of the American shad that enter the Muddy Run Project area in turn exit the Muddy Run Project area, Exelon would propose a plan and schedule for operational modifications to the extent feasible, reasonable, and technically sound to enhance fish passage at the project.[25]
- By January 15, 2015, submit a plan and schedule to provide for 95 percent survival of juvenile American shad and 80 percent survival of adult American shad that pass downstream through the project area, with full implementation of the plan by 2015. By February 15, 2026, Exelon would conduct a "discrete passage study" to measure the downstream passage of shad past the project, with the target passage rates noted above. If the target passage rates are not met, Exelon would propose appropriate mitigative measures.

[25] This bullet describes the new language in the clarified certification, which modified the previous requirement for a Tier II radio telemetry study.

- Implement the American Eel Passage Plan for an eel trap and truck program to trap, hold, and transport American eels from the Conowingo Project and Octoraro Creek to designated points in the Susquehanna River watershed until at least 2030, and then either continue the trap and truck program or construct a volitional eel passage facility at Conowingo dam.
- No earlier than October 1, 2016, and when Pennsylvania DEP determines that sufficient numbers of American eel are present upstream of the project to require downstream passage, conduct downstream eel passage studies to confirm at least 85 percent eel passage through the project area. If the target downstream passage rate is not met, Exelon would propose appropriate mitigative measures.
- Once every 10 years through the term of the license, evaluate all state and federal endangered and threatened species that may be present within the project boundary, and if the evaluation identifies the presence, critical habitat, or critical dependence of endangered species, propose and implement a protection plan for each species.
- Provide annual grants up to $450,000 total to be split between the Lancaster County and York County Conservation Districts (grants will expire in 2030) for the implementation of agricultural pasture and barnyard best management practices (BMPs) to control sediment loading to the Susquehanna River.
- Provide $50,000 annually to the Pennsylvania FBC to perform habitat improvement projects including removal of small dams.
- Provide the version of the Lower Susquehanna River OASIS Model to the Susquehanna River Basin Commission (SRBC) within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become 'final' (i.e., are no longer appealable or subject to ongoing litigation), as provided in the *Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRB*C dated November 19, 2013.

Conowingo Project

On January 30, 2014, Exelon applied to Maryland DOE for certification for the Conowingo Project. Maryland DOE received this request on January 30, 2014. On December 4, 2014, Exelon withdrew its application and plans to refile an application within 90 days of that date; Exelon will withdraw and refile its application on an annual basis until a sediment study to be conducted by Exelon and Maryland DOE, in coordination with other state and federal agencies, is completed in 2016 or 2017.

1.3.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Six federally listed species are known to occur in the general vicinity of one or more of the projects: shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus),* bog turtle (*Glyptemys* [*Clemmys*] *muhlenbergii*), Indiana bat (*Myotis sodalis*), Delmarva Peninsula fox squirrel (*Sciurus niger cinereus*), and swamp pink (*Helonias bullata*) (letters from FWS, to K.D. Bose, Secretary, FERC, Washington, D.C., January 4, 2007, and privileged information filed by Exelon on October 14, 2014). Also, FWS proposed to create a species-specific rule for the northern long-eared bat under section 4(d) of the ESA if it deems listing as a threatened species is appropriate, and reopened the public comment period on its previous October 2, 2013, proposed rule to list the northern long-eared bat under the ESA as an endangered species.[26]

Our analysis of project impacts on threatened and endangered species is presented in section 3.3.4, *Threatened and Endangered Species*, and our recommendations in section 5.1, *Comprehensive Development and Recommended Alternative*.

We conclude that relicensing of the York Haven and Muddy Run Projects would have no effect on the shortnose or Atlantic sturgeon because neither species is known to have been collected or passed via the Conowingo fish lifts since they began operation in 1972. While there is suitable habitat downstream of Conowingo for both species, 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 Conowingo Project would not be likely to adversely affect the shortnose and Atlantic sturgeon. NMFS concurred with our no effect determination for shortnose sturgeon and Atlantic sturgeon for the York Haven and Muddy Run Projects, by letter filed September 23, 2014, but has not yet concurred with our determination for the Conowingo Project.

Bog turtles have been confirmed near the Muddy Run and Conowingo Projects. Bog turtles are not known to occur at the York Haven Project.[27] Implementing Exelon's Bog Turtle Management Plan for the Muddy Run Project with FWS' recommended

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[26] 80 Federal Register 2371 (January 16, 2015).

[27] Under the terms of its January 30, 2014, Settlement Agreement, York Haven Power has agreed to conduct a bog turtle habitat assessment within potentially suitable habitat on Three Mile Island prior to construction of its proposed nature-like fishway.

modified mowing restrictions for mowing areas C, D, and F[28] and implementing Interior's recommended bog turtle management plan at the Conowingo Project, including habitat management at any confirmed breeding locations and other practices to protect the existing population and improve bog turtle habitat, would minimize effects on bog turtles and their habitat due to project maintenance or recreation. Therefore, we conclude that relicensing the York Haven, Muddy Run, and Conowingo Projects would not be likely to adversely affect the bog turtle. In letters filed on January 7, 2015, the FWS' Pennsylvania Field Office and Chesapeake Bay Field Office concurred with our findings.[29]

Potential Indiana bat habitat may exist within the three project areas, along the riparian forested edges of the river and reservoirs, and forested edges along transmission line rights-of-way and recreational areas. Neither York Haven Power nor Exelon propose any activities that would result in more than a minimal amount of tree clearing. At the Muddy Run Project, continued routine vegetation management practices, such as trimming and herbicide application, would be unlikely to affect trees large enough to provide roosting habitat. Therefore, the York Haven, Muddy Run, and Conowingo Projects would not be likely to adversely affect the Indiana bat. In letters filed on January 7, 2015, the FWS' Pennsylvania Field Office and Chesapeake Bay Field Office concurred with our findings.

Because the swamp pink is not listed by the FWS as occurring in the counties occupied by York Haven or Muddy Run Projects, these projects would have no effect on the species and it is not analyzed further in this document. Although swamp pink has been previously documented in Cecil and Harford Counties where the Conowingo Project is located, we conclude the Conowingo Project would have no effect on the swamp pink because this species is not known to occur in those project areas according to FWS' Information, Planning, and Conservation System website.

The three projects would have no effect on the Delmarva Peninsula fox squirrel because it is not known to exist in the projects' action areas.

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[28] FWS' Pennsylvania Field Office included the modified mowing restriction recommendation in its January 7, 2015, letter for the Muddy Run Project.

[29] In its letter dated January 7, 2015, FWS' Pennsylvania Field Office agreed with our finding that project impacts in this area are not likely to adversely affect this species within the majority of the project boundary, and that once it receives and reviews York Haven Power's bog turtle habitat assessment for the proposed nature-like fishway, "…it will make an effects determination for this portion of the project."

1.3.4 Coastal Zone Management Act

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 U.S.C. §1456(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

The York Haven and Muddy Run Projects are not located within the Pennsylvania-designated coastal management zone. The projects are located outside of Pennsylvania's Lake Erie and Delaware Coastal Zones, and the projects would not affect Pennsylvania's coastal resources. Therefore, the projects are not subject to Pennsylvania coastal zone program review, and no consistency certification is needed for the action. By emails dated June 24 and December 10, 2009, the Pennsylvania Coastal Resource Management Program concurred.

On September 4, 2012, Exelon filed a letter with the Maryland Consistency Coordinator of the Maryland DOE stating that the Conowingo Project complies with the enforceable polices of the Maryland Coastal Zone Management Program and would be operated in a manner consistent with this program. On March 5, 2013, the Maryland Office of the Attorney General filed a letter with the Commission that included a written agreement between Maryland and Exelon to extend the coastal zone consistency review period to 1 year from when Exelon files its request for certification. Exelon filed its request for certification with Maryland DOE on January 30, 2014, and with the Commission on January 31, 2014. On December 4, 2014, Exelon withdrew its application for water quality certification and plans to refile an application with Maryland DOE within 90 days of that date. In that same letter, Exelon also agrees to extend the federal consistency 6-month time clock until one year after the date that Exelon refiles its application for certification. Exelon further agrees that, if the withdrawal and resubmission of the application for water quality certification continues to be necessary, the federal consistency time clock would continue to be automatically stayed until one year after the date that Exelon resubmits its application for certification with Maryland DOE. Consequently, a coastal zone management program consistency determination would not be due from Maryland until at least one year after Exelon refiles an application for water quality certification with Maryland DOE.

1.3.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires that every federal agency "take into account" how each of its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

In response to York Haven Power's May 29, 2009, request, and Exelon's March 12, 2009, request, the Commission designated York Haven Power and Exelon as non-federal representatives for the purposes of conducting section 106 consultation under the NHPA on July 24, 2009, and May 11, 2009, respectively. Pursuant to section 106, and as the Commission's designated non-federal representative, York Haven Power consulted with the Pennsylvania State Historic Preservation Officer (SHPO) and affected Indian tribes, and Exelon consulted with the Pennsylvania and Maryland SHPOs to locate, determine National Register eligibility, and assess potential adverse effects on historic properties associated with the projects.

In April 2012, York Haven Power prepared a draft Historic Properties Management Plan (HPMP) to address project-related effects on historic properties and unevaluated cultural resources. The Pennsylvania SHPO provided comments on the draft HPMP (letter from D.C. McClearen, Chief, Division of Archaeology and Protection, Pennsylvania Historical and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to D. Weaver, York Haven Power Company, York Haven, Pennsylvania, September 14, 2012), and York Haven Power addressed those comments in a revised HPMP filed with the Commission on December 28, 2012 (Stallings and Franz, 2012).

In its application, Exelon stated that continued operation of the Muddy Run Project would not affect historic properties that are listed or eligible for listing on the National Register. For this reason, an HPMP for the Muddy Run Project was not developed. However, Exelon proposes a license article that would require section 106 consultation prior to any project-related ground-disturbing activity, including recreational development, and a requirement to develop a cultural resources management plan should any previously unidentified cultural materials be discovered during project activities.

In December 2012, Exelon prepared an HPMP to address project-related effects on historic properties and unevaluated cultural resources at the Conowingo Project (Sara et al., 2012). No comments on the HPMP received from the Pennsylvania SHPO or Maryland SHPO have been filed with the Commission. On October 17, 2014, the Onondaga Nation filed comments on the HPMP.

To meet the requirements of section 106, the Commission intends to execute Programmatic Agreements (PAs) for the protection of historic properties from the effects of the operation of the York Haven Project, Muddy Run Project, and Conowingo Project. The terms of the PAs would ensure that York Haven Power and Exelon address and treat all historic properties identified within the projects' areas of potential effects (APE) through the finalization of the existing draft HPMPs for the York Haven Project and the Conowingo Project and the development of an HPMP for the Muddy Run Project. Draft PAs were issued for each project on September 8, 2014. York Haven Power filed comments on the York Haven PA on October 9, 2014, and the Onondaga Nation filed comments on the draft PAs for the Muddy Run and Conowingo Projects on October 17, 2014.

1.3.6 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act requires federal agencies to consult with NMFS on all actions that may adversely affect essential fish habitat. In correspondence during scoping, in response to the ready for environmental analysis notices, and in comments filed on the draft EIS, NMFS did not identify any essential fish habitat in segments of the Susquehanna River affected by the projects. Therefore, we conclude that the Susquehanna River Projects would have no effect on essential fish habitat.

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations (18 Code of Federal Regulations [CFR] §§5.1-5.16) require that applicants consult with appropriate resource agencies, tribes, and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act, ESA, NHPA, and other federal statutes. Prefiling consultation must be complete and documented according to the Commission's regulations

1.4.1 Scoping

Before preparing the draft EIS, we conducted scoping to determine what issues and alternatives should be addressed. Scoping documents (SD1s) were distributed to interested agencies and others for the York Haven Project on July 24, 2009, and for the Muddy Run and Conowingo Projects on May 11, 2009. A publicly noticed scoping meeting for the York Haven Project was held in New Cumberland, Pennsylvania, during the evening of August 26, 2009, and a second daytime meeting was held in Harrisburg, Pennsylvania, on August 27, 2009. A publicly noticed evening scoping meeting for the Muddy Run Project was held on June 10, 2009, in Holtwood, Pennsylvania, and for the Conowingo Project on June 11, 2009, in Darlington, Maryland. A joint daytime meeting to discuss both the Muddy Run and Conowingo Projects was held on June 12, 2009, in Darlington, Maryland. A court reporter recorded all comments and statements made at the scoping meetings, and these are part of the Commission's public record for the projects. In addition to comments provided at the scoping meetings, the following entities provided written comments.

Commenting Entities	Date Filed
York Haven Project	
York Haven Planning Commission	August 7, 2009
Honorable Todd Platts	September 21, 2009
Pennsylvania Department of Natural Resources	September 24, 2009
York Haven Power Company, LLC	September 28, 2009
Borough of Goldsboro	September 28, 2009
The Nature Conservancy	September 29, 2009
U.S. Fish and Wildlife Service	September 29, 2009

Susquehanna River Basin Commission	September 29, 2009
Pennsylvania Fish and Boat Commission	September 29, 2009
Exelon Generation Company, LLC	September 29, 2009
U.S. Army Corps of Engineers	September 29, 2009
Pennsylvania Department of Environmental Protection	September 29, 2009
James Toothaker	October 5, 2009
Cynthia Gross	October 5, 2009

Muddy Run Project

Maryland Department of Natural Resources	July 10, 2009
Susquehanna River Basin Commission	July 10, 2009
U.S. Fish and Wildlife Service	July 10, 2009
Pennsylvania Fish and Boat Commission	July 10, 2009
Pennsylvania Department of Environmental Protection	July 10, 2009

Conowingo Project

Town of Port Deposit	June 16, 2009
Alex Balboa	June 19, 2009
Ronald Steelman	July 6, 2009
Susquehanna River Basin Commission	July 10, 2009
Maryland Department of Natural Resources	July 10, 2009
Pennsylvania Fish and Boat Commission	July 10, 2009
Robert B. Campbell	July 13, 2009
Jere Hess	July 13, 2009
Pennsylvania Department of Environmental Protection	July 13, 2009
Lower Susquehanna River Keeper	July 13, 2009
U.S. Fish and Wildlife Service	July 13, 2009
Honorable Benjamin L. Cardin	August 3, 2009

Muddy Run and Conowingo Projects

American Rivers	July 10, 2009
Exelon Corporation	July 10, 2009
Lancaster County Planning Commission	July 10, 2009
The Nature Conservancy	July 10, 2009
National Marine Fisheries Service	July 10, 2009
PPL Holtwood, LLC	July 10, 2009

In addition to the commenting entities listed above for the York Haven Project, more than 1,400 individuals signed petitions that were filed between September 12 and October 5, 2009, opposed to the decommissioning of the York Haven Project.[30]

A revised scoping document addressing these comments was issued for the York Haven Project on November 13, 2009, and on August 24, 2009, for the Muddy Run and Conowingo Projects.

1.4.2 Interventions

On April 29, 2013, the Commission issued notices accepting the York Haven Power and Exelon applications to relicense the York Haven, Muddy Run, and Conowingo Projects, and soliciting motions to intervene. These notices set September 30, 2013, as the deadline for filing protests and motions to intervene; however, by notices issued August 30, 2013, and December 13, 2013, the Commission granted extensions of time for stakeholders to file motions to intervene and protests until January 31, 2014. In response to the notices, the following entities filed motions to intervene:

Intervenors	Date Filed
York Haven Project	
PPL Brunner Island, LLC	November 13, 2012
U.S. Department of the Interior	May 31, 2013
Susquehanna River Basin Commission	June 11, 2013
Safe Harbor Water Power Corporation	June 17, 2013
PPL Holtwood, LLC	June 20, 2013
Pennsylvania Department of Environmental Protection	June 21, 2013
Pennsylvania Fish and Boat Commission	June 21, 2013
New Energy Capital Partners, LLC[31]	October 21, 2013
Exelon Corporation	December 5, 2013
The Nature Conservancy	January 31, 2014

[30] A number of federal and state resource agencies, SRBC, and The Nature Conservancy recommended that the Commission consider decommissioning as a reasonable alternative to relicensing. The Borough of Goldsboro, York Haven Power, and a petition signed by more than 1,400 individuals, requested that the Commission not consider project decommissioning as a reasonable alternative to relicensing. Those opposed to project decommissioning cite the potential loss of Lake Frederic, a significant economic and recreation resource in the area.

[31] On November 4, 2013, York Haven Power filed a motion in opposition to the intervention of New Energy Capital Partners, LLC. The Commission issued a notice granting intervention on June 12, 2014.

Intervenors	Date Filed
American Rivers	January 31, 2014
Maryland Department of Natural Resources, Maryland Department of the Environment	January 31, 2014
Muddy Run Project	
PPL Holtwood, LLC	November 13, 2012
U.S. Department of the Interior	May 31, 2013
Susquehanna River Basin Commission	June 11, 2013
Safe Harbor Water Power Corporation	June 17, 2013
Pennsylvania Department of Environmental Protection	June 21, 2013
Pennsylvania Fish and Boat Commission	June 21, 2013
New Energy Capital Partners, LLC	September 27, 2013
Olympus Power Company, LLC	December 6, 2013
National Marine Fisheries Service	January 31, 2014
The Nature Conservancy	January 31, 2014
American Rivers	January 31, 2014
Maryland Department of Natural Resources, Maryland Department of the Environment	January 31, 2014
Conowingo Project	
Stewards of the Lower Susquehanna, Inc.	September 7, 2012
PPL Holtwood, LLC	November 13, 2012
U.S. Department of the Interior	May 31, 2013
Susquehanna River Basin Commission	June 11, 2013
Safe Harbor Water Power Corporation	June 17, 2013
Pennsylvania Department of Environmental Protection	June 21, 2013
Pennsylvania Fish and Boat Commission	June 21, 2013
Clean Chesapeake Coalition	June 25, 2013
Stewards of the Lower Susquehanna, Inc., Lower Susquehanna Riverkeeper, and Waterkeepers Chesapeake	July 17, 2013
Calpine Corporation	July 24, 2013
Chesapeake Conservancy	July 24, 2013
Chesapeake Bay Foundation	August 20, 2013
Mason-Dixon Trail System, Inc.	September 5, 2013
Citizens for Pennsylvania's Future	September 25, 2013
New Energy Capital Partners, LLC	September 27, 2013
Cecil Land Use Association	October 30, 2013
Olympus Power Company, LLC	December 6, 2013
Midshore Riverkeeper Conservancy, Inc.	December 11, 2013
Chester River Association and Sassafras River Association	December 23, 2013
Onondaga Nation	December 24, 2013
National Marine Fisheries Service	January 30, 2014

Intervenors	Date Filed
The Nature Conservancy	January 31, 2014
American Rivers	January 31, 2014
Maryland Department of Natural Resources, Maryland Department of the Environment	January 31, 2014

1.4.3 Comments on the Application

On April 29, 2013, the Commission issued Ready for Environmental Analysis notices for the three projects and requested comments, recommendations, preliminary terms and conditions, and preliminary fishway prescriptions. By notices issued August 30, 2013, and December 13, 2013, the Commission granted extensions of time for stakeholders to file comments, recommendations, and terms and conditions until January 31, 2014. The following entities filed comments, terms and conditions, recommendations, or prescriptions:

Commenting Agencies and Other Entities	Date Filed
York Haven Project	
Lancaster County Conservancy	January 17, 2014
U.S. Department of the Interior	January 30, 2014
The Nature Conservancy et al.	January 31, 2014
American Rivers et al.	January 31, 2014
Muddy Run Project	
New Energy Capital Partners	November 22, 2013
Lancaster County Conservancy	January 17, 2014
National Marine Fisheries Service	January 31, 2014
U.S. Department of the Interior	January 31, 2014
American Rivers et al.	January 31, 2014
The Nature Conservancy et al.	January 31, 2014
Conowingo Project	
U.S. Environmental Protection Agency	August 6, 2013
New Energy Capital Partners	November 19, 2013
Henry Immanuel	November 19, 2013
Pennsylvania Fish and Boat Commission	December 11, 2013
Chesapeake Conservancy	December 13, 2013
Vicki Rinkerman	December 13, 2013
Lancaster County Conservancy	January 17, 2014
Midshore Riverkeeper Conservancy	January 29, 2014
National Marine Fisheries Service	January 30, 2014
Citizens For Pennsylvania’s Future	January 31, 2014
Maryland’s Department of Natural Resources and Department of the Environment	January 31, 2014
Clean Chesapeake Coalition	January 31, 2014
City of Havre de Grace	January 31, 2014

Commenting Agencies and Other Entities	Date Filed
Town of Fort Deposit, Maryland	January 31, 2014
Town of Perryville, Maryland	January 31, 2014
Susquehanna River Basin Commission	January 31, 2014
Harford County Government	January 31, 2014
Cecil County Government	January 31, 2014
Power Plant Research Program	January 31, 2014
Chesapeake Bay Foundation	January 31, 2014
Lower Susquehanna Heritage Greenway Inc.	January 31, 2014
Stewards of the Lower Susquehanna, Inc.	January 31, 2014
U.S. Department of the Interior	January 31, 2014
American Rivers et al.	January 31, 2014
The Nature Conservancy et al.	January 31, 2014

1.5 SETTLEMENT AGREEMENT

On January 30, 2014, York Haven Power, FWS, Pennsylvania FBC, Maryland Department of Natural Resources (Maryland DNR), and SRBC[32] (Settling Parties) filed a Settlement Agreement for the York Haven Project.

The Settlement Agreement resolves among the Settling Parties all issues associated with issuance of a new license for the project regarding upstream passage of American shad and American eels, downstream passage of juvenile and post-spawning American shad, downstream passage of silver stage American eel, resident fish passage, flow management, water quality and debris management, and endangered species and species of special concern. We consider the Settlement Agreement to represent the Proposed Action regarding these issues for this project.

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[32] SRBC was established by the Susquehanna River Basin Compact, a federal interstate agreement among New York, Pennsylvania, Maryland, and the United States (Pub. L. No. 91-575, 84 Stat. 1509 [1970]). Pursuant to the Compact, SRBC has specific duties that include developing and effectuating plans, policies, and projects relating to water resources; adopting, promoting, and coordinating policies and standards for water resources conservation, control, utilization, and management; and promoting and implementing the planning, development, and financing of water resource projects within the Susquehanna River Basin.

In 1975, the Commission and SRBC entered into a Memorandum of Understanding. Under the November 5, 1975, Memorandum of Understanding, the Commission and SRBC committed to cooperate in the processing of license applications to the extent feasible, and the Commission agreed to give due regard to any SRBC recommendations.

On February 19, 2014, the Commission issued a Notice of Settlement Agreement. In response to that notice, PPL Brunner Island, LLC, filed a Protest and Comment in Opposition to the proposed Settlement Agreement. The basis for the opposition is that during low-flow periods, the measures specified in the Settlement Agreement could limit the amount of water available for withdrawal by the downstream Brunner Island Steam Electric Station which would restrict generation. York Haven Power filed a response to the opposition on March 4, 2014. On December 29, 2014, in its comments on the draft EIS, PPL Brunner Island, LLC withdrew its Protest and Comment in Opposition.[33]

1.6 COMMENTS ON THE DRAFT EIS

On July 30, 2014, Commission staff issued the draft EIS for the relicensing of the projects. Comments on the draft EIS were due by September 29, 2014. In addition, we conducted two public meetings on September 16, 2014, in Darlington, Maryland, and one public meeting on September 17, 2014, in Harrisburg, Pennsylvania, to receive public comments on the draft EIS. In addition to comments received at the public meetings, written comments on the draft EIS were filed by the following entities:

Commenting Agencies and Other Entities	Date Filed
York Haven Project	
Pennsylvania Game Commission	August 14, 2014
Hugh Rogers	September 15, 2014
New Energy Capital Partners	September 26, 2014
York Haven	September 26, 2014
FWS/Susquehanna River Anadromous Fish Restoration Cooperative	September 29, 2014
Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy	September 29, 2014
Onondaga Nation	September 29, 2014
U.S. Department of the Interior[34]	September 29, 2014
Exelon	September 29, 2014
State of Maryland[35]	September 29, 2014
Dr. Amy Roe	September 29, 2014

[33] We retain but modify our discussion of PPL Brunner Island, LLC's concerns in sections 2 and 3, but removed the environmental measure that PPL Brunner Island, LLC had recommended from sections 4 and 5.

[34] Interior filed a comment letter for the Susquehanna River Projects that includes comments on behalf of the National Park Service and FWS.

[35] The State of Maryland filed comments on behalf of Maryland DNR and Maryland DOE.

Commenting Agencies and Other Entities	Date Filed
National Marine Fisheries Service	September 29, 2014
U.S. Environmental Protection Agency	September 29, 2014
Susquehanna River Basin Commission	September 29, 2014
The Nature Conservancy	September 29, 2014
American Rivers	September 29, 2014
Stewards of the Lower Susquehanna, Lower Susquehanna Riverkeeper, Waterkeepers Chesapeake	September 29, 2014
Clean Chesapeake Coalition	September 29, 2014
Muddy Run Project	
Pennsylvania Game Commission	August 14, 2014
Hugh Rogers	September 15, 2014
Patrick Kelly	September 19, 2014
New Energy Capital Partners	September 29, 2014
FWS/Susquehanna River Anadromous Fish Restoration Cooperative	
Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy	September 29, 2014
Onondaga Nation	September 29, 2014
U.S. Department of the Interior	September 29, 2014
National Marine Fisheries Service	September 29, 2014
Exelon	September 29, 2014
State of Maryland	September 29, 2014
Dr. Amy Roe	September 29, 2014
Susquehanna River Basin Commission	September 29, 2014
The Nature Conservancy	September 29, 2014
American Rivers	September 29, 2014
Stewards of the Lower Susquehanna, Lower Susquehanna Riverkeeper, Waterkeepers Chesapeake	September 29, 2014
Clean Chesapeake Coalition	September 29, 2014
Onondaga Nation	October 17, 2014
Conowingo Project[36]	
James Byrne	August 8, 2014
Pennsylvania Game Commission	August 14, 2014
Matt Teffeau	August 21, 2014
Maryland Farm Bureau	September 9, 2014

[36] On January 9, 2015, an organization called "Support Conowingo Dam" filed a petition of support for the project that included 11,500 signatures. The organization, however, did not include any specific comments on the draft EIS.

Commenting Agencies and Other Entities	Date Filed
Susquehanna River Boaters Association[37]	September 10, 2014
Hugh Rogers	September 15, 2014
The Honorable Benjamin L. Cardin	September 19, 2014
Patrick Kelly	September 19, 2014
Broad Creek Civic Association	September 26, 2014
New Energy Capital Partners	September 26, 2014
Pennsylvania Fish & Boat Commission	Septembers 29, 2014
Susquehanna River Boaters Association[38]	September 29, 2014
FWS/Susquehanna River Anadromous Fish Restoration Cooperative	September 29, 2014
Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy	September 29, 2014
Onondaga Nation	September 29, 2014
U.S. Department of the Interior	September 29, 2014
National Marine Fisheries Service	September 29, 2014
Exelon Corporation	September 29, 2014
State of Maryland	September 29, 2014
Citizens for Pennsylvania's Future	September 26, 2014
Dr. Amy Roe	September 29, 2014
U.S. Environmental Protection Agency	September 269 2014
Susquehanna River Basin Commission	September 29, 2014
The Nature Conservancy	September 29, 2014
American Rivers	September 29, 2014
Stewards of the Lower Susquehanna, Lower Susquehanna Riverkeeper, Waterkeepers Chesapeake	September 29, 2014
Clean Chesapeake Coalition	September 29, 2014
Onondaga Nation	October 17, 2014

Appendix H summarizes all comments received, includes our responses to those comments, and indicates where we modified this final EIS.

[37] Motion to Intervene.

[38] Susquehanna River Boaters Association filed a second Motion to Intervene on September 29, 2014.

2.0 PROPOSED ACTIONS AND ALTERNATIVES

2.1 NO-ACTION ALTERNATIVE

Under the no-action alternative, the Susquehanna River Projects would continue to operate under the terms and conditions of the existing licenses, and no new environmental protection, mitigation, or enhancement measures would be implemented. We use this alternative to establish baseline environmental conditions for comparison with other alternatives and to judge the benefits and costs of any measures that might be required under a new license.

2.1.1 Existing Project Facilities

Figure 2-1 shows the location and project boundaries of the Susquehanna River Projects.

2.1.1.1 York Haven Project

The project is located on the Susquehanna River in York, Dauphin, and Lancaster Counties in south central Pennsylvania (figure 2-2). The Susquehanna River Basin above York Haven dam has a drainage area of about 24,973 square miles. The project powerhouse is located at about RM 55, 17 miles downstream of the city of Harrisburg.

The project is located upstream of the Muddy Run Project at about RM 22 and the Conowingo Project at about RM 10. The Three Mile Island nuclear station, also owned by Exelon, is on Three Mile Island in Lake Frederic, the impoundment formed by York Haven dam. Pennsylvania Power and Light's (PPL) Brunner Island Station, a coal-fired steam electric generating plant, is located about 1.5 miles downstream of the project.

The project includes an east channel dam, main dam, headrace wall, impoundment, powerhouse, substation, fish passage facilities, and recreation facilities. The project operates in a modified run-of-river mode, in that there is limited storage in the reservoir (about one hour worth of storage). During periods of moderate to high runoff in the Susquehanna River that exceed the station's maximum hydraulic capacity (about 17,000 cubic feet per second [cfs] under optimal head conditions), the project cannot control water levels and spills water. Spills can occur at the main dam, headrace wall, and east channel structures.

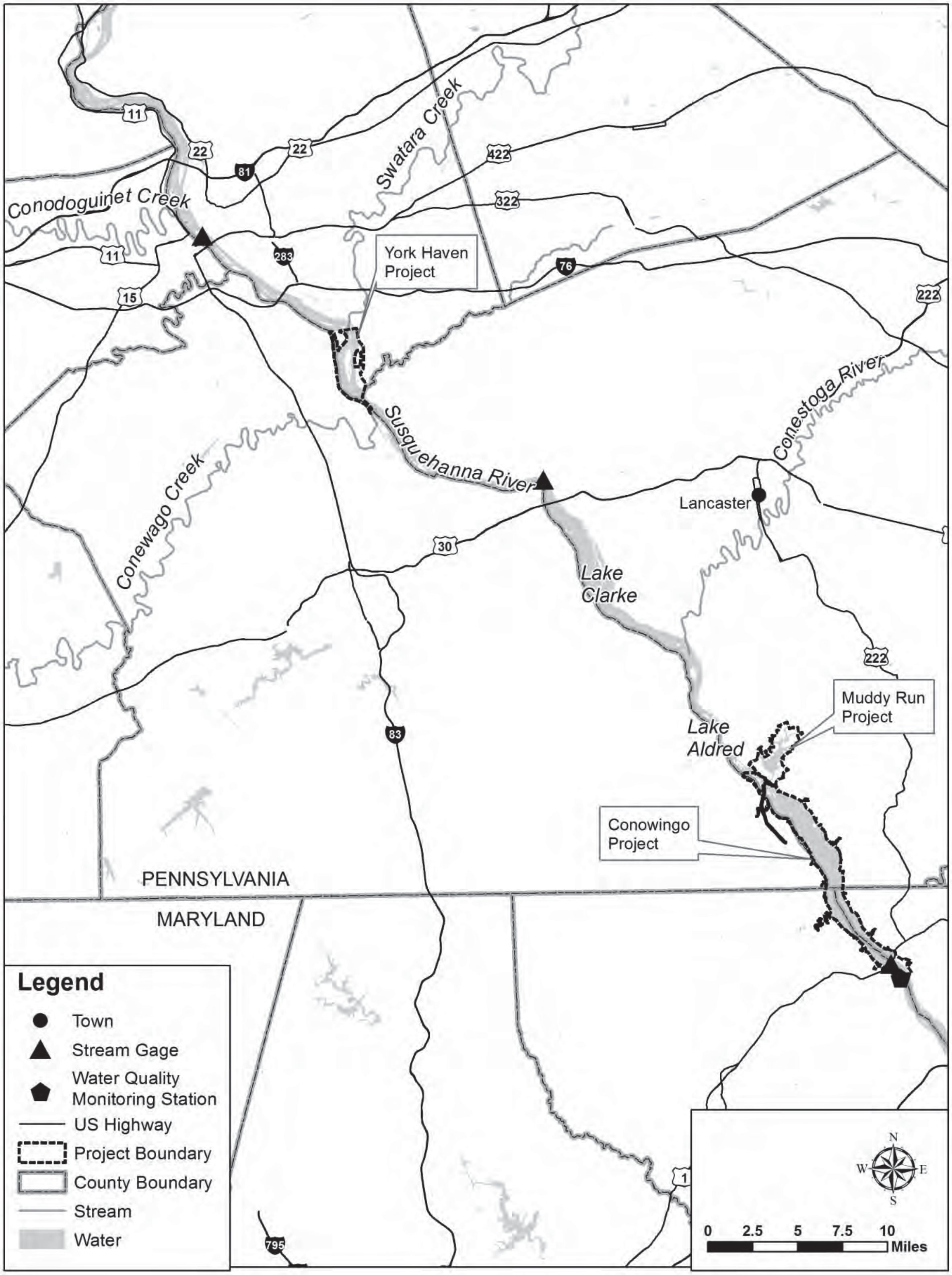

Figure 2-1. Location and project boundaries for lower Susquehanna River Projects (Source: staff).

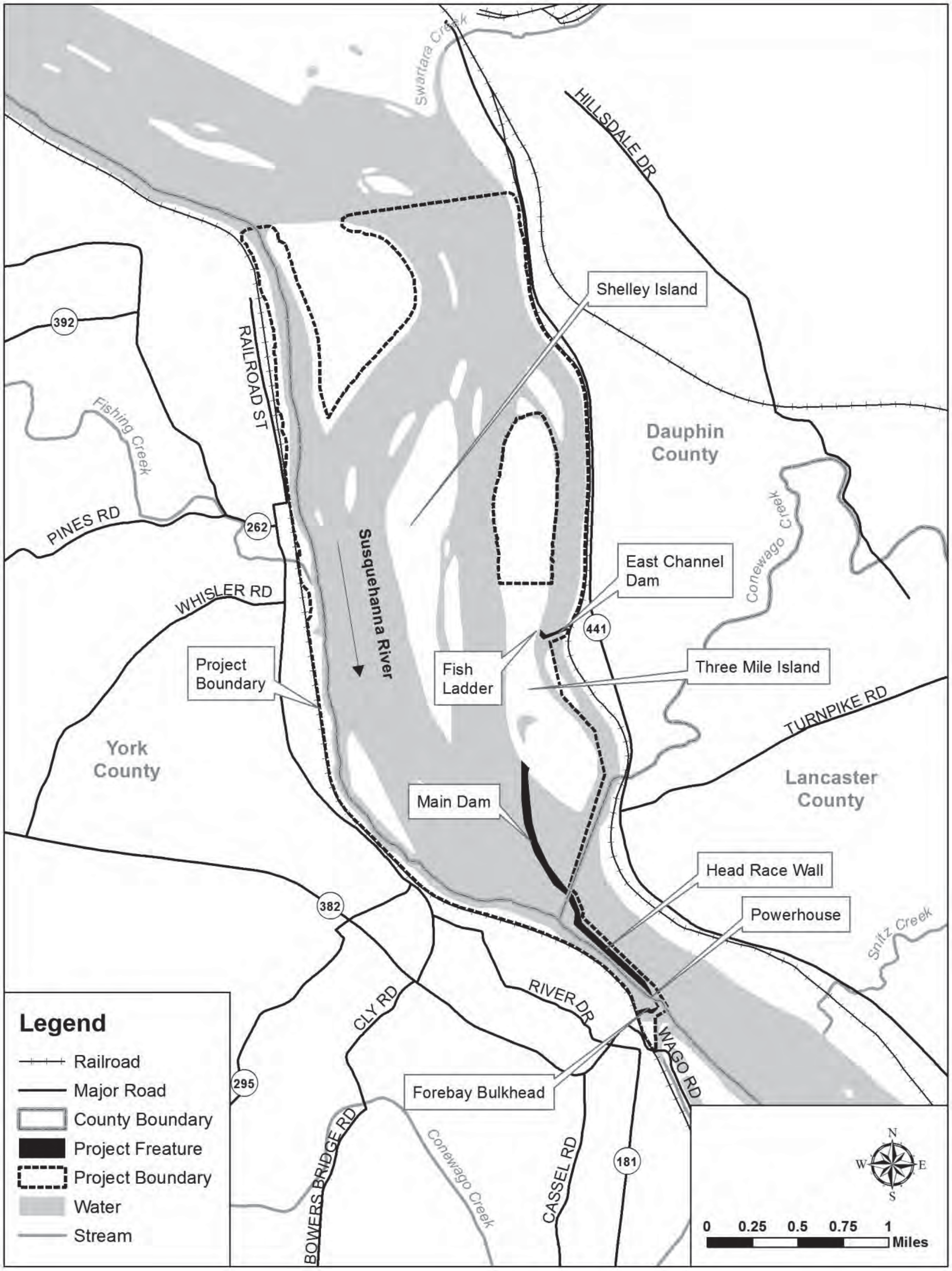

Figure 2-2. Project facilities for the York Haven Project (Source: staff).

East channel dam is a concrete gravity overflow dam, which extends about 928 feet in an easterly direction from the east shore of Three Mile Island to the east bank of the river. It has an average height of 9 feet. The crest of east channel dam is at elevation 278.95 feet National Geodetic Vertical Datum of 1929,[39] and it incorporates a vertical slot fishway.

The main dam extends diagonally downstream approximately 4,970 feet from the west shore of Three Mile Island to the upstream (north) end of the headrace wall. The main dam is constructed of concrete-covered rock fill and rock fill/timber crib sections with a maximum height at the crest of 18 feet and an average height of 10 feet. The crest elevation of the majority of the main dam crest ranges from 277.86 feet[40] to 278.78 feet. Two short sections of the dam crest are at about elevation 280.00 to 280.20 feet.

The stone masonry headrace wall extends 3,000 feet downstream from the south end of the main dam to the powerhouse. The headrace wall serves to direct water to the powerhouse. The elevation of the crest of the headrace wall includes sections at elevations 280.00 and 282.45 feet.

The project impoundment, Lake Frederic, is about 3.5 miles long with about 29 miles of shoreline within the project boundary, including the shoreline of the islands in Lake Frederic. The maximum depth of Lake Frederic is about 18 feet with a mean depth of about 6 feet. At the normal water surface elevation of 277.86 feet, Lake Frederic has a surface area of 2,218 acres and about 9,600 acre-feet of gross storage capacity. Usable storage capacity is limited to the allowable 1.1-foot fluctuation providing about 1,700 acre-feet of storage, or about 1 hour of storage at the plant's maximum hydraulic capacity.

The brick and stone masonry powerhouse is about 472 feet long and 48 feet wide and is located parallel to the west bank of the Susquehanna River. This structure contains the turbines, generators, and appurtenant power generating equipment. Steel trashracks with 4-inch clear spacing are installed at the intakes at each of the 20 turbine-generator units. The forebay includes a trash sluice gate at its downstream end that is 14 feet wide and 10.5 feet high. The sluice gate is capable of releasing about 600 cfs.

The powerhouse contains 20 turbine units with an installed capacity of 19.62 MW. Six are vertical shaft propeller turbines, and 14 are horizontal Francis turbines.

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[39] Unless otherwise noted, all elevation data in this EIS are given in National Geodetic Vertical Datum of 1929.

[40] The value of 277.86 feet represents the low point of the main dam, which under current operations is considered to be the normal elevation when river flows are less than the maximum turbine capacity of about 17,000 cfs.

Each of the turbines has a fixed gate and, therefore, no adjustments can be made to discharge less than the maximum turbine discharge other than reducing the water level in Lake Frederic. The minimum discharge from the powerhouse is about 700 cfs and occurs when only Unit 14 is operating. The project does not include a traditional tailrace, and each of the units discharges directly into the Susquehanna River.

The project includes an outdoor substation that contains the station's generator step-up transformers, station service transformers, and manual switching structures. There are no primary transmission lines included as part of the project because it interconnects with the 115-kilovolt (kV) electric grid at a substation immediately downstream of the project's downstream forebay wall. A secondary service feed comes into the project substation via Line No. 722 at 13.2 kV.

The project includes an east channel upstream fish passage facility located at the western end of east channel dam, which has been operational since April 2000, includes two sections: a weir cut and a vertical-slot fish ladder. The weir cut section provides supplemental attraction flows to the fishway, and the upper portion of the weir cut includes three, 25-foot-diameter cofferdam cells between which two 20-foot-wide fixed-wheel gates are installed, with each gate having a 1,000-cfs discharge capacity. The lower section of the weir cut includes a 67-foot-wide adjustable weir and a stop gate. The 250-foot-long fish ladder has an entrance diffuser, serpentine baffles that form eight pools, and an exit flume. A counting station is located in the exit channel just upstream of the last fish ladder pool.

York Haven Project recreation facilities include: the Historic Canal Lock, East Shore Boat Launch, Goosehorn Island Picnic Area, Shelley Island Recreation Area, Goodling Island Picnic Area, Beshore Island Recreation Area, Battery Island Recreation Area, Cly Shore recreational lot sites, York Haven Power Plant Recreation Area, and a Canoe Portage trail. These facilities are owned and operated by York Haven Power.

2.1.1.2 Muddy Run Project

The Muddy Run Project (figure 2-3) is a pumped storage hydroelectric generating facility 22 miles upstream of the Chesapeake Bay on the eastern shoreline of the Susquehanna River, within Drumore and Martic Townships, Lancaster County, Pennsylvania. The project includes a Recreation Lake dam and spillway, main dam embankment, the east dike, upper reservoir spillway, canal dam embankment, upper reservoir (Muddy Run reservoir), intake structure, powerhouse, lower reservoir, a primary transmission line, and recreation facilities.

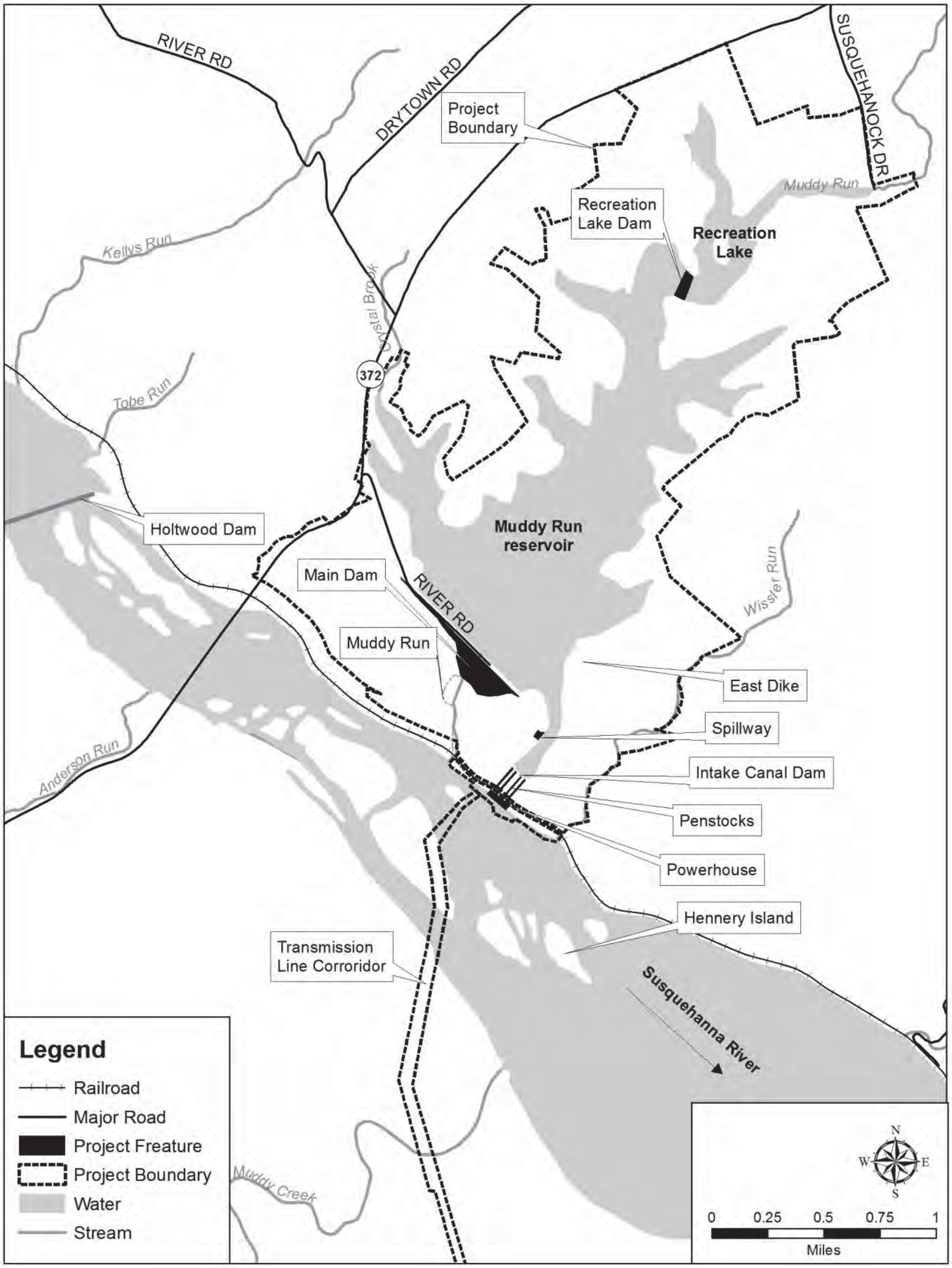

Figure 2-3. Project facilities for the Muddy Run Project (Source: staff).

The Recreation Lake dam, located in the drainage for the upper reservoir about 2 miles upstream of the main dam, is a zoned earth and rockfill embankment. The dam is approximately 750 feet long, and it has a maximum height of about 90 feet and a crest width of 34 feet. The crest of the non-overflow section of the Recreation Lake dam is at elevation 530.00 feet. The Recreation Lake dam includes a 4-foot-diameter concrete outlet pipe controlled from the upstream end by a flap gate. The Recreation Lake spillway consists of a nearly level rock cut channel approximately 140 feet wide with a concrete weir at crest elevation 520.00 feet. The spillway is traversed by a steel and concrete bridge that is used by pedestrian traffic and recreation area maintenance vehicles. The Recreation Lake has a total storage capacity of 709 acre-feet and is maintained at a constant elevation of 520 feet for recreational purposes. The surface area is approximately 100 acres at that elevation.

The main embankment dam is constructed as a zoned embankment with an impervious core. The dam is 4,800 feet long and has a maximum height of 260 feet. The crest of the dam is at elevation 533.00 feet, and it is 34 feet wide and traversed by a 20-foot-wide, two-lane roadway (River Road). The east dike is also a zoned earth and rock-fill embankment with an impervious core. The dike is approximately 800 feet long, has a crest width of 20 feet, and a maximum height of about 12 feet. The crest of the east dike is at elevation 530.80 feet.

The upper reservoir 200-foot-long ogee spillway is located on the west side of the intake canal. The spillway is 20 feet high, has a crest elevation of 521 feet, and discharges into a vegetated natural ravine that joins Muddy Run Creek just above its confluence with the Susquehanna River. The spillway is constructed within the canal dike and is flanked by concrete retaining walls. Since initial filling of the upper reservoir in 1967, the spillway has never been required to pass discharges from either natural inflows or over-pumping.

The canal embankment (also referred to as the intake channel dam), forms the upper part of the intake channel, which leads from the upper reservoir to the powerhouse intake structure. The lower part of the channel is excavated in rock. The embankment has a maximum height of about 35 feet and a minimum crest width of 25 feet. The upstream face of the embankment and the rock cut channel are lined with a 9-inch-thick reinforced concrete slab extending about 1,000 feet upstream on both sides of the canal from the powerhouse intake structure. The upstream portion of the canal is an unlined soil and rock cut. A bridge for River Road crosses this section of the canal.

The normal operating elevation of the upper reservoir ranges from 470 to 520 feet. At elevation 520 feet, the upper reservoir has a total storage capacity of 56,731 acre-feet with a usable capacity of 33,894 acre-feet, and a surface area of 892 acres. At the maximum drawdown elevation (470 feet), the upper reservoir has a surface area of 471 acres.

The intake structure consists of four cylinder gates with trashracks having clear spacing of 5.37 inches. Each intake supplies two units and includes a cylindrical tower that leads to a 430-foot-deep vertical shaft. The vertical shaft and horizontal power tunnels are concrete lined with a diameter of 24.50 feet. The concrete-lined power tunnels bifurcate approximately 500 feet upstream of the powerhouse, transitioning to 14-foot-diameter steel penstocks that connect to one of eight pump turbine units in the powerhouse. There are no inlet valves at the downstream end of the penstocks.

The Muddy Run powerhouse is approximately 600 feet long by 133 feet wide, and is constructed entirely of concrete. The powerhouse is a semi-outdoor structure located on the east bank of the Susquehanna River and contains eight vertical-shaft, reversible pump-generating units that each have a rated capacity of 100 MW and a hydraulic capacity of 4,000 cfs, for a total discharge capacity of 32,000 cfs. The pumping capacity of the pump turbines is 3,500 cfs each, for a total powerhouse pumping capability of 28,000 cfs. The units are equipped with trashracks, also with clear spacing of 5.75 inches, between the draft tube outlet and the river.

The lower reservoir for the Muddy Run Project is Conowingo Pond, which is a portion of the Susquehanna River impounded by Conowingo dam. The lower reservoir has a total surface area of approximately 8,500 acres and approximately 310,000 acre-feet of gross storage at the maximum normal level of 109.2 feet.

The primary transmission line consists of two 230-kV three-phase, three-wire circuits. The lines, owned by Exelon, but leased to the PECO Energy Company, an affiliate of Exelon, are identified as lines 220-06 and 220-07. Both lines begin at a 220-kV switching station on the roof of the powerhouse and run about 4.25 miles to the Peach Bottom Atomic Power Station (PBAPS) North Substation located in York County.

Muddy Run Project recreation facilities include: (1) Muddy Run Park (owned by Exelon, operated by a vendor); (2) Wissler's Run Park (owned and operated by Exelon); and (3) Muddy Run Wildlife Management Area (WMA) (owned by Exelon and leased and managed by Pennsylvania Game Commission).

Exelon holds title or rights to all project lands within the project boundary. The project boundary encompasses all of the project facilities and lands required for project operation and maintenance. However, only a portion of the 800-acre Muddy Run WMA is within the existing project boundary.

2.1.1.3 Conowingo Project

The Conowingo Project (figure 2-4) consists of a main dam, spillway, reservoir (Conowingo Pond), intake structure, powerhouse, two fish lifts, and recreation facilities. The dam is a concrete gravity dam with a maximum height of 94 feet and a total length of 4,648 feet. The dam has four distinct sections from east to west: a 1,190-foot-long, non-overflow gravity section with a crest elevation of 115.70 feet; an ogee-shaped spillway, the major portion of which is 2,250 feet long with a crest elevation of 86.70 feet, and the minor portion of which is 135 feet long with a crest elevation of 99.2 feet; an intake-powerhouse section which is 946 feet long; and a 127-foot-long abutment section.

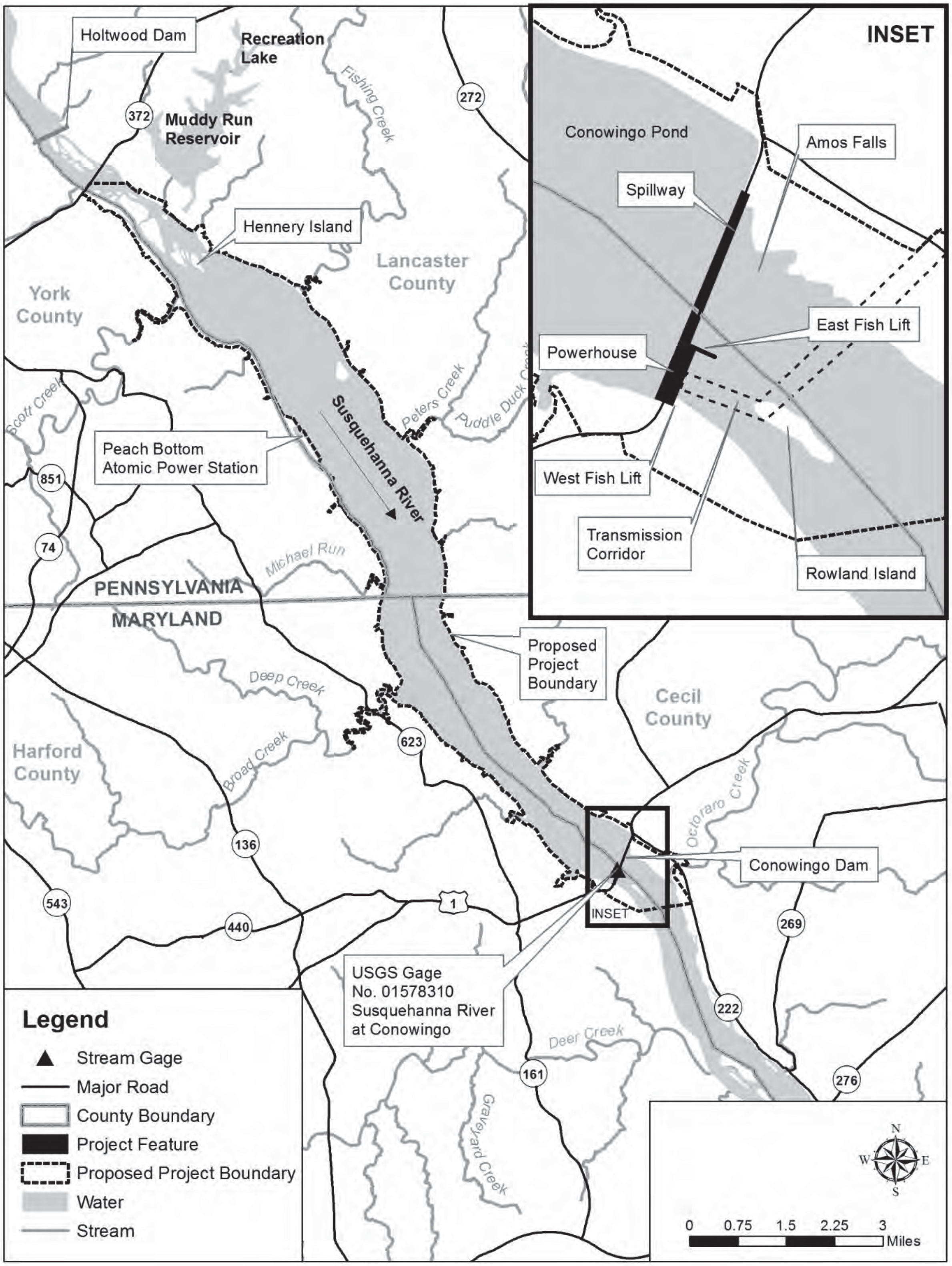

Figure 2-4. Project facilities for the Conowingo Project (Source: staff).

The tailrace and spillway sections of the dam are separated by a dividing wall extending 300 feet downstream of the powerhouse. The dam and powerhouse also support U.S. Route No. 1 which passes over the top of Conowingo dam.

Flow over the ogee spillway sections is controlled by 50 stony-type crest gates with crest elevations of 86.70 feet and two regulating gates with crest elevations of 99.2 feet. Each crest gate is 22.50 feet high by 38 feet wide, and the gates have a collective discharge capacity of about 16,000 cfs at a reservoir elevation of 109.2 feet.

The two regulating gates are 10 feet high by 38 feet wide and have a discharge capacity of about 4,000 cfs per gate at a reservoir elevation of 109.2 feet. The effective usable storage between the licensed minimum and maximum pond elevations of 101.2 feet and 110.2 feet is 75,287 acre-feet.

Conowingo Pond extends 14 miles upstream from Conowingo dam to the lower end of the Holtwood Project (FERC Project No. 1881) tailrace. Conowingo Pond is generally maintained at an elevation of 109.2 feet, with a surface area of about 8,500 acres and a total design capacity of 310,000 acre-feet at that elevation. The pond serves as the lower reservoir for the Muddy Run Project, located 12 miles upstream of Conowingo dam.

The intakes for each turbine are individually protected by seven trashracks; the five lower racks are entirely steel with a clear spacing of 5.37 inches, and top two are steel-framed with wood racks with a clear spacing of 4.75 inches.

The 13 project generating units have a total installed capacity of 574.54 MW. The estimated total maximum hydraulic capacity of the project is about 86,000 cfs under optimum head conditions. Units 1 through 7 and the two house (station service) units are completely enclosed within the powerhouse, while Units 8 through 11 are of outdoor type construction, without superstructure.

The powerhouse enclosing Units 1 through 7 includes a generator room and an electrical bay. The electrical bay is located between the generator room and the powerhouse intakes and consists of the 13.8-kV bus and switching equipment.

The tailrace is approximately 2,800 feet long, extending from the powerhouse to the downstream end of Rowland Island. The tailrace width ranges from about 900 feet near the powerhouse to 1,500 feet near Rowland Island. The tailwater elevation downstream of the dam, which varies with discharge, is at an approximate elevation of 20.5 feet with all units operating with no spillway discharge.

The project currently operates two fish lifts: the west fish lift and the newer east fish lift. There are no primary transmission lines associated with the project. Electricity generated at the project is transmitted by two 220-kV generator leads extending from the project substation to the East Nottingham substation.

The Conowingo Project recreation facilities include: Lock 13, Lock 15, Muddy Creek Boat Launch, Cold Cabin Boat Launch, Dorsey Park, Line Bridge, Broad Creek

Public Landing, Glen Cove Marina, Conowingo Swimming Pool and Visitor's Center, Peach Bottom Marina, Conowingo Creek Boat Launch, Funk's Pond, Fisherman's Park/Shures Landing, Conowingo Dam Overlook, and the Octoraro Creek Access area. Exelon operates seven of these facilities and leases the other eight to local and state entities or commercial operators.

Exelon holds title or rights to all of the lands within the project boundary. The project boundary encompasses all of the project facilities and lands required for project operation and maintenance.

2.1.2 Project Safety

The York Haven Project has been operating for almost 110 years under past and current licenses (current license issued in 1980). The Muddy Run Project has been operating for almost 47 years under the existing license issued in 1964, and the Conowingo Project has been operating for almost 86 years under previous and the current licenses (current license issued in 1980). During this time, Commission staff has conducted operational inspections focusing on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the licenses, and proper maintenance. The York Haven Project was exempted from the requirement to file Part 12 independent consultant safety inspection reports every 5 years. The Muddy Run and Conowingo Projects have been inspected and evaluated every 5 years by an independent consultant, and a consultant's safety report has been submitted for Commission review. As part of the relicensing process, the Commission staff would evaluate the continued adequacy of the proposed project facilities under new licenses. Special articles would be included in any license issued, as appropriate. Commission staff would continue to inspect the projects during the new license terms to assure continued adherence to Commission-approved plans and specifications, special license articles relating to construction (if any), operation and maintenance, and accepted engineering practices and procedures.

2.1.3 Existing Project Operation

2.1.3.1 York Haven Project

The York Haven Project is operated in a run-of-river mode and maintains a normal pool elevation of 277.86 feet under low to moderate flow conditions (<17,000 cfs). Under low-flow conditions, York Haven Power has the ability to draw down the impoundment by up to 1.10 feet, generally for purposes of dam maintenance. During periods of moderate to high flow conditions (>17,000 cfs), the project turbines cannot control water levels and the impoundment elevation varies above normal pool elevation depending upon river flow. Under these conditions, water overtops the main dam, east channel dam, and headrace walls when their crest elevations are exceeded.

Flows required by the current license are discussed in section 2.1.4.1, *Existing Environmental Measures, York Haven Project*. A license requirement to maintain continuous flow is accomplished by maintaining at least two of the York Haven turbines operating at full gate providing approximately 1,000 to 1,500 cfs downstream and supplementing the turbine discharge with spill over the main dam spillway.

The York Haven powerhouse is manually operated at all times with two operators on duty during the day and one operator on duty at night. During normal operation, units are brought on-line based on anticipated flow rates given that the only available method of flow control at the project is through on/off operation of each of the 20 generating turbines. Project outflow adjustments typically occur in 700- to 1,100-cfs increments, up to the station hydraulic capacity. Historically, adjustments are made during the day-shift or at a shift change. Project operators ensure run-of-river operation through a series of checks and balances, monitoring operation and streamflow gage data, observing impoundment elevations, and applying project operational experience.

2.1.3.2 Muddy Run Project

The Muddy Run Project is a pumped storage hydroelectric facility. Water is pumped from the lower reservoir (Conowingo Pond) to the upper reservoir which has 33,894 acre-feet of active storage available for pumped storage operation. Typically, pumping occurs during low-load periods when energy costs are low, while generation occurs during high-load periods.

The Muddy Run Project is typically operated from control panels at the Muddy Run powerhouse. The project, however, has automatic generation control equipment capable of starting, running, and stopping the units. This equipment permits remote operation of the plant in generation mode from the corporate office in Kennett Square, Pennsylvania.

Operation of the Muddy Run Project is generally not affected by changes in hydrologic conditions when compared to conventional hydroelectric projects. Pumped storage projects are typically considered to be closed systems, in that they maintain a usable volume of water that is cycled between the upper and lower reservoirs without the need to store or use water flowing through the project from the upper reaches of the drainage basin. Given this, the operation of the Muddy Run Project depends upon maintaining a specific total usable volume of water between the Muddy Run upper reservoir and Conowingo Pond, to limit effects on power production.

During mean flow years, flow issues do not typically arise at the project, as there are sufficient flows to maintain the total usable volume of water for project operation and to provide flows downstream of Conowingo dam. During a high-flow year, the project also has sufficient water available to maintain the total usable volume in the system, while also passing higher levels of flow downstream.

However, during extreme high-flow events, project operation could be affected by having excess water in the system. Exelon typically adjusts Muddy Run operation to reduce the levels in the upper reservoir prior to high Susquehanna River flow conditions. This allows the upper reservoir to be re-filled during high-flow periods and possibly reduce spill conditions at Conowingo dam. Extended periods of high-flow conditions (potential spill situation at Conowingo dam) could reduce the generation at the Muddy Run Project when Conowingo Pond is at or near full pond conditions, in order to reduce spill over Conowingo dam.

During adverse water years, with limited inflow, the water management for the project requires adjustments in the generation cycle. The most typical occurrence is a reduction in the total usable volume of water available for project operation. The extent of the adjustments in flow and the volume of water retained in the Muddy Run upper reservoir and Conowingo Pond depends upon the level of low flow experienced, as well as the length of time of the adverse low-flow conditions. Maintaining the licensed Conowingo Pond levels and minimum flow requirements below Conowingo dam are the primary factors affecting the total usable volume of water.

2.1.3.3 Conowingo Project

The Conowingo Project is a peaking hydroelectric facility that uses a limited active storage reservoir to generate during peak electricity demand periods. The project is typically operated semi-automatically as the generation setting (in MW) is programmed into the control system; however, turbines are brought on- line manually by an operator to ensure an efficient start-up until the generation setting is reached. At times, the project is also operated in either full manual or automatic mode, and this type of operation is typically dictated by the prevailing river flow and system load conditions. The current Conowingo Project license allows for the Conowingo Pond to fluctuate between elevation 101.2 feet and 110.2 feet. There are critical water levels associated with water withdrawals that influence reservoir levels in Conowingo Pond (see section 3.3.2, *Water Resources*, for details).

The current flow regime downstream of Conowingo dam is as follows:

Date	Minimum Flow
March 1 - March 31	3,500 cfs or natural inflow (as measured at the USGS Marietta gage), whichever is less;
April 1 - April 30	10,000 cfs or natural inflow, whichever is less;
May 1 - May 31	7,500 cfs or natural inflow, whichever is less;
June 1 - September 14	5,000 cfs or natural inflow, whichever is less;
September 15 - November 30	3,500 cfs or natural inflow, whichever is less; and
December 1 - February 28	3,500 cfs intermittent (maximum 6 hours off followed by equal amount on).

The downstream discharge must equal these values or the discharge measured at the Susquehanna River at the USGS Marietta gage (No. 01576000), whichever is less. The Marietta gage is located about 35 miles upstream of Conowingo dam above Safe Harbor dam. The gage is generally considered reflective of the lower Susquehanna

River's natural flow regime. During high electrical demand periods with low inflow Exelon uses water from the available Conowingo Pond storage (within its license constraints) to meet this demand. During non-peak periods of electrical demand, some combination of turbine units is used to provide the minimum flow requirements at the project. When inflows are below the minimum turbine capacity, any additional water needed to meet minimum flow requirements would be taken from storage.

During periods of regional drought and low river flow, Exelon has on six occasions over the period 1998 to 2014 (1998, 1999, 2001, 2002, 2005, and 2007) requested and received Commission approval for a temporary variance in the required minimum flow release from the Conowingo Project. When requested, Exelon seeks to have the leakage from the Conowingo Project (approximately 800 cfs) count towards its minimum flow requirement at that project. This temporary variance is typically approved by the Commission following receipt of comments from consulted resource agencies (i.e., SRBC, Maryland DNR, Pennsylvania FBC, and FWS). When implemented, the temporary variance allows Exelon to maintain an adequate pond level elevation and storage capacity throughout a low-flow period, not only for electric generating capacity, but also to ensure an adequate water supply is available for recreational interests and consumptive water usage on Conowingo Pond.[41]

During high-flow events, typically all units are operated at maximum wicket gate opening and crest gate operation is used to pass the remainder of the streamflow. Under such conditions, Conowingo Pond is usually kept near elevation 109.2 feet to prevent splashing of water onto the U.S. Route 1 roadway and debris from "floating over" the closed crest gates. There is a skimmer beam, bottom elevation 109.2 feet, that provides protection to motorists and prevents floating debris from going over the closed crest gates, whose top elevation is 110.2 feet.

2.1.4 Existing Environmental Measures

2.1.4.1 York Haven Project

Article 30 of the current FERC license requires York Haven Power to discharge a continuous minimum flow of 1,000 cfs from the powerhouse and an average daily flow of not less than 2,500 cfs, unless the inflow to the impoundment is less than these amounts, in which case the discharge from the project shall not be less than the inflow.

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[41] This leakage credit, however, may also be adjusted in consideration of the operation of PBAPS. Per the Consumptive Use Mitigation Plan for PBAPS, approved by SRBC on August 3, 2012, mitigation releases are accounted for by the Conowingo Project via leakage through the non-operating turbines. The Plan calls for a reduction in the leakage credit waiver request amount during August, September, and October by 220 cfs during low-flow conditions to provide for PBAPS mitigation.

These flows may be temporarily modified if required due to operating emergencies beyond the control of York Haven Power.

The project includes a weir cut and vertical-slot fish ladder at the east channel dam, which became operational in 2000. When the east channel fish ladder is operated for the upstream migration of adult American shad (typically mid-April to mid-June), York Haven Power is required to spill 4,000 cfs at the main dam and to release 2,000 cfs at the east channel dam, which includes 67 cfs provided directly through the fish ladder. After the American shad upstream passage season and during the resident fish passage period, the project maintains a minimum flow of 400 cfs in the east channel until the seasonal closure of the fish ladder. Fish ladder closure occurs the earlier of December 15 or when average daily river water temperature is equal to or less than 40°F for 3 consecutive days.

Downstream passage for adult and juvenile American shad is provided at the powerhouse by an operating protocol that includes: (1) when river flow is less than the project hydraulic capacity, prioritization of powerhouse generation through units 1 through 6 (propeller units) on a first-on/last-off basis, followed by units 7 through 20 (Francis units); (2) opening the forebay sluice gate located in the lower forebay corner adjacent to unit 1 for downstream fish passage; and (3) using temporary lighting above the forebay sluice gate to aid in attracting alosine species to the sluice gate exit.[42] At river flow greater than project hydraulic capacity, which occurs about 60 percent of the time, downstream fish passage occurs via spillage over the dam.

York Haven Power owns and operates the following project recreation facilities: the Historic Canal Lock, East Shore Boat Launch, Goosehorn Island Picnic Area, Shelley Island Recreation Area, Goodling Island Picnic Area, Beshore Island Recreation Area, Battery Island Recreation Area, Cly Shore recreational lot sites, York Haven Power Plant Recreation Area, and Canoe Portage trail. In addition, York Haven Power implements a recreational lot permitting program to accommodate boating, fishing, and other day-use activities.

2.1.4.2 Muddy Run Project

Prior to predicted high Susquehanna River flow events, Exelon typically voluntarily adjusts Muddy Run operation to reduce the levels in the upper reservoir. This allows the upper reservoir to be re-filled during high-flow periods and possibly reduce spill conditions at Conowingo dam.

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[42] This downstream passage protocol was reported to the Commission by filing of a "Downstream Passage Report" on March 19, 2002. That report was required by Ordering Paragraph (C) of the Commission's June 30, 1994, Order Approving Fish Passage Settlement Agreement, which was the agreement that led to the eventual construction of the east channel fish ladder.

Exelon maintains three recreation areas at the project. The primary project recreation site is Muddy Run Park, a 700-acre park that includes day-use areas, a 189-site campground, the 100-acre Recreation Lake that abuts the upper reservoir, and a visitor information center. Immediately downstream of the powerhouse is Wissler's Run Park, a day-use area with parking for 130 vehicles. In addition, the project includes the 800-acre Muddy Run WMA, located on project and non-project land. Roads and trails within this area provide access for hunters, hikers, birders, and equestrians.

2.1.4.3 Conowingo Project

The current license allows Conowingo Pond to fluctuate between elevation 101.2 and 110.2 feet, except on weekends between Memorial Day and Labor Day, when the elevation must be at or above 107.2 feet to meet recreational needs. However, other operating constraints (see section 3.3.2, *Water Resources*, for details) result in Conowingo Pond typically being maintained at or above elevation 109.2 feet. Pursuant to a Settlement Agreement approved by the Commission on January 24, 1989, Exelon operates the east and west fish lifts at Conowingo dam, and maintains seasonal minimum flows downstream of the dam ranging from 3,500 to 10,000 cfs, and described in more detail in section 2.1.3.3, *Existing Project Operation, Conowingo Project*. Article 37 of the current license includes provisions to protect cultural resources.

Exelon currently enhances DO by a turbine venting system at units 1-7 and aerating runners at units 2 and 5. Downstream DO is continuously monitored by Exelon from May 1 through October 1. Exelon also removes floating and submerged debris from in front of the powerhouse intakes and sponsors community-based clean-ups at Conowingo Pond and downstream of Conowingo dam.

Exelon provides 16 project-related recreation facilities that include parks, day-use areas, marinas, boat launches, and a visitor center: (1) Lock 13; (2) Lock 15; (3) Muddy Creek Boat Launch; (4) Cold Cabin Boat Launch; (5) Dorsey Park; (6) Line Bridge; (7) Broad Creek Public Landing; (8) Glen Cove Marina; (9) Conowingo Swimming Pool and Visitor's Center; (10) Peach Bottom Marina; (11) Conowingo Creek Boat Launch; (12) Funk's Pond; (13) Fisherman's Park/Shures Landing; (14) Octoraro Creek Access; (15) 3.5 miles of the Mason-Dixon Trail; (16) and the Susquehanna State Park.

2.2 APPLICANTS' PROPOSALS

2.2.1 Proposed Project Facilities

York Haven Power proposes to construct a nature-like fishway[43] at the north end of the York Haven Project main dam where it abuts Three Mile Island. Construction would require modifications to the north end of the dam. No other modifications are proposed to project facilities.

No modifications are proposed to project facilities at the Muddy Run Project.

Exelon proposes to construct an eel trap and transport facility on the west side of the Conowingo Project tailrace, and to construct a similar facility on the east side of the river on Octoraro Creek. No other modifications to project facilities are proposed at the Conowingo Project.

2.2.2 Proposed Project Operation

In conjunction with the construction of the nature-like fishway, York Haven Power proposes to modify project flow releases to provide fish passage attraction flows to the nature-like fishway and to establish the nature-like fishway as the primary fish passage facility and the existing east channel fishway as the secondary passage facility. The proposed flow release changes would redistribute minimum flow releases among the various project flow release structures (east channel spillway, east channel fishway, nature-like fishway, main dam, and powerhouse). The overall project minimum flow requirements downstream of the project would not change. The flow release changes are also discussed in section 2.2.3.1, *Proposed Environmental Measures, York Haven Project*.

No modifications to Muddy Run or Conowingo project operation are proposed.

2.2.3 Proposed Environmental Measures

2.2.3.1 York Haven Project

The Settlement Agreement resolves among the Settling Parties all issues associated with issuance of a new license for the project regarding upstream passage of American shad and American eels, downstream passage of juvenile and post-spawning American shad, downstream passage of silver stage American eel, resident fish passage, flow management, water quality and debris management, and endangered species and species of special concern. We consider the Settlement Agreement to represent the

[43] A nature-like fishway is a fishway that is designed to appear and operate similar to a natural riffle, with a gradually sloping channel interspersed with rock weirs and pools. These fishways are typically suitable for a wide range of species.

proposed action regarding these issues for this project.[44] For measures related to other environmental issues (i.e., recreation, land use, and cultural resources) we assume the proposed measures presented in the final license application continue to be proposed.

Under the terms of the Settlement Agreement, York Haven Power would continue the following existing environmental measures at the project (we indicate the designation of the measure in the Settlement Agreement in parenthesis):

- Provide a year-round, continuous, minimum flow from the project of 1,000 cfs and an average daily minimum flow of 2,500 cfs, or inflow, whichever is less, to protect and enhance aquatic resources downstream of the project (measures 3.2.1[c][i], 3.2.1[c][ii],3.2.2[c][i], and 3.2.2[c][ii]).
- Operate the project in a run-of-river mode when inflow to the project is less than 3,000 cfs, without deliberate impoundment drawdown or storage for purposes of generating electricity in particular time periods (measures 3.2.1[c][iii] and 3.2.2[c][iii]).
- Operate and maintain the existing east channel fishway as the primary means for upstream fish passage until the proposed nature-like fishway is completed (measure 3.1.8[a]).
- Provide a minimum flow of 2,000 cfs at the east channel dam and a spillage flow of 4,000 cfs at the main dam during the American shad upstream passage season when the east channel fishway is in operation, until the proposed nature-like fishway is completed. The upstream passage season is determined by the Fish Passage Technical Advisory Committee but generally extends from mid-April through mid-June (measures 3.2.1[a][i] and 3.2.1[a][ii]).
- After the American shad upstream passage season until the end of the resident fish passage season (the earlier of December 15 or until the average daily river temperature is $\leq 40^{o}$F, maintain a minimum flow of 400 cfs in the east channel downstream from the east channel fishway during the period that the east channel fishway is operated to allow upstream

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[44] Our summary of the measures in the Settlement Agreement may differ from the specific language of the Settlement Agreement. Details of individual components of the measures listed in section 3.0 of the Settlement Agreement (measures that the parties agree should be incorporated in the terms of the license), including programmatic elements such as schedules for developing plans and details of monitoring, evaluation, and reporting, are not listed. Characterization of these measures is our attempt to provide a concise summary of the measures for this final EIS and is not intended to modify any of the terms of the Settlement Agreement.

passage of resident fish species, until the proposed nature-like fishway is completed, per a June 2010 Consent Order and Agreement between York Haven Power and Pennsylvania DEP (measures 3.2.1[b][i] and 3.2.1[b][ii][1]).

- Continue an existing downstream juvenile American shad passage protocol, which calls for the operation of units 1-6 (Kaplan and propeller units) to be first online and last offline during the juvenile shad downstream migration period (which typically is from October 1 through November 30), and opening the forebay sluice gate at specific times for downstream fish passage. If river flows exceed the capacity of units 1-6, unit 14 would be operated, and if flows exceed the capacities of units 1-6 and 14, units 7-13 and 15-30 would be operated in ascending order (measures 3.1.6[a][i], 3.1.6[b][i], and 3.2.1[b][ii][2]).
- To prevent a buildup of debris that could affect project and fish passage operations, remove non-natural debris from the forebay and sluice remaining natural debris downstream after notifying the downstream PPL Brunner Island Station (measure 3.3 [b]).
- Contribute $25,000 per year to the York County Conservation District or such other entity identified by Pennsylvania DEP for the purposes of debris removal in the lower Susquehanna River watershed (measure 3.3[a]).

The Settlement Agreement includes provisions for York Haven Power to implement the following suite of measures designed to improve upstream and downstream fish passage and reallocate the existing minimum flows (upon completion of the nature-like fishway) to facilitate migration of American shad and American eel:

- Construct, operate, and maintain a nature-like fishway in the vicinity of the apex of the main dam and Three Mile Island, in compliance with design criteria specified in appendix A of the Settlement Agreement, which would become the primary means of upstream fish passage at the project.
- Pass about 370 cfs through the forebay sluice gate for 1 or 2 hours in the morning during weekdays if river flows exceed the sum of: (1) the turbine hydraulic capacity; (2) flows through the nature-like fishway, once constructed; (3) flows through the east channel; and (4) flows (if any) over the main dam from May 1 through June 30, to facilitate downstream passage of post-spawning adult American shad; and any day that river flow exceeds the combined hydraulic capacity during the juvenile American shad downstream passage period, to facilitate downstream passage of juvenile American shad.
- Pass about 370 cfs through the forebay sluice gate between the hours of 5 and 11 p.m. during the entire juvenile American shad passage period to

facilitate the downstream passage of juvenile American shad (measures 3.1.6[a][ii] and 3.1.6[b][ii]).

- Develop designs within 4 years of license issuance for: (1) removal of obstructions in or deepening of the plunge pool below the forebay sluice gate, and (2) a chute structure to convey flows beyond the roadway on the downstream side of the stone masonry forebay bulkhead wall to protect outmigrating juvenile and adult American shad that pass into the downstream plunge pool.

- Cooperate with resource agencies and other interested parties to conduct a lower Susquehanna River downstream eel migration study that would include monitoring silver eels at the project and providing $25,000 to support the study (measures 3.1.7[b], 4.1.1[a], and 4.1.2[a]).

- Conduct a site-specific silver eel route of passage study at the project including the potential for providing $50,000 to resource agencies for collection and tagging of silver eels at upstream locations (measures 3.1.7[c] and 4.1.1[b]).

- Conduct a site-specific silver eel survival study as described in appendix H of the Settlement Agreement (measure 3.1.7[c]).

- Conduct a downstream eel passage improvement study if downstream eel passage goals are not achieved with provisions for subsequent monitoring and adjustments (measures 3.1.7[e], 3.1.7[f], 3.1.7[g], and 3.1.7[h]).

York Haven Power proposes to construct, operate, and maintain a nature-like fishway in the vicinity of the apex of the main dam and Three Mile Island in compliance with design criteria specified in appendix A of the Settlement Agreement (measures 3.1.1 and 3.1.2). Prior to and upon completion of the nature-like fishway, York Haven Power proposes to implement the following measures:

- Develop an erosion and sediment control plan for construction of the nature-like fishway.

- Prior to construction of the nature-like fishway, conduct vegetation surveys, wetlands delineations, invasive species surveys, rare species surveys, bog turtle habitat assessments, and bald eagle surveys in the area of the nature-like fishway.

- Conduct American shad upstream passage effectiveness studies using radio telemetry beginning during the second year of nature-like fishway operation. If the project area passage success criterion is not achieved, York Haven Power would implement corrective measures, followed by two additional years of radio telemetry studies to confirm achievement of the project area passage success criterion (measure 3.1.3).

- Conduct a juvenile American shad headrace turbine avoidance study consistent with design criteria included in appendix D of the Settlement Agreement (measure 3.1.6[d]).
- If the juvenile American shad headrace turbine avoidance goals are not achieved, implement measures that would enhance the effectiveness of downstream juvenile shad passage and conduct a supplemental juvenile American shad headrace turbine avoidance study within 2 years of implementing the measures. Provisions are made for subsequent measures and evaluations (measures 3.1.6[f], 3.1.6[g], and 3.1.6[h], and 3.1.6[i]).
- Provide an average daily minimum flow in the east channel below the east channel dam of 267 cfs year round to protect aquatic resources in the east channel and provide a minimum passage flow for fish ascending the east channel and using the east channel fishway (measures 3.2.2[a][i] and 3.2.2[b][b][i]).
- Provide at least 5 percent of river flow through the nature-like fishway and supplemental attraction flow channels when flows entering the project during the American shad upstream passage season are between 5,000 and 150,000 cfs. This would equate to a minimum flow through the nature-like fishway of between 1,000 and 7,500 cfs depending on inflow (measure 3.2.2[a][ii]).
- Outside of the American shad upstream passage season, provide a minimum flow of 200 cfs through the nature-like fishway when the river elevation is at the crest of the main dam (measures 3.1.6[b][iii] and 3.2.2[b][ii]).
- To the extent controllable by York Haven Power, when flows exceed the hydraulic capacity of all available generating units, manage flows to maximize flow over the main dam and the nature-like fishway to provide attraction flow to the vicinity of and from the nature-like fishway to maximize fishway effectiveness (measure 3.2.2[b][iii]).

York Haven Power also proposes to implement the following additional environmental measures included in the final license application but not included in the Settlement Agreement:

- Maintain existing project recreation facilities, and consult with the resource agencies on recreation resources and management strategies every 10 years after the effective date of any new license.
- Continue the current permitting program for the approximately 300 recreational lots located within the project boundary, but terminate permits and remove from the licensing program existing recreational lots upon abandonment by the lessee, or when existing structures become damaged

and are not replaced by structures conforming to all applicable federal, state, and local regulations.

- Implement the HPMP filed with the Commission on December 28, 2012, to manage project effects on historic properties eligible for listing on the National Register.

2.2.3.2 Muddy Run Project

Exelon proposes the following environmental measures at the project:

- Develop a DO monitoring plan no earlier than November 1, 2027, with measures designed to ensure that the project does not violate DO standards.
- Develop FPOP for minimizing delay and potential fish entrainment during upstream and downstream fish passage past the project tailrace during generating and pumping cycles, with specific targets for upstream and downstream passage at the Muddy Run Project, and corrective actions if targets are not met.
- In 2018, develop a plan and schedule, as part of fish passage monitoring, for a radio telemetry study or equivalent Tier II study of American shad passage and behavior within the Muddy Run Project boundary, although no such plan would be required if available data indicate that 75 percent of the shad that pass the downstream Conowingo Project also pass through the Holtwood Project fish passage facilities (Tier I requirement), and that 50 percent of the shad that pass the Conowingo Project pass the Holtwood Project within 5 days (Tier II requirement). The Tier II study, if required, would determine the percentage of shad that enter the Muddy Run Project area at the northern tip of Sicily Island and exit the Muddy Run Project area at the southern tip of Deepwater Island. The radio transmitters would be inserted into shad at the Conowingo Project or other locations approved by Pennsylvania DEP. At the end of the 4-year study period, or such longer time as established by Pennsylvania DEP, if the results indicate that, as a result of Muddy Run operations, less than 88 percent of the American shad that enter the Muddy Run Project area in turn exit the Muddy Run Project area, Exelon would propose a plan and schedule for operational modifications to the extent feasible, reasonable, and technically sound to enhance fish passage at the project.
- By January 15, 2015, submit a plan and schedule to provide for 95 percent survival of juvenile American shad and 80 percent survival of adult American shad that pass downstream through the project area, with full implementation of the plan by 2015. By February 15, 2026, Exelon would conduct a "discrete passage study" to measure the downstream passage of shad past the project, with the target passage rates noted above. If the

target passage rates are not met, Exelon would propose appropriate mitigative measures.

- Implement the American Eel Passage Plan[45] filed with the license application for an eel trap and truck program to trap, hold, and transport American eels from the Conowingo Project and Octoraro Creek to designated points in the Susquehanna River watershed until at least 2030, and then either continue the trap and truck program or construct a volitional eel passage facility at Conowingo dam.[46]
- No earlier than October 1, 2016, and when Pennsylvania DEP determines that sufficient numbers of American eel are present upstream of the project to require downstream passage, conduct downstream eel passage studies to confirm at least 85 percent eel passage through the project area. If the target downstream passage rate is not met, Exelon would propose appropriate mitigative measures.
- Implement the Bald Eagle Management Plan filed with the license application providing for the management of bald eagle habitat on Exelon lands in accordance with recommendations from the *National Bald Eagle Management Guidelines* (FWS, 2007a) and state agency guidance. Bald eagle habitat, including nest sites, forage sites, and communal roost sites, on Exelon lands would be managed through a range of measures that would be tailored to the types of activities with potential to affect eagles. These measures would include, but not be limited to, seasonal restrictions on maintenance activities such as herbicide applications during the breeding season, distance buffers, and landscape buffers.
- Implement the Bog Turtle Management Plan filed with the license application to minimize impacts on bog turtles and that includes: (1) restricting mowing in the wetland documented to support bog turtles; (2) controlling invasive and woody plants, particularly reed canary grass; and (3) limiting public access to the wetland without advertising the reason.

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[45] Exelon filed an Eel Management Plan with its final license application. In the water quality certification for the Muddy Run Project, the Pennsylvania Department of Environmental Protection called this plan an American Eel Passage Plan, and we use this title throughout the EIS.

[46] Exelon is proposing that a Muddy Run Project measure be implemented at the Conowingo Project, which is not under the same license. It is Commission policy that a condition for one license cannot be required and implemented through the license of another project.

- Once every 10 years through the term of the license, evaluate all state and federal endangered and threatened species that may be present within the project boundary, and if the evaluation identified the presence, critical habitat, or critical dependence of endangered species, propose and implement a protection plan for each species.
- Provide annual grants up to $450,000 total to be split between the Lancaster County and York County Conservation Districts through 2030 for the implementation of agricultural pasture and barnyard BMPs to control sediment loading to the Susquehanna River.
- Provide $50,000 annually through 2030 to the Pennsylvania FBC to perform habitat improvement projects including removal of small dams.
- Implement the Recreation Management Plan filed with the license application that includes measures for maintenance and capital improvements and contains specific enhancements at project recreation facilities.
    - At Muddy Run Park and Campgrounds: (1) replace the Recreation Lake boat launching facility and boat dock with an improved launching ramp and barrier-free dock; (2) implement shoreline erosion measures to improve runoff and stability in the vicinity of an ADA-compliant picnic area and boat rental dock; (3) replace an existing wood retaining wall with a sheet pile retaining wall to reduce shoreline erosion near the boat dock area; (4) upgrade the electric service to 50 campsites in the park, and monitor future need and upgrade additional sites when the demand occurs; (5) expand an existing playground area near the Visitor's Center with safety swings and three modular play structures suitable for younger children (tot lots); and (6) install a mulch safety surface, and construct a 2,000-square-foot water spray park near the entrance to Muddy Run Park, along with paving resurfacing.
    - At Wissler's Run Park: (1) complete the replacement of the picnic pavilion;[47] (2) designate and sign two additional barrier-free parking spaces near the picnic pavilion for compliance with standards set by *ADA Accessibility Guidelines for Buildings and Facilities*; and (3) remove the existing non-functioning fish cleaning station.
    - At Muddy Run WMA: (1) continue to lease the Muddy Run WMA to the Pennsylvania Game Commission for the management of the

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[47] The walkway from the parking area to the picnic area and the parking lot were both repaved in 2011.

Muddy Run WMA to provide hunting opportunities in the area; and (2) erect and maintain FERC Part 8 signs at the River Road and Furniss Road WMA parking areas to identify the conditions of access to the site.

- Implement the Shoreline Management Plan (SMP) filed with the license application and consistent with *Guidance for Shoreline Management Planning at Hydropower Projects* (FERC, 2001). The SMP includes specific measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, and use of project lands and BMPs for controlling sediment introduction from lands within the project boundary.
- Implement the osprey management policy described in Exelon's proposed SMP.
- Implement a cultural resources management plan if cultural materials are identified during project-related ground-disturbing activities.
- Within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become final, provide the version of the Lower Susquehanna OASIS model to SRBC as per a letter agreement dated November 19, 2013.[48]

2.2.3.3 Conowingo Project

Exelon proposes to continue the following environmental measures at the project:

- Operate the project with a normal range of operation of Conowingo Pond between elevations 101.2 and 110.2 feet, with a minimum elevation of 107.2 feet on weekends between Memorial Day and Labor Day, to meet recreational needs.
- Provide minimum flow releases from the project, as described below, or a minimum flow equal to the discharge (natural inflow) measured at the Marietta USGS gage (No. 01576000), whichever is less:
  - March 1 – March 31: 3,500 cfs or natural inflow;
  - April 1 – April 30: 10,000 cfs or natural inflow;

[48] On November 19, 2013, Exelon sent a letter agreement to SRBC stating that it would provide SRBC with a version of the OASIS model as we describe. SRBC signed the letter agreement on November 21, 2013, and that agreement is appendix 2 in the water quality certification for the Muddy Run Project.

- May 1 – May 31: 7,500 cfs or natural inflow;
- June 1 – September 14: 5,000 cfs or natural inflow;
- September 15 – November 30: 3,500 cfs or natural inflow; and
- December 1 – February 28: 3,500 cfs intermittent (maximum 6 hours off followed by equal amount on).

- Enhance DO at the project using the turbine venting systems on Units 1 through 7 and the aerating runners on Units 2 and 5, and continuously monitor DO levels from May 1 through October 1 at the Station 643 location about 0.6 mile downstream of Conowingo dam.
- Operate the east fish lift for upstream passage of American shad, river herring, and other migratory fishes, and the west fish lift for American shad egg collections and other research purposes.
- Manage debris to include clamming (with three gantry cranes with grapple attachments) to remove submerged debris from the area upstream of the powerhouse intakes and floating surficial debris in front of the powerhouse intakes, and the sponsorship of community-based clean-ups in the pond and downstream of the dam.
- Maintain the project's public recreation facilities.

Exelon proposes the following new environmental measures at the project:

- Implement the Sediment Management Plan filed with the license application that identifies benchmarks and thresholds for action to address sediment issues that may affect project operation.
- Conduct a bathymetric survey of Conowingo Pond every 5 years to monitor sediment transport and depositional patterns.
- Implement a preventive maintenance program for the east fish lift that would extend the useful life of the facility over the next license term.
- Use the project turbines as the route for downstream passage of American shad and river herring, based on studies that show high survival for fish passing through the turbines.
- Construct a permanent trap and transport facility for upstream passage of American eel, consisting of an eel ramp and collection facility on the west bank of the Conowingo tailrace and a similar facility on the east side of the river on Octoraro Creek.
- After 2030, construct volitional eel passage facilities on the west and east banks that consist of full eel ramps with resting pools.

- Implement the final Bald Eagle Management Plan filed with the license application providing for the management of bald eagle habitat on Exelon lands in accordance with recommendations from the *National Bald Eagle Management Guidelines* (FWS, 2007a) and state agency guidance. Bald eagle habitat, including nest sites, forage sites, and communal roost sites, on Exelon lands would be managed through a range of measures that would be tailored to the types of activities with potential to affect eagles. These measures would include, but not be limited to, seasonal restrictions on maintenance activities such as herbicide applications during breeding season, distance buffers, and landscape buffers.
- Implement the Recreation Management Plan filed with license application to guide the operation and maintenance of Exelon's recreation facilities and the implementation of recreation facility enhancements as outlined above.
- Implement improvements to project recreation facilities as follows:

Recreational Facility	**Summary of Capital Improvements**
Lock 13	Install a trailhead directional sign at the Lock 12 parking area (access to Lock 13 is from Lock 12, a facility owned by Holtwood-PPL), and clear vegetation from within the lock to provide an unobstructed view of the structure; construct light fencing on each side of the lock structure to protect visitors
Lock 15	Designate two barrier-free parking spaces in the existing parking area and install a dock on the shoreline near the picnic area to allow boaters to access the site; construct a concrete pad for portable restroom placement; stabilize the open shoreline area near the parking area to prevent erosion
Muddy Creek boat launch	Designate two boat trailer spaces and one vehicle space for barrier-free parking in the existing parking lot; stabilize areas adjacent to the southwest corner and southerly side of the parking area to improve drainage and redirect flow away from the parking area and the river; install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out
Cold Cabin boat launch	Improve access by designating a one-way directional traffic pattern through the site and constructing parking for 11 vehicles (five boat trailer and six

Recreational Facility	Summary of Capital Improvements
	vehicle spaces), including two barrier-free spaces; reinforce existing boat ramp to prevent undermining of the ramp and install a boat dock; install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out; provide two ADA-compliant picnic tables; install a concrete pad for the placement of two portable restrooms (one ADA-compliant, one standard)
Dorsey Park	Rebuild both boat ramps at Dorsey Park; designate one barrier-free boat trailer space and one barrier-free vehicle space in the existing lot; install a concrete pad for three portable restrooms (one barrier-free, two standard); install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out
Conowingo Creek boat launch	Designate one barrier-free parking space in the existing parking area; stabilize a roadside ditch along Mt. Zoar Road and construct a stone-lined drainage ditch along the south side of the parking lot to redirect runoff from the parking lot and boat ramp; install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out
Glen Cove Marina	Expand parking at the marina by adding seven additional boat trailer spaces (one barrier-free) and 11 vehicle (two barrier-free) spaces; repair the marina's bulkhead wall
Funk's Pond	Designate one barrier-free parking space in the existing parking area
Line Bridge	Perform shoreline erosion control and stabilization work at this unimproved carry-in boat access area
Conowingo swimming pool	Install an barrier-free access facility at the swimming pool and an barrier-free access ramp at the wading pool
Conowingo dam overlook	Reopen the facility and designate three barrier-free vehicle spaces in the existing parking lot; demolish the existing pavilion and replace it with a new 24-foot by 24-foot wooden pavilion; remove pavement from the easterly corner of the existing paved parking area,

Recreational Facility	Summary of Capital Improvements
	loam and seed, and install three barrier-free pathways and picnic tables; install security fencing around the site to restrict access to Conowingo dam, while allowing unobstructed views from the pavilion and picnic area
Fisherman's Park and Shures Landing	Widen the access road to the facility by 3 to 5 feet to allow construction of 12-foot wide lanes; construct a retaining wall along the easterly 250 feet of the existing parking area along the access road; designate five additional barrier-free parking spaces in the existing parking lot; widen the access road leading to Shures Landing by 4 feet along the eastbound lane for 320 feet, and widen the access road from the trailhead parking northerly to the retaining wall by 2 feet; construct an additional 13-space parking area near the Lower Susquehanna Heritage Greenway trailhead at the southerly end of Fisherman's Park; demolish the existing hard surface boat launch and asphalt access at Shures Landing and place stone fill next to the existing wall down to existing grade along the Susquehanna River shoreline; construct a new 20-foot wide hard surface carry-in boat launch with a floating dock and breakwater at Shures Landing, to replace the existing launch area
Peach Bottom access	Construct a small (approximately four vehicle) road-side parking area near the existing informal boat launch area south of Peters Creek; install a sign providing information on Conowingo dam canoe portage and the location of the portage take-out

- Implement the SMP filed with the license application that includes specific measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, BMPs for controlling sediment introduction from lands within the project boundary, and use of project lands.
- Implement the osprey management policy described in Exelon's proposed SMP.
- Implement the HPMP filed with the license application for the management of archaeological and historic resources throughout the term of any new

license, including: (1) a schedule and methodology for completing any additional recommended studies and implementing monitoring measures; (2) management measures for identified historic properties including Conowingo dam and powerhouse; (3) protection of any historic properties threatened by project-related activities, including project operation, shoreline and aquatic recreation, shoreline development, routine project maintenance, and other project activities or operations; and (4) public outreach, education, and signage for the purpose of reducing looting and vandalism of sites.

Project Boundary Revisions

York Haven Power proposes to add 1.9 acres to the total York Haven Project boundary acreage to encompass the project's East Shore Boat Launch and Canal Lock recreation area.

Exelon proposes to modify the Conowingo Project boundary by removing lands that are not necessary for operation and maintenance of the Conowingo Project or for other specified project purposes, such as public recreation or protection of environmental resources. These lands include: 0.06 acre of land not owned by Exelon in the upper reaches of Conowingo Pond; 34.4 acres along the Susquehanna River shoreline at the Muddy Run Project (to minimize the overlap of project lands between the two projects); 205.6 acres on upper Broad Creek, a tributary to Conowingo Pond; and 1,758.7 acres of the Susquehanna River and shoreline downstream of Conowingo dam. The Lower Susquehanna Heritage Greenway, Deer Creek Access, Lapidum Boat Launch, and McLhinney Park are non-project recreation sites located on a thin ribbon of land along the west bank of the Susquehanna River, downstream of Conowingo dam. This area was included in past licenses so as to incorporate the railroad that was used to shuttle material to the dam during initial construction. The proposed project boundary for the Conowingo Project contains 9,919 acres, including 8,850 acres of project waters and 1,069 acres of land above the normal high water elevation in Lancaster and York Counties, Pennsylvania, and Harford and Cecil Counties, Maryland. Exelon would negotiate leases with existing recreation facility operators for the continued operation of those facilities located on lands owned by Exelon, but no longer within the project boundary. Exelon would also negotiate a new lease with Maryland DNR for the continued protection and use of the collocated Lower Susquehanna Greenway Trail and Mason-Dixon Trail on Exelon-owned lands outside of the project boundary. The existing lease expires in August 2014.

2.2.4 Modifications to the Applicants' Proposals – Mandatory Conditions

We recognize that the Commission is required to include valid water quality certification conditions and section 18 fishway prescriptions in any licenses issued for the projects. The staff alternative with mandatory conditions would include the respective staff-recommended measures along with the mandatory conditions that we did not include in the staff alternative. Mandatory conditions were filed for the York Haven and Muddy Run Projects (both water quality certification conditions and preliminary fishway prescriptions), but no mandatory conditions were filed for the Conowingo Project. Both Interior and NMFS, however, specified a reservation of authority under section 18 to prescribe fishways during the term of the license for the Conowingo Project.

Water Quality Certification Conditions

Pennsylvania DEP issued a final water quality certification for the York Haven Project on August 19, 2014 (see appendix D). In its comments on the draft EIS, York Haven Power indicated that the water quality certification substantially reflects relevant elements of the Settlement Agreement. While York Haven Power has not indicated the final certification represents its proposal, our review of the final certification found that it is nearly identical to the Settlement Agreement. Therefore, we include these measures in the list of York Haven's proposed measures in section 2.2.3.1, *Proposed Environmental Measures, York Haven Project*, and identify them in the discussions in section 3.3.2.2, *Water Resources*. However, we are not recommending in the staff alternative one measure included in the certification: to contribute $25,000 per year to the York County Conservation District or such other entity identified by Pennsylvania DEP for the purposes of debris removal in the lower Susquehanna River watershed.

On December 21, 2013, Pennsylvania DEP issued a draft certification for public comment for the Muddy Run Project. In its reply comments filed on March 18, 2014, Exelon requested the Commission incorporate the conditions in the draft certification in its licensing proposal. Pennsylvania DEP issued final certification on June 3, 2014, and filed the final certification with the Commission on June 9, 2014. Pennsylvania DEP also filed a clarified version of the certification on December 10, 2014. By letter filed January 21, 2015, Exelon confirmed that the clarified water quality certification filed by Pennsylvania DEP on December 10, 2014, continues to represent Exelon's licensing proposal for the Muddy Run Project. Therefore, we include these measures in the list of Exelon's proposed measures in section 2.2.3.2, *Proposed Environmental Measures, Muddy Run Project*, and identify them in the discussions in the resource sections to which they apply. However, we are not recommending in the staff alternative four measures included in the Muddy Run certification: (1) implement the Eel Management Plan filed with the license application for the eel trap and truck program to trap, hold, and transport American eels from the Conowingo Project to designated points in the Susquehanna River watershed until at least 2030, and then either continue the trap and truck program or construct a volitional eel passage facility at Conowingo dam;[49]

[49] However, we are recommending the upstream American eel passage measures proposed by Exelon for the Conowingo Project, which includes essentially the same measures as those in the Muddy Run American Eel Passage Plan.

(2) provide the version of the Lower Susquehanna River OASIS Model to the Susquehanna River Basin Commission within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become 'final' (i.e., are no longer appealable or subject to ongoing litigation) as provided in the "*Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRBC*"; (3) provide annual grants up to $450,000 total to be split between the Lancaster County and York County conservation districts through 2030, for the implementation of agricultural pasture and barnyard BMPs to control sediment loading to the Susquehanna River; and (4) provide $50,000 annually to Pennsylvania FBC to perform habitat improvement projects including the removal of small dams.

Incorporation of these mandatory conditions into new licenses for the York Haven and Muddy Run Projects, however, would not cause us to modify or eliminate any of the environmental measures that we include in the staff alternative.

Section 18 Prescriptions

York Haven Project

Interior's section 18 preliminary prescription specifies:

- A reservation of authority to prescribe fishways during the term of the license.
- Design populations for American shad, river herring, and American eel.
- Operational flows at the project that are the same as provided in the Settlement Agreement as described above.
- An operational schedule for upstream and downstream fish passage facilities.
- Fishway operating procedures for each fishway.
- Construction of a nature-like fishway at the apex of the main dam by November 30, 2021.
- Required monitoring and effectiveness studies for the nature-like fishway, to ensure that at least 75 percent of the shad passed at the downstream Safe Harbor Project be passed at the York Haven Project, or that at least 85 percent of the shad that arrive in the York Haven Project area be passed above the York Haven Project.
- Criteria for determining if required effectiveness is met, and measures to be implemented if effectiveness is not met.
- That the upstream end of the nature-like fishway be designed to accommodate installation of Passive Integrated Transponder (PIT) tag monitoring devices at such time that PIT tag monitoring devices become

available and feasible for reliably monitoring American shad exiting the nature-like fishway.

Muddy Run Project

Interior's section 18 preliminary prescription specifies:

- A reservation of authority to prescribe fishways during the term of the license.[50]
- FPOP to describe Muddy Run Project operation during the fish passage season, including regular maintenance activities and emergency procedures to allow safe, timely, and effective fish passage past the Muddy Run Project.
- A fish passage monitoring plan (FPMP), including an American shad passage monitoring plan, for post-FPOP implementation monitoring, and the criteria for success consistent with the goals and objectives set forth in the Susquehanna River Anadromous Fish Restoration Plan.
- An eel passage program with other licensees on the river, so that Muddy Run operation does not interfere with passage objectives at the upstream Holtwood Project.
- An American Eel Passage Plan at the project, including an eel trap and transport program from the downstream Conowingo Project to upstream locations, with design plans due to FERC within 1 year of license issuance.
- Financial support to FWS of $20,000/year for its eel trapping facility at Conowingo dam until the Muddy Run facility is completed.
- Field testing to determine the best locations for eel traps for upstream passage of elvers, prior to construction of permanent traps that would consist of two ramp-style traps with the capacity to capture 50,000 eels/day, along with facilities for holding and transport, and a quality assurance/quality control program to ensure target survival of 95 percent.
- Instream evaluation of the presence of eels in the river and tributaries every 3 years, and a 2-year downstream passage study of silver eels within 3 years of license issuance.

[50] NMFS also specifies a Reservation of Authority to later prescribe fishways at the Muddy Run Project.

2.3 STAFF ALTERNATIVE

York Haven Project

Under the staff alternative, the project would include most of York Haven Power's proposed measures as outlined in section 2.2.3.1, *Proposed Environmental Measures, York Haven Project*, above, with the following additions and modifications:

- Develop a recreation management plan that provides for York Haven's proposed maintenance of its existing recreation facilities with additional provisions to update the plan every 12 years consistent with every other Form 80 reporting period deadline, include safety measures during construction of the nature-like fishway, continue the licensing program for approximately 300 recreational lots within the project boundary, and implement revisions to the program to allow for the termination of permits and removal of lots from the program if structures are abandoned by the lessee, or when existing structures become damaged and are not replaced by conforming structures.
- Develop an SMP that includes specific measures and policies related to shoreline management at the project and include a provision to update the plan every 10 years.
- Modify the proposed HPMP to add: (a) a requirement to request access to sites on private lands within the project boundary if project impacts are identified during monitoring activities, assess these effects, and evaluate the affected sites for listing on the National Register; (b) a plan and schedule to evaluate archaeological sites on York Haven fee lands within the project boundary for their National Register eligibility to ensure that any effects on sites owned by York Haven Power are fully considered in accordance with section 106; (c) inclusion of two additional sites (36YO300, 36YO334) in the monitoring schedule, or clarification regarding why they were excluded; and (d) the National Park Service (Park Service) as a consulting party.

Muddy Run Project

Under the staff alternative, the project would include most of Exelon's proposed measures as outlined above with the following additions and modifications:

- Visit FWS' Chesapeake Bay Field Office and the Pennsylvania Field Office websites prior to any ground disturbance and follow the bog turtle and bald eagle guidelines.
- Modify Exelon's proposed Recreation Management Plan to include recreation use monitoring and plan updates every 12 years in concert with every other Form 80 reporting deadline.

- Modify Exelon's proposed SMP to include a provision to update the plan every 10 years.
- Develop an HPMP that provides for the management of historic properties and unevaluated cultural resources within the project APE and includes: (a) a plan for further archaeological investigations of additional areas of interest (AOIs) and other potentially affected areas as recommended in the Phase IB report; (b) a detailed discussion of the three sites (36LA67, 36LA103, 36LA368) identified during the Phase IA cultural resources survey and two additional sites (36LA70, 36LA47) located outside of the project boundary that could be affected by the project; (c) requirements for National Register evaluation of affected sites in consultation with the Pennsylvania SHPO; (d) requirements for formal National Register evaluation of the Muddy Run Project; (e) documentation of all consultation with the Delaware Nation and Onondaga Nation; and (f) addition of the Park Service as a consulting party.

Conowingo Project

Under the staff alternative, the project would include most of Exelon's proposed measures as outlined above, with the following additional modifications and measures:

- Modify Exelon's proposed Sediment Management Plan to include periodic dredging at the Conowingo Creek, Peters Creek (Peach Bottom Marina), and Broad Creek boat ramps, where sediments have been accumulating, to improve and maintain recreational boating access; and include with the results of each bathymetric survey an analysis of any change in sediment deposition or scour in the pond from the previous survey(s).
- Modify Exelon's proposed minimum flow regime to enhance minimum flows from December through February, by eliminating periods with no minimum flow, and by increasing the minimum flow during the first 2 weeks of June, summarized as follows:
  - September 15 – March 31: 3,500 cfs or natural inflow (as measured at the USGS Marietta gage No. 0157600), whichever is less;
  - April 1 – April 30: 10,000 cfs or natural inflow, whichever is less;
  - May 1 – June 15: 7,500 cfs or natural flow, whichever is less; and
  - June 16 – September 14: 5,000 cfs or natural inflow, whichever is less.
- Implement measures designed to improve upstream fish passage through modification to the existing west and east fish lifts that would include: (a) replacing the existing hopper at the west fish lift with a 1,500 gallon hopper; (b) improving the west fish lift sorting and loading process to facilitate trap and truck operations and implementing a trap and truck

program for American shad; (c) conducting a feasibility study to determine engineering feasibility, potential fish passage benefits, and costs for additional attraction flow at the west fish lift and if determined feasible and beneficial, install additional flow capacity; (d) restoring the attraction flow in the east fish lift to its original design capacity of 900 cfs; (e) adding a second 3,300-gallon hopper to the east fish lift in the space provided for in the original design, and upgrading the electrical and mechanical equipment to allow for a 15-minute lift cycle; and (f) conducting a feasibility study for modifying the locations of entrances A and B if 2 years of effectiveness studies, after restoration of the 900-cfs attraction flow, show poor attraction at the east fish lift, and make the necessary modifications if feasible.

- Modify Exelon's proposed Bald Eagle Management Plan to include measures to minimize recreation-related disturbance in proximity to roosting or foraging eagles.
- Develop a northern map turtle protection plan to minimize project impacts on map turtles through monitoring, habitat management, and nest site protection.
- Develop a waterfowl nesting protection plan to identify waterfowl nesting habitat that is routinely flooded by project peaking operations during the breeding season, and where feasible, establish mitigation measures to minimize impacts on waterfowl nests.
- Develop a bog turtle management plan, in consultation with FWS and Maryland DNR, to minimize impacts on bog turtles, that includes: (1) the restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) limits on public access to the wetland without advertising the reason.
- Modify Exelon's proposed Recreation Management Plan to include recreation use monitoring and plan updates every 12 years in concert with every other the Form 80 reporting deadline, a plan to provide angler access to the catwalk on a limited basis with security measures in place that address the vulnerability of the facility and the safety of the users of the catwalk, and a plan to manage floating debris on the surface of Conowingo Pond to improve boater safety.
- Modify Exelon's proposed SMP with the addition of a provision to update the plan every 10 years.
- Modify Exelon's proposed HPMP to include the following additional provisions: (a) a revised APE with the narrow strip of land in the current project boundary extending downstream from Spencer Island along the west side of the river to Havre de Grace, Maryland; (b) a discussion of all

48 sites and 27 historic structures identified to date within the project APE or an explanation of why they are not considered; (c) correction to identify the Susquehanna and Tidewater Canal and Columbia & Port Deposit Railroad eligible for listing; (d) requirements to inventory any lands within the revised APE, evaluate identified cultural resources for eligibility, and address potential effects before sale or transfer of those lands; (e) a requirement to make good faith effort to obtain access to private property to conduct studies if project effects on cultural resources on private lands are identified; (f) a revised list of project activities involving the Conowingo Project that can be completed without Maryland SHPO review; (g) a process for assessing project-related ground-disturbing activities to determine whether or not archaeological sites would be affected, particularly in areas that have not had archaeological surveys; (h) requirements to ensure confidentiality of cultural resources location information during implementation of public outreach programs; (i) a description of project-related activities that would require consultation with the Delaware Nation and the Onondaga Nation in accordance with section 106 of the NHPA and documentation of all consultation with the Delaware Nation and Onondaga Nation; and (j) inclusion of the Park Service as a consulting party.

Under the no-action alternative, each project would continue to operate under the terms and conditions of the existing licenses, and no new environmental protection, mitigation, or enhancement measures would be implemented.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

We considered several alternatives to the applicants' proposals, but eliminated them from further analysis because they are not reasonable in the circumstances of this case. They are: (1) issuing non-power licenses, (2) federal takeover, and (3) retiring one or more of the projects.

2.4.1 Issuing Non-Power Licenses

A non-power license is a temporary license that the Commission will terminate when it determines that another governmental agency will assume regulatory authority and supervision over the lands and facilities covered by the non-power license. At this point, no agency has suggested a willingness or ability to takeover any of the three projects. No party has sought a non-power license and we have no basis for concluding that any of the Susquehanna River Projects should no longer be used to produce power. Thus, we do not consider issuing a non-power license a realistic alternative to relicensing in this circumstance.

2.4.2 Federal Government Takeover of the Projects

We do not consider federal takeover to be a reasonable alternative. Federal takeover and operation of any of the projects would require Congressional approval. Although that fact alone would not preclude further consideration of this alternative, there is no evidence to indicate that federal takeover should be recommended to Congress. No party has suggested federal takeover would be appropriate, and no federal agency has expressed an interest in operating any of the three projects.

2.4.3 Retiring the Projects

Project retirement could be accomplished with or without dam removal. Either alterative would involve denial of the relicense applications and surrender or termination of the existing licenses with appropriate conditions. One commentor suggested that the four dams on the lower Susquehanna River should be removed to allow a free-flowing river, but provided no supporting analysis. No resource agency has suggested that dam removal at any of the projects would be appropriate in this case, and we have no basis for recommending it. Energy currently generated at the projects by a renewable resource would be lost. In addition, the project reservoirs are a major source of water supply for the region and support significant recreational activities, regardless of whether power is produced. Thus, dam removal is not a reasonable alternative to relicensing the projects with appropriate protection, mitigation, and enhancement measures.

The second project retirement alternative would involve retaining the dams and disabling or removing equipment used to generate power. Project works would remain in place and could be used for historic or other purposes. This would require us to identify another government agency with authority to assume regulatory control and supervision of the remaining facilities. No agency has stepped forward, and no participant has advocated this alternative. Nor have we any basis for recommending it. Furthermore, because the power supplied by the projects is needed, a source of replacement power would have to be identified. In these circumstances, we do not consider removal of the electric generating equipment at any of the projects to be a reasonable alternative.

3.0 ENVIRONMENTAL EFFECTS

In this section, we first describe the general environmental setting in the project vicinity and any environmental resources that could be cumulatively affected by relicensing the Susquehanna River Projects. Then, we address each affected environmental resource. For each resource, we first describe the affected environment—the existing condition and the baseline against which to measure the effects of the proposed project and any alternative actions—and then the environmental effects of the proposed projects, including the proposed measures discussed in section 2.2.3, *Proposed Environmental Measures*. Unless otherwise identified, the sources of our information are the license applications for the projects (York Haven Power, 2012a; Exelon, 2012a and 2012b) and the Settlement Agreement (January 30, 2014). We provide citations for information obtained from other sources. Staff conclusions and recommended measures are discussed in section 5.1, *Comprehensive Development and Recommended Alternative*.

3.1 GENERAL DESCRIPTION OF THE RIVER BASIN

The Susquehanna River originates near Cooperstown, New York, at Otsego Lake, and flows for about 444 miles to the Chesapeake Bay at Havre de Grace, Maryland (SRBC, 2008a). The drainage area of the Susquehanna River encompasses portions of New York, Pennsylvania, and Maryland and 27,510 square miles. The Susquehanna River Basin has six major subbasins: the Upper Susquehanna, Chemung, West Branch Susquehanna, Middle Susquehanna, Juniata, and Lower Susquehanna (see figure 1-1).

The Susquehanna River Projects are located in the Lower Susquehanna River subbasin. The lower Susquehanna River subbasin contains ridges spanning southwest to northeast and valleys of moderate width. The river cuts through these ridges in a perpendicular direction and widens as it flows south to southeast through hills and valleys. The southern portion of the Lower Susquehanna River subbasin consists of carved deep gorges in the narrowing river valley, and it is the most developed and suited for hydropower development because of the steep river slope.

The York Haven Project is located at RM 55 on the mainstem of the Susquehanna River, about 17 miles downstream from the city of Harrisburg, Pennsylvania. The upper reservoir of the Muddy Run Project is located on Muddy Run, a tributary (at RM 22) of the Susquehanna River, and the drainage area above the Muddy Run dam is 9.2 square miles. The Muddy Run Project uses Conowingo Pond as its lower reservoir. The Conowingo Project is at RM 10 of the Susquehanna River, in Maryland.[51]

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[51] The Safe Harbor (FERC No. 1025) and the Holtwood (FERC No. 1881) Projects are located downstream of the York Haven Project at RMs 32.2 and 24.6, respectively. The licenses for these projects expire on April 22, 2030 (Safe Harbor), and August 31, 2030 (Holtwood). Table 3-1 contains further information.

The major tributaries to the Lower Susquehanna River subbasin are the Conestoga River and Conodoguinet, Swatara, Conewago, and Penn's Creeks (see figures 2-1, 2-2, and 2-3). Muddy Creek is a major tributary to Conowingo Pond. Smaller named tributaries to Conowingo Pond include Conowingo Creek, Broad Creek, Hanes Branch, Michaels Run, Peters Creek, Barnes Run, Fishing Creek, Wissler's Run, and Muddy Run. Numerous unnamed tributaries also discharge to Conowingo Pond. The major tributaries of the Conowingo Project below Conowingo dam are Octoraro Creek and Deer Creek.

Climatic conditions vary within the Lower Susquehanna River subbasin. The Ridge and Valley physiographic province in the northwest part of the subbasin experiences a humid continental climate with large seasonal temperature variations. This contrasts to the more coastal-type climate experienced in the Piedmont physiographic province in the southeastern part of the subbasin where temperatures are more moderate and precipitation is slightly greater. The average annual precipitation in the Susquehanna River Basin is 39.15 inches per year and is distributed fairly evenly throughout the year; however, long-term records indicate wet and dry periods, and droughts have been fairly common, at times threatening groundwater supplies. During the 1990s through the mid-2000s, droughts have occurred in 8 of 16 years (SRBC, 2013). The annual average temperature ranges from 53°F at the Maryland-Pennsylvania border to 45°F in the upper Susquehanna River Basin.

3.2 CUMULATIVELY AFFECTED RESOURCES

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (50 CFR §1508.7), an action may cause cumulative impacts on the environment if its impacts overlap in space or time with the impacts of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time, including hydropower and other land and water development activities.

Based on information in the license applications, agency comments, other filings related to the projects, and preliminary staff analysis, we identified the following resources that have the potential, in combination with other activities, to be cumulatively affected by the continued operation of the Susquehanna River Projects: water quantity, water quality, migratory fisheries, and Chesapeake Bay habitat. We chose these resources because operation of the York Haven, Muddy Run, and Conowingo Projects, in combination with other hydroelectric projects on the river, regulates river flows and in turn may affect water quality. In addition, along with the other hydroelectric projects on the river, all three projects affect migratory fish migration throughout the lower Susquehanna River. All four mainstem dams (York Haven, Safe Harbor, Holtwood, and Conowingo) have fish passage facilities, but each one provides a different level of effectiveness. Finally, flow regulation from Conowingo and the other hydroelectric projects affects aquatic habitat downstream to the upper Chesapeake Bay.

3.2.1 Geographic Scope

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 the 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. Flows and water quality are not affected by the York Haven Project, in concert with other water uses, once upstream of the influence of the York Haven reservoir. Migratory fishes are affected by the five lower river hydroelectric projects (including Muddy Run Project), but once migratory fishes reach upstream of the influence of the York Haven reservoir, any effects experienced from other dams on the river (low head, non-hydroelectric dams are located at Harrisburg and farther upstream in Sunbury, Pennsylvania) are unrelated to lower river hydroelectric operation. Aquatic habitat in the 60 miles of the lower Susquehanna River may be affected by operation of the lower river projects, but those effects generally do not extend downstream of the mouth of the river. The river becomes tidal about 5 miles downstream of Conowingo dam, and an additional 5 miles of tidal river from this point to the mouth of the river tends to dampen any effects of the projects. However, recent data from the Lower Susquehanna River Watershed Assessment (LSRWA) (U.S. Army Corps of Engineers [Corps] and Maryland Department of the Environment [MDE], 2014) indicate that nutrients stored in Conowingo and other lower river reservoirs may affect water quality in upper Chesapeake Bay, and we include discussion of those effects in section 3.3.2.2 of this final EIS.

3.2.2 Temporal Scope

The temporal scope of our cumulative analysis in the EIS will include a discussion of past, present, and future actions and their effects on each resource that could be cumulatively affected. Based on the terms of the new licenses, the temporal scope will look 30 to 50 years into the future, concentrating on the effects on the resources from reasonably foreseeable future actions. The historical discussion will, by necessity, be limited by the amount of available information for each resource.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

This section outlines the proposed action and the action alternatives with regard to: (1) geology and soils, (2) water resources, (3) terrestrial resources, (4) threatened and endangered species, (5) recreation and land use, (6) cultural resources, (7) aesthetics, and (8) socioeconomics.

3.3.1 Geology and Soils

3.3.1.1 Affected Environment

Geology

The Susquehanna River Basin is located within the Appalachian Highlands physiographic region, and the Susquehanna River Projects are located within the Piedmont Province of this region, which is dominated by rolling lowlands, broad highlands, and ridges. Rock types consist predominantly of red shale, siltstone, sandstone, and some conglomerate that formed in the Jurassic and Triassic periods. Upland terraces of river-transported material occur at various elevations above the present river channel.

The York Haven Project is located within the Gettysburg-Newark Lowland Section within the Piedmont Province. The project's main dam is bounded by diabase, a hard igneous rock. The geology of the remaining project area consists mostly of shale.

Both the Muddy Run and Conowingo Projects are within the Piedmont Upland Section of the Piedmont Province and are underlain by igneous and metamorphic rocks. The bedrock islands along the Susquehanna River below Holtwood dam (known as the Holtwood Gorge) are recognized as an outstanding geologic feature of Pennsylvania. Specifically, the Pennsylvania Department of Conservation and Natural Resources (Pennsylvania DCNR) considers the potholes and cliffs along the gorge as heritage geology sites called erosional remnants.

Prior to construction of Conowingo dam, the river in the current impoundment reach and below the dam was a bedrock channel that was difficult-to-navigate for boats. Preconstruction maps show two sets of falls upstream of the current Conowingo dam (Hector's Falls and Amos's Falls), although they were essentially a series of rapids where the river profile was steeper than in nearby reaches.

Soils

Surficial geologic sediments form a mantle of predominantly unconsolidated weathered bedrock, river-transported sediment (alluvium), and gravity-transported material (colluvium). Soils are predominantly non-hydric. Some hydric soils exist mainly along tributaries.

Shoreline Erosion

Shoreline erosion as a result of fluctuations in the impoundment elevation is relatively minor at the York Haven Project because it is operated as a run-of-river facility. Erosion occurs from natural causes (flood flows, storm waves, runoff, freeze/thaw action, ice scour) and from recreational usage (boat wakes, foot traffic along the shore). Erosion rates are not available but are expected to be small and typical for a river in this type of setting, with large floods being the primary erosion driver.

The Muddy Run Project upper reservoir shoreline consists largely of a wide and gently sloping non-vegetated zone that is alternately exposed and inundated. The zone contains unweathered bedrock covered with fragmented weathered bedrock, colluvium, and alluvium. It is crossed by gullies, rills, and sheet flow features formed by runoff from the surrounding riparian areas or by groundwater seeps. Parts of the excavated intake canal consist of near-vertical walls of exposed bedrock.

There are three locations with high and moderate erosion along the upper reservoir shoreline: weathered bedrock is eroded along the intake canal embankment near the east side of the River Road crossing; gully erosion has created deep crevasses in a steep channel downstream of the Recreation Lake spillway; and, on the northside of the finger-shaped cove to the south of the recreation dam, a top-of-bank erosion scarp face in soils developed from the underlying bedrock. Exelon is monitoring erosion at these locations regularly and is prepared to mitigate adverse effects as needed. There is minimal to no erosion along the remainder of the shoreline with the exception of a 300-foot-long location with moderate erosion (i.e., signs of slumping without adverse effects on resources) in the northeastern corner of the upper reservoir.

The shorelines around Conowingo Pond and below Conowingo dam consist largely of bedrock, unconsolidated natural materials (alluvium, colluvium), and disturbed/artificial materials (e.g., walls, fill, rail embankment, and canal tow path berm). Low to moderate erosion has been observed along unconsolidated shorelines. Instances of high erosion rates have not been observed to encroach on infrastructure. Shoreline erosion along tributaries is also considered low to moderate. Shoreline accretion occurs at the downstream ends of existing islands in the Conowingo Pond and at or near tributary mouths. Deposits are eventually stabilized by natural vegetation growth.

Sediment Transport

The Susquehanna River is the largest tributary to the Chesapeake Bay and consequently contributes the largest sediment load (i.e., 25 percent of the load from non-tidal sources; Langland, 2009). The sediment loading is largely a function of flow, but is affected by the trapping ability of the lower Susquehanna River reservoirs.

As a result of the run-of-river operation and small reservoir (Lake Frederic), the York Haven Project has little control over sediment accumulation in the impoundment. However, given its shallow depth of less than 18 feet (with a mean depth of 6 feet), sediment that may accumulate in the impoundment during low-flow periods is likely flushed out to a large extent during high-flow events.

The Muddy Run Project in essence does not contribute to sediment loading in the Susquehanna River because it is an off-stream reservoir. Instead, a fraction of the suspended sediment contained in the Susquehanna River water that is regularly pumped into the Muddy Run reservoir is expected to settle out of the water column; however, net sediment deposition rates in the reservoir are not available.

In 2009, USGS assessed the potential sediment trapping capacity of the lower Susquehanna River reservoirs and potential effects on the Chesapeake Bay (Langland, 2009). Of the three lower river reservoirs—Lake Clarke (Safe Harbor Project), Lake Aldred (Holtwood Project), and Conowingo Pond (Conowingo Project)—USGS estimated that only Conowingo Pond had any sediment trapping capacity remaining (figure 3-1). Both Lake Clarke and Lake Aldred have been in long-term equilibrium for 50 years or more, with the amount of sediment exiting the reservoirs equal to the amount of sediment entering the reservoirs. USGS estimated that the sediment trapping capacity of the upper and middle parts of Conowingo Pond was minimal and that the only remaining capacity was in the lower part of the reservoir. In 2008, an estimated 174 million tons of sediment were stored in the reservoir; the reservoir's remaining storage capacity was about 30 million tons.

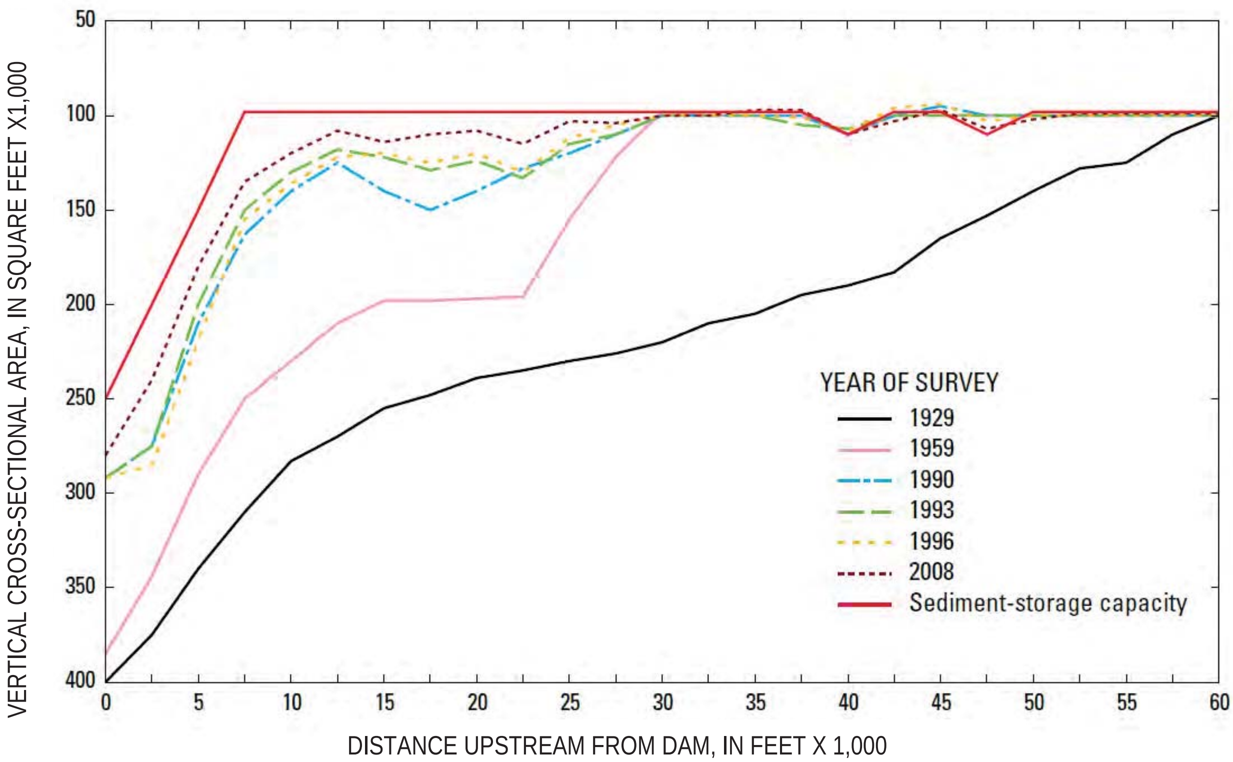

Figure 3-1. Changes in vertical cross-sectional area for selected years and remaining sediment-storage capacity in Conowingo Pond (Source: Langland, 2009).

Detailed sediment transport investigations during the more recent LSRWA study (Corps and MDE, 2014) revealed that Conowingo Pond is now in a state of dynamic equilibrium. A state of dynamic equilibrium implies that sediment will continue to accumulate in Conowingo Pond until a large high-flow event occurs, which will scour sediment already deposited. Scoured sediments are then transported over the dam and flow into the Chesapeake Bay. High-flow events temporarily increase the trapping capacity in the reservoir, and thereby reduce the sediment load entering the Bay, until the next episodic high-flow event will again scour sediment from the pond. Thus, in a state of dynamic equilibrium there is no absolute capacity or point at which the pond is "full" and will no longer trap any sediment. Applying a long-term average, sediment loads delivered to the Chesapeake Bay via the Susquehanna River equal the load delivered into the three lower Susquehanna River reservoirs.

For the last 20 years (1993-2012), USGS estimated the amount of sediment entering Conowingo Pond at 3.8 million tons/year, of which about 2 million tons/year was being trapped by the reservoir (Corps and MDE, 2014). The remaining average sediment load of 1.8 million tons/year was carried past Conowingo dam into the Chesapeake Bay. This sediment load in the lower Susquehanna River varies widely, however, because sediment transport processes are strongly affected by discharge rates. The river carries the highest sediment loads from its watershed during peak flow events. In addition, sediment is mobilized through scour in the three lower Susquehanna River reservoirs. The threshold for scour in Conowingo Pond occurs at approximately 400,000 cfs, which is considered a 4- to 5-year return flow event (Corps and MDE, 2014).[52] Langland and Koerkle (2014) suggested that tropical storm Agnes, in 1972, with a peak discharge rate of approximately 1.1 million cfs, resulted in scour of 13.5 million tons of sediment from Conowingo Pond.

Downstream of Conowingo dam, the streambed consists of a discontinuous surface of exposed bedrock or bedrock with a much thinner alluvial cover than in Conowingo Pond. The streambed is likely in similar condition to the bed prior to dam construction because the flow in the rapids was strong enough to inhibit sediment deposition.

3.3.1.2 Environmental Effects

Shoreline Erosion

Minor shoreline erosion effects at the York Haven Project would continue to occur as a result of natural forces similar to current conditions, considering that project operation would remain unchanged. York Haven Power does not propose any shoreline erosion control measures.

In preparation for the construction of the nature-like fishway, York Haven Power proposes to develop an erosion and sediment control plan and apply to Pennsylvania DEP for a National Pollutant Discharge and Elimination System (NPDES) permit for

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[52] The LSRWA study (Corps and MDE, 2014) found that the scour threshold (the average flow when scouring begins transporting sediment out of the reservoirs to the Chesapeake Bay) for the current reservoir conditions ranges from about 300,000 cfs to 400,000 cfs, with the threshold for mass scouring occurring at about 400,000 cfs. Trace erosion occurs at even lower flows (150,000 to 300,000 cfs).

stormwater discharge associated with construction activities, as specified in the explanatory statement filed with the Settlement Agreement. York Haven Power would also map usable rocks and boulders downstream of the dam to be used for the construction of the fishway. Construction would occur during three low-flow seasons. Rocks and boulders retrieved from the river would be stored in designated staging areas until fishway construction begins.

Shoreline erosion due to upper reservoir level fluctuations at the Muddy Run Project, combined with occasional natural overflows over the Recreation Lake spillway after rain events, surface runoff, mass-wasting, and wind induced waves, is considered minimal with the exception of three locations. Specifically, as described above, weathered bedrock is eroded along the intake canal embankment, gully erosion has created crevasses downstream of the Recreation Lake spillway, and a top-of-bank scarp face formed along the shoreline of the finger-shaped cove to the south of the recreation dam. Aside from regular monitoring for erosion at these locations, Exelon plans to implement an SMP that would allow modifications to shoreline vegetation to construct erosion control measures, provided the modifications do not impair the overall function of the vegetated buffer. Trees and shrubs on steep slopes will be maintained whenever possible.

Shoreline erosion within Conowingo Pond and downstream of the Conowingo Project dam is minor and largely caused by natural processes. Project-induced erosion effects are not discernible from natural effects. As part of its SMP measures, Exelon proposes to adopt BMPs for controlling sediment introduction from lands within the project boundary (see further discussion in section 3.3.5, *Recreation and Land Use Resources*). Proposed erosion control measures include monitoring and remediation of identified and characterized erosion-prone areas.

Our Analysis

Shoreline erosion from the continued operation of the York Haven Project would be minor. For construction of the nature-like fishway, any effects would be minimal with the proper implementation of York Haven's proposed erosion and sediment control plan. In addition, the number of rocks and boulders required for the construction of the fishway would be small relative to the size of the river and the area where the rocks and boulders would be harvested; furthermore, these rocks and boulders would essentially remain part of the riverbed, although placed in a different location (i.e., within the course of the nature-like fishway).

Overall, shoreline erosion effects from the operation of the Muddy Run Project would also be minor. We find that regular monitoring and mitigation (if needed) of the active erosion locations along with the implementation of the SMP would provide adequate measures to control erosion at the upper reservoir.

Shoreline erosion effects in the Conowingo Project area are largely a function of natural high-flow events, wave scour, and mass-wasting processes. Minor shoreline erosion, and deposition of eroded shoreline sediment in the reservoir, is expected to continue at similar rates as at present, considering that there are no significant changes to project operation. We find that the SMP includes adequate measures to address erosion control issues in the reservoir.

Sediment Transport

York Haven Project Area

The small size and shallow depth of the project reservoir, along with the project's run-of-river operation, minimally affects sediment transport in the river. Sediment that settles in the reservoir during low-flow periods would be remobilized during high-flow events and transported downstream of the dam. York Haven Power is not proposing any measures related to sediment transport. The proposed flow redistribution across the dam after the proposed new fish passage facility is in place would not affect overall sediment transport through the project area.

Muddy Run Project Area

As a pumped storage facility, Muddy Run Project operation would not affect sediment loading and transport processes in the Susquehanna River. Sediment suspended in the water that is pumped into the upper reservoir would largely remain in suspension and be returned to the river during power generation. A small fraction of the suspended sediment would settle in the reservoir. The amount of sediment eroded from the upper reservoir shoreline and added to the water column would be minimal.

The certification for the Muddy Run Project requires Exelon to pay a total of $500,000 per year of "compensatory mitigation" from 2014 to 2030, to the Lancaster County Conservation District, the York County Conservation District, and the Pennsylvania FBC, or to such other conservation district, resource agency, or 501(c)(3) organization as directed by Pennsylvania DEP, for the implementation of agricultural pasture and barnyard BMPs to address sediment loading to the Susquehanna River and other habitat improvement projects including small dam removals.

Conowingo Project Area

As stated above, sediment trapping in Conowingo Pond has reached a state of dynamic equilibrium, where, on balance, the full sediment load (and the associated nutrient load) is carried by the river through the reservoir to the Chesapeake Bay (Corps and MDE, 2014; Hirsch, 2012). The LSRWA study (Corps and MDE, 2014) has also been assessing the lower Susquehanna River watershed to identify strategies for reducing sediment and nutrient loading and habitat restoration in the river and in the Chesapeake Bay. The study included a review of existing data and watershed-level modeling to characterize the complex relationship among river flow, sediment loading, and ecological resources. Project partners include the Corps, Maryland DOE, Maryland DNR, SRBC, USGS, Chesapeake Bay Program, and The Nature Conservancy. The draft final report for this study, published in November 2014, includes an assessment of the role of scour in the reservoirs and evaluates appropriate sediment management strategies to address the effects of future scour events. Management options considered by the study include dredging, modifying dam operation, and sediment bypass strategies. Exelon attended LSRWA meetings and provided feedback and information throughout the LSRWA study.

Several agencies and organizations commented in response to the Ready for Environmental Analysis notice that the findings of the LSRWA study should be available before the Commission completes its National Environmental Policy Act (NEPA) analysis for project relicensing. These entities include the U.S. Environmental Protection Agency (EPA); Maryland DNR; SRBC; NMFS; Chesapeake Bay Foundation; Stewards of the Lower Susquehanna, Inc.; Midshore Riverkeeper Conservancy, Inc.; and Clean Chesapeake Coalition. The commenters stated that Exelon's proposed management plans are not ready for analysis without an understanding of the sediment-related effects of scour in Conowingo Pond during peak flow events on the water quality and living resources in the Chesapeake Bay. The Stewards of the Lower Susquehanna, Inc. also recommended that Exelon remove at least 4 million tons of sediment annually from the reservoir to eventually remove all sediment subject to scouring. The Clean Chesapeake Coalition requested that Exelon be required to dredge Conowingo Pond, and restore oyster beds north of the Bay Bridge and submerged aquatic vegetation (SAV) in the upper Bay and its tributaries that were buried by sediment scoured from Conowingo Pond. The Town of Port Deposit, American Rivers, and Henry Immanuel also recommended that Exelon prevent and mitigate for the downstream effects of scoured sediments. Maryland DNR noted, however, that it is premature to conclude that the LSRWA study will be adequate to appropriately identify and evaluate sediment and nutrient effects on the Bay's resources related to the Conowingo Project. Similar comments were received from multiple entities after the draft EIS was published.

The Nature Conservancy commented that the elimination of coarse-grained sediments (sand, gravel, and cobble) via storage in Conowingo Pond, and turbulence and high velocities resulting from hydropower operation at the Conowingo Project, adversely affect the amount of lower river habitat available to fish species, such as American shad, river herring, shortnose and Atlantic sturgeon, map turtle, and freshwater mussels, as well as SAV. The Nature Conservancy and American Rivers recommended developing alternatives to mitigate the effects of continued operation on living resources.

Exelon responded that its operation does not increase the amount of sediment discharged into the Chesapeake Bay and that sediment and nutrients are almost entirely introduced to the river during runoff from the watershed, which is outside of Exelon's control. Therefore, Exelon stated that it should not be required to mitigate any potentially resulting effects and, in fact, Conowingo Pond has been functioning as a BMP preventing sediment and nutrients from being transported to the Chesapeake Bay.

Exelon proposes to conduct a bathymetric survey every 5 years to monitor sediment transport and deposition patterns in Conowingo Pond. In addition, as part of its Sediment Management Plan, Exelon would control sediment runoff from project lands and identify action benchmarks and thresholds at the powerhouse intakes to address sedimentation-related issues that might affect project operation. Exelon states that sediment going through the turbine typically does not damage the runner, although it might cause slight wear of the shaft packing and wicket gate end bushings. The turbines would be inspected regularly for signs of abrasion, which would be a benchmark for considering sediment removal.

Exelon is further evaluating potential management actions (e.g., hydraulic or mechanical dredging) to improve recreational boat access to three recreation areas where sediment has been accumulating around the boat launches (Conowingo Creek, Peach Bottom Marina, and Broad Creek; see further discussion in section 3.3.5, *Recreation and Land Use Resources*).

On December 4, 2014, Exelon withdrew its application for water quality certification with Maryland DOE and plans to refile an application within 90 days of that date. Exelon also proposes to conduct a sediment study with Maryland DOE and other state and federal agencies, and to contribute $3.5 million for the study, which is to be completed in 2016 or 2017. Exelon will withdraw and refile its application on an annual basis with Maryland DOE until the sediment study is completed.

Our Analysis

The York Haven Project minimally affects sediment loading. Sediment accumulated in the reservoir during low-flow periods is remobilized during high-flow events, slightly increasing the suspended sediment concentration and the bedload carried by the river at those times. The increase is relatively small due to the shallow depth and limited storage capacity of the reservoir and we would not expect the continued run-of-river operation with the 1.1-foot fluctuation to change the existing minimal contribution to sediment loading in the river.

The Muddy Run Project has a negligible effect on sediment transport processes in the Susquehanna River and sediment loading to the Chesapeake Bay. The "compensatory mitigation" requirement of the water quality certification generally states that mitigation is compensating for resident fish entrainment. Funds, though, would be used for BMPs to reduce sediment loading to the river and for habitat improvement, including dam removal. This requirement, while appearing to be related to a project effect, would not necessarily be implemented in the project area. The specific projects that would be funded are not identified, and we have no basis for evaluating the benefits of any such measures and if they are related in any way to the Muddy Run Project.

Sediment transport issues for the Conowingo Project are more complex. Findings of the draft LSRWA study report (Corps and MDE, 2014), made available to the public and the Commission staff on November 13, 2014, are now considered in our analysis in this final EIS.

Nearly all sediment entering Conowingo Pond is contributed by the river's upstream watershed; contributions from project lands are minimal. The draft LSRWA study report (Corps and MDE, 2014) concludes that all three lower Susquehanna River reservoirs (Lake Clarke, Lake Aldred, and Conowingo Pond) are no longer trapping sediment over the long-term. The reservoirs have reached a state of dynamic equilibrium in which the net change in sedimentation (i.e., deposition during low-flow periods and scour during floods) remains relatively constant. On a long-term basis, the full sediment load carried by the river is transported into the Chesapeake Bay, as would have occurred prior to construction of the lower Susquehanna River reservoirs.

High-flow events carry suspended sediment from the river's watershed, as well as sediment scoured from the three lower river reservoirs. The relative contribution of scoured sediment within the total amount of sediment passing the dam varies substantially, as it is a function of factors such as peak flow discharge, duration of the high-flow event, and length of time between high flow events when sediment could accumulate in the reservoirs. USGS estimated that the scoured sediment load within the total river sediment load below Conowingo dam during a10-year recurrence flow event would be 22 to 40 percent; this event would have a streamflow rate of 600,000 cfs (Langland and Koerkle, 2014). Similarly, the scoured sediment contribution during a 25-year recurrence flow event (at 800,000 cfs) would be 26 to 37 percent; and the contribution during a 60-year recurrence flow event (at 1,000,000 cfs) would be 39 to 50 percent. The added storage capacity in the three reservoirs created by high-flow events greater than 400,000 cfs (which is considered the threshold for scour) reduces the sediment load to the Chesapeake Bay during smaller flow events (less than 400,000 cfs), and thus aids the health of the Bay, until the next high-flow event occurs (Corps and MDE, 2014).

At steady state, areas immediately upstream of the dam would remain turbulent with high velocities and inhibit sediment deposition near the powerhouse intakes. However, over time, this zone of turbulence near the dam could narrow, and there is potential for sediment accumulation near the intakes that could affect hydropower operation. As sediment builds up near the intakes, sediment-laden water could damage turbines and other hydropower components due to increased abrasion (Neopane et al., 2011). Benchmarks established under Exelon's Sediment Management Plan should help identify appropriate actions to allow for continued operation of the project.

Sand and gravel would continue to be trapped by the three lower Susquehanna River reservoirs. However, grain size data show that, as the storage capacity has decreased, the grain size of the bottom sediments in Conowingo Pond has become increasingly sandy (Langland, 2013). Because Conowingo Pond has now reached its storage capacity, more sand is expected to eventually reach the Susquehanna River below the dam, as mobilized from the pond during high-flow events. The substrate below Conowingo dam consists mainly of bedrock, with some boulders, cobbles, and areas of finer sediments. Flow conditions in the river are naturally turbulent with high velocities, inhibiting deposition until the change in gradient near the mouth of Deer Creek, about 4 miles downstream from the dam. The river substrate in this reach was likely similar to today's conditions prior to the construction of Conowingo dam, with areas of localized sediment inflows from tributaries. Therefore, high-velocity turbulent flow conditions in the river below the dam would eventually transport the sand and gravel that bypass the Conowingo dam toward the Chesapeake Bay.

The Nature Conservancy expressed concern about the effect on downstream habitat of interception of coarser grained sediment (sand, gravel, and cobble) by Conowingo Pond. We find that placement of coarser grained sediments downstream of the dam, if attempted as a mitigative measure, would likely have limited success because of high velocities and turbulence that would transport those materials farther downstream and away from areas where habitat enhancement was targeted.

Once the river enters the Chesapeake Bay, and flow velocities and thus the sediment carrying capacity of the water decreases, the coarser grained scoured sediments settle out of the water column first in the northern part of the Bay. Finer grained particles remain suspended in the water column longer and are transported further to the south in the Bay. This was observed after Hurricane Lee when sands were deposited on the Susquehanna Flats, and finer grained sediments were distributed more widely in the Bay (Cheng et al., 2013).

The lower Susquehanna River and the Chesapeake Bay are affected by sediment transport (including sediment scoured from Conowingo Pond). The draft LSRWA study report (Corps and MDE, 2014) finds that the nutrients associated with scoured sediment are more harmful to the Bay's aquatic life than the sediment itself. Particle-bound nutrients settle to the bottom of the Bay and, under certain conditions, can recycle back into the water column in dissolved form where they contribute to algae growth. Excessive algae growth in turn may result in DO depletion (see additional discussion in section 3.3.2, *Water Resources).*

On December 29, 2010, EPA established the Chesapeake Bay Total Maximum Daily Load (TMDL) for sediment, nitrogen, and phosphorus, with rigorous accountability measures to restore water quality in the Bay (EPA, 2013). This TMDL considered current loading of the Bay as well as loading after the storage capacity in the lower Susquehanna River reservoirs has been reached. The current TMDL incorporated an estimated current trapping efficiency of Conowingo Pond of 55 percent for sediment, 2 percent for nitrogen, and 40 percent for phosphorus (see additional discussion in section 3.3.2, *Water Resources*). The TMDL will be implemented in phases with an interim target allocation of 60 percent total load reductions by 2017, and 100 percent by 2025. EPA will assess a state's progress toward meeting TMDL goals every 2 years. EPA assumes that the trapping of sediment would continue through the TMDL planning horizon of year 2025 (EPA, 2010). If future monitoring showed a reduction in trapping capacity, EPA plans to adjust the milestone loads for upland jurisdictions. These jurisdictions might need to increase their sediment-reduction efforts to accommodate the loss of trapping capacity in Conowingo Pond and the other lower river reservoirs.

The LSRWA study (Corps and MDE, 2014) evaluated a number of sediment management alternatives to reduce the amount of sediment (and associated nutrients) scoured from the three lower Susquehanna River reservoirs during peak flows. These sediment management alternatives included reduction of sediment yield from the Susquehanna River watershed, minimizing sediment deposition within the reservoirs, and increasing storage volume in the reservoirs.

Alternatives for minimizing sediment deposition in the three reservoirs include sluicing (removal of water and sediment through outlets located in the lower level of the dam), density current venting (gravity flow of turbid water under water of different density), flushing (remobilizing sediment through natural flows by drawing down the reservoirs), and agitation dredging (using equipment to resuspend deposited sediment). The LSRWA study (Corps and MDE, 2014) found that these management options would have only limited potential benefits to sediment management. At the same time, these options would have adverse cumulative effects on competing water uses, operational limitations, structural constraints, and health and safety considerations. As a result, Corps and MDE (2014) decided to drop these alternatives from further consideration.

Alternatives for increasing storage volume included dredging of the reservoirs and a sediment bypass (via a tunnel, or submerged or floating pipeline). Corps and MDE (2014) found that increasing the storage volume is possible, but the Chesapeake Bay ecosystem benefits are minimal and short-lived. Benefits would depend on factors such as the timing (i.e., season) of sediment removal and quantity of sediment removed. In addition, dredging the sediment load entering the reservoirs annually would be complicated by the effects on other resources in the reservoirs (water quality, fisheries, and recreational use) and the need for suitable locations for placing/disposing large quantities of sediment, year after year. Costs would be very high. Corps and MDE (2014) estimated dredging costs of $48 to $267 million annually just to keep up with the annual sediment load of about 3 million tons entering Conowingo Pond. The final dredging costs would depend significantly on a wide range of factors including dredging approach, dewatering of dredged sediments, placement locations, and constraints due to contaminants in the sediment. Over time, costs would increase as lower cost disposal locations would be filled up with sediment and no longer be available.

Increasing storage volume through a sediment bypass would also have high costs ($15 to $48 million annually), although not as high as dredging. Under this alternative, the total annual sediment load (and associated nutrient load) would continue to enter the Chesapeake Bay on average, although the added amount of scoured sediment in the total transported sediment load during high-flow events would be reduced. Instead, sediment loading would be spread out more evenly throughout the year. Nevertheless, Corps and MDE (2014) estimates that the environmental costs of bypassing sediment (i.e., diminished DO and increased chlorophyll) are roughly 10 times greater than the benefits gained from reducing sediment scour in Conowingo Pond.

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 LSRWA study provides a better understanding of sediment deposition and transport processes in Conowingo Pond, and helps to establish necessary benchmarks for potential actions (e.g., prediction of sediment deposition near the intakes that could impede project operation). Exelon's proposed bathymetric surveys in Conowingo Pond at 5-year intervals would allow for verification of model predictions, a better understanding of the sediment transport processes in the pond at its current state of dynamic equilibrium, and the identification of appropriate management actions.

The draft LSRWA study report (Corps and MDE, 2014) concludes that the primary effect to living resources in the Chesapeake Bay is from nutrients and not sediment. Management opportunities in the Chesapeake Bay watershed to reduce nutrient delivery to the Bay are considered to be likely more effective than sediment load removal methods, for reducing effects on the Bay's water quality and aquatic ecosystem from scour events. Corps and MDE (2014) recommended further study on nutrient reduction. 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.

3.3.1.3 Cumulative Effects

For the York Haven and Muddy Run Projects, shoreline erosion in the reservoirs is minimal and the amount of sediment added to the Susquehanna River system would not contribute to cumulative effects in the river.

Conowingo Pond would continue to trap coarser grained sediment during periods of flows below the scour threshold (about 400,000 cfs). During high-flow events (greater than about 400,000 cfs), sediment would be scoured from the pond and transported along with the suspended sediment from the river's watershed into the Chesapeake Bay. The Chesapeake Bay TMDL is designed to mitigate the effects from this increased sediment loading to the Bay by requiring specific load reductions from the seven jurisdictions within the Bay's 64,000-square-mile watershed. Regular dredging of Conowingo Pond and placement of the dredged material offsite, if deemed feasible, might reduce these load reduction requirements for jurisdictions to some extent. However, as recognized by the TMDL and the LSRWA study (Corps and MDE, 2014), the long-term solution would require a basin-wide approach of primarily nutrient load reductions.

3.3.2 Water Resources

3.3.2.1 Affected Environment

The Susquehanna River Projects affect water resources within the lower 60 miles of the mainstem of the Susquehanna River.

Water Quantity

The Susquehanna River drains portions of western and central New York State, a large portion of Pennsylvania, and a small part of Maryland. Five hydroelectric projects on the lower Susquehanna River use flow from the river and its tributaries to generate electricity (table 3-1). No large mainstem reservoirs or hydropower projects are located on the Susquehanna River upstream of the York Haven Project, although there are Corps' flood control projects on several tributaries (see figure 1-1).

Table 3-1. Hydroelectric projects on the lower Susquehanna River (Source: York Haven Power, 2012a; Exelon, 2012a, 2012b; FERC, 2008).

Project	River Mile	Generating Capacity (MW)	Maximum Plant Discharge (cfs)	Drainage Area (sqm)	Reservoir Surface Area (acres)	Usable Storage (acre-feet)
York Haven	55	19.62	17,000	24,973	2,218	1,700
Safe Harbor	32.2	417	113,000	26,117	7,360	68,870[a]
Holtwood	24.6	195.5	62,100	26,794	2,400	15,224[b]
Muddy Run	22	800.25	32,000	9.2	892	33,894
Conowingo	10	574.54	86,000	27,100	9,000	71,000

[a] Storage volume is based on the upper 17 feet, although actual drawdowns are much less.

[b] Between elevation 163.5 feet and the top of the flashboards/rubber dam at elevation 169.75 feet.

York Haven Project

Table 3-2 shows monthly flow statistics for the Susquehanna River at York Haven Project, based on flows at the Marietta USGS gage, about 10 miles downstream from the York Haven Project (figure 3-2). Monthly flows are generally highest in March and April and lowest in July, August, and September. The range of monthly flows observed at the Marietta gage is substantial, from a low of 2,066 cfs to a high of nearly 1 million cfs (Hurricane Agnes).

Table 3-2. Prorated flows (in cfs) at the York Haven Project based on monthly flow data from USGS gage no. 01576000 Susquehanna River at Marietta, Pennsylvania, for October 1, 1967, to September 30, 2009 (Source: USGS, 2013, as modified by staff).

Month	Mean	Median	Maximum	Minimum	10% Exceedance	90% Exceedance
Jan	41,560	25,943	534,243	4,036	90,312	11,636
Feb	47,042	30,940	428,548	6,342	98,970	14,413
Mar	70,392	54,001	426,626	8,648	134,522	23,263
Apr	73,049	58,325	414,135	16,815	140,383	27,260
May	44,318	35,552	214,274	11,050	77,811	17,872
Jun	32,006	21,572	999,304	4,641	52,954	10,570
Jul	18,278	13,356	214,274	3,565	33,707	6,458
Aug	13,467	9,196	191,213	2,527	24,983	4,892
Sep	16,977	8,316	523,674	2,066	30,757	4,256
Oct	21,599	10,762	236,374	3,430	49,446	5,150
Nov	33,162	25,223	254,630	4,314	65,772	7,625
Dec	46,623	35,552	334,383	4,910	92,243	15,480
Annual	38,133	24,694	999,304	2,066	83,115	6,774

Note: Data from USGS gage no. 01576000 about 10 miles downstream from the York Haven Project were prorated by 24,973/25,990 to account for the difference in the drainage area between the gage and York Haven dam.

Safe Harbor Project

Water discharged from York Haven dam flows downstream through about 13 miles of riverine habitat to the beginning of the 10-mile-long Lake Clarke, the impoundment of the Safe Harbor Project. The Safe Harbor Project does not have a minimum flow requirement in its license (which expires in 2030), and normal maximum impoundment elevation ranges between 227.2 feet in summer to 228.0 feet in winter. The project is operated to support peak electricity demands and, since 1997, a fish lift has operated at this facility to pass resident and migratory fish upstream during the spring.

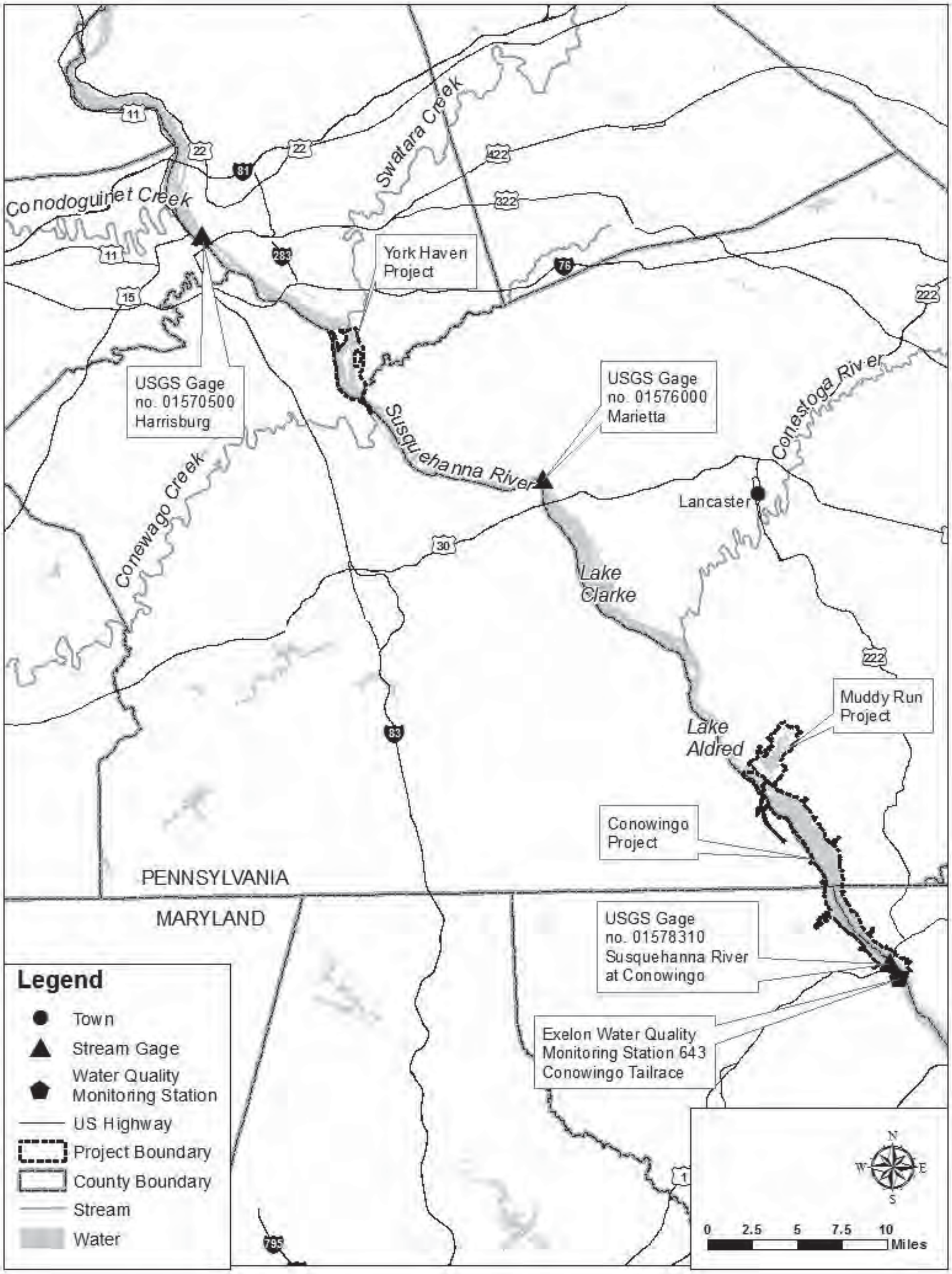


Figure 3-2. Stream gages in the Susquehanna River Projects area (Source: staff).

Holtwood Project

Water discharged from Safe Harbor dam flows immediately into Lake Aldred, the Holtwood Project impoundment. Holtwood dam is located about 8 river miles downstream of Safe Harbor dam, and full generation from the Safe Harbor Project substantially exceeds the hydraulic capacity of the Holtwood Project, which results in spillage at Holtwood dam and a water surface gradient within Lake Aldred; at lower releases from Safe Harbor the water surface gradient within Lake Aldred is generally flat. The generation capacity of the Holtwood Project was recently upgraded to 195.5 MW with a daily minimum flow of 800 cfs, or inflow if less, and a maximum hydraulic capacity of about 62,100 cfs. Even with the Holtwood expansion, the Safe Harbor maximum discharge still exceeds the Holtwood capacity by about 40,000 cfs. Lake Aldred is managed to maintain a minimum operating level of elevation 167.5 feet from May 15 through September 15 to support reservoir recreational uses and access. The top of the flashboards at the dam are at elevation 169.75 feet, and the minimum operating level during the balance of the year is elevation 163.5 feet. Leakage through the dam and flow from a 10-inch-diameter pipe through the dam maintain a small, continuous flow in the bypassed reach. The flow rate through the pipe depends on the water surface elevation of Lake Aldred, but PPL estimated it at 11 cfs at maximum normal water elevations. Leakage through the flashboards, which varies based on reservoir elevation and the adequacy of seals between flashboards, ranges between 4 and 40 cfs. When generating units are not operating, leakage through the units maintains about 210 cfs continuous flow in the tailrace (FERC, 2008).

When the Holtwood Project is not generating, the water level in Conowingo Pond, created by Conowingo dam 14.6 miles downstream, normally controls the tailwater elevation below the Holtwood powerhouse. The bypassed reach on the western side of the river is primarily rock ledge interspersed with shallow, interconnected pools with some vegetation and receives flow only during spillage over the dam.

Muddy Run Project

The Muddy Run Project, which is on the east side of the Susquehanna River, uses Conowingo Pond as its lower reservoir. Although there are no USGS gaging stations on Muddy Run, according to Exelon, the average annual flow from Muddy Run to the Muddy Run reservoir is about 7 cfs.

Muddy Run's upper reservoir has a usable storage of 33,894 acre-feet between elevations 470 and 520 feet. Conowingo Pond has an effective storage of about 34,050 acre-feet between elevation 105.2 feet and 109.2 feet, the typical fluctuation range. The Conowingo Project's existing license conditions allow fluctuations between 101.2 and 110.2 feet. The Muddy Run powerhouse turbines have a maximum generating discharge capacity of 32,000 cfs and a maximum pumping capability of 28,000 cfs.

The Recreation Lake, which was created by impounding an arm of the Muddy Run reservoir, is maintained at a constant elevation of 520 feet with a surface area of about 100 acres.

Table 3-3 provides the average monthly withdrawal and discharge for 2006 through 2010 and shows that the average daily withdrawals and discharges range from about 11,750 to about 15,100 acre-feet. The monthly numbers in this table indicate that the annual discharge is about 35 acre-feet higher than the withdrawal from Conowingo Pond. Table 3-4 provides the water withdrawal and return characteristics for three 30-day high-flow periods (between March and April) and three 30-day low-flow periods (between August and September). These data show that Muddy Run operation does not substantially vary between low-flow and high-flow periods.

Table 3-3. Muddy Run Project monthly average withdrawals and discharge for 2006 to 2010 (Source: Gomez and Sullivan and Normandeau, 2012b).

Month	**Average Daily Withdrawal (acre-feet)**	**Average Daily Discharge (acre-feet)**
January	13,899	14,074
February	13,825	13,828
March	11,757	11,840
April	11,938	11,754
May	14,381	14,675
June	14,915	15,102
July	14,568	14,206
August	13,571	13,844
September	14,448	14,289
October	14,522	14,451
November	13,227	13,350
December	13,924	13,979

Table 3-4. Summary of daily and hourly Muddy Run Project discharge and withdrawal characteristics for 30-day high- and low-flow periods for 2008 to 2010 (Source: Exelon, 2012a, as modified by staff).

Flow Period	**Average Flow at the Marietta USGS gage (cfs)**	**Average Daily Withdrawal from Conowingo Pond (acre-feet per day)**	**Average Daily Discharge to Conowingo Pond (acre-feet per day)**	**Maximum Daily Withdrawal from Conowingo Pond (acre-feet per day)**	**Maximum Daily Discharge to Conowingo Pond (acre-feet per day)**	**Maximum Hourly Withdrawal from Conowingo Pond (cfs)**	**Maximum Hourly Discharge to Conowingo Pond (cfs)**
Water Withdrawal and Returns Statistics for 30-Day High-Flow Periods							
Mar 5 - Apr 3, 2008	132,645	28,537	29,028	43,345	46,163	34,274	36,539
Mar 11 - Apr 9, 2009	54,194	17,597	18,378	35,793	39,409	29,410	32,120
Mar 13 - Apr 11, 2010	96,459	19,074	18,801	34,932	36,535	29,484	32,158
Water Withdrawal and Returns Statistics for 30-Day Low-Flow Periods							
Aug 28 - Sep 26, 2008	6,523	28,823	28,087	40,299	41,891	29,187	37,616
Sep 1 - Sep 30, 2009	13,722	25,697	26,381	33,186	47,640	29,187	34,460
Sep 1 - Sep 30, 2010	5,691	26,678	27,060	37,732	49,785	27776	37,022

Conowingo Project

The Conowingo Project is the farthest downstream dam on the Susquehanna River. It is located 10 miles upstream from the Chesapeake Bay and impounds the river about 14 miles upstream to the Holtwood Project, creating a 9,000-acre reservoir that contains 310,000 acre-feet of design storage capacity and 71,000 acre-feet of usable storage. On a daily basis, the Conowingo Project operates in a peaking mode and generates 574.54 MW at full generating capacity. Conowingo dam uses a limited active storage in combination with the operation of the Muddy Run Project to meet peak electrical demand. Two fish lifts at this facility (east and west) seasonally pass resident and migratory fish upstream.

Conowingo Pond serves as the source of cooling water for the 2,186-MW PBAPS, about 7 miles upstream of Conowingo dam, which has a maximum withdrawal capacity of 3,450 cfs. The York Energy Center is permitted to withdraw up to 20 cfs for cooling water. The pond is also a public water supply source for the city of Baltimore, Harford County (Maryland), and the Chester (Pennsylvania) Water Authority. The permitted range of water level fluctuation in the impoundment is 9 feet, from elevation 101.2 to 110.2 feet (figure 3-3). Exelon states that, although 9 feet of fluctuation is permitted, the current operating regime typically restricts fluctuations to about 4.5 feet (between elevation 104.7 to 110.2 feet) to minimize the potential for intake difficulties at PBAPS and cavitation within the Muddy Run turbines. During summer weekends, the impoundment water level is maintained at elevation 107.2 feet to provide a water level suitable for summertime recreational use. Critical water level elevations for Conowingo Pond include the following:

- 107.2 feet: The pond must be maintained at this elevation on weekends between Memorial Day and Labor Day to meet recreational needs;
- 104.7 feet: Below this level, Muddy Run cannot operate its pumps due to cavitation;
- 104.2 feet: PBAPS begins experiencing cooling water problems when the elevation of the pool drops to this level;
- 100.5 feet: Below this elevation, the Chester Water Authority is unable to withdraw water from the pond;
- 99.2 feet: The Nuclear Regulatory Commission license for PBAPS requires the plant to shut down completely at this water level;
- 98.0 feet: The York Energy Center cannot withdraw water below this elevation; and
- 91.5 feet: The city of Baltimore cannot withdraw water from the pond below this water elevation.

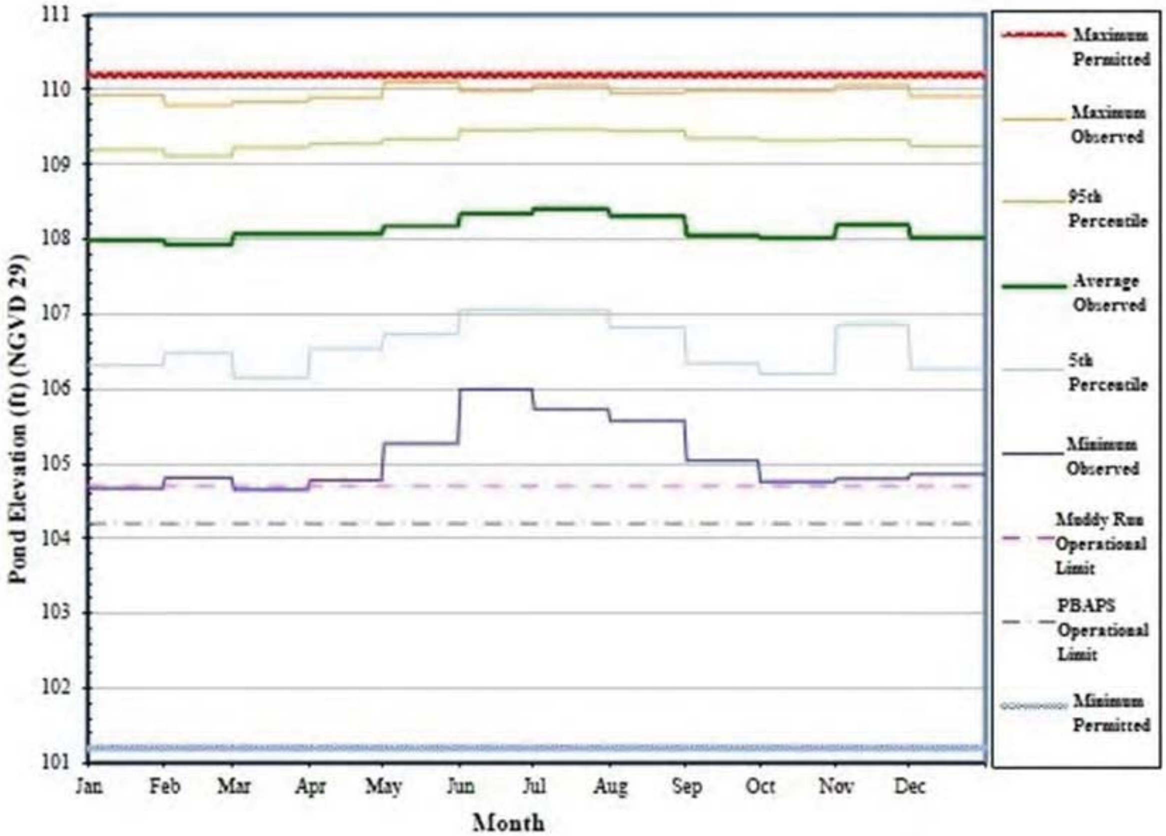


Figure 3-3. Conowingo monthly pond elevations, January 2004 through December 2010 (Source: URS and Gomez and Sullivan, 2012a).

A minimum flow regime was established in a Settlement Agreement in 1989 between Exelon and several federal and state resource agencies. The Settlement Agreement specifies that the flows represent turbine releases and exclude gate leakage. Table 3-5 shows the 1989 negotiated minimum flow schedule agreed to by all parties.

The Commission granted temporary flow variances to Exelon on six occasions over the period 1998 to 2011(1998, 1999, 2001, 2002, 2005, and 2007) during summer drought periods, permitting leakage to be counted toward the minimum flow requirement. Flows released from Conowingo dam are measured by USGS gage no. 01578310 immediately downstream of the dam (table 3-6). Flows are generally highest in March and April and lowest in July, August, and September. The peaking operation of the Conowingo Project during low-flow periods often results in substantial changes in the flow and stage (figure 3-4) in the river below Conowingo dam. Muddy Run Project operation also affects the water level of Conowingo Pond as figure 3-5 shows.

Table 3-5. Minimum flows for the Conowingo Project agreed upon in 1989 Settlement Agreement, with natural inflow measured at the upstream USGS Marietta gage (Source: Exelon, 2012b).

Date	Minimum Flow
March 1 - March 31	3,500 cfs or natural inflow, whichever is less;
April 1 - April 30	10,000 cfs or natural inflow, whichever is less;
May 1 - May 31	7,500 cfs or natural inflow, whichever is less;
June 1 - September 14	5,000 cfs or natural inflow, whichever is less;
September 15 - November 30	3,500 cfs or natural inflow, whichever is less; and
December 1 - February 28	3,500 cfs intermittent (maximum 6 hours off followed by equal amount on).

Table 3-6. Monthly flow data (cfs) from USGS gage no. 01578310 Susquehanna River at Conowingo, Maryland, for October 1, 1967, to September 30, 2009 (Source: Exelon, 2012b).

Month	Mean	Median	Maximum	Minimum	10% Exceedance	90% Exceedance
Oct	23,755	13,800	245,000	295	57,170	3,750
Nov	36,037	28,700	272,000	303	70,410	5,807
Dec	50,533	40,300	357,000	777	98,350	13,610
Jan	45,340	30,250	622,000	511	93,980	10,210
Feb	50,783	36,800	470,000	758	98,500	15,500
Mar	73,846	58,900	462,000	287	139,000	24,410
Apr	76,957	61,800	467,000	6,090	144,000	29,690
May	47,092	39,400	235,000	5,220	81,100	18,100
Jun	34,894	24,500	1,120,000	622	59,000	8,658
Jul	20,001	15,700	213,000	269	37,500	5,421
Aug	14,917	10,650	202,000	367	28,280	4,490
Sep	19,109	10,400	662,000	363	35,240	3,037
Annual	41,026	27,800	1,120,000	269	85,400	5,840

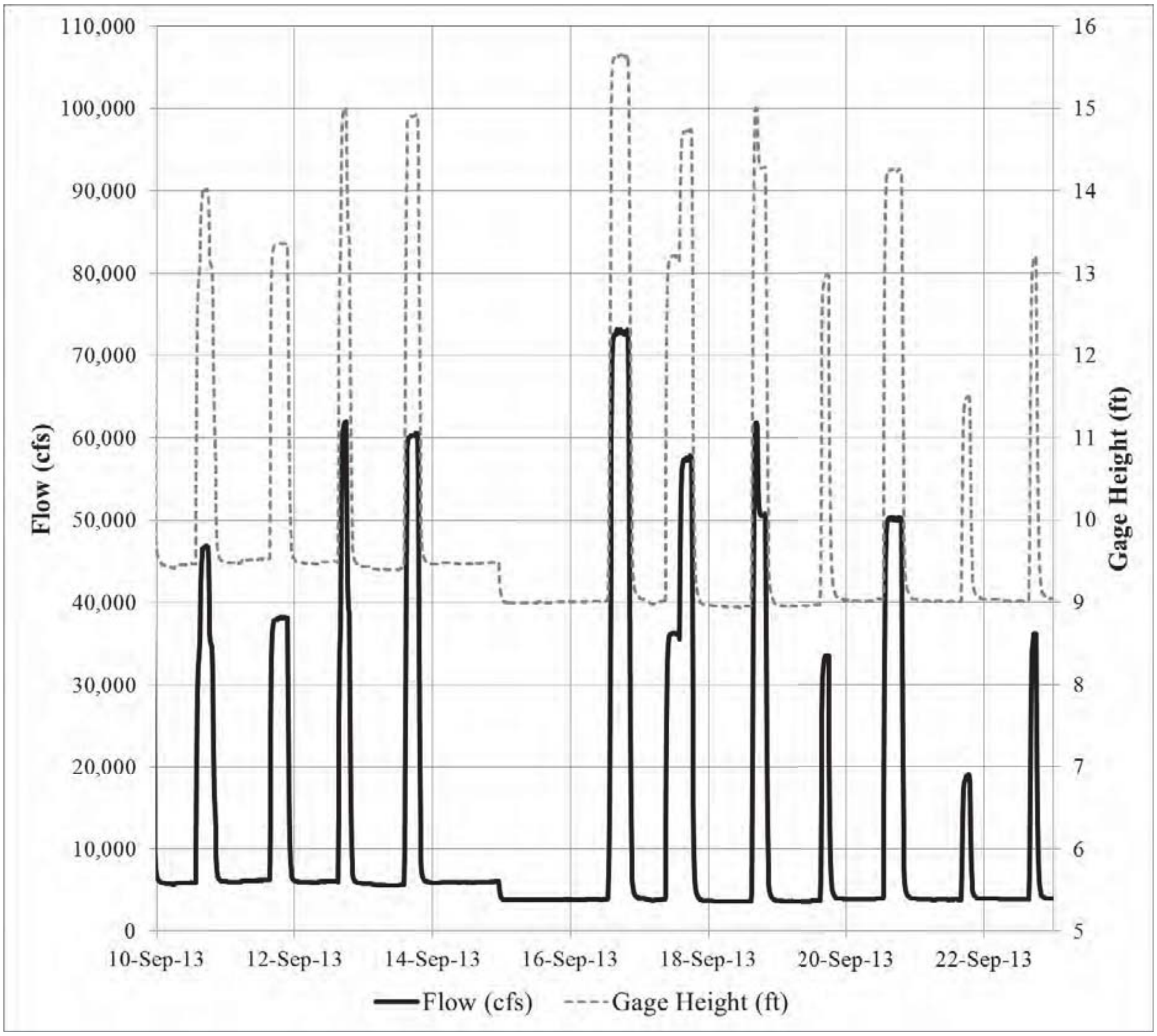


Figure 3-4. Flow and stage variation at USGS gage no. 01578310 downstream of Conowingo dam (Source: USGS, 2013, as modified by staff).

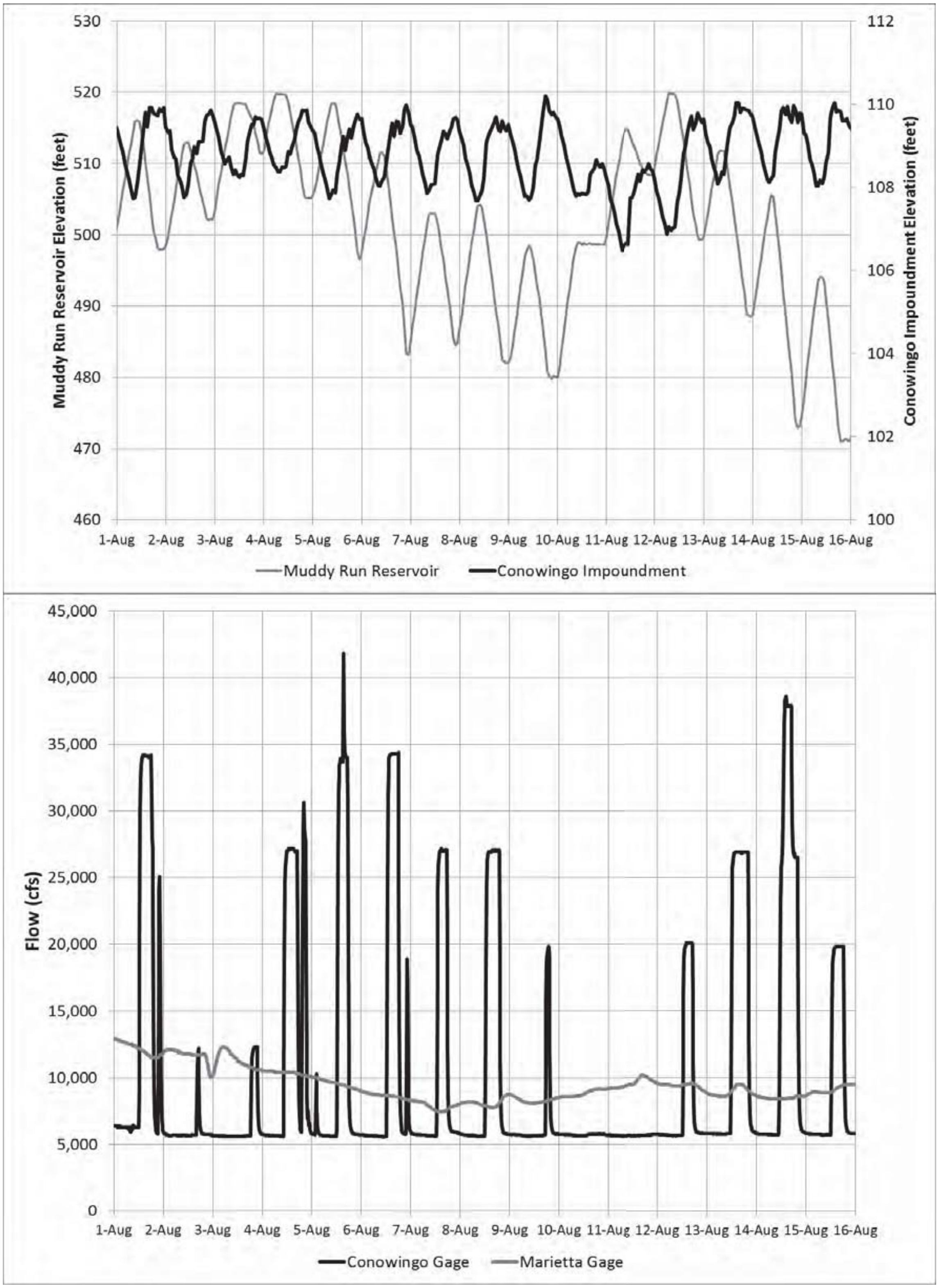
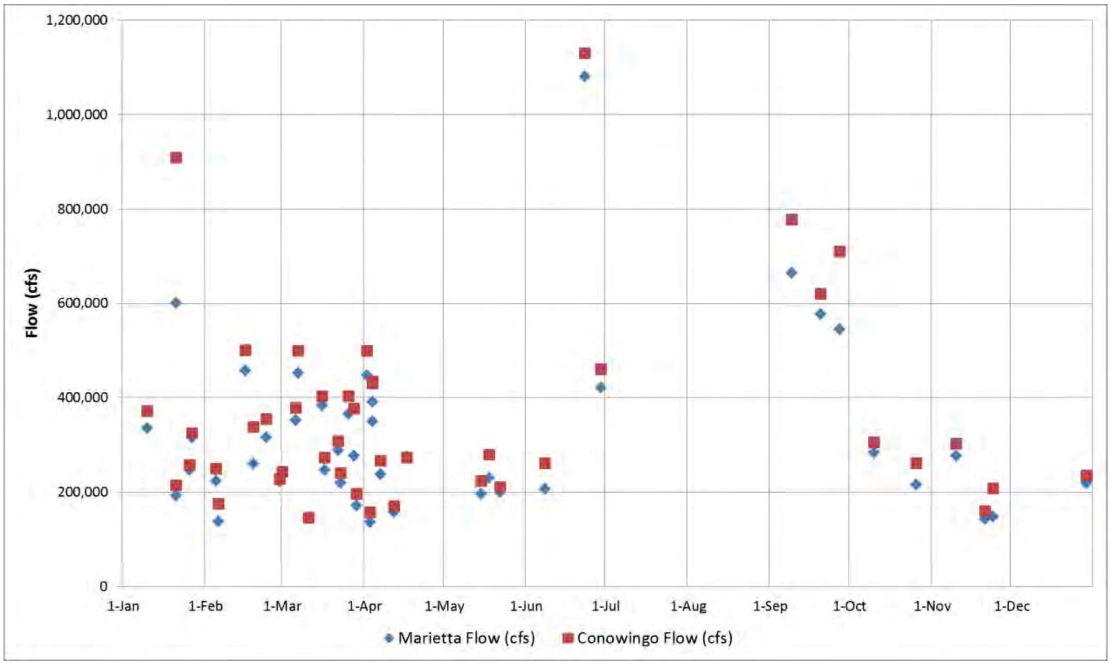


Figure 3-5. Typical impoundment and Conowingo tailrace flow fluctuations during a low-flow period in 2008 (Source: USGS, 2013; Gomez and Sullivan and Normandeau, 2012b, as modified by staff).

Peak Flows

Normal annual high flows (figure 3-6) in the lower Susquehanna River occur in the late winter and spring. Extreme flood events such as those in late June 1972, and September of 1975, 2004, and 2011 were the result of rainfall from tropical systems Agnes, Eloise, Ivan, and Lee, respectively. The other noticeable high-flow event (January 1996) was the result of heavy rain, snowmelt, and ice jams.



Note: Data for the Marietta gage are not prorated.

Figure 3-6. Peak annual flows at the Marietta and Conowingo USGS gages, 1968 to 2012 (Source: USGS, 2013, as modified by staff).

Water Use

Water in the Susquehanna River Basin is used for hydropower production and cooling for fossil and nuclear power plants, as well as for municipal and private water supply, agricultural production, and recreation. Consumptive water use in the basin is largely for public water supply diversion and utility power generation, with smaller uses for recreation, manufacturing, mining, and educational facilities (figure 3-7). The maximum approved daily consumptive water use in the Susquehanna River Basin is 563.1 million gallons per day (mgd), and the majority of the use occurs in the lower basin. About half of the water used each year occurs during low-flow periods (i.e., July through November), with peak use in July.

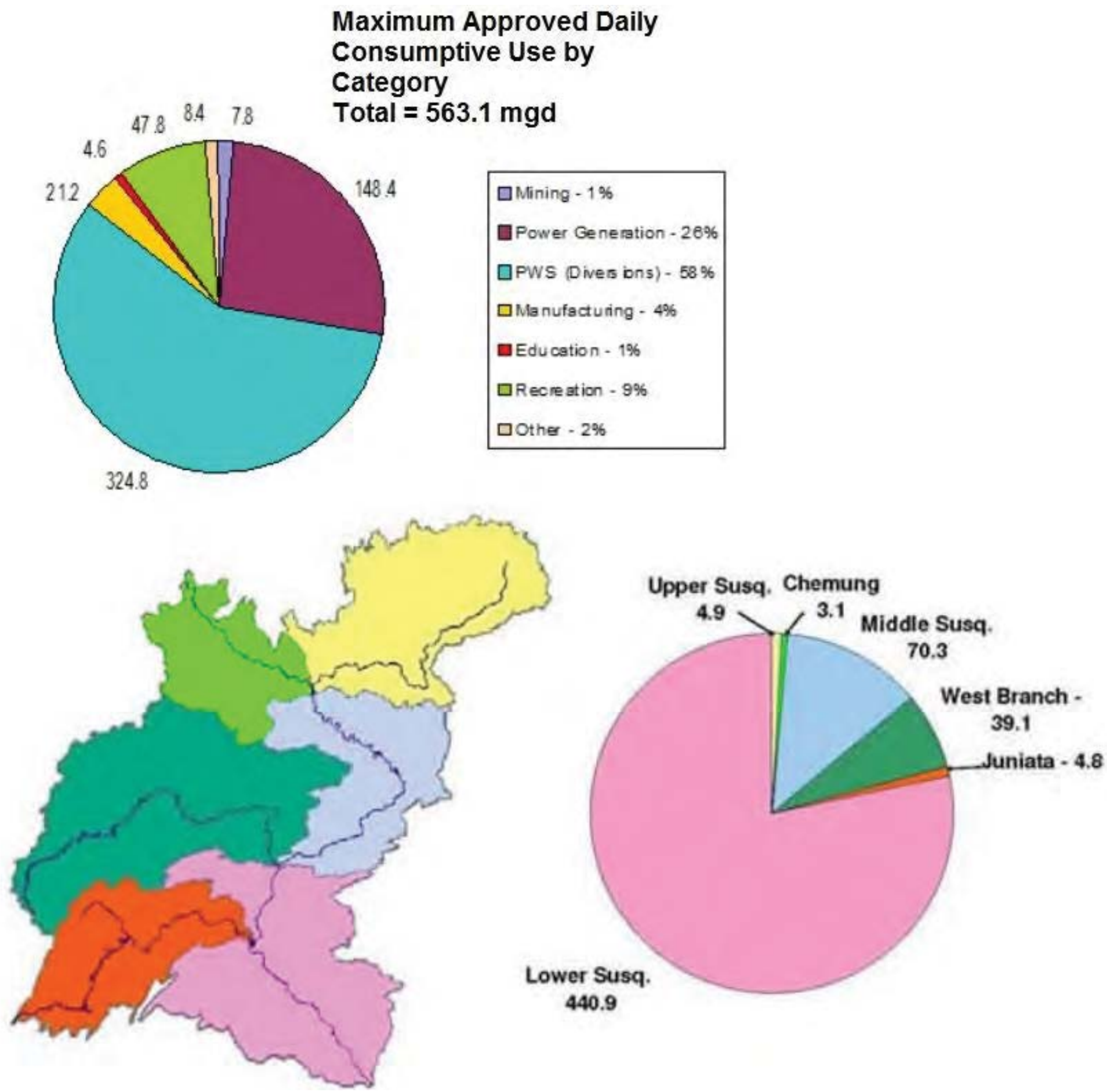


Figure 3-7. Consumptive water use in the Susquehanna River Basin (Source: SRBC, 2013).

Water use for utility power generation in the lower Susquehanna River includes five hydroelectric projects (York Haven, Safe Harbor, Holtwood, Muddy Run, and Conowingo) and two nuclear power plants (Three Mile Island and PBAPS).[53] PBAPS requires about 2,230 mgd (3,450 cfs) at full power operation, and the majority of the water is returned to Conowingo Pond. The York Energy Center, a natural gas electric generation facility, withdraws cooling water about 8 miles upstream of Conowingo dam, at RM 18. Table 3-7 summarizes the consumptive water use for these electric generation projects.

Table 3-7. Consumptive use for power generation in the lower Susquehanna River (Source: York Haven Power, 2012; Exelon, 2012b).

	Daily Consumptive Water Use	
Facility	**(mgd)**	**(cfs)**
Three Mile Island	21.0	32.5
York Energy Center	12.62	19.5
PBAPS	28.0	43.3

Note: The 30-day average consumptive use at Three Mile Island is 18.0 mgd.

Water transported from the Susquehanna River Basin for use outside the basin is considered an out-of-basin diversion. Table 3-8 provides the existing out-of-basin diversion locations and their authorized diversion volumes as approved by SRBC.

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[53] In addition, on June 30, 2014, Exelon filed an application for Non-Project Use of Conowingo Lands and Reservoir with the Commission. The application requests the approval of an agreement to allow Old Dominion Electric Cooperative to use project lands and waters for the withdrawal of 8.7 mgd of water from Conowingo Pond and discharge of about 0.8 mgd back into Conowingo Pond (net consumption of 7.9 mgd or 12.2 cfs), necessary to support a 1,000-MW combined-cycle electric power generating plant that Old Dominion Electric Cooperative proposes to build and operate in Cecil County, Maryland (Wildcat Point Project). Construction of the Wildcat Point Project was scheduled to commence in January 2015, but the Commission has not yet approved the application for non-project use of project lands and waters. The Commission issued an Environmental Assessment (EA) for the application on December 29, 2014, and the EA concluded that the proposed action would not result in significant long-term environmental effects or significant cumulative effects on water resources. The EA stated the amount of water withdrawn under the proposed action would be minor when compared to the total volume of water available and Susquehanna River flow through Conowingo Pond (FERC, 2014).

Table 3-8. Out-of-basin diversions in the lower Susquehanna River (Source: York Haven Power, 2012; Exelon, 2012b).

Name	Location/Description	Million Gallons Per Day (mgd)	cfs
City of Aberdeen, Maryland	Deer Creek to the Chesapeake Bay	3.0 mgd, but limited to 1.8 mgd as of 2008	4.6 and 2.8
Baltimore, Maryland	Susquehanna River to the Chesapeake Bay	250 mgd, but limited by pumping capacity to 137 mgd; limited to 64 mgd during low flows[a]	387, 212, 99, respectively[a]
Chester, Pennsylvania Water Authority	Susquehanna River to Delaware River Basin	30	46
Chester, Pennsylvania Water Authority	Octoraro Creek to Delaware River Basin	30	46
Coatesville, Pennsylvania, Municipal Water Authority	West Branch Octoraro Creek to Delaware River Basin	2.0	3.1
Morgantown Properties, L.P., New Morgan Borough, Pennsylvania	Conestoga River to Delaware River Basin	0.004	0.006
Perryville, Maryland	Susquehanna River to the Chesapeake Bay	1.0	1.5

[a] These values are from the Conowingo final license application; the remaining values are from the York Haven final license application.

Water Quality

Because the Susquehanna River Projects may affect water quality within the lower 60 miles of the mainstem Susquehanna River, we discuss the overall water quality within this reach of the lower river, as well as water quality conditions at each project.

The mainstem of the Susquehanna River in York, Lancaster, and Dauphin Counties, Pennsylvania (the reach from York Haven downstream to Conowingo Pond), is classified as a warmwater fishery and migratory fishery (25 Pa. Code §93.9o) and is subject to specific water quality criteria that are applicable statewide for warmwater fishery and migratory fishery streams. The Pennsylvania-Maryland border bisects Conowingo Pond about 5.7 miles upstream of Conowingo dam, so the lower 15.7 miles of the Susquehanna River are within the state of Maryland, which has its own stream classification system and water quality criteria. Under the Maryland classification system (Code of Maryland Regulations Title 26, Subtitle 08, Chapter 2), Conowingo Pond is classified as Use I-P (Water Contact Recreation, Protection of Aquatic Life and Public Water Supply). The Susquehanna River from Conowingo dam downstream to the confluence with the Chesapeake Bay is classified as Use II (Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting – includes applicable Use I-P categories). Chesapeake Bay tidal tributaries, including the Susquehanna River (which is tidal in the lower 5 miles of the reach below Conowingo dam), have sub-category designations of "Migratory Spawning and Nursery Use" and "Open Water Fish and Shellfish Use" on a Bay Segment scale during specified periods of the year. Table 3-9 summarizes the stream classifications and associated water quality criteria for the lower Susquehanna River.

Table 3-9. Summary of stream classifications and water quality criteria for the lower Susquehanna River (Source: 25 Pa. Code §93.7; Code of Maryland Regulations Title 26, Subtitle 08, Chapter 2).

Stream Classification	Parameter	Criteria
Pennsylvania		
Warmwater fishery and migratory fishery	Water temperature	Maximum allowable temperature varies by month, ranging from 40°F (4.4°C) in the over-winter period to 87°F (30.6°C) in the mid-summer
	DO	Minimum daily average of 5.0 milligrams per liter (mg/L); minimum instantaneous of 4.0 mg/L
	pH	Between 6.0 and 9.0 units
Maryland		
Use I-P	Water temperature	The maximum temperature outside of a mixing zone (i.e., an area where an effluent mixes with surface waters) may not exceed 90°F (32°C) or the ambient temperature of the surface water, whichever is greater; a thermal barrier that adversely affects aquatic life may not be established
	DO	Minimum instantaneous of 5.0 mg/L

Stream Classification	Parameter	Criteria
Use II (downstream of Conowingo Dam)	Water temperature	Same as above for Use I-P
	DO	*2/1 through 5/31*: ≥ 6.0 mg/L for 7-day average; 5.0 mg/L as instantaneous minimum
		6/1 through 1/31: ≥ 5.5 mg/L for 30-day average; 4.0 mg/L for 7-day average; 3.2 mg/L as instantaneous minimum (year-round); *Shortnose sturgeon criteria*: 4.3 mg/L as instantaneous minimum at water temperature greater than 77°F (29°C)

An excellent source of long-term data for water quality in the lower Susquehanna River (although with some data gaps) is from the USGS Harrisburg gage No. 01570500, located 13 miles upstream of the York Haven Project. Figures 3-8 through 3-10 provide a summary of water temperature, DO, and pH data available from the Harrisburg gage for the period November 2008 to November 2013 (the past 5 years). These data indicate that Susquehanna River water quality entering the York Haven Project area generally meets Pennsylvania water quality standards for these parameters during most of the past 5 years. For water temperature, in 3 of the past 5 years (2010, 2011, and 2012) water temperatures did exceed the maximum state standard during parts of the summer period, but this did not occur in 2009 and 2013 (figure 3-8). For DO levels, there was only one event in the past 5 years when DO failed to meet the minimum instantaneous criteria of 4.0 milligrams per liter (mg/L), and that minimum DO levels generally exceeded 5 mg/L except in the summer of 2010 (figure 3-9). Generally, pH levels remained within the criteria range, except for short periods in 2009, 2010, and 2012 when the maximum level of 9.0 was exceeded (figure 3-10).

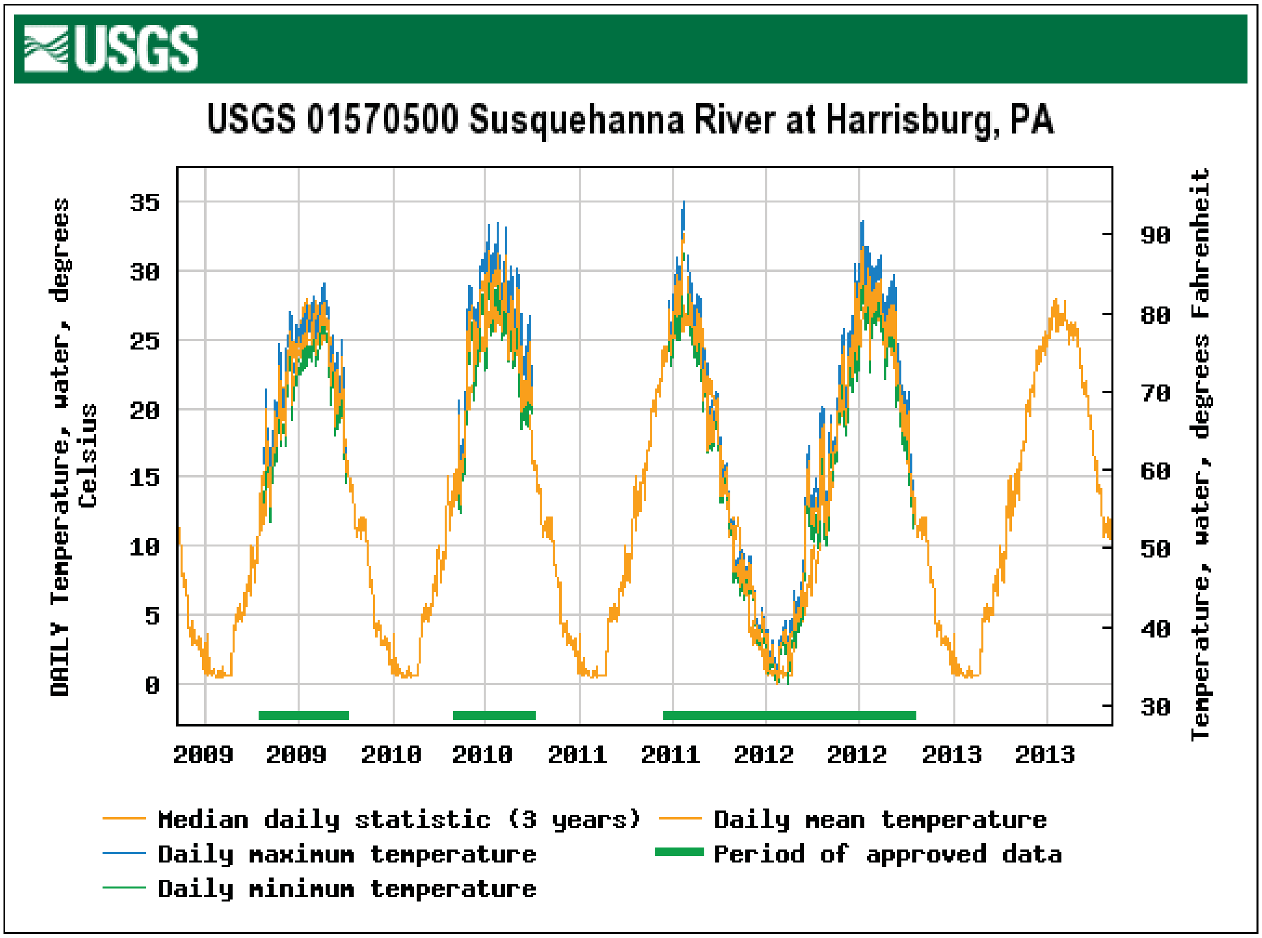

Figure 3-8. Summary of Susquehanna River water temperature data at Harrisburg, Pennsylvania, 2008 to 2013 (Source: http://waterdata.usgs.gov/pa/nwis/uv?site_no=01570500).

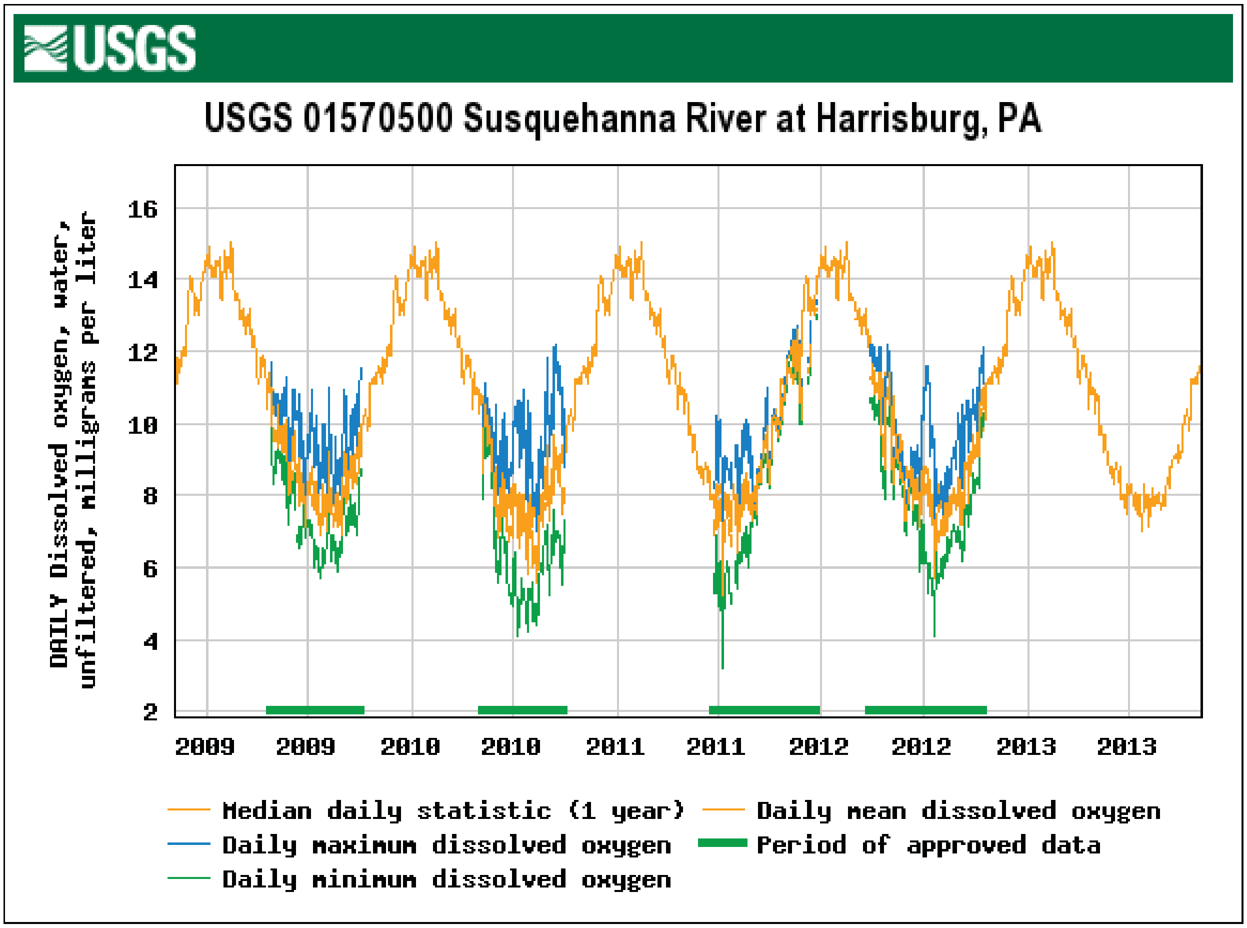

Figure 3-9. Summary of Susquehanna River DO data at Harrisburg, Pennsylvania, 2008 to 2013 (Source: http://waterdata.usgs.gov/pa/nwis/uv?site_no=01570500).

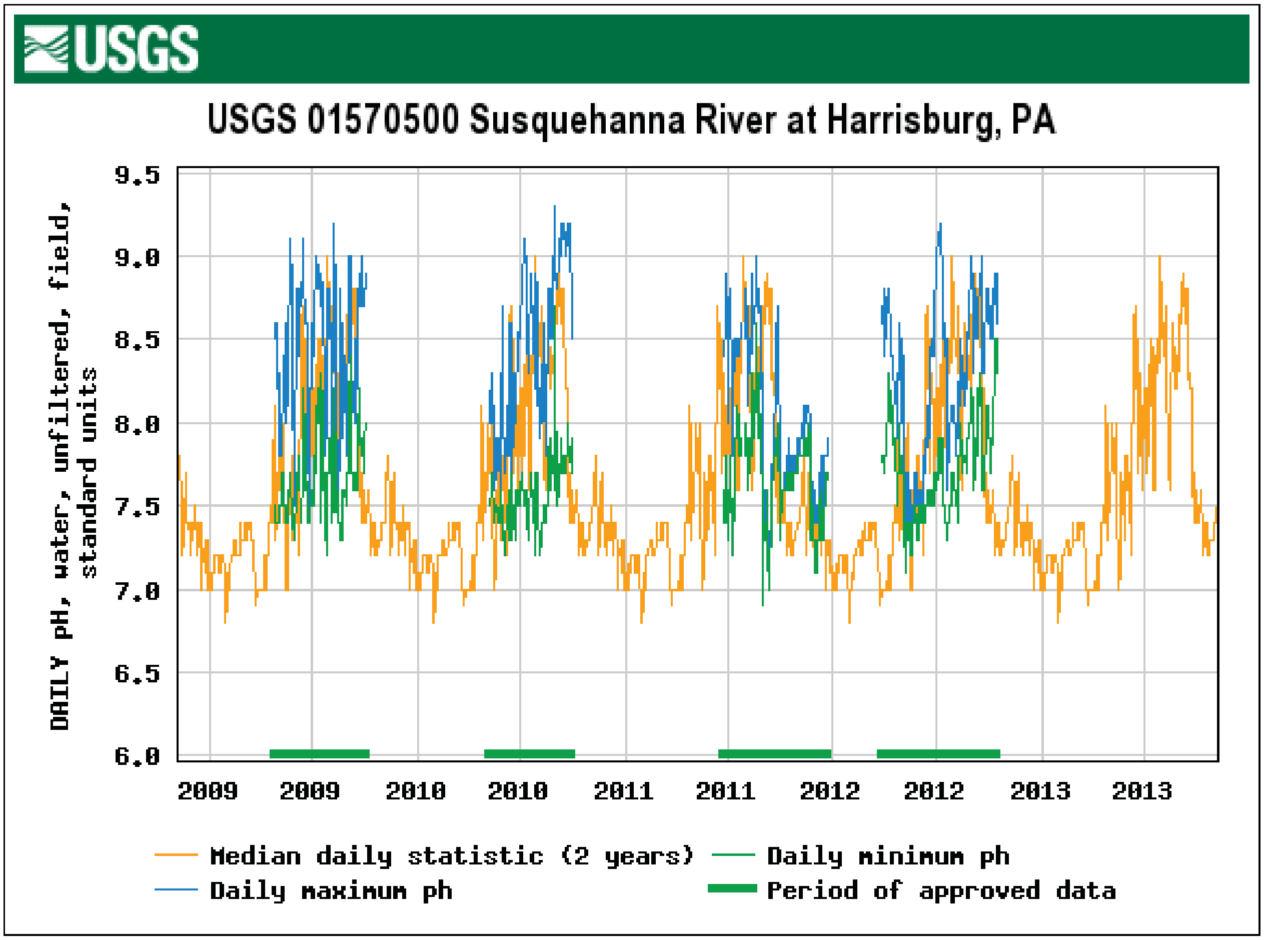

Figure 3-10. Summary of Susquehanna River pH data at Harrisburg, Pennsylvania, 2008 to 2013 (Source: http://waterdata.usgs.gov/pa/nwis/uv?site_no=01570500).

Other water quality data are available for the lower Susquehanna River from several other sources, including monitoring studies conducted by government agencies and other studies conducted by utilities associated with the operation of hydroelectric, nuclear, and fossil-fuel generating stations. SRBC monitors water quality throughout the Susquehanna River Basin and periodically publishes reports on the results of its monitoring. Its large river assessment project has monitored water quality and biological (macroinvertebrates) parameters throughout the basin since 2007, and released its most recent report on that program in September 2011 (Shenk, 2011). Shenk (2011) concluded that overall water quality in the Susquehanna River is fairly good. For the monitoring station closest to the lower Susquehanna River, located at the mouth of the tributary Juniata River upstream of Harrisburg, monitoring at that station indicated slightly impaired conditions (Shenk, 2011). Because many of the other monitoring studies have been related to the operation or licensing of energy facilities in the lower river, those study results will be discussed for each project discussed in this draft EIS.

York Haven Project

York Haven Power conducted continuous water quality monitoring from May through October 2010, to support relicensing. Parameters sampled at seven sites within the project area included water temperature, DO, and pH.

Water temperatures ranged from 52°F to 93°F and closely mimicked ambient air temperatures. Water temperatures occasionally exceeded the maximum state criteria (87°F) at sample sites, although those exceedances occurred most often at the shallow shoreline sample site on Shelley Island and at the most upstream sample site at the head of the project impoundment. In contrast, the powerhouse tailrace sample site had generally cooler water temperatures with fewer exceedances of state water temperature criteria.

DO levels generally met or exceeded state standards, except at a shoreline sample site on Hill Island in Lake Frederic and at the east channel site upstream of the dam. However, the Hill Island site failed to meet average daily minimum DO levels on only 4 percent of the sample days, and failed to meet instantaneous minimums in only 2.7 percent of the data. The east channel site only failed to meet minimum DO standards 0.9 percent of the time. Diurnal DO patterns were observed in all locations, as influenced by photosynthesis and respiration, and fluctuations in DO levels were greatest in the warmer summer months and in areas of Lake Frederic with denser growth of SAV.

Generally, pH levels remained within state standards, but did show diurnal variation, probably due to fluctuations in carbon dioxide levels associated with photosynthetic activity. Inflowing waters to the project had fewer exceedances of state standards than waters being discharged from the project, but project outflows exceeded state criteria (higher than a pH of 9.0) only 2.9 percent of the time. Most of those exceedances ranged from 9.1 to 9.3 units. Minimum pH levels seldom dropped below neutral (pH = 7.0), with the lowest value of 6.3 observed at the shoreline sample site on Shelley Island.

Muddy Run Project

Exelon conducted water quality studies in multiple years prior to filing the final license application: 2006, 2007, 2010, and 2011. The surveys are summarized as follows:

- In 2006, Exelon continuously monitored water temperature, DO, and pH in the project discharge for 1 month from August 8 to September 3.
- The 2007 surveys involved spot measurements of water temperature and DO in the project discharge during low-flow and high-temperature periods in July and August.
- In 2010, Exelon monitored water temperature, DO, pH, specific conductivity, turbidity, and chlorophyll *a* via biweekly depth profile sampling from April through October along a single transect (three stations)

in the upper reservoir, and continuously monitored water temperature, DO, pH, and specific conductivity at the cylinder gate intake for Unit 1 and Unit 2 in the upper reservoir power canal, and in the tailrace where Units 3 and 4 discharge into Conowingo Pond.

- In 2011, Exelon continued water quality monitoring in July and August in both the reservoir and the tailrace by weekly sampling of water quality depth profile data (water temperature, DO, pH, specific conductivity, and turbidity) at two locations in the project's upper reservoir, and three locations in Conowingo Pond both upriver and downriver of the tailrace. Exelon also conducted continuous monitoring of water quality parameters (water temperature, DO, pH, and specific conductivity) at the cylinder gate intake for Unit 1 and 2 in the upper reservoir power canal, from the tailrace at the Unit 1 and 2 discharge into Conowingo Pond, and in Conowingo Pond 0.25 mile upriver of the project tailrace.

Tables 3-10 and 3-11 summarize the water quality data collected by Exelon over the 4 years of monitoring in the tailrace and the upper reservoir. These data indicate that waters discharged from the project generally met state standards (table 3-10), although DO levels occasionally dropped below state standards during the warmer summer months. The Muddy Run reservoir does not thermally stratify, but does exhibit DO stratification in the main body of the reservoir in some locations, with DO levels as low as 2.4 mg/L at depth (table 3-11). The monitoring also found that there is substantial mixing occurring in the reservoir near the head of the intake canal during project operation, particularly during pumping operation when Susquehanna River (Conowingo Pond) waters, which are typically well-oxygenated, are entering the reservoir. In 2011, monitoring at times showed a weak inverse DO stratification (higher DO in deeper water and lower DO in surface water) as Susquehanna River waters entered the reservoir at depth, under the Muddy Run reservoir surface waters that were lower in DO. All other measured parameters met state standards.

Table 3-10. Summary of water quality data collected in or near the tailrace of the Muddy Run Pumped Storage Project, 2006 through 2011 (Source: Exelon, 2012a; Normandeau and Gomez and Sullivan, 2012p).

Parameter	2006	2007	2010	2011
Water temperature	Met state water quality criteria; max recorded=86.7°F	Met state water quality criteria; temperatures in July about 4°F cooler than in August	Met state water quality criteria; temperatures ranged from 57.6 to 86.0°F; temperatures were higher than the long-term 53-year average (up to 10°F in some months) in April through September and lower in October	Generally met state water quality criteria; minimum and maximum recorded temperatures ranged from 72.1 to 87.3°F with cooler temperatures in August; no temperature stratification was observed at any of the tailrace monitoring locations, but diurnal cycles were observed, particularly in Muddy Run reservoir waters
DO	Met state water quality criteria; min recorded=5.2 mg/L. DO levels in the tailrace typically decreased by 1 to 1.5 mg/L during generation and increased when generation stopped or the number of generating units was reduced	Met state water quality criteria; average DO was 6.6 mg/L in July and 6.1 mg/L in August	Some violations of state water quality criteria; seasonal decrease in DO levels from high in April to lows in August; average daily DO value < 5.0 mg/L on 3 days in July and 1 day in August; instantaneous DO values were less than 4.0 mg/L on 12 days in July and 2 days in August	Mostly met state water quality criteria; average daily DO values were above 5.0 mg/L at all stations and dates, but continuous DO readings decreased from early July highs of 8.2 mg/L to early August lows of 3.5 mg/L, with increases in mid to late August; only one hourly reading less than 4.0 mg/L in July in the tailrace monitor, and other

Parameter	2006	2007	2010	2011
				nearby river monitors were generally 1 to 2 mg/L higher
pH	Met state water quality criteria; within pH range of 7.4 to 8.0	NA	Generally met state water quality criteria; fluctuated between 7.0 and 8.0, with the lowest pH of 6.7 and highest of 9.1	Met state water quality criteria; pH range of 7.5 to 8.5
Turbidity	NA	NA	NA	Met state water quality criteria; observed range of 3.3 to 26.1 nephelometric turbidity units (NTUs) (state standard ≤40 NTU)

Table 3-11. Summary of water quality data collected in the Muddy Run Pumped Storage Project reservoir, 2010 and 2011 (Source: Exelon, 2012a; Normandeau and Gomez and Sullivan, 2012p).

Parameter	2010	2011
Water temperature	Met state water quality criteria; thermal stratification did not occur in the reservoir; surface water temperatures ranged from 52.2 °F on April 5 to 84.6 °F on July 26; 98.4-foot-deep water temperatures ranged from 48.2°F on April 5 to 84.2°F on July 26	Met state water quality criteria; thermal stratification did not occur in the reservoir; surface water temperatures ranged from 75.2 to 85.5 °F with cooler temperatures in August; temperatures at depth ranged from 75.2 to 85.3°F
DO	Some violations of state water quality criteria; seasonal decrease in DO levels from high in April to lows in August; strong DO vertical stratification in main	Some violations of state water quality criteria; DO vertical stratification in main reservoir in some locations, with DO levels as low as 2.4 mg/L at depth; a weak

Parameter	2010	2011
	reservoir with DO less than 5.0 mg/L at depths deeper than 25 feet in July and throughout the water column in August; no stratification at head of intake canal because of mixing of flows at that location; continuous monitoring found 70 instantaneous hourly DO values less than 4.0 mg/L with most (42 or 60 percent) recorded at the cylinder gate (intake) monitor in August when the project was in an idle mode; average daily DO value was also less than the state standard of 5.0 mg/L on 7 days in August and 1 day in September at the cylinder gate monitor	inverse DO stratification (higher DO in deeper water and lower DO in surface water) observed at head of intake canal, likely due to higher oxygenated Conowingo Pond water being pumped into the Muddy Run reservoir; continuous monitoring found instantaneous hourly DO values less than 4.0 mg/L 15 percent of the time between July 16 and August 7, with a higher occurrence of lower DO levels during the idle mode compared to pumping or generating; consistent increase in DO in the intake canal during the pumping mode as a result of the introduction of higher oxygenated river (Conowingo Pond) water
pH	Met state water quality criteria; pH range of 7.0 to 8.6	Met state water quality criteria; pH range of 7.2 to 8.4
Conductivity	NA	Conductivity ranged from about 250 to 370 µS/cm in July and 220 to 400 µS/cm in August, with a decrease in conductivity with the onset of high flows in late-August
Turbidity	NA	Met state water quality criteria; observed range of 3.1 to 26.0 nephelometric turbidity units (NTUs) (state standard ≤40 NTU)
Chlorophyll *a*	Values ranged from 0.401 to 20.9 (milligrams per cubic meter (mg/m^3) during the 15 bi-weekly sampling events	NA

Conowingo Project

The Conowingo Project area has an extensive, long-term history of water quality sampling associated with the operational monitoring for PBAPS, and operational monitoring and prior relicensing studies for the Conowingo Project. These data extend back to the 1950s, and parameters of primary concern are water temperature and DO.

Conowingo Pond is a large temperate reservoir that follows a typical seasonal pattern of warming and cooling, with minimum temperatures of 32°F in January/February,[54] warming during the period of March through July, reaching a maximum average high temperature of about 81°F in July/August, and then cooling from August through December. Thermal stratification does not occur in Conowingo Pond, although during the warmest summer months, bottom temperatures may be a few degrees cooler than the surface temperatures in the deeper parts of the reservoir, especially on sunny, calm days.

Average surface DO levels show an opposite trend to water temperatures, with highest DO levels of nearly 14 mg/L occurring in January/February, and lowest DO levels in July/August/September, with the lowest average level of 7 mg/L in August. DO levels remain well mixed throughout the water column during much of the year, but DO stratification occurs in the deeper parts of the reservoir closer to Conowingo dam during the warmer, low-flow summer months. Stratification generally occurs when river flows are less than 20,000 cfs and water temperatures are greater than 70°F. The stratification usually begins in late June or early July, with low DO levels (<5 mg/L) occurring by mid to late July, and most common at depths greater than 30 feet. The deepest portions of the pond may approach or become hypoxic (DO <2 mg/L) and even anoxic under certain conditions. This DO stratification can persist for up to 60 days depending on river flows and other weather conditions, with an increase in river flows and the onset of strong winds mixing the pond and eliminating stratification. Diurnal variation in DO levels occurs in surface waters in Conowingo Pond at depths less than 20 feet, with this variation sometimes as great as 5 mg/L. Peak DO levels normally occur in the mid to late afternoon as a result of photosynthesis, and reach their low point at dawn as a result of plant respiration overnight.

Conowingo Pond water quality directly affects water quality in the tailrace and lower Susquehanna River. Exelon's Station 643, located along the Susquehanna River west shore 0.6 mile downstream of the dam and a long-term monitoring station for water temperature and DO, is designated as the primary Maryland State standard compliance

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[54] Conowingo Pond may freeze over in colder winters, but not in all winters, as strong northwest winds may act to break up any ice cover that forms. Conowingo Pond also receives the heated discharge from PBAPS, which may act to maintain open water along the west shore of the reservoir downstream of PBAPS.

monitoring location. Water temperature in the tailrace closely reflects the temperatures in the pond, with similar seasonal trends and minimum and maximum levels. Because the Conowingo generating units withdraw water from the bottom of the reservoir, DO levels in the project discharge have been similar to levels at depth (40 to 70-foot depths) in the pond. During low-flow, high-temperature periods in the summer, when reservoir bottom DO levels approached anoxic conditions, DO levels in the tailrace were historically as low as 2 mg/L. However, from 1989 to 1991, Exelon installed aeration (turbine venting) on all the Francis units (Units 1 through 7). Prior to installation of aeration, in some years, hourly DO levels were less than 5 mg/L up to 40 percent of the time. Following installation of aeration, hourly DO readings were less than 5 mg/L only 0.03 percent of the time (from 1989 to 2007), and no readings were less than 4.3 mg/L. Exelon also installed aerating turbine runners in two Francis units in 2005 and 2008, further enhancing its ability to provide additional aeration in the tailrace.

Other water quality data were collected by USGS in the discharge from Unit 8 from 1978 to 2000, and a subset of those data are summarized in table 3-12.

Table 3-12. Selected water quality parameters recorded by USGS at the Unit 8 discharge from January 1978 to June 2000 (Source: Exelon, 2012b).

Parameter	Minimum	Mean	Maximum
Water temperature (°F)	32.0	56.2	87.8
Turbidity (nephelometric turbidity units)	0	13	410
Conductivity (µS/cm)	110	218	420
DO (mg/L)	1.4	10.4	17.8
pH	6.0	7.5	8.8
Alkalinity (mg/L CaCO3)	8	40	82
Total dissolved solids (TDS)(mg/L)	53	120	246
TDS loading (tons/day)	490	29,332	99,500
Total suspended solids (mg/L)	1	45	1200
Total suspended solids loading (tons/day)	12	32,230	2,020,000
Dissolved nitrogen (mg/L N)	0.4	1.8	6.6
Total phosphorus (mg/L P)	0.010	0.072	1.500

Recent Water Quality Studies

Exelon conducted additional studies in 2010 to better understand water temperature, DO, and other water quality parameters upstream and downstream of the project, and to provide information for project relicensing. Sampling occurred in both Conowingo Pond and the tailrace from April through October, and focused on water temperature, DO, pH, turbidity, and fecal coliform bacteria. Conowingo Pond sampling confirmed historical observations of the absence of thermal stratification in the pond, although small differences in temperature (less than 4°F) were observed between the surface and bottom in some locations.

The 2010 sampling also showed that, similar to historical data, DO stratification occurs in Conowingo Pond during July and August, with DO levels less than 2 mg/L in deeper pond locations. Figure 3-11 shows DO profiles taken immediately upstream of Conowingo dam from July through September. These profiles show the summertime stratification but also show that DO levels were below 4 and 5 mg/L (the state standards) from surface to bottom during many sampling weeks. Exelon also reported that, during those weeks, sampling stations upriver in Conowingo Pond showed stratification, but this stratification broke down in the lower pond just upstream of the dam. The water column was mixing in the lower pond, and the mixing of the lower DO and higher DO waters resulted in an overall lower DO profile from top to bottom. Stratification begins to break down in the pond in September; by early October, stratification has disappeared and DO levels are above 8 to 9 mg/L throughout the water column.

Turbidity and pH data in 2010 (collected at midpoint stations in Conowingo Pond) remained within the ranges observed in long-term sampling at Conowingo dam (see table 3-12). Turbidity ranged from 1.2 to 146.5 NTUs, and pH ranged from 7.0 to 8.9.

Fecal coliform sampling in Conowingo Pond found generally low levels during the April through October sampling period. The Pennsylvania state standard for swimming (full body contact) is no greater than 200 colonies/100 milliliters,[55] and only five samples out of a total of 28 samples collected in the Pennsylvania part of Conowingo Pond in 2010 had fecal coliform levels greater than the state standard, one in the swimming season (May through September) and the remainder in October. Similarly, in the Maryland portion of Conowingo Pond, only three of 28 samples had fecal coliform levels greater than 200 colonies/100 milliliters, all in October.

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[55] The standard is based on a statistically sufficient number of samples (generally not less than five samples equally spaced over a 30-day period), and the geometric mean of the indicated bacterial densities of fecal coliform should not exceed 200 colonies/100 milliliters during the swimming season (May 1 through September 30) and should not exceed 2,000 colonies/100 milliliters for the remainder of the year. This is consistent with EPA criteria.

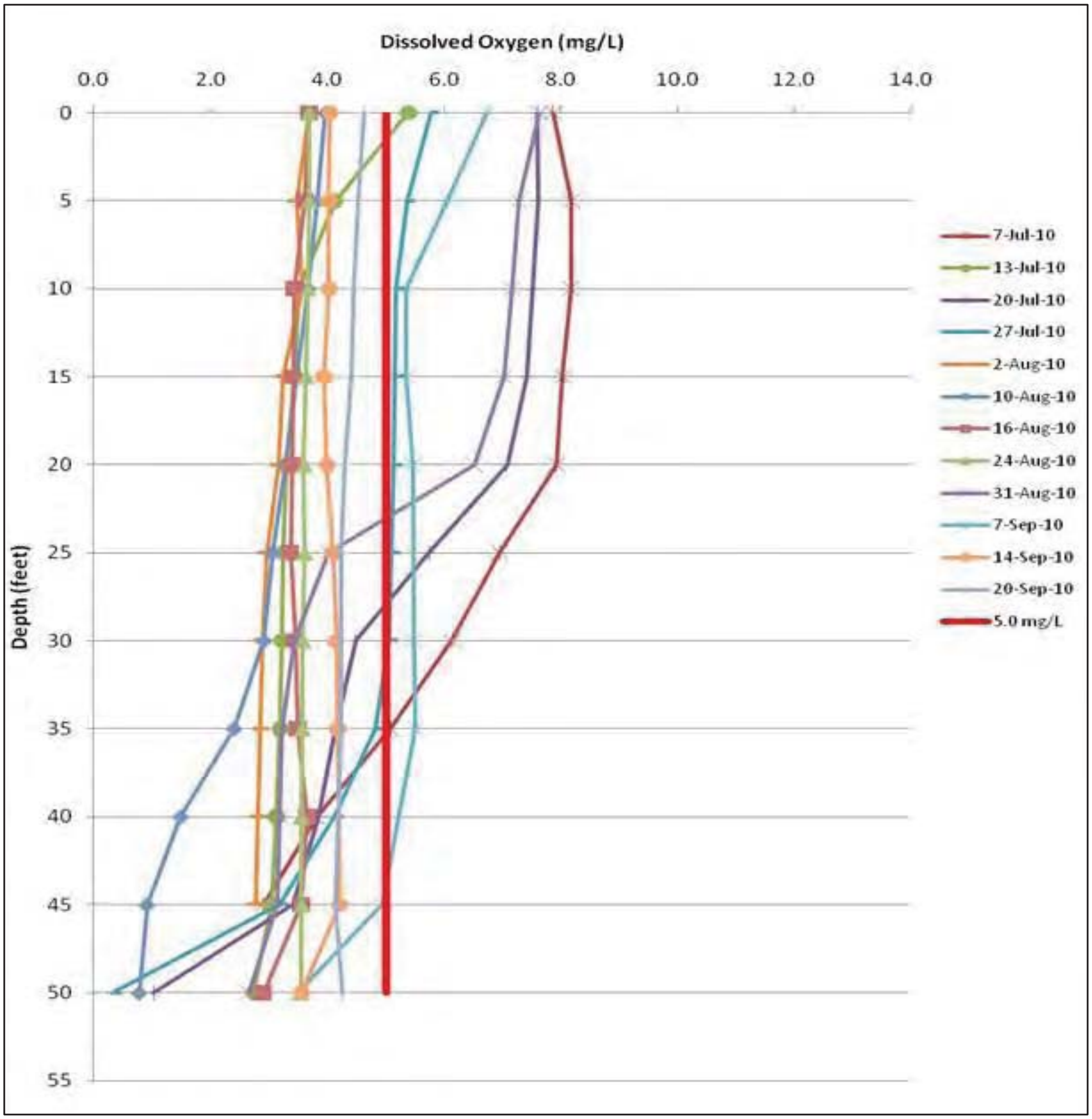

Figure 3-11. DO profiles taken immediately upstream of Conowingo dam from July through September 2010 (Source: Exelon, 2012b).

Conowingo tailrace sampling in April through October 2010 involved monitoring water temperature and DO using three methodologies: sampling at specific stations in the tailrace, continuous monitoring at the long-term station 643 located 0.6 mile downstream of the dam, and discharge boil sampling on 20 dates in July and August. Water temperatures were similar to long-term data described above, with peak temperatures recorded in late-July and early-August, and then decreasing into October. Water temperatures measured at station 643 were representative of those measured elsewhere in the tailrace. Maximum water temperatures observed in the discharge boils generally ranged from 84 to 86°F in July, but reached as high as 90°F. Only small differences in temperature were observed among the discharge boils, indicating relatively homogeneous temperatures in the overall discharge from the dam.

Tailrace DO levels remained relatively high (met state standards) throughout the 2010 sampling, likely reflecting the effects of the aeration systems in place on the seven Francis generating units. Minimum DO levels exceeded the state standard of 5 mg/L in the discharge boils 97.8 percent of the time, with minimum recorded levels of 4.4 to 4.9 mg/L. At station 643, no DO levels less than 5 mg/L were recorded, and minimum levels were generally above 6 mg/L. DO levels at station 643 were usually slightly higher than measured at the dam, but the difference was small (less than 1 mg/L) and sampling indicated that station 643 monitoring results were representative of conditions in the tailrace. Variability in DO levels was observed among the discharge boils across the powerhouse, especially between the Francis units that have aeration systems and the Kaplan units (8 through 11) that do not have aeration. Differences were also observed among the Francis units, sometimes as high as almost 3 mg/L.

Salinity Encroachment on the Lower Susquehanna River

Exelon investigated the extent of salinity encroachment in the lower Susquehanna River (Gomez and Sullivan, 2012b). The Susquehanna River is tidally influenced up to about 5 river miles downstream of Conowingo dam (at RM 10). Both Maryland DNR and the City of Havre de Grace, Maryland, maintain salinity monitors near the mouth of the Susquehanna River and have salinity data available since 1997. The City of Havre de Grace monitors salinity at its water supply intake to ensure that salinity levels do not exceed federal requirements for drinking water (less than 0.25 parts per thousand [ppt]). The Maryland DNR station is closer to the Chesapeake Bay (it is about 0.5 mile downstream of the City of Havre de Grace's station). Salinity levels at both stations are relatively low, with median daily salinity levels between 0.005 and 0.02 ppt, although occasionally (less than 0.1 percent of the time) they exceed the federal criteria of 0.25 ppt. Observed salinities ranged from 0.01 to 0.26 ppt at the City monitoring station, and from 0.08 to 0.46 ppt at the Maryland DNR monitoring station. Levels varied seasonally with salinity generally highest in the fall and late-winter and lowest during spring and summer, coinciding with or immediately after the period of highest Susquehanna River flows.

Gomez and Sullivan (2012b) analyzed the relationship of salinity to river flows, including short-term project operational changes, as well as the influence of tidal fluctuations on salinity. This analysis found that salinity appears to be primarily affected by longer term flows (30-, 45-, and 60-day moving average), with short-term flow variations having little effect. The highest salinities were observed after extended low-flow periods. Tidal fluctuations also had more of an effect on salinity during higher salinity, low-flow periods because saltwater is pushed upstream and downstream in the river as the tide rises and falls.

Sediment Loading

The LSRWA study (Corps and MDE, 2014) investigated the sediment trapping capacity of the lower Susquehanna River reservoirs, including Conowingo Pond, and the potential effects on the Chesapeake Bay; details of the LSRWA study are described in section 3.3.1.2, *Geology and Soils*, *Environmental Effects*. Essentially, that study concludes that Conowingo Pond has reached its sediment capacity and is now in a state of dynamic equilibrium where high-flow events scour sediment (and associated nutrients) from the reservoirs, followed by periods with lower flows when sediment accumulates within the storage space created by the high-flow events. On average, sediment and nutrient loads delivered to the Chesapeake Bay via the Susquehanna River equal the load delivered into the three lower river reservoirs.

Aquatic Biota

Fishery resources in the lower Susquehanna River are substantial with both an important resident warmwater fishery and anadromous and catadromous species that are passed upstream and downstream over the mainstem hydroelectric dams. Primary warmwater game species in the river include smallmouth bass, largemouth bass, walleye, channel catfish, flathead catfish (a recent introduction), and panfish species such as redbreast sunfish, bluegill, black and white crappie, and pumpkinseed. Other common species include gizzard shad, quillback, spotfin shiner, other shiners, and common carp. Juvenile gizzard shad and the shiners serve as forage species for game species.

Each project reservoir has substantially different characteristics and aquatic habitat. Lake Frederic is about 3.5 miles long with about 29 miles of total shoreline within the York Haven project boundary, including the shoreline of the islands in Lake Frederic. The maximum depth of Lake Frederic is about 18 feet and the mean depth is about 6 feet. At the normal water surface elevation of 277.86 feet, Lake Frederic has a surface area of 2,218 acres. The normal drawdown is about 1.1 feet. Lake Frederic has a substrate of primarily bedrock, boulder, cobble, and gravel with limited areas of finer substrates (sand, silt, clay). One such area is located in the east channel immediately upstream of east channel dam, and has one of the few dense stands of SAV in the reservoir. Two other areas of SAV are located along the shorelines of Hill and Shelley Islands.

Muddy Run reservoir has a maximum depth of about 100 feet, a surface area of 892 acres at elevation 520 feet, and 471 acres at the maximum drawdown elevation (470 feet). The arm of the reservoir that is the Recreation Lake has a total area of about 100 acres and is maintained at a constant elevation of 520 feet for recreational purposes. Aquatic habitat in the power reservoir consists of a wide and gently sloping non-vegetated shoreline that is subject to large daily and weekly water level fluctuations (up to 50 feet on a weekly basis). Substrates are primarily unweathered bedrock covered in places with fragmented weathered bedrock, colluvium, and alluvium. Bedrock outcroppings and overhangs also occur along the shoreline littoral areas. Little SAV occurs within Muddy Run reservoir because of the constantly fluctuating water levels.

Conowingo Pond extends 14 miles upstream from Conowingo dam to the lower end of the Holtwood Project tailrace. The Conowingo Pond normal maximum elevation is 109.2 feet, resulting in a surface area of about 8,500 acres and a maximum depth of about 100 feet. Normal drawdown is about 2 feet, although it may reach 3 feet and greater during brief periods, but generally not during the summer recreation season. The Conowingo Pond shoreline is relatively steep, but through the years the pond has substantially filled in with sediment (except in the more upstream riverine, bedrock dominated reach), so the substrate in a large part of the pond is now primarily sand, silt, and gravel with several areas of dense SAV along the shoreline. An estimated 312 acres of SAV occurs within Conowingo Pond at full reservoir elevation, and that acreage substantially declines at elevations lower than 106 feet. The largest areas of SAV occur along the east shoreline of Conowingo Pond across from the PBAPS, in shallow areas that have filled over the years. Five SAV species were identified as dominant within Conowingo Pond: Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), water stargrass (*Heteranthera dubia*), Canadian waterweed (*Elodea canadensis*), and coontail (*Ceratophyllum demersum*). Hydrilla, an invasive species, however, dominates SAV beds within the pond. Exelon also investigated SAV downstream of Conowingo dam in 2010 (URS and Gomez and Sullivan, 2012b). That study found that SAV communities were primarily located in the lower portion of the reach below Conowingo dam in areas with fine-grained substrates and lower velocities. The upper portion closer to the dam with its higher water velocities and primarily bedrock/boulder substrate contains little or no SAV growth. Four SAV species were identified downstream of Conowingo: Eurasian watermilfoil, hydrilla, water stargrass, and wild celery (*Vallisneria americana*); Eurasian watermilfoil dominates SAV beds, covering more than 95 percent of the area occupied by SAV beds.

The Conowingo Pond and the Muddy Run Recreation Lake support an active boat and shoreline sport fishery for resident species, and fishing also occurs in both project tailwaters, from the shoreline and by boat. The tailrace fishery downstream of Conowingo, however, is more intense than in the Muddy Run tailrace. Muddy Run reservoir contains essentially the same species composition as Conowingo Pond, via the pumping of eggs, larvae, and other life stages from Conowingo Pond. Exelon reports that the fish standing crop is higher than many conventional reservoirs, but carp dominated the overall standing crop estimate (69 percent), with walleye, smallmouth bass, white crappie and channel catfish comprising 12.8 percent of the mean standing crop. Muddy Run reservoir is closed to fishing. However, the Recreation Lake is open to boat and shoreline fishing and is stocked annually with rainbow trout. Other species (walleye, tiger muskellunge, and channel catfish) have been stocked over the years.

There has been an active program for restoring anadromous fish populations to the Susquehanna River for the past 35 years or more. Historically, the river supported large runs of American shad, river herring (blueback herring and alewife), hickory shad, as well as the catadromous American eel. These populations declined in the late 1800s and early 1900s because of the construction of canal feeder dams, overfishing, water pollution, and eventually the construction of the hydroelectric dams between 1904 and 1928. The York Haven Project at RM 55 was the first hydroelectric dam on the river, having been constructed in 1904. The dam, however, is a low-head structure from 6 to 22 feet high, and may have been partially passable by shad during higher flow periods. Holtwood dam was constructed in 1910 at RM 25, and at 55 feet high, totally blocked upstream fish migration. Two fishways were constructed at Holtwood at the time of its initial construction—a rock ramp type fishway on the west shore of the bypassed reach, and a pool-and-weir type fishway on the east shore of the tailrace. Neither fishway reportedly ever passed shad successfully, but the rock ramp fishway did pass some American eel, although the numbers are not known. In 1928, the 95-foot-high Conowingo dam was constructed at RM 10 without fish passage and became the downstream-most obstruction to upstream fish migration on the river.

Modern anadromous fish restoration efforts on the Susquehanna River began in the 1950s and 1960s with a number of feasibility studies, followed by the construction of a trap and truck facility (the west fish lift) at Conowingo dam in 1972, the initiation of fertilized shad egg stocking in the basin, the construction of a shad hatchery by Pennsylvania FBC in the mid-1970s, and the total closure of the shad fishery in the Susquehanna River and the upper Chesapeake Bay by the state of Maryland in 1980. The number of shad returning to the river increased through the years, and by 1991 a new fish lift (east fish lift) was constructed at the Conowingo Project, followed by new fish lifts at the Holtwood and Safe Harbor Projects in 1997. The York Haven Project east channel vertical slot fishway became operational in 2000.

The Holtwood Project fish lifts (tailrace and spillway) were renovated as part of the recent expansion of the Holtwood Project, which includes the addition of a new powerhouse and 88.3 MW of generating capacity. To improve migratory fish passage at the project, PPL: (1) modified the existing spillway fish lift, (2) rerouted the discharge of Unit 1 in the existing powerhouse to improve attraction to the spillway fish lift, and (3) excavated in the project tailrace and Piney Island Channel to improve fish access to the fish lifts. These improvements were completed in 2013, and the improved fish passage facilities were operational for the first time in 2014.

Table 3-13 summarizes the passage of American shad at the four lower river hydroelectric projects since 1997. Table 3-13 shows that passage success at Holtwood has generally been poor, as a percentage of Conowingo shad passage. Generally, higher success rates have occurred during years with lower river flows, while lower success rates have occurred in years with higher flows. The recent fish passage improvements at Holtwood should increase the efficiency of the Holtwood fish lifts. Operation in 2014 showed a small increase in the percentage of shad lifted at Holtwood, but not a substantial improvement in total numbers passed because the overall number of shad in the Susquehanna River was the lowest since volitional passage was established in 1997. Safe Harbor Project passage has generally been excellent, with a relatively high percentage of the fish passed at Holtwood also passed at Safe Harbor. Lake Aldred, which backwaters into the Safe Harbor tailrace is only about 7 miles long, and the design of the Safe Harbor fish lift, along with the usual lack of spillage during the fish migration season, allows migrating fish to more easily locate the entrances to the Safe Harbor fish lift. Only low numbers of shad typically are counted at the York Haven east channel fishway (table 3-13). However, the river reach from Safe Harbor to York Haven is about 22 miles, including about 10 miles of Lake Clarke and 12 miles of free-flowing river that includes habitat suitable for shad spawning. Not all shad passing Safe Harbor would need to pass York Haven if they spawn downstream of York Haven, and, as a result, fish counts at the east channel fishway compared with Safe Harbor counts, do not indicate the actual efficiency of the fishway.

Table 3-13. Summary of American shad passage on the Susquehanna River, 1997–2014 (Source: Pennsylvania FBC, 2014).

Year	Conowingo[a]	Holtwood	Safe Harbor	York Haven
1997	90,971	28,063	20,828	--
1998	39,904	8,235	6,054	--
1999	69,712	34,702	34,150	--
2000	153,546	29,421	21,079	4,675
2001	193,574	109,976	89,816	16,200
2002	108,001	17,522	11,705	1,555
2003	125,135	25,254	16,646	2,536
2004	109,360	3,428	2,109	219
2005	68,926	34,156	25,425	1,772
2006	56,899	35,968	24,929	1,913
2007	25,464	10,338	7,215	192
2008	19,914	2,795	1,252	21
2009	29,272	10,896	7,994	402
2010	37,757	16,472	12,706	907
2011	20,571[b]	21	8	0
2012	22,143	4,238	3,089	224
2013	12,733	2,503	1,927	202
2014	10,425	2,528	1,336	8

[a] Passage numbers are for the east fish lift, which releases fish into Conowingo Pond. The west fish lift is operated to collect shad for hatchery egg supply, and for other experimental purposes.

[b] In 2011, Conowingo fish passage operations were terminated earlier than normal because the resource agencies requested termination of fish passage at Conowingo dam as a result of high river flows in the spring of 2011 that greatly impeded shad passage at facilities upstream of Conowingo dam. Therefore, all upstream fish lifts were also shut down after only brief operation.

Few other anadromous species currently pass upstream through the lower Susquehanna Projects. Table 3-14 provides passage data for the other anadromous species and the gizzard shad, which is a non-anadromous migratory species that moves upstream from the Chesapeake Bay to spawn in the spring. All the lower Susquehanna River reservoirs also contain landlocked gizzard shad populations, so fish passage counts at Holtwood, Safe Harbor, and York Haven may also reflect individuals from those populations. The peak passage of river herring occurred at Conowingo in 1997 and 2001, when about 243,000 herring passed in 1997 and 285,000 herring passed in 2001. During those same years, only about 1,000 to 1,300 herring passed the Holtwood Project, less than 1 percent of the number passed at Conowingo, with less than 1,000 herring reaching Safe Harbor in both years. The highest alewife passage (7,458) occurred in 2001. Since 2003, the number of blueback herring and alewife passed at Conowingo has been less than 1,000 fish, with few or no herring and alewife recorded in some years. Since 2003, only sporadic herring and alewife passage has occurred at upriver dams with no herring or alewife passage recorded at York Haven since 2002. Only occasional hickory shad have been passed at Conowingo since 1997, with essentially none appearing at upriver dams. Small numbers of striped bass have been lifted at Conowingo dam (typically in the hundreds of fish per year), and a few of those have been passed at upriver dams, with a few striped bass consistently recorded at York Haven dam.

Catadromous American eel elvers[56] occur at the base of Conowingo dam, and a few may be passed upstream at Conowingo through the fish lift, although fish lifts are generally not effective in passing elvers, which are also difficult to quantify because they are small enough to pass through crowding devices and screens. Some of the eels that manage to pass Conowingo may appear at Holtwood and the upstream dams. Both FWS and Exelon have been collecting eels downstream of Conowingo dam since 2005, to assess the spatial distribution and size characteristics of American eels in the Conowingo tailrace, to assist in determining the feasibility and potential locations for upstream eel

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[56] Elvers are juvenile American eel that ascend the river during the spring and summer months.

passage facilities. These studies used both experimental eel ramps and eel pots on the west shoreline of the tailrace near the west fish lift, as well as in locations near the east fish lift and in the spillway. Catches have been variable, ranging from total annual catches typically in the hundreds up to a maximum of 85,000 eels in eel ramps near the west fish lift in 2011. FWS collected more than 400,000 eels in 2013.[57] Eels collected by the ramps have ranged in length from 76 to 225 millimeters (about 3 to 9 inches) and are likely primarily elvers, while eels collected in the eel pots are generally larger, up to 770 millimeters (30 inches) in length, indicating the presence of older age classes that are residents to the lower river downstream of Conowingo dam.

Table 3-14. Summary of other anadromous fish (not including American shad) and gizzard shad passage on the Susquehanna River, 1997–2014 (Source: Pennsylvania FBC, 2014; SRAFRC annual reports).

Year	Conowingo[a]	Holtwood	Safe Harbor	York Haven
1997				
Blueback herring	242,815	1,042	534	-
Alewife	63	0	1	-
Gizzard shad	344,332	167,916	116,158	-
Hickory shad	0	1	0	-
Striped bass	1,015	4	0	-
1998				
Blueback herring	700	62	16	-
Alewife	6	0	4	-
Gizzard shad	654,575	138,713	102,702	-
Hickory shad	0	0	0	-
Striped bass	1,467	116	12	-
1999[b]	NA	NA	NA	NA
2000				
Blueback herring	14,963	27	159	0
Alewife	2	0	657	2
Gizzard shad	317,753	141,176	120,696	72,972
Hickory shad	0	0	0	0

[57] Email from S. Minkkinen, FWS, Annapolis, MD, to S. Johnson, Earthjustice, Washington, D.C., December 11, 2013.

Year	Conowingo[a]	Holtwood	Safe Harbor	York Haven
Striped bass	802	4	3	12
2001				
Blueback herring	284,921	1,300	710	4
Alewife	7,458	1	13	0
Gizzard shad	429,461	188,098	151,873	89,272
Hickory shad	0	0	0	0
Striped bass	543	4	5	8
2002				
Blueback herring	2,037	13	0	0
Alewife	74	0	1	1
Gizzard shad	513,794	107,600	98,137	60,247
Hickory shad	6	0	0	0
Striped bass	913	7	1	10
2003				
Blueback herring	530	3	0	0
Alewife	21	2	0	0
Gizzard shad	459,634	145,732	110,652	112,000
Hickory shad	0	0	0	0
Striped bass	267	2	1	26
2004				
Blueback herring	101	0	0	0
Alewife	89	2	1	0
Gizzard shad	602,677	170,411	127,628	84,234
Hickory shad	0	0	0	0
Striped bass	391	3	0	2
2005				
Blueback herring	4	0	0	0
Alewife	0	0	0	0
Gizzard shad	305,100	52,708	44,331	11,969
Hickory shad	0	0	0	0
Striped bass	49	0	11	6

Year	Conowingo[a]	Holtwood	Safe Harbor	York Haven
2006				
Blueback herring	0	0	0	0
Alewife	0	0	0	0
Gizzard shad	655,990	227,443	179,150	164,869
Hickory shad	4	0	0	0
Striped bass	75	0	8	5
2007				
Blueback herring	460	0	0	0
Alewife	429	0	0	0
Gizzard shad	508,627	121,927	84,466	21,843
Hickory shad	0	0	0	0
Striped bass	127	3	2	0
2008				
Blueback herring	1	0	0	0
Alewife	4	0	0	0
Gizzard shad	919,975	234,967	163,354	15,930
Hickory shad	0	0	0	0
Striped bass	20	0	3	5
2009				
Blueback herring	71	0	0	0
Alewife	160	0	0	0
Gizzard shad	876,412	228,370	170,686	76,995
Hickory shad	0	0	0	0
Striped bass	66	0	0	7
2010				
Blueback herring	4	0	0	0
Alewife	1	0	0	0
Gizzard shad	813,429	182,929	130,482	48,152
Hickory shad	0	0	0	0
Striped bass	34	2	5	6

Year	Conowingo[a]	Holtwood	Safe Harbor	York Haven
2011 [c]				
Blueback herring	17	-	-	-
Alewife	2	-	-	-
Gizzard shad	257,522	-	-	-
Hickory shad	20	-	-	-
Striped bass	21	-	-	-
2012				
Blueback herring	24	0	0	0
Alewife	27	0	0	0
Gizzard shad	1,064,708	211,478	136,369	86,515
Hickory shad	0	0	0	0
Striped bass	122	2	1	5
2013				
Blueback herring	7	0	0	0
Alewife	0	8	0	0
Gizzard shad	1,076,048	418,310	348,753	106,395
Hickory shad	1	0	0	0
Striped bass	200	3	3	7
2014				
Blueback herring	6	0	0	NA[b]
Alewife	130	2	0	NA
Gizzard shad	1,170,200	297,522	216,826	NA
Hickory shad	2	0	0	NA
Striped bass	110	1	6	NA

[a] Numbers are for the east fish lift, which releases fish into Conowingo Pond. The west fish lift collects shad for hatchery egg supply and other experimental purposes.

[b] Data were not available from the Pennsylvania FBC website.

[c] In 2011, Conowingo fish passage operations were terminated earlier than normal because the resource agencies requested termination of fish passage at Conowingo dam as a result of high river flows in the spring of 2011 that greatly impeded shad passage at facilities upstream of Conowingo dam. Therefore, all upstream fish lifts were also shut down after only brief operation.

Several other species have successfully used the fish lifts in the lower Susquehanna River, including substantial numbers of game species such as walleye and smallmouth bass. In a review of resident fish passage from 1997 to 2007, 49 fish species were recorded in the fish passage facilities of the lower Susquehanna River (Shiels, 2007). The species that dominates fish passage through the lower river dams is the gizzard shad. The gizzard shad, however, is not considered a game or sport species, does not support a directed fishery, and is considered by many to be useful only as a forage species for other fish during its juvenile life stage, because of its large adult size. The number of gizzard shad annually passing the lower river dams typically numbers in the hundreds of thousands, reaching over a million fish at Conowingo in 2012 and 2013 (see table 3-14). Shiels (2007) reported that gizzard shad comprised about 75 percent of all fish passed over the lower river dams from 1997 to 2007. While the number of gizzard shad passed at each upstream dam decreases substantially between dams, large numbers of gizzard shad are passed annually at York Haven, often exceeding 100,000 fish, as in 2003, 2006, and 2013.

Engineered downstream fish passage facilities have generally not been provided at any of the lower Susquehanna River projects. Studies have been conducted at all of the projects to assess downstream passage of anadromous clupeids and the American eel. In addition, behavioral devices (lights and sound) were tested with shad at the York Haven Project, both as a deterrent to prevent turbine passage and as a guidance mechanism to move fish toward the forebay sluice gate for safe passage. Downstream passage at York Haven occurs via natural spillage over the dam or via the forebay sluice gate in combination with lights and sequencing of unit operations. Downstream passage at the other projects has generally been via the turbines, where passage survival has been found to be relatively high for juvenile anadromous clupeids (particularly at Safe Harbor and Conowingo). For example, at Safe Harbor dam, downstream passage survival was estimated at 97 percent for juvenile shad and 88 percent for adult shad (RMC Environmental, 1991; Normandeau, 1998), and at Conowingo dam at 90 to 95 percent for juvenile shad and about 90 percent for adult shad (Normandeau and Gomez and Sullivan, 2012f; 2012i). Some fish may also pass downstream over the project spillways if a high-flow event and spillage coincides with the outmigration period.

Freshwater Mussels

York Haven Project

Strayer and Fetterman (1999) list 14 mussel species from the Susquehanna River system. Spoo (2008) reported 13 species from the Susquehanna River system, and the Pennsylvania Natural Heritage Program reported seven mussel species from Lancaster County in the vicinity of Brunner (Lows) Island and Conewago Creek. Meyer (2010) reported an apparent decline in populations of the eastern elliptio in Pennsylvania, although it is considered stable throughout most of its north Atlantic slope distribution (NatureServe, 2010).

A mussel reconnaissance survey was conducted in July 2010 during low-flow conditions (6,000 cfs at USGS 01570500 gage at Harrisburg, Pennsylvania) at the York Haven Project. Based on substrate conditions, water depth, and velocity, representative aquatic habitat types within the project area were searched for live mussels and shells. Shoreline and exposed bars were checked for shell material and middens.[58] Using results from the reconnaissance survey, seven sites were chosen for detailed analysis in four areas: main channel 1 (spillway reach), main channel 2 (middle section), main channel 3 (lower section including the powerhouse area) and the east channel of the river (figure 3-12).

A detailed survey was conducted in August 2010 when discharge was 6,000 to 7,000 cfs at USGS 01570500 gage at Harrisburg, Pennsylvania. Five species and 56 live mussels were collected during 23.4 hours of searching (tables 3-15 and 3-16). An additional four species were found only as dead shells. Catch-per-unit-effort (CPUE) ranged from 2.7 to 9.3 at three locations, and with an average value of 2.6 for all sites combined. The mussel assemblage was dominated by eastern floater which comprised 58.9 percent of the fauna and was approximately three times more abundant than the second most common species, yellow lampmussel. Several small eastern floaters and a single juvenile yellow lampshell were collected, which indicates that these species are likely recruiting in the area.

Aquatic habitat in the project area consisted mainly of bedrock and boulders, which is not particularly suitable for freshwater mussels. No live mussels were found at sites 1-3 in the main channel. Virtually all of Site 1 was unsuitable, and the unconsolidated substrate between boulders and bedrock outcrops at Sites 2a, 2b, and 3 was only marginally suitable for mussels. Fourteen mussels representing three species were found at Site 4, in the upper reach of the main channel in the project area, which consisted mainly of bedrock with only small amounts of gravel.

No live mussels were found at Site 5 in the lower east channel, which was characterized by high velocity water, bedrock, boulders, and only small areas of cobble and gravel overlain by sand. Live mussels were collected at Sites 6 and 7, in the mid and upper east channel, respectively. Seven live mussels (eastern floater and yellow lampmussel) were collected during 2.08 hours of searching at Site 6. Habitat at this location was more suitable for mussels than at Site 5, and was a shallow pool/slow run with a mixture of cobble, gravel, and sand with some bedrock and boulders. Site 7 in the upper east channel supported the most abundant assemblage in the project area; 5 species and 35 individuals were collected and overall CPUE equaled 9.3. Substrate was a mixture of gravel, cobble, and sand with some areas of silt.

[58] Middens are small collections or piles of mussel shell material, often accumulating as a result of river flow patterns.

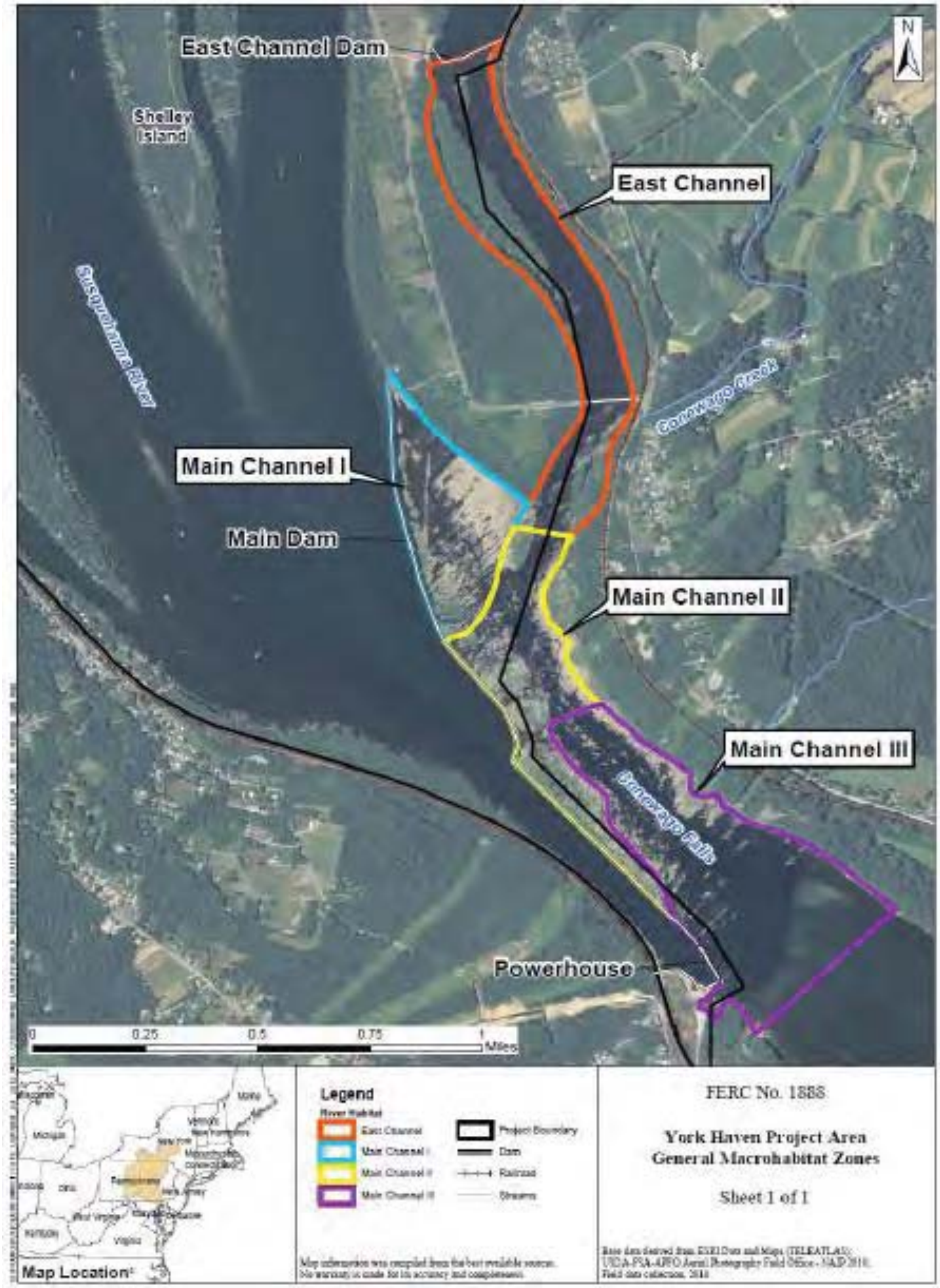

Figure 3-12. Mussel sampling sites located below the York Haven Power Plant, Susquehanna River (Source: York Haven Power, 2012a).

Table 3-15. Mussel species collected in the Susquehanna River, York Haven Project, August 2010 (Source: York Haven Power, 2012a).

		Live Mussels			
Common Name	**Scientific Name**	**Number**	**% Abundance**	**Shell Material**	**Status[a]**
Eastern floater	*Pyganodon cataracta*	33	58.9	X	Not listed
Yellow lampmussel	*Lampsilis cariosa*	10	17.9	X	S3, S4
Eastern elliptio	*Elliptio complanata*	7	12.5	X	Not listed
Alewife floater	*Anodonta implicata*	4	7.1	X	S3, S4
Creeper	*Strophitus undulatus*	2	3.6	X	Not listed
Rainbow mussel	*Villosa iris*			X	S1
Green floater	*Lasmigona subviridus*			X	S2
Susquehanna elktoe	*Alasmidonta marginata*			X	S4
Triangle floater	*Alasmidonta undulata*			X	S3, S4
Total live mussels		56			

[a] Status designations are based on Pennsylvania Natural Heritage Program (PNHP, 2011a) and PNHP (2011b): S1-Criticially imperiled; S2-Imperiled; S3S4-Vulnerable/apparently secure; and S4-Apparently secure.

Table 3-16. Live mussels collected using semi-quantitative methods in the Susquehanna River, York Haven Project, August 17 to 18, 2010 (Source: York Haven Power, 2012a).

Location	Total Search Time, hours	CPU, #/hour	Species	Number
1-Main Channel tailrace	3.65	0.0	None	
2a-Main Channel, LDB	2.00	0.0	None	
2b-Main Channel, RDB	0.35	0.0	None	
3-Main Channel	1.52	0.0	None	
4-Spillway Con	5.25	2.7	Eastern floater	8
			Alewife floater	3
			Yellow lampmussel	3
5-East Channel DS Bridge	3.20	0.0	None	
6-East Channel, US Bridge	2.08	3.4	Eastern floater	5
			Yellow lampmussel	2
7-Upper East Channel	3.75	9.3	Eastern floater	20
			Eastern elliptio	7
			Yellow lampmussel	5
			Creeper	2
			Alewife floater	1
For the project Area	21.80	2.6		56

Because comparatively small numbers of live native mussels were taken in this semi-qualitative survey, it is not possible to provide a thorough analysis of population demography or recent recruitment in the York Haven Project area. Based on survey results, total shell length for eastern floater ranged from 40-110 millimeters, and for yellow lampmussel from 43-98 millimeters. Intermediate-sized organisms of both species were collected, and presence of comparatively small-sized individuals indicates that at least these two species had recruitment in or immediately outside the project area within the last several years. No federally listed threatened or endangered mussel species were found during this survey.

Muddy Run Project

Native freshwater mussels were not collected in Muddy Run reservoir or in the Susquehanna River below the dam. No federally listed threatened or endangered mussel species have been reported within the project boundary.

Conowingo Project

Marshall (1930) surveyed for mussels in September 1929, approximately 1 year after Conowingo dam was constructed. He reported two live eastern elliptio, as well as yellow lampmussel (one shell) and eastern lampmussel (*Lampsilis radiata*) (four shells). Ashton (2009) described results from three surveys conducted during 2008 and 2009. Methods included benthic trawling and SCUBA diving by personnel from Marshall University, West Virginia, and collections by personnel from Maryland DNR's Monitoring and Non-tidal Assessment Division. Live individuals and dead shells of six species were found in 2008 and 2009, including eastern elliptio, alewife floater, eastern floater, tidewater mucket, northern lance (*Elliptio fisheriana*), and creeper. Ashton (2009) also reported that eastern lampmussel was collected in 1990 and 1998 by personnel of Maryland DNR's Natural Heritage Program. In 2010, Ashton conducted mainly timed-snorkel searches in suitable mussel habitat downstream of Conowingo dam (Ashton, 2011). He collected dead shells of northern lance (*Elliptio fisheriana*), not taken in his previous two surveys, and was the first to report the presence of the invasive zebra mussel (*Dreissena polymorpha*) in the project area.

Contact with nine museums yielded few historical records for mussels in the project area. Three records from the National Museum of Natural History in Washington, D.C., were from upper Chesapeake Bay approximately 8 to 10 miles downstream of the study reach; one was for tidewater mucket and two were for eastern lampmussel. The Canadian Museum of Nature had two records from the Susquehanna River near the mouth of Deer Creek. One is for eastern elliptio and the other is for *Anodonta fluviatilis*, a taxon that is no longer recognized. It is likely this was the eastern floater (*Pyganodon cataracta*) based on synonymies in Strayer and Jirka (1997). Two additional records at the Canadian Museum of Nature were for eastern elliptio and the eastern lampmussel. The exact location of these records was not clear, although they were likely from downriver of the project area.

In 2010 and 2012, semi-quantitative (timed searches) mussel surveys were conducted in the Susquehanna River below Conowingo dam (figure 3-13). The 2010 studies were conducted by Normandeau and Gomez and Sullivan (2012e), and the 2012 studies were conducted by Biodrawversity and Gomez and Sullivan (2012). A total of 128 sites were sampled using semi-quantitative methods during the 2 years. In 2010, locations likely to support live mussels were sampled; the 2012 study was designed to include areas not covered during the first survey. Semi-quantitative collections were obtained by wading, snorkeling, or SCUBA diving. During the 2012 survey, notes were made on water depth, substrate type, and flow conditions.

Five species and 6,301 native mussels were collected in 2010 and 2012 using semi-quantitative methods (table 3-17). For all species and sites combined, CPUE ranged from 0 to 612 (mean = 64.1, standard deviation = 94.5). Most sites with the greatest number of mussels were within or near tidal areas at the downstream end of the study reach. CPUE values of less than 5.0 were recorded at 21.1 percent of sites. Although sites with comparatively few mussels were found throughout, most were near the mouth of Octoraro Creek, near Bird Island, Rowland Island, or in the back channel of Mud Island at the upstream end of the study reach. Overall, eastern elliptio strongly dominated comprising 96.3 percent of the assemblage and found at 93.7 percent of sites. Average CPUE for this species was 61.7 (standard deviation = 91.8). Eastern elliptio was particularly abundant in the downstream project area, mainly in tidal areas. Remaining four species together comprised less than 4 percent of the fauna; average CPUE for each ranged from 1.55 (standard deviation = 2.99) to 0.10 (standard deviation = 0.48). A single shell of the creeper was found in the project area by Maryland DNR in 2010.

No federally listed threatened or endangered mussel species were found during this survey. In the state of Maryland, alewife floater was listed as S3, eastern lampmussel was listed at S1 and S2, and tidewater mucket was listed as SU (table 3-17).

A total of 117 live mussels were collected in the 66 quadrat samples collected during both study years. The fauna was dominated by eastern elliptio (95.7 percent), and equal numbers of alewife floater and eastern floater (both 3.1 percent). Mean total density ranged from a low of 0.11 (99 percent confidence interval: -0.07 to 0.29) to a high of 4.26 (99 percent confidence interval: 1.39 to 7.15). The highest densities were obtained at two locations in the secondary channel of McGibney Island. Mussels were more likely to be found in quadrats where silt, sand, and gravel comprised 30 to 80 percent of total substrate. Population estimates for all species combined for the 450 m^2 plots ranged from 50 mussels (90 percent confidence interval = -32 to 132 mussels) to 1,920 mussels (90 percent confidence interval = 623 to 3,217 mussels).

The mussel fauna in the project area was characterized by dominance of a single species (eastern elliptio), and fewer numbers of five other species. This species was much more abundant at this location (96.3 percent), compared to the reach downstream of the York Haven Project (compare tables 3-15 and 3-17). Comparatively high numbers of eastern elliptio downstream of the Conowingo Project are likely due to greater availability of American eel downstream of Conowingo dam; the American eel is the most important host species for eastern elliptio (Lellis et al., 2013). Physical conditions of substrate and water velocity were patchy in the project area, which likely caused high variability in overall CPUE (ranging from at or near 0 to more than 600). Although it can be difficult to assess recent recruitment of these long-lived organisms over a short sampling, few small individuals of any species were taken in either type of sampling. Based on quantitative sampling, 95 percent of eastern elliptio measured 60 to 130 mm, and only two were less than 40 mm total shell length. Only a single (0.01 percent of the total collection) juvenile-sized (32.0 mm) eastern floater was collected using semi-quantitative methods.

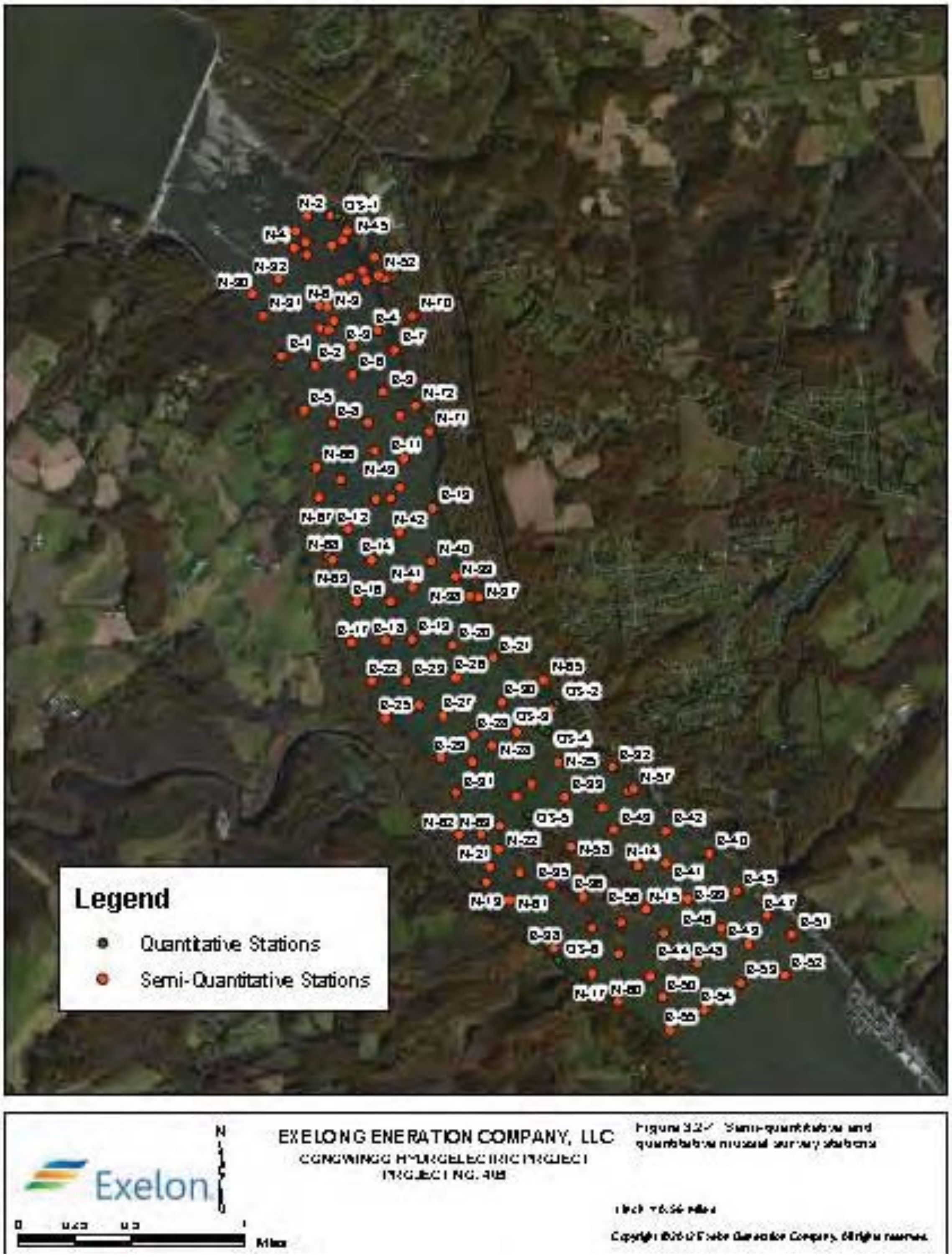

Figure 3-13. Mussel sampling sites located below Conowingo dam, Susquehanna River (Source: Normandeau and Gomez and Sullivan, 2012e).

Table 3-17. Freshwater mussels collected in the Conowingo Project area (Source: Biodrawversity Inc. and Gomez and Sullivan Engineers, 2012).

Common Name	Species	Percent Abundance	Frequency of Occurrence	CPUE Mean	CPUE SD	Status[a]
Eastern Elliptio	*Elliptio complanata*	96.3	93.8	61.70	91.8	
Alewife Floater	*Anodonta implicata*	2.1	35.9	1.55	2.99	S3
Eastern Floater	*Pyganodon cataracta*	1.1	22.7	0.47	1.11	
Tidewater Mucket	*Leptodea ochracea*	0.4	17.2	0.25	0.69	SU
Eastern Lampmussel	*Lampsilis radiata*	0.1	5.5	0.10	0.48	S1, S2

Notes: Results of two similarly conducted surveys were combined: Normandeau Associates (August 9– September 3, 2010), and Biodrawversity (July 16-19, 2012). A total of 6,301 live mussels were collected using semi-quantitative methods at 128 sites.

[a] Status from the Maryland Natural Heritage Program (2010): S1-Criticially imperiled; S2-Imperiled; S3-Vulnerable; and SU - Possibly rare in Maryland, but of uncertain status.

The distribution of freshwater mussels varies with distance from Conowingo dam, proximity to tidal influence, substrate conditions, and hydraulic conditions. Results indicate that water velocity, shear stress, and substrate type affect mussel distribution. In the project area, mussel species were either very uncommon or not collected in habitats prone to frequent dewatering, areas with poor substrate, or areas subjected to high shear stress. Mussels were more prevalent where modeled shear stress was relatively low. Areas of highest CPUE observed in this study were typically along the east side of the river in the downstream half of the project area, where flow is considerably less than near the dam in the upstream half of the project area. In addition to this overall trend, the several sites with highest CPUE values in the project area also occurred in zones of local flow refugia, where stream flow models showed shear stress to be lower than in immediate surrounding areas. These results are similar to findings from other mussel studies from other parts of the country (Layzer and Madison, 1995; Strayer, 1999; Morales et al., 2006; Allen and Vaughn, 2010).

Invasive Species

York Haven Project

Asian clams (*Corbicula* sp.) were collected downriver of the York Haven Project as part of macroinvertebrate studies. Although zebra mussels have been found in the upper Susquehanna River drainage (Kazyak et al., 2005), none were found in Lake Frederic or downriver of the project area.

Muddy Run Project

Dead zebra mussel shells were observed along the shore of Muddy Run reservoir in November 2008, approximately 1 month after they were discovered in Conowingo Pond.

Conowingo Project

Zebra mussel veligers were found in 2009 and 2010 in the intake canal at PBAPS on the west bank of Conowingo Pond in Delta, Pennsylvania, during Exelon's ongoing zebra mussel monitoring program at PBAPS. Zebra mussels were found at eight sites downstream of Conowingo dam; three were close to the dam, and the remainder were collected either at the mid- or extreme-lower portion of the project area. Asian clams were observed at nearly every site in the project area (Ashton, 2009).

3.3.2.2 Environmental Effects

Brunner Island Station Cooling Water

The Brunner Island Station, owned by PPL Brunner Island LLC (PPL BI), is located 1.5 miles downstream of the York Haven powerhouse on the west side of the Susquehanna River. The station is a coal-fired generating station that uses up to 1,200 cfs of water from the river for cooling when operating at full capacity. Stations such as this typically run at a set output, preferably peak or full capacity, to provide baseload electricity to the power grid. They are typically operated at that level for a set period of time, or run continuously, as needed. On August 6, 2012, PPL BI filed comments pertaining to the York Haven Project draft license application with the Commission expressing its concerns that, under low-flow conditions, new minimum flow requirements could allow the river flow in the vicinity of the Brunner Island Station water intake to fall below 1,200 cfs (PPL BI, 2012). PPL BI's concern is that, during low-flow conditions when flows fall to or below 1,200 cfs, large areas of exposed rock can cause debris to affect water flow patterns in the natural channel upstream of, and in the vicinity of, the Brunner Island Station water intake.

In the final license application, York Haven Power stated that it did not anticipate changing its flow releases, and that it would consult with PPL BI if that changed. York Haven Power also stated in exhibit B of the license application that it voluntarily releases 1,000 cfs on the west side of the river for the benefit of the Brunner Island cooling water intake. Although the Settlement Agreement would change where flows are released from

York Haven dam and generally reduces the magnitude of the releases at those locations, the minimum flows at the project would remain as a continuous minimum flow of 1,000 cfs and a 2,500 cfs average daily minimum flow (or inflow, if less) downstream of the project as currently licensed. Inflow is based on river flows as recorded at the USGS gaging station at Harrisburg, Pennsylvania.

On February 19, 2014, PPL BI filed a Protest and Comments on the Settlement Agreement (PPL BI, 2014). PPL BI stated that York Haven Power had not consulted with it during the settlement process and reiterated its concerns that the proposed minimum flow releases would result in periods of time when river flows downstream of the York Haven Project in the vicinity of the Brunner Island Station water intake would fall below 1,200 cfs, requiring PPL BI to reduce output at Brunner Island Station accordingly. PPL BI also stated that this has happened in the past, resulting in a station shutdown, further resulting in fish kills due to thermal changes in the Brunner Island Station discharge channel. PPL BI requested that a new license for the project include a requirement to release a continuous minimum flow of 1,500 cfs to ensure that Brunner Island Station operation is not affected.

On March 4, 2014, York Haven Power filed additional information with the Commission to support its proposal and contend that PPL BI's concerns about the proposed operation of the York Haven Project are unfounded. It provided the additional information to demonstrate that York Haven Power is not responsible for any detrimental effects on Brunner Island Station due to instream flows (York Haven Power, 2014b).

York Haven cited historical flow data provided in the license application that show extreme low flows in the range of 2,000 cfs.[59] York Haven Power notes that sections 3.2.1(cc) and 3.2.2 of the Offer of Settlement state that, when inflows are less than 3,000 cfs, the project (York Haven) would be operated on a run-of-river basis, adding or suspending operations at turbines to reflect, to the extent practicable, inflow from upstream and without adding or suspending turbine operations to deliberately draw down or store water for purposes of generating electricity during particular time periods. As such, York Haven Power would have no ability to provide additional flows to ensure that Brunner Island had sufficient flows to operate at full capacity.

York Haven Power suggests that PPL BI did not understand York Haven Power's proposed minimum flow releases related to the proposed nature-like fishway and the reduced flows for the east channel fishway. A flow of 200 cfs would be diverted from the east channel fishway and passed through the nature-like fishway. Because the nature-like fishway is farther downstream of the east channel on the west shore of the bypassed reach, the flows passing downstream of the project would be distributed in a similar pattern to existing releases. York Haven Power expects that the result would be at least

[59] The actual minimum value from the record was 2,066 cfs.

as favorable, if not more favorable flow conditions for operation of the Brunner Island station, than what is currently occurring.

In response to PPL BI's concern that the distribution of flows in the vicinity of the Brunner Island cooling water intake may affect its ability to receive adequate flows at Brunner Island, York Haven Power notes that once the flows pass downstream of the York Haven Project, the project has no control over the distribution of flows in the natural channel.

With regard to debris in the channel that could hinder flows reaching the Brunner Island intake, York Haven Power points to its debris management program, which entails the passing of natural debris that accumulates in the forebay following notification to PPL BI that debris would be released. Any other debris passes over the east channel and main dams without being handled by York Haven Power. York Haven Power states that it has no control over the debris or where it may accumulate downstream of the project.

In a filing dated October 15, 2014, PPL BI withdrew its Protest and Comment on the Settlement Agreement, citing subsequent conversations with York Haven Power that have resulted in an improved understanding of the Settlement Agreement's implications for downstream flows, and an agreement with York Haven Power regarding notification of potential flow disruptions that could adversely affect the operation at Brunner Island.

Our Analysis

Under the terms of the Settlement Agreement, the York Haven Project would operate under run-of-river operation during extreme low-flow periods, and would therefore have no ability or responsibility to provide supplemental flows to enable the Brunner Island station to operate at full capacity under such flow conditions. The Settlement Agreement would change where flows are released from York Haven dam and generally reduces the magnitude of the releases at those locations, but the minimum flows at the project would remain as a continuous minimum flow of 1,000 cfs and a 2,500 cfs average daily minimum flow (or inflow, if less) downstream of the project as currently licensed. Thus, these changes would not be noticed at Brunner Island. Further, York Haven Power would provide PPL BI with advanced notice when debris is going to be manually passed downstream, and York Haven Power has no control over the debris once it passes downstream.

Competing Water Withdrawals within Conowingo Pond

There are several entities that draw water from the Conowingo Pond as discussed in section 3.3.2.1, *Water Resources, Affected Environment*, some of which are consumptive uses; others return water to Conowingo Pond. Although the current license allows Exelon to operate Conowingo Pond between elevation 101.2 feet and 110.2 feet, the pond is typically not drawn below elevation 105.2 feet to ensure adequate volume to meet the water withdrawals from Muddy Run and PBAPS. The other water withdrawals are very small in comparison to the withdrawals from Muddy Run and PBAPS. The pond is typically maintained at about elevation 109.2 feet. Exelon proposes to continue the current water level management in Conowingo Pond.

Although competing water withdrawals was included as a scoping issue, no specific stakeholder concerns were raised in regard to competing withdrawals in response to the license application for the Conowingo Project and the proposed project operation.

Our Analysis

The current water level management has provided adequate water supply for the existing water withdrawals, and the proposed continuation of this management should continue to be adequate to support future water withdrawals, such as the proposed Wildcat Point Project.

Downstream Flooding at the Conowingo Project

Flooding downstream of Conowingo dam in the town of Port Deposit, Maryland, was raised as an issue during scoping by the mayor of the town. The mayor indicated that flooding occurs frequently and that it should be adequately evaluated during scoping studies. The mayor also indicated that the relationship between dam releases, coordination of those releases with the upriver dams, and flooding should be examined and the full range of solutions explored. The mayor also suggested that solutions could include better flow anticipation, management, and coordination of releases and physical/structural actions to prevent flooding (i.e., flood control doors on the underpasses in town and storm drain check valves devices).

Exelon does not propose any project operational changes in regard to downstream flooding, and none of the stakeholders recommended changes in the agency terms and conditions or public comments filed with the Commission following the filing of the final license application.

Our Analysis

Exelon conducted a study in 2011 (Gomez and Sullivan, 2012a) using a HEC-RAS model to evaluate the Conowingo Project's actual and potential influence on downstream flooding at Port Deposit during several flood events (10-, 50-, 100-, and 500-year floods). Three alternative operating scenarios were investigated for their potential to reduce downstream flooding. The first alternative simulated drawing down Conowingo Pond prior to arrival of high-flow events. The second alternative simulated the effect of targeting lower pond levels during the storm. The third alternative simulated using the reservoir storage during the storm peak to reduce downstream flows. Additionally, a no-dam scenario was included, which simulated Port Deposit stage time series to estimate what conditions would be like if Conowingo dam did not exist.

The study results indicated that none of the alternative operating scenarios evaluated would substantially reduce downstream flooding. The first alternative was found to have no effect on downstream flooding magnitude and only a slight reduction in flooding duration. The second alternative had no considerable effect on flooding magnitude or duration (less than 15 minutes). The third alternative negligibly reduced flooding magnitudes (less than 0.02 foot) and duration (less than 15 minutes). The no-dam scenario had slightly increased (0.00 to 0.08 foot) flooding magnitudes and slightly decreased flooding durations, relative to existing conditions.

Based on the study results, Conowingo Project operation has little effect on downstream flooding. The three alternatives investigated that were considered to be the best possible mitigation alternatives showed negligible or no improvement over existing conditions. The storage available in Conowingo Pond is not enough to mitigate even relatively small events such as the 10-year flood. The no-dam scenario showed the current flooding durations would only be slightly different than if the dam did not exist. The study concluded that substantially higher storage capacity would be required in Conowingo Pond in order for the project to be a viable flood control mechanism. There do not appear to be any operational changes that could be made that would reduce Port Deposit flooding for the 10-, 50-, 100-, or 500-year storm events.

Water Quality Effects

York Haven Project

As described in section 3.3.2.1, *Water Resources, Affected Environment*, water quality in the York Haven Project area generally meets state water quality standards, and there have been no specific recommendations made by commenting entities regarding measures required to protect or enhance water quality. The Settlement Agreement also did not include any specific measures to address water quality.

Our Analysis

Water temperatures exceeded the maximum state standard of 87°F (temperatures as high as 93°F were recorded) up to about 19 percent of the time in sampling locations at the head of the project impoundment and at the upstream tip of Shelley Island. This indicates that inflows to the project reservoir already exceeded state standards due to normal summer warming. Water temperatures recorded in the project tailrace exceeded the state standard only about 12 percent of the time. While small localized deviations from water quality standards (water temperature and DO) have been reported in parts of the reservoir, those deviations are not a result of project operation. The operation of the Three Mile Island nuclear station does not appear to have any effect on water temperatures or thermal stratification at the project. The station has a closed-loop cooling system and does not discharge heated waters to the project reservoir.

DO levels were below state standards for 4 percent and about 1 percent of the sampling observations at only two of the sampling sites--the shoreline of Hill Island and a location in the east channel upstream of the dam--respectively. Diurnal fluctuations in DO were also observed in the reservoir as a result of the natural photosynthesis/respiration cycle, particularly in areas with substantial SAV beds. Fluctuations in pH levels in the reservoir also appeared to reflect natural variations.

Muddy Run Project

As described in section 3.3.2.1, *Water Resources, Affected Environment*, waters discharged from the project generally meet state standards, although DO levels occasionally drop below state standards during the warmer summer months. The Muddy Run reservoir does not thermally stratify, but does exhibit DO stratification in the main reservoir in some locations, with DO levels as low as 2.4 mg/L at depth. Substantial mixing occurs in the reservoir near the head of the intake canal during project operation, particularly during pumping operation when Susquehanna River (Conowingo Pond) waters are entering the reservoir. In 2011, monitoring at times showed a weak inverse DO stratification (higher DO in deeper water and lower DO in surface water) as Susquehanna River waters entered the reservoir at depth, under the Muddy Run reservoir surface waters that were lower in DO. All other measured parameters met state standards.

Exelon proposes to implement the conditions in the draft certification, which states that it must maintain state water standards at the project, and requires that it submit a DO monitoring plan to Pennsylvania DEP no earlier than November 1, 2027; implement the plan; and if violations in state standards occur (fail to meet criteria less than 99 percent of the time), submit a plan to Pennsylvania DEP to resolve any DO violations. Pennsylvania DEP issued a final certification on June 3, 2014, and filed a clarified certification on December 10, 2014. By letter filed January 21, 2015, Exelon confirmed that the clarified water quality certification continues to represent Exelon's licensing proposal for the Muddy Run Project. Therefore, Exelon’s proposal has not changed.

There were no other specific recommendations from stakeholders or agencies regarding water quality measures in response to the final license application. However, during scoping, questions were raised by FWS about the potential effects of flow reversals[60] in Conowingo Pond associated with Muddy Run pumping operation during low-flow conditions, and the possible re-distribution of heated discharges from PBAPS.

Our Analysis

Exelon recorded some instances when DO levels within the Muddy Run reservoir and in discharges from the project did not meet state standards (see tables 3-10 and 3-11). In general, project releases had fewer instances where DO did not meet the state standard than did the reservoir. The Muddy Run Project discharges into the upper, more riverine reach of Conowingo Pond where river velocities are typically strong as a result of discharges from the upstream Holtwood Project. This results in immediate mixing of

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[60] Flow reversals mean that flow patterns in Conowingo Pond may be affected by Muddy Run Project pumping such that currents would move upstream toward the project, potentially pulling the heated PBAPS discharge upstream or causing a wider distribution of heated waters in the pond.

Muddy Run discharges with the Susquehanna River flow and would act to quickly raise DO levels to above state standards. Based on Exelon's monitoring studies, and the location of the project at the upstream reach of Conowingo Pond, there appears to be no need to require measures to further protect or enhance water quality. Nevertheless, the certification conditions when implemented would ensure that state DO standards are maintained.

Regarding the potential for Muddy Run pumping operation to result in flow reversals that would draw heated water from the downstream PBAPS in an upstream direction toward the Muddy Run Project, Exelon's studies did not find any instances of the PBAPS' heated discharge reaching as far upstream as the Muddy Run tailrace.

Conowingo Project

In section 3.3.2.1, *Water Resources, Affected Environment*, we describe existing water quality conditions in both Conowingo Pond and in the river downstream of Conowingo dam. Based on many years of monitoring in Conowingo Pond, the pond exhibits DO stratification (higher DO levels in near-surface waters and low DO levels at depth) resulting in the potential for entrainment of lower DO waters through the low-level intakes. This occurred over a period of years until Exelon installed turbine venting in Units 1 through 7 between 1989 and 1991, and aerating turbine runners in two of the seven Francis units (Units 2 and 5) in 2005 and 2008. As a result of these modifications, releases from Conowingo dam now meet state standards nearly 100 percent of the time. Water temperature has not been an issue at Conowingo, and normally meets state standards, even with the presence of the heated discharge from PBAPS into Conowingo Pond.

Commenting entities did not recommend additional water quality enhancement measures at Conowingo, although The Nature Conservancy recommends that project operation not result in violation of water quality standards or non-attainment of water quality criteria established for the river and the Chesapeake Bay, including the Chesapeake Bay TMDL. Maryland DOE, in its comments in response to the REA notice, states that it is premature to make conclusions as to the effect of the project on water quality, because it would fully assess project effects during its review of the certification application.

Our Analysis

For the two water quality parameters that may be typically affected by hydroelectric project operation, water temperature and DO, existing project operation generally does not exceed state standards. Past violations of state DO standards have been eliminated by the addition of turbine venting to seven Francis units and aeration to two of the seven Francis units. While comments were filed regarding the effects of the project on nutrients and sediment loading (discussed in the following section), there appears to be no need for further measures to protect or enhance water temperature and DO at the project.

Sediment and Nutrient Loading

Sediment transport in the Susquehanna River and the effects of the presence of the lower river hydropower reservoirs on that transport are of concern to many stakeholders. This is primarily an issue for the Conowingo Project, because it has the largest and deepest reservoir on the lower river, and the greatest capacity for sediment storage. The York Haven Project reservoir has minimal storage capacity, because of its small size and shallow depth. The Muddy Run Project, because it is an off-stream pumped storage reservoir, also has minimal effect on sediment transport or storage in the river. Sediment transport is discussed in detail in section 3.3.1, *Geology and Soils*.

Sediment transported by the river is also rich in nutrients (nitrogen and phosphorus). With the Susquehanna River being the largest source of freshwater to the Chesapeake Bay, it is also the largest source of nutrients, contributing about 70 percent of the total nitrogen and 55 percent of the total phosphorus (Smullen et al., 1982, as cited by Cheng et al., 2013). These nutrients and organic matter in the sediment support the growth of phytoplankton, algae, and aquatic plants, but if high nutrient loading occurs, this may enhance eutrophication and result in hypoxia (the depletion of DO in the water column). High turbidity levels associated with high sediment loads may also block sunlight in the water column, adversely affecting plant photosynthesis and the production of DO. As we previously described, EPA has set a TMDL for the Chesapeake Bay with total watershed limits on the contribution of nitrogen, phosphorus, and sediment to the Bay. The TMDL calls for a reduction in that loading from current levels.

Exelon proposes a Sediment Management Plan to control sediment from project lands, to identify benchmarks for actions needed to address sediment issues that would affect project operation, and it would conduct a bathymetric survey every 5 years to track depositional patterns in the pond. EPA, Maryland DNR, SRBC, NMFS, Chesapeake Bay Foundation, Stewards of the Lower Susquehanna, Inc., Midshore Riverkeeper Conservancy, Inc., and Clean Chesapeake Coalition state that Exelon's proposed management plans are not ready for analysis without an understanding of the sediment-related effects of scour in Conowingo Pond during peak flow events on the water quality and living resources in the Chesapeake Bay. The Stewards of the Lower Susquehanna, Inc., also recommend that Exelon remove at least 4 million tons of sediment annually from the reservoir to eventually remove all sediment subject to scouring. The Clean Chesapeake Coalition requests that Exelon be required to dredge Conowingo Pond and restore oyster beds north of the Bay Bridge and SAV in the upper Bay and its tributaries that were buried by sediment scoured from Conowingo Pond. The Town of Port Deposit, American Rivers, and Henry Immanuel also recommend that Exelon prevent and mitigate for the downstream effects of scoured sediments. Maryland DNR notes, however, that it is premature to conclude that the draft LSRWA study report (Corps and MDE, 2014; described above in *Geology and Soils*) will be adequate to appropriately identify and evaluate sediment and nutrient effects on the Bay's resources related to the Conowingo Project.

Our Analysis

As we describe in *Geology and Soils*, sediment and nutrient loading from the Susquehanna River Basin is a long-term natural process that has been interrupted by the construction of the lower river hydropower reservoirs. Beginning in 1910, with the construction of Holtwood dam, followed by the construction of Conowingo and Safe Harbor dams in 1928 and 1930, a portion of the Susquehanna River sediment and nutrient load has been stored in these reservoirs, and has not reached the Chesapeake Bay. So, during parts of the past 100 or so years, nutrient loading in the Bay has been lower than it would have been without the lower river reservoirs. Some of this sediment and nutrient load, however, has been and continues to be re-suspended and scoured from the reservoirs during flood events, and deposited in the Bay. The Bay TMDL does recognize that this is a watershed-wide issue.

Some commenters have suggested dredging Conowingo Pond, to allow for continued storage of sediment and nutrients, and to avoid the large spikes in loading that may occur during scouring flood events. The TMDL recognizes the existing storage capacity of the three lower river reservoirs, and that storage capacity may be reduced over time as the reservoirs fill in. If that occurs, the TMDL requires that governmental jurisdictions in the watershed might need to increase their sediment and nutrient-reduction efforts to meet the allocations they have been assigned in the Bay TMDL. A primary focus of the TMDL is the preparation of watershed implementation plans that detail how and when the six Chesapeake Bay states and the District of Columbia will meet their pollution allocations in the TMDL. It is reasonable that Exelon and the other project owners on the lower river are not considered the primary source of sediment and nutrient loading to the Bay, and that the TMDL recognizes that it is a watershed issue.

The recent LSRWA study (Corps and MDE, 2014) finds that nutrients associated with scoured sediment are more harmful to the Bay's aquatic life than the sediment itself. The LSRWA study evaluated potential water quality effects on the upper Chesapeake Bay of a scouring event in January 1996 (river flow reached a daily high flow of 622,000 cfs at the Conowingo USGS gage, and remained above 400,000 cfs for 3 days), by modeling the effects of nutrient scour from Conowingo Pond on light attenuation in the water column, chlorophyll increases, and bottom DO under the TMDL condition. This modeling found that the effects on these water quality parameters would be small: an increase in light attenuation of 0.01/m[61]; chlorophyll increase of from 0.1 to 0.3 mg/m^3; and a decrease in bottom DO of 0.1 to 0.2 mg/l. The LSRWA study found, however, that these effects were evident in the Chesapeake Bay as far south as the Potomac River, and that effects vary seasonally, with a late-spring storm having a greater effect than a fall storm. The LSRWA study also modeled the effect of dredging 3 million to 28 million

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[61] Light attenuation is reported as the coefficient of diffuse light attenuation and has units of inverse depth (value per meter – 0.01/m).

cubic yards of sediment from Conowingo Pond. Results indicate minor improvements in these water quality parameters with dredging, although the highest dredging amount had slightly better improvements.

The LSRWA study (Corps and MDE, 2014) indicates that operational changes at Conowingo would not address the sediment transport issue, and that dredging of Conowingo Pond would be cost prohibitive and ineffective. The study concludes that management opportunities in the Chesapeake Bay watershed to reduce nutrient delivery are likely to be more effective than sediment load removal methods. Because it is a watershed-wide issue, 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.

Reservoir Fluctuations

York Haven Project

Reservoir fluctuations have the potential to dewater shoreline habitat, which could strand nearshore biota such as young fish, especially if drawdowns occur during the spawning and rearing season for shoreline spawning nestbuilders such as smallmouth bass, largemouth bass, and sunfish. Fluctuations can also limit the development of SAV and emergent vegetation. Nearshore aquatic vegetation is often an important habitat element for benthic macroinvertebrates and fish.

York Haven Power proposes to continue to operate the York Haven Project as it has in the past, in a run-of-river mode with a maximum drawdown of 1.1 feet for purposes of dam maintenance. No specific recommendations pertaining to reservoir fluctuations have been made by any commenting entities, and the Settlement Agreement does not include any measures that pertain to reservoir fluctuations.

Our Analysis

Proposed continued operation of the project in a run-of-river mode would result in nearly constant reservoir water surface elevations, when the project has sufficient control over river flows. Flow and reservoir level fluctuations would continue to occur during high flows, or changing natural inflows, but this would be beyond the control of the project. Drawdowns of up to 1.1 feet are reserved for specific project maintenance activities and generally scheduled for late summer through fall. This timing avoids the spring to mid-summer spawning period of nearly all resident fish, and the young of shoreline nest building species would have reached the juvenile life stage and be mobile enough to leave shallow shoreline habitat prior to any maintenance drawdown. There has been no evidence of fish stranding or any negative effect on nearshore spawning habitat attributed to the current drawdown regime.

Muddy Run Project

Muddy Run reservoir can have water surface elevation changes of up to 50 feet on a weekly basis during typical operation. Although such fluctuations create poor nearshore habitat for aquatic biota, creel surveys in 1972 and 1987 (when the public was allowed to fish the reservoir) identified gamefish populations in Muddy Run reservoir; large white crappie dominated the catch. This suggests that the forage base in the reservoir is adequate. The likely source of both forage and game fish is pumping operation from Conowingo Pond. However, Muddy Run reservoir is currently off-limits to public recreation and is surrounded by fencing that precludes public access. The Muddy Run Recreation Lake, which abuts Muddy Run reservoir, is a 100-acre lake that provides a stable water level habitat that supports an important recreational fishery from the entire shoreline and small boats.

Exelon is not proposing any changes in its Muddy Run Project operation, and no specific recommendations pertaining to reservoir fluctuations have been made by any commenting entities.

Our Analysis

Sufficient angling opportunities exist at this project at the Recreation Lake under current conditions, and they would continue during the term of a new license. Significant fluctuations in the Muddy Run reservoir would continue to affect fish populations, but given that the reservoir would remain off-limits to the public, there would be little benefit to restricting current fluctuations. We discuss reservoir fluctuations at Conowingo Pond, the lower reservoir of the Muddy Run Project, in the following section.

<u>Conowingo Project</u>

Exelon proposes to continue to operate the Conowingo Project as it has in the past, including maximum reservoir fluctuations between elevations 101.2 and 110.2 feet. On weekends between Memorial Day and Labor Day, however, the water level would be maintained at or above elevation 107.2 feet to accommodate recreational boating and associated activities. No entity has recommended an alternative reservoir fluctuation regime. However, The Nature Conservancy and American Rivers suggest run-of-river operation of the Conowingo Project. Such operation would result in a relatively constant water surface elevation except when inflow to the project exceeds the hydraulic capacity of the turbines.

Our Analysis

Conowingo Pond fluctuations primarily influence aquatic habitat in the lower 11 miles of the reservoir (from Hennery Island to Conowingo dam, referred to as the lower pond). Upstream of Hennery Island, flow releases from the Holtwood Project have a greater influence on water surface elevations than operation of the Conowingo Project. Although the current license for the Conowingo Project allows the reservoir to fluctuate between elevations 101.2 and 110.2 feet, typical operation results in reservoir fluctuations between elevations 105.2 and 109.2 feet. As shown in figure 3-3, the minimum average monthly reservoir elevation from January 2004 through September 2010 was at or above elevation 104.7 feet for nearly the entire 6+ year period. This is most likely because the Muddy Run Project experiences pumping cavitation when Conowingo Pond is below this elevation. Exelon estimates that there are a total of 453 acres of habitat within the 9-foot permitted reservoir fluctuation zone based on an analysis of bathymetry and reservoir fluctuations in the lower pond. Of this total, 380 acres (84 percent) are between elevations 101.2 and 106.0 feet. The greatest amount of habitat in any 1-foot increment in the maximum drawdown zone (98 acres) is between elevations 104 and 105 feet. Consequently, under current and proposed future operation, most of the aquatic habitat in the drawdown zone would remain submerged.

A key element of nearshore habitat for aquatic biota in lakes and reservoirs is cover, where benthic macroinvertebrates and young fish can forage and hide from larger predators. In Conowingo Pond, a substantial amount of cover is provided by SAV. Exelon estimates that 320.8 acres of SAV occupy the drawdown zone, which is 71 percent of the total aquatic drawdown zone habitat of the lower pond. Most of the SAV was found between elevations 104 and 107 feet. The primary growing season for SAV is during the warm summer months (June, July, and August). This also is the primary spawning and nursery period for important nearshore spawning fish such as black bass and sunfish. This corresponds with the period when Exelon is required to maintain the water level of Conowingo Pond at or above elevation 107.2 feet on weekends for recreational purposes. The net result of this requirement is evident in figure 3-3, where the minimum monthly elevation during June, July, and August is above elevation 105.5 feet and the average monthly elevation is above elevation 108.0 feet. During this period, weekly average water surface fluctuations range between elevation 107.5 and 108.8 feet. This likely explains why most but not all of the SAV occurs below elevation 107 feet under current conditions.

Consequently, continuing to maintain the existing reservoir fluctuation regime within an overall range between elevations 101.2 and 110.2 feet and a summer weekend minimum elevation of 107.2 feet would be protective of nearshore aquatic habitat and associated biota. We note that when inflow to Conowingo Pond exceeds the hydraulic capacity of the turbines, Exelon would operate the spill gates to maintain reservoir level control, but under spillage conditions the maximum water level in the pond may exceed the elevation 110.2-foot high end of the permissible range. We acknowledge that if the Conowingo Project would be operated in a run-of-river mode, as The Nature Conservancy and American Rivers suggest, the reservoir level would be essentially constant at elevation 110.2 feet, which would represent a slight enhancement to nearshore habitat compared to existing conditions. An elevation of 110.2 feet would provide an additional 55 acres of aquatic habitat, compared to the current normal maximum elevation of 109.2 feet. We expect the incremental benefits of run-of-river operation over existing conditions to be minimal.

While a constant reservoir elevation of 110.2 feet would result in a slight enhancement to nearshore habitat, it would also allow nuisance invasive plant species such as hydrilla to infest areas between the 107-foot contour and the full pond elevation of 110.2 feet. This would likely negatively affect shoreline fishing and boating. In addition, as discussed in section 3.3.5.2, *Recreation and Land Use Resources,* *Environmental Effects*, it would also negatively affect the ability of larger boats to access the reservoir from the tributary boat ramps because at full pond they are not able to pass under the railroad bridges at Peters and Conowingo Creeks.

Downstream Flow Releases

York Haven Project

In the Settlement Agreement, York Haven Power proposes a continuous minimum flow release of 1,000 cfs and an average daily minimum flow release of 2,500 cfs, or inflow if less, as measured at the Harrisburg, Pennsylvania, USGS gaging station (York Haven Power, 2014a). However, York Haven Power also proposes to install a new nature-like fishway at the north end of the main dam, which would serve as the primary fish passage facility. The east channel fishway would continue to operate as a secondary passage facility. York Haven Power proposes to continue the existing flow releases at the east channel dam until the nature-like fishway is operational, and then attraction flows would be reallocated. Table 3-18 presents a summary of the flow management distribution at the project before and after the proposed nature-like fishway construction.

The proposed flow distribution once the nature-like fishway is operational would result in a lower minimum flow in the east channel during the upstream passage seasons for American shad and resident species, and more flow at the apex of the main dam, to enhance passage through the nature-like fishway.

The only comment received by the Commission in opposition to the settlement agreement proposed flow releases was from PPL BI in regard to adequate flows for its cooling water purposes, as discussed above.

Our Analysis

York Haven Power's flow proposal is similar to its currently licensed flow regime that it has provided for more than 30 years. The primary difference would be less flow in the east channel, which has had additional flow releases since the east channel fishway began operating in 2000 to attract fish to that facility. The current proposal would shift primary upstream fish passage route to the nature-like fishway, less flow would be provided to the east channel, and more flow would shift to the nature-like fishway and main dam most of the year. The current 4,000-cfs flow along the main dam during the shad migration season (2 months) would no longer be provided, but a 1,000-cfs flow would be provided at the apex of the main dam with Three Mile Island. Changes would likely have minimal effects on downstream aquatic habitat, although some previously wetted areas would receive less, and other areas would receive more, flow. No stakeholders expressed concerns about the environmental effects of these flow distribution changes, which overall should improve upstream fish passage once the nature-like fishway is operating. Because the project has a low hydraulic capacity and minimal control over flows, with spillage occurring on average about 60 percent of the time, flow distribution changes would only be evident at extremely low river flow levels.

Table 3-18. Proposed minimum flow schedule for York Haven Project (Source: York Haven Power, 2014a).

Location and Season	Before Nature-like Fishway Construction (existing conditions)	After Nature-like Fishway Construction	Reason for Change (from existing conditions to after fishway construction)
<u>Minimum flow below project</u> (powerhouse + main dam + east channel) (all year)	Continuous: 1,000 cfs or inflow, whichever is less Average daily: 2,500 cfs or inflow, whichever is less	Continuous: 1,000 cfs or inflow, whichever is less Average daily: 2,500 cfs or inflow, whichever is less	No change. These flows may be delivered via any combination of turbines, spill at the main dam, and gate releases.
<u>East channel dam</u>			
(1) Resident upstream fish passage (April 1 through beginning of American shad passage season (about mid-April)	400 cfs	267 cfs	Flow shift to nature-like fishway as primary resident fish passage route; discourage migration into east channel
(2) American shad upstream passage (about mid-April through mid-June)	2,000 cfs	267 cfs	Flow shift to maximize attraction flow to nature-like fishway; discourage migration into east channel
(3) Resident fish passage (mid-June to end of upstream passage season – December 15)	400 cfs	267 cfs	Flow shift to the nature-like fishway as primary resident fish passage route; discourage migration into east channel
(4) Winter (December 15 through April 1)	0	267 cfs	Enhance east channel winter habitat conditions; east channel fishway to be left open during winter

Location and Season	Before Nature-like Fishway Construction (existing conditions)	After Nature-like Fishway Construction	Reason for Change (from existing conditions to after fishway construction)
Main channel dam/ nature-like fishway			
(1) American shad upstream passage season (about mid-April through mid-June)	4,000 cfs	1,000 cfs (total) through nature-like fishway channel and nature-like fishway supplemental attraction flow channel Design to provide total attraction flow ≥ 5 percent of river flow from 5,000 to 150,000 cfs.	Provide attraction flow to nature-like fishway at main dam apex; maintain habitat and adequate migration flow below main dam
(2) Resident fish passage (mid-June through mid-April)	0	200 cfs minimum flow through nature-like fishway channel[a]	Provide attraction flow to nature-like fishway at main dam apex for resident fish; enhance main channel habitat conditions; maintain nature-like fishway as resident fish passage route year round

[a] When river flows are greater than the hydraulic capacity of the generating units plus the required flows in the east channel, and at the main dam/ nature-like fishway, flows would be managed to maintain an east channel flow of 267 cfs, and maximize the remainder of flows over the main dam and through the nature-like fishway, with the supplemental attraction flow channel to be operated with the objective of maintaining a higher attraction flow through the nature-like fishway (except during the winter period of December 15 to the earlier of April 1 or the start of the American shad upstream passage season, when total nature-like fishway flow would be 200 cfs).

Conowingo Project

Exelon proposes to continue to provide the minimum flow releases required under the current license, as follows:

- March 1 – March 31: 3,500 cfs or natural river flow (as measured at the upstream USGS Marietta gage No. 0157600), whichever is less;
- April 1 – April 30: 10,000 cfs or natural river flow, whichever is less;
- May 1 – May 31: 7,500 cfs or natural river flow, whichever is less;
- June 1 – September 14: 5,000 cfs or natural river flow, whichever is less;
- September 15 – November 30: 3,500 cfs or natural river flow, whichever is less; and
- December 1 – February 28: 3,500 cfs intermittent release (maximum 6 hours off followed by equal amount on).

Several commenters made statements regarding the adverse effects of flow releases from the project. Interior, in its section 10(j) recommendation, states that Exelon should finalize and implement a flow management plan and implement the flow recommendations of The Nature Conservancy or any more restrictive flows required by the Maryland certification (when that is issued), returning the river downstream of Conowingo to more natural conditions. The Nature Conservancy, in its comments filed January 31, 2014, recommended flows be released downstream of Conowingo dam sufficient to achieve the following objectives:

(1) restore persistent habitat and maximum weighted usable area (MWUA)[62] for the spawning, migration, and egg and larval development of diadromous and resident fish and for macroinvertebrates by providing at least 50 percent of historic maximum persistent habitat, minimize the amount of time that less than 25 percent of historic maximum persistent habitat is available, and target 70 percent of MWUA across species and life stages;

(2) increase the probability of lift entry for American shad, river herring, and American eel;

(3) eliminate stranding-related mortality of adult and juvenile fish;

(4) provide at least 50 percent of available mussel habitat with suitable shear stress;

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[62] Weighted usable area is an index of aquatic habitat that is calculated using the Instream Flow Incremental Methodology. It is meant to be used as a comparative statistic (for comparing alternative flow levels) and is not an absolute measure of habitat.

(5) increase the stability and suitability of basking and hibernation habitats for map turtles; and

(6) increase the suitability for SAV and emergent vegetation establishment.

The Nature Conservancy also recommends that the EIS evaluate two operational alternatives: (1) run-of-river operation (passage of the daily average flow measured at the USGS Marietta, Pennsylvania, gage plus any intervening flows that enter the river between the Marietta gage and Conowingo dam); and (2) the set of operational constraints that The Nature Conservancy identified as a potential approach for meeting its performance goals, listed above. We refer to this second alternative as the TNC Flow Regime. Table 3-19 summarizes the components of the TNC Flow Regime, and includes Exelon's proposed flow regime. The TNC Flow Regime includes restrictions on upramping and downramping. In addition, Pennsylvania FBC recommends that Exelon should reduce ramping-related 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 fishes.

Table 3-19. Summary of Exelon and TNC flow recommendations (Source: staff).

	Minimum flow (cfs)					
	Exelon	TNC				
Month	Minimum	Minimum Q>50[b]	Minimum Q<50	TNC Maximum flow (cfs)	TNC Maximum Downramping (cfs/hr)	TNC Maximum Upramping (cfs/hr)
January	0/3,500[a]	11,000		86,000 (January and February)	20,000 (January through June)	40,000 (year-round)
February	0/3,500	12,500				
March	3,500	30,000	24,000			
April	10,000	35,000	29,000			
May	7,500	25,500	17,500			
June	5,000	14,000	10,000			
July	5,000	8,500	5,500	65,000 (March through September)	10,000 if Q<30,000	
August	5,000	6,000	4,500		20,000 if Q<86,000 (July through September)	
September 1-14	5,000	5,500	3,500			

Month	Minimum flow (cfs) Exelon Minimum	TNC Minimum Q>50[b]	TNC Minimum Q<50	TNC Maximum flow (cfs)	TNC Maximum Downramping (cfs/hr)	TNC Maximum Upramping (cfs/hr)
September 15-30	3,500	5,500	3,500			
October	3,500	6,000		86,000 (October through December)	20,000 (October through December)	
November	3,500	11,000				
December	0/3,500	11,000				

[a] From December 1 through February 28, Exelon proposes an intermittent flow regime, with 6 hours of 3,500 cfs followed by 6 hours with no minimum flow.

[b] If natural inflow is greater than the median flow.

Under Exelon's proposed flows, minimum flow releases would range from as low as 0 cfs for up to 6 hours at a time from December through February, up to 10,000 cfs in April. Minimum flows under the TNC Flow Regime would vary monthly between 3,500 and 35,000 cfs, also depending on whether natural flows at the Marietta gage are greater than or less than the median flow (for the months of March through September). Under the TNC Flow Regime, the maximum generating flow would also be limited to 65,000 cfs from March through September,[63] upramping rates would be limited to 40,000 cfs per hour year-round, and downramping rates would be limited to 20,000 cfs per hour overall and 10,000 cfs from July through September if flows are less than 30,000 cfs.

Exelon, in its reply comments filed on March 18, 2014, states that (1) commenting entities have no basis for stating that the existing flow regime harms fish and wildlife, (2) stranding has not resulted in adverse effects on migratory and resident fishes, (3) a robust fishery occurs both upstream and downstream of the project, and (4) the recommended TNC Flow Regime would have a major adverse effect on project power production and economics.

[63] The Nature Conservancy recommendation does not specify what would occur if inflows to the Conowingo Project exceed 65,000 cfs, as often occurs during the spring months, but we assume that maximum generating flows could exceed 65,000 cfs so that flows in excess of 65,000 cfs are not spilled, up to the maximum generating capacity at Conowingo (86,000 cfs).

Our Analysis

The flow regime downstream of Conowingo dam has the potential to affect a wide range of resources, including SAV; the spawning, incubation, and rearing habitat for a variety of fish species; and habitat for freshwater mussels, other invertebrates, map turtles, and waterfowl nesting. Flow fluctuations associated with project operation also have the potential to cause fish mortality due to stranding and to affect upstream fish migration. We assess the effects of Exelon's proposed operation, alternative run-of-river operation, and the TNC Flow Regime on SAV, fish habitat, fish migration, fish stranding, freshwater mussels, and other aquatic invertebrates. Effects on map turtles and waterfowl nesting habitat are evaluated in section 3.3.3, *Terrestrial Resources*.

SAV. As we previously described, SAV downstream of Conowingo dam is limited to areas that have finer-grained substrate or are protected from high water velocities associated with high river flows. The highest concentrations of SAV are in the lower part of the river closer to the mouth of the river, where river levels are influenced by tidal flow from the Chesapeake Bay and velocities tend to be lower. Portions of the river closest to Conowingo dam have a steeper gradient, a substrate of primarily bedrock and boulder, and little SAV. SAV distribution downstream of the dam is more influenced by existing substrate conditions and natural high-flow events, which have the potential to scour and redistribute finer-grained substrate, than by normal day-to-day project operation. While normal peaking operations may result in discharges as high as 86,000 cfs (although USGS flow records indicate normal peaking operations seldom exceed a maximum discharge of 80,000 cfs and are often less than 70,000 cfs during the summer months), those typical peaking flows have less of an effect on scouring and substrate redistribution than typical annual high-flow events. For example, monthly 10-percent exceedance flows are greater than 80,000 cfs in 6 months of the year (December through May), while maximum recorded flows representing natural high-flow events exceed 200,000 cfs in all months of the year, reaching the range of 400,000 to 600,000 cfs in the spring months (table 3-6). These natural high-flow events that are several magnitudes greater than normal project discharges would logically have a greater effect on scour and substrate redistribution, and therefore affect the distribution of substrate suitable for SAV growth.

Fish Habitat. To assess the effects of proposed operation and alternative flow regimes on habitat for fish and invertebrates, Exelon conducted study 3.16, *Instream Flow Habitat below Conowingo Dam* (Gomez and Sullivan and Normandeau, 2012a). The study included evaluation of effects on different life stages of American shad, striped bass, shortnose sturgeon, smallmouth bass, several taxa of aquatic insects (mayflies, stoneflies, caddisflies), and freshwater mussels. The study used the River2D model to simulate hydraulic conditions in a study reach extending from Conowingo dam to the downstream end of Spencer Island (where tidal effects begin). The calibrated hydraulic model was used to simulate habitat conditions over a range of flows. In addition, the study included a habitat persistence analysis to assess the effects of peaking operation by determining the area of habitat that maintained a habitat rating of "good" (composite habitat suitability index of 0.5) or higher over the flow range that represents a given peaking cycle.[64] The Nature Conservancy used the results of this persistence analysis to develop the TNC Flow Regime.

Implementing run-of-river operation downstream of Conowingo dam would benefit motile life stages of fish (fry, juveniles and adults) by reducing the frequency and magnitude of flow changes compared to current and proposed operation, which would improve habitat stability. This would help fish to seek out and remain in areas with suitable depth, velocity, and substrate conditions, without incurring the energetic costs associated with shifting locations to seek favorable habitat when flow conditions change. Implementing the TNC Flow Regime flows would reduce the magnitude and rate of flow changes compared to existing and proposed operation, which would provide an intermediate level of reduction in energetic costs. Reducing the magnitude and extent of flow fluctuations would provide even greater benefits to non-motile life stages of fish (eggs) and less motile organisms including fish larvae and aquatic invertebrates. Any increase in the production of aquatic insects would increase the amount of forage available and the potential production of juvenile fish.

Assessing the extent of the benefit that would be provided to any individual life stage and species of fish or invertebrate from reducing the magnitude of flow fluctuations is a complex challenge. Evaluating the effects on any individual life stage requires substantial assumptions to be made regarding the effects of changes in amount, quality, and location of the available habitat for that life stage, as well as the influence of the rate at which those attributes change. Any benefits that may occur to a particular species and life stage from a specific flow level, however, may not necessarily transfer to another species and life stage. These uncertainties are magnified during the assessment of potential population effects for a species, which requires incorporating effects on each life stage.

Focusing the instream flow evaluation on the spring migration and spawning period for American shad, river herring, and hickory shad may have the most merit. Enhancing flows during the spring period has the potential to provide increases in the production of these anadromous species without unnecessarily constraining project operation in other seasons, including the summer and winter seasons when there are

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[64] The persistence analysis was not a field evaluation of habitat availability at different flows, but instead was a modeling exercise in which polygon areas of quality habitat for one flow for a particular species life stage were overlaid with the quality habitat polygon area for the same species for another flow. The persistent habitat was the area of overlap between the quality habitat polygons, with the assumption that this overlap area had quality habitat for both flows (typically a minimum flow and a higher generation flow). This analysis was most useful for assessing effects on non-motile life stages.

peaks in the demand for power for cooling and heating. Substantial use of the river downstream of Conowingo dam for spawning by each of these species has been documented (Normandeau and Gomez and Sullivan, 2012b), and juveniles of these species (as well as gizzard shad) likely provide a seasonal source of forage for migratory striped bass. We provide a further analysis of effects on anadromous and resident species below under "*Alternative Flow Regime*."

Fish Migration. Although Exelon's studies have found little evidence of a relationship between operational flow releases and the ability of upstream migrating fish to find and enter the east and west fish lifts, it is possible that reducing the frequency and magnitude of flow fluctuations could improve fish passage efficiency.[65] The results of radio telemetry studies conducted in 2010 and 2012 (Normandeau and Gomez and Sullivan, 2011; 2012c) indicate that many American shad that migrate upstream to the tailrace area subsequently returned downriver within a few hours or days. While this type of movement has been observed on other rivers unaffected by fluctuating flow releases from hydroelectric projects, if the magnitude of operational flow changes was reduced during the migration season, it is possible that some of these fish would remain in the tailrace area for a longer period of time and increase their success in finding and entering one of the fish lifts. Additional discussion of effects on fish migration is included below under our discussion of upstream fish passage.

Fish Stranding. Reducing the magnitude and frequency of flow fluctuations could benefit fisheries resources by reducing the number of fish that are injured or killed when they are stranded as flow and water levels downstream of Conowingo dam are reduced. However, stranding studies conducted by Exelon (Normandeau and Gomez and Sullivan, 2012d) indicated that few fish are killed by stranding under existing operation, and about 90 percent of those killed were gizzard shad, carp, and catfish species (table 3-20). Although implementing run-of-river or TNC Flow Regime flows could reduce this source of mortality, the results of Exelon's stranding surveys indicate that the magnitude of this benefit would be minor. There would also be minimal benefit in implementing the Pennsylvania FBC recommendation to extend the retaining wall at the east end of the east fish lift, add boulder fill in that area to prevent generation flow from flooding the spillway pool at high levels of generation, or dredge a channel(s) from the spillway pool area to downstream areas to provide egress for stranded fishes.

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[65] However, the fish lifts at Conowingo were designed so that the tailrace entrances are functional at the full range of normal operations at the project, from minimum to maximum generation flows and up to a specific level of spillage.

Table 3-20. Total number of dead fish and crabs observed during 12 stranding surveys (4 in each season) conducted within and just downstream of the spillway reach below Conowingo dam (Source: Normandeau and Gomez and Sullivan, 2012d).

	Spring	Summer	Fall	Total	%
American eel		1		1	0.1
River herring	1			1	0.1
American shad	46			46	4.4
Gizzard shad	675	40	41	756	72.5
Carp	80	4	3	87	8.3
Minnows			1	1	0.1
Quillback	2			2	0.2
Shorthead redhorse	1		1	2	0.2
Catfishes	75	7	12	94	9.0
White perch		1		1	0.1
Striped bass	1			1	0.1
Banded killifish			6	6	0.6
Smallmouth bass		2	1	3	0.3
Largemouth bass		9	1	10	1.0
Sunfish		4		4	0.4
Walleye		1	4	5	0.5
Darters		3		3	0.3
Unidentified	19			19	1.8
Blue crabs		1		1	0.1

Freshwater Mussels. As part of study 3.16, *Instream Flow Habitat Below Conowingo Dam* (Gomez and Sullivan and Normandeau, 2012a), Exelon examined the effects of operational flows on mussel habitat by calculating and mapping shear stress at the river bed in the study area over a range of flows. Study results indicated that stations with the highest CPUEs tended to have relatively low shear stresses. At river discharge values of 3,500 cfs and 5,000 cfs, the highest CPUEs were associated with shear stress less than 40 to 60 dynes per square centimeter. Results of Exelon's instream flow study, as well as observations by field biologists, indicated that distribution and abundance of mussels in the study reach were negatively affected by high shear stress brought about by high-flow events or peaking operations.

Currently, mussel distribution and abundance below Conowingo dam is limited by the shear stress that occurs during high-flow events. Areas that are sufficiently protected from high shear stress during these events would likely be sufficiently protected from shear stress during peaking operation. We conclude that reducing flow fluctuations by implementing run-of-river or the TNC Flow Regime operations would provide a limited benefit to mussels. Impacts on mussels due to high shear stress would still occur in the Susquehanna River during natural high-flow events.

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. Selection of an alternative flow regime would require balancing among the several target species and life stages (determine which life stage is most important for each time interval), as well as consideration of the effects of an alternative regime on project power production and economics. As we note above, Exelon's instream flow study included a habitat persistence analysis, and the report summarized that analysis by month, using only the species and life stage that may be present during that month and for which there is a relatively high amount of structural habitat available (relative to total wetted area).

Based on comments filed on the draft EIS that our representation of Exelon's habitat persistence analysis was incorrect, we provide further information and analysis of that habitat persistence analysis, which was a modeling exercise to attempt to illustrate the amount of potential quality habitat that would be available over the range of operating flows (from the minimum flow up to the maximum generation flow). While we agree that such an 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. Under typical peaking operations at Conowingo, flow releases from the dam may be at the licensed minimum flow for some hours per day, at a mid-range peaking flow for part of the day, and at a higher peaking flow (up to the maximum hydraulic capacity of the project, but not always[66]) for some hours per day. The amount of time that project

[66] For example, while the Conowingo Project may occasionally generate up to its maximum hydraulic capacity of 86,000 cfs, based on flow data from the Conowingo USGS gage no. 01578310, it more commonly generates up to a maximum of about 78,000 to 80,000 cfs, because that is the most efficient gate setting for full generation at the project. During the summer, low-flow months, discharges from the project seldom reach greater than 70,000 cfs during peaking operations.

releases are either at the minimum flow or at a higher generation flow varies on a daily, weekly, or seasonal basis depending on natural river flow, electrical demand, or other constraints on operation.

In comparing flow pairs for the habitat persistence analysis (such as a proposed minimum flow and a maximum generation flow), those flow pairs would not be constant throughout the entire period for a specific life stage (such as for shad spawning). Flow releases would be variable throughout a life stage period, for the reasons discussed above, especially a life stage that may have a duration of residence downstream of the project covering 2 to 3 months.[67] To better represent the actual flow ranges that now occur downstream of Conowingo dam on a monthly and seasonal basis, we examined the flow record from the Conowingo USGS gage no. 01578310 (table 3-6). The 90 percent exceedance flow (a flow that is exceeded 90 percent of the time, based on the flow record) would represent the lower end of the flow range that would typically occur under normal project operations. The 10 percent exceedance flow (the flow that is exceeded 10 percent of the time) would represent the higher end of the flow range that would normally occur. While these flow metrics are based on daily average flows measured at the Conowingo gage, those daily average flows are reflective of the hourly flows occurring throughout the day. As an alternative to an analysis of flow pairs assuming that a specific minimum and maximum flow occurs throughout a life stage period (regardless of river flow conditions), we assessed persistent habitat using the 90 percent and 10 percent exceedance flows, by month, to represent actual average flow conditions currently occurring downstream of Conowingo dam.

Table 3-21 summarizes our 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.[68]

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[67] For example, river flows in April and early May may be too high for the project to be able to reduce generation to as low as its licensed minimum flow, and generation during those months may more resemble run-of-river operations where generation and flow releases would remain relatively constant or would not vary substantially over a 24-hour period. Lower flows in June may allow the project to reduce generation to the minimum flow, and allow a store-and-release mode of operation. Lower summer river flows, however, may also not allow the project to reach maximum generation levels in all days, weeks, or months, as illustrated by USGS gaging data.

[68] Most of the life stages in table 3-21 occur in the spring and early-summer period, although we include the deep-slow habitat guild that includes a total of 13 fish species plus macroinvertebrates that have life stages present year-round. If the 10 percent exceedance flow for a month equals or exceeds the maximum generation flow of 86,000 cfs, we use 86,000 cfs as the maximum generation flow.

We used the habitat persistence tables in appendix G of Gomez and Sullivan and Normandeau (2012a) as the data source for persistent habitat, and use the flow pairs in those tables that are as closely matched as possible to the flow levels analyzed herein. This analysis 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. While the TNC Flow Regime generally shows a higher range of percent of maximum persistent habitat, the range is higher for smallmouth bass under the existing flow scenario. 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.[69] Table 3-21 also includes data on percent of MWUA that would occur under run-of-river operation, based on the mean monthly flows at the Conowingo gage (see table 3-6). While MWUA is not directly comparable to persistent habitat, MWUA under a run-of-river alternative would essentially be "persistent" because flow releases would not vary substantially during the day; Exelon would be required to match project discharges to the daily average flow measured at the USGS Marietta, Pennsylvania, gage, plus any intervening flows that enter the river between the Marietta gage and Conowingo dam. These data indicate that run-of-river operation may have the highest biological benefits, but there are other potential issues with run-of-river operations that we discuss following the table.

Table 3-21. Summary of habitat persistence analysis, comparing the TNC flow regime to existing flow conditions, along with percent of MWUA for run-of-river operation (Source: Gomez and Sullivan and Normandeau, 2012a; staff).

	Minimum Flow Scenario (% of maximum persistent habitat)		
Species/Life Stage	**TNC**	**Existing Conditions (90% exceedance as min. flow/10% exceedance as max. flow)**	**Run-of-River Operation – % of MWUA (mean monthly flows)**
American shad spawning	9 to 74	12 to 48	73 to 100
American shad fry	13 to 56	23 to 37	93 to 98
Shortnose sturgeon spawning	59 to 83	56 to 66	93 to 100

[69] In addition, for American shad, the overall objective of the restoration plan is to maximize the upstream movement of shad to upriver spawning areas, so the contribution of habitat in the lower river to the overall restoration program may be less important than upriver habitat.

Species/Life Stage	Minimum Flow Scenario (% of maximum persistent habitat) TNC	Existing Conditions (90% exceedance as min. flow/10% exceedance as max. flow)	Run-of-River Operation – % of MWUA (mean monthly flows)
Shortnose sturgeon fry	3 to 40	7 to 27	94 to 99
Striped bass spawning	16 to 88	18 to 71	89 to 97
Striped bass fry	1 to 88	2 to 69	64 to 96
Smallmouth bass spawning	5 to 6	3 to 7	37
Smallmouth bass fry	7 to 8	8 to 13	29 to 34
Deep-slow habitat guild	4 to 10	5 to 13	16 to 59

Note: Range in percentages reflects the ranges in minimum flows over the 2- to 3-month periods for most of these life stages, and a 12-month period for the deep-slow guild. Also, the TNC Flow Regime includes two different minimum flows for several months, depending on inflow. Maximum flow for the TNC Flow Regime ranges from 65,000 to 86,000 cfs, depending on month (see table 3-19).

In response to comments on the draft EIS, we also revisited our analysis of the range of flows that would provide The Nature Conservancy target of 70 percent of MWUA by month. Table 5.1-1 of Gomez and Sullivan and Normandeau (2012a) shows the flow ranges that provide a range of percentages of MWUA for several species and life stages.[70] Table 3-22 summarizes the flow ranges that provide 70 percent of MWUA for evaluation species and life stages, as reported in table 5.1-1 of the instream flow report. Table 3-22 also shows the normal range of flows during Exelon's existing and proposed operation, and the median unregulated flow. This table shows the evaluation fish species

[70] Gomez and Sullivan and Normandeau (2012a) state that some flow ranges were limited by the lowest or highest production run flow (modeled flows ranged from 2,000 to 86,000 cfs), thus the true flow range providing this habitat may fall outside of the modeled flows. However, flows less than 2,000 cfs would not be associated with project generation and would essentially be leakage, while flows greater than 86,000 cfs would mean the project is spilling and flows would be beyond the control of Exelon.

selected by the Exelon/agency study team, as well as the deep-slow habitat guild. This guild represents 13 fish species plus macroinvertebrates that have life stages present year-round. Table 3-22 also highlights the "key" species (American shad and striped bass), if the management objective is to focus on key species, with lower priorities for other species. Table 3-22 does not show shortnose sturgeon as a key species. While shortnose sturgeon is a federally listed endangered species, because only occasional sturgeon have been documented in the lower Susquehanna River, the river probably does not support a spawning population. 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. Thus, decisions would need to be made as to what the key management species are.

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. From December through March, when Exelon reduces to zero minimum flow for 6-hour intervals, however, the MWUA criterion would not be met for those 6-hour intervals. Eliminating the zero minimum flow periods during those months would provide some benefits to aquatic habitat, and Exelon would likely have no trouble in meeting a continuous flow requirement (of 3,500 cfs), because median flows during those months are higher than most other months of the year, except April and May. For the remainder of the year, Exelon's minimum flows are higher than the low end of the 70 percent MWUA criterion from April through November.

However, if only the key species are considered as shown in table 3-22, Exelon's minimum flows are lower than the low end of the 70 percent MWUA criterion from January through June. From January through March, the low end of the 70 percent MWUA criterion would be 21,450 cfs, based on the adult striped bass life stage. This compares to the Exelon minimum flow of an intermittent 3,500 cfs in January and February and a continuous 3,500 cfs in March. However, it is unlikely that adult striped bass occur in the Susquehanna River during the winter months, as striped bass are believed to overwinter in deeper channels within the Chesapeake Bay or in coastal areas near Virginia/North Carolina. Crance (1984) also reports that preferred water temperatures for adult striped bass range from about 50 to 85°F, indicating that adult striped bass would avoid the cold overwinter water temperatures (which reach the 30°s F). In April, Exelon provides a minimum flow of 10,000 cfs (compared to the 70 percent minimum criterion of 13,861 cfs, for the key species), but because April is the highest flow month of the year, Exelon overall maintains higher average releases during

April, and minimum releases may on average exceed the licensed minimum flow.[71] In May and June, Exelon's minimum flow is lower than the 70 percent minimum criterion for the key species designated in table 3-22. In June, at the end of the spawning period for shad and striped bass, Exelon currently reduces its minimum flow from 7,500 to 5,000 cfs. If that reduction occurs on June 1 (as it does currently), that could adversely affect spawning and early-fry development for later spawning shad and striped bass by reducing the area of suitable spawning and incubation habitat during the period of the day when only the minimum flow is provided. Areas that would be available for spawning and incubation during higher generation periods of the day may not be available or may be dewatered at a minimum flow of 5,000 cfs. This indicates that there would be justification for increasing the minimum flow in the month of June. Extending the 7,500-cfs minimum flow until mid-June would provide additional protection to spawning and incubation habitat. There would be no need to extend this minimum flow into late June, as spawning and early-fry development would have ended by then. For the remainder of the year, Exelon minimum flows are higher than the low end of the 70 percent MWUA criterion for the key species.

Maximum flows have also been a concern at Conowingo, and The Nature Conservancy recommended that maximum flows be capped at 65,000 cfs from March through September.[72] The MWUA analysis, however, does not support such a restriction, as some of the key life stages in all months still maintain the 70 percent minimum criterion at the full station discharge of 86,000 cfs. While 86,000 cfs is the high end of the flow range that was limited by the production run flow, according to Gomez and Sullivan and Normandeau (2012a), that analysis still indicates that there is little basis for a 65,000-cfs maximum flow cap. In addition, as we describe above, a maximum flow of 86,000 cfs may seldom occur in reality. Based on our review of flow data from the Conowingo USGS gage, maximum generation usually is in the range of 78,000 to 80,000 cfs, because that is the most efficient gate setting for full generation at the project. During the summer low-flow months, maximum discharges from the project seldom reach greater than 70,000 cfs during peaking operations, close to the maximum releases recommended by The Nature Conservancy. Figure 3-4 shows typical operation in September 2013, when the maximum release exceeded 70,000 cfs on only 1 day. For the remainder of the days, maximum releases were generally in the range of 40,000 to 60,000 cfs. While this figure is only a small snapshot of operations at Conowingo, review of the

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[71] The 90 percent exceedance flow in April at the Conowingo USGS gage is 29,690 cfs (see table 3-6). Because of the higher April flows, Exelon may in fact be unable to reduce project releases to its licensed minimum flow.

[72] However, as we state above, we assume that this is contingent upon river flows allowing station discharges to be capped at 65,000 cfs.

Conowingo USGS gage data indicates that this is typical operation during the summer and fall months.

The analysis of instream flows downstream of Conowingo is complex, where certain species and life stages may have narrower or higher flow bands where MWUA is provided, and results depend on which evaluation species and life stages are selected as being most important. However, Exelon's studies have provided substantial information on the effects of flow releases from Conowingo. Based on this information, Exelon's current flow regime is generally adequate for protection of aquatic resources downstream of the project, although some adjustments to these flows as we discussed (eliminating periods of zero minimum flow in December through February, and increasing the minimum flow to 7,500 cfs in the first half of June) could provide additional protection to downstream aquatic habitat.

The Nature Conservancy recommends that run-of-river operation be considered at Conowingo. We previously discussed potential benefits of such operation (see table 3-21), but strict run-of-river operation may not be technically feasible at Conowingo. If any run-of-river operation is tied to inflow at the Marietta gage (plus inflow downstream of Marietta), Exelon may not be able to duplicate Marietta flows, because of the operation of the upstream Safe Harbor and Holtwood Projects. Safe Harbor, with a total hydraulic capacity of 110,000 cfs, generally controls lower Susquehanna River flows at natural inflow less than its hydraulic capacity. Safe Harbor is a peaking station with no required minimum flow releases, so downstream flows may fluctuate from zero up to full capacity on a daily basis. The Holtwood Project is immediately downstream of Safe Harbor and also controls the river up to its current newly expanded capacity of about 61,000 cfs. If Conowingo was to attempt to operate so that it passes on a continuous basis the daily average flow at the Marietta gage, plus inflow downstream of Marietta, as recommended by The Nature Conservancy, it would likely be an operational challenge.[73] Exelon's operation would likely be in a constant state of flux because actual inflow to Conowingo Pond would be fluctuating over a wide range (as a result of upstream operation at Safe Harbor and Holtwood), potentially causing major fluctuations in Conowingo Pond as Exelon attempted to match Conowingo releases to the Marietta flows (plus other inflow), as well as operate the Muddy Run Project. In addition, not all of the tributaries between Marietta and Conowingo are gaged, so Exelon would not have reliable inflow data for all of the tributaries.

[73] The Nature Conservancy recommends providing run-of-river flows on an hourly basis.

Table 3-22. Summary of Exelon's habitat persistence analysis by month, showing the range of flows (cfs) providing 70 percent of the MWUA for evaluation species and life stages likely to occur during each month,[74] compared to Exelon's current operation and median unregulated flow. Shaded cells indicate the "key" evaluation species (Source: Gomez and Sullivan and Normandeau, 2012a; staff).

Species/ life stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shad spawning	-	-	-	14,472 to 82,757	14,472 to 82,757	14,472 to 82,757	-	-	-	-	-	-
Shad fry	-	-	-	-	7,744 to 67,028	7,744 to 67,028	7,744 to 67,028	-	-	-	-	-
Shad juvenile	-	-	-	-	-	-	2,000 to 52,641	2,000 to 52,641	2,000 to 52,641	2,000 to 52,641	2,000 to 52,641	-
Shad adult	-	-	-	13,861 to 86,000	13,861 to 86,000	13,861 to 86,000	-	-	-	-	-	-
SNS spawning	-	-	-	13,008 to 86,000	13,008 to 86,000	-	-	-	-	-	-	-
SNS fry	-	-	-	-	8,546 to 86,000	8,546 to 86,000	8,546 to 86,000	-	-	-	-	-

[74] This table uses the evaluation species and life stages, and the timing of those life stages, as presented in Gomez and Sullivan and Normandeau (2012a).

Species/ life stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SNS juvenile	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000
SNS adult	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000	6,228 to 86,000
Striped bass spawning	-	-	-	20,450 to 86,000	20,450 to 86,000	20,450 to 86,000	-	-	-	-	-	-
Striped bass fry	-	-	-	22,977 to 86,000	22,977 to 86,000	22,977 to 86,000	22,977 to 86,000	-	-	-	-	-
Striped bass juvenile	-	-	-	-	-	7,961 to 86,000	7,961 to 86,000	7,961 to 86,000	7,961 to 86,000	7,961 to 86,000	7,961 to 86,000	7,961 to 86,000
Striped bass adult	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000
SMB spawning	-	-	-	-	2,000 to 13,430	2,000 to 13,430	-	-	-	-	-	-
SMB fry	-	-	-	-	-	2,000 to 3,778	2,000 to 3,778	-	-	-	-	-
SMB juvenile	-	-	-	-	-	-	-	2,000 to 18,051	2,000 to 18,051	2,000 to 18,051	2,000 to 18,051	2,000 to 18,051

Species/ life stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SMB adult	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491	3,127 to 44,491
Deep-slow guild	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565	2,000 to 12,565
Flow range for 70% MWUA (all species combined)	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000
Flow range for 70% MWUA (key species)	21,450 to 86,000	21,450 to 86,000	21,450 to 86,000	13,861 to 86,000	13,861 to 86,000	13,861 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	2,000 to 86,000	7,961 to 86,000
Current Exelon operation	0/3,500 to 86,000	0/3,500 to 86,000	3,500 to 86,000	10,000 to 86,000	7,500 to 86,000	5,000 to 86,000	5,000 to 86,000	5,000 to 86,000	5,000/3,500 to 86,000	3,500 to 86,000	3,500 to 86,000	0/3,500 to 86,000
Median unregulated flow	27,732	32,617	61,744	63,752	38,768	20,661	13,045	9,201	7,995	9,845	22,927	30,672

Note: SNS = shortnose sturgeon; SMB = smallmouth bass.

Upstream Fish Passage

As we described in section 3.3.2.1, *Water Resources, Affected Environment,* volitional upstream fish passage for anadromous species has been provided at the four lower-river hydroelectric projects since the year 2000. An experimental fish trap (with trucking) was first installed in 1972 at Conowingo dam, but passage was not provided at all four dams until completion of the east channel fishway at York Haven in 2000. While fish passage facilities have been in place for many years, inefficiencies in their operation have been documented at some of the projects. Only the Safe Harbor Project has demonstrated consistently high efficiency. Inefficiencies in upstream passage were a stakeholder concern at both York Haven and Conowingo, and those issues are discussed separately by project. American eel passage to date has been limited to experimental operations and trapping and trucking from Conowingo, but is also an issue for all the projects on the Susquehanna River. The American eel issue is discussed separately below.

York Haven Project

York Haven Power is proposing, consistent with the Settlement Agreement, to improve upstream fish passage at the project by constructing a nature-like fishway where the upstream end of the main dam joins Three Mile Island (referred to as the "apex"). Pennsylvania DEP did not sign the agreement but has indicated it would issue certification that is consistent with the agreement.

Our Analysis

American shad passage counts on the river (table 3-13) show that shad passage at the east channel fishway has been relatively low, generally only from about 2 to 22 percent of the count at the downstream Safe Harbor dam, and not exceeding 10 percent since 2003. This may not have been entirely as a result of inefficiency at the east channel fishway.[75] Radio telemetry studies conducted by York Haven Power in 2010 found that many shad that did reach the project area did not reach the east channel fishway. Of 174 radio-tagged shad exiting the downstream Safe Harbor fish lift, 70 percent reached the York Haven Project area. Of those, 100 percent passed through the York Haven tailrace and 78 percent were detected in the apex area of the main dam, where tagged fish spent the most time of any of the locations at York Haven. Only

[75] There is spawning habitat in the 22 river miles between the Safe Harbor Project and York Haven and in years when spring water temperatures increase rapidly in the river, shad may cease migration once spawning temperatures are reached and use spawning habitat downstream of York Haven. While some shad may spawn downstream of York Haven in any year that portion of the run may be greater if water temperatures increase rapidly.

4 percent (5 tagged shad) successfully passed above York Haven dam through the east channel fishway, and another 2 fish passed through the fishway but immediately dropped back downstream through the attraction flow gates (York Haven Power, 2011; 2013). These data indicate that the apex area of the main dam would be a good location for a fishway, likely a better location than the existing east channel fishway.

Fish passage options at this site, which has a maximum head of only 7 feet, would be a pool and weir or vertical slot fishway, similar to the east channel fishway, or a nature-like fishway. A fish lift would not be a good option at this site because of the low head and the somewhat remote location, making operation and maintenance more difficult. As the record shows, consultations with the fisheries agencies resulted in the selection of the nature-like fishway as the preferred alternative, ultimately resulting in the inclusion of this design in the Settlement Agreement. The proposed fishway would consist of an approximately 300-foot-wide and 500-foot-long channel with arched weirs made from natural stone and boulders to be harvested from the river immediately downstream of the main dam. The fishway base material would consist of a large stone mix with a median diameter (D50) of 18 inches, and large rock/boulders that form the fishway weirs would be 3- to 5-foot-diameter rock set into the 18-inch D50 base material. The large rocks would be arranged to form an arched weir, with the large rocks approximately 1-foot apart. Flows through the fishway would pass between and over the large rocks with the water level dropping approximately 0.7-foot from the upstream to downstream side of each rock weir. There would be a 65-foot-wide 'thalweg' located within the fishway, which would have a channel invert approximately 1-foot lower in elevation than the adjacent fishway channel. This would provide a deeper channel to concentrate flows during periods of low headpond elevations and river flows outside of the adult American shad migration season. The gradient through the fishway would be approximately 1.5 percent. Figure 3-14 shows the location of the proposed nature-like fishway, the east channel dam, the rock harvesting area, and staging areas.

The fishway would have a normal minimum flow through the fishway of 200 cfs and would include a supplemental attraction water supply of 800 cfs, to be provided via a parallel concrete channel. This would result in a total minimum flow of 1,000 cfs from the apex area of the dam, to attract shad to the fishway location. At the same time, the minimum flow from the east channel would be reduced to 267 cfs year-round (from the current minimum of 2,000 cfs during the shad passage season). This would reduce attraction of shad to the east channel and increase attraction toward the nature-like fishway, which would become the primary route for upstream passage at the project. The east channel fishway would continue to operate year-round for resident fish passage, but it would become a secondary route for shad and other anadromous species. The nature-like fishway would also be designed so that a full range of anadromous, catadromous, and resident species could use the facility for upstream passage, and downstream passage if fish can locate the facility on their downstream migration. Downstream passage is discussed below in greater detail.

Figure 3-14. Proposed location of the York Haven nature-like fishway and associated construction sites (Source: York Haven Power filing of updated figure for Nature-like Fishway Conceptual Design Final Report, filed June 10, 2013).

With this arrangement for fish passage, some shad would likely continue to be attracted to the powerhouse tailrace, because under low-flow conditions the majority of flow from the project would be released from the powerhouse (up to full powerhouse capacity). However, the applicant’s radio telemetry studies found that 78 percent of the fish that were detected in the tailrace ended up in the apex area, where the nature-like fishway would be located, and those fish lingered in that area for the longest time of any of the locations monitored. The proposed location and design of the nature-like fishway would constitute an enhancement of existing upstream fish passage facilities at the project, and should improve fish passage effectiveness at the project. Another future monitoring technology provided for in the Settlement Agreement is the use of PIT tag monitoring devices. While the methodology for using these devices in a 300-foot-wide nature-like fishway has not yet been developed, the upstream end of the nature-like fishway would be designed to accommodate future installation of PIT tag monitoring devices at such time that these tag monitoring devices become available and feasible for reliably monitoring American shad exiting the fishway.

Under the Settlement Agreement, York Haven Power proposes to conduct an effectiveness study beginning in year 2 of fishway operation, continuing for 2 years, using radio-tagged shad. The Settlement Agreement establishes an "Upstream Shad Passage Target" that at least 75 percent of the shad counted at the downstream Safe Harbor Project be passed above York Haven dam (using all passage routes), and a "Project Area Passage Success Criteria" that 85 percent of the shad that reach the York Haven Project successfully pass upstream of the project (using all passage routes). If the passage target or success criteria are met after 2 successive years of study, then the project would be considered as successfully meeting its target and no additional passage studies would be needed. If the target effectiveness or success criteria are not met, after consideration of extenuating circumstances such as unusual river flows or high water temperatures, 2 additional years of study would be conducted after a hydraulic evaluation of the fishway and possible modifications to the design or operation (attraction flows) of the fishway.

Radio telemetry studies can be an effective methodology for monitoring fish movements as they approach a fishway and for determining the percentage of fish that are able to pass it. The proposed studies are appropriate for a major new fish passage facility, particularly because a nature-like fishway design has never been constructed for American shad at a hydroelectric project on a major North American river.[76] The establishment of passage targets and success criteria, used properly, allow a determination of whether the fishway is operating as designed. Caution is needed, however, because many factors beyond engineering design and hydraulics may affect effectiveness, particularly for shad.

The Safe Harbor Project is considered to have the most effective upstream fish passage facilities on the Susquehanna River, and perhaps one of the most effective on the

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[76] A nature-like fishway was recently installed on a lock and dam on the Cape Fear River in North Carolina, but effectiveness data are not yet available for that facility.

Atlantic coast. Safe Harbor consistently lifts on-average about 71 percent of the shad counted at the downstream Holtwood Project, but that has ranged from 45 to 98 percent since 1997, with 13 of 17 years not reaching the target effectiveness of 75 percent (table 3-23). While Safe Harbor has not met the 75 percent criteria proposed for York Haven in all years, Safe Harbor is still considered highly effective. The distance between Holtwood and Safe Harbor is only 7 miles of reservoir habitat, while the distance between Safe Harbor and York Haven is about 22 miles, including both large reservoir (about 10 miles) and riverine habitat (about 12 miles) that contains suitable spawning habitat. It may be unrealistic to expect that the same effectiveness can be achieved at York Haven, especially because fish reaching York Haven would be doing so at the end of the migration period when water temperatures may be warming quickly, and reaching the range when fish would begin spawning.[77]

Table 3-23. Numbers of shad lifted at Holtwood and Safe Harbor dams, and the effectiveness of the Safe Harbor fish lift, reported as percent of the Holtwood passage (Source: staff).

Year	Holtwood	Safe Harbor	% of Holtwood
1997	28,063	20,828	74
1998	8,235	6,054	74
1999	34,702	34,150	98
2000	29,421	21,079	72
2001	109,976	89,816	82
2002	17,522	11,705	67
2003	25,254	16,646	66
2004	3,428	2,109	62
2005	34,156	25,425	74
2006	35,968	24,929	69
2007	10,338	7,215	70
2008	2,795	1,252	45
2009	10,896	7,994	73

[77] In fact, York Haven Power's 2010 radio telemetry study found that only 70 percent of the tagged fish released at Safe Harbor reached the York Haven Project area, indicating that some fish did use the habitat between the projects, or had no motivation to continue upstream migration to York Haven.

Year	Holtwood	Safe Harbor	% of Holtwood
2010	16,472	12,706	77
2011	21	8	--[a]
2012	4,238	3,089	73
2013	2,503	1,927	77
2014	2,528	1,336	53
		Average	71

[a] The Conowingo and Holtwood fish lifts were not operated the entire migration season because of construction at Holtwood, so 2011 was not a representative year.

The Settlement Agreement acknowledges this issue, and while the upstream shad passage target is at least 75 percent of the shad counted at the downstream Safe Harbor Project to be passed above York Haven dam, compliance is based on the project area passage success criteria that 85 percent of the shad that successfully reach the York Haven Project area successfully pass upstream of the project. This properly recognizes that York Haven Power has no control over whether or not shad reach the project area.

Muddy Run Project

The Muddy Run Project is a pumped storage project with an offstream upper reservoir that does not physically block upstream fish migration, but instead may affect migration by creating flow patterns that may confuse migrating fish or create areas with high velocities that may delay migration. There is no proposal or need for passing fish into the Muddy Run upper reservoir, and in fact the objective is to keep migrating fish out of the reservoir. Some migrating fish would be entrained and pumped into the upper reservoir, resulting in a loss of those fish to the overall population, unless those fish are able to survive passage back to the Susquehanna River/Conowingo Pond during the generation cycle. Both Interior and NMFS reserve their authority to prescribe fishways during the term of the license, and both agencies recommend that the project be operated to allow safe, timely, and effective fish passage past the project. Interior, as part of its preliminary fishway prescription, requires preparation of FPOP to describe Muddy Run Project operation during the fish passage season including regular maintenance activities and emergency procedures. Interior also requires an FPMP, including an American shad passage monitoring plan, for post-FPOP implementation monitoring, with the criteria for success to be consistent with the goals and objectives set forth in the Susquehanna River Anadromous Fish Restoration Plan (85 percent passage effectiveness), along with a recently developed goal of passage of 80 percent within 36 hours (Sweka and Eyler, 2013). However, in a letter filed with the Commission on February 28, 2014, Interior amended its preliminary fishway prescription, and dropped the requirement for specific target effectiveness at Muddy Run (80 percent within 36 hours), but instead would require that Muddy Run demonstrate safe, timely, and effective fish passage past the project, based on site-specific studies or other available information. Interior states that while it believes that Muddy Run operation may affect fish migration, the effects may not be sufficient to affect the fisheries agencies goals for this reach of the river. As part of the FPMP, Exelon would be required to conduct an effectiveness monitoring study every 10 years beginning in 2018, and if effectiveness is not met, Exelon would be required to implement operational or structural measures to improve effectiveness.[78] NMFS is concerned that flow patterns in the vicinity of the project may delay American shad migration, and recommends that FWS' reanalysis of a 2008 shad radio telemetry study be considered in the analysis of this issue. Passage measures related to American eel are discussed below in a separate section.

In its reply comments filed on March 18, 2014, Exelon states that it is opposed to Interior's preliminary fishway prescription, but is in agreement with the conditions of the draft certification. Pennsylvania DEP issued a final certification on June 3, 2014, and filed a clarified version of the certification on December 10, 2014. By letter filed January 21, 2015, Exelon confirmed that the clarified water quality certification filed by Pennsylvania DEP on December 10, 2014, continues to represent Exelon's licensing proposal for the Muddy Run Project. Thus, we conclude that Exelon is in agreement with the fish passage conditions of the certification that require at least 88 percent successful passage of upstream-migrating adult shad past the Muddy Run Project,[79] 80 percent survival of downstream-migrating adult shad, and 95 percent survival of downstream-migrating juvenile shad. In addition, Exelon agrees to conduct additional effectiveness studies at Muddy Run if the upstream Holtwood Project fails to meet its target effectiveness and Pennsylvania DEP determines that Muddy Run operation is a proximate cause for Holtwood failing to meet its target. Radio telemetry studies would be conducted over a 4-year period, and if the studies demonstrate that less than 88 percent

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[78] By its filing of March 28, 2014, Interior notified the Commission that it had reached an agreement in principle with Exelon on a modified fishway prescription, but that agreement has yet to be reduced to writing and signed. Because we are unsure of the details of that agreement, our analysis focuses on the preliminary fishway prescription, as amended by Interior's February 28, 2014, filing.

[79] This differs slightly from Interior's previously recommended 85 percent passage effectiveness, with target passage of 80 percent within 36 hours. However, Interior commented that the Pennsylvania DEP certification conditions for fish passage (when issued) should be considered an alternative for consideration. The clarified certification also provided somewhat different criteria that 75 percent of the shad that pass the downstream Conowingo Project should pass through the Holtwood Project fish passage facilities (Tier I requirement), and that 50 percent of the shad that pass the Conowingo Project should pass the Holtwood Project within 5 days (Tier II requirement).

of the tagged shad are successful in passing upstream of the Muddy Run Project area, Exelon would amend its FPOP to provide measures to enhance upstream passage past Muddy Run. Exelon would also submit a plan to continue to provide for the target downstream passage survival rates (80 percent for adult shad and 95 percent for juvenile shad) by January 15, 2015. By February 15, 2026, Exelon would prepare a plan for Pennsylvania DEP approval to measure the passage of American shad moving downstream through the project area. If the studies determine that the project is not achieving the minimum passage rates, then Exelon would be required to develop a mitigation plan.

Our Analysis

Exelon conducted multiple studies on the effects of Muddy Run operation on migratory fishes, summarized in Normandeau and Gomez and Sullivan (2012k). These studies included three radio telemetry studies involving more than 500 radio-tagged adult shad, data from other lower Susquehanna River studies pertaining to shad run timing, hydraulic modeling from the expansion of the upstream Holtwood Project, and near-field velocity profiles at Muddy Run. Other available reports included FWS re-analysis of Exelon telemetry data and juvenile shad entrainment at Muddy Run (Sweka, 2013; Pugh, 2013). The Exelon studies concluded that the effects of the Muddy Run Project on upstream and downstream shad passage are negligible. Radio telemetry studies found that a majority of shad in upper Conowingo Pond migrate upstream along the east bank of the river and would pass in close proximity to the Muddy Run tailrace. This would be expected because higher flows occur on the east side of the river associated with flows discharging from the upstream Holtwood tailrace and Muddy Run releases. Those studies found that successful upstream passage of tagged (and detected) shad past the Muddy Run Project was 91 percent in 1989, 80 percent in 2001, and 84.5 percent in 2008 (average of 85.2 percent). Telemetry studies in 2001 and 2008 provided data on the adult shad entrainment rate during Muddy Run pumping operation from April to June, and those rates ranged from 3.6 to 5.1 percent. Exelon's review of Holtwood Project modeling found that river velocities may approach 7.5 to 10.0 fps when both post-expansion Holtwood and Muddy Run are generating at or near full capacity (total flow of about 94,000 cfs). This indicates that parts of the river channel would be reaching velocities that may deter shad, potentially causing some migratory delays, but Exelon states that large portions of the river channel would remain with suitable velocities for upstream migration, based on field measurements of velocities in the immediate project vicinity. For downstream juvenile shad passage, Exelon estimated that for fish that were in the zone of influence during pumping, 22.6 percent of those fish could be entrained. For the overall population, however, Exelon estimated that only 2.9 to 6.6 percent of the population would be vulnerable to entrainment during peak outmigration times, because the project is not pumping during many of the peak hours of outmigration (Normandeau and Gomez and Sullivan, 2012g). These data indicate that the project already meets the agencies' effectiveness targets for upstream adult shad passage and downstream juvenile shad passage.

The reviews by Sweka (2013) and Pugh (2013), however, do not agree with the Exelon study results and argue that Exelon has understated the effects of the project on upstream migration and entrainment of juvenile shad. Sweka (2013) states that the Exelon data show that project releases do result in a slower travel time for adult shad migrating upstream in those flows. He also states that only 18 percent of upstream forays by migrating shad were successful at continued passage past the Muddy Run tailrace from the downstream Sicily Island to the upstream Deepwater Island with no fall back behavior, and some individual fish needed to make several forays prior to successfully passing Muddy Run. Sweka concludes that project operation results in migratory delays and possible termination of upstream migration by shad. Pugh (2013) states that by adjusting the periods when juvenile shad may actually be passing the project, based on information from the scientific literature, the actual entrainment rate for juvenile shad would be from 12.3 to 14.5 percent of the population, and not 2.9 to 6.6 percent as estimated by Exelon.

Exelon, in its reply comments filed on March 18, 2014, states that the Sweka (2013) and Pugh (2013) reviews of the data were flawed and that they overstate the actual effects of the project.

Our assessment of these conflicting studies and analyses is that the argued differences in migration and entrainment rates may be within the range of error for the field studies and the data analysis. While the field studies may do a reasonable job of representing the "real world," there are issues with any field study (tag losses, differences in behavior of tagged fish, equipment failures, etc.) that may influence the study results. Instead of trying to determine whose studies or analyses are most correct, our conclusion is that the studies and analyses have overall shown that the Muddy Run Project does not have an adverse effect on a major proportion of the shad population migrating past the project, and has not resulted in major delays to the shad migration. In addition, with Exelon now agreeing to the conditions of the certification, Exelon has committed to maintaining the effectiveness targets required by Pennsylvania DEP, would monitor this effectiveness via the studies required by the certification as part of its FPOP, and would mitigate any effects of the project if the target effectiveness is not maintained.

Both the fishway prescription and the certification would require additional effectiveness studies, but on different time schedules. The fishway prescription would require periodic studies (every 10 years) beginning in 2018, while the certification would require upstream passage effectiveness studies only if Pennsylvania DEP determines that Muddy Run operation is causing the upstream Holtwood Project to not meet its effectiveness targets. Downstream passage effectiveness studies would be required beginning in 2026, for the certification. Both the fishway prescription and the certification would require that additional measures be implemented if effectiveness targets are not met. It appears that the fishway prescription and the certification would accomplish the same goals, but on a slightly different timetable.

Conowingo Project

The Conowingo Project currently operates two fish passage facilities: the east fish lift for volitional upstream passage into Conowingo Pond, and the west fish lift, for collection of adult shad for egg-taking and other experimental purposes. Exelon proposes to continue operating these facilities and to implement a preventive maintenance program at the east fish lift, to extend the life of the facility through the new license term. Several commenting entities have stated that the current facilities are inadequate and outdated and fail to meet the required effectiveness to achieve successful anadromous fish restoration in the Susquehanna River. Both Interior and NMFS reserve their authority to prescribe additional fishways during the term of the license. Interior also recommends an operation and maintenance plan and a fish passage effectiveness monitoring plan (FEMP) for the Conowingo fish passage facilities. Interior originally recommended, as a section 10(j) measure, implementing an alternative G to improve fish passage at the project.[80] Alternative G would include:

- Phase I: Construct a new west fish lift for both trap and trucking and direct volitional upstream shad passage (two 6,500-gallon hoppers), with an auxiliary water system of 2,600 cfs. The objective would be to truck 50,000 adult shad per year. Create a 5,000-foot zone of passage[81] on the east and west shores of the tailrace below the dam. Implement a maximum downramping rate of 20,000 cfs/hour. Make channel modifications downstream to eliminate stranding in the spillway channel.
- Phase II: Modify the east fish lift stilling basin to allow a 900-cfs attraction flow, as originally designed. Relocate east fish lift entrance A to upstream of the Kaplan unit boils. Construct a new entrance D and collection gallery to east fish lift, along the Kaplan units and connect to a new second hopper. Reconstruct entrance B to the east fish lift at 45 degrees to the river flow (see figure 3-15).
- Phase III: If passage efficiency is not met in Phase I and II, make daily adjustments to minimum flows and turbine operation, construct an east fish lift auxiliary water supply of 4,325 cfs, and upgrade east fish lift equipment to allow a 15-minute cycle time.

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[80] Alternative G was one of several alternatives that Interior studied for improvement of the Conowingo Project fish passage facilities.

[81] A zone of passage is a reach within a stream where depth and velocities are maintained within suitable ranges for upstream or downstream fish passage.

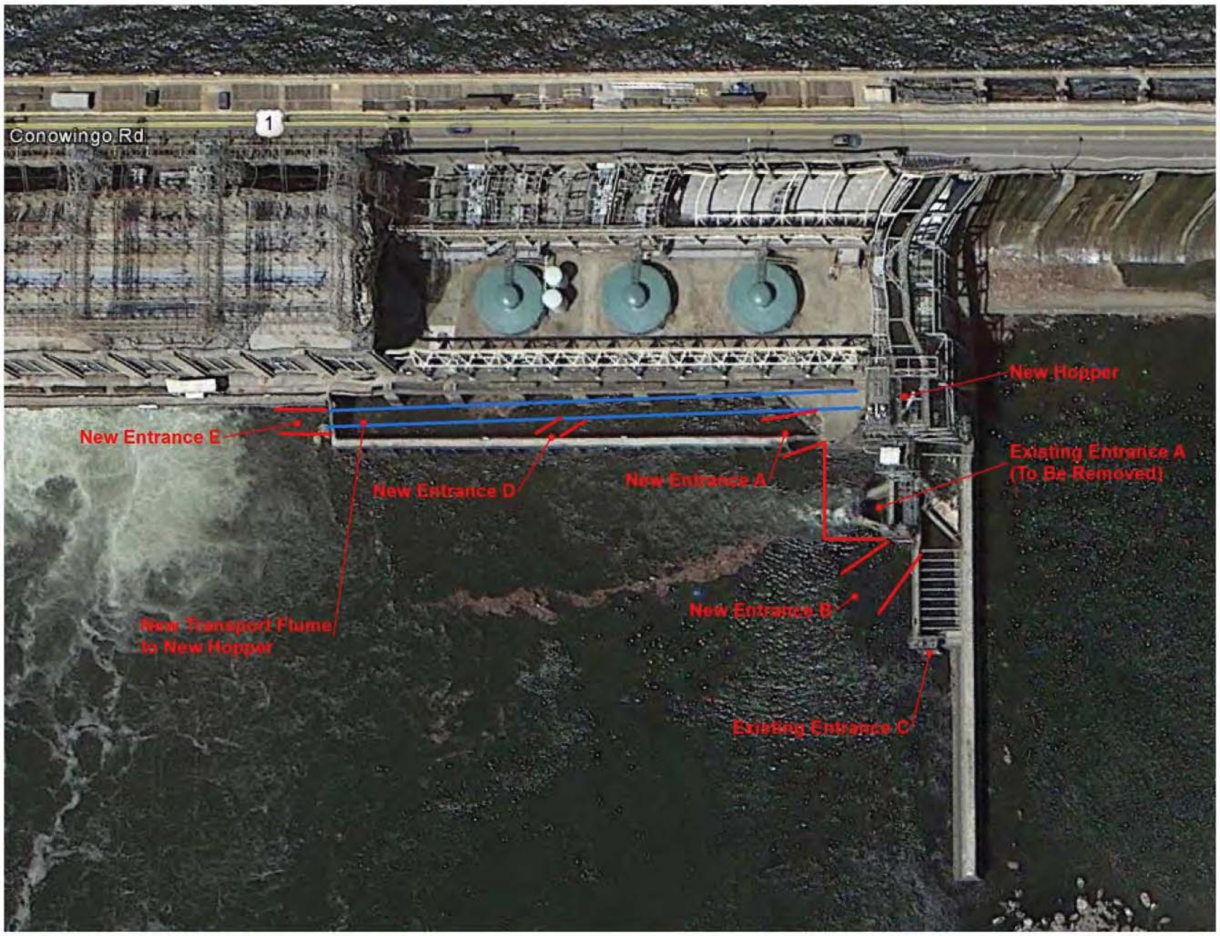

Figure 3-15. View of the east end of the Conowingo powerhouse showing the approximate locations of Interior's alternative G entrance modifications to the east fish lift (Source: Google Earth; Morales and Towler, undated; staff).

Exelon, in its reply comments, states that there is currently no need to construct additional fish passage facilities at Conowingo dam, that the recent shad population trends in the Susquehanna River and along the Atlantic coast do not indicate that large increases in shad populations are likely, and that there is no scientific basis for the target effectiveness rates that Interior and other agencies have recommended for fish passage facilities at Conowingo and the other Susquehanna River hydroelectric projects. Exelon also comments that past agency management decisions for the Susquehanna River have been flawed, including the decision to terminate shad trap and truck operations from Conowingo after 1996, resulting in a decrease in the number of spawners reaching upriver spawning habitat.

In its comments on the draft EIS, Interior withdrew its section 10(j) recommendation to implement alternative G. However, we retain our analysis of alternative G because Interior indicates that alternative G is its most developed alternative and its section 18 fishway prescription, when eventually issued, may be similar to alternative G. While Interior is not yet formally recommending or prescribing alternative G, we evaluate it as a potential fish passage alternative in our discussion of fish passage requirements at the Conowingo Project. However, because Interior no longer recommends alternative G, we do not analyze the expected cost in our economic analysis in section 4 of this EIS.

Our Analysis

Exelon conducted several studies as part of relicensing to assess the effectiveness of the existing fish lifts and to identify which operating conditions at the project resulted in the best fish passage. Exelon also conducted an engineering evaluation to assess alternatives for improvements to the facilities to improve fish passage. In addition to the current studies, there are more than 40 years of operational experience with the fish passage facilities at Conowingo dam, with a multitude of associated studies. Numerous other studies and operational experiences at fish passage facilities for American shad and other anadromous species are also available for other projects on the Atlantic and Pacific coasts that may have some applicability to the Susquehanna River. Fish passage at Conowingo is one of the primary issues for relicensing, as passage at Conowingo has a major effect on fish passage upstream of Conowingo and on the restoration program for the Susquehanna River. Ultimately, should Interior and NMFS file fishway prescriptions under section 18, they would become conditions of any license issued for Conowingo. Nevertheless, we present our independent analysis of this issue below including our assessment of alternative G.

Fishway Effectiveness

Fishway effectiveness is an important aspect of fishway operations on the Susquehanna River, as the objective is to pass as many spawners as possible to areas upstream of York Haven dam, where the best spawning habitat for shad occurs. Some spawning habitat is also available between the Safe Harbor and York Haven Projects (about 12 miles of river), in some of the tributaries (such as the Conestoga River), and in limited areas in the upper reaches of Conowingo Pond and Lake Aldred (Holtwood reservoir). But the primary focus of the shad restoration program has always been a target population as measured at the York Haven Project. As stated in the current restoration plan for the river (SRAFRC, 2010), the goal of the program is: "*Restore self-sustaining, robust, and productive stocks of migratory fish capable of producing sustainable fisheries, to the Susquehanna River Basin throughout their historic 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. Goals for American eel and other migratory species are yet to be determined.*" In order to achieve that goal, the plan also states as a primary objective (Task A1): "*Develop and implement upstream passage plans and performance measures at all four lower river hydroelectric dams to ensure that each facility passes at least 75 percent of the adult American shad passed at* *the next downstream facility, or at least 85 percent of the adult American shad reaching project tailwaters.*" The fishway effectiveness target has also recently been revised slightly by Interior to say that 80 percent of the fish in each tailwater must pass within 36 hours, to reduce delay at each project.[82] The basis for the restoration plan effectiveness targets is not provided in the plan, but is believed to be a reflection of the effectiveness at the Safe Harbor Project, which has the highest effectiveness of any shad passage facility on the Susquehanna River (or perhaps on the Atlantic coast), averaging about 71 percent of the passage at the downstream Holtwood Project. Recent population modeling by both Exelon (Normandeau and Gomez and Sullivan, 2012j) and FWS (Sweka and Eyler, 2013; Sweka, 2014) also indicate that the most important factor in achieving a population growth in line with restoration goals is providing a sufficient numbers of spawners to upriver habitat. Without high fishway effectiveness or trucking of spawners to that habitat, the shad population would not substantially grow or reach restoration goals. This modeling also included hatchery contributions of shad fry, and while hatchery production may result in some population growth, the most important factor is providing sufficient numbers of spawners to upriver habitat (see discussion below on *Susquehanna River Shad Population Trends*).

While fishway effectiveness is important, we previously discussed our concerns about specific target effectiveness goals at the York Haven Project, and whether target effectiveness is something that can entirely be controlled by the licensees. At Conowingo, Exelon's studies showed that the east fish lift attraction efficiency[83] ranged from 73 percent in 2010 to about 44 percent in 2012 (Normandeau and Gomez and Sullivan, 2012a; 2012b). Total fish passage effectiveness[84] ranged from 45 percent in 2010 to 26 percent in 2012. Several variables were assessed for the two study years; river flows and project discharges were generally higher in 2012 than 2010, possibly resulting in lower attraction efficiency in 2012. The portion of those fish that entered the fish lift and ended up successfully passing the fish lift was similar in both years (61.5 percent in 2010 and 58.6 percent in 2012). This would be expected as once fish are

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[82] This new effectiveness target was developed by FWS as a result of a modeling evaluation of the effects of migratory delays on shad spawning success in the Susquehanna River (Sweka and Eyler, 2013). Alternative G includes this target effectiveness as a goal for any fish passage improvements at the Conowingo Project. However, Pennsylvania FBC has a slightly different criterion that 80 percent of the fish should pass a project within 5 days.

[83] That is, the percentage of radio-tagged shad documented in the tailrace that subsequently entered the east fish lift.

[84] That is, the percentage of radio-tagged shad documented in the tailrace that successfully completed passage through the east fish lift.

inside the facility the hydraulic conditions are more controlled than what fish may experience in the river or tailrace. However, in both years fish made multiple forays, both successful and unsuccessful, into the fish lift and were detected in many areas of the tailrace, indicating searching behavior.

This searching behavior results in delay of fish locating the fish lift entrances and achieving passage, and is a concern expressed by Interior and other agencies. Fish that experience delays in passing Conowingo and the other lower river hydroelectric projects may not reach upstream spawning areas in time to complete spawning, as Susquehanna River water temperatures typically increase quickly in late spring as river flows recede. FWS analyzed radio telemetry data from the 2010 and 2012 studies, to assess the amount of delay that fish encountered in entering and passing the east fish lift (Morales, undated). According to this analysis, fish in 2010 required from 3.5 hours to 383 hours (average of 129 hours – about 5.4 days) from their initial entry into the tailrace (as detected by radio telemetry), for successfully completing passage into Conowingo Pond, and only 10.1 percent of the fish met the current Interior criteria that passage should occur within 36 hours. In 2012, fish required from 56 hours to 768 hours (average of 276 hours – 11.5 days) for completing passage, and no fish met the Interior criterion that passage should occur within 36 hours.

The basis for Interior 36-hour criteria appears to be the modeling by Sweka and Eyler (2013), but what an acceptable delay may be in the "real world" may be more difficult to determine. To further assess potential "acceptable" delays, we examined water temperature data from the Harrisburg USGS gage (No. 01570500), located just upstream of York Haven, for 2008 through 2013 (data not available for 2011), to determine when water temperatures typically reach the upper range of most suitable spawning temperatures for shad (71°F – Walburg and Nichols, 1967). The assumption is that once the maximum suitable temperature is reached and maintained and then exceeded, there would be little successful spawning after that point. In reality, however, some spawning would likely continue at higher temperatures, as Walburg and Nichols (1967) report that spawning may occur at temperatures as high as 78°F. The following summarizes when a temperature of 71°F was first reached and then maintained at Harrisburg:[85]

- 2008 – May 31
- 2009 – June 7

[85] There were instances when this temperature was reached for a short time, but then decreased after a few days as a result of colder weather or higher flows. We used the date when the temperature first reached 71°F and then remained above that for a prolonged period.

- 2010 – May 26
- 2012 – June 9
- 2013 – May 28.

Conowingo dam typically begins fish lift operations by about April 1, although substantial numbers of shad are usually not available until mid-April. An approximate average of the above dates when water temperatures would exceed 71°F would conservatively be about May 31, which would mean that shad reaching Conowingo dam in mid-April would need to pass York Haven in about 45 days. This would mean that fish would need an average of about 10 days to pass each project dam and migrate the distance between each project.[86] For later arriving fish, however, this window would be shorter, with fish arriving by May 1 having a 30-day window, needing to pass each project in an average of about 7 days. If we subtract the travel time (5 to 6 days – see footnote below), this would further reduce the window at each project to an average of about 6 days for fish to locate and successfully pass the fishway at each dam. While we understand Interior's objective to reduce delay at each project, our simple analysis indicates that Interior's 36-hour criteria may be overly conservative, and that fish could still reach habitat upstream of York Haven at suitable spawning temperatures as long as they could pass each project within a matter of days. Our estimate is more in line with the Pennsylvania FBC criteria that 80 percent of the fish pass a project within 5 days.

In any event, the fish passage effectiveness at Conowingo dam, based on Exelon's studies, appears relatively low (45 percent in 2010 to 26 percent in 2012), with average delay ranging from 5.4 to 11.5 days. While this effectiveness may be within the range of other fish passage facilities in the Northeast (such as Holyoke dam on the Connecticut River), the Holyoke dam is located at RM 86, and has suitable and ample spawning habitat both downstream and upstream of the dam. On the Susquehanna River, fish must pass four dams before reaching the best spawning habitat.

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[86] The distances between projects on the lower Susquehanna River, however, are not large, although fish would also have to pass by the Muddy Run Project. With Conowingo dam at river mile 10 and York Haven dam at river mile 54, shad would only need to travel 44 river miles to reach York Haven. At a shad cruising speed of about 3 fps (2 miles per hour) (Bell, 1991), an unobstructed shad could travel 44 miles in about 22 hours (about a day), if it migrated continuously. However, Normandeau and Gomez and Sullivan (2012h) reported much slower migration speeds in Conowingo Pond of 4 to 6.7 miles per day. At an average speed of 5 miles per day, fish would require about 9 days to reach York Haven. Because the 44-mile-reach is a combination of reservoir and riverine habitat, we assume that travel time to York Haven may be in the range of 5 to 6 days, for a freely-migrating shad.

The best example of a multiple-dam system that has an established healthy shad run is the Columbia River, although the American shad is an introduced species in the Columbia River and is not a management species of interest. The Columbia River shad runs have reached more than 6 million fish annually, probably the largest run in North America, and the hydroelectric projects have large fishways designed for salmon with high volumes of attraction water not typically seen in Atlantic coast projects. Table 3-24 summarizes American shad counts on the Columbia River for three lower-river dams: The Dalles, John Day, and McNary. Bonneville dam is the lowermost dam on the river, but because a large segment of the shad run passes through the navigation lock at Bonneville (resulting in higher counts at the next upstream dam, The Dalles), we are using The Dalles counts as the "beginning" count on the Columbia.

While some shad may use navigation locks for passage at all the dams on the Columbia River, the fishway counts at The Dalles and above dams are believed to reasonably represent shad passage at these dams. These data show that John Day dam passes an average of 51 percent of the count at The Dalles (range of 27 to 70 percent), and McNary dam passes an average of 55 percent of the John Day passage (range of 32 to 108 percent [potential counting error]). The Dalles reservoir is about 24 miles long, and John Day reservoir is about 76 miles long, and both reservoirs contain suitable shad spawning habitat that is likely used by shad that cease upstream migration. The passage at McNary dam averages 28 percent of the passage at The Dalles (range of 13 to 58 percent). These data show that there has been a wide range in passage effectiveness through the years, but the long-term average is that about 50 percent of the fish passed at the lower dam is passed at the next upstream dam. These long-term data show that the target passage effectiveness recommended for the Susquehanna River (75 percent from dam to dam) has only been occasionally met on the Columbia River, and in most years is much less than that target. While the shad is not a target species of interest on the Columbia River, the Corps and fisheries agencies still have an interest in effectively passing the shad at each dam, so that shad successfully move through the fishways and do not affect or block the passage of the salmonid species of interest, many of which are federally listed. Consistently maintaining a high fish passage effectiveness (75 percent) on all the Susquehanna River Projects, as recommended by Interior and other commenting entities, may not be a realistic objective, but as fish counts on the Columbia River have shown, somewhat lower passage efficiencies may still result in substantial growth and maintenance of a large shad population (table 3-24).

Table 3-24. American shad passage at lower Columbia River dams, and passage effectiveness between dams, 1984 to 2013 (Source: http://www.fpc.org/, accessed March 22, 2014).

Year	The Dalles (RM 192)[a]	John Day (RM 216)	JD % of The Dalles	McNary (RM 292)	McN % of John Day	McN % of The Dalles
2013	--[b]	--	--	1,246,494	--	--
2012	--	--	--	675,421	--	--
2011	--	--	--	224,905	--	--
2010	1,241,770	--	--	276,673	--	22
2009	1,641,362	--	--	486,725	--	30
2008	1,805,516	--	--	623,010	--	35
2007	3,591,988	--	--	985,466	--	27
2006	4,611,592	--	--	1,176,899	--	26
2005	6,067,028	--	--	1,951,001	--	32
2004	5,472,400	--	--	1,751,728	--	32
2003	4,258,889	2,735,108	64	1,077,670	39	25
2002	3,218,050	1,850,942	58	599,294	32	19
2001	2,724,946	1,796,826	66	1,063,568	59	39
2000	1,556,619	851,598	55	350,457	41	23
1999	1,718,679	763,007	44	248,895	33	14
1998	2,149,097	1,025,044	48	393,305	38	18
1997	2,571,260	1,007,896	39	340,090	34	13
1996	2,648,553	959,262	36	352,755	37	13
1995	1,959,564	1,033,727	53	481,081	47	25
1994	1,801,545	935,958	52	668,528	71	37
1993	2,394,394	647,097	27	701,404	108	29
1992	2,824,313	1,963,060	70	1,635,089	83	58
1991	2,191,077	1,382,009	63	674,483	49	31
1990	3,706,855	1,641,943	44	866,940	53	23
1989	2,971,017	1,773,938	60	1,076,473	61	36
1988	2,008,572	908,741	45	665,925	73	33

Year	The Dalles (RM 192)[a]	John Day (RM 216)	JD % of The Dalles	McNary (RM 292)	McN % of John Day	McN % of The Dalles
1987	1,289,698	748,767	58	575,338	77	45
1986	1,361,854	609,363	45	307,361	50	23
1985	1,389,547	682,344	49	438,329	64	32
1984	1,135,982	586,015	52	281,793	48	25
		Average %	51		55	28

[a] Bonneville dam is at RM 146.

[b] The Corps ended shad counts at The Dalles in 2011 and at John Day in 2004.

Susquehanna River American Shad Population Trends

The resource agencies and cooperating project owners have made progress in restoration of shad to the Susquehanna River over the past 40 years. As described in Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC, 2010), the number of shad collected annually in the west fish lift generally numbered in the hundreds of fish in the 1970s and early 1980s, and did not consistently exceed 1,000 fish until 1985. As table 3-13 shows, the numbers of shad passed at Conowingo increased substantially into the late 1990s with the completion of the east fish lift and reached a peak of 193,574 in 2001. Since 2001, however, the numbers have consistently declined. Maryland DNR has also been making shad population estimates for the Conowingo tailrace since the 1980's (SRAFRC, 2013), using both a Petersen mark/recapture methodology and surplus production method (SPM).[87] These estimates are shown in figure 3-16, and show a similar trend to the fish lift counts, with strong population growth up until 2000 to 2001, with an overall decline since then. The Petersen estimates show much higher numbers than the SPM in some years, believed to be because of very low recapture rates in some years. Both methods show a small increase in population estimates from 2007 to 2012. In 2012, Maryland DNR estimated a tailrace shad population of 150,743 fish using the Petersen method and 111,500 fish using the SPM.[88]

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[87] The SPM is a mathematical technique in which the population estimate is based on the previous-year's population, the intrinsic rate of population increase, the estimated maximum population size, and assumed losses associated with upstream and downstream fish passage and by-catch mortality in the Atlantic herring fishery in the previous year.

[88] The east fish lift passed 22,143 shad in 2012, or about 15 percent of the Petersen population estimate and 20 percent of the SPM estimate. An additional 1,486 shad were collected in the west fish lift for egg collections and other experimental purposes.

Maryland DNR finds that the Petersen method may overestimate the actual population size, while the SPM may underestimate the population, but also indicates that the cessation of trucking in 1997 has been a factor in the decline of the shad population in the lower river (SRAFRC, 2013).

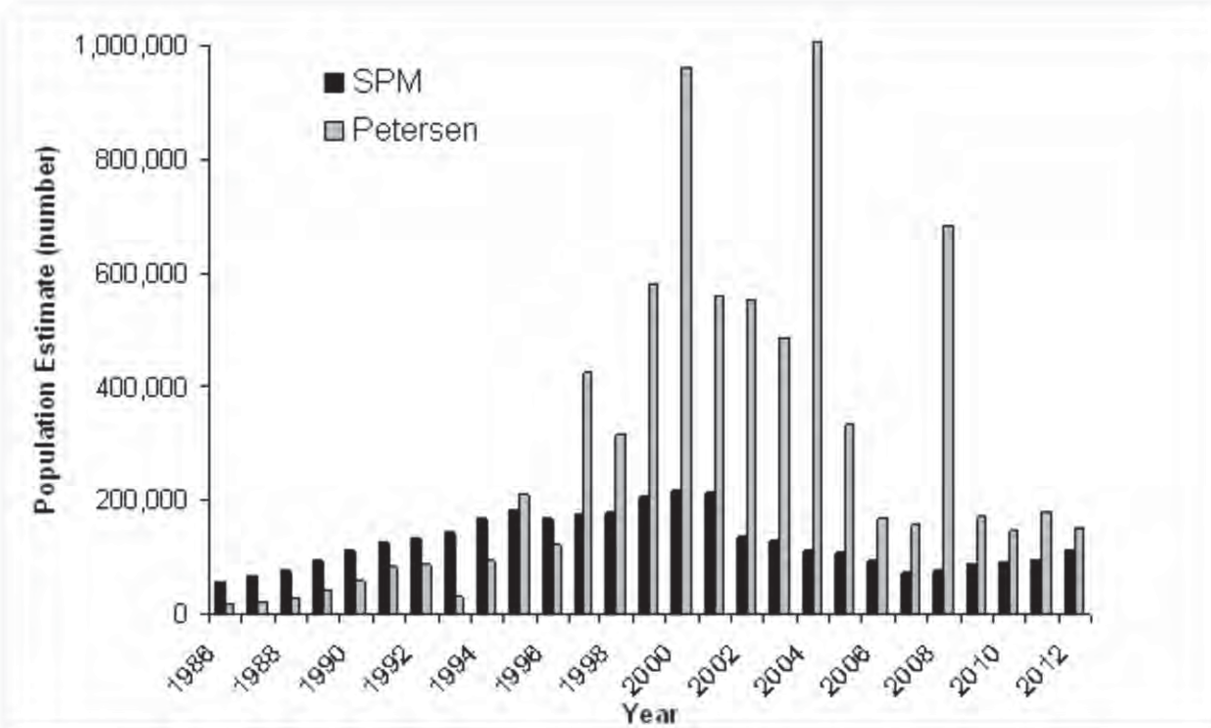

Figure 3-16. Maryland DNR American shad population estimates for the Conowingo tailrace, 1986 to 2012 (Source: SRAFRC, 2013).

Other factors in the decline may include the strong growth of the gizzard shad population, the increase in the number of predators in the river (including the introduction of the flathead catfish), and continued harvest of shad in offshore fisheries. Table 3-14 illustrates the strong increase in the gizzard shad population in the river, with annual passage at the Conowingo east lift now reaching more than 1 million gizzard shad, and an additional 300,000 to 400,000 gizzard shad taken in the west lift. The effects of crowding in the fish lifts are unknown but there is the potential that large numbers of gizzard shad may delay or hinder American shad entry to the lifts. Another effect of gizzard shad on American shad and other species that rely on zooplankton as a food source for early life stages (larvae and juveniles), is that large numbers of larval and juvenile gizzard shad may have an adverse effect on zooplankton populations via extensive grazing of that population (Sullivan et al., 2011). With a large population of juvenile gizzard shad in the lower river, interspecific competition for that food source may affect the growth and survival of juvenile American shad. The effects of a voracious predator such as flathead catfish has not been quantified, but this invasive species is now regularly caught throughout the lower river, with hundreds now typically collected in the Conowingo lifts and in the York Haven east channel ladder, and is also recorded in the Holtwood and Safe Harbor fish lifts (SRAFRC, 2013). Flathead catfish has also now become a target species of interest for anglers in the Susquehanna River, and the Pennsylvania FBC reports that flathead catfish in excess of 40 pounds are commonly caught within Pennsylvania (http://www.fish.state.pa.us/catfish_flathead.htm, accessed May 15, 2014). An offshore ocean fishery for American shad, both directed and by-catch, continues along the Atlantic coast, although that fishery has shown declines as the stocks have reached lower levels and with the closure of an ocean intercept fishery in 2005.[89] Because of its concern about this continued source of mortality to American shad stocks, including the Susquehanna River, the Atlantic States Marine Fisheries Commission (ASMFC) has adopted a strategy to quantify and manage sources of by-catch mortality where possible (ASMFC, 2010).

Several comments have been made by both the agencies and Exelon that the cessation of trucking to upriver habitat has been a factor in the recent decline of the shad population, and that reinstatement of some trucking would likely benefit the population by "jump-starting" population growth. We further examined this issue by summarizing the total number of spawners reaching upriver habitat by trucking from the east and west fish lifts since the beginning of the program, as well as out-of-basin trucking,[90] and compared that to the number of spawners reaching upriver habitat since volitional passage was established at all the dams in 2000. Table 3-25 and figure 3-17 show that the number of spawners reaching upriver spawning habitat since trucking was eliminated in 2000 has decreased significantly, particularly after 2001. Based on these data, it is likely that the recent decrease in the shad numbers at Conowingo is related to the significant decrease in spawners reaching upriver habitat. The peak number of upstream spawners occurred from 1994 to 1996, followed by peak returns to the east lift in 2000 to 2004, from 4 to 8 years after the peak number of upstream spawners occurred. Most shad return to spawn at ages IV to VII, with some age VIII fish reported (SRAFRC, 2013). To illustrate the potential benefits of trucking, simple math shows that if fish are allowed to pass the three dams upstream of Conowingo via volitional passage at 75 percent effectiveness at each dam, only about 42 percent of the fish exiting the Conowingo fish lifts would reach above York Haven. In contrast, 100 percent of the fish trucked from Conowingo would reach habitat upstream of York Haven, minus any mortalities in transport, which in past trucking operations were minimal. A sustained trucking program

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[89] An ocean intercept fishery is a commercial fishery in the ocean directed at stocks of migratory fishes on their way to spawning streams.

[90] From 1980 to 1987 pre-spawn shad were trucked to the Susquehanna River from other river basins (most from the Delaware River).

would have the potential to maintain greater numbers of spawners in upriver locations when the shad population is low, as now, than volitional passage over four dams.

Table 3-25. Number of American shad spawners, from multiple sources reaching upriver spawning habitat (primarily upstream of York Haven), 1980 to 2014 (Source: SRAFRC, 2010; Pennsylvania FBC, 2014).

Year	Out-of-basin Trucking	Trucking from Conowingo	Volitional Passage to York Haven	Total Spawners
1980	114	--	--	114
1981	1,165	--	--	1,165
1982	2,565	800	--	3,365
1983	4,310	64	--	4,374
1984	3,777	0	--	3,777
1985	2,834	967	--	3,801
1986	4,965	4,172	--	9,137
1987	6,051	7,202	--	13,253
1988	--	4,736	--	4,736
1989	--	6,469	--	6,469
1990	--	15,075	--	15,075
1991	--	24,662	--	24,662
1992	--	15,674	--	15,674
1993	--	11,717	--	11,717
1994	--	28,681	--	28,681
1995	--	56,370	--	56,370
1996	--	33,825	--	33,825
1997	--	10,528	--	10,528
1998	--	4,593	--	4,593
1999	--	5,508	--	5,508
2000	--	1,351	4,675	6,026
2001	--	--	16,200	16,200
2002	--	--	1,555	1,555
2003	--	--	2,536	2,536

Year	Out-of-basin Trucking	Trucking from Conowingo	Volitional Passage to York Haven	Total Spawners
2004	--	--	219	219
2005	--	--	1,772	1,772
2006	--	--	1,913	1,913
2007	--	--	192	192
2008	--	--	21	21
2009	--	--	402	402
2010	--	--	907	907
2011	--	--	0	0
2012	--	--	224	224
2013	--	--	202	202
2014	--	--	8	8

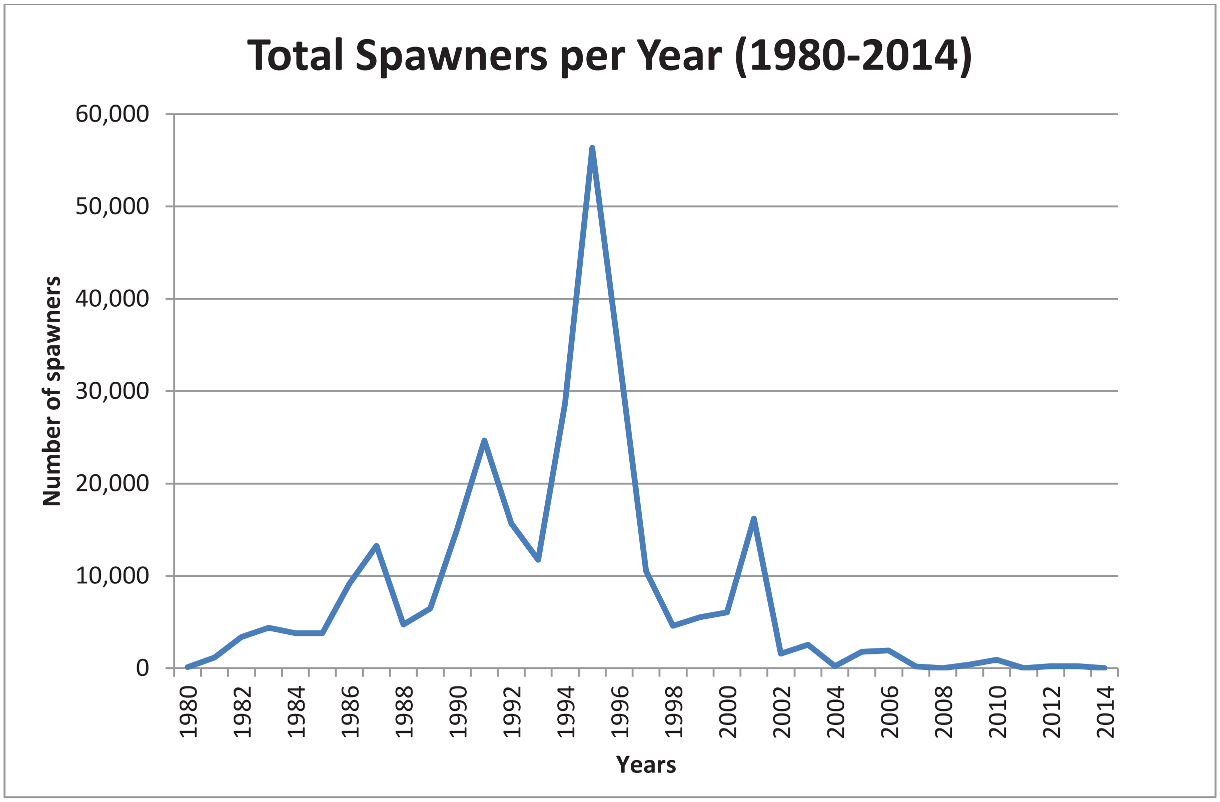

Figure 3-17. Graphical depiction of number of American shad spawners, from multiple sources, reaching upriver spawning habitat (primarily upstream of York Haven), 1980 to 2014 (Source: SRAFRC, 2010; Pennsylvania FBC, 2014).

Hatchery production of shad has also been a part of the Susquehanna River restoration program since 1976. Fertilized American shad eggs have been collected over the years on several rivers on the Atlantic coast (Susquehanna, Delaware, Connecticut, Hudson, Potomac, York, James River and its tributaries) and from the Columbia River in Oregon/Washington. In recent years, egg-taking has also occurred at the west fish lift via artificial tank spawning. Since the Pennsylvania FBC Van Dyke hatchery went into operation in 1976, more than 220 million shad fry and juveniles (mostly fry) have been stocked into the Susquehanna River and its tributaries, ranging on an annual basis from 660,000 to 13.5 million. In the last 5 years the numbers stocked have ranged from about 2.5 to 5.5 million, totaling 18.6 million, almost exclusively fry. SRAFRC (2013) estimated that for the 1986-2007 year classes, stocking of approximately 404 hatchery larvae was required to return one adult to the Conowingo lifts. Assuming that 400 fry are required for each adult return, stocking in the past 5 years could result in a return of about 46,500 adult shad to the lifts, but spread over 4 to 5 years and longer. For trucked fish, SRAFRC (2013) estimated that transport of 1.28 adults to upstream areas was required to return one wild fish to the lifts. Thus, 59,520 fish would need to be trucked to produce a return of 46,500 fish. However, past experience has shown that up to 56,000 fish were trucked in 1 year (see table 3-25), so this production could occur in 1 year, instead of being spread over 5 years, as with the recent hatchery program. Even a more modest trucking program of 30,000 fish per year over 5 years (stocking of 150,000 spawners) would result in the production of about 117,000 returning adults to the lifts, using current survival rates. A modest trucking program would have the potential to produce more adult returns than a hatchery program similar to that of the recent 5 years. Actual survival rates and adult returns to the Conowingo tailrace may even be higher, however, than estimated by SRAFRC because not all returning adults successfully enter the lifts.

Atlantic coast and Chesapeake Bay American shad population trends

The current decline in shad populations on the Susquehanna River parallels declines that have been occurring coast wide, including in the Chesapeake Bay. A report by the Chesapeake Bay program (http://www.chesapeakebay.net/indicators/indicator/american_shad_abundance, accessed March 26, 2014) states that, in 2013, the Bay-wide shad restoration program reached 41 percent of its goal, but most of the increase in recent years has been due to the improvement in the Potomac River shad run.[91] The recent trend for the other major tributaries to the Bay has been either a decline or continued maintenance of lower levels short of the goals. These other rivers include the York, James, Rappahannock, and Susquehanna. Fish passage impediments were removed on the James River (Bosher's dam fishway) and on the Rappahannock River (removal of Embrey dam) some years ago, but shad populations have not responded as expected to this increased availability of habitat. The James River shad population has remained at relatively low levels, and the Rappahannock River shad population, while recently reaching about 90 percent of its population target, has been relatively stable and not shown a major population increase in response to removal of Embrey dam in 2004, compared to the population level prior to dam removal.

For other Atlantic coast rivers, ASMFC (2010) reports that shad populations in most of the Atlantic coast rivers remain at historic lows and are not recovering to acceptable levels. ASMFC (2010) notes that data on annual numbers of fish passing upriver at dams on several Atlantic coastal rivers showed a coast-wide pattern of an increase followed by a decrease in the past 20 to 30 years. In fact, most fish passage numbers declined at about the same time (beginning in the late 1990s to early 2000s).

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[91] Jim Cummins, director for living resources at the Interstate Commission on the Potomac River Basin and co-chair of the Chesapeake Bay Program's American Shad Indicator Action Team, recently stated, "While there are several factors behind the shad recovery in the Potomac River, improved water quality is the cornerstone" (http://www.chesapeakebay.net/blog/post/potomac_river_sees_rise_in_returning_shad_driving_bay_wide_abundance_trend, accessed December 29, 2014).

This simultaneous decline suggests a coast wide change in environmental conditions or mortality factors that affected stocks from South Carolina to Maine within the last 5 to 10 years. This suggests that operation of hydroelectric projects on Atlantic coast rivers, many of which have fish passage facilities, has not been a primary cause of the population declines observed, and that additional or more effective fish passage facilities on these rivers may not necessarily result in population increases.

Alternative G and improvements to Conowingo fish lifts

As described above, alternative G would include major renovations to the Conowingo fish lifts. Other agencies and other entities also generally recommend major renovations to the lifts to improve the effectiveness of the lifts, but only Pennsylvania FBC provides specific step by step recommendations for fish lift improvements. Table 3-26 summarizes the improvements included in alternative G and recommended by Pennsylvania FBC.

Table 3-26. Summary of alternative G and Pennsylvania FBC recommendations for upstream anadromous fish passage at Conowingo dam (Source: Interior and Pennsylvania FBC terms and conditions; staff).

Alternative G	Pennsylvania FBC recommended improvements
Phase I: Construct a new west fish lift for both trap and trucking and direct volitional upstream shad passage (two 6,500-gallon hoppers), with an auxiliary attraction water system of 2,600 cfs. The objective would be to truck 50,000 adult shad per year. Create a 5,000-foot zone of passage on the east and west shores of the tailrace below the dam. Implement maximum downramping rate of 20,000 cfs/hour. Make channel modifications downstream to eliminate stranding in the spillway. Timeline: No schedule given, but we assume 1 year for design and 2 years for construction, for total of 3 years.	Item 1: Incorporate performance criteria into new license where 80 percent of the shad that enter the project area must pass the project within 5 days, to be based on telemetry study of 150 shad per year for 3 years. If goal is not reached, initiate operational changes as specified by the agencies and test for 3 years using telemetry study. If goal is still not reached after 3 years, make structural changes to the fish lifts as specified by the agencies, and test for an additional 3 years using a telemetry study. If goal is still not reached within 3 years, additional structural changes may be required, depending on behavior of tagged shad. Timeline: Potential for 12 years – 3 years for initial studies, 3 years for study of operational changes, 3 years for structural changes, and 3 years for additional monitoring.

Alternative G	Pennsylvania FBC recommended improvements
Phase II: Modify the east fish lift stilling basin to allow 900-cfs attraction flow, as originally designed. Relocate east fish lift entrance A to upstream of the Kaplan unit boils. Construct new entrance D and collection gallery to east fish lift, along the Kaplan units and connect to a new second hopper. Reconstruct entrance B to east fish lift at 45 degrees to the river flow (see figure 3-15). Timeline: To begin when new west fish lift begins operation; we assume 1 year for design and 2 years for construction, for total of 3 years	Item 2: Modify east fish lift to include a larger hopper, increased attraction flow, and addition of a collection gallery in front of units 8-11. Timeline: No schedule given as to when improvements would be required in relation to item 1, but we assume these would be the structural changes that would occur after the first 6 years of studies. Assume 1 year for design and 2 years for construction. Similar to Interior Phase II.
Phase III: If passage efficiency is not met in Phase I and II, make daily adjustments to minimum flows and turbine operation, construct an east fish lift auxiliary attraction water supply of 4,325 cfs, and upgrade east fish lift equipment to allow a 15-minute cycle time. Timeline: No timeline given but we assume 1 year for design and 1 year for construction, for total of 2 years.	Item 3: Complete the rebuild of the west fish lift to include additional attraction water and provision to expand to volitional passage if needed. Ultimately, fish passage facilities at Conowingo will need to pass a design population of 5 million fish, and fish lifts will be required on both sides of the tailrace. Timeline: No schedule given as to when improvements would be required in relation to item 1, but we assume these would be the structural changes that would occur after the first 6 years of studies. Assume 1 year for design and 2 years for construction. Similar to Interior Phase I. Item 4: Telemetry study of gizzard shad is needed to understand the issues of passage efficiency, capacity, and interference with American shad, and the recycling of gizzard shad in the west fish lift. Timeline: No schedule given but we assume a 1-year study during the first 3 years of study in Item 1.

Alternative G and Pennsylvania FBC's recommendations are similar in that they both call for the complete re-build of the west fish lift and major improvements to the east fish lift that would involve major structural changes. The Pennsylvania FBC recommendations differ from alternative G, in that Pennsylvania FBC appears to recommend that at least 6 years of radio telemetry studies first be conducted to determine fish passage effectiveness before structural changes are made, and after first studying operational changes for 3 of those 6 years. Interior does not specify any studies prior to making structural improvements in alternative G, only after the improvements are made.

While we understand that any final Interior fishway prescription that would require major structural improvements to the fish lifts would become conditions of any license issued, rebuilding both the east and west fish lifts does not appear to be justified at this time. Although we describe above that the effectiveness of the Conowingo fish lifts have not been high in two recent years of studies (2010 and 2012), we also find that other fish passage facilities for American shad have similarly exhibited a wide range of effectiveness, with some exhibiting low effectiveness. Even at Safe Harbor dam, which has demonstrated the highest effectiveness of the four fish passage facilities on the Susquehanna River (and perhaps of any fish passage facility on the Atlantic coast), has not met the minimum Interior criteria in many years. The current declining trend in the shad population in the Susquehanna River and elsewhere along the Atlantic coast also does not indicate that the existing fish passage facilities will be exceeding their current design capacity for American shad anytime soon. There is, however, a concern about the continuing increase in the gizzard shad population in the Susquehanna River, and the ability of the current lifts to handle that population.

Other concerns are that the existing facilities have not been well maintained by Exelon, are showing their age, and have not been operating as originally designed. For example, the west fish lift first began operation in 1972 for a 5-year period, and is still in operation, but with a hopper that is relatively small and that has the capacity to hold fewer numbers of fish than desired in light of current fish populations in the tailrace (particularly gizzard shad). The east fish lift was designed to operate with an attraction flow of 900 cfs (about 1 percent of the full Conowingo station capacity of about 86,000 cfs), but because of excessive turbulence within the fish lift at that flow, and issues with some of the gates, it now operates at an attraction flow of only 300 cfs (0.3 percent of full capacity). The west fish lift was designed with a total attraction flow of 300 cfs, so current total attraction flow at Conowingo is 600 cfs (about 0.7 percent of full capacity). Experience has shown that the Conowingo fish lifts are most effective when station discharge is much less than full capacity, when the total attraction flow is a greater percentage of ambient station discharge. The Interior and NMFS criterion for attraction flow is that it should be from 3 to 5 percent of full powerhouse capacity (Towler and Orvis, 2013), which at Conowingo would range from 2,580 to 4,300 cfs. Towler and Orvis (2013) also provide a summary table of attraction flows at fish passage facilities along the Atlantic coast, and for the major fish passage facilities listed (including those on the Connecticut, Merrimack, Penobscot, and Santee Rivers), Conowingo attraction flows are the lowest percentage of any of the major facilities. Conowingo also has the lowest attraction flows of the Susquehanna River fish passage facilities. Making structural modifications within the east lift to increase the east lift attraction flow to its original design capacity of 900 cfs would be a reasonable way to increase attraction to the east lift without having to make major changes to the lift associated with constructing a new attraction water supply system.

Another operational deficiency of the existing east fish lift is that entrance A, which faces the Kaplan units (numbers 8 through 11), is not usable when the Kaplan units are operating. The Kaplan units' discharge drowns out the attraction flow from entrance A, resulting in the closure of that entrance when the Kaplan units are operating. Alternative G would relocate entrance A to upstream of the Kaplan unit boils, to provide a better attraction flow jet to the quiescent area upstream of the boils (see figure 3-15). While this may have some merit, in that it would be similar to one of the Safe Harbor dam fish lift entrances that operates with good effectiveness, this would involve a major modification of the east lift. An alternative approach would be to first restore the 900-cfs attraction flow, and determine whether that additional flow, combined with operational modifications with the Kaplan units, would provide better attraction to entrance A when the Kaplan units are in operation. If the attraction problem persists after restoration of the 900-cfs flow, then the feasibility of relocating the entrance could be investigated. Alternative G would also reconstruct entrance B to a 45-degree angle to the river flow. This appears to be counter to normal Interior guidance that attraction flow should be parallel to river flow, but this is another entrance modification that could be investigated if restoration of the 900-cfs attraction flow does not produce improvements in attraction flow patterns.

Interior's alternative G and Pennsylvania FBC's recommendation call for construction of a collection gallery upstream of the Kaplan units' discharge, with alternative G stating that the collection gallery be connected to a new second hopper, to increase the capacity of the east fish lift, in light of the large number of gizzard shad now being lifted, and to help meet the American shad design capacity. Addition of a collection gallery would also be a major modification to the east lift, and may not be warranted, based on the current population size and the questionable value of a collection gallery for shad. Few of the major passage facilities for shad on the Atlantic coast have collection galleries,[92] and where small collection galleries have been installed (Holyoke and Turners Falls dams on the Connecticut River), shad primarily use the shoreline entrances and the gallery entrances have collected few fish and in some cases have been closed. The Safe Harbor Project, which has a similar size tailrace to Conowingo with a total hydraulic capacity of 110,000 cfs (larger than Conowingo), does not have a

[92] The Columbia River projects that pass shad have collection galleries, originally built for salmon, but the extent of collection gallery use by shad has not been reported.

collection gallery and has the highest fishway effectiveness on the river. Construction of a collection gallery should be a last step in making improvements to the fish lift entrances at Conowingo, and only if the previously discussed steps (restoring 900-cfs attraction water, and reconstructing entrances A and B) are unsuccessful, and there is evidence that large numbers of shad are in the tailrace and not locating the entrances. The past operation of the east fish lift has shown the capability to collect and lift large numbers of American shad (193,574 in 2001), as well as more than a million gizzard shad in recent years, so making a major modification such as a collection gallery should not be required unless a preponderance of information indicates that large numbers of shad are not locating the entrances.

The installation of a second hopper, however, is an east lift improvement that warrants consideration. The current hopper at the east lift has a stated design capacity of 750,000 shad annually, and an unknown number of other species. As we illustrated in table 3-14, large numbers of adult gizzard shad are now lifted at Conowingo (and all the Susquehanna River Projects), and the gizzard shad, which is only slightly smaller than the American shad, occupies much of the available space in the east-lift hopper. Addition of a second hopper, while it may not double the capacity at the lift, should provide an increase in capacity of at least 150 percent (Gomez and Sullivan and Normandeau, 2012). The original design of the east lift included the provision for adding a second hopper, so the space is there and no major modifications to the overall fish lift structure would be required. We have additional discussion of required hopper size below, under our discussion of west lift improvements.

Phase III of alternative G also calls for addition of an auxiliary attraction water supply of 4,325 cfs at the east lift (5 percent of the maximum powerhouse discharge) if passage efficiency is not met in Phase I and II, and the modification of fish lift equipment to allow a 15-minute lift cycle time. While we do not agree that an auxiliary attraction water supply is needed at this time,[93] we do agree that the fish lift should be able to achieve a lift cycle time of 15 to 20 minutes (the original design was to be a 15-minute cycle). Gomez and Sullivan and Normandeau (2012) report that the current lift cycle time is about 1 hour, which is inadequate for a fish lift that is handling millions of clupeids and other species annually. A shorter lift cycle time is needed to minimize the delay in lifting fish, and to reduce the potential for overcrowding the hopper on days of peak fish movement. Gomez and Sullivan and Normandeau (2012) state that one of the main reasons that the cycle time is about an hour is that the hopper floats when it is lowered back into the collection channel, and takes a while to fill with water and sink to the bottom. This has not been a major issue at other fish lifts on the Susquehanna and

[93] As we describe earlier in this section, we conclude that the originally designed 900-cfs attraction flow should first be restored and tested before making any major changes to the attraction flow system.

elsewhere, and it appears it could be easily remedied by the installation of hinge flap valves on the hopper floor.

Alternative G and the Pennsylvania FBC recommendation call for complete reconstruction of the west fish lift so that it can serve as a trap and truck facility and for volitional passage. Alternative G would include volitional passage and operation of a trap and truck facility (50,000-fish capacity) with two large hoppers (6,500-gallon) and a 2,600-cfs attraction water supply. Pennsylvania FBC does not specify the facilities required at the west lift, although it appears to also recommend a trap and truck facility with the provision to expand to volitional passage if needed in the future, to meet the design population of 5 million shad at Conowingo. We agree that the west lift should be improved and used for trap and trucking of shad, but it is premature to completely reconstruct the lift on the scale described in alternative G. Even in its current condition, the west lift continues to collect about 5 to 20 percent of the shad lifted at the east lift, with 2,030 collected in 2013 (16 percent of the east lift catch).[94] During the peak year of trap and trucking (1995) when about 56,000 shad were trucked upstream from Conowingo, about 12,000 shad were collected in the west lift and trucked upstream (21 percent of the total trucked). While trucking of shad has not occurred since the year 2000, the current fish sorting process at the west lift is labor-intensive and is essentially the same process using the same sorting tank initially installed in 1972. Trap and trucking operations at more recently constructed fish lifts typically involve a more automated process where transported fish can be more efficiently delivered to the transport truck, reducing the stress on trucked fish. Modifying the west lift facilities to improve the sorting and loading process would be an important measure as part of the reestablishment of a trap and trucking program from Conowingo. While alternative G would establish an objective to truck 50,000 shad per year, the peak shad catch for the west lift was about 16,000 fish in 1990, so the initial handling facilities could be sized with a lower capacity but use a design that could be expanded in the future if needed. Reestablishment of trap and trucking would also require purchase of trucks and transport tanks and associated aeration systems, unless some of that equipment is available from the previous program.

Another alternative G west lift improvement would be replacement of the existing hopper, which has a volume of 900 gallons, or the capacity to hold 700 fish (1.3 gallons per fish) according to Gomez and Sullivan and Normandeau (2012).[95] Interior has commented that the current hopper volumes at both lifts are inadequate for the design population and the other non-target species collected with shad (particularly gizzard shad that vastly outnumber American shad). Towler and Morales (2012) have estimated that

[94] The west lift also collected 480,000 gizzard shad in 2013.

[95] In contrast, the east lift hopper has a capacity of 3,300 gallons.

using a design population of 2 million shad, and the Interior criterion of 0.10 cubic foot per pound of fish in a hopper, the required hopper size at Conowingo (total of both lifts) would range from 842 to 1,768 cubic feet (depending on whether a 1963 log-correlation or a 2011 regression is used). At 7.48 gallons per cubic foot, this would require hopper sizes of 6,298 gallons to 13,225 gallons (alternative G describes hopper sizes of 6,500 gallons at a new west lift). Towler and Morales (2012), however, also factor in a non-target species allowance (gizzard shad), which increases these hopper sizes by 9 times with an 800 percent non-target species allowance. Towler and Morales (2012) conclude that sufficient hopper volume, as per the Interior criterion, cannot be achieved through any reasonable number of lifts at Conowingo, and recommend sorting as a way to eliminate nontarget species from the lifts.

At the current hopper size and using the Interior criterion of 0.10 cubic foot per pound of fish, the west lift hopper with 900 gallons (120.3 cubic feet) would have a capacity of about 1,200 pounds of fish. The east lift hopper at 3,300 gallons (441.2 cubic feet) would have a capacity of about 4,400 pounds of fish. If we use a combined average weight of 2 pounds for American and gizzard shad,[96] the west lift hopper has a capacity of about 600 fish and the east lift hopper has a capacity of about 2,200 fish. Gomez and Sullivan and Normandeau (2012) estimated that the current west lift hopper has a capacity of 700 fish (which would be an average weight of 1.7 pounds). Gomez and Sullivan and Normandeau (2012) also describe that the existing west lift hopper could be replaced with a larger 1,500-gallon hopper without changing the existing footprint of the west lift, although it would require changes in the steel superstructure and electrical and other mechanical components. This would have a capacity of about 2,000 pounds of fish, or about 1,000 fish using our calculations, and 1,150 fish as stated by Gomez and Sullivan and Normandeau (2012). While this would not meet the alternative G design for a 6,500-gallon hopper (capacity of about 8,700 fish), that design is well in excess of what is currently needed. A new 1,500-gallon hopper would increase the fish capacity by about 40 percent, which would be a substantial improvement over the existing hopper, particularly if hopper replacement is combined with structural and electrical/mechanical improvements, and an improved fish sorting and delivery system. Adding a second hopper of 3,300 gallons to the east lift as we describe above, would increase the lifting capacity of the east lift by an average of 2,200 fish, meaning that the total lifting capacity at Conowingo would increase to about 1,100 cubic feet (8,100 gallons), with a fish lifting capacity of about 5,500 fish. Even if the lifts were only able to cycle at one lift per hour (which we believe should be shortened), this would provide a lifting capacity of about

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[96] Walburg and Nichols (1967) state that male American shad average 2 to 3 pounds, and female shad average 3 to 4 pounds. Gizzard shad are generally smaller than American shad, but larger gizzard shad do overlap in size with American shad. Morales (2013) uses an average weight of 1.2 pounds for gizzard shad.

55,000 fish over a 10-hour day, a substantial improvement over the existing capacity at Conowingo.

Alternative G would include a major increase in attraction flows at the west lift to 2,600 cfs under phase I, and an increase in attraction flows at the east lift to 4,325 cfs under phase III, as we previously discussed. A flow of 2,600 cfs would be 3 percent of the powerhouse maximum hydraulic capacity, while the combined attraction flows of 6,925 cfs would be 8 percent of powerhouse capacity. We previously discussed that it would be appropriate to increase the east lift attraction flow to its original design capacity of 900 cfs. For the west lift, the current attraction flow is supplied by the house generating units, which provide on-site local power to the station, and is limited to about 300 cfs. This is a somewhat low attraction flow for the west side of the tailrace, and an attraction flow similar to the restored east lift flow (900 cfs) would be desirable, providing a total attraction flow from Conowingo of 2.1 percent, coming close to the Interior minimum of 3 percent of total station discharge. In addition, if higher attraction flows could be provided during periods of lower generation, these attraction flows could be more effective in attracting shad during off-peak generation. Providing additional attraction flow at the west lift would require additional structures at the lift, because the current supply through the house units could not be increased. Tailrace pumps or additional withdrawals from the reservoir would be required, and it is not known if the existing lift structure could accommodate an additional 600 cfs through its entrance weir gates without modification. Gomez and Sullivan and Normandeau (2012) did not include an assessment of adding additional attraction flow to the west lift, so a feasibility study would be required before additional action could be taken on this measure.

Alternative G and the Pennsylvania FBC recommendation both call for modification of the west lift so that it could be used for direct volitional passage to Conowingo Pond. Alternative G would provide volitional passage now, while the Pennsylvania FBC recommendation is that a new west lift be designed so that volitional passage could be provided later, if needed. We agree with Pennsylvania FBC that there would be no immediate need for west lift volitional passage, which would be a challenging engineering project. The west bank has no easy access route to Conowingo Pond for a volitional fish passage facility because of the west dam embankment, the presence of U.S. Route 1 on the dam, and the administrative offices on the west end of the powerhouse. Any fish passage channel conveying fish to Conowingo Pond would need to tunnel through the dam embankment and under U.S. Route 1, or pass through the administrative offices. An alternative approach would be to dedicate the west lift to trap and trucking, egg taking, and experimental purposes, while the east lift would continue operating exclusively for volitional passage. Upstream project owners also have major investments in fish passage facilities, so it wouldn't be appropriate to substantially reduce volitional upstream migration from Conowingo. The east lift has been shown to be capable of lifting large numbers of American shad in the past, and if additional improvements are made as we describe, this capability should be enhanced. Enhancing the west lift for trap and trucking, as we discuss, would provide an important boost to the overall shad population if good numbers of shad can be successfully trucked to upstream habitat. A decision on volitional passage at the west lift could be postponed until all the project fish passage improvements (including trap and trucking) that we describe are implemented and are operated for a period of time, to determine (based on fish returns) whether any additional volitional passage is required, or whether trap and trucking is still needed.

Alternative G also includes in phase I the creation of a 5,000-foot zone of passage on the east and west shores of the tailrace below the dam, implementation of a maximum downramping rate of 20,000 cfs/hour, and channel modifications downstream of the dam to eliminate stranding in the spillway. Our review of Exelon's report on tailrace water velocities (Normandeau and Gomez and Sullivan, 2012o) and several other studies conducted in the tailrace (such as shad radio telemetry studies in 2010 and 2012), found no indication of a blockage or substantial hindrance to migration associated with high water velocities. While high velocities were observed in the tailrace, there were also adequate zones of passage along the shoreline and in other locations, and none of the radio telemetry studies indicated that fish were unable to reach the powerhouse. While rapid downramping can cause fish stranding below hydroelectric projects, Exelon's fish stranding survey did not find evidence of substantial stranding of target species downstream of Conowingo dam (Normandeau and Gomez and Sullivan, 2012d). Although some fish stranding was observed, non-target species such as carp and gizzard shad comprised more than 90 percent of those observed. Total mortality of stranded fish ranged from 18 percent of the fish observed in the spring to 4 percent in other seasons. There appears to be little justification for requiring specific measures to prevent stranding below the dam.

Pennsylvania FBC recommends additional effectiveness studies for 3 to 6 years before any structural improvements to the fish lifts are made. We find that this additional round of studies would be unnecessary. Exelon has decade's worth of operational experience with the Conowingo fish lifts, and also conducted several studies during relicensing to address the fish passage issues. Sufficient information is available now to serve as the basis for fish passage improvements. We agree that additional effectiveness studies would be necessary to evaluate improvements made, but not prior to making the improvements. Pennsylvania FBC also recommends a gizzard shad telemetry study to understand the issues of passage efficiency, capacity, and interference with American shad, and the recycling of gizzard shad in the west fish lift.[97] This would be an important study to better understand how the gizzard shad affects the passage of American shad in the Conowingo lifts.

[97] Recycling means that fish enter the west fish lift, are sorted and released back to the tailrace, and then the fish re-enter the fish lift.

Downstream Passage and Fish Entrainment

York Haven Project

At each of the hydroelectric projects on the Susquehanna River, fish are susceptible to injury or mortality if they are entrained through the powerhouse turbines. Migratory fish species in the Susquehanna River that are susceptible to entrainment during their migration to the ocean include American shad, river herring (alewife and blueback herring) and American eel. River herring and American eel, however, have only been documented in the York Haven project area a few times since fish passage in the east channel became operational in 2000. Resident game fish including smallmouth bass, walleye, sunfish, and catfish that occur in the project area do not need to migrate downstream past the project to complete their life history, but these species may also be subject to entrainment through the project turbines.

Post-spawned adult American shad in the Susquehanna generally migrate downstream from June through mid-July, and juveniles migrate downstream from mid-September through mid-November. Post-spawned river herring tend to migrate downstream during the late-spring and summer, and the juvenile outmigration extends into the early fall. Adult American eel migrate downstream in the fall.

Under the terms of the Settlement Agreement, York Haven Power has agreed to implement several measures that are intended to or may serve to reduce fish entrainment mortality. These include: (1) increasing spill flows at the east channel and main dams during the American shad upstream passage season[98]; (2) continuing the current downstream juvenile American shad passage protocol, which schedules the operation of units 1-6 (Kaplan and propeller units) to be first online and last offline during the juvenile shad downstream migration period (which typically is from October 1 through November 30); (3) pass about 370 cfs through the forebay sluice gate for 1 or 2 hours in the morning during weekdays if river flows exceed the sum of the turbine hydraulic capacity, flows through the nature-like fishway (once constructed), flows through the east channel, and flows (if any) over the main dam from May 1 through June 30 to facilitate downstream passage of post-spawning adult American shad; (4) pass about 370 cfs through the forebay sluice gate between the hours of 5 p.m. and 11 p.m. during the entire juvenile American shad passage period to facilitate downstream passage of juvenile American shad; and (5) develop designs within 4 years of license issuance for removal of obstructions in or deepening of the downstream plunge pool from the forebay sluice gate, and a chute structure to convey flows beyond the roadway on the downstream side of the

[98] The magnitude of these flows would vary depending on whether the nature-like-fishway is in operation or not. Post-spawned shad begin downstream migration immediately after spawning, and could take advantage of increased spillage flow during the upstream passage season.

cable alley structure to protect outmigrating juvenile and adult American shad that land in the downstream pool.

Under the terms of the Settlement Agreement, York Haven Power also proposes to construct, operate, and maintain a nature-like fishway in the vicinity of the apex of the main dam and Three Mile Island in compliance with design criteria specified in appendix A of the Settlement Agreement. Upon completion of the nature-like fishway, York Haven Power proposes to implement several additional measures that may reduce fish entrainment mortality. These include: (1) conducting a juvenile American shad headrace turbine avoidance study; (2) if the juvenile American shad headrace turbine avoidance goals are not achieved, implement measures that would enhance the effectiveness and conduct a supplemental juvenile American shad headrace turbine avoidance study within 2 years of implementing the measures; (3) provide an average daily minimum flow of 267 cfs in the east channel below the east channel dam year round; (4) provide at least 5 percent of river flow through the nature-like fishway and supplemental attraction flow channels when flows entering the project during the American shad upstream passage season are between 5,000 and 150,000 cfs; (5) provide a minimum flow of 200 cfs through the nature-like fishway when the river elevation is at the crest of the main dam and outside of the American shad upstream passage season; and (6) to the extent controllable by York Haven Power, when flows exceed the hydraulic capacity of all available generating units, manage flows to maximize flow over the main dam and the nature-like fishway.

Our Analysis

Currently, both migratory and resident fish species can move downstream past the project via four routes: (1) the powerhouse turbines, (2) the sluice gate located at the downstream end of the powerhouse, (3) the main dam spillway, and (4) the east channel dam spillway and gates. Once construction of the nature-like fishway has been completed, this will provide a fifth potential avenue for downstream passage.

As part of study 2.3, *Assessment of American Shad at the York Haven Project*, York Haven Power conducted a desktop assessment of turbine entrainment and mortality, which was included as appendix G in the Initial Study Report. The assessment included a literature review of relevant fish entrainment and passage survival data applicable to the project and an evaluation of the flows passed via each potential passage route to assess the overall effects of entrainment and passage survival at the project.

Passage survival over the project spillways and sluice gate was evaluated by reviewing studies conducted at other low-head (equal to or less than 60 feet) non-turbine exit routes including sluices, spillways, and bypass pipes. These studies were conducted at seven different hydroelectric projects under a total of 17 different release locations or test conditions (head or spill volume). Survival rates estimated during these studies using the balloon-tag testing method ranged from 91 to 100 percent. Based on a comparison of site characteristics to the sites where the field studies were collected, York Haven Power concluded that the survival rate of fish passing the spillways and sluice gate at York Haven is likely about 97 percent.

York Haven Power used a variety of approaches to estimate the likely fish passage survival rates for fish that are entrained through the project turbines, based on an assessment prepared by Normandeau (2011), which was included as Attachment B of the desktop assessment. This included a review of site-specific data, analysis of comparable data from similar projects, and the use of a predictive turbine blade strike model developed by Franke et al. (1997). For outmigrating juvenile American shad, Normandeau estimated that the survival rate of juvenile American shad likely ranges between 83 and 98 percent at the six Kaplan units (units 1-6), and 66-92 percent at the 14 Francis units (units 7-20). The available data for juvenile American shad included the results of site-specific tests conducted in 2000, which produced survival estimates of 92.7 percent at unit 3 and 77.1 percent at unit 7, both of which fell within the ranges estimated for Kaplan and Francis units, respectively. For outmigrating post-spawned adult American shad, Normandeau estimated that the survival rate likely ranges between 61 and 91 percent at the Kaplan units (units 1-6), and 60-78 percent at the Francis units (units 7-20). The turbine blade strike model predicted that survival rates at all turbines would decline with increasing fish size, from about 95 percent for 4-inch fish to about 54 percent for a 40-inch fish, the approximate maximum length for an adult American eel. More typical sizes for adult eels are from 18 to 30 inches (Scott and Crossman, 1973), so survival should be higher for the more typical sizes.

The percentage of fish passing the project that are entrained through the powerhouse and subject to potential turbine entrainment mortality is likely to be roughly proportional to the percentage of the river flow that passes through the powerhouse. The hydraulic capacity of the project is exceeded about 60 percent of the time, and on average the proportion of the flow that passes through the project powerhouse varies from about 23 percent in April to nearly 100 percent from July through September. However, fall rainstorms that increase Susquehanna River flows (and may trigger downstream migrations of juvenile shad and American eel) may also result in spillage at York Haven, providing for safe downstream passage. Each of the measures proposed by York Haven Power that would increase the amount of flow that passes the project via routes other than the turbines (including spillways, sluice gates and the nature-like fishway, once constructed) are likely to reduce the number of fish that are entrained through the turbines and subject to potential injury or mortality. York Haven Power's proposal to remove obstructions in or deepen the plunge pool below the forebay sluice gate, and a chute structure to convey flows beyond the roadway, would help to ensure that fish passed via the sluice gate would be subject to minimal, if any, injury or mortality.

York Haven Power's proposal is to continue the current downstream juvenile American shad passage protocol, which requires the operation of units 1-6 (Kaplan and propeller units) to be first online and last offline during the juvenile shad downstream migration period (which typically is from October 1 through November 30), and to pass about 370 cfs through the forebay sluice gate between the hours of 5 and 11 p.m. during the entire juvenile American shad passage period. This protocol would reduce entrainment mortality by reducing the amount of flow that passes through the Francis turbines and by increasing the proportion of fish that emigrate through the sluice gate, as opposed to the turbines. Conducting a juvenile American shad headrace turbine avoidance study and implementing any measures that may be needed to meet headrace turbine avoidance goals would further improve the survival rate of juvenile American shad passing the project.

York Haven Power's proposal for downstream passage of post-spawned adult American shad is to pass about 370 cfs through the forebay sluice gate for 1 or 2 hours in the morning during weekdays if river flows exceed the sum of the turbine hydraulic capacity, pass flow through the nature-like fishway (once constructed), continue flow through the east channel, and utilize any spillage flow over the main dam from May 1 through June 30. During the radio telemetry monitoring conducted by York Haven Power in 2012 (York Haven Power, 2012b), 13 out of 59 adult American shad (22 percent) that were documented passing the project passed through the forebay sluice gate. Continuing the operation of this sluice gate would ensure that a considerable portion of downstream-migrating adults can utilize this safe passage option, while other passage routes would provide additional options for safe passage.

Muddy Run Project

Downstream passage concerns at Muddy Run are somewhat different than at the other projects, because Muddy Run does not form a blockage to migration (like a dam), and fish do not require passage through the project to reach the ocean. The primary concern at Muddy Run is that downstream-migrating fish may be entrained and killed or pumped to the upper reservoir, and lost to the population. Resident species may also be entrained but few concerns were expressed by stakeholders about effects on resident fishes. Commenting agencies have generally recommended the same downstream passage survival rates at Muddy Run as recommended at the other projects (80 percent survival of adult shad and 95 percent survival of juvenile shad). Exelon states that it believes the downstream passage survival criteria are already met, but also has agreed to the Pennsylvania DEP certification conditions. Those conditions state that: (1) Exelon must submit a plan and schedule to provide for 95 percent survival of juvenile American shad and 80 percent survival of adult American shad that pass through the project area, with full implementation of the plan by 2015; (2) by February 15, 2026, or later, Exelon would be required to submit a plan to measure the passage of American shad moving downstream past the project to Pennsylvania DEP for approval (the "discrete passage study"); (3) Exelon would conduct the discrete passage study, and if results indicate that passage goals are met, specific operational measures or protocols would be incorporated into the FPOP to ensure that goals are continued to be met; and (4) if study results indicate that passage goals are not met, Exelon would propose a plan and schedule for mitigation to meet the passage goals.

Our Analysis

We previously discussed the downstream migration of juvenile shad past the Muddy Run Project. Exelon's studies estimated that for juvenile shad that were in the zone of influence during pumping, 22.6 percent of those fish could be entrained. For the overall population, however, Exelon estimated that only 2.9 to 6.6 percent of the population would be vulnerable to entrainment during peak outmigration times, because the project is not pumping during many of the peak hours of outmigration (Normandeau and Gomez and Sullivan, 2012g). These data indicate that the project essentially already meets the target effectiveness for downstream juvenile shad passage. The FWS review of Exelon's study (Pugh, 2013) stated, however, that by adjusting the periods when juvenile shad may actually be passing the project, based on information from the scientific literature, the actual entrainment rate for juvenile shad would be from 12.3 to 14.5 percent of the population, and not 2.9 to 6.6 percent as estimated by Exelon. Exelon, in its reply comments filed on March 18, 2014, states that the Pugh (2013) review of the data was flawed and that he overstates the actual effects of the project. We previously concluded that: (1) these conflicting studies and analyses and the argued differences in migration and entrainment rates may be within the range of error for the field studies and the data analysis; and (2) the studies and analyses have overall shown that the Muddy Run Project has not had an adverse effect on a major proportion of the shad population migrating downstream past the project. Interior also states, in an amendment to its preliminary fishway prescription filed on February 28, 2014, that while it believes that Muddy Run operation may affect fish migration, the effects may not be sufficient to affect the fisheries agencies goals for this reach of the river.

In addition, with Exelon now agreeing to the conditions of the Pennsylvania DEP certification, Exelon has committed to maintaining the effectiveness targets required by Pennsylvania DEP, would monitor this effectiveness via the studies required by the certification as part of its FPOP, and would mitigate any effects of the project if the target effectiveness is not maintained.

Conowingo Project

The Conowingo Project has the potential to entrain and injure or kill migratory fish moving downstream, as well as non-migratory species from Conowingo Pond. As is the case for the upstream hydroelectric projects, large numbers of American shad migrate past the project each year (although those numbers have decreased in recent years), while very few American eel and river herring occur upstream of Conowingo dam. Resident game fish species that are common in Conowingo Pond that may be subject to turbine entrainment include channel catfish, smallmouth bass, largemouth bass, walleye, green sunfish, pumpkinseed, bluegill, and white crappie. The reservoir currently supports a large population of gizzard shad as well as other species of forage fish, which may also be subject to entrainment.

Exelon proposes to continue to provide downstream passage via the project turbines at the Conowingo Project for juvenile and adult American shad. Interior, The

Nature Conservancy, Pennsylvania FBC, and Chesapeake Bay Foundation all recommend that Exelon implement measures to meet the downstream passage survival goal of 95 percent for juvenile American shad passing the Conowingo Project, as specified in the SRAFRC 2010 Restoration Plan. The Nature Conservancy and Chesapeake Bay Foundation further recommend that Exelon meet the 80 percent downstream passage survival goal for adult American shad established in the SRAFRC 2010 Restoration Plan.

Interior also recommends that Exelon develop an FEMP in consultation with Interior, to ensure that any changes in structure or operation as a result of relicensing continue to meet the survival goal for juvenile American shad of 95 percent. Interior recommends that Exelon provide an annual report detailing implementation of the FEMP to the resource agencies, including any deviations from the FEMP, followed by an annual meeting. Any required modifications to the FEMP would have to be submitted to the resource agencies within 30 days of receipt of a request for the modification unless a longer period is approved by Interior. The modifications to the FEMP would have to be implemented consistent with the approval of Interior.

In its reply comments, Exelon contends that relicensing studies demonstrate that the project meets the downstream targets requested by the parties and it is unnecessary to include these passage rates as conditions in the license.

Our Analysis

As part of Revised Study Plan (RSP) 3.2, Exelon conducted a desktop study of turbine entrainment and mortality (Normandeau and Gomez and Sullivan, 2012i). The study included an assessment of the potential for fish impingement on the trashracks, assessment of entrainment potential based on habitat use, and estimation of passage survival rates for the Francis and Kaplan turbines at the project. The turbine passage survival assessment included a review of site-specific studies, analysis of comparable data from similar projects, and the use of a predictive turbine blade strike model developed by Franke et al. (1997).

To evaluate the potential for impingement on the trashracks, the desktop assessment included an evaluation of the swimming capability of American shad, American eel, and six representative resident fish species in relation to the approach velocity at the powerhouse trashracks, estimated fish widths, and trashrack spacing. The estimated approach velocity at the trashracks ranged from 2.4 to 3.7 feet per second at Units 1-11, which have trashracks with a 5.37-inch clear spacing. The two smaller house units have a clear spacing of 1.5 inches and an estimated approach velocity of 1.4 feet per second. The results of this analysis indicate that the potential for fish impingement at the project is minimal, because most larger fish would have sufficient swimming ability to avoid being swept into the trashracks, and smaller fish with lower swim speeds would likely pass through the trashracks and pass through the units. A possible exception is that larger channel catfish could be impinged, because they may have lower swimming speeds than other species, although no swim speed information was available. Results of the habitat use assessment indicated that entrainment potential was low for littoral species such as bluegill, largemouth bass and smallmouth bass because the bottom intakes are in the deepest part of the reservoir and not located near shallow water littoral areas where these species are typically found.

The desktop assessment also included an evaluation of turbine passage survival rates measured at other sites, but the results of these studies showed a wide range of values that are likely less informative than the results of site-specific testing that Exelon performed using juvenile and adult American shad.

Site-specific testing of turbine passage survival of juvenile American shad was conducted in 1993 (RMC, 1994) at one of the Kaplan turbines and in 2011 (Normandeau and Gomez and Sullivan, 2012n) at one of the Francis turbines using the balloon tag testing technique. Testing at the Kaplan turbine (unit 8) was conducted with a wicket gate opening of 55-56 percent, which was considered to provide less than optimal passage conditions, and resulted in a short-term (1-hour) survival estimate of 94.9 percent. Testing of juvenile American shad passed through the Francis turbine (unit 5) in 2011 resulted in a survival estimate of 89.9 percent. Testing at the Francis unit was conducted at near-peak efficiency, the setting the unit operates at most of the time when juvenile American shad would be moving past the Conowingo Project.

Site-specific testing of the turbine passage survival of adult American shad was conducted in 2011, also using the balloon tag testing technique (Normandeau and Gomez and Sullivan, 2012f). Testing was conducted at the Francis turbine (unit 2) at near-peak efficiency, and testing at the Kaplan turbine (unit 8) was conducted at a turbine discharge of 8,842 cfs (efficiency not given, but assumed to be near-peak). The resulting survival estimates for adult American shad passed through the Francis and Kaplan turbines were 93.0 and 86.3 percent, respectively. The turbine passage survival rate of adult American shad was also estimated using the turbine blade strike model developed by Franke et al. (1997). The blade strike model predicted a survival rate of 79.8 to 90.4 percent for the Francis unit and 82.1 to 94.5 percent for the Kaplan unit.

The site-specific turbine passage survival rates estimated for adult American shad using the balloon-tag testing technique were consistent with survival rates estimated using the blade strike model, providing a reasonable degree of assurance that the passage survival rates for adult American shad meet or exceed the 80 percent downstream passage survival goal for adult American shad established in the SRAFRC 2010 Restoration Plan. The site-specific passage survival estimated for juvenile American shad indicates that survival rates likely equal the downstream passage survival goal of 95 percent at the Kaplan turbines, but are about 5 percent below this goal in the Francis turbines.

An FEMP, as recommended by Interior, would provide additional information on any variations in turbine passage survival associated with differences in operating conditions, and would provide an improved understanding of the survival rates of juvenile and adult American shad that are entrained through turbines at the Conowingo

Project. Although the available data indicate that the passage survival rate for juvenile American shad through the Francis units may be about 5 percent lower than the passage survival goal of 95 percent, none of the stakeholders have suggested measures that may be feasible to improve passage survival in order to meet this goal. In the absence of any potentially feasible measures that could be implemented, the benefit of conducting additional testing of passage survival rates is unclear.

American Eel Passage

Our previous discussion of upstream and downstream fish passage focused on anadromous species. Because American eel differ in life history (a catadromous species), behavior, and swimming ability, they require different types of passage facilities. Accordingly, we discuss American eel passage separately.

York Haven Project

Eel passage has not been a major issue at York Haven because American eel have not occurred in appreciable numbers in the project area since construction of the lower river dams blocked upstream migration. American eel have occasionally been experimentally stocked in the upper river through the years, and recent studies and restoration efforts to date have been focused at Conowingo. Some eels collected at Conowingo have been transported to Susquehanna River tributaries upstream of York Haven (York Haven Power, 2011).[99]

York Haven Power conducted a review of potential upstream and downstream eel passage measures at the project (York Haven Power, 2011), and included provisions for eel passage in the Settlement Agreement. No additional upstream fish passage measures are proposed for eels, because York Haven Power and the signatories to the Settlement Agreement believe that the proposed nature-like fishway and the low-head nature of the dam would provide adequate upstream passage. For downstream passage, York Haven Power would cooperate with the agencies and other project owners in a lower Susquehanna River downstream eel study to investigate the behavior and passage routes for migrating silver eels in the lower river and in the vicinity of York Haven. This would be a 2-year study to occur in about 2017-2020. York Haven Power would also conduct an eel survival study for passage through the turbines. If studies indicate that eel survival objectives are not met, York Haven Power would conduct a downstream eel improvements study, to identify measures that could be implemented to improve survival, to be followed by implementation and testing of those measures, and additional consultations as required.

[99] FWS has been trapping and trucking eels from the Conowingo tailrace since 2008, and transported about 300,000 eels through 2012.

Our Analysis

American eels do not occur in the project area in any numbers, with only experimental upstream stockings to date. Because upstream passage at downstream dams on the river would require several years to be implemented, it would be many years before upstream migrating eels arrive in the project area through volitional migrations. We agree that the nature-like fishway and the low-head configuration of the dam would likely provide for adequate upstream passage once upstream migrating eels arrive at the project. If trap and trucking of eels is implemented at Conowingo as proposed, it is likely that eels would be trucked upstream of York Haven in the immediate coming years.[100] These eels would remain in the river for 10-20 years before maturing to the silver eel phase and out-migrate to the ocean. At that time, downstream passage over the project would be needed.

The Settlement Agreement includes provisions for the eventual downstream passage of eels at the project, including studying the migratory pathways at the project and survival through the turbines, and then implementing protective measures if needed. These provisions of the Settlement Agreement would adequately protect downstream migrating eels once they arrive at the project.

Muddy Run Project

American eel are not currently migrating through the Muddy Run Project area, as existing studies are focused downstream of Conowingo dam, and any experimental trucking has focused on upriver areas. However, the certification for the project has several measures related to eel, although many of those measures would be implemented at Conowingo. Exelon would be required to implement its American Eel Passage Plan with all measures to occur at Conowingo. Thus, we discuss those measures below under the Conowingo Project.[101] For downstream passage, Exelon would comply with downstream eel passage rates of at least 85 percent through the Muddy Run Project area. However, the compliance date when that would be required is October 1, 2026, once sufficient numbers of eels have been released into the Susquehanna River to produce a substantial number of downstream migrating silver eels. Exelon would be required to conduct studies to demonstrate compliance with the passage rate, and if not achieved would be required to provide mitigation.

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[100] Exelon would begin trap and trucking after issuance of any new license and would continue that program until 2029, when volitional passage would begin.

[101] Although mandatory conditions such as those contained in the certification would be requirements of any license issued, the Commission could not require a condition in the Muddy Run license for actions to take place at another licensed project (Conowingo).

Both NMFS and Interior reserve their authority to require fishways during the term of the license, and Interior also provides a preliminary fishway prescription. For American eel, the preliminary fishway prescription requires an eel passage program with other licensees on the river, so that operation at Muddy Run does not interfere with passage objectives at the upstream Holtwood Project. The prescription also requires establishment of an Eel Passage Advisory Group within 6 months of license issuance, and an American Eel Passage Plan that would be implemented at the downstream Conowingo Project, which we discuss below.[102]

For downstream passage, Interior requires a downstream eel passage study to evaluate the timing, magnitude, duration, annual variation and environmental conditions associated with active migration of silver eels from tributaries stocked with elvers, through the lower Susquehanna River and past the Muddy Run Project to the Chesapeake Bay. This study would be conducted for at least 2 years and would begin 3 years after license issuance. Concurrent with the downstream eel passage study or at a later date as approved by Interior, Exelon would also conduct a site-specific route of passage study to evaluate the entrainment rate of silver eels migrating in the vicinity of the project. If the results of the study indicate that the project's existing operating measures do not meet the downstream passage criterion (survival of 85 percent of silver eels passing the project), Exelon would prepare and submit a plan and schedule for evaluating the feasibility and costs of potential physical and/or operational modifications to the project to facilitate downstream eel passage.

Our Analysis

The downstream passage measures at Muddy Run required by both the certification (which Exelon has agreed to) and the Interior preliminary fishway prescription are similar, in that they both require monitoring studies of downstream-migrating silver eels past the project. If downstream passage survival criteria are not met, then operational or physical changes to the project would be required to mitigate any effects. Exelon has already conducted a radio telemetry study of silver eel passage past the Muddy Run Project (Normandeau and Gomez and Sullivan, 2012g), and found that nearly all the eels migrated past the project with minimal delay, and that the entrainment rate (i.e., pumped to the upper reservoir) was only 7 percent (exceeding the Interior 85 percent passage survival criterion). Eels used in the study were transported from the Delaware River, because virtually no silver eels are currently available from the Susquehanna River upstream of Conowingo.

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[102] Interior does not specify the location of upstream eel passage facilities, only that immigrating juvenile eels be trapped "from a point downstream of the Muddy Run Project, and transport them to designated points in the Susquehanna River watershed." We assume that this unnamed location would be the Conowingo dam tailrace, where the FWS has been conducting eel trapping investigations for more than 8 years.

The certification and Interior preliminary fishway prescription requiring later monitoring of downstream silver eel passage past the project is reasonable, although it would be more appropriate to conduct these studies farther into the future when "native" Susquehanna River silver eels are available for passage studies. The certification requirement appears to reflect that objective, in that it would not require such studies until after 2026 (at least 12 years into the future). The Interior preliminary fishway prescription, however, requires a 2-year study that would begin 3 years after license issuance. This would be much too soon to have substantial numbers of Susquehanna River silver eels available from any required trap and trucking operation (typical freshwater residence time is 10 to 20 years), and any such study would essentially be a repeat of Exelon's recent study using eels from another river system. More valuable data would be collected if naturally migrating Susquehanna River silver eels were used in the study, instead of eels trucked from another river.

Conowingo Project

Exelon's proposal for upstream passage at Conowingo is to construct an eel trap and transport facility on the west side of the tailrace, and cooperate with other licensees in implementing a trap and transport program for eel downstream passage from tributaries upstream of York Haven. As we discussed above, as part of the Interior preliminary fishway prescription for Muddy Run, Interior is requiring an eel trap and transport program from downstream of Muddy Run (we assume Conowingo) to upstream locations. Interior's recommendations for Conowingo[103] include an eel trap and transport program beginning with a facility on the west shore of the Conowingo tailrace, to be completed within 1 year of completion of any construction at the west fish lift, or within 1 year of license issuance if no construction occurs at the west fish lift. This trap and truck facility would operate until 2029, and volitional passage would begin in 2030. Exelon would also be required to investigate a location for an eel trap on the east side of the Susquehanna River or in Octoraro Creek, and establish a temporary trap and truck facility within 2 years of license issuance and a permanent facility within 5 years of license issuance. This trap and truck facility would be operated until 2029; volitional passage would begin in 2030, we assume from a facility on the east side of the Susquehanna River below Conowingo dam.

Interior included additional details on upstream eel passage in its Muddy Run preliminary fishway prescription that it did not include in its Conowingo recommendations. However, because it appears the Muddy Run preliminary fishway

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[103] Interior's recommended terms and conditions filed January 31, 2014, include a statement that the Commission should require the conditions included in Attachment A to their letter in any license issued for the Conowingo Project. Attachment A includes measures for upstream eel passage as described herein.

prescription actually applies to actions at Conowingo, we discuss those details here.[104] Interior recommends that Exelon provide financial support to Interior of $20,000/year for its eel trapping facility at Conowingo dam until Exelon's facility is completed. The recommendation would require field testing to determine the best locations for eel traps, prior to construction of permanent traps that would consist of two ramp-style traps with capacity to pass 50,000eels/day. Exelon would also need to provide facilities for holding and transport and implement a quality assurance/quality control program to ensure that a target survival of 95 percent is achieved. An instream evaluation of the presence of eels in the river and tributaries would be required every 3 years, and a 2-year downstream passage study of silver eels would be required within 3 years of license issuance (discussed above under Muddy Run).

The certification for Muddy Run also provides substantial detail for American eel passage in its specified American Eel Passage Plan. This plan is very similar to the Interior Muddy Run preliminary fishway prescription, requiring facilities at Conowingo and the detailed steps and schedules required. The certification also requires an eel trap and truck facility on the east shore, although it specifies that the facility be placed in Octoraro Creek, with the caveat that the location may be changed to other locations on the east side of the tailrace if the Octoraro Creek location is not successful. Similar to the Muddy Run preliminary fishway prescription, the certification also requires volitional passage at Conowingo, but states that will occur *if* the eel trap and transport program terminates in 2030.

Our Analysis

Because Exelon has accepted the conditions of the certification for Muddy Run, it has essentially also accepted the FWS preliminary fishway prescription for Muddy Run, with some minor differences. As American eel restoration in the Susquehanna River is in its beginning stages, a phased approach for passage at Conowingo as agreed upon by Exelon, FWS, and Pennsylvania DEP is a reasonable way to proceed. We note that all parties have agreed to proceed with volitional passage at Conowingo at a fixed date in the year 2030. The assumption may be that over the next 15-year period the number of juvenile eels approaching the dam would increase to the point that trucking would no longer be a viable option, or that it may take that long to properly design and construct

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[104] As previously noted, although mandatory conditions such as those contained in a fishway prescription would be requirements of any license issued for the Muddy Run Project, the Commission could not require a condition in the Muddy Run license for actions to take place at another licensed project (Conowingo).

effective volitional facilities at all projects that may need them.[105] The former may or may not be a good assumption, because even if the number of silver eels emigrating from the Susquehanna River increases over the next several years of trap and trucking, that would not necessarily translate into an increasing number of juvenile eels returning from the sea. Because American eel are thought to be one, well-mixed, single-breeding population (panmictic), the distribution of juvenile eels along the Atlantic coast is random with no homing to specific watersheds (Interior, 2007). A trap and trucking program may still be viable past 2030 and would give managers the option to stock specific watersheds that may not be available with volitional passage, or in the event volitional passage facilities at the three lower Susquehanna River projects are not highly effective.

For downstream passage, Exelon proposed to cooperate with other licensees on the lower Susquehanna River in implementing a trap and transport program and studies on eel passage from upstream of York Haven. In its comments on the draft EIS, however, Exelon states that, based on available study data and subsequent discussions with resource agencies, downstream trap and trucking of American eel is no longer a component of its licensing proposal. Because essentially no silver eels are currently emigrating from the Susquehanna River, and because site-specific studies for Muddy Run and Conowingo demonstrate that downstream eel passage past the Muddy Run pump/turbines and through the Conowingo turbines does not result in significant mortality (Normandeau and Gomez and Sullivan, 2012g; FWS, 2012), downstream eel passage is not a major issue or requirement at this time.

Freshwater Mussels

York Haven Project

Because substratum in the project area consists mainly of bedrock and large boulders and is subjected to frequent periods of elevated water velocity, this river reach provides little optimum mussel habitat. Based on sampling conducted in August 2010, five mussel species and 56 individuals were collected during 21.8 hours of searching; half of the sites yielded no live mussels. Weathered shells and shell material were observed along the shore and in shallow water, and there were no large deposits of fresh shells that indicate presence of a nearby dense mussel assemblage. Although obtaining quantitative, total substratum sampling was not an objective of this survey, the fact that some small mussels were collected using qualitative methods indicates that conditions are suitable for limited mussel recruitment.

[105] The year 2030 is also the year that the upstream Holtwood and Safe Harbor project licenses will expire (and potentially be renewed), and may coincide with implementation of eel passage measures at those projects.

Our Analysis

The York Haven Project operates run-of-river and is not designed for flood control; therefore, downstream frequencies of major hydraulic events remain largely unchanged from pre-project conditions. There are no specific effects on resident mussels associated with operation of this project. The relatively low habitat value of the project area, compared with other reaches of the Susquehanna River, results mainly from existing conditions of substratum and water flow.

In June 2010, York Haven Power agreed to maintain minimum releases of 400 cfs in the east channel for aquatic habitat enhancement and resident fish passage.[106] Continuing this minimum release would benefit mussels and other aquatic organisms in the east channel. Based on results of York Haven Power's mussel surveys, the east channel provides the best aquatic habitat for mussels in the project area.

Lellis et al. (2013) determined that the American eel is the most effective host species for the eastern elliptio mussel. Two other reported hosts for this mussel species (mottled sculpin and slimy sculpin) are not found in the lower Susquehanna River. The other two reported host species (brook trout and lake trout) are occasionally taken by anglers in the lower Susquehanna River; because they are likely part of a put-grow-and-take fishery in tributaries to the Susquehanna River, they do not reproduce in the river. Because eel passage is limited by the dams, it is likely that eastern elliptio abundance in the lower river, with the exception of the reach below Conowingo dam, is negatively affected by limited upstream eel passage at the lower river dams. Downstream of York Haven dam, the eastern elliptio ranked third in abundance and comprised 12.5 percent of the assemblage. This was considerably less abundant than downstream of Conowingo dam, where the species dominated the mussel fauna (compare tables 3-15 and 3-17). Exelon proposes an interim trap and transport program, and ultimately volitional upstream passage facilities, to enhance upstream passage of American eel at Conowingo dam. The Holtwood Project, as a requirement of its recent license amendment to add a second powerhouse, will also provide dedicated upstream eel passage when facilities at Conowingo are operational. These eel passage improvements would increase the number of American eels successfully passing the lower river projects, which should ultimately benefit the eastern elliptio population. An increase in the eastern elliptio population would have secondary beneficial effects on water quality and suspended sediments in the Susquehanna River and the Chesapeake Bay.

Conowingo Project

The Conowingo Project has the potential to affect freshwater mussels downstream of the dam by flow and water level fluctuations associated with peaking operation,

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[106] The minimum releases are pursuant to the June 2010 Consent Order and Agreement between York Haven Power and Pennsylvania DEP.

impeding the passage of fish species that serve as hosts for mussel species and altering substrate composition downstream of the dam. Exelon proposes measures to restore passage of American eel to tributaries upstream of the project by implementing a trap and truck program, which could benefit the eastern elliptio by expanding the range of this host species. The Nature Conservancy recommends that Exelon mitigate for loss of coarse sediments (such as sand, gravel, and cobble) within the project area between Conowingo dam and the Chesapeake Bay, to enhance the habitat for living resources, including freshwater mussels.

Our Analysis

The Nature Conservancy suggests that loss of coarse sediments below Conowingo dam could be mitigated by extracting appropriate material from another location and placing it in appropriate areas that would not be subjected to erosive flow. Although this would likely increase the quantity of suitable habitat, it is unlikely that this would cause a notable increase in either mussel density or species richness. Mussel habitat below the dams is negatively affected by high discharge events, and increasing the amount of substrate appropriate for mussels would not eliminate the effects of high flow events.

Implementing Exelon's proposal to transport American eel to and from tributaries upstream of the York Haven Project could provide some benefit to the eastern elliptio, but because many other species of fishes act as fish host for eastern elliptio this benefit is likely to be minimal. Given the diverse fishery that occurs upstream and downstream of Conowingo dam and the variety of fish that are passed upstream of Conowingo dam via the existing fish lifts, it is likely that there would continue to be sufficient fish host species to support a diverse freshwater mussel fauna.

We addressed the potential effects of flow and water level fluctuations associated with project operation and recommendations to modify operational constraints earlier in this section in our discussion under *Downstream Flow Releases*.

Invasive Species

Limited numbers of zebra mussels have been detected downstream of Conowingo and York Haven dams, although no major infestations have been documented at the lower Susquehanna River projects, which do not directly influence spread of the invasive zebra mussel and other exotic mollusks. Because of concern over fouling by non-native bivalves at power plants, Exelon developed a set of mussel fouling prevention/control options that would be a starting point in developing an effective zebra mussel control program. Measures include oxidizing biocides, non-oxidizing molluscicides, and a series of non-chemical options such as manual cleaning, use of pigs,[107] high pressure water jets,

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[107] Pigs are devices that are placed inside pipes, to clean the inside of the pipe, often while the pipe remains in operation.

strains, traps, filters and thermal treatment. Personnel would be prepared to further evaluate and deploy any of these control methods if required.

3.3.2.3 Cumulative Effects

We previously identified water quantity, water quality, migratory fishes, and Chesapeake Bay habitat as resources that could be cumulatively affected by operation of the three projects, in combination with other projects and activities in the basin. While there would be some continuing effects from all the lower river hydroelectric projects related to flow regulation and effects on migratory species, the applicants for the York Haven, Muddy Run, and Conowingo Projects are proposing a number of environmental enhancement measures that would offset some of the continuing effects. Staff is also recommending modifications to the applicant-proposed measures, and additional measures that would act to minimize cumulative effects. In addition to measures already implemented (such as minimum flows and fish passage facilities at the projects), new measures proposed and recommended include: (1) a nature-like fishway at the York Haven main dam, as well as measures to protect eel passage once they arrive in the project area; (2) investigations to ensure that migratory fish are successfully migrating past the Muddy Run Project; (3) increased minimum flows at Conowingo as recommended by staff; (4) improvements to the existing fish lifts at Conowingo as recommended by staff; and (5) provision of eel passage at Conowingo. All of these measures, in combination with fish passage improvements recently completed at the Holtwood Project, and the ongoing operation of the highly effective Safe Harbor Project fish lift, would result in an overall positive cumulative effect on migratory fish passage in the Susquehanna River. Flow regulation in the lower Susquehanna River would not be substantially changed under alternatives evaluated by the staff, although we evaluated an increase in minimum flows at Conowingo, which should enhance aquatic habitat downstream of the project into the Chesapeake Bay.

Consumptive water uses in the lower Susquehanna River also would not change as a result of relicensing the three hydroelectric projects. As we previously described, consumptive uses in the lower river are relatively minor compared to the total flow of the Susquehanna River, and even with the addition of the proposed Wildcat Point Project, with a net consumption of 7.9 mgd from Conowingo Pond (FERC, 2014), would not result in adverse cumulative effects on water consumption in the lower river. Water quality has generally been protected in the lower river, including downstream of Conowingo dam with the addition of turbine venting and aeration that now maintains state DO standards nearly 100 percent of the time. Exelon is proposing to continue DO monitoring downstream of Conowingo and at Muddy Run in the future, and this would help ensure that state DO standards are continuing to be met. Overall, these measures would have a net beneficial cumulative effect on water quality, and aquatic habitat in the lower Susquehanna River and parts of the upper Chesapeake Bay that are influenced by project operation.

The Susquehanna River watershed would continue to contribute a high sediment load to the river and to the Chesapeake Bay, some of which would continue to settle out in Conowingo Pond and other lower river hydroelectric project reservoirs located upstream of Conowingo Pond. However, the draft LSRWA study report (Corps and MDE, 2014) concludes that all three lower Susquehanna River reservoirs (Lake Clarke, Lake Aldred, and Conowingo Pond) are no longer trapping sediment over the long-term. The reservoirs have reached a state of dynamic equilibrium in which the net change in sedimentation (i.e., deposition during low-flow periods and scour during floods) remains relatively constant. On a long-term basis, the full sediment load carried by the river is transported into the Chesapeake Bay, as would have occurred prior to construction of the lower Susquehanna River reservoirs. The primary water quality effect of this sediment loading is the nutrients associated with scoured sediment, which may be more harmful to the Bay's aquatic life than the sediment itself. Particle-bound nutrients settle to the bottom of the Bay and under certain conditions can recycle back into the water column in dissolved form where they contribute to algae growth. Excessive algae growth in turn may result in DO depletion in some parts of the Bay. Based on the findings of Corps and MDE (2014), however, because the lower river reservoirs have reached a long-term state of dynamic equilibrium, continued operation of the projects would not cumulatively affect sediment and nutrient loading to the Chesapeake Bay.

3.3.3 Terrestrial Resources

3.3.3.1 Affected Environment

Vegetation

The dominant upland cover classes in the vicinity of all three projects form a mosaic of agricultural, forest, and developed lands. Agricultural land ranges from intensely cropped cornfields and horticultural nurseries to less intensely used hayfields and pastures. Upland forest is typically found on land that has marginal utility for contemporary agricultural use, such as steep slopes and poorer quality soils.

Natural overstory vegetation within the York Haven project boundary includes red and silver maple, yellow birch, and black and northern red oak. Common shrub species include northern arrowwood, hornbeam, witch-hazel, and spicebush. The herbaceous layer is highly variable. Representative species include wild oats, false Solomon's-seal, May-apple, and pipissewa. The major upland vegetation type within the project boundary is red oak-mixed hardwood forest, which is characterized by a well-developed canopy of mature red and black oak and red maple. Most of this community is located on the southern section of Three Mile Island.

Overstory vegetation within the Muddy Run and Conowingo project boundaries includes green ash, sycamore, black willow, and box elder along the reservoir shorelines; red and white oak, American beech, eastern hemlock, pignut hickory, sweet birch, black cherry, tulip polar, and sugar maple in forest interiors, with black locust and black walnut along forest edges. Evergreen communities are present in the project area, including eastern red cedar and Virginia, white, and sort-leaf pine. Representative shrub species include pawpaw, bladdernut, rosebay, eastern redbud, witch-hazel, northern arrowwood, maple-leaved viburnum, and spicebush. Herbaceous vegetation may include wild oats, may-apple, and striped wintergreen. The major upland vegetation type within both project boundaries is mixed mesophytic and species-rich hemlock-mesic hardwood forest (1,260 acres at Muddy Run and 856 acres at Conowingo). Lesser amounts of upland vegetation types include dry oak-mixed hardwood or red oak-mixed hardwood forest (265 acres at Muddy Run and 202 acres at Conowingo) and Virginia pine-mixed hardwood forest (38 acres at Muddy Run and 323 acres at Conowingo). In addition, maintained lawns comprise about 257 acres and agricultural croplands about 148 acres of vegetation within the Muddy Run project boundary. About 800 acres, some of which is within the Muddy Run project boundary, is the Muddy Run WMA, which is managed to provide food and cover for wildlife. As noted in section 2.1.1, *Existing Project Facilities*, of the three projects, only the Muddy Run Project has primary transmission lines, two 4.25-mile-long, 230-kV transmission lines running from the powerhouse to the PBAPS North Substation along a 300-foot-wide corridor. The transmission lines pass from the powerhouse across about 0.5 mile of open water of the Susquehanna River. On the west side of the Susquehanna River, the transmission lines are surrounded by deciduous forest for about 1 mile after which the lines pass through agricultural fields (pasture and cropland) to the substation.

Wetland and Riparian Habitat

York Haven Project

York Haven Power characterized wetland habitats occurring within the project boundary using FWS' National Wetland Inventory digital mapping, which provides information on wetland habitats using remote sensing and aerial photo interpretation techniques (table 3-27). Extensive vegetated wetland communities are generally lacking in the project boundary. Wetlands within the project area are represented by riverine (open-water), palustrine forested, and palustrine emergent wetland types.

Open-water areas are well represented in and adjacent to the project boundary, and Lake Frederic is an example of this open-water wetland habitat. Open-water habitats associated with Lake Frederic occupy about 2,363 acres. Lake Frederic contains many areas of SAV (primarily wild celery; Torocco et al., 2012) mostly found along island perimeters and areas of shallow water depth.

The palustrine forested wetland habitats located within the project boundary are primarily forested silver maple floodplain areas. This forested wetland type typically occurs along larger rivers with a well-developed floodplain. Aside from the usually dominant silver maple, other trees include red maple, black willow, river birch, and American elm. Shrubs include poison ivy, spicebush, American elder, and northern arrow-wood. Common herbs include jewelweed, Japanese stiltgrass, and sensitive fern.

The largest areas of emergent wetlands occur on the southern section of Three Mile Island, within topographic depressions separate from the riparian zone associated with Lake Frederic. Several small emergent wetlands are mapped in the vicinity of where the main dam abuts Three Mile Island. Large areas of emergent vegetation are found bordering the western side of the access road leading to Three Mile Island. This area supports a variety of communities located within the floodplain of the Susquehanna River that are formed naturally by river flows and sedimentation. However, York Haven Power observed evidence of fill berms, old access roads, and other types of disturbance during various site visits associated with relicensing studies.

Table 3-27. York Haven Project wetland types and acreages (Source: York Haven Power, 2012).

Class (FWS map code)	Subclass	Water Regime	Total Acres Within Project Boundary
Unconsolidated bottom (R2UBH)	Not applicable	Permanently flooded	2,240
Unconsolidated shore (R2USC)	Not applicable	Seasonally flooded	111
Emergent (R2EM2H)	Nonpersistent	Permanently flooded	10
Unconsolidated bottom (R2UBHx)	Not applicable	Permanently flooded	3
Forested (PFO1E)	Broad-leaved deciduous	Seasonally flooded/saturated	31
Forested (PFO1C)	Broad-leaved deciduous	Seasonally flooded	4
Scrub-shrub (PSS1)	Broad-leaved deciduous	Seasonally flooded	6
Forested (PFO1A)	Broad-leaved deciduous	Temporarily flooded	13
Unconsolidated bottom (PUBHx)	Not applicable	Permanently flooded	1
Emergent (PEM1Cx)	Persistent	Seasonally flooded	17
Total wetland acreage			**2,436**

Three Mile Island has a mixture of floodplain forest located along the island boundaries, areas of emergent wetland, and large areas of open water bordered by palustrine forested and palustrine scrub-shrub wetland communities. York Haven Power notes that during overbank flooding this area holds a considerable amount of floodwater as the open water areas are inundated with water up to several feet in depth. The water regime in this system is typically seasonally flooded (i.e., surface water present for extended periods at certain times of the year). The vegetation associated with the wetlands on Three Mile Island consists of a mature canopy of various trees including red maple, silver maple, river birch, and sycamore. Common shrubs include species contained in the over-story layer, as well as black willow, elderberry, and silky dogwood. The herbaceous layer contains cattails, bur-reed, common rush, sedges, and smartweeds.

Muddy Run Project

The Muddy Run Project power reservoir and the Recreation Lake provide open water habitat, and Exelon estimates that 84 percent of the reservoir shoreline is bordered by riparian woody vegetation, such as green ash, sycamore, black willow, and box elder. The littoral zone around the power reservoir is about 240 acres, and the reservoir margin is free of emergent or submergent vegetation because of the magnitude and frequency of rapid water fluctuations (up to 50 feet on a weekly basis). Exelon identified six wetlands within the project boundary using FWS National Wetland Inventory mapping but did not quantify the area of each, although the descriptions suggest that they are relatively small. Each of these six wetlands was reviewed in the field to enable further characterization.

Three wetlands are emergent wetlands (PEM) that appear to be supported by springs or seeps, and only one is adjacent to the power reservoir. Two of these emergent wetlands are dominated by sedges, rushes, and jewelweed. One of these two wetlands is within the transmission line right-of-way in a pasture. The third emergent wetland, located along a non-project natural gas pipeline, is dominated by the invasive common reed and reed canary grass; sedges, rushes, and jewelweed are also present along with cattails, goldenrod, and aster. This wetland has compacted soils related to the presence of the pipeline.

One wetland is a forested wetland (PFO1) along a small stream that drains into the power reservoir. It is dominated by red maple, spicebush, and skunk cabbage. A second forested wetland with emergent components (PFO1/EM) is associated with a stream that ultimately flows into the reservoir. Dominant vegetation in this wetland includes sycamore and skunk cabbage.

The sixth wetland within the Muddy Run project boundary is an emergent/scrub-shrub (PEM/SS1) wetland adjacent to the upper reaches of the recreation lake. Dominant vegetation in this wetland includes sedges, rushes, cattails, rice cutgrass, sweetflag, and blue vervain.

Conowingo Project

Wetland habitat within the Conowingo Project boundary is governed by predominant substrate type and river hydrology. Conowingo Pond is generally operated at a maximum elevation of 109.2 feet, at which 8,605 acres of open-water habitat is provided. In the 7,000-foot-long reach from Holtwood dam to the downstream end of Hennery Island (see figure 2-2), the substrate is predominantly exposed bedrock.

Downstream of Hennery Island, the bedrock channel bottom is covered with a thickening wedge of alluvial sediment that has been accumulating behind Conowingo dam since its construction in 1928. Downstream of Conowingo dam, a bedrock channel similar to that downstream of Holtwood dam influences the types of wetlands that are present. We discuss wetland habitat separately for the bedrock and alluvial channel types within the project boundary.

Bedrock reach--The bedrock reach at the upstream end of Conowingo Pond is characterized by riverbed emergent wetlands (REM). The wetland vegetation in the upper portion of the reach grows in cracks and crevasses on the protected downstream side of rocks. Pools in this upper reach are smaller (less than 100 square feet) and more isolated than further downstream where the pools are larger with more contiguous areas of open water (up to 10,000 square feet). Upstream vegetation is generally shorter and less abundant than downstream vegetation because the upstream, more-constricted reach is subjected to higher water levels and velocities than lower reaches. As the energy conditions diminish downstream, the vegetation becomes more prominent, growing on most available rock surfaces. Dominant vegetation within the lower elevation channel with longer periods of inundation includes water willow and purple loosestrife. Dense root mats with trapped sediment ultimately develop and may be stripped from the rock during high-flow events. This lower elevation zone transitions to grasses, sedges, and rushes, the width of which is a function of slope. Along the shore margins of the river and islands, the riverbed emergent wetlands transition to a riparian wetland community dominated by woody vegetation such as black willow and red maple saplings (PSS1). The vegetation near the shoreline is composed of elements found growing on the riverbed as well as elements that encroach from the riparian forest located upgradient.

Similar to the riverbed emergent wetlands described in the previous paragraph, wetlands downstream of Conowingo dam consist largely of water willow that has taken root in fine sediment trapped within bedrock crevasses and interstices among boulders. However, emergent vegetation does not extend across the channel, as it did at places in the upper end of Conowingo Pond, but is restricted to river and island margins and tributary mouths.

Alluvial reach--In the alluvial-dominated reach of Conowingo Pond, opportunities for the establishment of wetlands occur at sites of accumulating sediment, often at the mouths of tributaries. Wetland surveys of the alluvial reach conducted by Exelon in 2008 and 2010 identified 32 emergent wetlands (PEM) within the project boundary with varying degrees of open-water and scrub-shrub elements. The distribution of these wetlands reflects different geomorphic settings, water sources, and hydrodynamics. Although these wetlands are mapped, no indication of the area of each wetland or the total acreage of wetlands is provided. From the descriptions of the wetlands, they appear to be relatively small (i.e., each less than 1 acre). During typical, non-storm conditions, Exelon determined that the major driver of wetland properties of 9 wetlands was primarily flows in the Susquehanna River (pond margin), 2 wetlands were strongly influenced by both the river and tributaries (pond/tributary), and 21 wetlands were influenced primarily by tributaries.

Common species occurring in the emergent wetlands include water willow, water pepper, broadleaf cattail, purple loosestrife, and Japanese stiltgrass. Although water willow was observed in most emergent wetlands, wetland vegetation generally comprised more than one dominant species (URS and Gomez and Sullivan, 2012a).

Invasive Plant Species

Invasive upland, wetland, and aquatic plants are known to occur at all three projects. The applicants did not propose and no entities requested that directed invasive plant surveys be conducted. However, incidental observations of invasive species were made during other studies at all three projects. York Haven Power identified invasive species that have the potential to occur at the York Haven Project, and this listing would also be applicable to the other two projects (table 3-28). Similarly, it would be expected that invasive species found at Conowingo or Muddy Run could be found at York Haven.

Table 3-28. Invasive plants with potential to occur in the vicinity of the Susquehanna River Projects (Source: York Haven Power, 2012; Exelon, 2012a, 2012b, staff).

	Observed in Vicinity of Projects[a]		
Common name	**York Haven**	**Muddy Run**	**Conowingo**
	Aquatic		
Eurasian water-milfoil			X
Hydrilla			X
Water chestnut			
Brittle waternymph			X
	Terrestrial		
Goutweed			
Garlic mustard			
Musk thistle			
Canada thistle			
Bull thistle			
Jimsonweed			
Goatsrue			
Giant hogweed			

	Observed in Vicinity of Projects[a]		
Common name	**York Haven**	**Muddy Run**	**Conowingo**
Dame's rocket			
Purple loosestrife			X
Star-of-Bethlehem			
Wild parsnip			
Beefsteak plant			
Japanese knotweed	X		X
Lesser celadine			
Cheatgrass			
Japanese stiltgrass	X	X	X
Reed canary grass		X	
Shattercane			
Common reed		X	X
Johnson grass			
European barberry			
Russian olive			
Autumn olive		X	
Border privet			
Common privet			
Amur (bush) honeysuckle		X	
Morrow's honeysuckle			
Bell's honeysuckle			
Standish honeysuckle			
Tartarian honeysuckle			
Common buckthorn			
Glossy buckthorn			
Wineberry			
Multiflora rose			X
Sycamore maple			

	Observed in Vicinity of Projects[a]		
Common name	**York Haven**	**Muddy Run**	**Conowingo**
Tree-of-heaven		X	X
Empress tree			
Siberian elm			
Fiveleaf akebia			
Porcelain-berry			
Oriental bittersweet			
Japanese honeysuckle			
Mile-a-minute vine	X	X	
Kudzu			

[a] Directed surveys for invasive plant species were not conducted at any of the three projects, but incidental observations were made during fieldwork associated with other studies.

At the York Haven Project, Japanese stiltgrass, Japanese knotweed, and mile-a-minute vine were observed along old road edges and disturbed areas in the southern section of Three Mile Island. Within the floodplain of the Susquehanna River below the east channel dam and spillway, located in the southern section of Three Mile Island, large infestations of Japanese stiltgrass were observed in monotypic stands, where mile-a-minute vine was also commonly observed.

Invasive species, including mile-a-minute, tree-of-heaven, autumn olive, bush honeysuckle, and Japanese stiltgrass, were prevalent in areas along the western shore of the Muddy Run reservoir, but less so along the eastern shore. Invasive plants were most common along edge areas near the recreation park and in transmission line rights-of-way. Hydrilla and Eurasian water-milfoil were often the dominant species in SAV beds in the alluvial-dominated reach of Conowingo Pond. Downstream of Conowingo dam, Eurasian water-milfoil is the dominant SAV species, and hydrilla and purple loosestrife are also present. SAV is discussed in greater detail in section 3.3.2, *Water Resources*.

Sensitive Plants

York Haven Power and Exelon consulted with state natural resource agencies during pre-filing consultation and reviewed available literature to identify state-protected plant species and plant species that could be state-protected in the future with the potential to occur in the vicinity of each project. This process identified 31 such species that could occur near at least one of the projects (table 3-29), along with habitat preferences and whether or not the species was observed.

Table 3-29. State protected plant species with potential to occur in the vicinity of the York Haven, Muddy Run, and/or Conowingo Projects (Source: York Haven Power, 2012; Exelon, 2012a, 2012b).

Common Name (*Scientific Name*)	**State--Status**	**Potential Project Occurrence[a]**	**Preferred Habitat**	**Documented Occurrence**
Bradley's spleenwort (*Asplenium bradleyi*)	PA -- Threatened	C	Acidic rock outcrops and barrens, within crevices and ledges, and on cliff faces	Historically occurred in the vicinity of the Conowingo project area. Although the general habitat for a plant may be present in the project area, Bradley's spleenworts were not observed in the project area.
Aster-like boltonia (*Boltonia asteroides*)	PA, MD -- Endangered	YH, C	Open canopy wetlands with sandy to loamy acidic soils; gravel shores; sandy, wet thickets, alluvial meadows and marshes, and openings in forested floodplains	Reportedly found in the riverside outcrop community of the Holtwood dam spillway area; however, none were observed in the project area.
Reflexed flatsedge (*Cyperus refractus*)	PA -- Endangered	MR, C	Found in dry woods with an open canopy and sandy soils; also associated with fields, barrens	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, reflexed flatsedges were not observed in the project areas.

Common Name (*Scientific Name*)	State--Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
Flat-stemmed spike-rush (*Eleocharis compressa*)	PA, MD -- Endangered	YH, C	Found in wet depressions in woodlands and limestone glades, wet prairies, roadside ditches; and other wet seeps in calcareous grasslands, fens, sandy ground, stream banks and waste places	Reportedly found between Conowingo dam and the mouth of Octoraro Creek (in or near Susquehanna Floodplain Protection Area). However, this species was not observed within the project boundary.
Ellisia (*Ellisia nyctelea*)	PA -- Threatened	YH	Found in damp, shady stream banks with rich alluvial soils and sometimes on disturbed ground	Potentially could occur within 0.5 mile of the York Haven Project area. Although the general habitat for the plant may be present in the project area, ellisia was not observed in the project area.
Harbinger-of-spring (*Erigenia bulbosa*)	PA -- Threatened	C	Found in rich, mixed hardwood forests located in lowlands, coastal plains, and mountain valleys	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for the plant may be present in the project area, harbinger-of-spring was not observed in the project area.

Common Name (*Scientific Name*)	**State--Status**	**Potential Project Occurrence[a]**	**Preferred Habitat**	**Documented Occurrence**
Bicknell's hoary rockrose (*Helianthemum bicknellii)*	PA, MD -- Endangered	C	Found in dry, open areas with abundant sun and generally thin soil; around exposed banks, dry rocky slopes and outcrops, open woods, serpentine barrens and open forests	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, Bicknell's hoary rockroses were not observed in the project area.
American holly (*Ilex opaca*)	PA -- Threatened	C	Typically found in shallow, well-drained, sandy soil; also found in coastal dunes and deciduous woodlands; and within moist alluvial woods and along wooded slopes	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, American hollies were not observed in the project area.
Common hemicarpa (*Lipocarpha micrantha)*	PA -- Endangered	C	Prefers moist, sandy soil; found along sparsely vegetated ponds, streams, and sandy beaches without large water level fluctuations or strong currents	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, common hemicarpas were not observed in the project area.

Common Name (*Scientific Name*)	State--Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
False loosestrife seedbox (*Ludwigia polycarpa)*	PA -- Endangered	C	Found on level terrain in open canopy areas, including former oxbows, river channels in floodplain swamps, marshes, and wet prairies, and on the shores of ponds and other wet places	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, false loosestrife seedbox were not observed in the project area.
Umbrella magnolia (*Magnolia tripetala)*	PA -- Threatened	MR, C	Prefers upland areas with fine to medium textured soils that are neutral to slightly acidic; found in rich woods and ravines, near mountain streams and other wet areas, and in mesic shaded coves	Historically occurred in the vicinity of both Muddy Run and Conowingo Project areas. Although the general habitat for a plant may be present in the project areas, umbrella magnolias were not observed in the project area.
Three-flowered melicgrass (*Melica nitens*)	PA -- Threatened	C	Prefers a partly open canopy and calcareous or sandy loam soil; found in open dry woods; rocky grasslands; streambanks; and dry to mesic prairies	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, three-flowered melicgrasses were not observed in the project area.

Common Name (*Scientific Name*)	**State--Status**	**Potential Project Occurrence[a]**	**Preferred Habitat**	**Documented Occurrence**
Sticky goldenrod (*Solidago simplex ssp. randii var. racemosa*)	PA -- Endangered	C	Typically found in boulder/cobble river bars	Documented community in a riverside outcrop below Holtwood Dam, included areas downstream of the Norman Wood Bridge within the Conowingo Project. However, this species was not identified within the project boundary.
Slender goldenrod (*Solidago erecta*)	PA -- Endangered and MD -- Threatened	C	Found in both loamy and sandy soils; typically in open woods and fields	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, slender goldenrods were not observed in the project area.
Tawny ironweed (*Vernonia glauca*)	PA -- Endangered	C	Typically found in sandy to clay soils that can be acidic, neutral, or basic; usually in upland woods, dry fields and clearings, and rich woods	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, tawny ironweeds were not observed in the project area.

Common Name (*Scientific Name*)	State--Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
Appalachian gametophyte fern (*Vittaria appalachiana*)	PA -- Threatened	C	Found on noncalcareous rocks, in dark moist cavities, and occasionally as an epiphyte on tree bases	Historically occurred in the vicinity of the Conowingo Project area. Although the general habitat for a plant may be present in the project area, Appalachian gametophyte ferns were not observed in the project area.
Davis' sedge (*Carex davisii*)	MD -- Endangered	C	Found in both upland and floodplain woodlands where the canopy is somewhat open; also inhabits deciduous forested floodplains and moist limestone woodlands, rocky shores, abandoned fields and wet meadows, and unpaved trails	Documented scattered populations found in forested floodplains, rocky shores, and moist woods in or near the Northern Susquehanna Canal Protection Area north of the mouth of Deer Creek. However, this species was not observed within the project boundary.
Hitchcock's sedge (*Carex hitchcockiana)*	MD -- Endangered	C	Found under a mostly closed canopy of rich mesic woods, in rock soils along unstable slopes, and in calcium-rich loams on slopes near streams	Documented occurrences in or near the Susquehanna Slopes Protection Area along the wooded shoreline slopes north of Conowingo Creek. However, this species was not observed within the project boundary.

Common Name (*Scientific Name*)	**State--Status**	**Potential Project Occurrence[a]**	**Preferred Habitat**	**Documented Occurrence**
Glade fern (*Diplazium pycnocarpon*)	MD -- Threatened	C	Prefers neutral to slightly alkaline soils and found in moist open woods and slopes, moist meadows, swamps, and forested ravines	Documented scattered populations found in forested floodplains, rocky shores, and moist woods in or near the Northern Susquehanna Canal Protection Area north of the mouth of Deer Creek. However, this species was not observed within the project boundary.
Sweet-scented Indian plantain (*Hasteola suaveolens*)	MD -- Endangered	C	Prefers an open Canopy; found in alluvial soils on high-energy floodplains and stream banks but can also be found within open woodlands and along the edges of thickets	Documented scattered populations were found in forested floodplains, rocky shores, and moist woods in or near the Northern Susquehanna Canal Protection Area north of the mouth of Deer Creek. However, this species was not observed within the project boundary.

Common Name (*Scientific Name*)	**State--Status**	**Potential Project Occurrence[a]**	**Preferred Habitat**	**Documented Occurrence**
Goldenseal (*Hydrastis canadensis*)	MD -- Threatened	C	Found in moist, well-drained acidic sandy loam soil that contains abundant organic matter; possibly found within mixed hardwood forests (Henson, 2001), rich moist woodlands, and along wooded streams	Documented population in the wooded bluffs in or near Glen Cove Marina and in or near the Susquehanna Slopes Protection Area along the wooded shoreline between U.S. Route 1 and Conowingo Creek boat landing and north of Conowingo Creek. However, this species was not observed within the project boundary.
American gromwell (*Lithospermum latifolium*)	PA -- and MD -- Endangered	C	Prefers a partly closed canopy with light to medium shade; found in loamy soil that contains abundant organic matter in rich deciduous woods, wooded slopes, and along shaded riverbanks	Documented along the shoreline, mostly in rich moist woods, between U.S. Route 1 and Conowingo Creek boat landing (in or near the Susquehanna Slopes Protection Area). However, this species was not observed within the project boundary.

Common Name (*Scientific Name*)	**State--Status**	**Potential Project Occurrence[a]**	**Preferred Habitat**	**Documented Occurrence**
Tall dock (*Rumex altissimus)*	MD -- Endangered	C	Prefers full to part sun and rich fertile soil and may tolerate gravel and/or clay; found in wet depressions, stream margins and low areas along ponds, lakes and riverbanks	Documented on the north and south sides of the Octoraro Creek mouth (in or near the Susquehanna Floodplain Protection Area). However, this species was not observed within the project boundary.
Veined skullcap (*Scutellaria nervosa)*	MD -- Endangered	C	Found in wet to mesic deciduous woodlands, near wetland edges, and in wet depressional floodplain forests	Documented along the shoreline, mostly in rich moist woods, between U.S. Route 1 and Conowingo Creek boat landing (in or near the Susquehanna Slopes Protection Area). However, this species was not observed within the project boundary.
Virginia mallow (*Sida hermaphrodita*)	PA -- and MD -- Endangered	C	Prefers mostly open canopy; found in sandy or rocky alluvial soil and on stream and riverbanks	Documented in the Wetlands of Special State Concern of Wildcat Ravine. However, this species was not observed within the project boundary.

Common Name (*Scientific Name*)	**State--Status**	**Potential Project Occurrence[a]**	**Preferred Habitat**	**Documented Occurrence**
Star-flowered false Solomon's seal (*Smilacina stellata*)	MD -- Endangered	C	Prefers wetlands and shallow soils; also found on rocky, well-drained side hills, coastal plains, thickets, and open forests adjacent to streams	Scattered populations observed in the forested floodplains, rocky shores, and moist woods in or near the Northern Susquehanna Canal Protection Area north of the mouth of Deer Creek. However, this species was not observed within the project boundary.
Swamp oats (*Sphenopholis pensylvanica*)	MD -- Threatened	C	Requires full sun and grows in wet meadows and woods, swamps, and stream sides	Documented along the shoreline in swamp habitat between U.S. Route 1 and Conowingo Creek boat landing (in or near the Susquehanna Slopes Protection Area). However, this species was not observed within the project boundary.

Common Name (*Scientific Name*)	State--Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
Valerian (*Valeriana pauciflora*)	MD -- Endangered	C	Found in the rich loamy soils associated with forested floodplains, mesic forests, and along moist wooded stream banks	Documented on the floodplain downstream of Octoraro Creek (in or near the Susquehanna Floodplain Protection Area) and in forested floodplain, rocky shore, and moist woods habitat in or near the Northern Susquehanna Canal Protection Area north of the mouth of Deer Creek. However, this species was not observed within the project boundary.
Eastern gama-grass (*Tripsacum dactyloides)*	PA -- Undetermined	MR	Found in wetter areas associated with swales, thickets, woodland borders, abandoned fields, wet shores, roadsides, and limestone glades and prefers an open canopy	Historically, may have occurred in the vicinity of Muddy Run Project area. Although the general habitat for a plant may be present in the project area, this species was not observed in the project area.
Cranefly orchid (*Tipularia discolor*)	PA -- Rare	MR	An upland plant species found in rich well-drained soils within in mixed hardwood forests. Known to occur within the boundaries of the Ferncliff Wildlife and Wildflower Preserve	Historically occurred in the vicinity of Muddy Run Project area. Although the general habitat for a plant may be present in the project area, cranefly orchids were not observed in the project area.

Common Name (*Scientific Name*)	State--Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
Netted chainfern (*Woodwardia areolata*)	PA -- Non-listed	MR	Typically found in wetlands with moist, acidic soils; found in acidic bogs, woodland swamps, thickets, on seeps, siliceous cliffs and ledges, and near still water	Historically occurred in the vicinity of Muddy Run Project area. Although the general habitat for a plant may be present in the project area, this species was not observed in the project area.

[a] YH= York Haven, MR= Muddy Run, C= Conowingo

Wildlife

Open-water, wetland, riparian, and upland habitat within the three project boundaries supports a variety of wildlife. Wildlife occupying each habitat type at all three projects is expected to be similar.

Reptiles and Amphibians

Representative reptile and amphibians that are typically found in open-water, riparian, and wetland habitats such as Lake Frederic, tributaries, and the Susquehanna River include snapping turtle, red-eared slider, common musk turtle, map turtle, northern water snake, northern spring peeper, bullfrog, northern leopard frog, pickerel frog, and green frog. These species use aquatic habitats for foraging, resting, protection, reproduction, and hibernation. Representative reptiles and amphibians typically found in upland and riparian habitat in the vicinity of the projects include: eastern garter snake, northern ribbon snake, American toad, gray tree frog, wood frog, spotted salamander, and northern red-backed salamander.

Birds

The Susquehanna River and associated water resources and bottomland areas in the projects' vicinity are used by migratory waterfowl, neotropical passerines, and numerous other species protected under the Migratory Bird Treaty Act. Representative avian species typically found in wetland habitats and along the shoreline include the great blue heron, cattle egret, great egret, yellow-crowned night heron, red-winged blackbird, swamp sparrow, song sparrow, mallard, wood duck, American black duck, common merganser, and Canada goose.[108] Species such as the ducks may nest within vegetated shallows and bottomlands and forage in open water.

Upland and riparian habitat associated with project areas provide breeding, migratory stopover, and wintering habitat for a high diversity of bird species including neotropical songbirds and resident species. Black capped chickadee, house wren, song sparrow, white-breasted nuthatch, brown creeper, and an assortment of woodpeckers occur along the wooded shorelines. Birds that inhabit non-forested areas within the project areas include American robin, eastern bluebird, mourning dove, and rock dove. A high diversity of migrating warblers also use upland habitats, and several birds of prey, including bald eagle, osprey, Cooper's hawk, red-tailed hawk, American kestrel, great

[108] According to the Maryland and District of Columbia's breeding bird atlas (2002 to 2006), several waterfowl species (including mallard, wood duck, American black duck, and Canada goose) are confirmed or probable breeding birds in the vicinity of Conowingo dam. Data are available at: http://www.pwrc.usgs.gov/bba/index.cfm?fa=explore.ResultsSummary&BBA_ID=mddc2002, accessed December 11, 2014.

horned owl, and barred owl, are known or suspected to use project areas. These species use different habitat types throughout the year including woodland, scrub-shrub or early successional areas, and wetland, and open-water areas.

Mammals

White-tailed deer is the most common big game species in the project vicinities, commonly occurring along forest edges characterized by brushy and woody vegetation, swamp borders, and areas interspersed with fields and woodland openings. Raccoon are also common, especially along the riparian corridor associated with the Susquehanna River. Other mammals present in the project vicinities include: urban and suburban species such as striped skunk and opossum; furbearers such as red and gray fox and long-tailed weasel; small game species such as gray and red squirrel and eastern cottontail; rodents such as white-footed, deer and house mouse; and little and big brown bat.

Sensitive Wildlife Species

York Haven Power and Exelon conducted pre-filing consultation with state natural resource agencies and reviewed available literature to identify state-protected wildlife species that may occur in the project vicinity; 13 state-listed species either do or could occur in the vicinity of at least one of the three projects. Several of these, including eastern redbelly turtle (York Haven), bald eagle (Muddy Run and Conowingo), osprey (Muddy Run and Conowingo), black-crowned night-heron (Conowingo), and rough green snake (Muddy Run), were studied during licensing proceedings. Table 3-30 shows the 13 state-protected species and the one species proposed for federal listing, along with habitat preferences and whether or not the species were observed in the vicinity of the project. The bog turtle is both state and federally listed and is discussed in section 3.3.4, *Threatened and Endangered Species*. In addition, FWS has proposed to list the northern long-eared bat for protection under the ESA, as discussed in section 3.3.4, *Threatened and Endangered Species*. Existing and potential future project operation could affect the bald eagle, osprey, northern map turtle, and northern long-eared bat, and we provide more detailed information regarding these species in the following subsections.

Bald eagle

The bald eagle is listed as threatened in Pennsylvania and is federally protected under the Bald and Golden Eagle Protection Act of 1940, as amended. Bald eagles are currently found in every state except Hawaii. Eagles prefer undisturbed areas near large lakes and reservoirs, marshes and swamps, and stretches along rivers with open water and their primary food, fish. Nests are primarily constructed in dominant mature trees (often pine, sycamore, red oak, and red maple), or cliffs near water but occasionally are also built on man-made structures. Egg laying and incubation by local populations occur between January and April with fledging occurring as early as mid-June and as late as the end of July. Nesting eagles are particularly sensitive to human intrusions and such activities can compel eagles to abandon a nest.

Table 3-30. State-protected wildlife species with potential to occur in the vicinity of the York Haven, Muddy Run, and/or Conowingo Projects (Source: York Haven Power, 2012; Exelon, 2012a, 2012b).

Common Name	State Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
Bald eagle	PA -- Threatened	YH, MR,[b] C[c]	Undisturbed areas near large lakes and reservoirs, marshes and swamps, or stretches along rivers with open water and access to fish; nearby tall trees for roosting and nesting. Can be found in the projects' vicinities year round.	Please see previous detailed discussion.
Osprey	PA -- Threatened	YH, MR,[d] C[e]	Along seacoast and major waterways with access to fish; nests usually built near water in large trees, but also use channel markers, telephone poles, chimneys, and platforms built specifically for their use. Found near projects in spring and summer.	Please see previous detailed discussion.
Peregrine falcon	PA -- Endangered	YH	Nest and roost on high prominences, building, cliffs, and other open spaces with expansive views.	Reportedly a pair returned to nest at the Three Mile Island Unit 1 Reactor Building in 2010; however, none observed during project-related field work, and there is no suitable nesting habitat in the project area, other than

Common Name	State Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
				at Three Mile Island.
American bittern	PA -- Endangered	YH	Found in expansive wetland habitats and wetland borders along lakes, ponds, rivers, and streams; breed in large wetlands, especially those with dense stands of cattails, bulrushes, grasses, and sedges, and pockets of open water.	Not observed in the vicinity of the project and expansive wetland habitats are lacking.
Yellow-crowned night-heron	PA -- Endangered	YH	Typically feed along small, shallow streams and nest in brush or trees, usually sycamores, found on islands or along streams.	The project area below the east channel dam and along the southeastern side of Three Mile Island provides riparian forest and scrub-shrub wetlands that could provide suitable habitat, but none observed during 2010 and 2011 field seasons.
Black-crowned night-heron	PA -- Endangered	YH, C[f]	Found primarily near rivers and creeks, but also margins of lakes and reservoirs and wetlands; often colonial nest on forested islands or along wooded streams.	Reported to occur in the vicinity of York Haven but none were observed during 2010 and 2011 field seasons. Three to six black-crowned night-herons were regularly observed near the Conowingo dam tailrace and spillway and on Rowland

Common Name	State Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
				Island during 2010 and 2011, foraging below the dam and roosting in trees on the island. No nests observed, but potential nesting habitat is present.
Common tern	PA -- Endangered	YH	Typically seen flying over lakes, slow-moving rivers, or occasionally marshes, or perched on beaches, sand pits, mudflats, or on structures such as buoys or piers. Nesting habitat restricted to sandy shorelines and barren islands of large lakes; currently not known to nest in PA.	No common terns were observed during 2010 or 2011 field seasons.
Black tern	PA -- Endangered	YH	When not nesting, found along the coast; move inland to nest on prairies or extensive marsh complexes that are half open water and half emergent vegetation. Northwest PA is the only location in state where nesting occurs.	Expansive wetland complexes do not occur in the vicinity of the project. No black terns observed during 2010 or 2011 field survey seasons.
Yellow-bellied flycatcher	PA -- Endangered	YH	In shady coniferous forests and forested wetlands at higher elevations; nesting occurs in	Habitat generally lacking in the project boundary. No yellow-bellied flycatchers

Common Name	State Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
			remote areas.	were observed during 2010 and 2011 field survey seasons.
Hellbender salamander	MD -- Endangered	C	Fast-moving, mid-sized streams/channels with good water quality and gravel or sand substrate and abundant large structures for hiding; breed in late summer.	Only historic (confirmed and unconfirmed) records of occurrence in Cecil County and unconfirmed historic records for Harford County, all in the Susquehanna River and tributaries (Stranko et al., 2010).
Northern map turtle	MD -- Endangered	C	Deep slow-moving large rivers and lakes with ample locations for basking; muddy bottoms with aquatic vegetation are preferred.	Please see previous detailed discussion.
Eastern redbelly turtle	PA -- Threatened	YH[g]	Water depths ranging from 6.5 to 12.0 feet deep with an abundance of aquatic vegetation, reduced current velocities, soft substrates, and rocks and logs for basking. They nest on sandy areas along shorelines.	York Haven Power conducted targeted surveys during 2011 for eastern redbelly turtles in Lake Frederic using established protocols and none were found.
Rough green snake	PA -- Endangered	YH, MR,[h] C	Moist areas such as wet meadows and the borders of lakes, marshes, and woodland	Documented in PA only from Greene and southern Chester Counties although

Common Name	State Status	Potential Project Occurrence[a]	Preferred Habitat	Documented Occurrence
			streams; frequently found in woody vegetation growing along or overhanging water.	recent evidence places them in Lancaster County near the Muddy Run and Conowingo Projects. Suitable habitat is present in the vicinity of the projects. No rough green snakes were observed during targeted surveys (at Muddy Run) or other field studies at all three projects.
Northern long-eared bat	PA -- Candidate for rare species designation	YH, MR, C	During the summer, roosting occurs underneath bark, cavities, or hollows of trees or snags; in winter, they hibernate in caves or similar sites	See section 3.3.4, *Threatened and Endangered Species.*

[a] YH= York Haven, MR= Muddy Run, C= Conowingo
[b] Study 3.8: Study to identify habitat use areas for bald eagle, Muddy Run Pumped Storage Project.
[c] Study 3.23: Study to identify habitat use areas for bald eagle, Conowingo Hydroelectric Project.
[d] Study 3.15: Osprey nesting survey, Muddy Run Pumped Storage Project.
[e] Study 3.30: Osprey nesting survey, Conowingo Hydroelectric Project.
[f] Study 3.31: Black-crowned night-heron nesting survey, Conowingo Hydroelectric Project.
[g] Eastern redbelly turtle phase II presence/absence and nesting surveys for the York Haven Hydroelectric Project.
[h] Study 3.9B: Study to identify potential habitat and presence/inferred absence of rough green snake, Muddy Run Pumped Storage Project.

At the York Haven Project, one bald eagle nest was reported to occur at the southern end of Three Mile Island based on York Haven Power's review of available information (no site specific surveys for bald eagles were proposed by the applicant or recommended by other entities). Lake Frederic provides large populations of warm-water fish species that form a reliable source of live prey for foraging bald eagles. One active nest and a communal roosting site have been documented within the Muddy Run Project boundary and a reported nest was found on a Conowingo Pond island traversed by the Muddy Run transmission line corridor. At the Conowingo Project, bald eagle surveys conducted by Exelon documented 11 pairs of breeding bald eagles, 18 communal bald eagle roosts, and many foraging bald eagles along Conowingo Pond and downstream of Conowingo dam. Exelon observed up to 153 bald eagles per week during bald eagle surveys of known roosting areas in 2010 and 2011 (Center for Conservation Biology et al., 2012). Bald eagles occur in the vicinity of the three projects year round, but are less common during the winter.

Osprey

The osprey is listed as threatened in Pennsylvania and is federally protected under the Migratory Bird Treaty Act of 1918. Ospreys are found along seacoasts and major waterways on every continent except Antarctica. Fish are the primary prey for osprey, although they also feed on small waterfowl, mammals, and carrion. Ospreys typically inhabit salt marshes, large inland rivers, lakes, ponds, and wetlands bordered by mature trees. Nests are usually built near water in large, often dead, trees but nests have also been found on channel markers, telephone poles, chimneys, and manmade platforms built specifically for their use. Preferred foraging habitat of local osprey populations was reported to be shallow water with low turbidity. Osprey pairs typically return to Pennsylvania in late March to early April to nest and depart by the end of September.

At the York Haven Project no directed osprey surveys were proposed or requested, but an osprey nest is located on the York Haven powerhouse and field staff performing other studies frequently observed osprey flying in the vicinity of Lake Frederic. Exelon conducted osprey nest surveys at the Muddy Run and Conowingo Projects in 2010 and 2011. During both years an active osprey nest was documented along the shore of Muddy Run reservoir. Eleven osprey nests were documented in the Conowingo project area in 2010, and a twelfth in 2011 (8 were in Pennsylvania and 4 in Maryland). All of the nests observed in 2010 were active in 2011, with the exception of two nests in Pennsylvania. Osprey activity was frequently observed at the Muddy Run transmission line crossing of the river and entailed ospreys using the transmission towers for perching.

Northern map turtle

The northern map turtle is listed by Maryland as an endangered species. Map turtles are found in deep, slow-moving large rivers and lakes with ample locations for basking. Muddy bottom with aquatic vegetation are preferred and vegetation comprises the majority of the map turtle diet. Mollusks and crayfish are also occasionally consumed. Eggs are laid from April to mid-July in areas with open canopies most often on sunny days after rain events. Turtles were found to make almost immediate use of newly-opened gaps (i.e., tree-falls) in the forest canopy. Hatching occurs from mid-August through September.

According to Towson University studies, a reproductively active population occurs both upstream and downstream of Conowingo dam, although most turtles are concentrated in a 1.2-mile-long river reach downstream of the dam in the vicinity of Port Deposit and Susquehanna State Park in Maryland (Seigel et al., 2014). Nesting occurs in relatively open areas on both in-river islands, along the banks of Octoraro and Deer Creeks, and in the town of Port Deposit. Most nesting areas are heavily disturbed by recreational visitors, raccoons, foxes, and feral dogs. Towson University biologists observed basking map turtles from late April through mid-November, with the most intensive activity in September. Basking occurs predominantly on rocks and large woody debris, but can also occur on man-made structures such as bulkhead footings and riprap. Basking is an essential activity for most aquatic turtles, serving to raise body temperatures so that physiological processes such as digestion and egg development are maximized. Reptiles that are precluded from basking may suffer reduced reproductive output and growth rates (Seigel et al., 2014).

3.3.3.2 Environmental Effects

Effects of project operation and water level fluctuations on riparian, littoral, and wetland habitat

For all three projects, project operation, including water level fluctuations, could affect riparian, littoral, and wetland habitat. Reservoir fluctuations and changes in downstream flows could affect the distribution, species composition, and health of wetland and riparian habitat. Wetland and riparian habitats are important for functions such as water quality, habitat for fish and wildlife, regulating flooding, and stream recharge.

According to the terms of the Settlement Agreement, York Haven Power proposes to maintain the overall project minimum flow requirements downstream of the project, but it would modify project flow releases to redistribute minimum flow releases among the various project flow release structures (east channel spillway, east channel fishway, nature-like fishway, main dam, and powerhouse).

Exelon does not propose any changes to the existing project operation at Muddy Run or Conowingo. There are no recommended measures specifically relating to wetlands, riparian, or littoral habitat at either project; however, The Nature Conservancy recommended, and Interior endorsed, an alternate flow regime for flows below Conowingo dam, referred to as the TNC Flow Regime. The TNC Flow Regime is described in greater detail in section 3.3.2.2, *Water Resources, Environmental Effects*, but in general it would stabilize flows below the dam, particularly from March through June.

Our Analysis

Under existing and proposed operation, extensive vegetated wetland communities are and would be generally lacking in the York Haven Project boundary. Three Mile Island contains the largest of the emergent marsh wetlands as well as forested floodplain wetlands. Existing and proposed project operations would allow for 1.1 feet of draw down from the impoundment for dam maintenance activities. Because proposed operation would not change the reservoir levels or the overall minimum flows downstream of the York Haven Project, it is not expected that wetland, riparian, or wildlife habitat conditions would change.

The Muddy Run Project operates as a pumped storage facility by moving water from the upper reservoir to the lower reservoir (Conowingo Pond) via gravity to generate power. Water levels in the upper reservoir can fluctuate up to 50 feet within a week. With these large fluctuations, shoreline habitat would vary between dry and flooded periods. As a result, the upper reservoir margins are generally free of emergent or submerged vegetation. Exelon plans to implement an SMP that includes erosion control measures (see further discussion in section 3.3.5, *Recreation and Land Use Resources*) at the Muddy Run upper reservoir to minimize erosion. Of the six wetlands identified in the project boundary, only one (which is adjacent to the upper reservoir) would appear to be affected by project operation; however, even this wetland has its own source of hydrology. Because the Muddy Run Project would be operated as it has in the past, the existing wetland and riparian habitat would remain similar to their present condition and wildlife habitat would not be affected. Fluctuations of the lower reservoir, Conowingo Pond, are discussed below for the Conowingo Project.

Within the Conowingo Project, wetlands are prevalent in the alluvial reach of the Conowingo Pond where the river deposits sediment loads, but are not as prevalent elsewhere. Conowingo Pond generally operates with a maximum pool elevation of 109.2 feet, but allows for a maximum fluctuation of 9 feet, from elevation 110.2 down to 101.2 feet. The existing wetland and riparian habitat distribution is affected by current project operation (and the operation of the Muddy Run Project). For example, in the bedrock reach at the upstream end of Conowingo Pond, vegetation is generally shorter and less abundant than downstream vegetation, as the upstream, more-constricted reach is subjected to higher water levels and velocities than lower reaches. As the energy conditions diminish downstream, the vegetation becomes more prominent, growing on most available rock surfaces. Because Exelon does not propose to change Conowingo or Muddy Run project operations, the existing wetland and riparian conditions in the upstream reach would be expected to remain unchanged, and wildlife habitat would not be affected. Additionally, although Conowingo Project operation may influence sediment distribution and water level fluctuations in the alluvial reach of Conowingo Pond, because Exelon does not propose to change project operation, the existing conditions would be expected to remain unchanged. However, the TNC Flow Regime,[109] if implemented, would stabilize flow releases below the dam, which could benefit wetlands, riparian habitat, and wildlife habitat downstream. In addition, more stabilized minimum flows may or may not result in less fluctuation in Conowingo Pond; less fluctuation would also benefit wetlands. However, based on our evaluation of Conowingo Pond fluctuations in section 3.3.2.2, *Water Resources, Environmental Effects, Reservoir Fluctuations*, any such benefits would be minor.

Maintenance of project facilities and right-of-way

York Haven Power and Exelon manage vegetation around project facilities, including the project transmission line at Muddy Run, around powerhouses, and recreation areas during routine maintenance activities. Vegetation maintenance could affect the presence or proliferation of invasive species, rare plant species, and wildlife habitat. Neither York Haven Power nor Exelon conducted targeted surveys for rare plants at any of the three projects; however, there are multiple rare plant species known to historically occur within 0.5 mile of the three projects.

York Haven Power and Exelon propose no specific project maintenance measures, invasive species management measures, or rare plant protection measures. However, Exelon manages vegetation along the 4.25-mile-long transmission line right-of-way at the Muddy Run Project in accordance with American National Standards Institute A300 standards, which includes Integrated Vegetation Management (IVM). This approach provides for managing plant communities in which compatible and incompatible vegetation are identified, action thresholds considered, control methods evaluated, and selected controls implemented to achieve a specific objective. IVM also includes provisions for protection of species of concern, wetlands and streams, and cultural resources. The portion of the right-of-way within the wire zone[110] is managed to promote a low-growing plant community dominated by grasses, herbs, and small shrubs less than 3 feet high. The rest of the right-of-way is managed to promote shrubs and small trees lower than 25 feet high at maturity. Exelon uses a combination of manual, mechanical, and herbicide control techniques. In addition, Exelon proposes the implementation of an SMP at both the Muddy Run and Conowingo Projects. The SMP contains shoreline vegetation management measures to protect shoreline vegetation wherever feasible and sensitive natural resources policies that would limit or restrict land use in areas of rare species and wetlands.

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[109] This flow regime has been recommended by The Nature Conservancy and Interior and would include increased and more stabilized minimum flow releases and decreased maximum flow releases from the project.

[110] The wire zone is the section of right-of-way directly under the transmission wires and extending outward 10 feet on each side of the wires.

There were no recommendations made by stakeholders regarding vegetation maintenance at any of the three projects.

Our Analysis

Rare Plants

Although it is possible that rare plant species occur within any of the three projects, no rare plant species were observed within the project boundaries during studies conducted for the projects. Project maintenance at all three projects would be expected to continue similarly to how it has in the past, with vegetation habitats remaining as they exist currently. Overall, proposed maintenance activities such as tree trimming, lawn care, herbicide use, and building maintenance would create minimal vegetation disturbance and result in minimal vegetation removal. As a result, it is expected that if rare plant species exist in the project areas they are not likely to be affected by project maintenance.

At the Muddy Run Project, Exelon uses manual, mechanical, and herbicide methods to maintain the transmission line right-of-way free of tall-growing species that could interfere with line reliability. Again, because this IVM would continue under the terms of any new license, any rare plant species that currently may exist in the right-of-way would not be expected to be affected by the proposed project maintenance. The proposed SMP at the Muddy Run and Conowingo Projects would likely benefit rare plant species, if they occur, because it would limit the amount of shoreline vegetation removed and, if any rare plants are found during the life of any licenses issued, these locations would be integrated into the SMP's sensitive natural resources land use protection program.

Invasive Species

Regular project maintenance activities, such as vegetation mowing, trimming, and clearing, and herbicide applications around project facilities, as well as project-related recreation facility use at all three projects would create disturbance that could contribute to the spread of invasive species. The presence and spread of invasive species could also affect rare plant populations by outcompeting such species. At the York Haven Project, York Haven Power observed invasive species along road edges and disturbed areas of Three Mile Island and at the Muddy Run Project, Exelon observed invasive species along the western shore of the power reservoir and areas near recreation facilities and in the transmission line right-of-way. All of these areas are routinely disturbed by project maintenance and, in some cases, public use. With York Haven and Exelon continuing their project maintenance activities, invasive species would continue to exist in the project boundaries and could potentially spread. Eradicating or even controlling invasive species populations is very difficult, however, because outside activities can continuously introduce new populations of invasive species into the project boundary. Because the presence and spread of invasive species is an issue that extends far beyond the three projects, the effect of project maintenance on invasive species proliferation would be minimal. In addition, at Muddy Run, at the location where invasive species could directly affect the federally listed bog turtle, Exelon proposes, as part of its Bog Turtle Management Plan, to conduct invasive species control measures. The bog turtle is discussed further in section 3.3.4.2, *Threatened and Endangered Species, Environmental Effects.*

Recreation Facilities

Existing and proposed recreation facilities at the three project areas could cause disturbance to wildlife by creating noise and human activities, which cause wildlife to leave the area. Proposed recreation facilities would result in the loss of some wildlife or possibly rare plant habitat, if any still exists.

York Haven Power does not propose any new recreation facilities. Exelon proposes improvements to existing recreational areas within the Muddy Run Project. Improvements that would disturb vegetation include: a new boat ramp and shoreline improvements at the Muddy Run Campground, and expanding the playground and other facilities at the Visitor's Center. At the Conowingo Project, Exelon proposes several recreation facility improvements that would disturb vegetation such as vegetation clearing, additional parking spaces, and new docks at Lock 13 and 15; a new parking lot and concrete pad for restroom placement at the Cold Cabin Campground; installation of new drainage ditches at the Conowingo Creek boat launch; parking lot expansion at the Glen Cove Marina; replacing the existing pavilion and removing a portion of the parking lot at the Conowingo dam overlook; widening access roads, constructing a retaining wall, creating additional parking, constructing a new boat launch, and replacing the existing launch area at the Fisherman's parking/Shures landing site; and, constructing a new road at the Peach Bottom access. See section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, for additional details describing specific changes made in each area.

Our Analysis

Existing recreation facilities in the three project boundaries are not expected to adversely affect wildlife species because it is likely that most wildlife species that occur in those areas have adapted to current levels of activity. Some more sensitive wildlife species would likely continue to move out of the areas during high recreation use. Proposed recreation improvements at Muddy Run and Conowingo are expansions or improvements to existing facilities. As a result, increased noise and human activity would be expected to result in only minor disturbance to wildlife. Proposed recreation enhancements at Muddy Run and Conowingo would, however, result in the loss of wildlife habitat through the removal of vegetation. Although the exact amount of vegetation that would be cleared for the proposed facilities is unknown, the nature of the facilities at both Muddy Run and Conowingo is not expected to have a large construction footprint outside already disturbed areas. Because all of Exelon's proposed improvements would be at existing sites, most land clearing would likely occur in previously disturbed areas. Direct mortality of smaller, less mobile wildlife species could occur; however, more mobile species would be expected to disperse into nearby similar habitat. In addition, ground disturbance during construction could result in the increased presence and proliferation of invasive species.

Nature-like Fishway Construction at the York Haven Project

York Haven Project

In the Settlement Agreement, York Haven Power proposes, and the Settling Parties recommend, the installation of a nature-like fishway at the north end of the main dam. Further discussion can be found in section 3.3.2.2, *Water Resources, Environmental Effects*. The nature-like fishway would serve as a primary fish passage facility. The facility would consist of an in-river nature-like fishway near the toe of the main dam and reaching upstream from the main dam and would be approximately 300 feet wide. York Haven Power proposes in the explanatory statement filed with the Settlement Agreement that during the finalization of the nature-like fishway plans and required permitting it would conduct vegetation cover type mapping, wetland delineation, invasive species surveys, rare species surveys, a bog turtle habitat assessment, and a bald eagle survey in 2014 in the area right around the proposed nature-like fishway. In addition, it would follow all necessary steps to submit applications for a section 404 permit from the Corps and an NPDES Permit for Stormwater Discharge Associated with Construction Activities from Pennsylvania DEP in 2015. Interior commented that York Haven Power should follow conservation measures that protect bald eagles in addition to adopting the National Bald Eagle Management Guidelines.

Our Analysis

Construction of the proposed nature-like fishway would disturb vegetation located at the apex of the main dam and abutment with the west shore of Three Mile Island and wetlands within the Susquehanna River. Initial construction of the nature-like fishway would result in the loss of vegetation and wildlife habitat in the construction footprint. During construction, human activity and construction noise would result in a temporary disturbance to wildlife in the area. Following construction, wildlife disturbance would return to pre-construction conditions.

Ground disturbance and vegetation removal activities associated with construction of the nature-like fishway could disturb or directly affect rare plant and wildlife species such as the bald eagle, as well as result in the spread of invasive species or wetland impacts. However, because York Haven proposes to conduct all the indicated surveys, complete the resource agency consultation required to obtain the section 404 and NPDES permits, and follow all protection measures and BMPs contained in any permits they receive, including measures to protect any bald eagles identified during surveys and FWS consultation, the proposed nature-like fishway would not adversely affect rare terrestrial resources.

Bald Eagle and Osprey Management

Bald eagle and osprey populations occur within the vicinity of all three project areas mainly along the reservoirs and river edges. Project recreation and maintenance could potentially affect raptors such as the bald eagle and osprey by creating human disturbance and cutting trees and vegetation. The Muddy Run transmission line could also potentially affect large raptors from electrocutions or collisions.

York Haven Project

Although York Haven Power does not propose any measures specifically for bald eagle, osprey, or raptor management, York Haven Power proposes to conduct a bald eagle survey around the proposed nature-like fishway facility. No resource agencies recommend any raptor measures at the York Haven Project other than the Settling Parties' recommendation to construct the nature-like fishway facility as included in the Settlement Agreement and Interior's comment that York Haven Power follow conservation measures that protect bald eagles and adopt the National Bald Eagle Management Guidelines.[111] This is discussed above under *Nature-like Fishway Construction at the York Haven Project*. Overall, even though bald eagles, osprey, and other raptors occur in the York Haven project area, because York Haven Power does not propose to change the overall minimum flows below the dam or any new recreation facilities and the project does not include a transmission line, it would not affect these species and they are not analyzed further.

Muddy Run and Conowingo Projects

At both the Muddy Run and Conowingo Projects, Exelon proposes to implement the Bald Eagle Management Plans included in its license applications that provide for the management of bald eagle habitat on Exelon lands based on recommendations from the FWS *National Bald Eagle Management Guidelines* and state agency guidance. This includes implementing distance and landscape buffers around nesting sites and avoiding certain activities during nesting season. In addition, the Bald Eagle Management Plans include general guidelines for activities around roosting and foraging areas. The plans also include provisions for monitoring of nesting, roosting, and foraging sites every 5 years and injury and mortality procedures.

In addition, Exelon proposes, as part of the SMPs at both projects, to implement an osprey management policy that states that Exelon would work with state and federal agencies to provide appropriate buffers dictated by the types of activities carried out in

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[111] In letters filed January 7, 2015, and January 28, 2015, regarding endangered species concurrence for the York Haven and Muddy Run projects, FWS' Pennsylvania Field Office also provided general recommendations for avoiding and minimizing impacts on migratory birds (including bald eagles) within and around the project area, for both the York Haven and Muddy Run projects.

either visual or auditory proximity to nests during breeding and nesting season (January to late July). This includes implementation of: (1) nest buffers during the breeding season of 330 feet for most activities and larger buffers up to 600 feet for activities with the potential to emit excessive noise (which excludes routine project operation and maintenance activities); and (2) restriction on herbicide application within 330 feet of osprey nests during breeding season. Exelon would also consult with FWS and Pennsylvania Game Commission to determine BMPs and obtain applicable permits in the event an osprey nest on project transmission line towers is identified as a problem nest that needs to be removed or relocated.

For both the Muddy Run and Conowingo Projects, Interior recommends under section 10(j) that Exelon finalize and implement Bald Eagle Management Plans in consultation with FWS, Maryland DNR, and the Pennsylvania Game Commission. The management plan would manage bald eagle habitat on Exelon land in accordance with recommendations in the *National Bald Eagle Management Guidelines* (FWS, 2007a) and state agency guidance. Bald eagle habitat, including nest sites, forage sites, and communal roost sites, would be managed through a range of conservation measures that meet the provisions of the Bald and Golden Eagle Protection Act, including incidental take of eagles. The range of measures would include seasonal restrictions, distance buffers, and landscape buffers. For the Conowingo Project, Interior indicates two specific measures that Exelon should reconcile to avoid disturbance of eagle concentration areas: (1) enforcement of human traffic restrictions on both sides of Rowland Island, under the towers in the river, and on the Cecil County side of the river where current human activities disturb perching and foraging eagles; and (2) a requirement that Exelon release information pertaining to federal regulations that protect eagles and great blue heron rookeries, and other migratory birds if any lands are potentially donated by Exelon.[112]

Exelon, in its response to Interior's recommendations on the Conowingo Project, states that its proposed Bald Eagle Management Plan was developed in consultation with FWS and Maryland DNR. Exelon states that its proposed Bald Eagle Management Plan would manage, through a range of measures, bald eagle nest habitat, including nest sites, forage sites, and communal roost sites, on Exelon land. Exelon states that it would consult with FWS and other pertinent resource agencies to finalize the Bald Eagle Management Plan.

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[112] We interpret Interior's comment as recommending, in the event that Exelon donates land, that Exelon must provide information to the recipient regarding bald eagles and other migratory bird species that are present, and the state and federal protection afforded to these species.

Our Analysis

In August 2012, Exelon completed a transmission line avian interaction study report for the Muddy Run Project. The report focused on the biology and morphology of avian species, environmental factors, and site configuration of the lines and structures. Birds that are large in size, such as eagles, osprey, herons, and vultures are thought to have a greater risk of mortality around transmission lines due to large body size and wing span contacting transmission lines during flight, and nesting on towers. Many avian species prefer nesting on these structures because of height and openness overlooking foraging areas.

As part of the study, Exelon conducted bird surveys between April 2010 and October 2010 along the 4.25-mile-long transmission line right-of-way that connected the Muddy Run powerhouse to the PBAPS north substation. Data collected were used to determine the potential risk of electrocution and collision at the project transmission line. The study covered 86 observational hours with 1,376 avian sightings and one mortality. Large raptors, including bald eagles and osprey, concentrate in a section of the project, known as the Water Crossing, where the transmission line perpendicularly crosses Conowingo Pond from the Muddy Run powerhouse to a slope above Muddy Creek Boat Launch. The 2012 study determined this area to have a higher collision risk for raptors and other birds because the abundance of large species, the configuration of lines perpendicular to shorelines in an open/shoreline environment, and the presence of shield wires. Electrocution, on the other hand, is not a risk because the separation of the transmission line's energized and grounded components is larger than the wing span of the largest bird in the area. Electrocution is unlikely to occur if a bird is not able to touch multiple components at once.

Overall, although the Water Crossing area of the Muddy Run Project has a higher risk for avian collision, the transmission line interaction study documented only one mortality with more than 1,376 avian sightings, suggesting that raptor mortality from collisions with the transmission line may not be common. Although the study is unlikely to have observed every instance of avian mortality and occasional mortality from collisions is possible, the Muddy Run Project transmission line is not expected to result in adverse effects on raptor populations, including bald eagles and osprey.

Implementation of the Bald Eagle Management Plan, as proposed by Exelon and recommended by Interior, would benefit bald eagles within the Muddy Run and Conowingo project boundaries. FWS' *National Bald Eagle Management Guidelines* include active nest protection buffers ranging from 330 feet to 1 mile, depending on the nature of disturbance under consideration. By following the proposed Bald Eagle Management Plan, Exelon would comply with bald eagle management guidelines and state guidelines, as they relate to nesting eagles, during construction of recreational facility enhancements, project maintenance, and other proposed project measures. In addition, conducting monitoring every 5 years would identify new nesting, roosting, and foraging sites and identify sites that have been abandoned. This would ensure that future bald eagle nest, roost, and foraging areas are also protected by the Bald Eagle Management Plan. Finally, the mortality reporting component of the proposed plan would ensure that FWS and the Pennsylvania Game Commission are aware of any project-related bald eagle mortality for the term of any new license and allow Exelon and the agencies to identify and address any increase in project-related mortality.

At the Muddy Run and Conowingo Projects, both the Exelon proposed and Interior recommended Bald Eagle Management Plans would result in the same benefit to nesting, roosting, and foraging bald eagles. At the Conowingo Project, Interior's recommendation to enforce restrictions to human activity in the vicinity of eagle concentration areas would result in greater protection of foraging and communal roosting bald eagles from human disturbance. Although Exelon's proposed Bald Eagle Management Plan provides project-specific restrictions, buffers, and other measures to protect nests in accordance with the National Bald Eagle Management Guidelines, it only mentions general guidelines related to foraging and roosting areas. Exelon has current human activity restrictions below Conowingo dam; however, information provided by Interior in its 10(j) letter indicates that Exelon is not implementing protection measures to avoid or minimize disturbance to the large core of non-breeding, overwintering eagles present on structures, rocky shoreline, and forested habitats downstream of Conowingo dam, and that FWS receives inquiries from the public about disturbances to eagles at Conowingo dam. Interior's recommendation would require Exelon to develop measures as part of the Bald Eagle Management Plan to enforce the existing restrictions, as they relate to foraging, perching, and roosting bald eagles. Such measures could include increased signage, patrols of the area, or possibly, physical restrictions. As Exelon has not proposed to donate lands as part of the proposed project, it is not necessary at this time to include a measure in the proposed Bald Eagle Management Plan that would require Exelon to release information on bald eagles or other migratory species to a recipient.

Similar to the bald eagle, Exelon's proposed osprey management policy would result in landscape and seasonal buffers around osprey nests. By implementing appropriate buffers, as determined in consultation with FWS and Pennsylvania Game Commission, Exelon is likely to protect the osprey during construction of recreational facility enhancements, project maintenance, and other proposed project measures. In addition, it would ensure that Exelon follows BMPs identified by FWS and the Pennsylvania Game Commission and obtains necessary permits before removing active osprey nests. Overall, the proposed policy would benefit the osprey by enacting protection measures.

Waterfowl Nesting Protection

Waterfowl nesting habitat is present in wetland and riparian habitat within the projects' boundaries. As a result, project operations that result in water level fluctuations in project reservoirs or varying flows downstream could flood waterfowl nests. Waterfowl species, protected under the Migratory Bird Treaty Act and reported as nesting in the vicinity of Conowingo dam, include wood duck, American black duck, mallard, and Canada goose.

York Haven Power and Exelon do not propose measures related to waterfowl protection, and waterfowl nesting protection was not identified as a concern by resource agencies or other stakeholders at the York Haven or Muddy Run Projects.

For the Conowingo Project, Interior recommended under section 10(j) that Exelon develop a waterfowl nesting protection plan in consultation with FWS. The plan would identify waterfowl nesting areas within the project area that are vulnerable to flooding associated with project peaking operations during nesting season, and create a range of alternatives and recommendations to avoid flooding active nests.

Exelon, in its response to Interior's recommendation, states that there is no evidence that Conowingo Project operation affects waterfowl or that a waterfowl protection plan would be necessary. Exelon states that it was not asked to conduct an assessment of the effects of project operation on waterfowl during the relicensing process. In addition, Exelon states that the zone of fluctuation around Conowingo Pond does not provide waterfowl nesting habitat and that project fluctuations around Conowingo Pond and flows downstream of the dam would not affect foraging habitat.

Our Analysis

Exelon does not propose to change project operation at the Conowingo Project; however, project operation would continue to result in fluctuations of Conowingo Pond of up to 9 feet. In addition, waterfowl nesting downstream of the Conowingo Project could be affected by proposed seasonal fluctuations in flow, specifically the increase in minimum flow, from 3,500 cfs in March to 10,000 cfs in April, during the early stages of waterfowl nesting. The perimeter of Conowingo Pond and the Susquehanna River downstream of Conowingo dam does provide waterfowl nesting habitat, and water level fluctuations due to project operation, where peaking flows may range from the minimum flow up to about 80,000 cfs, may affect nesting success, if fluctuating flows and reservoir levels coincide with critical periods of waterfowl nesting (egg laying or incubation). Therefore, implementation of a waterfowl nesting protection plan, as recommended by Interior, would be valuable in identifying areas where waterfowl nesting habitat is affected by inundation or dewatering due to project operation. If specific, project-related effects on waterfowl nesting are identified, then such a plan would then allow appropriate protection or mitigation measures to be established. Overall, implementation of a waterfowl nesting protection plan at the Conowingo Project, in consultation with FWS and the state agencies, would benefit nesting waterfowl by allowing Exelon to determine if the Conowingo Project is affecting waterfowl nesting habitat, identifying which species of nesting waterfowl the project is affecting, and establishing appropriate protection or mitigation measures. The TNC Flow Regime, if implemented, would result in more stable minimum and maximum flows during waterfowl nesting season, which could result in less inundation due to peaking operations downstream of the dam.

Northern Map Turtle Management

The northern map turtle is known to occur at several locations along the Susquehanna River both above and below Conowingo dam, including Wood Island, the town of Port Deposit, and Octoraro Beach. Operation of the Conowingo Project, including changes in minimum flow releases could affect map turtle nesting and basking sites. Maryland DNR comments that Exelon failed to address effects on the map turtle, which occurs upstream and downstream of Conowingo dam. It states that constant water level changes from the Conowingo Project affect map turtle basking sites, nesting areas, and egg production and viability.

The Nature Conservancy and Interior recommended an alternative flow regime downstream of Conowingo dam, partly to benefit basking northern map turtles. The TNC Flow Regime would result in more stable flows downstream of the dam, particularly during the spring season.

Exelon, in its response to Maryland DNR's comment, stated that it has funded several map turtle studies through Towson University since 2011; however, at this time there is no substantial evidence that project operation is adversely affecting the map turtle and that implementing any protection, mitigation, or enhancement measures would be premature. Exelon states that it is currently working with the State of Maryland and Towson University researchers to develop a plan of study for 2014, which would include the following research components: (1) nesting habitat enhancement; (2) assessment of ecology and viability of populations upstream of Conowingo; (3) development of artificial basking structures to mitigate loss of basking sites; (4) rapid assessment of population size to determine population trends; (5) hatchling and juvenile ecology; and (6) working with the State of Maryland to develop potential protection and enhancement measures for any identified project-related adverse effects.

Our Analysis

Towson University conducted interim northern map turtle studies from 2011-2013 that discussed the effect of Conowingo Project operation on the northern map turtle (Seigel et al., 2014). The studies have indicated that turtle nest predation and disturbance is prevalent in the Conowingo Project area, particularly at the Octoraro Beach site. Encroachment of woody vegetation and brush at the site meant that the turtles had to concentrate nests in the few open areas where predators could locate nests more easily.

Exelon, at Towson's request made some nesting habitat improvements in 2012 and 2013, and Towson's study indicates that these improvements, such as opening up canopy, decreased predation and improved nesting success. In 2011, the map turtle predation rate was 96.7 percent. Following Exelon's habitat improvements in 2012 and 2013, the predation rates lowered to 44 percent and 66 percent, respectively. Towson stated that such habitat manipulations would need to continue biannually to maintain the improved conditions. In addition, human disturbance to nesting areas during nesting season is likely to limit the nesting success.

The studies also have shown that basking sites below the dam are affected by human disturbance during recreation and could be affected by water level and flow changes. According to the 2013 study, kayaks appeared to be the most likely cause of disturbance to basking turtles; however, other sources of disturbance include fishing boats, speed boats, canoes, and swimmers. Additionally, the seasonal period when boat traffic is the heaviest (specifically, June and August) and the time of day when boat traffic is heaviest (between 11 a.m. and 1 p.m.) coincided with the map turtle's critical basking times. The study hypothesized that the disturbance to basking turtles as a result of boat traffic during the early summer may lead to reduced production of map turtle offspring.

Although some map turtle disturbance, such as predation, is not a result of project operation, fluctuations in river flow and human disturbance from recreational activities may be partly project-related. The 2013 study determined that a combination of flow rates from the dam in combination with tide level results in water level fluctuations that submerge basking sites, limiting the ability of the map turtle to bask. As described above, initial studies indicate that project operation and project-related recreation could affect map turtle nesting and basking success. Although Exelon indicates that it is continuing to work with Towson University and the State of Maryland on northern map turtle studies and the development of protection, mitigation, and enhancement measures, if Exelon develops and implements a formal northern map turtle protection plan, in consultation with Towson University and Maryland DNR, that incorporates nest management and mitigation measures to improve and maintain nesting habitat, create new alternative nesting and basking sites, and implement measures to restrict human access to nesting sites during nesting season, the project would benefit the northern map turtle.

In addition, it appears that high flow releases from Conowingo dam may contribute to the submergence of turtle basking sites, which in turn could affect reproductive success. It is likely that more stable flows, such as those in the TNC Flow Regime, would benefit basking turtles by allowing basking sites to be available for longer periods.

Wildlife Species of Special Concern

In addition to the species of special concern discussed above (e.g., bald eagle, osprey, and northern map turtle), there are four additional species that are either known to occur or could potentially occur within the three project boundaries during the year, for breeding, foraging, migration, or overwintering. Neither York Haven Power nor Exelon proposed any measures and no stakeholders proposed measures relating to these species in response to the Commission's ready for environmental analysis notice.

The peregrine falcon has been observed in and around the York Haven Project; however, the project contains no suitable nesting habitat other than buildings. In addition, York Haven Power does not propose to change existing project operation.

Because project operation would not change, York Haven Power does not propose any additional recreation facilities which would increase human disturbance, and project maintenance is unlikely to affect falcon habitat it is unlikely that the York Haven Project would affect any peregrine falcons that may use the project area.

According to the license applications, black-crowned night-herons were not observed at either the York Haven or Muddy Run Projects; however, this species has been observed regularly foraging and roosting in the Conowingo dam tailrace, spillway, and around Rowland Island. However, Conowingo Project operation and maintenance, and recreation activities at the project, particularly in the portion of Rowland Island identified as potential nesting habitat, may affect black-crowned night-heron nesting activity. Exelon does not propose to change existing project operation or maintenance, nor does it propose any recreation facilities on Rowland Island; therefore, it is likely that night-herons that presently forage within the project area would continue to do so. The TNC Flow Regime would result in more stable flows below the dam, which could improve night-heron habitat suitability.

York Haven Power and Exelon did not observe the rough green snake during any non-targeted surveys in 2010 and 2011. Although potential habitat was identified in the Muddy Run Project, no rough green snakes were observed during Exelon's targeted surveys at the Muddy Run Project. It is unlikely that this species would be affected by operation of the three projects. Project maintenance in suitable rough green snake habitat at the three projects has the potential to cause mortality to individuals, but based on the lack of observation, it is unlikely that maintenance would affect this species. Lastly, construction of staging areas for the York Haven Project's nature-like fishway would not likely affect this species, as management practices to minimize impacts on wildlife during construction would be employed.

Exelon did not observe the red-bellied turtle during any non-targeted surveys in 2010 and 2011, nor has it been identified as occurring in the project areas. Although potential habitat was identified in the York Haven area, York Haven Power conducted protocol-level surveys and did not locate any turtles. Although project operation could affect red-bellied turtle habitat, because red-bellied turtles were not observed in the project area after a thorough search, this species would not likely be affected.

Rare, Threatened, and Endangered Species Review for Muddy Run

Pennsylvania DEP filed with the Commission on June 9, 2014, a water quality certification for the Muddy Run Project, and filed a clarified version of the certification on December 10, 2014. The certification included a mandatory condition requiring Exelon to conduct an evaluation of all state and federal endangered or threatened species that may be present within the project boundary every 10 years, and to propose a plan and schedule for protection if its evaluation identifies the presence, critical habitat, or critical dependence of such species within the Muddy Run project boundary.

Over the course of any new license, the presence and locations of rare, threatened, and endangered species in the Muddy Run project boundary is likely to change. Exelon proposes to evaluate all state and federal endangered or threatened species that may be present within the project boundary once every 10 years through the term of the license. If the evaluation identifies the presence, critical habitat, or critical dependence of endangered species, Exelon would propose and, following approval, implement a plan to ensure protection of endangered or threatened species.

Although we agree that this measure would allow Exelon to continue to be aware of the current rare, threatened, and endangered species populations in the Muddy Run Project during the length of any license, the Commission typically includes in its licenses a standard license article with a fish and wildlife reopener provision that could be used to require changes to project facilities upon Commission motion or as recommended by the appropriate federal and state fish and wildlife agencies after notice and opportunity for hearing. This standard reopener provision retains authority for the Commission to implement any measures that may be needed to protect threatened or endangered species or other fish and wildlife resources over the term of any license issued for the project.

3.3.4 Threatened and Endangered Species

3.3.4.1 Affected Environment

In a letter filed January 4, 2007, Interior provided a list of federally listed species that may occur in the project area. Staff also referred to FWS' website (http://ecos.fws.gov/ipac/; accessed March 11, 2014, and May 12, 2014) to gather recent information on the potential presence of federally listed threatened and endangered species within the counties that contain the three projects, and contacted FWS and Maryland DNR regarding a bog turtle record close to Conowingo dam. Six federally listed species are known to occur in the vicinity of one or more of the projects: shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), bog turtle (*Glyptemys [Clemmys] muhlenbergii*), Indiana bat (*Myotis sodalis*), Delmarva Peninsula fox squirrel (*Sciurus niger cinereus*), and swamp pink (*Helonias bullata*).

Aquatic Species

Shortnose Sturgeon

The shortnose sturgeon (*Acipenser brevirostrum*) is a federally listed (endangered) species with a range along the Atlantic coast extending from New Brunswick, Canada, to Florida. NMFS recognizes 19 distinct population segments (DPSs) occurring in New Brunswick, Canada (1), Maine (2), Massachusetts (1), Connecticut (1), New York (1), New Jersey/Delaware (1), Maryland/Virginia (1), North Carolina (1), South Carolina (4), Georgia (4) and Florida (2). The species typically occurs in coastal tidal rivers and spawns in fresh water, sometimes moving substantial distances upstream. Shortnose sturgeon have been collected in the Connecticut River as far upstream as the Holyoke

Project, at RM 86. Shortnose sturgeon are not considered anadromous or strongly migratory but have been found in brackish and salt water, moving some distance from its natal stream (Scott and Crossman, 1973). It is a relatively small sturgeon, seldom reaching a length of greater than 35 inches and a weight of 8 or 9 pounds. The populations of shortnose sturgeon vary substantially over their range, and it is thought that they no longer occur in some tributary rivers to the Chesapeake Bay, including the Susquehanna. The nearby Delaware River, however, has been estimated to have a stable shortnose sturgeon population of from 10,000 to 20,000 fish, based on several population estimates. Delaware River fish are able to access the lower Susquehanna River via the Chesapeake and Delaware Canal, which connects Delaware Bay to the upper Chesapeake Bay.

Documented shortnose sturgeon occurrences in the Susquehanna River in recent years have been limited, with only a total of seven fish reported. Five fish were recorded in the tidal portion of the river from 1992 to 2004, and two fish were reportedly caught by anglers in the Conowingo tailrace in 1986. No shortnose sturgeon are known to have been collected or passed via the Conowingo fish lifts since they began operation in 1972 (Normandeau and Gomez and Sullivan, 2012l). An additional three shortnose sturgeon were collected in the upper Chesapeake Bay (Susquehanna Flats), but analysis of genetic samples found that the source of these fish was likely Delaware Bay. In 2010 and 2011, Exelon conducted monitoring for acoustically tagged shortnose and Atlantic sturgeon in the lower Susquehanna River downstream of Conowingo dam near Port Deposit and downstream of the I-95 bridge. The objective was to determine if any sturgeon acoustically tagged by other researchers in Chesapeake and Delaware bays made forays into the Susquehanna River. No tagged fish were recorded.

Exelon assessed Susquehanna River shortnose sturgeon (and other species) habitat downstream of Conowingo dam in the 4.5-mile non-tidal reach ending just upstream of Port Deposit (Gomez and Sullivan Engineers and Normandeau Associates, 2012). Shortnose sturgeon was selected as one of the target species of special concern, and the analysis found that there is suitable habitat for all sturgeon life stages in this reach of the river at a range of flows modeled.

Atlantic Sturgeon

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus)* is also federally listed with a range along the Atlantic coast from Maine to Florida. NMFS recognizes five DPSs: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. Atlantic sturgeon are listed as threatened in the Gulf of Maine DPS and endangered in the remaining four DPSs. Atlantic sturgeon are considered an anadromous species, spawning in freshwater generally in the spring and early-summer and returning to estuarine or marine waters where they spend most of their lives. Atlantic sturgeon are believed to be present in 32 rivers along the Atlantic coast, with spawning occurring in 20 of those rivers. Atlantic sturgeon are larger in size than shortnose sturgeon, and may reach a length of 14 feet and up to 800 pounds (http://www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon.htm#distribution, accessed March 7, 2014).

Atlantic sturgeon are commonly reported in the Chesapeake Bay, particularly during the winter months, but none have been documented in the Susquehanna River. Undocumented anecdotal reports of Atlantic sturgeon in the Susquehanna River have been made, but none in recent years. As with shortnose sturgeon, there is evidence that Atlantic sturgeon may use the Chesapeake and Delaware Canal for movement between the Chesapeake and Delaware Bays. No Atlantic sturgeon have been collected in the Conowingo dam fish lifts since beginning operations in 1972. Exelon's instream flow study (Gomez and Sullivan Engineers and Normandeau Associates, 2012a) did not use Atlantic sturgeon as an evaluation species, but did include the species in the "deep slow" and "deep fast" habitat guilds, and found suitable habitat for all Atlantic sturgeon life stages in the lower Susquehanna River.

Bog Turtle

The bog turtle (*Glyptemys* [*Clemmys*] *muhlenbergii*) is a federally listed species (threatened) that has been documented at the Muddy Run Project, and has the potential to occur at the York Haven and Conowingo Projects. The bog turtle was listed as threatened under the ESA in 1997. The bog turtle is also listed by Maryland DNR as a threatened species, and by Pennsylvania FBC as an endangered species.

The bog turtle is native to the eastern United States and ranges from Georgia to the lower New England states. In Pennsylvania, extant populations of bog turtle are known from 14 counties (including Lancaster and York) located primarily in the southeastern quadrant of the Commonwealth. Bog turtle populations are also known from the vicinity of Conowingo dam in adjoining Harford County, Maryland.

Bog turtles inhabit distinct types of headwater wetland habitats that include spring-fed hydrology and loose, saturated soils. Small spring-courses, rivulets, and shallow pockets of surface water typify the surface hydrology of bog turtle wetlands. Subterranean tunnels that access flowing groundwater are often used by bog turtles as hibernacula for winter brumation and as refugia during the hot summer months. Deep, loose, saturated soils (unofficially described as "mucky", and not to be confused with muck) in which bog turtles can burrow are an important component of their habitat. Ideal bog turtle wetlands contain mostly emergent vegetation with open canopy (minimal woody species), though some shrubs and small trees may be scattered throughout.

Bog turtles in Pennsylvania typically emerge from hibernation in March or early April, and return to hibernacula in late October to November, depending on weather conditions. Breeding occurs from late April through early June, with nesting in Pennsylvania occurring from June through early July. Turtles typically lay eggs within or on top of suitable vegetation such as sedges or sphagnum moss. Hatchlings emerge from the nest August through September and overwinter near their nest.

York Haven Project

Although the York Haven Project is located within the range of the bog turtle, York Haven Power did not conduct specific surveys during its relicensing proceedings. Potential habitat for bog turtles may exist within the project boundary, mostly on the southern section of Three Mile Island within the relatively large wetland complexes, York Haven Power noted several small fringe riparian wetlands along the banks of the east channel and in isolated pockets below the main dam and headrace wall, but the frequent flooding of these wetlands during high-flow periods likely makes these habitats unsuitable for bog turtles. The wetland habitat located on Three Mile Island within the project boundary may provide habitat for bog turtles; however, no bog turtles were observed during the Eastern Redbelly Turtle Phase II Presence/Absence and Nesting Survey or any other surveys conducted in 2010 or 2011. York Haven Power indicates that it will conduct a bog turtle habitat assessment in the vicinity of the nature-like fishway during the 2014 field season.

Muddy Run Project

The Muddy Run Project is located within the range of the bog turtle. Exelon conducted studies during the spring and summer of 2010 and 2011 to identify potential habitat for herpetofaunal species within the Muddy Run Project area. Qualified biologists searched all land areas to identify potential habitats. Of the six wetlands identified within the project study area, four wetlands were not potential habitat and did not warrant further surveys, and two wetlands were potential habitat. Bog turtles were found to occupy one wetland within the project study area during surveys in June 2011.

Conowingo Project

According to the Muddy Run bog turtle report, bog turtles are known to exist in the vicinity of Conowingo dam in adjoining Harford County, Maryland. Exelon conducted surveys in 2008 and determined that none of the 31 wetlands surveyed around Conowingo Pond contain suitable bog turtle habitat. As documented in telephone and e-mail memoranda filed April 23, 2014, and June 9, 2014, FWS staff stated that a bog turtle was sighted close to Conowingo dam in 2013, and directed Commission staff to contact Maryland DNR for further information. On October 14, 2014, Exelon filed additional, privileged information it had previously received from Maryland DNR indicating that bog turtles have been found twice in the past 10 years in a wetland and a stream located near a project recreation area.

Terrestrial Species

Indiana Bat

The Indiana bat (*Myotis sodalis*) was originally listed as endangered under the Endangered Species Preservation Act of 1966. Currently, the Indiana bat is federally listed as endangered. This species, mainly dominant in Indiana, ranges from Florida north to Vermont and extending as far west as Eastern Oklahoma. It could potentially occur throughout Pennsylvania. The Indiana bat is a temperate, insectivorous, migratory bat that hibernates colonially in caves and mines in the winter. Spring migration to new habitat happens from mid-March to mid-May. During spring months, females migrate, forming maternity colonies to raise their young in wooded areas. Males and non-reproductive females remain near their location for winter hibernation or migrate to summer habitat. Summer colony roosts are typically behind exfoliating bark of large, often dead, trees (typically >5 inches dbh) where individuals roost in similar smaller trees (as small as 3 inches dbh). Between mid-August and mid-October, males and females return to their dwelling to hibernate. During winter months, Indiana bats are restricted to underground dwelling, but during summer month's female roosts seek out forested habitat. Roosting Indiana bats prefer the bark of dead trees that retain large, thick slabs of peeling bark, such as shagbark hickory and oaks, that are usually located within canopy gaps, along fence lines and wooded edges. Indiana bats typically roost in riparian zones, forested wetlands and upland communities, and forage along forested edges and within forested and riparian areas (FWS, 2007).

Delmarva Peninsula Fox Squirrel

The Delmarva Peninsula fox squirrel (*Sciurus niger cinereus*) is federally listed as endangered. Historically, the fox squirrel was found within the eight counties in the Delmarva Peninsula of Delaware, Maryland, and Virginia, including Cecil County. Although SD1 indicated that the Delmarva Peninsula fox squirrel would be assessed, the FWS website indicates that this species is not currently known to occur in Cecil County, Maryland (FWS, 2014c). Therefore, we do not analyze it further in this document.

Swamp Pink

Swamp pink (*Helonias bullata*) is federally listed as a threatened plant species. New Jersey contains the majority of the remaining populations of the species; however, according to FWS, the species is known to occur or is believed to occur in Cecil County (FWS, 2014b). Swamp pink belongs to the lily family and is characterized by a hollow flower stem (1 to 3 feet tall), evergreen, lance shaped leaves that lay flat on the ground, and topped by a cluster of pink flowers (FWS, 2006). Swamp pink inhabits forested and scrub-shrub wetlands usually bordering meandering streamlets, headwater wetlands, and spring seepage areas, although swamp pink is limited to perennial saturated wetlands that are not inundated by floodwater. Ideal swamp pink habitat contains mainly shaded forested areas with the water close to surface level fluctuating little during the spring and summer.

Because the swamp pink is not listed by FWS as occurring in the counties occupied by York Haven or Muddy Run Projects, these projects would have no effect on the species and it is not analyzed further in this document. Although Exelon did not conduct targeted swamp pink surveys at the Conowingo Project, and no swamp pink communities were incidentally observed during any of Exelon's 2010 and 2011 field survey activities, potential habitat may occur within the Conowingo Project area in forested wetland, riparian habitat along the river and reservoir edges and Rowland Island.

Northern long-eared bat

The northern long-eared bat (*Myotis septentrionalis*) is not currently federally listed, but has been proposed for listing under the ESA.[113] In Pennsylvania, it is a candidate for listing as a rare species, but more information is needed before adequate management decisions can be made (PNHP, 2014).

The northern long-eared bat's range extends from Maine to North Carolina along the Atlantic coast, including the Susquehanna River in the vicinity of the three projects. The northern long-eared bat historically occurred in Lancaster County based on pre-1980 data, and currently occurs in York and Dauphin Counties based on data from 1980 to the present (PNHP, 2014). During winter hibernation, the northern long-eared bat dwells in underground caves and similar sites. Suitable roosting caves need large open space with cracks and crevices, cool temperature (32 to 48°F), high humidity, and low air movement. Spring migration to new habitat happens from mid-March to mid-May. During summer migration, roosting occurs underneath bark, cavities or hollows of trees or snags (typically greater than 3 inches diameter at breast height [dbh]), although occasional roosting in barns and sheds have occurred. Preferred roosting trees such as shagbark hickory and oaks usually display exfoliating bark, hollows, cavities, and crevices. The northern long-eared bat forages in lowland woods, along forest edges and in corridors, feeding on insects. Fall migration and the return to wintering habitat occur between mid-August and mid-October (FWS, 2014a). Neither York Haven Power nor Exelon conducted surveys for the northern long-eared bat and no entity requested that surveys be conducted.

3.3.4.2 Environment Effects

Shortnose and Atlantic Sturgeon

Both sturgeon species have been reported in the Chesapeake and Delaware bays, but neither species has been documented in the lower Susquehanna River or in the Conowingo tailrace, other than anecdotal reports.

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[113] FWS has proposed to create a species-specific rule for the northern long-eared bat under section 4(d) of the ESA if it deems listing as a threatened species is appropriate, and reopened the public comment period on its previous October 2, 2013, proposed rule to list the northern long-eared bat under the ESA as an endangered species. See 80 Federal Register 2371 (January 16, 2015).

Our Analysis

Neither sturgeon species has any possibility of occurring near the York Haven Project, unless they were to pass upstream through the existing fish lifts at the Conowingo, Holtwood, and Safe Harbor Projects. None, however, have been recorded passing these projects since the fish lifts began volitional passage in 1997. No sturgeon, likewise, have ever been reported at the Conowingo fish lifts since they first began operations in 1972. Thus, we conclude that relicensing of the York Haven and Muddy Run Projects would have no effect on the shortnose or Atlantic sturgeon. While there is suitable habitat downstream of Conowingo for both species, 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 Conowingo Project would not be likely to adversely affect either the shortnose or Atlantic sturgeon. NMFS concurred with our no effect determination for shortnose sturgeon and Atlantic sturgeon for the York Haven and Muddy Run Projects, by letter filed September 23, 2014, but has not yet concurred with our determination for the Conowingo Project.

Bog Turtle

No bog turtles are known to occur within the York Haven project area. Nevertheless, there is potential habitat in the vicinity of the proposed nature-like fishway and construction activities could affect any turtles occupying that area. As bog turtles have been confirmed within the Muddy Run Project area, recreation and maintenance activities that occur within the Muddy Run Project boundary have the potential disturb bog turtles or habitat. Interior, in its January 31, 2014, letter, states that bog turtles and habitat are present near Conowingo dam.

York Haven Power proposes to conduct bog turtle surveys at the proposed nature-like fishway site during the 2014 field season. York Haven Power would provide the results of the field studies to applicable agencies for review and adhere to any provisions contained in state or federal wetland permitting and NPDES permitting. In addition, Interior commented that York Haven Power should contact the FWS Pennsylvania Field Office prior to any land-clearing activity.

Exelon proposes, and Interior recommends, the finalization and implementation of the Bog Turtle Management Plan for the Muddy Run Project, in consultation with FWS and Pennsylvania FBC. Both the Exelon proposed and the Interior recommended Bog Turtle Management Plan would include three components: (1) restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) possible limits on public access to the wetland without advertising the reason. In its January 7, 2015, letter, FWS' Pennsylvania Field Office recommends that the restrictions for mowing areas C, D, and F in the Bog Turtle Management Plan be revised to state "avoid mowing April to October during the turtle's active period."

Exelon does not propose any specific bog turtle measures at the Conowingo Project. Interior recommends under section 10(j) that Exelon develop and implement a bog turtle management plan in consultation with FWS, Pennsylvania FBC, and Maryland DNR as appropriate. The bog turtle management plan would include three components: (1) restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) possible limits on public access to the wetland without advertising the reason.

In its response to Interior's 10(j) recommendation at the Conowingo Project, Exelon indicates that no study requests were made at the Conowingo Project for bog turtle and therefore it cannot respond to Interior's statement that the bog turtle is known in the project area. Exelon indicates that if there is a known bog turtle record in the Conowingo Project area, the record information and a study request should have been provided by Interior during the relicensing study plan development process.

Our Analysis

York Haven Project

Bog turtles are not known to occur at the York Haven Project. However, construction of the nature-like fishway has the potential to affect potential bog turtle individuals and habitat located on Three Mile Island. According to the January 30, 2014, Settlement Agreement for the York Haven Project, York Haven Power has agreed to conduct bog turtle habitat assessments and surveys prior to construction to determine if bog turtles exist in this area. York Haven also proposes to consult with FWS and Pennsylvania FBC, and adhere to any protection or mitigation measures recommended by the agencies, such as time of year restrictions or pre-construction exclusion surveys, as part of required permits. Therefore, by following the above measures, construction of the nature-like fishway at the York Haven Project may affect, but is not likely to adversely affect, the bog turtle. In its letter filed January 7, 2015, FWS' Pennsylvania Field Office agreed with our finding that project impacts in this area are not likely to adversely affect this species within the majority of the project boundary, and that once it receives and reviews York Haven Power's bog turtle habitat assessment for the proposed nature-like fishway, "…it will make an effects determination for this portion of the project."

Muddy Run Project

Recreational and maintenance activities that occur within the Muddy Run Project boundary could affect known bog turtles if protection measures are not implemented. Maintained trails currently traverse the habitat, increasing accessibility to the area and the potential for habitat disturbance. These recreation trails would continue to be used in the same manner under any new license for the project. Exelon's proposed Bog Turtle Management Plan includes measures to prevent the public from veering off the trails and protocols for maintaining the habitat and trails. In addition, invasive species such as reed canary grass and mowing in the bog turtle wetland during the bog turtle's most active time could decrease the habitat quality and affect the bog turtle population health. In its letter filed January 7, 2015, FWS' Pennsylvania Field Office recommended that Exelon's plan be changed to increase the time restriction in mowing areas C, D, and F to be between April and October, as opposed to the April and June period in the plan. Although Exelon's plan would ensure that invasive species are controlled in the area and bog turtles are not affected by vegetation management during the emergence and breeding season, including FWS' extended mowing time restriction until October for areas C, D, and F would extend this protection through the bog turtle's active season. If the Exelon-proposed and Interior-recommended Bog Turtle Management Plan is developed and implemented by Exelon, in consultation with FWS and Pennsylvania FBC, it would protect the turtle by restricting access to the area, restricting mowing, and controlling invasive species. Through implementation of the Bog Turtle Management Plan, in consultation with FWS and Pennsylvania FBC, the Muddy Run Project would be not likely to adversely affect the species. In a letter filed on January 7, 2015, FWS' Pennsylvania Field Office concurred with our finding, provided that its modified mowing restrictions are included in Exelon's Bog Turtle Management Plan.

Conowingo Project

During relicensing investigations, Exelon determined that none of the 31 wetlands surveyed in 2008 at Conowingo Pond contained potential bog turtle habitat and neither Interior, nor Maryland DNR, nor Pennsylvania FBC requested further bog turtle studies. In its January 31, 2014, terms and prescriptions letter, Interior states that "[a] survey for bog turtle habitat and bog turtles has confirmed their presence near the dam." According to the April 23, 2014, and June 9, 2014, telephone and e-mail memoranda, FWS stated that the bog turtle sighting was "close" to Conowingo dam. On October 14, 2014, Exelon filed additional, privileged information it had previously received from Maryland DNR indicating that bog turtles have been found in a wetland and a stream located near a project recreation area twice in the past 10 years. If Exelon develops and implements Interior's recommended bog turtle management plan, in consultation with FWS and Maryland DNR, it would protect the turtle by restricting access to the area, restricting mowing, and controlling invasive species. Through implementation of a bog turtle management plan, in consultation with FWS and Maryland DNR, the Conowingo Project would not be likely to adversely affect the species. In a letter filed on January 7, 2015, FWS' Chesapeake Bay Field Office concurred with our finding.

Indiana Bat

All three project areas are located within the range of the Indiana bat. Project maintenance, such as cutting trees over 5 inches dbh, could affect the Indiana bat by removing potential roosting habitat or causing direct mortality during roosting season.

Neither York Haven Power nor Exelon proposed any measures directly related to the Indiana bat. In addition, no resource agency or other stakeholder recommended any Indiana bat measures. In its terms and conditions letters for the three projects, Interior did not identify the Indiana bat as species of concern in any of the three project areas.

Our Analysis

Although potential habitat may exist within the three project areas, along the riparian forested edges of the river and reservoirs, and forested edges along transmission line rights-of-way and recreational areas, neither York Haven Power nor Exelon propose any activities that would result in more than a minimal amount of tree clearing. At the Muddy Run Project, continued routine vegetation management practices, such as trimming and herbicide application, would be unlikely to affect trees large enough to provide roosting habitat. Therefore, York Haven, Muddy Run, and Conowingo Projects would not be likely to adversely affect the Indiana bat. In letters filed January 7, 2015, the FWS' Pennsylvania Field Office and Chesapeake Bay Field Office concurred with our findings for all three projects.

Swamp Pink

Although the swamp pink is known or is believed to occur in Cecil County, where the Conowingo Project is partly located, the FWS Information, Planning, and Conservation System website (FWS, 2014c) indicates that swamp pink has not been documented within the specific project area. Because this species does not appear to occur in the immediate project area, the Conowingo Project would have no effect on the swamp pink.

Northern Long-eared Bat

Although potential roosting and foraging habitat for the northern long-eared bat exists within the three project areas, along the riparian forested edges of the river and reservoirs, and forested edges along transmission line rights-of-way and recreational areas, neither York Haven Power nor Exelon propose any activities that would result in more than a minimal amount of tree clearing. Continued vegetation management practices, such as trimming and herbicide application, would be unlikely to affect trees large enough to provide roosting habitat for bats. Therefore, the York Haven, Muddy Run, and Conowingo Projects are not likely to jeopardize the continued existence of the northern long-eared bat. In letters filed on January 7, 2015, the FWS' Pennsylvania Field Office stated that: (1) it would be available to discuss potential conservation measures for the York Haven Project[114]; and (2) as continued routine vegetation management at the Muddy Run Project would be unlikely to affect trees large enough to provide suitable

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[114] If FWS lists the northern long-eared bat for protection under the ESA, further consultation may be necessary to determine if the York Haven Project, specifically construction of the proposed nature-like fishway, would be likely to adversely affect the northern long-eared bat. However, as of the date of this final EIS, FWS' Pennsylvania Field Office has not disagreed with our finding that the York Haven Project is not likely to jeopardize the continued existence of the northern long-eared bat.

habitat, the Muddy Run Project is not likely to adversely affect the northern long-eared bat. In a letter filed on the same day, FWS' Chesapeake Bay Field Office stated that, as long as the current or future activities at the Conowingo Project do not involve any tree clearing, it would not anticipate any effects on the northern long-eared bat.

3.3.5 Recreation and Land Use Resources

3.3.5.1 Affected Environment

Regional Resources

Recreation resources in the region provide a full range of activities, including boating, canoeing, swimming, fishing, water sports, hiking, camping, hunting, biking, and nature viewing. Lakes and reservoirs in the region, including the project reservoirs, provide a variety of recreation opportunities and varying levels of developed facilities for overnight and day-use activities. Paved roads and boat launches in the area provide opportunities for motorized boat use. The varying physical characteristics of the area provide for diverse recreational opportunities.

Safe Harbor and Holtwood hydroelectric reservoirs are located downstream of York Haven and upstream of Conowingo and Muddy Run. These FERC-licensed projects provide water-oriented recreation opportunities such as fishing, boating, swimming, and nature viewing that are similar to those offered at the projects analyzed in this document.

Susquehannock State Park is located on the eastern shore of Conowingo Pond downstream of the Muddy Run powerhouse, adjacent to the Muddy Run Project boundary and just outside the Conowingo Project boundary. The park is about 224 acres and offers recreational opportunities including scenic views from the 380-foot-high cliffs that overlook the river, picnicking, hiking/walking and horseback riding trails, and organized group overnight camping.

The lower section of the Susquehanna River Water Trail (see http://www.susquehannawatertrail.org/) extends from Harrisburg, Pennsylvania, to the Broad Creek Public Landing just below the Pennsylvania/Maryland state line (about 53 miles) and is part of the Chesapeake Bay Gateways and Watertrails Network and a designated National Recreation Trail.

Ferncliff Wildflower and Wildlife Preserve in Lancaster County is a designated National Park Service National Natural Landmark.[115] The preserve is located on the east

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[115] The National Landmark Program is administered by the National Park Service and recognizes and supports the voluntary conservation of outstanding geological and biological sites, regardless of ownership. Land acquisition by the federal government is not a goal of the program.

side of Conowingo Pond across from the PBAPS and encompasses old growth forest and wooded ravines home to plants common to the region. The preserve was established in 1972 due to the exceptional old growth forest and seasonal wildflowers at this 65-acre site, which has a short (0.62-mile) hiking trail for visitors. The preserve lands are privately owned and open to the public.

The Mason-Dixon Trail is a 193-mile-long trail that connects the Appalachian Trail with the Brandywine Trail. The trail begins in Cumberland County, Pennsylvania, travels east towards the Susquehanna River where it follows the western shoreline south to Havre de Grace before heading across the river and north to its terminus at Chadds Ford, Pennsylvania. The Appalachian Trail is a 2,180-mile-long continuously marked footpath along the crests and valleys of the Appalachian mountain range from Springer Mountain, Georgia, to Katahdin, Maine. The Brandywine Trail is a 36-mile-long trail along the East Branch of Brandywine Creek and the Brandywine River in Delaware. Sections of the Mason-Dixon Trail cross Exelon-owned land.

The Conestoga Trail is a 61-mile-long trail that begins in Furnace Hills where it intersects with the Horse-Shoe Trail, before meandering throughout Lancaster County, Pennsylvania and reaching its terminus with the Mason-Dixon Trail. Near the Muddy Run Project, the trail travels near the northwestern section of the Muddy Run WMA, before travelling across Holtwood Road, Route 372, to intersect with the Mason-Dixon Trail.

Public Recreation Sites around the Projects

York Haven Project

Recreation facilities available at the York Haven Project include boat launches, fishing platforms, a portage trail, nature trails, and day-use areas with picnic facilities, ball courts, and a catwalk fishing platform on the side of the powerhouse. Lake Frederic contains five significant islands (Battery, Beshore, Goodling, Goosehorn, and Shelley) with picnic facilities and nature trails provided and maintained by York Haven Power. Beshore Island currently only includes York Haven Power-licensed recreational lot sites and a boat launch. In addition, Lake Frederic contains several smaller islands that do not have facilities, but may be accessed by boaters. Camping and overnight use of the islands outside a recreational lot lease is prohibited. None of the publicly available recreation sites accommodate overnight use. Fishing platforms are provided in the headrace and tailrace areas. The tailrace fishing access is located on a walkway along the downstream face of the powerhouse. The land immediately adjacent to the York Haven Project powerhouse provides a playground and picnic facilities as well as tennis and basketball courts and ample parking. A 0.25-mile portage trail is provided on the right bank at this location.

There are five boat launches within the project boundary owned and operated by York Haven Power or public entities: Newberry Township Boat Launch, Beshore Island Boat Launch, Goldsboro Borough Boat Launch, Pennsylvania FBC Boat Launch, and the

East Shore Boat Launch (figure 3-18). Additionally, the Falmouth Boat Launch, owned and operated by Pennsylvania FBC, is located on the eastern shore of the Susquehanna River, downstream of the dam and across the river from the powerhouse. Although this boat launch is located outside of the project boundary, it often is used to gain access to the project spillway and tailrace. Three privately owned marinas and boat launches are also present along the shoreline of Lake Frederic. Fuel is available at Goldsboro Marina, Tri County Boat Club, and the Riverside Marina. Table 3-31 summarizes the recreation sites at the York Haven Project.

Muddy Run Project

At the Muddy Run Project, existing formal recreation opportunities include the Muddy Run Park and Campground, Wissler's Run Park, and Muddy Run WMA (figure 3-19). Exelon owns all of the lands used for recreation at the Muddy Run Project, and leases the operation of Muddy Run Park and Campground and the Muddy Run WMA to other parties. Exelon reports two informal recreation areas exist within the Muddy Run Project boundary. These are areas without developed recreation infrastructure and are not managed or maintained as such by any entity. The sites provide fishing access or informal boat launch access to the project.

The 800-acre Muddy Run Park and Campground is in the northern section of the project boundary. Within the park is the 100-acre Recreation Lake, separated from the Muddy Run reservoir by a dam and concrete sill that maintains a stable water elevation. The park is operated by a vendor, and the developed portion of the park includes overnight and day-use facilities. A 189-site campground with showers, playgrounds, covered picnic pavilions, and many other amenities is located on the northern shore of the Recreation Lake. The park also provides numerous separate facilities including picnic areas, trails, an outdoor amphitheater, ball field, sport courts, restrooms, wildlife viewing areas, and shoreline fishing opportunities. Boat rentals (canoes, kayaks, paddleboats, rowboats) are available at the park, as well as a boat ramp for visitors to launch their own boats. Gasoline-powered boats, swimming, and wading are not allowed in the Recreation Lake. A visitor's information center contains displays (static and interactive) and meeting rooms. The center also is used for park-related programs and rental functions. Table 3-32 summarizes the recreation facilities associated with the Muddy Run Project.

Wissler's Run is located on the eastern shore of Conowingo Pond just downstream of the Muddy Run powerhouse. The park provides a large green open space area for picnicking, bank fishing, and an overlook of the upper Conowingo Pond and islands. The site also includes a non-functioning fish cleaning station. A paved 130-space parking lot services the site. The Muddy Run WMA surrounds the southern portion of the Muddy Run reservoir. The 800-acre site is leased to Pennsylvania Game Commission and managed to provide food and cover for wildlife, which in turn promotes hunting and wildlife viewing opportunities. Two gravel parking areas provide vehicle access to the WMA while additional management roads and trails provide access for hunters, hikers, birders, and equestrians.

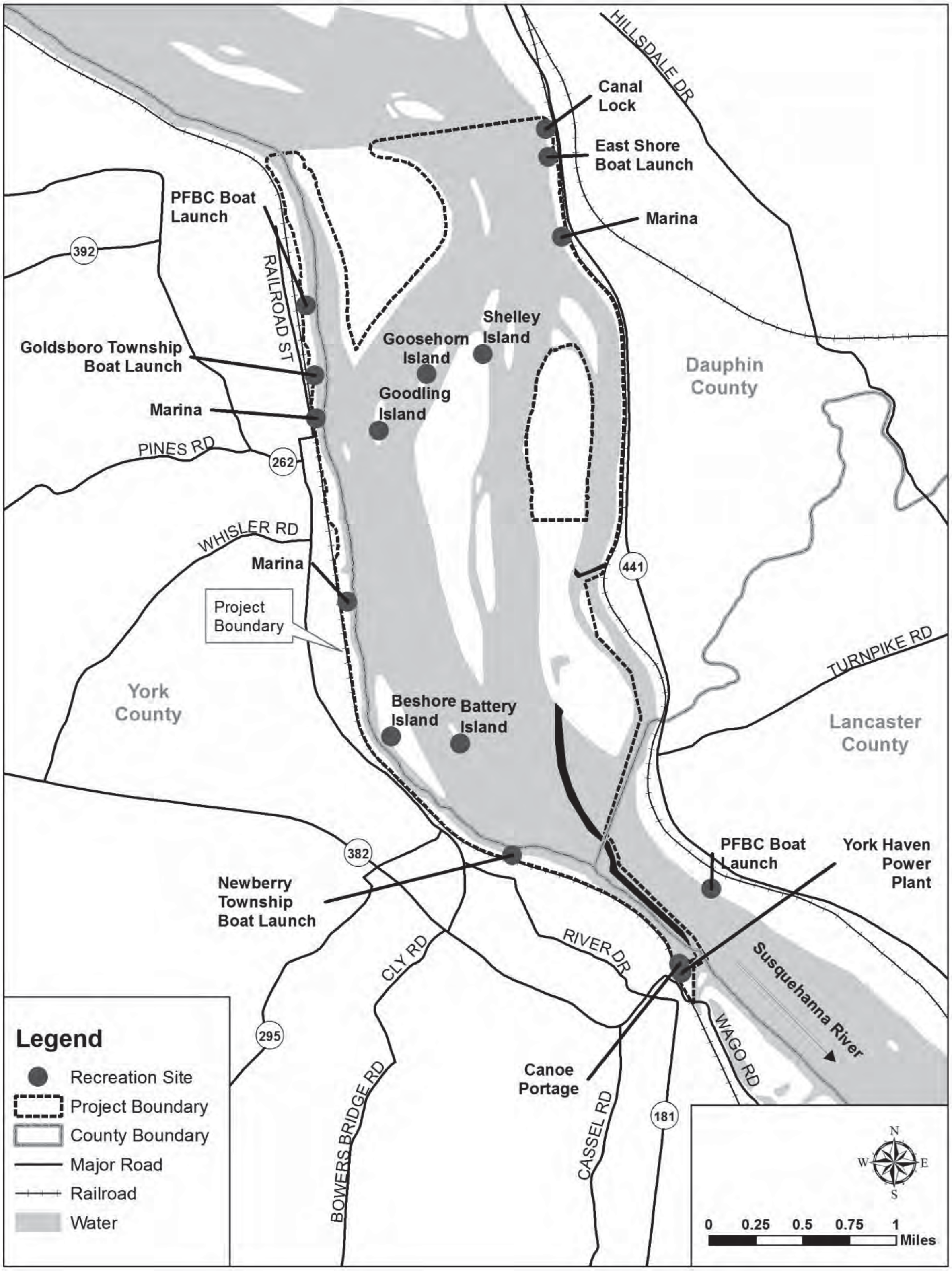

Figure 3-18. York Haven Project recreation facilities (Source: York Haven Power, 2012, as modified by staff).

Table 3-31. Recreation sites at the York Haven Project (Source: York Haven Power, 2012, as modified by staff).

Site Name	Owner	Project Facility	Facilities and Opportunities	Annual Estimated Use[a]
(Historic) Canal Lock	York Haven Power	Yes	Abandoned canal lock, picnic area	596
East Shore Boat Launch	York Haven Power	Yes	Boat launch, trail, picnic area	1,580
Goosehorn Island Picnic Area	York Haven Power	Yes	Picnic area	3,908
Shelley Island Recreation Area	York Haven Power	Yes	Recreational lots, picnic area, interpretive display, nature trail, historic cemetery	123
Goodling Island	York Haven Power	Yes	Picnic Area	740
Pennsylvania FBC Boat Launch	Pennsylvania FBC	No	Boat launch	6,903
Goldsboro Borough Boat Launch	Goldsboro Borough	No	Boat launch	235
Beshore Island Recreation Area	York Haven Power	Yes	Recreational lot sites	not applicable
Battery Island Recreation Area	York Haven Power	Yes	Picnic area	1,292
Newberry Township Boat Launch (Falls Landing)	Newberry Township	No	Boat launch	1,006
Cly Shore	York Haven Power	Yes	Recreational lot sites	not applicable
York Haven Power Plant Recreation Area	York Haven Power	Yes	Visitor's center, fishing pier, tailwater fishing, playground, picnic area, sport court	944
Canoe Portage Trail	York Haven Power	Yes	Canoe portage	28

[a] Estimated from spot counts conducted over 32 days throughout the year; estimate presented is the highest recorded number of visitors to each site observed during all visits to each site.

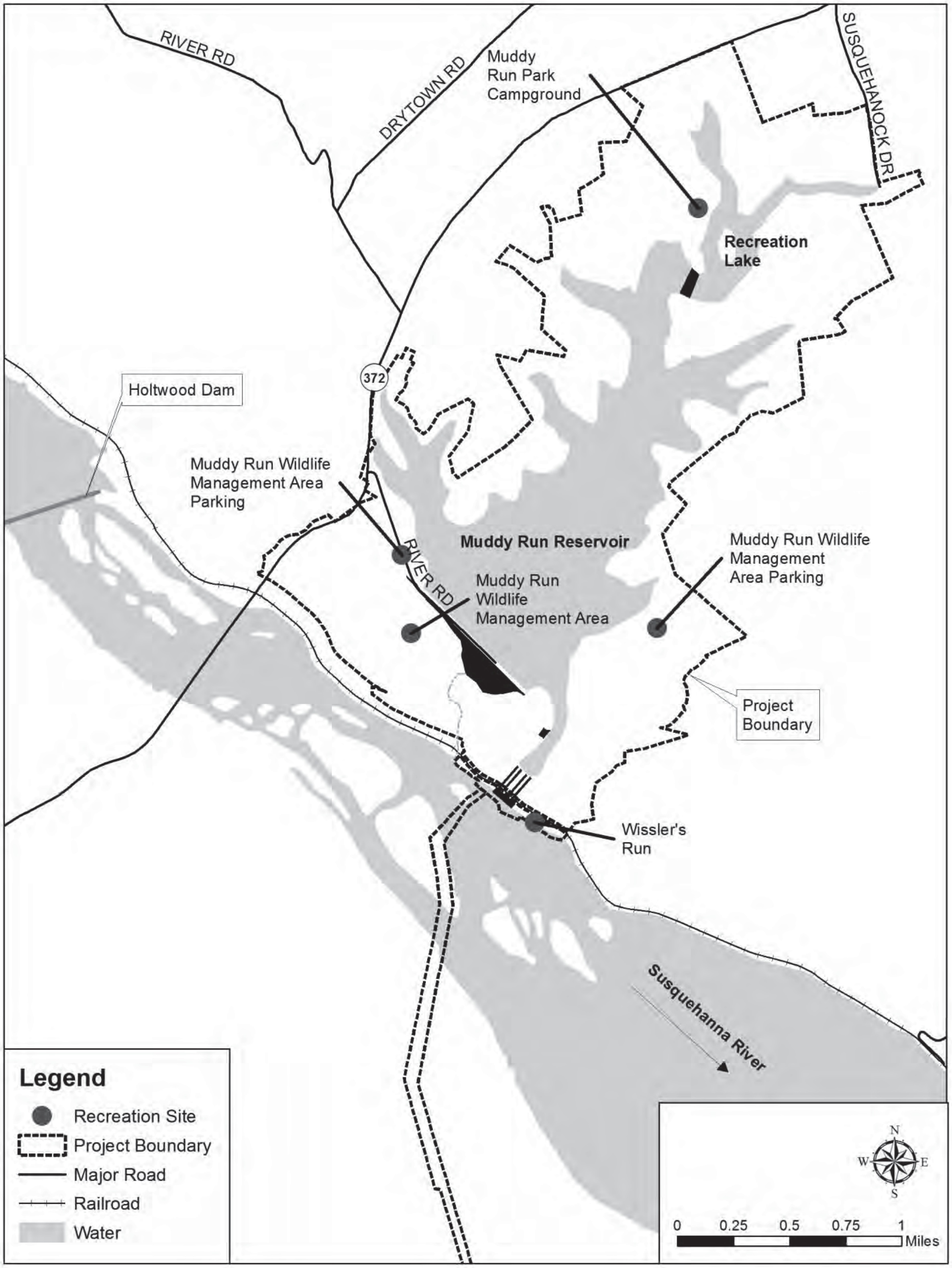

Figure 3-19. Muddy Run Project recreation facilities (Source: Exelon, 2012a, as modified by staff).

Table 3-32. Recreation facilities in the Muddy Run Project area (Source: Exelon, 2012a, as modified by staff).

Site Name	Owner	Project Facility	Facilities and Opportunities	Annual Estimated Use
Muddy Run Park and Campground	Exelon (leased to vendor)	Yes	Camping, picnicking, fishing, boating (electric motor only), playgrounds, sports fields and courts, etc.	254,000[a]
Wissler's Run	Exelon	Yes	Fishing, picnicking, wildlife/nature viewing	5,800b
Muddy Run WMA	Exelon (leased to Pennsylvania Game Commission)	Yes	Hunting, wildlife viewing, hiking and horseback riding	7,500b

[a] Estimated from a combination of data supplied by facility operator, traffic counts, and spot counts over 12 months.

[b] Estimated from spot counts recorded 6 days a month for 12 months.

Within the Muddy Run Project, the Mason-Dixon Trail crosses the transmission parcels located in York County, and travels near several recreation sites in the Conowingo Project. Exelon entered into a license agreement with the Mason-Dixon Trail System, Inc., allowing sections of the trail to be located on Muddy Run Project land.

Conowingo Project

The Conowingo Project is the most downstream of the FERC projects on the Susquehanna River and offers a large component of recreation opportunities in the lower Susquehanna River. There are 15 project recreation public access areas (see figure 3-20). Table 3-33 summarizes the public recreation facilities associated with the Conowingo Project. Exelon also identifies numerous informal access points around the reservoir and downstream of the dam.

Lock 13 is located at the site of the Susquehanna and Tidewater Canal Lock 13. The facility is maintained in a primitive state with no public amenities or interpretive improvements. Lock 13 is owned and managed by Exelon, but is accessed from the PPL Holtwood LLC Lock 12 parking lot (Holtwood Project, FERC No. 1881) via the Mason-

Dixon Trail. Recreation opportunities at Lock 13 include the Mason-Dixon trail and shoreline fishing.

Lock 15 is owned and operated by Exelon as a day-use and interpretive area. The site has a 36-space gravel parking lot and portable restrooms, and offers picnicking and shoreline fishing opportunities. There are interpretive signs on-site that describe the Susquehanna and Tidewater Canal system, how the lock worked, and the history of the site. A pathway connects the picnic area with the Muddy Creek Boat Launch immediately downstream. The Mason-Dixon Trail runs through the site and connects Lock 15 with Lock 13 to the north and Muddy Creek Boat Launch to the south.

Muddy Creek Boat Launch is owned by Exelon and leased and operated by Pennsylvania FBC. The facility provides shoreline fishing access, a 20-foot-wide hard surface ramp, courtesy docks, and portable toilets. The site is serviced by a paved parking lot (44 boat trailer spaces and 26 vehicle spaces) and used by both power boaters and car-top boaters. The Mason-Dixon Trail connects the site to the Lock 15 interpretive area.

Cold Cabin Boat Launch is owned by Exelon and managed by Peach Bottom Township, which developed the recreation facilities. Amenities include a 12-foot-wide hard surface boat launch, informal parking for approximately five vehicles, and a small picnic area. The Mason-Dixon Trail passes through this site.

Dorsey Park Boat Launch is located just upstream of PBAPS. Although the majority of the site is located outside of the project boundary, the boat ramps extend into and provide access to project waters. The site, which is owned and operated by Exelon, includes boat launching, shoreline fishing, and picnicking opportunities with several tables and grills. Amenities include two 32-foot-wide boat ramps, courtesy docks, a paved parking lot (25 boat trailer spaces and 30 vehicle spaces), portable toilets, picnic tables, and grills.

Peach Bottom Marina is owned by Exelon and operated by a commercial contractor. The marina offers boat launching, shoreline fishing, and picnicking opportunities. The facility amenities include a 25-foot-wide boat hard surface ramp, a paved parking area (17 boat trailer spaces and 33 vehicle spaces), boater courtesy docks, tie-up rental space, boat storage, repair shop, portable toilet, fueling facilities, and picnic tables. There is a launch fee charged to use the ramp. The marina is located on Peters Creek, a tributary on the east side of Conowingo Pond. The Norfolk Southern rail line extends along the entire east shore of the pond and access to/from the marina requires boating under the train trestle spanning Peters Creek.

The Line Bridge Access site is owned by Exelon and managed and maintained by Harford County under an agreement with Exelon. The property provides informal shoreline access, a three car parking area, and an unimproved carry-in boat access area.

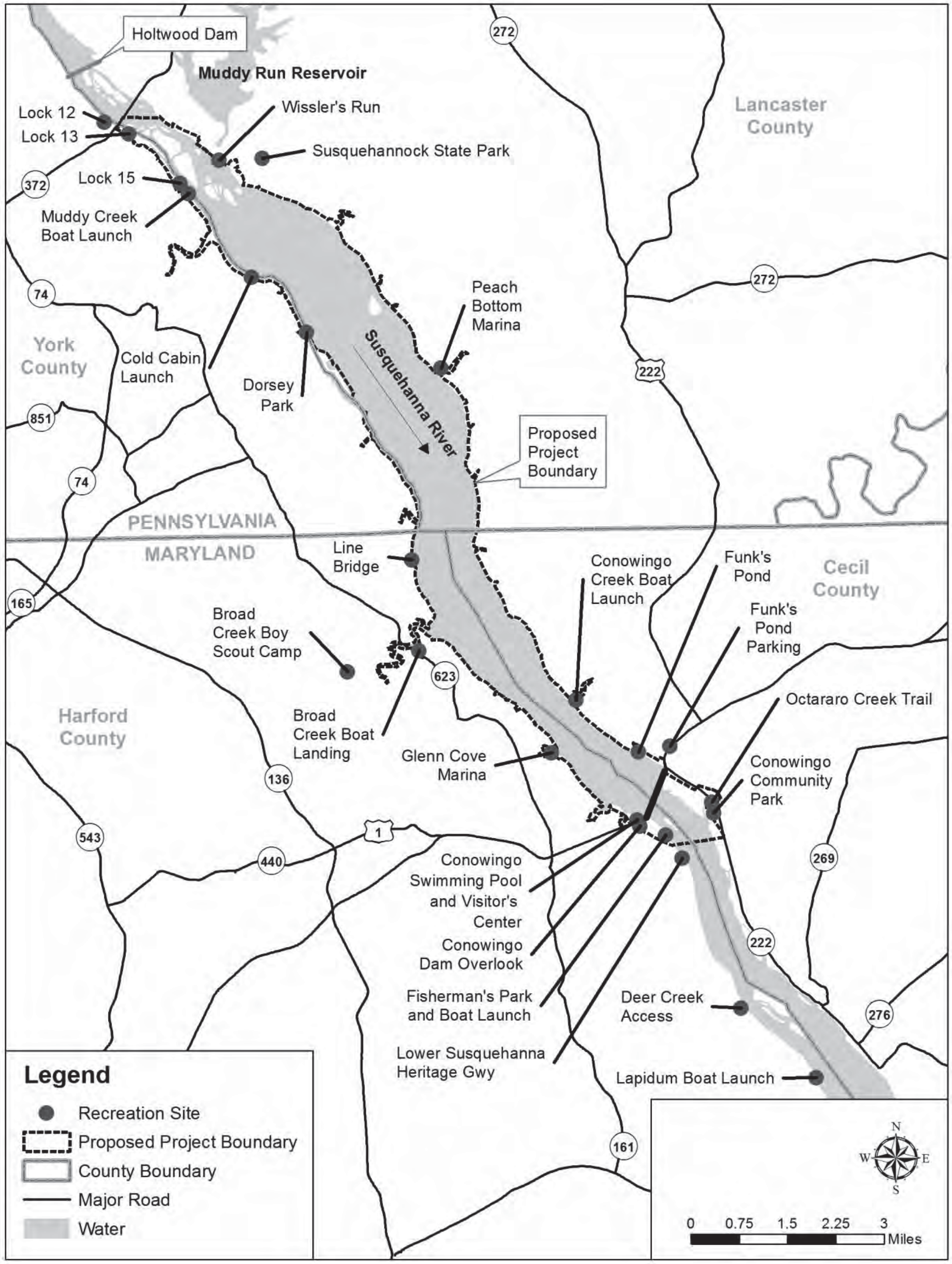

Figure 3-20. Conowingo Project recreation facilities (Source: Exelon, 2012b, as modified by staff).

Table 3-33. Recreation facilities in the existing Conowingo Project boundary (Source: Exelon, 2012b, as modified by staff).

Site Name	Owner	Project Facility	Facilities and Opportunities	Annual Estimated Use[a]
Lock 13	Exelon	Yes	Unrestored site with no public amenities or interpretive improvements	782
Lock 15	Exelon	Yes	Interpretive displays, picnic tables, bank fishing	13,066
Muddy Creek Boat Launch	Exelon (leased to Pennsylvania FBC)	Yes	Boat ramp, courtesy docks, and interpretive panels	38,742
Cold Cabin Boat Launch	Exelon (leased to Peach Bottom Township)	Yes	Boat ramp, picnic tables, and interpretive sign	11,968
Dorsey Park	Exelon (as part of Peach Bottom Nuclear Station)	Yes	Boat ramp, picnic tables, grills, benches, and interpretive signs	16,706
Peach Bottom Marina	Exelon (operated by commercial operator)	Yes	Boat ramp, docks, fuel, and boat maintenance	538
Line Bridge	Exelon (leased to Harford County)	Yes	Informal shoreline access; hand launch	5,789
Broad Creek Public Landing	Exelon (leased to Harford County, Maryland)	Yes	Boat ramp and courtesy dock, small open space for day use	10,138
Conowingo Creek Boat Launch	Exelon	Yes	Boat ramp, courtesy dock	10,594

Site Name	Owner	Project Facility	Facilities and Opportunities	Annual Estimated Use[a]
Glen Cove Marina	Exelon (operated by commercial operator)	Yes	Boat ramp, docks, picnic area, fuel, repair services, store and boat slips. Also serves as the take out for the Conowingo dam portage.	707
Funk's Pond	Exelon	Yes	Shoreline fishing, picnic area, and pedestrian trail	4,380
Conowingo Swimming Pool and Visitors Center	Exelon (operated by commercial operator)	Yes	Swimming pools, picnic tables, restrooms, playground, and visitor center	8,471
Conowingo Dam Overlook	Exelon	Yes	Picnic tables and view of the powerhouse and dam	closed during study period
Fisherman's Park/Shures Landing	Exelon	Yes	Shoreline and platform fishing, carry-in boat launch, observation areas, picnic areas	141,580
Octoraro Creek Access	Exelon	Yes	Creekside trail connecting to Susquehanna River, informational kiosk	7,485

Site Name	Owner	Project Facility	Facilities and Opportunities	Annual Estimated Use[a]
3.5 miles of Mason-Dixon Trail	Exelon (managed and maintained by Mason-Dixon Trail System, Inc.)	No	Trail passes through Lock 13, Lock 15, Muddy Creek, Cold Cabin, Broad Creek, Glen Cove, Swimming Pool/Visitors Center, and Fisherman's Park)	No estimate available
Lower Susquehanna Heritage Greenway Trail	Exelon (leased to State of Maryland)	No	Paved trail from Fisherman's Park to Deer Creek, collocated with Mason Dixon Trail, benches, tables, interpretive displays, and boardwalk	No estimate available
Susquehanna State Park	Exelon (leased to State of Maryland)	No	Camping, picnicking, shoreline fishing, walking trails, boat ramps, playgrounds, bike and equestrian riding trails, hunting area and an archery range	No estimate available
Deer Creek Access	Part of Susquehanna State Park	No	Informal car top boat launch, parking and shoreline access	No estimate available

Site Name	Owner	Project Facility	Facilities and Opportunities	Annual Estimated Use[a]
Lapidum Boat Launch	Part of Susquehanna State Park	No	Boat ramp, parking, restrooms, interpretive displays	No estimate available
McLhinney Park	Exelon (leased to City of Havre de Grace)	No	Playground, picnic area, restrooms, green space and non-motorized trails	No estimate available

[a] Estimated from one or a combination of methods depending on the type of site and could include spot counts, traffic counters, or facility operator records recorded over 12 months.

The Broad Creek Public Landing is owned by Exelon and managed and maintained by Harford County under agreement with Exelon. The facility provides a hard surface boat launch, small dock, shoreline fishing opportunities, and parking for four vehicles. A 33-space boat trailer off-site parking lot was constructed on nearby Paddrick Road due to the steep terrain and limited parking available at the boat launch site. The Mason-Dixon Trail extends through this site.

The Conowingo Creek boat launch is owned and operated by Exelon. The facility provides an 80-foot-wide hard surface boat ramp, two parking areas (one for 9 boat trailers and one for 10 vehicles), a small picnic area and shoreline fishing opportunities. The site is located on Conowingo Creek, a tributary on the east side of Conowingo Pond. The Norfolk Southern rail line extends along the entire east shore of the pond and access to/from the ramp requires passing under the train trestle spanning Conowingo Creek.

Glen Cove Marina is owned by Exelon and operated by a commercial contractor. Recreation opportunities include boat launching and picnicking. Facility amenities include a hard surface boat ramp, boat slips, portable toilets, fueling facilities, picnic tables, and parking for 16 boat trailers and 20 vehicles. There is a launch fee charged to use the ramp. The operator also provides repair services and a small onsite store. This facility also serves as the take-out for the Conowingo dam canoe portage. The Mason-Dixon Trail runs through the site.

Funk’s Pond is a small inlet separated from Conowingo Pond by the Norfolk Southern rail line. The “pond” is within the project boundary and accessed from a 24-vehicle parking lot and trail on adjacent non-project land. The site is owned and operated by Exelon. The site provides a non-motorized, 0.45-mile trail, picnicking and shoreline fishing opportunities.

The Conowingo swimming pool complex and Visitor's Center are located just upstream of Conowingo dam on U.S. Route 1. The Conowingo swimming pool complex is owned by Exelon and operated by a commercial contractor. Pool facilities include a swimming pool, wading pool, playground area, picnic area, concession stand, and changing/restrooms. The pool is open 11:00 a.m. to 7:00 p.m. from May to September, and users are charged an entrance fee. The Visitor's Center contains informational displays and brochures, restrooms, conference rooms, and office space for the Lower Susquehanna Heritage Greenway. The center is owned, operated, and staffed by Exelon. A small picnic area is also provided. A 213-space paved parking lot is shared by these two facilities. The Mason-Dixon Trail extends through the site.

Fisherman's Park is located on the western shore of the Susquehanna River immediately downstream of Conowingo dam and powerhouse. Fisherman's Park is owned and operated by Exelon and is a popular fishing and bird watching area. Amenities at the park include shoreline and platform fishing, a carry-in boat launch (Shure's Landing), observation areas, portable toilets, picnic areas, and scenic views. This area also serves as a trailhead for the Lower Susquehanna Heritage Greenway Trail to Deer Creek and a wildflower viewing area. There is a 124-space paved vehicle parking lot, a 14-space paved boat trailer parking lot, and a 12-vehicle gravel parking lot associated with this site. The fishing platform is accessible to persons with disabilities. The Mason-Dixon Trail passes through the lower part of the parking lot. The park is open 1 hour before sunrise to 1 hour after sunset.

Exelon investigated tributary access to the main reservoir between full pond (109.2 feet) and the minimum weekend recreation pool level (107.2 feet) between Memorial Day and Labor Day. Exelon reported that five tributaries provide recreational value; four due to the presence of public boat launch facilities, all of which are also commercial marinas (Peters Creek/Peach Bottom Marina, Conowingo Creek, Glen Cove, and Broad Creek). The fifth tributary, Muddy Creek, provides recreation value due to its large size.

Shallow water depths due to sediment accumulation limit boat launch egress and ingress at Peters Creek (Peach Bottom Marina), Conowingo Creek, and Broad Creek. The minimum recreation pool elevation is 107.2 feet. During a field reconnaissance of navigability conducted in August 2012 when the pool elevation ranged between 107.32 to 107.64 feet, Exelon documented that the boat launch and areas immediately surrounding the ramp at Broad Creek were not usable for motorized boats due to the shallow water and dense vegetation. Water depths leading to the boat launch were generally 2 feet with areas near the launch being less than 1 foot. At Conowingo Creek, water depths in the main channel were 4.5 feet and 2 feet in the vicinity of the boat launch. At Peters Creek, water depths were 4 to 5 feet in the main channel and zero at mud flats exposed at the time of the survey.

Exelon concluded that pond elevations do influence boat access at three of the four tributary boat launches. At full pond, boats higher than 5.2 feet above the water cannot navigate under the railroad bridge at Peters Creek. Similarly, boats higher than 4.9 feet cannot navigate under the railroad bridge at Conowingo Creek. Conversely, the minimum weekend recreation season elevation is too shallow to launch a boat limiting access from three tributary launches: Peters Creek, Conowingo Creek, and Broad Creek ramps. In addition, dense beds of SAV hamper the approach for boaters attempting to use these ramps at elevations of 107.2 feet or less. When Conowingo Pond elevation reaches 105.9 feet, boat access is denied at three of the four tributary boat launches.

Recreation in the River Downstream

York Haven Project

Pennsylvania FBC owns and operates the Falmouth Boat Launch located across from the York Haven powerhouse on the east shore of the Susquehanna River. The launch is outside the project boundary but provides water access, albeit shallow, to the bypassed reach, project spillway, and tailrace areas, as well as points further downstream within the Safe Harbor reservoir.

Conowingo Project

The Conowingo Project boundary extends 2.5 miles downstream of the dam along the east bank of the river and 0.5 mile downstream along the west bank of the river. In addition to Fisherman's Park/Shures Landing, access to the river below the dam within the project boundary is provided at the Octoraro Creek Access on the east bank and Susquehanna State Park on the west bank. Land based, non-project recreation exists further downstream along the Lower Susquehanna Heritage Greenway, which provides trails and informal access points to the river. Access to the Susquehanna River also is available at non-project public launch and commercial marinas downstream of Conowingo dam. Public access is provided at Deer Creek Access about 3 miles downstream of the dam, Lapidum boat launch, within Susquehanna State Park, about 5 miles downstream of the dam, in Port Deposit, Maryland, across the river from Lapidum boat launch, and McLhinney Park (or North Park) in Havre de Grace, which provides shoreline fishing and other predominantly passive recreational opportunities.

Recreation Use

York Haven Project

York Haven Power estimates that the York Haven Project supported more than 17,000 recreation days[116] during the 2008-2009 sampling season. The greatest use occurs during weekends during the late May through early September, peak season. The

[116] A recreation day is considered each visit by a person to a development for recreational purposes during any portion of a 24- hour period.

Goldsboro Borough Boat Launch was the most visited recreation site (see table 3-31). York Haven Power reports that an overwhelming majority of visitors to recreation facilities at the project are from Pennsylvania (99 percent), with many of those from the local, southeastern region of Pennsylvania, including the Harrisburg, Lancaster, and York areas. York Haven Power notes that peak weekend use approaches or exceeds capacity when the weather is favorable; however, the sites are capable of absorbing a great deal more use if visitors were to shift their use patterns and use the project sites more frequently or in greater numbers outside the peak weekends.

During the 2008-2009 recreation study, York Haven Power estimated the physical utilization for each recreation site. Table 3-34 shows the parking site utilization rates observed during the recreation study. Typically, use of the parking areas is well below the capacity; however, both Goldsboro Borough Boat Launch and East Shore Boat Launch were observed at or near capacity on holiday weekends. In general, all sites were observed well below capacity throughout the peak season.

Table 3-34. Physical capacity utilization of York Haven Project recreation sites (Source: York Haven Power, 2012, as modified by staff).

Site Name	Number of Parking Spaces	Highest Number of Spaces Used on Summer Weekend	Average Percent Utilization	Maximum Percent Utilization
Pennsylvania FBC Goldsboro Boat Launch	242[a]	209	23	86
East Shore Boat Launch	57	57	31	100
York Haven Power Plant Recreation Area	31	6	3	19

[a] Covering three parking areas.

Muddy Run Project

Exelon estimates that the Muddy Run Project supported slightly more than 267,000 recreation days during 2008-2009, with 95 percent occurring within the Muddy Run Park and Campground (see table 3-32). Exelon reports the majority of visitation occurs during summer (late May to late August) and that an estimated 21 percent of the recreation days spent at the park were coupled with overnight stays (camping). Swimming and wading are not permitted at any location within the park, and this limitation was cited most frequently in the Exelon visitor survey (27 percent). Activities in the WMA vary by season with hunting popular in the fall and winter, and running and walking popular in the summer. Wissler's Run Park saw the greatest usage during the spring season (52 percent), followed by summer (35 percent). Sightseeing is the most popular activity (71 percent), followed by shoreline fishing (21 percent).

During its 2008-2009 recreation study, Exelon estimated the physical utilization for each recreation site. Table 3-35 shows the utilization rates observed during the recreation study by recreation site.

Table 3-35. Physical capacity utilization of Muddy Run Project recreation sites (Source: Exelon, 2012b, as modified by staff).

Site Name	Number of Parking Spaces	Average Spaces Used on Summer Weekend	Percent Utilization
Muddy Run Park & Campground	582	338	58
Muddy Run WMA	80	3	4
Wissler's Run Park	130	3	2

Conowingo Project

Exelon estimates that the Conowingo Project supported just under 271,000 recreation days in 2008-2009, with about half of those recorded at Fisherman's Park/Shures Landing immediately downstream of the dam (see table 3-33). The vast majority of recreation days were recorded during the summer season. Within the Conowingo Project, the top three recreation activities were sightseeing (29 percent of total use), shoreline fishing (22 percent), and boating (21 percent). These three activities accounted for more than 7 out of every 10 visitors to the project in 2008-2009.

Exelon conducted a user preference survey that revealed recreation sites within the Conowingo Project were well regarded as a whole. Fisherman's Park received positive scores with 9 of 10 respondents giving the park a good or excellent rating. The most frequently requested specific improvements throughout the Conowingo Project were restrooms, boat ramps, parking, and trash cans/clean-up of site. Highest on the list for Fisherman's Park was the desire to reopen the catwalk on the downstream side of the powerhouse for fishing.

During the recreation study, Exelon also estimated the physical capacity utilization for each recreation site. Table 3-36 shows utilization rates observed during 2008-2009 by recreation site. As the table indicates, many of the sites are used well below the site capacity, with the exception of Cold Cabin Boat Launch and Line Bridge, both of which offer only a small number of parking spaces.

Table 3-36. Physical capacity utilization of Conowingo Project recreation sites (Source: Exelon, 2012b, as modified by staff).

Site Name	Number of Parking Spaces	Average Spaces Used on Summer Weekend	Percent Utilization
Lock 13	22	1	5
Lock 15	36	1	3
Muddy Creek Boat Launch	69	31	45
Cold Cabin Boat Launch	5	5	100
Dorsey Park	57	6	11
Line Bridge	3	3	100
Broad Creek Public Landing	41	4	12
Glen Cove Marina	47	22	47
Conowingo Swimming Pool and Visitors Center	213	80	38
Peach Bottom Marina	48	7	15
Conowingo Creek Boat Launch	19	3	16
Funk’s Pond	24	2	8
Fisherman’s Park/Shures Landing	124	34	27
Octoraro Creek Access	12	2	17

Land Use

Land use in the Susquehanna River Basin is primarily forest (70 percent), farmland (22 percent), and urban areas (7 percent). All three projects are located within the Lower Susquehanna Subbasin, which exhibits similar land use patterns to the overall basin. Harrisburg, the capital of Pennsylvania, is about 17 miles upstream of the York

Haven Project. Most of the population is centered in the urban areas of Harrisburg, York, and Lancaster, all within an hour drive from at least one of the projects. The larger cities of Baltimore, Wilmington, and Philadelphia are generally within a 2-hour drive of some portion of project waters.

Below the Conowingo Project, the Susquehanna River flows about 10 miles to the head of the Chesapeake Bay at Havre De Grace, Maryland. Counties in the project areas include Dauphin, York, and Lancaster in Pennsylvania and Harford and Cecil in Maryland.

York Haven Project

The York Haven Project includes about 3,220 acres, of which York Haven Power has acquired fee title and flowage rights to land within the project boundary, and claims by easement to all other near shore lands adjoining Lake Frederic. All of the islands within the impoundment are within the project boundary except for the portion of Hill Island located above the 282.5-foot contour, and the northern portion of Three Mile Island, where Exelon's Three Mile Island nuclear facility is located. The Three Mile Island nuclear facility has a 2,000-foot exclusion zone from the two nuclear reactors on the site that encompasses a small slice of shoreline on Shelley Island. The lands within the exclusion zone on Shelley Island are considered non-project lands located in the project boundary. The impoundment is about 3.5-miles-long with approximately 29 miles of shoreline. The York Haven Project boundary extends about 3.5 miles from the top of the impoundment to the downstream face of the dam and powerhouse. There are no lands of the United States within the project boundary.

York Haven Power leases 288 recreational lots at Cly Shore, Shelley Island, and Beshore Island. Sites are available to the public for a small fee. Current York Haven Power policy does not provide for new permitted recreational lots within the project boundary. In addition, permits for existing recreational lots that are abandoned or where existing structures become damaged and are not replaced by structures conforming to all applicable federal, state, and local regulations would be terminated.

York Haven Power lease conditions and rules require lot residents to comply with applicable federal, state, and local laws, including requirements related to potable water, sanitation, sewage facilities, waste disposal, and dock placement and use. Lease holders are not allowed to cut trees without York Haven's permission nor plant any non-indigenous or invasive plants on the islands. York Haven Power conducted an assessment of the sewage disposal systems by recreational lots on Shelley and Beshore Islands and five parcels near Cly Shore. York Haven Power reported that almost every site had water service through a well or withdrawal from the Susquehanna River and every site appeared to have sewage disposal means, either through an outhouse, septic tank, or a drain line that went underground.

The Pennsylvania Sewage Facilities Act and regulations adopted under that statute, including the Londonderry Township On-Lot Disposal Systems ordinance, cover sewage waste at leased recreational lots. The York Haven Power lot lease states that lot lessees are responsible for completing any sewage system upgrades or replacements required to comply with these statutes and ordinances.

In 2010, after a sewerage assessment on the islands, York Haven Power prohibited the use of water withdrawn from wells or the river for any potable purposes (drinking, cooking, showering, dishwashing, oral hygiene, etc.). Lot leaseholders are expected to provide their own supplies of bottled water for potable purposes. York Haven Power further noted that the Pennsylvania Sewage Facilities Act required ordinances related to sewage facilities are adopted at the local level and that new language in the local ordinance (2012) would force upgrades or replacements at the majority of leased lots. York Haven Power lease agreements make it clear this is the responsibility of the leaseholder.

Muddy Run Project

The Muddy Run Project lands include the 900-acre power reservoir and the 100-acre Recreation Lake in Lancaster County, and the transmission line corridor that spans the Susquehanna River and extends into York County. In total, the project consists of about 2,790 acres, 1,790 of which are upland consisting primarily of agricultural fields and forested land. The Muddy Run project boundary is irregularly shaped around the upper reservoir, parallels the Susquehanna River in the areas of Wissler's Run and the powerhouse and then extends east, and continues to parallel the river for another roughly 5,000 feet. The project boundary extends west across the Susquehanna River encompassing the transmission lines for about 4.5 miles to PBAPS.

Exelon has classified land use throughout the project based on its primary use. Existing classifications include:

- Project Operation (425 acres) – Lands used for power generation and electric transmission/distribution infrastructure and purposes;
- Developed Recreation (667 acres) – Lands managed for developed public recreation facilities and activities. This includes commercial recreation facilities.
- Public Access Lands (701 acres) – Lands generally open to the public but that are managed by a federal, state, county, or conservation entity.

Exelon has an SMP for the Muddy Run Project to manage shoreline resources through the following programs and policies: shoreline erosion control; general maintenance; woody debris management; game species management; sensitive natural resource projection overlays and policies; leased premises policy; and a policy restricting certain recreational uses. No lands of the United States are within the project boundary.

Conowingo Project

The Conowingo Project is located in Pennsylvania and Maryland. The northern 8 miles lie within Lancaster and York Counties, Pennsylvania, while Conowingo dam and the southern 5 miles within the project boundary are within Cecil and Harford Counties, Maryland. The Conowingo Project boundary extends approximately 14 miles upstream from Conowingo dam to the lower end of the Holtwood Project tailrace. The project boundary crosses the river just below Holtwood Road (Route 372) at the Norman Wood Bridge on the western shoreline, to approximately 0.5-mile south of the bridge on the eastern shoreline. The project boundary extends 2.5 miles downstream of Conowingo dam along the west bank of the river and 0.5 mile downstream along the east bank of the river. No lands of the United States are within the project boundary.

The Conowingo Project encompasses 11,721 acres: 9,951 acres of flowed land and 1,770 acres above the normal high water elevation. The land in and around the project boundary is mostly rural, consisting primarily of agriculture fields and forested lands.

Exelon leases more than 420 lots on project lands for seasonal residential cottage use. The leases stipulate that the cottages must remain shuttered from November through March 1. In addition to complying with all environmental regulations, zoning standards, and building codes, the cottage leases include a uniform set of standards that address the size, materials, and floatation materials used in dock construction as well as erosion control, vegetation removal, wastewater disposal, shoreline development, and cultural resource protection. Residents cannot dig wells, install septic systems, or expand homes without permission from the county and Exelon. It is Exelon's current policy not to create any new cottage lease lots within the project boundary and that any leases for existing cottages that are abandoned or become damaged and are not replaced by structures conforming to all applicable regulations will be terminated. All structures and improvements will be removed from the leased lot, the land will be restored to a natural condition, and the site will be precluded from future cottage leases.

3.3.5.2 Environmental Effects

Recreation Management

York Haven Project

York Haven Power proposes to maintain the existing public recreation facilities at the York Haven Power Plant Recreation Area (including the canoe portage trail), Battery Island Picnic Area, Goodling Island Picnic Area, Shelley Island Recreation Area, Goosehorn Island Picnic Area, and the East Shore Boat Launch and Canal Lock to ensure continued public use and enjoyment of project lands and waters through a future license. York Haven Power does not propose any improvements to these project recreation sites. York Haven Power also does not propose a recreation management plan; however, it proposes to consult with the Pennsylvania DEP, Pennsylvania DCNR, SRBC, and Pennsylvania FBC to consider the recreation resources and management strategies at the York Haven Project 10 years after the effective date of a future license. The review would take into consideration the recreation facilities, use levels, and operation and maintenance of both York Haven Power project facilities, as well as private and commercial facilities at the project. York Haven Power suggests it would conduct a recreation study if such information would be helpful in the consultation process.

The adequacy and condition of existing recreation facilities and access at the York Haven Project, including the ease of portaging and the potential for additional recreation facilities, was raised as a concern during project scoping. Specifically, Pennsylvania FBC recommended improvements to non-motorized watercraft portages at the project so that boaters would not have to notify York Haven Power in advance for assistance.

Our Analysis

York Haven proposes a number of operational and maintenance activities related to recreation, such as allowing anglers to fish the project's catwalk, maintaining public boat access areas, consulting on the recreation resources 10 years after license issuance, and complying with FERC Form 80 reporting requirements. York Haven Power does not, however, include a plan for implementing these measures or investigating whether or not the sites are meeting the demand over the course of a license. Developing a formal recreation management plan would provide a more cohesive guide for the protection, mitigation, and enhancement of these resources. Effective recreation management plans ensure that the project adequately provides for the recreation needs of the area. An effective plan would include procedures to consult with the Pennsylvania FBC, Pennsylvania DNR, and Pennsylvania Game Commission over the course of any license. Comprehensive recreation management plans would include summaries of the facilities and uses, current and future visitation estimates, and formal monitoring plans every 10 years as proposed by York Haven Power to ensure the sites meet the demand.

There are currently no known issues of crowding, overutilization, unsafe conditions, or general issues that compromise recreation use, access, and enjoyment of the York Haven Project lands and waters. Retrieval of river rocks for the proposed nature-like fishway would require the use of heavy machinery driving back and forth downstream of the main dam to collect and deliver the large boulders in an area popular with anglers, kayakers, and general exploration of the rocks. BMPs for in-water and near-water construction work associated with the nature-like fishway, including protecting human safety during construction, would be addressed within any required Corps' permits.

Muddy Run and Conowingo Projects

Exelon proposes to implement Recreation Management Plans for both the Muddy Run and Conowingo Projects. The plans address recreation resources, including: recreation facilities that are located within the FERC project boundary, are owned and managed by Exelon, and are on lands owned in fee title by Exelon. The plans would address maintenance and capital improvements to ensure continued public use and enjoyment of project lands and waters through a future license. The three recreation areas addressed by the proposed Recreation Management Plan at the Muddy Run Project include: Muddy Run Park and Campground, Muddy Run WMA, and Wissler's Run Park. The 15 recreation sites addressed by the proposed Recreation Management Plan for the Conowingo Project include: Lock 13, Lock 15, Muddy Creek Boat Launch, Cold Cabin Boat Launch, Dorsey Park, Line Bridge, Broad Creek Public Landing, Glen Cove Marina, Conowingo Swimming Pool and Visitors Center, Peach Bottom Marina, Conowingo Creek Boat Launch, Funk's Pond, Conowingo Dam Overlook, Fisherman's Park/Shures Landing, and Octoraro Creek Access. Specific elements of the plans, such as facility improvements, operation and maintenance, monitoring, and plan updates, are addressed below in our analysis.

In comments on the draft EIS, the Park Service recommends Exelon update the Recreation Management Plan for the Conowingo Project every 6 years (instead of every 12), which would coincide with all FERC Form 80 filings. The Park Service also wishes to be included in the list of parties to be consulted in implementing the Recreation Management Plan.

Recreational Facility Improvements and Rehabilitation

As part of the proposed Recreation Management Plans, Exelon would make capital improvements to two facilities at the Muddy Run Project and 13 facilities at the Conowingo Project. Proposed improvement projects would be implemented within the first year of license issuance. In addition, Exelon suggests it would pursue dredging as a means to maintain boater access at Peters, Conowingo, and Broad Creeks.

Exelon proposes to upgrade a variety of amenities within Muddy Run Park and make repairs at Wissler's Run Park near the Muddy Run powerhouse. As part of the improvements, Exelon would replace the existing boat launch facility at the Recreation Lake with a new concrete plank ramp that includes a new gangway and floating dock (barrier free) and also make shoreline improvements to limit erosion. Exelon also proposes to upgrade the barrier-free picnic site, stabilize 150 feet of the shoreline at the Recreation Lake between the barrier-free picnic site and the rental boat dock, convert the timber retaining wall to sheetpile retaining wall, upgrade service to 50-ampere electrical service at 50 sites, expand the playground adding a tot lot, construct a spray park, and provide Wi-Fi service to park users.

At Wissler's Run Park, Exelon proposes improvements that include removing the non-functioning fish cleaning station, rebuilding and repaving the existing walkway along the top of the bank, and designating two parking spaces near the picnicking pavilion as accessible for persons with disabilities. The walkway from the parking area to the picnic area and the parking lot were both repaved in 2011.

As part of the plan, Exelon also proposes to erect and maintain FERC Part 8 signs at River Road and Furniss Road Muddy Run WMA parking areas. Exelon proposes to continue to lease these lands to Pennsylvania Game Commission for the term of a future license.

The State of Maryland agrees that Exelon's proposed improvements to existing recreation facilities would enhance recreation use at the projects; however, it recommends additional measures, such as providing additional facilities for bird watchers and more hiking trails.

A number of individuals commented that the biggest issue at Peach Bottom Marina is that the harbor and river just outside of the railroad bridge are so badly silted in that boats cannot access the marina at normal low or even medium water levels.

Exelon proposes to upgrade and improve 13 existing recreation facilities at the Conowingo Project. The proposed recreation enhancements include:

- adding fencing and vegetation removal at Lock 13;
- new restrooms, dock, and parking enhancements at Lock 15;
- boat launch enhancements at Muddy Creek;
- parking, picnic area, and boat ramp upgrades at Cold Cabin;
- restroom and boat ramp upgrades at Dorsey Park;
- creek stabilization at Conowingo Creek;
- parking and wall improvements at Glen Cove Marina;
- improved signage at Funk's Pond;
- providing accessibility improvements at Conowingo Pond for persons with disabilities;
- upgrading pavilion, picnic area, fence and parking at Overlook;
- providing improvements to the boat ramp at Fisherman's Park;
- bank stabilization at Line Bridge; and
- providing shore access at Peach Bottom.

Recreation Facility Operation and Maintenance

As part of the proposed Recreation Management Plans, Exelon would maintain the existing and proposed recreation facilities as described in the plan for the term of a FERC license. Exelon, at its discretion, may also restrict use and access to (or close) a site, or any portion thereof, on a short-term basis for maintenance/construction activities, unsafe conditions, emergencies, and operational reasons. At the Conowingo Project, Exelon also proposes a number of programs and measures to meet safety objectives including: water release safety devices, upstream boat buoys and warning signs, flow information, a canoe portage shuttle, boat launch channel markers, security fencing/warning signs, maintaining water levels during the boating season, and general facility maintenance. Exelon states that, should additional project facilities be developed over the term of the

FERC license, it would be receptive to partnering with interested parties for the development, operation, and management of such facilities. Exelon would ensure that project facilities, existing and future, that are managed and operated by third parties, would be managed and operated in accordance with FERC rules and regulations and any license articles.

Susquehanna River Boaters Association comments that the recreation boating season is too short and raises issue that there are no minimum pond levels in place on weekdays. To remedy this concern, the Susquehanna River Boaters Association recommends: (1) extending the recreation boating season from May 1 to October 1 (from the current season of Memorial Day to Labor Day) and maintaining the recreational minimum water level on all holidays during the boating season, regardless of what day of the week they occur; (2) establishing a Peach Bottom Marina dredging plan; (3) measuring recreational minimum water levels at point of access *not* at the dam; (4) refunding two months of lease payments to Peach Bottom Marina members due to lack of dredging and boater access; (5) refunding lost revenue to the marina; and (6) adding new channel markers and updating maps.

Recreation Monitoring Program

As part of the Recreation Management Plans, Exelon proposes to use the FERC Form 80 Licensed Hydropower Development Recreation Use Report to assess and report recreation use and capacity every 6 years. Exelon states this level of monitoring would provide a comparison with the recreation use projections provided in the Recreation Management Plans to help determine if additional recreation facilities are warranted during the license period.

Our Analysis

Exelon (2012a and 2012b) concludes that, although visitors indicated high satisfaction with the facilities, many of the recreation sites managed by Exelon exhibited deferred maintenance (e.g., boat ramp upgrades, parking resurfacing) or a complete lack of highly desired amenities, such as restrooms. The lack of restrooms or restrooms in disrepair could pose potential health risks if visitors are forced elsewhere. Broken amenities, amenities in a state of disrepair, or amenities in need of routine maintenance also provide unsafe and uninviting conditions that diminish the quality of the recreation experience and resources. Implementation of the proposed Recreation Management Plans and the specific enhancements would provide a framework to guide the management of recreational resources to ensure that these sites receive updated amenities.

As currently proposed, the plans for the Muddy Run and Conowingo Projects put an increased emphasis on facility improvements, especially boater access and parking, and restrooms. Overall, 96 percent of survey respondents rated the facilities at Muddy Run Park as ‘good’ or ‘excellent.’ The comment received most frequently (27 percent) was that a swimming pool within the park or a roped-off swimming area at the recreation reservoir was desired by visitors. Construction of Exelon's proposed spray park would provide the body-contact recreation visitors requested while preserving the no-swimming policy at the Recreation Lake.

Improvements to the Recreation Lake boat ramp, barrier-free picnic area, shoreline and retaining walls would improve boater access and maintain water quality by reducing erosion from these areas. Improvements to the ramp would enhance boater access; a popular activity on the lake. Similarly, improvements to the campground electrical service, such as more 50-ampere service campgrounds and Wi-Fi, would address modern camper needs such as increased use of electronic devices (e.g., recreational vehicles with air conditioning, personal computers, smart phone charging).

Removal of the non-functioning fish cleaning station at Wissler's Park would eliminate the temptation for users to clean fish on site and leave the waste, which could negatively impact the aesthetics of the area. Enhancements to the pathway and designating two additional parking areas accessible for persons with disabilities would improve the overall recreation resources at the site.

As licensee, Exelon is responsible for providing reasonable public access to project lands and waters. Through the proposed Recreation Management Plans, Exelon recognizes the importance the two projects play in providing recreation in the region and acknowledge that the recreation facilities will be maintained for the duration of any license. However, the plans are limited in scope by failing to identify specifics of any monitoring programs to ensure the sites are meeting demand throughout any license other than through the FERC Form 80 process.

The FERC Form 80 is useful to analyze overall use levels and project-wide capacity; however, it provides broad, rather than site-specific, recreation information. Development of a monitoring program that includes input from users that mimics the methods used during the relicensing studies would enable Exelon to meet its stated goal of comparing recreation data, by site, with future use estimates, as described in the Recreation Management Plans. A recreation use and needs study would provide the mechanism to quantitatively and qualitatively assess recreation resources at the project and ensure the level of service the facility upgrades provide is maintained throughout the license term, while also balancing trends in changing recreation activities. As required now, the FERC Form 80 reports annual use estimates for the entire project, while Exelon is proposing a strategy that looks more closely at recreation use levels at each site. Including the methods of this monitoring effort in revised Recreation Management Plans for both projects would ensure the proper data collection to guarantee all the facilities are meeting the demand. Visitation rates can change dramatically year to year and through time; however, given the proposed facility enhancements, conducting a recreation use study every 12 years, consistent with every other FERC Form 80 reporting deadline throughout the license term, would ensure the proposed plans are current and the sites are meeting the demand.

Similarly, Exelon does not include provisions to update the plans. Since the projects were first constructed, recreation demand for water-based recreation has steadily grown. Over time, the facilities have aged, and as documented in the recreation reports, they exhibit wear and tear associated with regular use. Addressing maintenance of the recreation facilities is an important component of a recreation management plan. Recreation is not static, and ensuring that facilities are the right type for the demands over the term of a typical license requires monitoring to ensure the proposed Recreation Management Plans are revised to prevent any drop off in the quality of the resource. A revised recreation management plan that includes scheduled updates coordinated around a recreation use study could capitalize on the timing and information to address any changes in recreation resources that may be necessary in the middle of any license term. Having a scheduled update ensures the plan is kept current regardless of the extent of changes between plans. Given the larger costs associated with administering a recreation use and needs study, coordinating around every other Form 80 reporting year provides a reasonable balance between data collection, analysis, and Recreation Management Plan updates and the evolution of recreation trends, user perceptions, and facility conditions. Development of the recreation use monitoring methods in consultation with interested agencies and stakeholders would ensure sites and uses are monitored to guarantee that the recreation management plan remains current and includes appropriate diversity in recreation resources.

Exelon's proposed boat ramp and boat launch enhancements at existing recreation facilities would provide improvements to the project's recreational resources. Implementation of the proposed Sediment Management Plan, as discussed in section 3.3.1.2, *Geology and Soils, Environmental Effects*, would include monitoring the water depth at Peter's Creek (Peach Bottom Marina), Conowingo Creek, and Broad Creek (Harford County boat launch) every 5 years. However, the plan stops short of identifying at what depths the locations need to be dredged, scheduling dredging, identifying thresholds that would trigger dredging, or addressing storm events that could fill in the tributary boat launch areas between the 5-year intervals. These three boat ramps represent half of the boat ramps providing access to Conowingo Pond for motorized boating. Visitor survey results indicate that 6 percent of the comments received at Conowingo Creek targeted shallow water/dredging needs; however, because Exelon maintains the minimum pond elevation at 107.2 feet on weekends between Memorial Day and Labor Day, boaters may not perceive a need for dredging at most sites. Maintaining the minimum pond elevations as currently required would ensure the boating resources are maintained through the term of any license for weekend boaters. Dredging the tributary access areas and developing a plan to ensure they are maintained would ensure boating resources are available without being compromised by sediment. In addition to depth of water thresholds, dredging schedules could be based on thresholds related to sedimentation factors such as storm size (flows, precipitation, etc.) or frequency (e.g., annually). Development of the final Sediment Management Plan in consultation with resource agencies would ensure the correct measures are in place to minimize impacts on boating access stemming from sedimentation in these tributary boating access areas.

At Broad Creek Public Landing, the two most common comments received were the need for an improved boat ramp (29 percent) and higher water levels (14 percent) as mentioned by those fishing in the spring and summer. Stakeholders consulted in development of the Recreation Management Plan expressed dissatisfaction with the water depths and amount of siltation at Peach Bottom Marina. Because this is the only marina with gas on the Pennsylvania side of the river, siltation of the marina compromises a boater's ability to access the marina and weakens the businesses' ability to operate. Exelon reported that the depth of water at the toe of the Peach Bottom boat ramp was 3 feet, meeting the *States for Organizational Boating Access Design Handbook for Recreational Boating & Fishing Facilities* recommended minimum water depth of 3 feet. Overall, Peach Bottom Marina received the smallest share of visitation to the Conowingo Project; however, it is not clear how much sedimentation of the marina or other factors played in the site receiving such low amounts of use. After issuance of the draft EIS, Exelon filed with the Commission a summary of a meeting with the Susquehanna River Boaters Association in which it agreed to immediately initiate the permitting and dredging process for this marina (Exelon, 2014).

Maintaining pond elevations at 107.2 feet on weekends from Memorial Day through Labor Day ensures that the majority of recreational boaters can launch a boat at the project. Hydropower generation releases from Conowingo, as well as pumping operations from Muddy Run, could result in pond elevations lower than 107.2 feet during the week, which could compromise the ability to launch a boat. Exelon's tributary access study (Normandeau and Gomez and Sullivan, 2012q) reported that at minimum recreational pool (107.2 feet), a water depth of 2 to 3 feet near the boat launches at Peters Creek, Conowingo Creek, and Broad Creek may exclude larger boats and, at a pond level of 106.2 feet, most motorized boats are excluded from these three boat launches. At 106.2 feet, the Glen Cove Marina boat launch remains usable, but the approach to the gas dock is less than 1.5 feet. Dredging these areas would extend their utility during weekdays. Updating maps and adding channel markers could help inform boaters, after dredging, of the new boating channel into and out of these marinas. Refunds to marina members and owners would be at the discretion of Exelon under the authority of the existing lease structure. Extending the recreation boating season to include the period from May 1 to October 1, as recommended by the Susquehanna River Boaters Association, would increase the number of guaranteed weekend boating opportunities by 16 to 20 days depending on the year. Currently, the boating season is approximately 15 weekends and, as discussed above, ensures access when the pond is maintained at the recreation minimum level. Review of the water level management study (URS and Gomez and Sullivan, 2012a) pond elevation frequencies indicates pond levels are above the minimum recreation boating level between May 1 and October 1 the majority of the time under current operations. When considering the volume of stakeholder comments relative to boating issues, this finding suggests that reservoir levels are less of an issue for boating than boat access at the tributary access sites and debris management. Additional study of the demand for changes to the boating season could be included in the recreation use and needs study associated with the Recreation Management Plan update.

Exelon study results indicate the combination of pool elevation and sediment accumulation compromises motorboat launches from these sites under specific conditions. Cross referencing the bathymetric mapping proposed under the Sediment Management Plan at the three sites into the final Conowingo Recreation Management Plan would ensure bathymetric mapping sediment monitoring results are included in discussions related to boater access to the reservoir. Development of a final Sediment Management Plan that includes detailed benchmarks for dredging, a schedule, and commitment to dredging the three access areas as soon as the benchmark water depths are reached would ensure that recreation access is not lost or compromised indefinitely.

Reopening Catwalk on Conowingo Dam

Not included as part of the proposed Conowingo Recreation Management Plan is the continued closure of the catwalk on the downstream face of Conowingo dam. The catwalk is a narrow, steel and reinforced concrete extension walkway attached to the exterior of the powerhouse wall. The catwalk spans 820 feet along the length of the powerhouse.

The catwalk was very popular with anglers prior to its closure after the events of September 11, 2001. On May 1, 2007, the Director of the Office of Energy Projects issued an Order Amending Exhibit R (119 ¶ FERC 62,088) removing the catwalk as a project recreation facility. The order authorized new recreation facilities at Fisherman's Park on the west side of the river, which now provides anglers the only opportunity to fish just below the dam (the Fisherman's Wharf). This order also authorized public fishing access along the north and south banks of Octoraro Creek on the east side of the river. Exelon completed construction of the Octoraro Creek facility in May 2008 and completed the Fisherman's Park/Wharf in 2009. Fishing is allowed along the shoreline of the park (about 700 yards) except for an area within 100 yards of Conowingo dam.

Exelon evaluated closing of the catwalk to recreational fishing and concluded that while reopening the catwalk is physically feasible, opportunities at the project are sufficient to meet existing and reasonably projected demand without the catwalk. Exelon further questions the benefit gained by investing in security upgrades prior to opening the catwalk.

The State of Maryland disagrees with Exelon's proposal to keep the powerhouse catwalk closed to the public, and believes the new fishing pier does not mitigate for the loss of the catwalk. About a half dozen private citizens also recommend that Exelon reopen the catwalk because it provides a better angling experience.

Private anglers also recommend that Exelon expand the operating hours of Fisherman's Park/Wharf so as to be open between 4 a.m. to midnight. The comments received indicate the current policy of dawn to dusk limits the hours for boating access downstream of Conowingo dam because anglers would prefer to launch early in order to get lines in the water before sunrise when light changes drastically. Similarly, anglers would appreciate launching in the evening and being able to stay on the water later into the night to take advantage of feeding times around the changing light. According to the comment letters, striped bass, a popular game fish residing in the tailwater, feed closest to the surface and shore during these predawn and post dusk times.

Our Analysis

Reopening the catwalk would provide access to a historically popular angler opportunity. Fishing from the catwalk offers a different opportunity and experience than fishing from the shoreline, allowing anglers to cast with the river flow and directly into the middle of the channel. Seasonally, this can be advantageous depending on the fish run(s) because some species are more likely to be caught from the middle of the channel than from the bank (casts from the bank are pushed to the sides of the channel by the flow).

Since Exelon closed the catwalk in October 2001, it constructed a new fisherman's platform along the west bank of the shoreline and developed new trail access to the river on the east bank at Octoraro Creek. The Fisherman's Wharf provides barrier-free ramps and a concrete platform above the shoreline for anglers, while Octoraro Creek provides parking and a trail to the shore along the creek. Although neither provides anglers a chance to fish the main channel in a way that was similar to fishing from the catwalk, the enhancements do provide additional opportunities for this reach of the project. A third site, the Lower Susquehanna Greenway, provides shoreline access between the Fisherman's Park and Deer Creek. Exelon estimates that Fisherman's Park and Octoraro Creek receive the greatest percent of shoreline fishing activity downstream. Exelon estimates a reopened catwalk could support 150 anglers at one time. Exelon projections show the existing access below capacity out to year 2050; however, the estimates are based on general recreation trends and are not specific to unique features like the catwalk or tailraces of dams like at Conowingo.

Upstream of Conowingo, angling on the downstream faces of dams is popular on the catwalks at the York Haven and Safe Harbor Projects. York Haven Power can close the site with a single chain-link fence gate. Access is provided in proximity to both the sluice gate and the base of the powerhouse wall. Similarly, anglers at Safe Harbor are afforded access directly below the powerhouse; however, they must pass a security guard station prior to gaining access to fish. Additionally, Corps' lock and dam systems that also produce power often provide similar fishing opportunities in the tailrace below the powerhouses.

Exelon security experts recommend a number of improvements to the catwalk before considering reopening, including measures that deter, detect, and assess any unwanted activity; delay escape; respond to a threat; and harden the physical structure.

If Exelon were to reopen the catwalk to provide better angler access to the middle of the channel, it could implement select security measures that were identified as appropriate in its catwalk study report for addressing security risks at the catwalk (Security Management Solutions, 2012). Security measures, such as installing a new security guard station, checking anglers in and out, and operating on a limited basis, could provide angler opportunities while minimizing any potential security risks Exelon has reservations about public use of the catwalk. Limited operation of a reopened catwalk could follow specific fish species open seasons when use would be expected to be highest. On-line discussion forums warn anglers that fishing the shoreline downstream of Conowingo dam can be shoulder to shoulder during certain seasons with multiple anglers, indicating the shoreline immediately downstream of the dam is crowded (Stripers Online, 2014). Given the relative proximity of the dam to the large metropolitan areas of Baltimore, Maryland, and Wilmington, Delaware, reopening the catwalk would enhance the angling resources by providing access to a historically popular site and a different opportunity than is currently available.

Debris Management

Debris accumulation, removal, and passing are part of operating a hydroelectric project. The presence of debris in project reservoirs can present safety and aesthetic hazards; however, the dynamic nature of the volume and timing of debris within any reservoir at any given time makes managing it dynamic as well. The removal and/or passing of debris that has accumulated in front of the trashracks is an important component of operating hydroelectric projects of any size. Given the size of the lower Susquehanna River watershed, the amount of debris arriving and passing these projects can be significant.

York Haven Project

York Haven Power estimates the project traps an estimated 5,000 cubic yards of debris in the powerhouse trashracks annually. It states that almost all of the debris arrives at the project during high-flow events when river flows far exceed the hydraulic capacity of the project. In those conditions, much of that debris passes over the main dam. Non-natural debris that accumulates in the forebay is removed, and the remaining debris is sluiced downstream through a gated opening in the masonry non-overflow wall at the downstream end of the forebay. Prior to opening the sluice gate, York Haven Power notifies PPL’s Brunner Island Station that debris is to be sluiced.

In 2010, York Haven Power and Pennsylvania DEP reached an agreement that is reflected in the project’s current NPDES permit and in section 3.3 of the Settlement Agreement, providing for an annual payment of $25,000 to the York County Conservation District to finance debris removal in the Lower Susquehanna River Watershed. The Settlement Agreement requires York Haven Power to continue its current debris management practices, including prior notice to PPL's Brunner Island Station when debris is to be sluiced (absent extraordinary or emergency conditions).

Conowingo Project

During the initial scoping meeting held on the evening of June 11, 2009, the Lower Susquehanna Riverkeeper expressed concern that debris passing the Conowingo dam under high-flow conditions often gets deposited in the Sassafras River, causing damage and expense for cleanup to those living along the river. The Sassafras River is located in Maryland, approximately 10 miles downstream of the mouth of the Susquehanna River at the head of the Chesapeake Bay on the east side of the bay. The conditions described by the Riverkeeper were that the high flows entering the Chesapeake Bay from the Susquehanna River cause a backwater flow up the Sassafras River, such that instead of the debris passing out through the Chesapeake Bay, some of it gets trapped in the Sassafras River.

Historically, Exelon employed a skimmer boat to collect surface debris from throughout the pond and used gantry cranes with grapple attachments in front of the dam. Exelon retired the previous skimmer boat in 2008. In a letter to the Commission filed July 18, 2014, Exelon indicated it employs a new skimmer boat purchased in 2013 to clear floating debris in front of the dam in concert with the cranes. Debris removal occurs during low and normal flow conditions, but cannot take place during high river flows due to safety concerns. The methods and practices employed at Conowingo are comparable to methods employed at the York Haven, Safe Harbor, and Holtwood dams.

The amount of natural and human-made debris reaching Conowingo dam fluctuates from year to year. Between 1989 and 2011 (for years Exelon removed debris), Exelon estimates between 60 and more than 4,000 cubic yards have been removed on an annual basis. Exelon states some of the debris build-up can be as deep as 75 feet under the water surface in front of the dam. All debris removed is taken to Hopkinton Cove where it is separated and sorted as organic, tires, plastic, trash, or metal. Organic (natural) debris is recycled and ground up for mulch. All other debris is sent to a disposal/recycling facility or landfill.

Exelon also sponsors community-based clean-up events for the shoreline upstream and downstream of the dam, such as the Exelon Clean-up Day, clean-up of the Conowingo Creek boat launch, and the Lower Susquehanna Greenway River Sweep.

Based on the results of Exelon's debris management study (URS and Gomez and Sullivan, 2012c), Exelon determined that no additional practices were needed. None of the stakeholders recommended additional measures pertaining to debris management at Conowingo.

We discuss the aesthetics of the debris in section 3.3.7, *Aesthetic Resources.*

Our Analysis

A 2012 report on debris management (URS and Gomez and Sullivan, 2012c) identified quantities of debris passed and removed from the river at York Haven, Safe Harbor, Holtwood, and Conowingo dams; analyzed flow conditions that result in debris being passed naturally at the dams; and reviewed debris management methods and practices employed at the four dams.

Debris typically gets trapped at the dams when river flows are less than the hydraulic capacity of each project powerhouse, and are typically passed naturally over or through the dams when flows exceed the hydraulic capacity of the powerhouses in March and April. Since the hydraulic capacities of the four projects differ significantly (York Haven – 17,000 cfs; Safe Harbor – 110,000 cfs; Holtwood – 31,500 cfs; and Conowingo – 86,000 cfs), debris is passed naturally under different hydrologic conditions. Debris would only be passed downstream from Safe Harbor when inflows exceed 110,000 cfs. Similarly, debris is only passed at Conowingo when inflows exceed 86,000 cfs.

York Haven Project

Formalizing debris management at the York Haven Project as detailed in the Settlement Agreement would ensure debris does not pose long-term hazards to people and project operation. Notification of PPL's Brunner Island steam plant would be a continuation of the courtesy York Haven Power provides so as to allow PPL opportunity to plan or prepare for any inconvenience from passing debris.

Conowingo Project

As noted by the Lower Susquehanna Riverkeeper, debris is primarily deposited in the Sassafras River under high-flow conditions, when backwater effects on the Chesapeake Bay flow upstream into the Sassafras River. When river flows are between 86,000 and 110,000 cfs, debris is passed naturally at Conowingo dam from upstream in the watershed between Safe Harbor dam and Conowingo dam. When river flows exceed 110,000 cfs, debris from the entire Susquehanna watershed can be passed downstream of Conowingo. Under these conditions, the natural passage of debris is beyond the control of the Conowingo Project.

Review of the record on eLibrary indicates debris management has been an issue for the Conowingo Project throughout its existing license. URS and Gomez and Sullivan (2012c) report that debris trapped at Conowingo dam does not always originate from the entire Susquehanna watershed due to the hydraulic capacities of the two upstream hydroelectric projects. The report states that the quantity of debris reaching Conowingo dam is a combined function of the varied hydraulic capacities of upstream facilities and changing contributing watershed areas. Debris management practices employed at the Conowingo Project are consistent with BMPs and practices at the other dams upstream of Conowingo. Current practices remove up to several thousand cubic yards of debris each year. The State of Maryland, Susquehanna River Boaters Association, the Broad Creek Civic Association, and members of the public at the draft EIS public meetings expressed concerns that the amount of floating debris on Conowingo Pond poses risks to boats, boater safety, and compromises some types of boating activities (e.g., waterskiing). This could be coincidental to debris accumulating on the pond after Exelon retired its selfpropelled skimmer in 2008, a reflection of the amount of large woody debris within the watershed, or wind patterns distributing the debris away from Exelon clean-up operations.

URS and Gomez and Sullivan (2012c) report that, when the skimmer boat was operating, even when only deployed a few days a year, it outperformed the clamming method in front of the dam on a per unit of time basis. Deployment of the new skimmer boat, as recently indicated by Exelon, in addition to continuing to clam debris in front of the intakes, should improve boater safety because more debris would be removed from the pond surface. Debris removal in front of the intakes likely removes only a small fraction of the total amount of debris at the project after it has already floated the length of the pond and affected boating.

Deploying the new marine trash skimmer boat on a regular schedule would quickly and effectively reduce the amount of floating debris in areas where the skimmer is deployed, thereby enhancing boater safety throughout the recreation season in those areas. Developing BMPs for the storage of the debris materials at Hopkins Cove would ensure debris is secured on land so as to stay out of the pond.

Revising the Recreation Management Plan to include the debris management program and expanding it to include a new skimmer collection component would improve boating resources and safety. Including a complete description of how decisions relate to deploying debris collection, as well as how debris is managed after its collection, would ensure collection efforts are conducted regularly to minimize the amount of floating debris on the pond that could compromise boating. A revised Recreation Management Plan with debris management components developed in consultation with interested agency stakeholders and boating interest groups would provide: a mechanism to formalize the goals and methods of debris management; timeframes for when debris would be collected; frequency of skimmer and clamming operations; specifications of size criteria; procedures for storage and removal of stored debris; procedures for tracking debris storage and removal; and coordination with community-based clean-ups. Inclusion of a public hotline so boaters could link directly with Exelon to expedite the debris removal actions would help facilitate more immediate responses and could be tracked over time as another way to measure the debris removal effectiveness. Including debris management in a revised Recreation Management Plan would emphasize its importance to boaters; provide Exelon and consulting stakeholders an opportunity to reflect on the effectiveness of the measures; and allow for modification during Recreation Management Plan updates, as necessary.

Effects of Proposed Shoreline Management Plans

York Haven Power is not proposing an SMP as part of its final license application; however, it is proposing to continue to implement its shoreline leases of residential lots. York Haven Power would maintain the recreation lot lease program at the project (total of 288 leases) but indicates that it would terminate any leases when lots are abandoned by the lessee or when existing structures are damaged and not replaced by structures that meet current regulations.

As part of York Haven Power's lease agreement, renters may have non-permanent structures within an 8-foot by 32-foot area; however, as noted during the environmental site visit May 21, 2013, many lots have substantial additions of a more permanent nature. Lots can be handed down from generation to generation; however, once the chain stops or the structures are more than 50 percent damaged or destroyed, the lot is eliminated from the rental program. This allows York Haven Power to slowly reduce the number of lots for rent over time.

As part of its final license applications, Exelon proposes to implement the SMPs filed in August 2012 for both the Muddy Run and Conowingo Projects. The SMPs provide the framework for Exelon to manage the environmental and recreational resources within the project. Measures in the SMPs include general maintenance, shoreline erosion control, erosion and remediation policy, woody debris management, non-project use of project lands, shoreline vegetation management, viewsheds, access trails, and sensitive natural resource protection overlays and policies. Other land management-related policies include an HPMP (see section 3.3.6, *Cultural Resources*), Conowingo Island public use policy, and leased premises policy for cottages. Exelon also proposes to amend the SMP as the facts and circumstances may warrant.

The project land classifications used to define allowable uses are similar for both Muddy Run and Conowingo. Land classifications at Muddy Run include: (1) Project Operations, which identifies project lands used for generation and transmission facilities; (2) Developed Recreation, which identifies lands managed for public recreation facilities (including commercial facilities) and activities; and (3) Public Access lands, which identifies lands managed by federal, state, county, or conservation organizations under agreement with Exelon, whereby public access and use of the lands is allowed according to the rules of the managing entity (these lands are typically unimproved).

The land classifications at the Conowingo Project include the same classifications as Muddy Run and also include the following three classifications: (1) Natural/Undeveloped, which identifies lands that are primarily undeveloped and available for public access and use; (2) Industrial and Other non-project lands, which identify lands managed for industrial/commercial uses and other non-project uses including shoreline stabilization projects; and (3) Cottage Lands, which identifies lands leased to individuals for seasonal use.

The proposed leased premises policies address both private cottage lots, and public (state, county, or local agencies), or commercial vendors for the development of recreation related structures and facilities. Cottage lessees are required to comply with all applicable local, state, and federal laws for the development and use of the land, as well as the Exelon-imposed land use rules. Exelon rules and regulations for cottages address such issues as construction permits, lease transfers, erosion control, vegetation removal, water connections, wastewater disposal, shoreline development (e.g., piers, docks, boathouse, bulkhead, retaining wall), and cultural resource protection. In 2012, Exelon added language to the Conowingo lease documents that the "tenant must provide certification that all sanitary and gray water systems are in good working order in accordance w/applicable regulations, and tenant is not in default under any sewage pumping agreement by a cert. vendor on or before Nov. 1 annually." It is Exelon's policy not to create any new cottage lease lots within the project boundaries. As existing cottages are abandoned or become damaged and are not replaced due to local zoning restrictions, leases would be terminated. In such cases, all structures and improvements would be removed from the leased lot, and the property would be restored to a natural condition and the site would be precluded from future cottage leases.

Leases for public recreation and access facilities must comply with Exelon's "Rules and Regulations Governing the Use and Occupancy of Leased Premises," which parallel those developed for the cottage leases. In addition, leases must use the properties for park and public recreation access and facilities must comply with applicable local, state, and federal regulations.

Interior makes a 10(a) recommendation that Exelon prepare and implement SMPs in consultation with FWS that are consistent with *Guidance for Shoreline Management Planning at Hydropower Projects* (FERC, 2012). The SMPs shall include specific measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, and use of project lands. The licensee shall adopt BMPs for controlling sediment introduction from lands within the project boundary.

The lack of a central septic system for the islands where York Haven Power issues lease permits for residential lots was raised as a concern during project scoping. Each camp has some type of on-lot sewage disposal system; however, Pennsylvania FBC questions if this is an adequate, ecologically sound system for the island environment.

Our Analysis

York Haven Project

York Haven Power does not have a comprehensive shoreline permitting program; however, it does permit non-project uses via the existing standard land use article and shoreline permits for recreational lots. Implementation of York Haven Power's cottage lease agreements would continue to allow private use of portions of the islands and shoreline around Lake Fredric. York Haven Power suggests that routine monitoring would occur to ensure that cottages in disrepair are taken out of the program; however, the amount and type of monitoring of structures (e.g., conditions or encroachments) is not clearly described in the license application. Without a transparent process it is not clear what methods or interval York Haven Power uses to make findings to terminate leases and reclaim the lot area.

York Haven's policies implemented in 2010 prohibiting the use of water withdrawn from wells or the river should reduce the amount of wastewater being produced at the cottages because residents must now provide their own supply of bottled, potable water. According to York Haven Power, many of the lots are expected to use substandard sewage disposal systems. Lease agreements make it clear that leaseholders are responsible to undertake and complete any sewage system upgrades or replacements required to comply with the Pennsylvania Sewage Facilities Act and related rules and/or the Londonderry Township On-Lot Disposal System ordinance.

Although we have no reason to conclude that county and local agencies responsible for monitoring and issuing on-lot disposal system permits would allow systems to continue in an environmentally irresponsible manner, the ultimate responsibility for project land and the protection of associated water quality and recreation resources at Lake Fredric lies with York Haven Power. The Commission has no authority over the county or local agencies, and York Haven Power has an ongoing responsibility to supervise and control shoreline developments to ensure that they are not inconsistent with project purposes, including protection and enhancement of the project's scenic, recreational, and environmental values.

The Commission recognizes the need to consider multiple resource concerns and interests in the development of a comprehensive plan to manage the shoreline, and the need to involve interested parties in the development process. The lot lease agreements only address some of the resource values at the York Haven Project. Licensees have a responsibility to ensure that shoreline development activities that occur within a project boundary are consistent with project license requirements, purposes, and operation. A well prepared SMP can assist the licensee in meeting its responsibilities throughout the term of any license. While these plans are specific to a particular project, SMPs should generally contain a summary of the purpose, goals and objectives of the plan and a description of the shoreline use classifications, which identifies allowable and prohibited uses for existing and future use of the shoreline. A plan may have multiple classification or sub-classification types, but they usually fall within three general types: (1) a protected or natural resource preservation classification, (2) a limited development classification, and (3) a more intensive development classification. SMPs should also include: (a) maps showing the shoreline classifications in relation to the project reservoir, project boundary, and various other features; (b) a permitting program and guidelines developed by the licensee; (c) a monitoring and enforcement program; and (d) provisions for periodic review and update of the plan. Development and implementation of a comprehensive SMP in accordance with the Commission's published guidelines (FERC, 2012), and submitted for Commission review and approval, would ensure the shorelines are managed for the scenic, recreational, and environmental values for the duration of any future license.

Muddy Run and Conowingo Projects

Implementation of Exelon's proposed SMPs would provide a single source for shoreline management guidelines, policies, and an overall framework for managing the Muddy Run and Conowingo shorelines over the terms of any new licenses. Currently, cottage lots are managed with multiple policies and agreements, such as lot leases and erosion control permits. These documents do not, however, identify sensitive shoreline resources, public access areas, enforcement measures, or provisions for periodic review and updates. The proposed plans would bring all existing shoreline management programs and activities, such as the current residential lot and cottage lease program, and any other guidelines, into a single, comprehensive document.

Implementation of the land classification and shoreline management policies would provide for the management of land uses within the project boundaries. Project lands would remain available for public recreational uses, and private and commercial uses would continue to be allowed on project lands pending proper reviews. Exelon would review permit applications for activities such as improvements to leased cottages, construction of boat docks, piers, and landscaping, and would ensure that all residential cottages sewage systems meet local standards on an annual basis.

The proposed SMPs provide Exelon an opportunity to amend the plans as facts dictate; however, the plans do not include routine monitoring or consultation to verify the conditions that may warrant changing the plans. A monitoring and review process would inform Exelon and other interested parties if changes to the SMPs are necessary through the term of any license. The frequency with which an SMP should be reviewed depends upon several factors, including the rate of change on project lands and adjacent lands, as well as the level of stakeholder interest in shoreline development or water access. An SMP for a project located in an area subject to heavy development pressure or high stakeholder interest would likely need to be reviewed and updated more often than an SMP for a project located in an area that is not experiencing rapid change or is not of particular concern to stakeholders. FERC *Guidance for Shoreline Management Planning at Hydropower Projects* (2012) recommends SMPs be updated every 5 to 10 years. Given Exelon's policy to not issue new leases and terminate leases on abandoned cottages, and the lack of comments received from stakeholders specific to the proposed policies within the SMP, updating the SMP every 10 years would be reasonable. Consultation with the appropriate agencies and other stakeholders as part of periodic review would ensure that multiple interests and needs are addressed. Preparation of revised SMPs that includes regular consultation with interested stakeholders would ensure the plan is consistent with conditions at the projects.

The Park Service is responsible for the Captain John Smith Chesapeake National Historic Trail and the Star-Spangled Banner National Trail. Because of its involvement in numerous projects in the project area, including working with the Pennsylvania Historical and Museum Commission, Maryland Historical Trust, and the Onondaga Nation to identify contact period landscapes associated with the Captain John Smith

Chesapeake National Historic Trail, the Park Service has a direct interest in the management of project land and water resources. For this reason, including the Park Service as a consulting party in the SMP would be appropriate.

Erosion has occurred along various segments of Muddy Run and Conowingo shorelines as discussed in section 3.3.1, *Geology and Soils*. Exelon does not propose any changes to project operations that would affect existing erosion rates. However, because wind and wave action are likely to continue, erosion issues are likely to persist.

Effects of Changes to Project Boundary

York Haven Power proposes to add 1.9 acres to the total project boundary acreage to encompass the project's East Shore Boat Launch and Canal Lock recreation area. The proposed boundary modification would include the recreation site completely within the project boundary. The lands proposed to be added to the project are all owned in fee by York Haven Power and are outside the 30-foot setback from the centerline of the adjacent railroad line that constrains the project boundary on both sides of the impoundment.

Exelon proposes to remove 1,965 acres from the Conowingo Project boundary. A 1,760-acre area would be removed from the east and west banks downstream of Conowingo dam as the existing project boundary extends to Havre de Grace. The proposed project boundary would extend from a point approximately 3,000 feet downstream of Conowingo dam on the western shoreline continuing downstream across the river to a point along Maryland State Route 222 (Susquehanna River Road), approximately 2,000 feet downstream of the confluence of Octoraro Creek and the Susquehanna River. The original area within the existing project boundary was necessary during construction of the project; however, since construction is completed, Exelon proposes the lands are no longer necessary for the operation and maintenance of the project. The boundary adjustment would remove four non-project recreation facilities from the project boundary, including portions of the Lower Susquehanna Heritage Greenway, Deer Creek Access, Lapidum Boat Launch, and McLhinney Park.

A 205-acre area would be removed near the Boy Scout dam on Broad Creek in Maryland. The area begins at a point about 1 mile downstream from the Route 623 Bridge across Broad Creek and encompasses land along Broad Creek between this point and the Boy Scout dam. The area does not contain any existing project recreation facilities and is not necessary for operation and maintenance of the project.

Exelon would negotiate leases with recreation facility operators that would no longer exist in the project boundary, and would negotiate a new lease with Maryland DNR for continued operation of the Lower Susquehanna Greenway Trail and Mason-Dixon Trail on Exelon-owned lands.

Lancaster County Conservancy commented that the landscape of the lower Susquehanna River has been designated a Pennsylvania Conservation Landscape (known as the Susquehanna Riverlands), and is part of the Susquehanna Gateway Heritage Area. The area (potentially) affected by these projects includes a significant portion of the

Captain John Smith Chesapeake National Historic Trail and part of the Mason-Dixon Trail.

Our Analysis

The addition of 1.9 acres of project lands at the York Haven Project would ensure the entire East Shore Boat Launch and Canal Lock recreation area is recognized as a project feature and managed under any future license for the project. Currently, the project boundary does not encompass the entire recreation area. These lands would be managed for their recreation resources consistent with the requirements of any license issued for the project.

A relatively thin ribbon of land on the west bank downstream of Conowingo dam was included in past licenses so as to include the railroad that was used to shuttle material to the dam during construction. The old railroad is gone and lands in this area are now used for recreation; however, these lands serve no direct project purpose. Continuation of the lease agreements with the State of Maryland for Susquehanna State Park (which includes the Lower Susquehanna Heritage Greenway Trail, Deer Creek Access, and Lapidum Boat Launch) and the City of Havre de Grace for McLhinney Park would maintain recreation access at these locations if the project boundary were changed. With the exception of the Lower Susquehanna Greenway Heritage Trail, which connects Fisherman's Park with Susquehanna State Park lands, the rest of these sites are non-project recreation sites located more than 3 miles downstream of Conowingo dam. Removal of these lands would be consistent with FERC policy that only lands and waters needed for project purposes for the continued operation of the project should be included in the project boundary. Lands and waters needed may include those for (1) construction and operation of its project, and (2) to carry out other project purposes such as recreation, wildlife protection, and enhancement, etc. Execution of a new lease with Maryland DNR would ensure these lands are maintained for public recreation purposes; however, they would not be under FERC jurisdiction.

3.3.6 Cultural Resources

3.3.6.1 Affected Environment

Section 106 of the NHPA requires the Commission to evaluate potential effects on properties listed or eligible for listing in the National Register prior to an undertaking. An undertaking means a project, activity, or program funded in whole, or in part, under the direct or indirect jurisdiction of a federal agency, including, among other things, processes requiring a federal permit, license, or approval. In this case, the undertakings are the relicensing of the Susquehanna River Projects. Potential effects associated with these undertakings include project-related effects associated with any new construction activities associated with the projects, and the day-to-day operation and maintenance of the projects.

Historic properties are defined as any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. Traditional cultural properties are a type of historic property eligible for the National Register because of their association with cultural practices or beliefs of a living community that: (1) are rooted in that community's history or (2) are important in maintaining the continuing cultural identity of the community. In this EIS, we also use the term cultural resources to include properties that have not been evaluated for eligibility for listing in the National Register. In most cases, cultural resources less than 50 years old are not considered eligible for the National Register.

Section 106 also requires that the Commission seek concurrence with the Pennsylvania SHPO and Maryland SHPO on any finding involving effects or no effects on historic properties, and allow the Advisory Council an opportunity to comment on any finding of effects on historic properties. If Native American properties have been identified, section 106 also requires that the Commission consult with interested Native American tribes that might attach religious or cultural significance to such properties.

By letters filed May 11, 2009 (Muddy Run and Conowingo), and July 24, 2009 (York Haven), the Commission designated Exelon and York Haven Power, respectively, as the Commission's non-federal representatives for carrying out day-to-day consultation in regard to the relicensing efforts pursuant to section 106 of the NHPA. The Commission, however, remains ultimately responsible for all findings and determinations regarding project effects on any historic property, pursuant to section 106.

Area of Potential Effects

Pursuant to section 106, the Commission must take into account whether any historic property within each project's APE could be affected by the issuance of new licenses. According to the Advisory Council's regulations, the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 CFR 800.16[3]). The APE encompasses the likely extent of project operations and project-related environmental measures that could be undertaken during the term of any new licenses that are issued for the proposed projects.

In its application, York Haven Power defined the APE for the York Haven Project as the area within the project boundary as shown on the exhibit G maps provided in the application and includes all lands associated with York Haven dam and reservoir, the east channel dam, the powerhouse, transmission line, and associated project features. By letter filed April 26, 2010, the Pennsylvania SHPO concurred with this definition of the APE (letter from D.C. McLearen, Chief, Division of Archaeology and Protection, Pennsylvania Historic and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to D. Weaver, York Haven Power Company, York Haven, Pennsylvania, filed December 28, 2012).

In its application, Exelon proposed an APE for the Muddy Run Project that consists of all lands located within the project boundary as shown on the exhibit G maps provided in the application and includes all lands associated with Muddy Run dam and reservoir, the powerhouse, transmission line, and associated project features. In approving Exelon's study plan dated December 22, 2009, the Commission also approved the project APE.

In its application, Exelon proposed a revised project boundary for the Conowingo Project that includes Conowingo dam and reservoir, powerhouse, transmission line, and associated project features but terminates just downstream from Conowingo dam. Exelon describes the APE as including all lands located within this proposed project boundary plus an additional 3.8 miles downstream to Spencer Island that are located in the current project boundary. While Exelon proposes to remove lands currently in the project boundary located downstream of Spencer Island from the current project boundary, it stated that these lands would remain in the project APE because cultural resource sites could be affected by project-related flows in this area (personal communication between E. Carter [FERC], T. Sullivan, K. Smith, M. Hoover, and G. Lemay [Gomez and Sullivan]; B. Lynch and C. Hicks [Exelon]; and J. Ryan [VanNess Feldman], Washington, D.C., April 8, 2013). A narrow strip of land located in the current project boundary extending downstream from Spencer Island along the west side of the Susquehanna River to the city of Havre de Grace, Maryland, was excluded from the APE because Exelon did not identify any project effects in this area.

Cultural History Overview

The following discussion is adapted from the cultural overview provided in York Haven Power and Exelon's license applications.

The prehistory of the Susquehanna River Projects area can be divided into four general time periods: Paleoindian, Archaic, Woodland, and Protohistoric. Paleoindian peoples (12,000 – 7,500 B.C.) were nomadic hunter-gatherers who routinely used natural rockshelters as dwellings. Paleoindian sites are recognized by the presence of large fluted projectile points suitable for hunting large game present at the end of the Pleistocene. There are very few documented Paleoindian sites in the region, but one important site, Meadowcroft Rockshelter, is located in southwestern Pennsylvania. During the Archaic period (7,500 – 1,000 B.C.), people adapted to a warmer climate and increasingly relied on smaller game and abundant plant resources. These changes are reflected in changes in tool technologies to include smaller notched projectile points, groundstone tools, and steatite vessels. The Woodland period (1,000 B.C. – A.D. 1600) is marked by a transition to a more sedentary settlement pattern and the appearance of horticultural practices, elaborate ceramics, and increased ceremonialism evidenced by mound construction. The Susquehanna River Project areas primarily contain evidence of Archaic and Woodland period occupations, although one site believed to date to the Paleoindian period was identified within the York Haven APE. The final Prototohistoric period is characterized by profound changes in cultural practices as a result of contact with European explorers and settlers. Today, the Delaware Nation of Native Americans retains ties to the Susquehanna River region. Additionally, the Onondaga Nation has demonstrated ties to the Muddy Run and Conowingo project areas.

European exploration of the Susquehanna River region began in 1608 when John Smith reached the mouth of the river. However, European settlements did not appear until the late 1600s when William Penn began to grant settlement rights in the region. Lancaster County was established in 1729 and subsequently divided into York, Cumberland, Dauphin, Lebanon, and Northumberland Counties. The economy of the region was based primarily on mining, quarrying, milling, and agriculture, with tobacco being an important crop. The Colombia and Port Deposit Railroad was completed in the middle 1930s, and the Susquehanna and Tidewater Canal was opened in 1840. These developments provided an important means of transport to the larger eastern cities.

The York Haven and Conowingo Projects were two of four hydroelectric facilities built on the Lower Susquehanna River between 1904 and 1932. The York Haven Project Water and Power Company was incorporated in 1895 as a water supplier to York Haven residents and businesses. Construction of the project began in June 1901, and a powerhouse was designed by John Augustus Dempwolf using both utilitarian and Romanesque features. In March 1904, the structure was collapsed by an ice gorge and floodwaters, but repairs were completed by August of that same year. The powerhouse was expanded in 1907 to include additional generation capacity and new operating units went online in 1914. East channel dam was constructed in 1918.

Conowingo dam was constructed between 1926 and 1928 to supply power to Philadelphia and southeastern Pennsylvania. The facility also provided power to railroad lines between Washington, D.C., and New York. In 1927, PECO Energy Company, Public Service Company of New Jersey, and PPL reached a cooperative agreement to interconnect their power systems through transmission lines to concentrate power in industrial areas of New Jersey and Pennsylvania. Construction of the Conowingo Project was a large endeavor, and required the relocation of the village of Conowingo and rerouting 16 miles of Pennsylvania Railroad track and Baltimore Pike. At the time of its construction, it was the second largest hydroelectric development in the United States.

A license to construct the Muddy Run Project was issued to PECO Energy Company in September 1964. Construction of the project began that year, and the facility was in operation in 1967. At that time, it was the largest pumped storage facility in the world.

Prehistoric and Historic Archaeological Resources

York Haven Project

York Haven Power conducted research at the Pennsylvania Historical and Museum Commission and identified 24 previously recorded sites within the project APE and three areas that had been given "general site designations." The three "general site designations" were attributed to Shelley Island (36DA3), Three Mile Island (36DA52), and Hill Island (36DA86) for their general cultural sensitivity but are not considered to be sites per se. In June 2010, a shoreline archaeological reconnaissance of the known sites within the APE was undertaken (Stallings and Franz, 2011) to assess all known cultural sites in the APE for project-related effects. Of the 24 known sites, 17 are located on privately owned lands and were either not inspected or were surveyed by boat only. The remaining seven sites (36DA3, 36DA102, 36DA103, 36DA104, 36DA105, 36DA150, 36DA151) are located on lands owned by York Haven Power. None of the 24 sites have been formally evaluated for listing on the National Register, although 36DA99, 36DA100, 36DA101, and 36DA235 were described as being potentially eligible.

Muddy Run Project

Archival research conducted at the Pennsylvania Historical and Museum Commission enabled Exelon to identify three previously recorded sites within the Muddy Run Project APE (36LA67, 36LA103, 36LA368). Site 36LA67 is also located within the APE for the adjacent Conowingo Project. Phase IA archaeological studies also identified 12 areas of archaeological sensitivity. The shorelines of these AOIs were visited by boat and areas of erosion were identified and photographed. The resulting field inspections were described in *Phase IA Archaeological Study and Preliminary Historic Structures Assessment Report for the Muddy Run Pumped Storage Relicensing Application Project, Lancaster and York Counties, Pennsylvania* (Sara et al., 2011a). Field inspections indicated that one of the previously recorded sites (36LA0103) is currently inundated by Muddy Run reservoir. While the Phase IA report identified a moderate to high potential for archaeological resources at most of the 12 AOIs, only two AOIs (AOI 1, AOI 9) were identified as worthy of additional field research because they contained high localized erosion as well as moderate to high probability for sites. The other AOIs were not further inspected. In its December 28, 2012, response to the Commission's November 2, 2012, Additional Information Request, Exelon explained that the two AOIs identified for further research were located within the boundaries of a previously recorded site (36LA0067). These two AOIs were further investigated during Phase IB research with results presented in *Phase IB Archaeological Survey of Two High Priority Areas of Interest (AOIs 1 and 9), Muddy Run Pumped Storage Relicensing Application Project, Lancaster and York Counties, Pennsylvania* (Sara et al., 2012a). A series of 19 shovel test pits was excavated in the two AOIs; no cultural materials were identified. The Pennsylvania SHPO agreed with Exelon's Phase IB recommendations and stated that no further archaeological work at the two AOIs was required (letter from D.C. McClearen, Chief, Division of Archaeology and Protection, Pennsylvania Historical and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to C.E. Hicks, Exelon Corporation, Kennett Square, Pennsylvania, February 9, 2012). The third previously recorded site (36LA368) is situated above the shoreline and did not warrant further Phase IB investigations. No new archaeological resources were identified during Phase IA and Phase IB studies.

Conowingo Project

Archival research conducted at the Pennsylvania Historical and Museum Commission enabled Exelon to identify 37 previously recorded sites within the Conowingo Project APE. Phase IA studies also identified 45 areas of archaeological sensitivity. These AOIs and subsequent boat inspections of specific shoreline locations were described in *Phase IA Archaeological Study and Preliminary Historic Structures Assessment Report for the Conowingo Relicensing Application Project, Harford and Cecil Counties, Maryland and Lancaster and York Counties, Pennsylvania* (Sara et al., 2011b). During the Phase IA research, Exelon identified 19 AOIs with high localized erosion as well as a high probability for archaeological resources; nine of these were recommended for further field investigations. Subsequent Phase IB research entailed the excavation of a total of 369 shovel test pits dispersed throughout these nine AOIs. The results were presented in *Conowingo Project Relicensing Application, Harford and Cecil Counties, Maryland and Lancaster and York Counties, Pennsylvania, Phase IB Archaeological Survey of Nine High Priority Areas of Interest (AOIs 6, 18, 19, 33, 36A, 36B, 38, 39, and 45), FERC No. 405* (Sara et al., 2012b). During this study, seven new sites (18HA317, 18HA318, 18HA319, 18HA320, 18CE373, 18CE374, and 18CE375) and two isolated finds were documented bringing the total site count to 44 sites. As a result of both the Phase IA and IB studies, Exelon identified one site (18CE82) that has been previously determined to be eligible for listing on the National Register and one site (18CE16) that has been previously determined to be ineligible. Three previously recorded sites also considered to be eligible for listing (36LA51, 36LA56, 36LA67) and two sites (18CE14, 36LA69) were recommended as potentially eligible. Of these sites, 36LA67 is also located within the APE established for the Muddy Run Project. All seven of the newly identified sites were also recommended as potentially eligible. The remaining 30 sites in the Conowingo Project APE have not been evaluated, and their National Register eligibility is unknown.

Table 3-37 shows all archaeological and historic sites identified within the APEs for the Susquehanna River Projects.

Table 3-37. Recorded archaeological and historic sites identified within the Susquehanna River Projects APEs (Sources: Stallings and Franz, 2012; Exelon, 2012).

Resource Number	Resource Type	National Register Eligibility
York Haven Project		
36DA3 (general)	General prehistoric, open habitation	n/a
36DA51	General prehistoric, open habitation	Unknown

Resource Number	Resource Type	National Register Eligibility
36DA52 (general)	General prehistoric, open habitation	n/a
36DA86 (general)	General prehistoric, open habitation	n/a
36DA93	Late Woodland, open habitation	Unknown
36DA94	Transitional, open habitation	Unknown
36DA95	Late Archaic - Late Woodland, open habitation	Unknown
36DA98	General prehistoric, open habitation	Unknown
36DA99	Late Archaic, open habitation	Potentially eligible
36DA100	Early Archaic, open habitation	Potentially eligible
36DA101	Late Archaic; Late Woodland; 19^{th} century, multi-component	Potentially eligible
36DA102	Late Archaic open habitation	Unknown
36DA103	Middle - Late Archaic open habitation	Unknown
36DA104	Late Archaic, open habitation	Unknown
36DA105	Late Archaic, open habitation	Unknown
36DA106	Late Archaic, open habitation	Unknown
36DA107	Late Archaic - Transitional Archaic, open habitation	Unknown
36DA139	Island Late Archaic; Middle-Late Archaic, open habitation	Unknown
36DA149	Late Archaic, open, unknown function	Unknown
36DA150	General prehistoric; Late Woodland, open, unknown function	Unknown
36DA151	Late Woodland, open, known function	Unknown
36DA152	Archaic-Late Woodland, open, unknown function	Unknown
36DA235	18th to 20th century, farmstead	Potentially eligible

Resource Number	Resource Type	National Register Eligibility
36YO256	Archaic-Late Woodland, open habitation	Unknown
36YO264	General prehistoric, open habitation	Unknown
36YO300	Paleoindian-Archaic, Late Woodland, general historic, open, unknown function	Unknown
36YO334	Unknown	Unknown
Muddy Run Project		
36LA67	Prehistoric open habitation	Considered eligible
36LA103	Rockshelter	Unknown
36LA368	Prehistoric open habitation	Unknown
Conowingo Project		
Maryland		
18CE14	Multi-component Prehistoric	Potentially Eligible
18CE16	Late Archaic	Ineligible
18CE82	Rock art	Eligible
18CE347	19th century domestic	Unknown
18CE348	19th-20th century farm	Unknown
18CE349	Industrial Susquehanna Canal	Unknown
18CE366	Industrial Susquehanna Canal Lock	Unknown
18CE373	Prehistoric, Archaic-Woodland village site; 18th-20th century cemetery	Potentially Eligible
18CE374	Prehistoric, open habitation	Potentially Eligible
18CE375	Prehistoric, open habitation	Potentially Eligible
18HA21	Transitional Archaic; 19th century canal	Unknown
18HA240	19th-20th century canal lock gates	Unknown
18HA248	Middle to Late Archaic short-term camp	Unknown
18HA254	Middle to Late Archaic short-term camp	Unknown
18HA255	Late Archaic short term camp	Unknown

Resource Number	Resource Type	National Register Eligibility
18HA256	Late Archaic Lithic Scatter; 18th century domestic site	Unknown
18HA267	Late 19th-early 20th century barge/wreck	Unknown
18HA268	19th-20th century barge/shipwreck	Unknown
18HA269	Historic landing or wharf site	Unknown
18HA285	Mill Ruins	Unknown
18HA317	19th-20th century domestic structure and refuse	Potentially Eligible
18HA318	Archaic-Woodland base camp, 18th-20th century	Potentially Eligible
18HA319	Prehistoric, unknown lithic scatter	Potentially Eligible
18HA320	Woodland base camp, 18th-20th century	Potentially Eligible
Pennsylvania		
36LA28	Open habitation, prehistoric	Unknown
36LA29	Open habitation, prehistoric	Unknown
35LA34	Prehistoric open habitation	Unknown
36LA35	Prehistoric open habitation	Unknown
36LA43	Open habitation	Unknown
36LA45	Open habitation	Unknown
36LA47	Historic, prehistoric	Unknown
36LA51	Open habitation	Considered Eligible
36LA56	Prehistoric, open habitation	Considered Eligible
36LA65	Late Archaic, open habitation	Unknown
36LA67	Prehistoric, open habitation	Considered Eligible
36LA68	Prehistoric, open habitation	Unknown
36LA69	Prehistoric, open habitation	Potentially Eligible
36LA70	Prehistoric, open habitation	Unknown
36LA118	Prehistoric, open habitation	Unknown
36LA120	Prehistoric, open habitation	Unknown
36LA1252	Rockshelter	Unknown

Resource Number	Resource Type	National Register Eligibility
36LA1253	Prehistoric, open	Unknown
36LA1254	Shelter	Unknown
36YO381	Historic mill race	Unknown

Historic Structures

York Haven Project

York Haven Power conducted an architectural survey and identified five historic structural resources in the project APE (Stallings and Franz, 2011). Three of these structural resources are located on Shelley Island: the Shelly Island Schoolhouse and two historic cemeteries. By letter filed May 2, 2011, the Pennsylvania SHPO determined that the Shelley Island Schoolhouse is ineligible for listing[117] on the National Register (letter from D.C. McLearen, Chief, Division of Archaeology and Protection, Pennsylvania Historical and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to F. P. Stallings, Brockington Cultural Resources Consulting, Norcross, GA, May 2, 2011). The survey report also notes that cemeteries are generally not eligible for listing on the National Register but can be eligible under the National Register criteria if they obtain their primary significance from graves of person of transcendent importance, from age, from distinctive design features, or from an association with historic events (Park Service, 1992). York Haven Power recommended that the two cemeteries do not meet these criteria. The Three Mile Island nuclear plant is also located within the APE and has been previously determined eligible for listing on the National Register. However, while this facility is technically located within the project APE, it is situated within an area excluded from FERC jurisdiction. Only the York Haven Project was identified within the APE as potentially eligible for listing on the National Register under Criterion A for its contribution to the history of hydroelectric power in the region between 1901 and 1904. It was also recommended as eligible under Criterion C because of its association with the John Augustus Dempwolf firm and reflects both utilitarian and Richardsonian Romanesque architectural styles. In its May 2, 2011, letter, the Pennsylvania SHPO concurred with these recommendations.

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[117] The Pennsylvania SHPO did not indicate why the schoolhouse is ineligible for listing; however, the final license application at page 273 states: “many of the buildings on Shelley Island are replacements of earlier structures that were destroyed or heavily damaged during the Hurricane Agnes Flood of 1972.”

Muddy Run Project

Exelon conducted a study of potentially eligible historic structures associated with both the Muddy Run and Conowingo Projects. The results of the study for the Muddy Run Project are presented in *Final Report, Historic Structures Assessment Report for the Muddy Run Pumped Storage Project Relicensing Application, Drumore and Martic Townships, Lancaster County and Lower Chanceford and Peach Bottom Townships, York County, Pennsylvania* (Henry and Jenkins, 2012a). A single structure, the historic Ritchie-Robinson House (ca. 1846), was identified. According to the report, the Pennsylvania SHPO had previously determined that the structure was ineligible for listing on the National Register in 2001. Exelon re-evaluated the structure at the request of the Pennsylvania SHPO (letter from D. C. McLearen, Chief, Division of Archaeology and Protection, Pennsylvania Historical and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to F. P. Stallings, Brockington Cultural Resources Consulting, Norcross, GA, January 6, 2011). Exelon recommended that the house remain ineligible because (a) its previous occupants, William Ritchie and Michael Robinson, were not persons of historical significance on the local, state, or national level; (b) the structure has been altered with modern materials and additions that have compromised the house's integrity of design, materials, and workmanship; and (c) the farmstead itself does not contain a range of typical buildings and landscape features that would demonstrate important changes over time in the region's agricultural history. In its December 28, 2012, response to the Commission's November 2, 2012, Additional Information Request, Exelon explained that while the Pennsylvania SHPO's concurrence on this recommendation had been requested, no response had been received. The Muddy Run Project does not yet meet the 50-year threshold for National Register eligibility. However, Exelon's historic structures report states that the system is potentially eligible for listing under National Register Criterion A (energy production), Criterion C (engineering), and Criterion Consideration G, which recognizes significant architectural resources less than 50 years old. The report recommended further research and field survey to complete the Historic Structures Resource form for the Muddy Run facility and to formally evaluate its eligibility for the National Register.

Conowingo Project

A reconnaissance level architectural survey for the Conowingo Project identified a number of historic structures located within the project APE (table 3-38). The results of the study are presented in *Final Report, Historic Structures Report for the Conowingo Hydroelectric Project Relicensing Application, Hanford and Cecil Counties, Maryland, FERC Project No. 405* (Henry and Jenkins, 2012b). Archival research identified four structures or structural districts currently listed on the National Register (HA-112, HA113, HA-1551, and HA1591). By letter filed May 1, 2012, the Pennsylvania SHPO stated that the Susquehanna and Tidewater Canal (HA-112) and the Columbia & Port Deposit Railroad (CE-1554) had been evaluated for another project and were determined ineligible for inclusion in the National Register (letter from D.C. McClearen, Chief, Division of Archaeology and Protection, Pennsylvania Historical and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to C.E. Hicks, Exelon Corporation, Kennett Square, Pennsylvania, filed August 31, 2012). However, subsequently, the Pennsylvania SHPO reversed this determination and stated that these two structures are indeed eligible (letter from D.C. McClearen, Chief, Division of Archaeology and Protection, Pennsylvania Historical and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to K. Smith, Gomez and Sullivan Engineers, Henniker, NH, July 23, 2012). No reason for this change was provided. The Lower Deer Creek Valley Historic District (HA-1551) contains a number of contributing elements, nine of which are within the project APE. While the boundaries of the Havre De Grace Historic District (HA-1591) are also located within the APE, no structures associated with the district are present in the APE. There are five additional previously documented resources in the APE, three of which (CE-874, HA-1877, and HA-1971) have also been previously determined to be eligible for listing on the National Register. Two others (HA-1035 and HA-1183) are recommended as ineligible. One historic bridge (HA-1581) was demolished in 1997. A total of seven additional resources were newly identified during the study. All seven were recommended as ineligible for listing on the National Register.

Table 3-38. Historic structures identified within the Susquehanna River Projects APEs (Sources: Stallings and Franz, 2011; Henry and Jenkins, 2012a, 2012b).

Resource Number	Resource Type	National Register Eligibility
York Haven Project		
Unassigned	Shelley Island Schoolhouse	Ineligible
Unassigned	Shelley Family Cemetery	Recommended ineligible
Unassigned	Shelley Island Cemetery	Recommended ineligible
Unassigned	Three Mile Island Nuclear Plant	Eligible
Unassigned	York Haven Hydroelectric Project	Eligible
Muddy Run Project		
Unassigned	Ritchie-Robinson House	Recommended ineligible
Unassigned	Muddy Run Hydroelectric Project	Potentially eligible
Conowingo Project		
CE-0874	Bell Manor Road Bridge	Determined eligible 2001 (per Exelon)
CE-1554/ 1558 (new)	Columbia & Port Deposit Railroad including Bridge and Tunnels	Eligible (Pennsylvania SHPO 7/23/2012)
CE-1555	Perpendicular Lock of Susquehanna Canal	Recommended ineligible

Resource Number	Resource Type	National Register Eligibility
(new)		
CE-1556 (new)	Palmer House 900 Susquehanna Road	Recommended ineligible
CE-1557 (new)	McClenahan Bros./John W. Malone Quarry Building	Recommended ineligible
HA-0112	Susquehanna and Tidewater Canal Southern Terminus	National Register listed 1987, determined eligible (Pennsylvania SHPO 7/23/2012)
HA-0113	Susquehanna and Tidewater Canal Lockmasters House	National Register listed 1987
HA-1035	Old U.S. Route 1 (Glen Cove Road)	Recommended ineligible
HA-1183	Whitney Cottage	Recommended ineligible
HA-1581	MD 623 Bridge over Broad Creek	Demolished in 1997
HA-1591	Havre De Grace Historic District	National Register listed 1982
HA-1877	County Road 19 Bridge	Determined eligible 2001 (per Exelon)
HA-1971	U.S. Route 1 bridge over Conowingo Dam (Conowingo Hydroelectric Facility)	Determined eligible 2001 (per Exelon)
HA-2210/2211 (new)	Susquehanna Power Company Railroad Spur and Bridge	Recommended ineligible
HA-2212 (new)	Trenton Flint and Spar Company Building Ruins	Recommended ineligible
HA-2213 (new)	Bridge	Recommended ineligible
HA-2214 (new)	Culvert	Recommended ineligible
HA-1551	Lower Deer Creek Valley Historic District	Listed 1987

Resource Number	Resource Type	National Register Eligibility
HA-191	Rock Run Mill	Contributes to District
HA-195	Rock Run Bridge Toll House	Contributes to District
HA-196	Rock Run Bridge Piers	Contributes to District
HA-376	Lapidum Warehouse Wharf Road	Contributes to District
HA-377	Lapidum Inn site	Contributes to District
HA-380	Abrahams/Nicholson House	Contributes to District
HA-381	Pugh House/Ferncliff	Contributes to District
HA-382	Lapidum Lock	Contributes to District
HA-2190	Neff House	Contributes to District

Traditional Cultural Properties

On June 12, 2009, the Commission initiated consultation with the Delaware Nation and inquired regarding its interest in the Susquehanna River Projects relicensing (letter from A. Miles, Director of Hydropower Licensing, FERC, Washington, D.C., to K. Holton, President, Delaware Nation, Anadarko, OK, June 12, 2009). The Commission offered to meet with the tribe to discuss any issues or concerns that the tribe might have. York Haven Power also consulted with the Delaware Nation during study plan development and on October 26, 2010, the tribe responded by email stating that it desired to be a consulting party.[118] On April 7, 2011, York Haven Power provided the tribe with a copy of the cultural resources report for review and comment.[119] The tribe was also

[118] October 26, 2010, email from J. Ross, Cultural Preservation Department, Delaware Nation, Anadarko, OK, to P. Stallings, Brockington and Associates, Inc. Norcross, GA, filed December 28, 2012.

[119] April 7, 2011, letter from F.P. Stallings, Brockington and Associates, Inc. Norcross, GA, to T. Francis, Cultural Preservation Director, Delaware Nation, Anadarko, OK, filed June 12, 2009.

provided a copy of the draft and final license applications. The Delaware Nation is also included on Exelon's list of consulting parties. To date, no specific comments have been received from the Delaware Nation and no concerns regarding cultural resources in the project APE have been reported. On December 13, 2013, the Onondaga Nation expressed an interest in the lower Susquehanna River Projects.[120] Specifically, the tribe expressed concerns regarding cultural resources including traditional trails and trade routes in the vicinity of the Conowingo and Muddy Run project areas.

3.3.6.2 Environmental Effects

Project-Related Effects on Cultural Resources

Project-related effects on cultural resources within the APEs could occur from project operations, any proposed modifications to project facilities, changes in project boundaries, public use of project lands, and other activities. Project effects are considered to be adverse when an activity may alter, directly or indirectly, the characteristics of a historic property that qualify the property for inclusion in the National Register. If adverse effects are found, such effects would need to be resolved in consultation with the Maryland SHPO, Pennsylvania SHPO, and other parties. For the most part, assessment of effects on archaeological resources located within the APEs of the three projects focused on erosional effects.

York Haven Project

In its application, York Haven Power stated that, because 17 of the 24 previously recorded sites are located on private lands, they were not assessed for project effects, and are not subject to the management responsibilities of York Haven Power. Six of the 17 sites (36DA100, 36DA101, 36DA235, 36DA51, 36DA98, 36DA99) are situated within a "FERC-designated exclusion zone" established for the Three Mile Island Project and are exempt from cultural resource consideration associated with the project. Several sites are located on York Haven Power fee lands that are either permitted lots (36DA139, 36DA150, 36DA151) or are subject to non-intrusive agricultural practices (36DA104, 36DA105). Two additional sites on fee lands are reported to have been heavily collected in the past (36DA102, 36DA103). Regardless, York Haven Power stated that its archaeological reconnaissance did not identify any project-related effects on any of the 24 registered sites within the APE. Although areas of erosion were observed at several sites, and one site (36DA152) was identified as intermittently inundated, York Haven Power stated that any shoreline erosion at these sites is a consequence of natural river flows and not project operation (York Haven Power, 2012a).

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[120] December 12, 3013, Motion to Intervene of the Onondaga Nation from Chief I. Powless, Jr., Secretary, Onondaga Nation, Nedrow, NY, filed December 24, 2013.

Five historic structural resources were identified within the York Haven Project APE. One of these has been determined to be ineligible for listing on the National Register, and three are recommended as ineligible. Effects to these resources have therefore not been assessed. The remaining two structures are eligible or potentially eligible for inclusion in the National Register. Of these, the Three Mile Island nuclear plant is located within the FERC-designated "exclusion zone." No project effects on the plant were identified. However, normal operation and maintenance activities associated with the historic York Haven Hydroelectric Project facilities could adversely affect the character-defining features of this facility.

Muddy Run Project

In its November 2, 2012, Additional Information Request, the Commission requested that Exelon provide a discussion of the current status of the three previously recorded sites identified during Phase IA cultural resources studies. In its December 28, 2012, response, Exelon explained that one site is currently inundated by the Muddy Run reservoir (36LA103), and one site is unaffected by project-related erosional impacts (36LA368). Exelon stated that AOI 1 and AOI 9, which were investigated during Phase IB studies, were located within the boundaries of the third site (36LA67) and that no cultural materials or features were observed. However, because this site lies within the APEs for both the Muddy Run and Conowingo Projects, the Phase IB report recommends further investigation of the site as part of the Conowingo Project relicensing to determine the site's condition and to assess erosional impacts (Sara et al., 2012a). Exelon concluded in section 3.3.8.2 of its application that the continued operation of the Muddy Run Project and "associated Project recreation" could affect cultural resources. Exelon also notes that siltation may be considered to have a positive effect in some situations because it provides a layer of protection.

Exelon's application identifies a single architectural resource present within the Muddy Run Project APE. The Ritchie-Robinson House has been recommended as ineligible for listing on the National Register and therefore, project effects on this resource need not be assessed. Exelon's historic structures report (Henry and Jenkins, 2012a) also identified the Muddy Run Hydroelectric Project system as a potential historic property. Because the system has not yet reached the 50-year threshold for National Register eligibility, Exelon did not complete an assessment of effects for this resource.

Conowingo Project

Exelon concluded in section 3.3.8.2 of its application that the continued operation of the Conowingo Project and "associated Project recreation" could affect cultural resources. Exelon also noted that siltation may be considered to have a positive effect in some situations because it provides a layer of protection. Exelon's Phase IB report (Sara et al., 2012b) also recommended additional field study of the eight sites investigated in the study to determine site boundaries and eligibility. However, by letter filed July 3, 2012 (letter from D.L. Henry, Preservation Officer, Maryland Historical Trust, Crownsville, Maryland, to K.D. Bose, Secretary, FERC, Washington, D.C., July 3, 2012), the Maryland SHPO provided comments on Exelon's cultural resources investigations and stated that no further archaeological investigations were necessary for the relicensing at this time. Additionally, by email on April 26, 2012, the Maryland SHPO stated that the removal of specified lands from the Conowingo Project boundary and from federal jurisdiction would not result in an adverse effect on the Susquehanna and Tidewater Canal terminus because the Maryland Historical Trust holds a perpetual preservation easement on the property (email from D.L. Henry, Preservation Officer, Maryland Historical Trust, Crownsville, Maryland, to D.S. Searman, Maryland DNR, Annapolis, Maryland, filed June 21, 2011). The Maryland SHPO concluded that continued operation of the Conowingo Project would have no adverse effect on historic properties, including the historic Conowingo Project Hydroelectric Project facilities.

A ninth site investigated during the Phase IB study is located in Pennsylvania (36LA69). By letter filed February 16, 2012, the Pennsylvania SHPO recommended completing Phase II evaluations at this site because the site is threatened by ongoing erosion.

Historic Properties Management Plans

York Haven Project

In April 2012, York Haven Power prepared a draft HPMP to address project-related effects on historic properties and unevaluated cultural resources. The Pennsylvania SHPO provided comments on the draft HPMP (letter from D.C. McClearen, Chief, Division of Archaeology and Protection, Pennsylvania Historical and Museum Commission, Bureau for Historic Preservation, Harrisburg, Pennsylvania, to D. Weaver, York Haven Power Company, York Haven, Pennsylvania, September 14, 2012), and York Haven Power addressed those comments in a revised HPMP filed with the Commission on December 28, 2012 (Stallings and Franz, 2012).

In its HPMP, York Haven Power proposes to appoint a cultural resources coordinator and implement review procedures that would apply to non-routine maintenance activities, structural modifications, or additions that may be necessary in the future. Additionally, the HPMP includes measures and procedures for: (a) an employee cultural resources awareness program; (b) the treatment of inadvertent discoveries of cultural materials; (c) the treatment of human remains that may be identified during project activities; (d) additional archaeological investigations including protocols for any new construction activities intended to avoid affecting National Register-eligible resources; (e) any sale or transfer of project lands; (f) ground maintenance and landscaping within the project APE; (g) monitoring archaeological sites identified within the project APE including inspection and reporting policies; (h) potential effects on historic hydroelectric system structures; (i) activities that are exempt for further section 106 consultation; and (j) review and updates of the HPMP should license modifications become necessary or should regulation change. If these situations do not occur, the HPMP would be reviewed and revised every 10 years in consultation with the

Commission, the Pennsylvania SHPO, interested Native American tribes, and other parties as appropriate.

Muddy Run Project

Exelon stated that continued operation of the Muddy Run Project would not affect historic properties that are listed or eligible for listing on the National Register. For this reason, Exelon did not develop an HPMP for the Muddy Run Project. However, Exelon also stated that continued operation and maintenance and project-related recreation activities have the potential to affect sites and that "in some cases, sites are being affected by siltation, which may be considered a positive effect because it provides site protection." Exelon proposes to perform section 106 consultation prior to any project-related ground-disturbing activity, including recreational development. If previously unidentified cultural resources are identified during such activity, Exelon would consult with the Pennsylvania SHPO and if necessary, prepare a cultural resources management plan to address the discovery in compliance with section 106.

In its January 31, 2014, comments, recommendations, preliminary terms and conditions, and preliminary prescriptions, Interior provides a 10(a) recommendation in accordance with the FPA that Exelon prepare an HPMP for the Muddy Run Project in consultation with the Pennsylvania SHPO and other parties.

Conowingo Project

In its HPMP, Exelon proposes to appoint a cultural resources coordinator and implement review procedures that would apply to non-routine maintenance activities, structural modifications, or additions that may be necessary in the future. Additionally, the HPMP includes measures and procedures for: (a) appointment of a cultural resources coordinator who would be responsible for overseeing implementation of the HPMP and coordinating consultation activities; (b) potential project effects on the historic Conowingo Project facility and other historic structures, including consultation with the Maryland SHPO or Pennsylvania SHPO and others as appropriate; (c) ground-disturbing activities that have the potential to affect archaeological resources; (d) monitoring all archaeological sites and 19 AOIs identified within the project APE including inspection and reporting policies and a requirement to consult with the Maryland SHPO or Pennsylvania SHPO and others as appropriate should effects be identified; (e) Phase II evaluations at site 18LA69 as requested by the Pennsylvania SHPO within 1 year of HPMP implementation; (f) archaeological public outreach and interpretation programs, (g) the treatment of inadvertent discoveries of cultural materials; (h) emergency situations with the potential to affect historic properties; (i) consultation with the Delaware Nation and the Onondaga Nation; (j) the treatment of human remains that may be identified during project activities; (k) the curation of any cultural materials that may be recovered during archaeological fieldwork; (l) annual reporting to the Pennsylvania SHPO and Maryland SHPO; and (m) review and amendment of the HPMP as needed.

On October 17, 2014, the Onondaga Nation filed comments on Exelon's draft HPMP. Specifically, the Onondaga Nation stated that (a) it desired to be consulted regarding ground-disturbing activities; (b) it should be identified in the HPMP as a federally recognized Indian Nation with interests in the project; (c) it should receive copies of Exelon's proposed Annual Report on Historic Properties, (d) it should be permitted to suggest amendments to the HPMP; and (e) the project APE should include all lands affected by the project, not just lands within the project boundary.

Our Analysis

York Haven Project

York Haven Power's HPMP includes many of the standard requirements of an HPMP. However, some measures contained within the draft HPMP would benefit from clarification and/or more detail, and there are other measures that would be worth inclusion in the final HPMP.

A comprehensive archaeological survey of all lands within the York Haven Project APE was not undertaken, site boundaries and exact locations are not known, and many of the previously documented sites identified in the APE are situated on privately held lands. Where possible, these sites were inspected by boat. In its HPMP, York Haven Power states that it has no management responsibilities for sites on private lands without right-of-way entry permission from the relevant landowners. Section 106 of the NHPA and its implementing regulations found at 36 CFR 800.4(b)(1), require licensees to make a "reasonable and good faith effort" to identify historic properties within a project APE regardless of property ownership. However, no attempt was made by York Haven Power during study implementation to obtain permission from property owners to access these sites for recordation or assessment purposes. Section 106 permits a "phased" approach to inventory and evaluation in situations where access to lands within an APE is restricted (36 CFR 800.4[b][2]). To clarify, this approach is acceptable for sites located on privately held lands within the APE where access was requested but declined.

In its HPMP, York Haven Power includes shoreline sites on private lands in its proposed monitoring plan. Section 3.6 of the HPMP specifies that consultation with the Pennsylvania SHPO, Tribal Historic Preservation Officers, Indian Tribes, and other parties would be conducted if shoreline monitoring efforts identify project-related effects on archaeological sites in the future. However, the HPMP also states that "all archaeological sites *within YHPC-owned lands* will be protected under the provisions of this HPMP. Archaeological evaluations may be warranted by monitoring recommendations in the future" (italics added). If project effects on sites located on private lands are identified during shoreline monitoring, the HPMP should be clear that these sites are also protected under the provisions of the HPMP and section 106. If section 106 consultation is necessary to address these effects, inclusion in the HPMP of a requirement for the licensee to request landowner permission to access and evaluate these sites would ensure that the sites are appropriately addressed in accordance with section

106. Further, requesting access to sites on private lands concurrent with consultation with the SHPO and others would ensure that property owners are aware of the situation and would enable their input to be considered during determination of preferred preservation or mitigation measures.

In its HPMP, seven sites were identified that are located on York Haven Power fee lands (36DA102, 36DA103, 36DA104, 36DA105, 36DA139, 36DA150, 36DA151). York Haven Power states that some of these sites are subject to no-till farming, and others are reported to have been heavily collected in the past. York Haven Power proposes to undertake annual monitoring of these sites. While property owners may restrict access to privately held lands for survey purposes, this restriction does not apply to York Haven-owned fee lands. Full recordation of these sites would not require private landowner permission, would not require ground disturbance, and would enable site boundaries to be documented. This would result in a more accurate and timelier assessment of any potential effects.

In addition, inclusion of a plan and schedule to survey and record sites on fee lands and evaluate them for their National Register eligibility in the HPMP would ensure that any effects on sites owned by York Haven Power are fully considered in accordance with section 106. In its October 9, 2014, comments on the draft EIS, York Haven Power states that a requirement to evaluate sites on fee lands is not warranted given the "conservation archaeology approach"[121] reflected in the draft HPMP. For resources on both York Haven and private lands, it may be possible to evaluate sites using minimally intrusive methods (e.g., post hole inspections, inspection of cleared cut banks to determine depth of any archaeological deposit) combined with ethnographic research of the area. If evaluation is not possible at a particular site without full archaeological test excavation, and no project effects are identified, then York Haven Power's conservation archaeology approach would be acceptable on a case-by-case basis. In such situations, a site may be presumed to be eligible and the schedule for evaluation would call for the site to be evaluated on an as-needed basis in the future. However, if any sites are being affected by project activities, lessee activities on fee lands, or ongoing artifact collection,

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[121] In accordance with 36 CFR 800.4, National Register evaluation of sites identified within a project APE is required. However, a "*conservation archaeology approach*" to section 106 compliance refers to an approach that is sometimes used when there are no potential effects on a site and (a) section 106 consultations have identified concerns related to ground disturbance that could require evaluation of the site for listing on the National Register; or (b) there are other reasons why evaluation of the site would not be the best course of action (e.g., access restrictions, concerns regarding effects on other sensitive resources). In these situations, the "conservation archaeology approach" postpones evaluation until it is necessary to address identified project effects.

these sites should be evaluated using whatever means is necessary and mitigation measures developed in consultation with the SHPO and other parties as appropriate.

Appendix B of the HPMP provides a schedule for monitoring of archaeological sites located within the project APE based on potential effects, property ownership, and whether or not the sites are already being monitored under the requirements of an HPMP developed for the Three Mile Island Project. The monitoring plan and schedule is appropriate, but excludes monitoring of two sites: 36YO300 and 36YO334. These two sites are not listed in appendix B. While they are situated on privately held lands, it is not clear if they are located on the shoreline and can be monitored by boat like other sites on private lands, or if they are interior sites that cannot be monitored. Inclusion of these two sites in the monitoring schedule, or clarification regarding why they were excluded, would ensure that they are appropriately addressed. In its comments on the draft EIS, York Haven Power stated that the exclusion of these two sites from the monitoring schedule was an error and that the HPMP would be revised to include these sites in the monitoring program.

The Captain John Smith Chesapeake National Historic Trail and the Star-Spangled Banner National Trail are located in the vicinity of the project. For this reason, inclusion in the HPMP of the Park Service as a consulting party would be appropriate.

Muddy Run Project

Exelon proposes to prepare a cultural resources management plan only if cultural materials are identified during project-related activities. However, there are several reasons why the development of an HPMP prior to that time would be beneficial.

In the Commission's November 2, 2012, Additional Information Request, we requested that Exelon provide a discussion of the current status of the three sites identified during Phase IA cultural resources studies, including archaeological site 36LA67, which is considered eligible for listing on the National Register. In its response, Exelon stated that the two AOIs (1 and 9) investigated during Phase IB studies were located within the boundaries of site 36LA67 and that no cultural materials or features were observed. However, according to figure 4-1 of the Phase IA report (Sara et al., 2011a), AOI 1 is located on the northern shoreline of Muddy Run reservoir and AOI 9 is located in the vicinity of the dam.[122] According to figure 3-12 of the report, site 36LA67 is not located in either of these two locations but is in proximity to the project transmission line. Potential effects associated with the maintenance of this line are not

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[122] The Phase IA report prepared for the Muddy Run Project (Sara et al., 2012a) does not identify any AOI where site 36LA67 is located. However, this area is also located within the APE for the Conowingo Project and is identified as AOI 13 in the Phase IA report prepared for that project (Sara et al., 2011b). AOI 13 is described as having a high potential for archaeological resources.

addressed in the application. Further, this site is situated within an area that may be affected by reservoir discharge. While Exelon clarified that site 36LA103 is currently inundated, the current condition of sites 36LA67 and 36LA368 remains unclear. Two additional sites are located outside of the project boundary (36LA70, 36LA47) but also appear to be close to the reservoir discharge area and near the transmission line. Potential project effects on these sites as a result of discharge and transmission line access and maintenance should be considered in an HPMP.

While Exelon has stated that there are no project effects on historic properties, the three sites identified in the Phase IA report have not been formally evaluated and therefore remain potentially eligible for listing on the National Register. As noted by Exelon in its application, and as discussed above, these sites and others could be affected by continued operation, maintenance, and recreational activity associated with the project. Additionally, in its application, Exelon states that "some sites" are being affected by siltation and notes that this may result in a positive effect. However, the specific sites affected by siltation are not identified, and siltation does not necessarily result in a positive effect in all situations. Only a formal assessment of effects on a case-by-case basis in consultation with the Pennsylvania SHPO would establish whether there is any effect. To our knowledge, the Pennsylvania SHPO has only concurred that no further work is needed within the two AOIs investigated during the Phase IB study and has not concurred with Exelon's recommendation that the project will not affect historic properties.

A comprehensive archaeological survey of all lands within the Muddy Run Project APE was not undertaken, and only 2 of the 12 AOIs identified during Phase IA studies were inspected during Phase IB studies. The potential for additional, previously unidentified cultural resources that may be eligible for listing on the National Register within the project APE remains. Exelon's Phase IB report recommends that additional AOIs should be surveyed during the development of a future HPMP (Sara et al., 2012a). Additionally, while the pumped storage project facility may not currently meet the general 50-year threshold for National Register eligibility, the facility will meet that threshold within 2 years. Staff agrees with Exelon's historic structures report (Henry and Jenkins, 2012a) that recommends evaluating the system for listing.

Staff agrees with Interior's recommendation that development of an HPMP would be appropriate for this undertaking because unevaluated properties that are potentially eligible for listing on the National Register and may be affected by future operation, maintenance, and project-related recreational activities, are located within the Muddy Run Project APE. Preparation of an HPMP that includes the following items would ensure that cultural resources are appropriately addressed in compliance with section 106: (1) a plan for further archaeological investigations of additional AOIs and other potentially affected areas, as recommended in the Phase IB report; (2) a detailed discussion of the three sites (36LA67, 36LA103, 36LA368) identified during the Phase IA cultural resources survey and two additional sites (36LA70, 36LA47) located outside of the project boundary that could be affected by the project; (3) requirements for

National Register evaluation of affected sites in consultation with the Pennsylvania SHPO; (4) requirements for formal National Register evaluation of the Muddy Run Project facility; (5) documentation of all consultation with the Delaware Nation and Onondaga Nation; and (6) designation of the Park Service as a consulting party. Further, the HPMP should be prepared in accordance with the Advisory Council and Commission's joint guidance document for preparing hydroelectric project HPMPs (FERC and Advisory Council, 2002).

The Delaware Nation and the Onondaga Nation have been identified as the federally recognized tribes with cultural ties to the Muddy Run Project area and should be identified in the HPMP. In accordance with section 106, the tribes should be included in all correspondence related to cultural resources; however, the application does not describe consultation with the tribes completed by Exelon to date. The HPMP should identify both tribes as consulting parties and specify when consultation with the Delaware Nation and the Onondaga Nation would be required. Both tribes should receive copies of all correspondence related to cultural resources, including copies of any annual reports related to historic properties. Copies of all consultation documentation should be included as an appendix to the HPMP.

The Captain John Smith Chesapeake National Historic Trail and the Star-Spangled Banner National Trail are located in the vicinity of the project. For this reason, including the Park Service as a consulting party in the HPMP would be appropriate.

Conowingo Project

Exelon's August 2012 HPMP includes many of the requirements of an HPMP. However, there is background information provided that is not entirely clear, and there are several measures that would benefit from clarification and/or more detail. We also suggest other measures worthy of inclusion in the HPMP.

Exelon proposes a new project boundary that excludes lands downstream from Conowingo dam. The project APE includes most of these lands because Exelon states they may be affected by project operation in the future. The inclusion of these lands in the project APE is appropriate. However, while the Maryland SHPO concluded in its July 3, 2012, letter that continued operation of the Conowingo Project would have no adverse effect on historic properties, it is our understanding that this determination is primarily considering erosion and other physical effects on cultural resources. Interior's January 31, 2014, and September 29, 2014,[123] comments, however, express concern for the potential loss of resource protection, including protections to cultural resources, should lands be removed from the project boundary. Further, in accordance with 36 CFR 800.5(a)(2)(vii) of the regulations implementing section 106 of the NHPA, the "transfer, lease, or sale of property out of Federal ownership or control without adequate and

[123] The Park Service comments are included in Interior's comment letter.

legally enforceable restrictions or conditions to ensure long-term preservation" of historic properties may constitute an adverse effect.

For this reason, all lands within the current project boundary could be affected by a change in the project boundary and must be included in the project APE. This would include a narrow strip of land located in the current project boundary that extends downstream from Spencer Island along the west side of the river to the city of Havre de Grace, Maryland. Exelon excluded this area from the APE because it did not identify any physical project effects here. The APE maps provided in the HPMP therefore do not include this area. According to the Phase IA report (Sara et al., 2011a), this strip of land contains four additional previously recorded archaeological sites (18HA240, 18HA267, 18HA268, 18HA269). None of these sites are discussed in the text of the HPMP, although site 18HA269 is listed in the HPMP's table 3-2. Inclusion of these lands in the project APE would ensure that all four of these sites, and any other previously unidentified resources that may be present in this area, remain protected under the HPMP.

While the Commission determined that the removal of the Susquehanna and Tidewater Canal Southern Terminus (HA-112) from the project boundary would have an adverse effect on this resource (letter from C. Yeakel, Division of Hydropower Compliance, FERC, Washington, D.C., to R. Little, Maryland SHPO, Maryland Historic Trust, Crownsville, Maryland, May 14, 2010), as mentioned above, on April 26, 2011, the Maryland SHPO subsequently determined that removal of lands from the project boundary would *not* adversely affect this structure. However, inclusion in the HPMP of requirements to inventory any lands within the project APE (particularly AOIs identified in the Phase IA study that were not subject to Phase IB study), evaluate any identified cultural resources for National Register eligibility, and address potential effects prior to any sale or transfer of those lands would ensure that cultural resources located on these lands would be appropriately considered in compliance with section 106. This requirement would primarily relate to lands owned in fee by Exelon, although sites on privately held lands might also be affected. If project effects of any kind on cultural resources on private lands are identified over a new license term, Exelon would make a good faith effort to obtain access to the property to conduct appropriate studies.

In sections 3.3.8.1.3 and 3.3.8.2 of its application, Exelon states that nine archaeological sites were identified in the project APE during Phase IB studies. However, while Exelon is correct there were nine sites documented during this study, (two previously recorded sites and seven newly identified sites), the total number of sites identified in the Conowingo Project APE is 48, including 37 sites that had been identified during the Phase IA study and the additional four sites downstream of Spencer Island discussed above. Further, Exelon's HPMP includes a plan to monitor only 37 of the 48 archaeological sites located within the project APE. Revision of the HPMP to include all identified 48 sites would ensure that they are appropriately addressed in accordance with section 106.

A total of 27 historic structures or historic districts were identified within the Conowingo Project APE (see table 3-38). However, table 3-1 of Exelon's Conowingo HPMP lists only seven historic structures. One of the seven structures in the table is the Lower Deer Creek Valley Historic District (HA-1551); three structures (HA-191, HA-195, HA-196) are identified in the table as being contributing elements of the district that are located within the project APE. However, according to Exelon's historic structures report (Henry and Jenkins, 2012b), six additional structures that contribute to the district (HA-376, HA-377, HA-380, HA-381, HA-382, HA-2190) are also located within the project boundary and APE and have been excluded from the HPMP. Additionally, there are 14 other structures that have been excluded. Three of these structures are listed on the National Register, one is eligible for listing, and one has been demolished. The remaining nine structures have been recommended as ineligible for listing but to our knowledge, neither the Maryland SHPO nor the Pennsylvania SHPO has concurred with these recommendations. Inclusion of all 27 structures in the HPMP or an explanation regarding why they need not be considered in the HPMP would clarify their current status and ensure that they are considered under the requirements of section 106.

Of the seven structures listed in table 3-1, the National Register eligibility of the Columbia & Port Deposit Railroad is identified as both "undetermined" and "not eligible." In its letter filed July 23, 2012, the Pennsylvania SHPO determined that this structure is indeed eligible for listing on the National Register.

Exelon's historic structures report (Henry and Jenkins, 2012b), identifies site HA-1971 as both "Conowingo Hydroelectric Facility" and "U.S. 1 over Susquehanna River (Conowingo Dam)," while the description provided in table 3-1 of the HPMP identifies it as the "Conowingo Hydroelectric Facility." The structures report explains that, in 2001, a Historic Bridge Inventory Form was prepared for the U.S. Route 1 bridge (which consists of the dam), and that the bridge was recommended as eligible for listing on the National Register under Criterion C. According to the structures report, the Maryland Historical Trust accepted the Historic Bridge Inventory on April 3, 2001, and at that time, recommended that a separate form be completed for Conowingo dam and the hydroelectric components of the structure. However, Exelon's structures report further explains that Exelon's consultant was informed by the Maryland SHPO on October 21, 2010, that a separate form and evaluation of the hydroelectric component of the facility need not be completed for the hydroelectric facility. Clear identification in the HPMP of the name of the structure provided on the form for HA-1971 and documentation of the Maryland SHPO's current position on the necessity of any new form for the Conowingo Project structures would settle the issue. Exelon's HPMP contains a list of the character-defining features of the facility, which includes the powerhouse and machinery, the bridge, and the dam. In the HPMP, Exelon stated that it would consult with the Maryland SHPO to establish a PA that would detail project activities involving the system that can be completed without Maryland SHPO review. A list of activities exempt from SHPO review is provided in the HPMP. While we are not aware of any concurrence yet received from the SHPO on this list, staff finds that the activities listed would not require specific section 106 consultation. As the Commission intends to execute a PA with the Maryland SHPO that would implement a final HPMP that includes a list of exempt activities, an additional PA between Exelon and the Maryland SHPO would not be necessary. However, should the Maryland SHPO identify additional activities not currently included on the list, the HPMP could be revised to include those activities.

Exelon's HPMP states that, should ground-disturbing activities be proposed within the APE in an area that contains an existing archaeological site or could contain an archaeological site, Exelon would consult with the appropriate SHPOs regarding potential effects of the activity. However, in areas that have not been subject to archaeological survey, the HPMP does not specify how Exelon would make the determination that archaeological sites would or would not be affected. Inclusion in the HPMP of how these determinations would be made would provide clarity.

In the HPMP, Exelon proposes to conduct a public outreach program to inform the public about culturally significant areas within the APE to discourage vandalism and looting. While such outreach programs are worthwhile, they should focus on the general sensitivity of the project as a whole and not identify the locations of specific culturally sensitive areas.

The Delaware Nation and the Onondaga Nation have been identified as the federally recognized tribes with cultural ties to the Conowingo Project area and should be identified in the HPMP. In its HPMP, Exelon states that any correspondence would be directed to the Delaware Nation, but the HPMP does not specify when consultation with the tribe would be required nor does the application or HPMP describe consultation with the tribes completed by Exelon to date. In accordance with section 106, both tribes should be included in the HPMP as consulting parties and should receive copies of all correspondence related to cultural resources, including copies of any annual reports related to historic properties. Copies of consultation documentation should be included as an appendix to the HPMP.

The Captain John Smith Chesapeake National Historic Trail and the Star-Spangled Banner National Trail are located in the vicinity of the project. For this reason, inclusion in the HPMP of the Park Service as a consulting party would be appropriate.

Programmatic Agreements

The Commission intends to execute PAs among the Commission, Maryland SHPO, Pennsylvania SHPO, and the Advisory Council (should it choose to participate). York Haven Power, Exelon, the Park Service, participating tribes, and others, as appropriate, would be invited to sign the PAs as concurring parties. Any licenses issued for the projects would include a stipulation that would implement the PA for that project. If the HPMPs are finalized prior to license issuance, the PAs would include a measure to implement the final HPMP upon license acceptance. If the HPMPs are not finalized prior to license issuance, the PAs would instead require each HPMP to be finalized within a specified period of time post license acceptance, typically 1 year. Revising and implementing the HPMPs for the York Haven and Conowingo Projects to include Commission staff's additional measures and corrections, and the development of an HPMP for the Muddy Run Project, in consultation with the Maryland SHPO, Pennsylvania SHPO, participating tribes, and the Commission, would ensure that potential adverse effects of continued operation, maintenance, recreation or other activities on cultural resources would be addressed over the term of the licenses.

Draft PAs for the York Haven, Muddy Run, and Conowingo Projects were issued on September 8, 2014. York Haven Power filed comments on the York Haven draft PA on October 9, 2014, and the Onondaga Nation filed comments on the draft PAs for the Muddy Run and Conowingo Projects on October 17, 2014.

In its comments on the York Haven Project draft PA, York Haven Power questioned the necessity of including the Onondaga Nation as a consulting party for the project because the tribe has not previously expressed concerns or interest in the project. Further review of the record verifies this statement.

In its October 17, 2014, letter, the Onondaga Nation stated that the PAs for the Muddy Run and Conowingo Projects should be amended to provide the Native American Nation signatories similar power to terminate the PA upon consultation with other signatories. Pursuant to 36 CFR §§800.14(b)(3) and 800.6(c)(1), however, the only required signatories on a complex undertaking PA, such as the PAs for the Muddy Run and Conowingo Projects, are the agency that is triggering the relevant undertaking (in this case FERC, through its issuance of a new license), the relevant SHPO, and the Advisory Council if it is participating in the consultation. Furthermore, where historic properties may be affected, the Commission cannot issue licenses without executed PAs, and inviting other signatories would complicate our ability to execute PAs and issue licenses in a timely manner. Not being a signatory to the PA, however, does not limit the Onondaga Nation's, or any other concurring parties' ability to participate in consultations related to the Muddy Run or Conowingo project HPMPs.

3.3.7 Aesthetic Resources

3.3.7.1 Affected Environment

The Susquehanna River from Harrisburg to its confluence with the upper Chesapeake Bay passes through diverse natural and human built environments. The river corridor provides a wide range of geologic features, habitats, and human development such as hydropower plants and industrial yards dating back to the early 1900s. The river has a variety of unique geologic features including river potholes, exposed bedrock, steep cliffs, and wide deep pools. River banks and shorelines are generally covered in deciduous forest with residential lots, recreation access, and transportation infrastructure visible throughout. The river provides water to four hydroelectric facilities, one pumped storage project, two nuclear power plants, and one steam-electric station. Lands surrounding the river are rural with majority in agricultural uses. Higher elevations provide opportunities for sweeping views across the rolling topography and river valley and are dominated by the rural setting through which the river transverses.

At the York Haven Project, aesthetic features of Lake Frederic include views of surrounding shorelines, islands, and project features. Human development includes shoreline development (residential lots, recreation access, and commercial marinas), open space, and larger industrial features such as Three Mile Island nuclear generating station and Brunner Island Station, a coal-fired steam electric generating plant located about 1.5 miles downstream of York Haven.

Project features are only visible in proximity to the main dam, powerhouse, and east channel dam and fishway. The red brick powerhouse is characteristic of industrial structures built in the early 1900s while most of the other structures are of grey concrete. The islands within the impoundment consist of mixed uses including industrial (Three Mile Island generating station), cultivated crops, recreational lots, and developed recreation sites. The remainder of the York Haven Project area visual landscape includes rural community residential and commercial development, regional infrastructure (e.g., railroad), and deciduous forests.

Aesthetic features surrounding the Muddy Run Project are dominated by rolling hills covered with deciduous forest, agricultural uses, and recreation uses associated with Muddy Run Park and WMA and adjacent to the powerhouse. Views within the Recreation Lake and Muddy Run Park areas consist of manicured park settings with maintained lawns, mature trees, and public recreation infrastructure like buildings, picnic shelters, sports areas, a boat ramp, campgrounds, and other amenities described in detail in section 3.3.5, *Recreation and Land Use Resources*. The visual setting within the WMA is natural with the majority of the area in forested setting with small tracts of land cleared for parking areas or feed plots. Large portions of the project around the upper reservoir near the intake towers are not visible to the public because of limited access. The powerhouse is visible from Conowingo Pond and is set against the steep topography between the Muddy Run powerhouse along the Conowingo Pond shoreline and the upper reservoir. The powerhouse exhibits large industrial-type features dominated by grey concrete, the riprapped shoreline, overhead crane, transformer, substation, transmission lines, and parking areas. Portions of the upper reservoir dam are also visible from Conowingo Pond.

U.S. Route 1 crosses the top of Conowingo dam providing views of the reservoir and river downstream to passing motorists. Project structures of this area include the powerhouse, Conowingo dam, and the spillway. These facilities dominate the views from Fisherman’s Park/Shures Landing immediately below the powerhouse. Within Conowingo Pond, views include islands, residential lots, recreational access, and industrial features such as the Muddy Run Project facilities and PBAPS located on the west shoreline near the midpoint of the reservoir. Lands adjacent to the project boundary offer diverse aesthetic qualities because of the rolling topography, vegetation, agricultural uses, and general open space.

3.3.7.2 Environmental Effects

For all three projects, existing project facilities and operations are generally consistent with the existing visual aesthetics of the area. Some facilities are visible on the landscape and contrast with the surrounding setting, but have not been shown to detract substantially from the natural character of the area. York Haven Power and Exelon do not propose any specific measures for aesthetic resources. However, proposed environmental measures, such as construction of the nature-like fishway, operation of the Muddy Run Project, and debris removal from Conowingo Pond, may affect visual aesthetics over the term of any new licenses for the projects.

Effects of Construction of the Nature-Like Fishway

York Haven Power proposes to construct a nature-like fishway near the eastern end of the main dam and Three Mile Island. The fishway would consist of a series of rock weirs allowing fish passage over the main dam. Construction would include: improving existing access roads on Three Mile Island; a temporary, two-lane access road for retrieval and transport of river rock across the river bed below the dam; three staging areas on Three Mile Island; a cofferdam; a rock ramp fishway; an attraction water system; and concrete abutment walls. The new feature would extend from the toe of the dam into the existing reservoir, which at the apex of the main dam and Three Mile Island is about 10 feet high. The proposed fishway would be about 300 feet wide and about 500 feet long. York Haven Power expects the rock retrieval period of the project to last 3 years and final construction to be finished 8 years after any license is issued.

Our Analysis

Nature-like fishways are designed to simulate the geomorphology, hydraulics, and functions of natural river channels. Construction of the nature-like fishway would require the installation of a temporary cofferdam to isolate the construction of the rock ramp and other structures (e.g., intake gates and attraction water system). Large excavators would shuttle between extracting exposed river rock and transporting the rocks to the fishway weirs for about 3 years. The use of native river rocks would give the new structure a more naturally appearing aesthetic than traditional geometric fish ladders. The east edge of the fishway would terminate in a combination of a poured concrete abutment and conveyance system designed to control flows in the rock weirs and provide attraction flows to the base of the fishway, respectively. The finished fishway would be most visible to kayakers and other recreation users in the main channel downstream from the dam, in proximity to Three Mile Island. Between April and June when water is directed into the fishway for operations, the fishway would be covered in water as it flows through the artificial pool-riffle weirs. During times of the year when flows are not sufficient to spill and fill the fishway naturally, the rock ramp weirs would be dry with some pools of water.

Effects of Operation of the Muddy Run Pumped Storage Project

During project scoping, commenters raised concerns about the effects of lighting and project-associated noise on visitors to the area. Specifically, commenters raised concerns about the lighting and noise associated with the operations (generation and pumping) at Muddy Run; however, no specific locations or receptors were identified. Lights are installed on the intake towers in the upper reservoir and throughout the powerhouse area and access road along the shore with Conowingo reservoir.

Exelon does not propose, nor does any other entity recommend specific measures that pertain to managing light and noise specifically related to the project.

Our Analysis

Several formal recreation facilities are located within or in proximity to the Muddy Run Project boundary, including Wissler's Run Park, Muddy Creek Boat Launch, the Lock 15 Interpretive Area, Susquehannock State Park, Cold Cabin Boat Launch, Muddy Run WMA, and Muddy Run Recreation Park (see section 3.3.5, *Recreation and Land Use Resources*). Additionally, several islands are located in the Susquehanna River near the Muddy Run Project. Although there are no formal recreation facilities on these islands, they provide opportunity for passive daytime recreation, and some contain lots that are currently leased by cottage owners. Nighttime use of the islands is restricted to cottage owners.

Exelon recorded noise levels and took representative photos of day- and night-time conditions from 10 representative locations in relative proximity to project features. Figure 3-21 shows the locations of these public areas.

Typical operation of the Muddy Run Project consists of pumping water from Conowingo Pond to the Muddy Run reservoir during low-load (typically nighttime) periods when energy costs are low, then generating (releasing water from the Muddy Run reservoir back to Conowingo Pond) during high load (typically daytime) periods.

Exelon's aesthetic study results indicate that the level of impact (intensity of light or noise) is related to proximity to the powerhouse and that some sites are affected more than others. The Muddy Run powerhouse is clearly visible during both day and night from islands directly across from the powerhouse (Turkey Island, Lower Bear Island, and Big Chestnut Island), as well as from Wissler's Run Park. At the Muddy Creek Boat Launch, Lock 15 Interpretive Area, and Susquehannock State Park (public recreation areas in relative proximity to the powerhouse), the powerhouse usually cannot be clearly seen during the day, but the glow of its lights is visible at night. Other facilities, such as the transmission line towers on Lower Bear Island (day) and the intake towers lights (night), are generally visible at these sites.

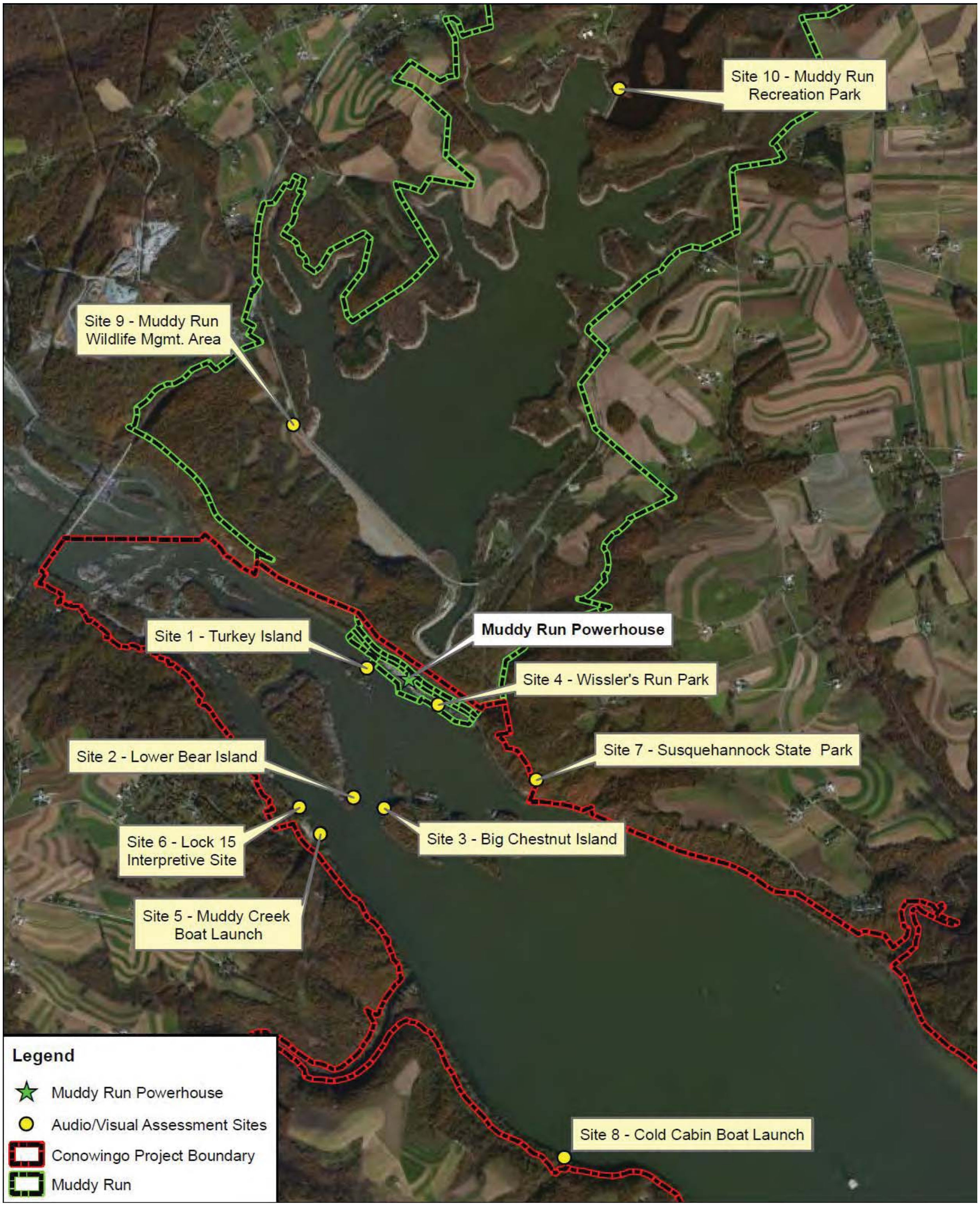

Figure 3-21. Aesthetic (audio and visual) assessment locations for the Muddy Run Project (Source: Exelon, 2012a, as modified by staff).

At Cold Cabin Boat Launch, no facilities can be seen during the day, and only the intake tower lights can be seen at night. At Muddy Run WMA, only the dam and reservoir can be seen during the day, and a faint glow from the powerhouse and/or intake towers can sometimes be seen at night. Lastly, at Muddy Run Recreation Park, only the power reservoir can be seen during the day; no lights can be seen at night.

Project lighting at nighttime is highest at select locations (i.e., Conowingo Islands); however, the Conowingo Islands have restrictions against public use at night. The amount of lighting visible from the surrounding locations changes with the seasons as leaf off conditions allow better sight lines to see the project's night lighting.

Noise has the potential to disturb visitors to the Muddy Run Project and vicinity, as well as to some of the Conowingo Project formal recreation sites. Noise-producing equipment at the projects includes pump-generators, ventilation fans, transformers, fans on the transformers, and powerlines. Exelon measured the ambient acoustic environment (the all-encompassing sound in a given environment) at the 10 locations. The soundscape at each location is influenced by motorboat, vehicular, and air traffic; construction activities; human activities; and other natural sound sources. To capture ambient sound levels, Exelon recorded 5 seconds of ambient noises every 5 minutes and averaged these for the duration (deleting loud, temporary sounds like a passing truck or overhead airplane) of the recording.

Exelon's results show that average ambient noises ranged from 34 to 61 decibels (dB) across all sites and seasons.[124] Not every site was dominated by sounds from the powerhouse; at some sites the project was audible and at other, more distant locations, the project was not audible at all. Table 3-39 summarizes average noise levels at each site by season for day and night. Comparing measurements with table 3-40 suggests that, at locations dominated by powerhouse sounds, noise levels are comparable to quiet urban settings.

Table 3-39. Audio assessment results (dB) for the Muddy Run Project (Source: Exelon, 2012a, as modified by staff).

Site Name	Spring		Summer		Fall		Winter	
	Day	Night	Day	Night	Day	Night	Day	Night
Turkey Island	48	52	50	56	54	57	52	57
Lower Bear Island	44	44	43	53	50	52	46	52
Big Chestnut Island	40	39	43	50	42	46	42	52

[124] Logarithmic scale known as the decibel scale (dB) used to quantify sound pressure into a manageable range.

Site Name	Spring		Summer		Fall		Winter	
	Day	Night	Day	Night	Day	Night	Day	Night
Wissler's Run Park	40	41	44	48	41	45	48	50
Muddy Creek Boat Launch	39	39	41	55	49	54	41	47
Lock 15 Interpretive Area	41	38	49	61	47	55	42	44
Susquehannock State Park	46	37	46	57	44	58	40	49
Cold Cabin Boat Launch	38	37	46	53	46	51	42	54
Muddy Run WMA	37	34	45	59	46	54	42	43
Muddy Run Park	41	36	45	52	42	50	43	43

Key: Red=powerhouse noise dominant; Yellow=powerhouse noise audible but not dominant; Green=powerhouse noise not audible.

Table 3-40. Loudness comparison chart (Source: Exelon, 2012a).

Common Outdoor Sounds	Noise Level (dB)
Threshold of human hearing	0
Quiet rural nighttime	20
Quiet suburban nighttime	30
Quiet urban nighttime	40
Quiet urban daytime	50
Heavy traffic at 300 feet	60
Lawn mower at 100 feet	70
Boat (single outboard) at 50 feet	80
Threshold of hearing damage due to prolonged exposure	85
Jet fly-over at 1,000 feet	110

Exelon's aesthetic assessments indicate that the current levels of light are relative to the proximity of the viewer to the light source and clearly visible from the islands and Wissler's Run park; however, nighttime use of the islands is prohibited. Public recreation sites on the west side of the river across from Muddy Run do not have clear sight lines but can see the glow of the lights on the powerhouse at night. The same assessment for noise indicates that noise at sites where powerhouse sounds are audible, but not the dominant sound, measure as much noise as the sites close to the powerhouse. This indicates that there are sufficient background noises other than the powerhouse that contribute to the overall noise levels in the project vicinity.

Effects of Debris Removal from the Conowingo Project

As discussed in section 3.3.5, *Recreation and Land Use Resources*, some of the natural and human-generated debris moving through the Susquehanna River watershed gets trapped behind the hydroelectric facilities on the mainstem of the lower Susquehanna River. Most debris is transported during high-flow events, particularly during March and April. Exelon has participated in clean-up efforts and debris studies dating back to 1982, and these studies reported that 75 percent of the total estimated volume of debris was discharged during high-flow events (January through May). A 1989 cooperative agreement by the operators of York Haven, Safe Harbor, Holtwood, Conowingo, SRBC, and regulatory agencies led to routine debris removal actions during normal to low flows. As such, Exelon routinely employs cranes and skimmers to reduce the amount of debris buildup behind Conowingo dam during low-flow periods.

Visitor perceptions and attitudes towards the debris were not recorded during relicensing studies. Within Conowingo Pond, debris typically accumulates near the dam intakes, within tributaries, and under or behind the railroad trestle bridges. Debris trapped in the reservoir makes its way to the dam where it is corralled and removed. The majority of the debris is natural; however, artificial (man-made) debris is intermixed with the large woody and natural debris degrading the visual appearance of the accumulated materials. The large accumulation of debris near the powerhouse intakes is visible for short durations from traffic on U.S. Route 1 (most notably for vehicles moving east to west) and boaters near the dam. Most of the other areas of debris accumulation are only visible from the water.

Our Analysis

Exelon's proposal to continue to remove debris from in front of the intakes is consistent with the cooperative agreement with the upstream hydroelectric projects and agencies. The amount of debris arriving at Conowingo Pond on an annual basis is a function of the flood flows during the winter months. The Susquehanna watershed is flood-prone, so passing and removing debris is a dynamic process causing Exelon to react to what arrives. Visually, the amount of debris on the pond, in tributaries, and collected in front of the intakes varies from year to year. Although debris removal coincides with the warmer, recreation season when more visitors are able to see Exelon actively removing the debris, those activities are concentrated in the area near the dam.

3.3.8 Socioeconomics

3.3.8.1 Affected Environment

For this socioeconomics discussion, the local area is defined as the area encompassing and immediately surrounding the project areas along the Susquehanna River. This includes residential and commercial developments, in addition to recreational and park lands, along the river shorelines. Socioeconomic information is also provided for the study area, which is the five-county region surrounding the projects.

The York Haven Project is located in York, Lancaster, and Dauphin Counties, Pennsylvania, with a total of eight townships and/or boroughs within the project area. The Muddy Run Project is located in Lancaster County, and Peach Bottom Township is the only census-designated place (CDP) within this project boundary. The Conowingo Project area includes Lancaster and York Counties in Pennsylvania and Harford and Cecil Counties in Maryland.

Population

The state of Maryland experienced a 9 percent population increase between 2000 and 2010, ranking 23rd in the United States for growth rate, and Pennsylvania experienced a 3 percent population increase between 2000 and 2010, ranking 42nd in the United States for rate of population growth (Census Scope, 2010a). Tables 3-41 and 3-42 summarize population trends for both states and all five counties.

Table 3-41. Population in Cecil and Harford Counties, Maryland, and the state of Maryland (Source: Census Scope, 2010a & b).

Year	Maryland	Cecil	Harford
2010	5,773,552	101,108	244,826
2000	5,296,486	85,951	218,590
1990	4,781,468	71,347	182,132
1980	4,216,975	60,430	145,930
1970	3,922,399	53,291	115,378
1960	3,100,689	48,408	76,722

Table 3-42. Population in Dauphin, Lancaster, and York Counties, Pennsylvania, and the state of Pennsylvania (Source: Census Scope, 2010a & b).

Year	Pennsylvania	Dauphin	Lancaster	York
2010	12,702,379	268,100	519,445	434,972
2000	12,281,054	251,798	470,658	381,751
1990	11,881,643	237,813	422,822	339,574
1980	11,863,895	232,317	362,346	312,963
1970	11,793,909	223,834	319,693	272,603
1960	11,319,366	220,255	278,359	238,336

Within York County, the York Haven Project is partially located within York Haven Borough (population 709), Goldsboro Borough (population 952), and Newberry Township (population 15,285). Within Dauphin County, the project is partially located in Londonderry Township (population 5,232), Lower Swatara Township (population 8,268), Middletown (population 8,901), and Royalton Borough (population 907). The project is also partially located within Conoy Township (population 3,194) in Lancaster County (U.S. Census Bureau, 2010a).

The Muddy Run Project is located entirely within Lancaster County and partially within Peach Bottom Township (population 4,813) (United States Census Bureau, 2010a). The project is not located within any other CDPs or communities in Lancaster County.

The Conowingo Project boundary contains no CDPs or communities, but includes two incorporated municipalities in Harford County: Aberdeen and Havre de Grace. The City of Havre de Grace has a population of 12,952, and the City of Aberdeen has a population of 14,959. The project boundary includes lands within Cecil County, but no CDPs or communities.

Employment and Income

Employment

Employment in Dauphin, Lancaster, and York Counties represented 2, 4, and 4 percent of total employment in the state of Pennsylvania in 2012, respectively; Cecil and Harford Counties represented 2 and 4 percent of total employment in the state of Maryland in 2012, respectively (BLS, 2013). Unemployment rates in Dauphin, Lancaster, and York Counties were lower than in the state of Pennsylvania as a whole; while unemployment rates were higher in Cecil and Harford Counties than in the state of Maryland as a whole in 2012. Of the five counties in the study area, Lancaster County had the lowest unemployment rate in 2012, while Cecil County had the highest unemployment rate (BLS, 2013). Employment levels along with unemployment rates are presented in table 3-43.

Table 3-43. Employment and unemployment percent numbers 2012 (Source: BLS, 2013).

Geography	Total Employment	Unemployment Rate (%)
United States	142,469,000	8.1
Maryland	2,909,571	6.8
Cecil County	46,810	8.4
Harford County	129,802	7.0
Pennsylvania	5,973,407	7.9
Dauphin County	128,581	7.7
Lancaster County	250,980	6.6
York County	211,027	7.7

Dauphin County is less rural than the other counties in the study area with the city of Harrisburg, the capital of Pennsylvania, located on the east side of the Susquehanna River within the county. According to the 2012 Census, the *primary* industries in Dauphin County are education (23 percent of total employment); retail trade (11 percent of total employment); and professional, scientific, management, administrative and waste management services and public administration (10 percent of total employment) (U.S. Census Bureau, 2012).

Lancaster, York, Cecil, and Harford Counties are largely rural in nature and dominated by agricultural land uses. However, employment in agriculture represents between less than 1 and 3 percent of total employment in these counties. The two industrial sectors with the largest employment in these counties are educational services and healthcare, and manufacturing sectors. The educational services and healthcare sector accounted for 23 percent of total employment in both Lancaster and York Counties and 22 percent in both Harford and Cecil Counties in 2012 (U.S. Census Bureau, 2010b) (EDC, 2012). Employment in manufacturing accounted for 16 and 18 percent of total employment in Lancaster and York Counties, respectively, and 11 and 7 percent of total employment in Cecil and Harford Counties, respectively, in 2012. Employment in retail trade accounted for between 10 and 14 percent of total employment in these counties in 2012 (U.S. Census Bureau, 2010b).

Income

Per capita income in the Pennsylvania counties is lower than per capita income in the Maryland counties within the study area. Lancaster County is lower than the

Pennsylvania average, while York and Dauphin County have similar per capita incomes to that of Pennsylvania. Dauphin and Lancaster Counties have experienced negative growth in per capita income between 2000 and 2010; York County has experienced no growth; and the state of Pennsylvania has only experienced a slight increase in per capita income during this period. Cecil and Harford Counties have slightly lower per capita income than that of Maryland, although all per capita income in the geographies has grown in Maryland (U.S. Census Bureau, 2010b). Table 3-44 shows per capita income for the study area and the states of Maryland and Pennsylvania.

Table 3-44. Per capita income for Pennsylvania and Maryland Counties in 2000 and 2010, with percent change (inflation adjusted, 2010$) (Source: U.S. Census Bureau, 2010b).

Geography	2000	2010	Percent Change
Maryland	$32,435	$34,469	6%
Cecil County	$27,079	$28,358	5%
Harford County	$30,685	$33,372	9%
Pennsylvania	$26,440	$27,004	2%
Dauphin County	$28,028	$27,052	-3%
Lancaster County	$25,830	$24,871	-4%
York County	$26,678	$26,702	0%

Project Power

All three projects offer benefits to the region in terms of providing low-cost energy; local, county, and state tax payments; employment and economic activity related to operation and maintenance of the project facilities; and public use facilities owned and operated by others that are located within the project areas. The York Haven Project has an installed capacity of 19.62 MW while the Muddy Run and Conowingo Projects have installed capacities of 800.25 and 574.54 MW, respectively. This amount of capacity at York Haven is capable of providing the equivalent of approximately 14,700 households with electricity each year; while the capacity at Muddy Run and Conowingo can provide the equivalent of approximately 600,000 and 430,000 households with electricity each year, respectively, assuming 1 MW of power services an average of 750 households per year (York Haven Power, 2012a; Exelon, 2012b).

Project Taxes

York Haven Power and Exelon are subject to a variety of state income and local property taxes. In 2010, these taxes totaled $143,615 for York Haven Power. In 2011, Exelon paid $5 million and $10.5 million in state income and local property taxes on the

Muddy Run and Conowingo Projects, respectively. Taxes paid by these two companies positively affect the public because state taxes are deposited into general funds, which are directed, in part, back to the county and city governments (York Haven Power, 2012; Exelon, 2012).

Project Employment

The York Haven Project is operated and maintained by 22 full-time employees, and the Muddy Run and Conowingo Projects are each operated by 56 employees. These employees positively affect the local and regional economy by consuming goods and services and paying taxes (York Haven Power, 2012; Exelon, 2012).

Project Recreation

As described in section 3.3.5, *Recreation and Land Use Resources*, recreation resources in the region provide a full range of activities, including boating, canoeing, swimming, fishing, water sports, hiking, camping, hunting, biking, and nature viewing. Recreation visitors spend money on activities and at business establishments during their stay in the region, supporting local and regional economies. This visitor spending supports local jobs and income, which, in turn, induces additional economic activity within the local economy, providing additional employment, income, and tax revenues to local governments.

Additionally, York Haven Power leases 288 recreational lots to the public for a small fee, while Exelon leases 420 lots for seasonal residential cottage use (as described in section 3.3.5, *Recreation and Land Use Resources*). Residents of these lots provide a positive benefit to the local economy through local spending that supports local jobs and income, which, in turn, induces additional economic activity within the local economy, providing additional employment, income, and tax revenues to local governments. These leaseholders also provide a small income to York Haven Power and Exelon through their fee payments.

3.3.8.2 Environmental Effects

York Haven Project

Current project operation has provided significant socioeconomic benefit to the area. The continued operation of the project, which includes the proposed construction of a new fish ladder, would have a positive effect on local and regional socioeconomic conditions by providing both direct and indirect jobs and significantly contributing to state, county, and local tax revenues. There are no plans for changing the operation of the facility that would significantly reduce these benefits, and there are no proposed environmental measures that would have a significant negative socioeconomic effect per the application provided by York Haven Power.

Our Analysis

Continued operation of the project, as well as project spending related to construction of the new fish ladder and other ongoing maintenance, would have a positive effect on the regional economy. Positive effects would be realized through support of companies providing materials and services for the project, the presence of the project workforce and associated consumer spending, and project tax contributions to state and local governments. As discussed in section 3.3.5, *Recreation and Land Use Resources*, it is York Haven Power's current policy not to create any new cottage lease lots within the project boundary and that any leases for existing cottages that are abandoned or become damaged and are not replaced by structures conforming to all applicable regulations will be terminated. Termination of lot leases would likely cause a decrease in spending in the local economy, along with a decrease in local income and property taxes, and result in negative impacts on the local economy. However, these permit terminations are expected to occur over a number of decades, resulting in minimal long-term impacts on the local economy. The proposed, continued operation of the York Haven Project would have no unavoidable adverse effect on socioeconomic resources.

Muddy Run and Conowingo Projects

Current operations have provided significant socioeconomic benefit to the area. The continued operation of these projects would have a positive effect on local and regional socioeconomic conditions by providing both direct and indirect jobs and significantly contributing to state, county, and local tax revenues. There are no plans for changing the operation of the facilities at these projects that would reduce these benefits. Therefore, there are no proposed environmental measures that would impact socioeconomics per the application provided by Exelon.

Our Analysis

Changes to Muddy Run and Conowingo project operations are not proposed, so no changes to socioeconomic conditions are expected. Project operations would continue to supply low cost electricity. Continued operation of the projects would have a positive effect on the regional economy through support of companies providing materials and services for the projects, the presence of the project workforces and associated consumer spending, and project tax contributions to state and local governments. Continued maintenance of the projects' facilities, including recreation facilities, would result in some construction-related jobs, although the labor force required is likely to be small and temporary. Continued operation of the Muddy Run and Conowingo Projects would have no known unavoidable adverse effects on socioeconomic resources.

Exelon's current policy of not creating any new leases on cottages within the Conowingo Project boundary, as discussed in section 3.3.5, *Recreation and Land Use Resources*, would continue. In addition, as existing cottages are abandoned or become damaged and are not replaced due to local zoning restrictions, leases would be terminated. Termination of lot leases would likely result in a decrease in spending in the local economy along with a decrease in local income and property taxes, resulting in negative impacts on the local economy. However, removal of leased cottages from Conowingo's land is expected to occur over many decades and would not result in significant adverse effects on socioeconomic resources.

3.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, the projects would continue to operate as they have in the past. None of York Haven Power's or Exelon's proposed measures or the resource agencies' recommendations and mandatory conditions would be required.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the York Haven, Muddy Run, and Conowingo Projects' use of the Susquehanna River for hydropower purposes to see what effect various environmental measures would have on the projects' costs and power generation. Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corp.*,[125] the Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of alternative power). In keeping with Commission policy as described in *Mead Corp.*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the cost of individual measures considered in the EIS for the protection, mitigation, and enhancement of environmental resources affected by the projects; (2) the cost of alternative power; (3) the total project cost (i.e., for construction, operation, maintenance, and environmental measures); and (4) the difference between the cost of alternative power and total project cost. If the difference between the cost of alternative power and total project cost is positive, the project produces power for less than the cost of alternative power. If the difference between the cost of alternative power and total project cost is negative, the project produces power for more than the cost of alternative power. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

4.1 POWER AND DEVELOPMENTAL BENEFITS OF THE PROJECTS

Table 4-1 summarizes the assumptions and economic information we use in our analysis for the York Haven Project, based on information provided by York Haven Power in its license application and subsequent submittals. Tables 4-2 and 4-3 summarize the assumptions and economic information we use in our analysis for the Muddy Run and Conowingo Projects, respectively, based on information provided by Exelon in its license application and subsequent submittals. We find that the values provided by the applicants are reasonable for the purposes of our analysis. For each project, cost items common to all alternatives include: taxes and insurance costs;

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[125] See *Mead Corporation, Publishing Paper Division*, 72 FERC ¶ 61,027 (July 13, 1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

estimated capital investment required to develop the project; licensing costs; normal operation and maintenance cost; and Commission fees.

Table 4-1. Parameters for economic analysis of the York Haven Project (Sources: York Haven Power and staff).

Parameter	**Value**[a]
Period of analysis (years)	30
Term of financing (years)	20
Federal income tax rate, (%)	35.00
Local tax rate, (%)	3.00
Insurance rate	Included in the operation and maintenance cost
Energy value, $/MWh	39.75
Capacity value, ($/kW-year)	45.53
Interest rate[b]	8.00
Discount rate[c]	8.00
Net investment	$900,000 (2011)
Licensing cost,[d] $	$3,000,000 (2011)
Operation and maintenance, $/year	$4,822,547 (2011)
Commission fees, $/year[e]	$54,129

[a] Values provided by York Haven Power in the license application, unless otherwise noted.

[b] Interest rate assumed by staff.

[c] Assumed by staff to be same as interest rate.

[d] Excludes protection, mitigation, and enhancement measures.

[e] Commission fees are the estimated value for 2013 from the FERC website.

Table 4-2. Parameters for economic analysis of the Muddy Run Project (Sources: Exelon and staff).

Parameter	Value[a]
Period of analysis (years)	30
Term of financing (years)	20
Federal income tax rate, (%)	34.9
Local tax rate, (%)	3.00
Insurance rate	Included in the operation and maintenance cost
Energy value,[b] $/MWh	51.34
Pumping energy,[b] $/MWh	27.76
Capacity value[b] ($/kW-year)	73.53
Ancillary services value,[b] $/year	$8,602,000
Interest rate[c]	8.00
Discount rate[d]	8.00
Net investment, $	$140,505,000 (2011)
Licensing cost, $[e]	$7,026,000 (2011)
Operation and maintenance, $/year	$6,857,000 (2011)
Commission fees, $/year[f]	$1,201,106

[a] Values provided by Exelon in the license application unless otherwise noted.

[b] Values from Exelon, filed with the Commission on March 24, 2014.

[c] Interest rate assumed by staff.

[d] Assumed by staff to be same as interest rate.

[e] Excludes protection, mitigation, and enhancement measures.

[f] Commission fees are the estimated value for 2013 from the FERC website.

Table 4-3. Parameters for economic analysis of the Conowingo Project (Sources: Exelon and staff).

Parameter	Value[a]
Period of analysis (years)	30
Term of financing (years)	20
Federal income tax rate, (%)	34.9
Local tax rate, (%)	3.00
Insurance rate	Included in the operation and maintenance cost
Energy value[b], $/MWh	40.55
Capacity value[b], ($/kW-year)	73.53
Ancillary services value[b], $/year	$405,000
Interest rate[c]	8.00
Discount rate[d]	8.00
Licensing cost, $[e]	$14,989,000 (2011)
Operation and maintenance, $/year	$15,985,000 (2011)
Annual capital cost, $/year	$15,974,000 (2011)
Commission fees, $/year[f]	$1,209,228

[a] Values provided by Exelon in its license application unless otherwise noted.

[b] Values from Exelon, filed with the Commission on March 24, 2014.

[c] Interest rate assumed by staff.

[d] Assumed by staff to be same as interest rate.

[e] Excludes protection, mitigation, and enhancement measures.

[f] Commission fees are the estimated value for 2013 from the FERC website.

4.2 COMPARISON OF ALTERNATIVES

Tables 4-4, 4-5, and 4-6 summarize, for the York Haven, Muddy Run, and Conowingo Projects, respectively, the installed capacity, annual generation, cost of alternative power, estimated total project cost, and difference between the cost of alternative power and total project cost for each of the alternatives considered in this EIS: no-action, the applicant's proposal, the staff alternative, and for York Haven and Muddy Run only, the staff alternative with mandatory conditions.

Table 4-4. Summary of the annual cost of alternative power and annual project cost for four alternatives for the York Haven Project (Source: staff).

	No Action	York Haven Power's Proposal	Staff Alternative	Staff Alternative with Mandatory Conditions
Installed capacity (MW)	19.62	19.62	19.62	19.62
Annual generation (MWh)	132,271	131,771	131,771	131,771
Dependable Capacity (MW)	17.57	17.57	17.57	17.57
Annual cost of alternative power ($/MWh)	$6,058,010 45.80	$6,037,750 45.82	$6,037,750 45.82	$6,037,750 45.82
Annual project cost ($/MWh)	$5,777,920 43.68	$6,374,440 48.38	$6,370,400 48.34	$6,386,650 48.47
Difference between the cost of alternative power and project cost ($/MWh)	$280,090 2.12	($336,690) (2.56)	($332,650) (2.52)	($348,900) (2.65)

Table 4-5. Summary of the annual cost of alternative power and annual project cost for four alternatives for the Muddy Run Project (Source: staff).

	No Action	Exelon's Proposal	Staff Alternative	Staff Alternative with Mandatory Conditions
Installed capacity (MW)	800.25	800.25	800.25	800.25
Annual generation (MWh)[a]	1,615,813	1,615,813	1,614,882	1,614,882
Annual pumping (MWh)[a]	2,096,726	2,096,726	2,095,633	2,095,633
Dependable Capacity (MW)	1,070	1,070	1,070	1,070

	No Action	Exelon's Proposal	Staff Alternative	Staff Alternative with Mandatory Conditions
Annual cost of alternative power ($/MWh)	$169,563,420 104.94	$169,563,420 104.94	$169,498,010 104.96	$169,498,010 104.96
Annual project cost ($/MWh)	$118,797,090 73.52	$119,329,530 73.85	$119,000,190 73.69	$119,325,730 73.89
Difference between the cost of alternative power and project cost ($/MWh)	$50,766,330 31.42	$50,233,890 31.09	$50,497,820 31.27	$50,172,280 31.07

[a] The incremental difference between the annual generation and pumping energy for the staff alternative versus the no-action alternative and Exelon's proposal was computed from the most recent OASIS model run results filed with the Commission by Exelon on September 29, 2014.

Table 4-6. Summary of the annual cost of alternative power and annual project cost for three alternatives for the Conowingo Project (Source: staff).

	No Action	Exelon's Proposal	Staff Alternative
Installed capacity (MW)	574.54	574.54	574.54
Annual generation (MWh)[a]	1,823,193	1,823,193	1,820,743
Dependable Capacity (MW)	566.14	566.14	566.14
Annual cost of alternative power ($/MWh)	$115,955,070 63.60	$115,955,070 63.60	$115,853,880 63.63
Annual project cost ($/MWh)	$81,232,410 44.56	$83,481,890 45.79	$84,625,070 46.48
Difference between the cost of alternative power and project cost ($/MWh)	$34,722,660 19.04	$32,473,180 17.81	$31,228,810 17.15

[a] The incremental difference between the annual generation for the staff alternative versus the no-action alternative and Exelon's proposal was computed from the most recent OASIS model run results filed with the Commission by Exelon on September 29, 2014.

4.2.1 No-Action Alternative

Under the no-action alternative, the York Haven, Muddy Run, and Conowingo Projects would continue as currently constructed and operated.

The York Haven Project would have a total capacity of 19.62 MW, a dependable capacity of 17.57 MW, and an average annual generation of 132,271 MWh. The average annual cost of alternative power would be $6,058,010, or $45.80/MWh. In total, the average annual project cost would be $5,777,920, or $43.68/MWh. Overall, the project would produce power at a cost that is $280,090, or $2.12/MWh, less than the cost of alternative power.

The Muddy Run Project would have a total capacity of 800.25 MW, a dependable capacity of 1,070 MW, an average annual generation of 1,615,813 MWh, and pumping energy requirements of 2,096,726 MWh. The average annual cost of alternative power would be $169,563,420, or $104.94/MWh. In total, the average annual project cost would be $118,797,090, or $73.52/MWh. Overall, the project would produce power at a cost that is $50,766,330, or $31.42/MWh, less than the cost of alternative power.

The Conowingo Project would have a total capacity of 574.54 MW, a dependable capacity of 566.14 MW, and an average annual generation of 1,823,193 MWh. The average annual cost of alternative power would be $115,955,070, or $63.60/MWh. In total, the average annual project cost would be $81,232,410, or $44.56/MWh. Overall, the project would produce power at a cost that is $34,722,660, or $19.04/MWh, less than the cost of alternative power.

4.2.2 Applicants' Proposals

Under the applicants' proposal, the existing projects would be modified or enhanced as described by the applicants, and would include environmental measures to protect and enhance project resources. The individual costs of these changes are presented in tables 4-7, 4-8, and 4-9.

Under York Haven Power's proposal, the York Haven Project would have a total capacity of 19.62 MW, a dependable capacity of 17.57 MW, and an average annual generation of 131,771 MWh. The average annual cost of alternative power would be $6,037,750, or $45.82/MWh. In total, the average annual project cost would be $6,374,440, or $48.38/MWh. Overall, the project would produce power at a cost that is $336,690, or $2.56/MWh, more than the cost of alternative power.

Under Exelon's proposal, the Muddy Run Project would have a total capacity of 800.25 MW, a dependable capacity of 1,070 MW, an average annual generation of 1,615,813 MWh, and pumping energy requirements of 2,096,726 MWh. The average annual cost of alternative power would be $169,563,420, or $104.94/MWh. In total, the average annual project cost would be $119,329,530, or $73.85/MWh. Overall, the project would produce power at a cost that is $50,233,890, or $31.09/MWh, less than the cost of alternative power.

Under Exelon's proposal, the Conowingo Project would have a total capacity of 574.54 MW, a dependable capacity of 566.14 MW, and an average annual generation of 1,823,193 MWh. The average annual cost of alternative power would be $115,955,070, or $63.60/MWh. In total, the average annual project cost would be $83,481,890, or $45.79/MWh. Overall, the project would produce power at a cost that is $32,473,180, or $17.81/MWh, less than the cost of alternative power.

4.2.3 Staff Alternative

The staff alternative would include the respective staff-recommended additions, deletions, and modifications to each applicant's proposed environmental protection and enhancement measures. For the York Haven, Muddy Run, and Conowingo Projects, tables 4-7, 4-8, and 4-9, show the respective staff-recommended additions, deletions, and modifications to each applicant's proposed environmental protection and enhancement measures, and the estimated cost of each.

For the York Haven Project, based on a total installed capacity of 19.62 MW, a dependable capacity of 17.57 MW, and an average annual generation of 131,771 MWh, the cost of alternative power would be the same as for the applicant's proposal: $6,037,750, or $45.82/MWh. The average annual project cost would be $6,370,400, or $48.34/MWh. Overall, the project would produce power at a cost that is $332,650, or $2.52/MWh, more than the cost of alternative generation.

For the Muddy Run Project, based on a total installed capacity of 800.25 MW, a dependable capacity of 1,070 MW, an average annual generation of 1,614,882 MWh (loss of 931 MWh compared to the no-action/proposed alternatives), the cost of alternative power would be $169,498,010, or $104.96/MWh. The average annual project cost, which includes pumping energy requirements of 2,095,633 MWh (reduction of 1,093 MWH of pumping energy costs compared to the no-action/proposed alternatives), would be $119,000,190, or $73.69/MWh. Overall, the project would produce power at a cost that is $50,497,820, or $31.27/MWh, less than the cost of alternative generation.

For the Conowingo Project, based on a total installed capacity of 574.54 MW, a dependable capacity of 566.14 MW, and an average annual generation of 1,820,743 MWh (loss of 2,450 MWh compared to the no-action/proposed alternatives), the cost of alternative power would be $115,853,880, or $63.63/MWh. The average annual project cost would be $84,625.070, or $46.48/MWh. Overall, the project would produce power at a cost that is $31,228,810, or $17.15/MWh, less than the cost of alternative generation.

4.2.4 Staff Alternative with Mandatory Conditions (York Haven and Muddy Run only)

The staff alternative with mandatory conditions would include the respective staff-recommended additions, deletions, and modifications to each applicant's proposed environmental protection and enhancement measures, as well as any mandatory conditions imposed on the projects under section 18 of the FPA and/or section 401 of the Clean Water Act. For the York Haven and Muddy Run Projects, tables 4-7 and 4-8, show the respective staff-recommended additions, deletions, and modifications to each applicant's proposed environmental protection and enhancement measures, as well as any mandatory conditions, and the estimated cost of each.

For the York Haven Project, this alternative would include the staff alternative with one additional measure: to contribute $25,000 per year to the York County Conservation District or such other entity identified by Pennsylvania DEP for the purposes of debris removal in the lower Susquehanna River watershed. Based on a total installed capacity of 19.62 MW, a dependable capacity of 17.57 MW, and an average annual generation of 131,771 MWh, the cost of alternative power would be the same as for the applicant's proposal: $6,037,750, or $45.82/MWh. The average annual project cost would be $6,386,650, or $48.47/MWh. Overall, the project would produce power at a cost that is $348,900, or $2.65/MWh, more than the cost of alternative generation.

For the Muddy Run Project, this alternative would include the staff alternative with four additional measures: (1) implement the Eel Management Plan filed with the license application for the eel trap and truck program to trap, hold, and transport American eels from the Conowingo Project to designated points in the Susquehanna River watershed until at least 2030, and then either continue the trap and truck program or construct a volitional eel passage facility at Conowingo dam; (2) provide the version of the Lower Susquehanna River OASIS Model to the Susquehanna River Basin Commission within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become 'final' (i.e., are no longer appealable or subject to ongoing litigation) as provided in the "*Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRBC*"; (3) provide annual grants up to $450,000 total to be split between the Lancaster County and York County Conservation Districts through 2030 for the implementation of agricultural pasture and barnyard BMPs to control sediment loading to the Susquehanna River; and (4) provide $50,000 annually to Pennsylvania FBC to perform habitat improvement projects including the removal of small dams.

Based on a total installed capacity of 800.25 MW, a dependable capacity of 1,070 MW, an average annual generation of 1,614,882 MWh (loss of 931 MWh compared to the no-action/proposed alternatives), the cost of alternative power would be $169,498,010, or $104.96/MWh. The average annual project cost, which includes pumping energy requirements of 2,095,633 MWh (reduction of 1,093 MWh of pumping energy costs compared to the no-action/proposed alternatives), would be $119,325,730, or $73.89/MWh. Overall, the project would produce power at a cost that is $50,172,280, or $31.07/MWh, less than the cost of alternative generation.

4.3 COST OF ENVIRONMENTAL MEASURES

Tables 4-7, 4-8, and 4-9 give the cost of each of the environmental enhancement measures considered in our analysis for the York Haven, Muddy Run, and Conowingo Projects, respectively. We convert all costs to equal annual (levelized) values over a 30-year period of analysis to give a uniform basis for comparing the benefits of a measure to its cost.

Table 4-7. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of continuing to operate the York Haven Project (Source: staff and York Haven Power).

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Geology and Soils Resources				
1. Develop an erosion and sediment control plan for construction of the nature-like fishway.	York Haven Power, Staff	$5,000	$0	$370[c]
Aquatic Resources				
2. Continue to operate and maintain the existing east channel fishway for upstream fish passage until the proposed nature-like fishway is completed.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[d]
3. Continue the current downstream juvenile American shad passage protocol, which calls for the operation of units 1-6 (Kaplan and propeller units) to be first online and last offline during the juvenile shad downstream migration period (which typically is from October 1 through November 30). If river flows exceed the capacity of units 1-6, unit 14 would be operated, and if flows exceed the capacities of units 1-6 and 14, units 7-13, and 15-20 would be operated in ascending order.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[d]
4. Provide a year-round, continuous, minimum flow from the project of 1,000 cfs and an average daily minimum flow of 2,500 cfs, or inflow, whichever is less.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[d]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
5. Continue to operate the project in a run-of-river mode when inflow to the project is less than 3,000 cfs, without deliberate impoundment drawdown or storage for purposes of generating electricity in particular time periods.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[d]
6. Pass about 370 cfs through the forebay sluice gate for 1 or 2 hours in the morning during weekdays if river flows exceed the sum of the turbine hydraulic capacity, flows through the nature-like fishway, once constructed, flows through the east channel, and flows (if any) over the main dam from May 1 through June 30 to facilitate downstream passage of post-spawning adult American shad and during the fall American shad passage period to facilitate downstream passage of juvenile American shad.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]
7. Pass about 370 cfs through the forebay sluice gate between the hours of 5 and 11 p.m. during the entire juvenile American shad passage period to facilitate downstream passage of juvenile American shad.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]
8. Develop designs within 4 years of license issuance for (1) removal of obstructions in or deepening of the downstream plunge pool from the forebay sluice gate; and (2) a chute structure to convey flows beyond the roadway on the downstream side of the cable alley structure to protect outmigrating juvenile and adult American shad during passage to the downstream plunge pool.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$20,000	$0	$1,480[f]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
9. Cooperate with resource agencies and other interested parties to conduct a lower Susquehanna River downstream eel migration study. This compensation would include monitoring of silver eels at the project and providing $25,000 to support the study.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$25,000	$0	$1,850[g]
10. Conduct a site-specific silver eel route of passage study as described in appendix G of the Settlement Agreement including the potential for providing $50,000 to resource agencies for collection and tagging of silver eels at upstream locations.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$50,000	$0	$3,700[g]
11. Conduct a site-specific eel survival study as described in appendix H of the Settlement Agreement.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$50,000	$0	$3,700[f]
12. Conduct a downstream eel passage improvement study if downstream eel passage goals are not achieved with provisions for subsequent monitoring and adjustments.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[h]
13. Until the nature-like fishway is completed, provide a minimum flow of 2,000 cfs at east channel dam and a spillage flow of 4,000 cfs at the main dam during the American shad upstream passage season when the east channel fishway is in operation (generally from mid-April through mid-June).	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
14. Until the nature-like fishway is completed, after the American shad upstream passage season until the end of the resident fish passage season (the earlier of December 15 or until the average daily river temperature is ≤ 40°F), maintain a minimum flow of 400 cfs in the east channel downstream of the east channel fishway during the period that the east channel fishway is operated to allow upstream passage of resident fish species, per the June 2010 Consent Order and Agreement between York Haven Power and Pennsylvania DEP.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]
15. Construct, operate, and maintain a nature-like fishway with required attraction flows.	York Haven Power, Settling Parties, Interior, Pennsylvania DEP, Staff	$6,315,520	$145,890	$562,020[i]
16. Upon completion of the nature-like fishway, conduct American shad upstream passage effectiveness studies using telemetry beginning during the second year of nature-like fishway operation.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$220,000	$0	$16,280[f]
17. Upon completion of the nature-like fishway, conduct a juvenile American shad headrace turbine avoidance study consistent with design criteria included in appendix D of the Settlement Agreement.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$50,000	$0	$3,700[f]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
18. If the juvenile American shad headrace turbine avoidance goals are not achieved, implement measures that would enhance the effectiveness and conduct a supplemental juvenile American shad headrace turbine avoidance study within 2 years of implementing the measures.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[h]
19. Upon completion of the nature-like fishway, provide an average daily minimum flow in the east channel below the east channel dam of 267 cfs year round.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]
20. Upon completion of the nature-like fishway, provide a minimum of 5 percent of the river flow through the nature-like fishway during the American shad upstream passage season such that when inflows to the project are between 5,000 and 150,000 cfs, total flow through the nature-like fishway would range from about 1,000 to 7,500 cfs, depending on inflow.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]
21. Upon completion of the nature-like fishway, provide a minimum flow of 200 cfs through the nature-like fishway when river elevation is at the crest of the main dam and outside of the American shad upstream passage season.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
22. Upon completion of the nature-like fishway, to the extent controllable by York Haven Power, when flows exceed the hydraulic capacity of all available generating units, manage flows to maximize flow over the main dam and the nature-like fishway.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[e]
Terrestrial Resources				
23. Conduct vegetation surveys, wetland delineations, invasive species surveys, rare species surveys, bog turtle habitat assessments, and bald eagle surveys in the area of the nature-like fishway prior to construction.	York Haven Power, Interior, Staff	$50,000	$0	$3,700[f]
Recreation and Land Use				
24. Develop and implement a recreation management plan, and update the plan every 12 years consistent with every other Form 80 reporting period deadline.	Staff	$40,000	$1,160	$3,710[j]
25. Maintain existing recreation facilities on four islands in Lake Frederic and the recreation facilities at the powerhouse, including a portage trail for canoeists and fishing access along the downstream face of the powerhouse, and consult with the resource agencies about recreation management and strategies every 10 years after the effective date of any new license.	York Haven Power, Staff	$0	$0	$0[d]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
26. Continue the licensing program for approximately 300 recreational lots and terminate permits and remove from the licensing program existing recreational lots upon abandonment by the lessee, or when existing structures become damaged and are not replaced by structures conforming to all applicable federal, state, and local regulations.	York Haven Power, Staff	$0	$0	$0[k]
27. Develop and implement an SMP to include: (a) summary of the purpose, goals, and objectives of the plan; (b) descriptions of shoreline use classifications, which identifies allowable and prohibited uses for existing and future use of the shoreline; (c) maps showing the shoreline classifications in relation to the project reservoir, project boundary, and various other features; (d) the lot lease and permitting program and guidelines developed to manage public uses; and (e) a monitoring and enforcement program; and provisions to update the plan every 10 years.	Staff	$70,000	$2,410	$6,750[l]
28. Remove non-natural debris from the forebay and sluice remaining natural debris downstream after notifying the downstream PPL BI station.	York Haven Power, Settling Parties, Pennsylvania DEP, Staff	$0	$0	$0[d]
29. Contribute $25,000 per year to the York County Conservation District or such other entity identified by Pennsylvania DEP for the purposes of debris removal in the lower Susquehanna River watershed.	York Haven Power, Settling Parties, Pennsylvania DEP	$0	$25,000	$16,250[g]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Cultural Resources				
30. Implement the HPMP filed with the Commission on December 28, 2012.	York Haven Power	$0	$5,170	$3,360
31. Implement York Haven's proposed HPMP with the following modifications: (a) include a requirement to request access to sites on private lands within the project boundary if project impacts are identified during shoreline monitoring activities, assess these effects, and evaluate the affected sites for listing on the National Register; (b) develop a plan and schedule to survey and record archaeological sites on York Haven-owned fee lands in the project boundary and evaluate them for their National Register eligibility to ensure that any effects on sites owned by York Haven Power are fully considered in accordance with section 106; (c) include two additional sites (36YO300, 36YO334) in the monitoring schedule, or clarification regarding why they were excluded; and (d) include the Park Service as a consulting party. Implement the final plan.	Staff	$20,000	$5,170	$4,840[m]

[a] All capital and annual costs were provided in 2011 dollars or 2013 dollars and were escalated to 2014 dollars for the purpose of this analysis. Annual costs typically include operational and maintenance costs and any other costs that occur on a yearly basis. All costs were provided by York Haven Power in its license application unless otherwise noted.

[b] All capital and annual costs are converted to equal annual costs over a 30-year period to give a uniform basis for comparing costs.

[c] Staff estimated the cost; assumes implementation cost is included in construction cost for nature-like fishway below.

[d] Staff estimates no additional cost because this is a continuing measure.

[e] Staff assumes that the cost of any lost energy is included in the lost energy estimate for the nature-like fishway below.

[f] Staff estimated the cost.
[g] Cost provided by York Haven Power in the Settlement Agreement.
[h] No cost estimated for this measure as it is speculative and may not be needed.
[i] Cost provided by York Haven Power in its additional information response filed with the Commission on March 15, 2013. Includes 500 MWh/year lost energy cost.
[j] Staff estimated the cost; annual cost assumes $50,000 in years 13 and 25 to update the plan.
[k] Staff assumed that no additional cost would be required for this measure.
[l] Staff estimated the cost; annual cost assumes $20,000 in years 11 and 21 to update the plan.
[m] Staff estimated the cost; capital cost for item (b) only.

Table 4-8. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of continuing to operate the Muddy Run Project (Source: staff and Exelon).

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Aquatic Resources				
1. Develop a DO monitoring plan no earlier than November 1, 2027, with measures designed to ensure that the project does not violate DO standards.	Exelon, Pennsylvania DEP, Staff	$0	$0	$0[c]
2. Implement the modified store-and-release flow regime proposed by The Nature Conservancy and recommended by Interior for the Conowingo Project (effect on Muddy Run operation).	TNC, Interior	$0	$3,055,520 (reflects a loss of generation with a reduction in annual pumping costs)	$1,989,490[d]
3. Implement the Staff-recommended flow regime determined for Conowingo (effect on Muddy Run operation).	Staff	$0	$22,410 (loss of generation with a reduction in annual pumping costs)	$14,590[e]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
4. Develop and implement FPOP for upstream and downstream fish passage and file with Pennsylvania DEP for review and approval by January 15, 2015.	Exelon, Pennsylvania DEP, Interior, Staff	$0	$0	$0[f]
5. In 2018, develop a plan and schedule for a radio telemetry study or equivalent Tier II study of American shad passage and behavior within the Muddy Run Project boundary, although no such plan would be required if available data indicate that 75 percent of the shad that pass the downstream Conowingo Project also pass through the Holtwood Project fish passage facilities (Tier I requirement), and that 50 percent of the shad that pass the Conowingo Project pass the Holtwood Project within 5 days (Tier II requirement). The Tier II study, if required, would determine the percentage of shad that enter the Muddy Run Project area at the northern tip of Sicily Island and exit the Muddy Run Project area at the southern tip of Deepwater Island. Objective is that 88 percent of the shad successfully pass through the Muddy Run Project area.	Exelon, Pennsylvania DEP, Interior, Staff	$0	$0	$0[g]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
6. Implement the Eel Management Plan filed with the license application for the eel trap and truck program to trap, hold, and transport American eels from the Conowingo Project to designated points in the Susquehanna River watershed until at least 2030 and then either continue the trap and truck program or construct a volitional eel passage facility at Conowingo dam.	Exelon, Pennsylvania DEP, Interior	$0	$0	$0[h]
7. Develop and implement a downstream eel passage plan to ensure safe and timely passage past the Muddy Run Project.	Exelon, Pennsylvania DEP, Interior, Staff	$0	$0	$0[i]
8. At all times, allow the project to be subject to inspection by representatives of FWS, to ensure compliance with any fish and wildlife protection, mitigation, and enhancements that may be contained in any Commission license issued for the project.	Interior, Staff	$0	$0	$0[f]
9. Provide the version of the Lower Susquehanna River OASIS Model to the Susquehanna River Basin Commission within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become 'final' (i.e., are no longer appealable or subject to ongoing litigation) as provided in the "Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRBC."	Exelon, Pennsylvania DEP, SRBC	$0	$0	$0

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Terrestrial Resources				
10. Implement the Bald Eagle Management Plan filed with the license application.	Exelon, Interior, Staff	$0	$1,150	$750
11. Implement the Bog Turtle Management Plan filed with the license application, which includes three components that Exelon would implement: (1) restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) limits on public access to the wetland without advertising the reason.	Exelon, Interior	$0	$12,650	$8,240
12. Implement the proposed Bog Turtle management Plan with a modification to the restrictions for mowing areas C, D, and F to state, "avoid mowing between April to October to avoid turtle's active period."	Staff	$0	$12,650	$8,240
13. Before ground disturbance work begins, visit the FWS Chesapeake Bay Field Office and Pennsylvania Field Office websites and follow bog turtle and bald eagle management guidelines.	Interior, Staff	$0	$0	$0[f]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
14. Once every 10 years through the term of the license, evaluate all state and federally listed endangered and threatened species that may be present within the project boundary, and if the evaluation identified the presence, critical habitat, or critical dependence of endangered species, propose and implement a protection plan for each species.	Exelon, Pennsylvania DEP	$0	$70	$50[j]
15. Implement the osprey management policy, as described in the SMP.	Exelon, Staff	$0	$0	$0[k]
16. Provide annual grants up to $450,000 total to be split between the Lancaster County and York County Conservation Districts through 2030 for the implementation of agricultural pasture and barnyard BMPs to control sediment loading to the Susquehanna River.	Exelon, Pennsylvania DEP	$0	$450,000	$292,960[l]
17. Provide $50,000 annually to Pennsylvania FBC to perform habitat improvement projects including the removal of small dams.	Exelon, Pennsylvania DEP	$0	$50,000	$32,550[l]
Recreation and Land Use				
18. Implement the Recreation Management Plan filed with the license application.	Exelon, Interior	$0	$0	$0[m]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
19. At the Muddy Run Park: (1) replace the Recreation Lake boat launching facilities and boat dock with an improved launching ramp and ADA-compliant dock; (2) implement shoreline erosion measures to improve runoff and stability in the vicinity of an ADA-compliant picnic area and boat rental dock; (3) replace an existing wood retaining wall with a sheet pile retaining wall to reduce shoreline erosion near the boat dock area; (4) upgrade the electric service to 50 campsites in the park, and monitor future need and upgrade additional sites when the demand occurs; (5) expand an existing playground near the visitor's center with safety swings and three modular play structures suitable for younger children (tot lot); and (6) install a mulch safety surface, and construct a 2,000 square foot water spray park near the park entrance, along with paving resurfacing.	Exelon, Staff[r]	$2,045,000	$66,000	$194,510
20. At Wissler's Run Park: (1) complete the replacement of the picnic pavilion, (2) designate and sign two additional ADA-compliant parking spaces near the picnic pavilion for compliance with standards set by the *ADA Accessibility Guidelines for Buildings and Facilities*, and (3) demolish the existing non-functioning fish cleaning station.	Exelon, Staff	$16,000	$2,500	$2,810[n]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
21. At Muddy Run WMA: (1) continue to lease the Muddy Run WMA to the Pennsylvania Game Commission for the management of the Muddy Run WMA to provide hunting opportunities in the area; and (2) erect and maintain FERC Part 8 signs at River Road and Furness Road WMA parking areas to identify the conditions of access to the site.	Exelon, Staff	$0	$0	$0[f]
22. Implement Exelon's proposed Recreation Management Plan with the addition of provisions to revise the plan in year 1 to include both recreation use monitoring and plan updates every 12 years in concert with every other the Form 80 reporting deadline.	Staff	$12,000	$2,280	$2,370[o]
23. Implement the SMP filed with the license application consistent with *Guidance for Shoreline Management Planning at Hydropower Projects*.	Exelon, Interior	$0	$0	$0[p]
24. Implement Exelon's proposed SMP with the addition of a provision to review and update the plan every 10 years in consultation with appropriate agencies and other stakeholders.	Staff	$12,000	$840	$1,440[q]
Cultural Resources				
25. Prepare a cultural resources management plan if cultural materials are identified during project-related activities.	Exelon	$8,000	$0	$590

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
26. Prepare an HPMP in accordance with FERC and Advisory Council guidance to address potential project effects on historic properties including: (a) a plan for further archaeological investigations of additional AOIs and other potentially affected areas as recommended in the Phase IB report; (b) a detailed discussion of the three sites identified during Phase IA cultural resources (36LA67, 36LA103, 36LA368) and two additional sites (36LA70, 36LA47) located outside of the project boundary that could be affected by the project; (c) requirements for National Register evaluation of affected sites in consultation with the Pennsylvania SHPO; (d) requirements for formal National Register evaluation of the Muddy Run Pumped Storage Project facility; (e) documentation of all consultation with the Delaware Nation and Onondaga Nation; and (f) the Park Service as a consulting party.	Interior, Staff	$25,000	$45,000	$31,150[r]

[a] All capital and annual costs were provided in 2011 dollars and were escalated to 2014 dollars for the purpose of this analysis. Annual costs typically include operational and maintenance costs and any other costs that occur on a yearly basis. All costs were provided by Exelon in its license application unless otherwise noted.

[b] All capital and annual costs are converted to equal annual costs over a 30-year period to give a uniform basis for comparing costs.

[c] No additional cost; continuing measure.

[d] Cost based on energy estimates filed with the Commission by Exelon on September 29, 2014; a loss of 146,837 MWh in generation and a reduction of 189,635 MWh of pumping energy.

[e] Cost based on energy estimates filed with the Commission by Exelon on September 29, 2014; a loss of 931 MWh in generation and a reduction of 1,093 MWh of pumping energy).

[f] Staff assumes no additional cost to implement this measure.

[g] No cost estimated for this measure because it is speculative and may not be needed.

[h] No cost directly related to Muddy Run Project; cost would be covered by the Conowingo Project and is addressed below.

[i] No cost is estimated at this time as the cost would occur more than 10 years into the future, and any mitigation would be speculative and would depend on whether or not the target passage rates would be met.

[j] Staff estimated the cost; annual cost assumes $1,000 in years 10, 20, and 30.

[k] This measure is included in the SMP, and the cost is assumed to be part of the ongoing costs of the project.

[l] This measure and cost were provided by Exelon in its reply comments filed March 18, 2014.

[m] Cost of enhancements to individual recreation facilities are shown below.

[n] Exelon proposes to construct facilities that are ADA-compliant; however, the staff alternative only requires that Exelon take into account persons with disabilities in the construction of its recreation facilities.

[o] Staff estimated the cost; annual cost assumes $50,000 in years 13 and 25 for updates to the plan.

[p] The only element of the SMP that would have additional cost is the Bald Eagle Management Plan, and the costs of that plan are listed separately above.

[q] Staff estimated the cost; capital cost to revise SMP, and annual cost assumes $15,000 in years 11 and 21 for updates to the plan.

[r] Staff estimated the cost; capital cost for items (a), (b), and (c).

Table 4-9. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of constructing and operating the Conowingo Project (Source: staff and Exelon).

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Geologic and Soil Resources				
1. Implement the Sediment Management Plan filed with the license application that identifies benchmarks and thresholds for action to address sediment issues that may affect project operation.	Exelon	$0	$9,550	$6,220
2. Conduct bathymetric surveys of Conowingo Pond at 5-year intervals, starting in year 2016.	Exelon	$0	$16,100	$10,480[c]
3. Implement Exelon's proposed Sediment Management Plan with the addition of provisions to (1) incorporate Exelon's proposed periodic dredging at the Conowingo Creek, Peters Creek (Peach Bottom Marina), and Broad Creek boat ramps, where sediments have been accumulating, to improve and maintain recreational boating access; and (2) include with the results of each bathymetric survey an analysis of any change in sediment deposition or scour in the pond from the previous survey(s).	Staff	$0	$25,650	$16,700[d]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Aquatic Resources				
4. Operate the project with a normal range of operation of Conowingo Pond between the elevations 101.2 feet and 110.2 feet with a minimum elevation of 107.2 feet on weekends between Memorial Day and Labor Day, to meet recreational needs.	Exelon, Staff	$0	$0	$0[e]
5. Provide minimum flow releases from the project as described below or a minimum flow equal to the discharge measured at the upstream USGS Marietta gage, whichever is less: (1) March 1-March 31: 3,500 cfs or natural inflow (as measured at the Marietta gage), if less; (2) April 1-April 30: 10,000 cfs or natural inflow, if less; (3) May 1-May 31: 7,500 cfs or natural inflow, if less; (4) June 1-September 14: 5,000 cfs or natural inflow, if less; (5) September 15-November 30: 3,500 cfs or natural inflow, if less; (6) December 1-February 28: 3,500 cfs intermittent (maximum 6 hours off followed by equal amount on).	Exelon	$0	$0	$0[e]
6. Develop and implement a flow management plan.	Interior	$40,000	$0	$2,960[f]
7. Implement the modified store-and-release flow regime proposed by The Nature Conservancy and recommended by Interior.	Interior, TNC	$0	-$534,740 (gain in generation)	-$348,130[g]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
8. Implement the staff-recommended modified minimum flow regime that would enhance Exelon's proposed minimum flows from December through February and in the first 2 weeks of June, as follows: September 15 – March 31: 3,500 cfs or natural inflow (as measured at the USGS Marietta gage No. 0157600), whichever is less; April 1 – April 30: 10,000 cfs or natural inflow, whichever is less; May 1 – June 15: 7,500 cfs or natural flow, whichever is less; June 16 – September 14: 5,000 cfs or natural inflow, whichever is less.	Staff	$0	$99,886 (loss in energy)	$65,030[h]
9. Continue the DO enhancement at the project using the turbine venting systems on units 1-7 and the aerating runners on units 2 and 5, and continuously monitor DO levels from May 1 through October 1 at the Station 643 location approximately 0.6 mile downstream of Conowingo dam.	Exelon, Staff	$0	$0	$0[e]
10. Operate the east fish lift for upstream passage of American shad, river herring, and other migratory fishes, and the west fish lift for American shad egg collections and other research purposes.	Exelon, Staff	$0	$0	$0[e]
11. Implement a preventative maintenance program for the east fish lift that would extend the useful life of the facility over the next license term.	Exelon, Staff	$0	$200,000	$130,200

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
12. Use the project turbines as the route for downstream passage of American shad and river herring, based on studies that show high survival for fish passing through the turbines.	Exelon, Staff	$0	$0	$0[e]
13. Incorporate performance criteria into the new license where 80 percent of the shad that enter the project area must pass the project within 5 days, to be based on telemetry study of 150 shad per year for 3 years. If the goal is not met, initiate operational changes as specified by the agencies and test for 3 years using a telemetry study. If the goal is still not reached after 3 years of monitoring, make structural changes to the fish lifts as specified by the agencies, and test for an additional 3 years using a telemetry study. If the goal is still not reached after 3 years, additional structural changes may be required, depending on the behavior of tagged shad.	Pennsylvania FBC	$300,000	$0	$22,230[i]
14. If warranted by the Pennsylvania FBC study above, complete the rebuild of the west fish lift to include additional attraction water and provision to expand to volitional passage if needed. Ultimately, fish passage facilities at Conowingo would need to pass a design population of 5 million fish, and fish lifts would be required on both sides of the tailrace.	Pennsylvania FBC	$0	$0	$0[j]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
15. If warranted by the Pennsylvania FBC study above, modify the east fish lift to include a larger hopper, increased attraction flow, and addition of a collection gallery in front of units 8-11.	Pennsylvania FBC	$0	$0	$0[j]
16. Reduce stranding of migratory fish by: (1) extending the retaining wall at the east end of the east fish lift; or (2) adding boulder fill in that area to prevent generation flow from flooding the spillway pool at high levels of generation; or (3) dredging a channel(s) from the spillway pool area to downstream areas to provide egress for stranded fishes.	Pennsylvania FBC	$1,000,000	$0	$74,100[k]
17. Conduct a study of the effect of gizzard shad on passage efficiency, capacity, and interference with American shad use of the lifts, and the recycling of gizzard shad in the west fish lift.	Pennsylvania FBC, Staff	$3,530	$0	$260[l]
18. Modify the west fish lift by replacing the existing hopper with a 1,500-gallon hopper, including associated structural, electrical, and mechanical upgrades.	Staff	$3,159,090	$0	$234,100[m]
19. Improve the west fish lift sorting and loading process to facilitate trap and truck operations, and purchase trucks, transport tanks, and associated equipment for the implementation of trap and truck operations.	Staff	$979,340	$626,030	$480,120[m]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
20. Conduct a feasibility study to determine if additional attraction flow is necessary at the west fish lift.	Staff	$30,000	$0	$2,220[f]
21. If the feasibility study determines that additional attraction flows are necessary and feasible at the west fish lift, install additional flow capacity.	Staff	$0	$0	$0[j]
22. Restore the original east fish lift design for a 900-cfs attraction flow.	Staff	$1,500,000	$0	$111,560[f]
23. Add a second 3,300-gallon hopper to the east fish lift in the space provided for the original design, and upgrade the electrical and mechanical equipment to allow a 15-minute lift cycle.	Staff	$1,683,470	$0	$124,750[n]
24. After restoration of the 900-cfs attraction flow, conduct a 2-year effectiveness study.	Staff	$100,000	$0	$7,410[f]
25. If the 2 years of effectiveness studies show poor attraction to the east fish lift at that flow, conduct a feasibility study of modifying the locations of entrances A and B.	Staff	$0	$0	$0[j]
26. If the feasibility study shows that modifications to entrances A and B are technically feasible and would result in improved effectiveness, implement changes to the entrances.	Staff	$0	$0	$0[j]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
27. Construct a west bank American eel trap and transport facility that consists of a limited length eel ramp and a collection facility in the existing parking lot.	Exelon, Interior, Pennsylvania FBC, Staff	$660,120	$604,340	$442,340[o]
28. Construct a west bank American eel volitional passage near the west fish lift that consists of a full eel ramp with resting pools from the tailrace to the pond elevation sited near the west fish lift superstructure.	Exelon, Interior, Staff	$1,751,030	$206,610	$264,260[o]
29. Construct an east bank American eel trap and transport facility that consists of a limited length eel ramp and a collection facility in the existing access area below the non-overflow section of the dam.	Exelon, Interior, Staff	$642,560	$604,340	$441,040[o]
30. Construct an east bank American eel volitional passage facility (after 2030) that consists of a full eel ramp with resting pools from the tailrace to the top of the dam.	Exelon, Interior, Pennsylvania FBC, Staff	$1,162,190	$206,610	$203,140[o]
31. Continue a debris management program that includes clamming (with three gantry cranes with grapple attachments) to remove submerged debris from the area upstream of the powerhouse intakes and floating surficial debris in front of the powerhouse intakes, and the sponsorship of community-based clean-ups in the pond and downstream of the dam.	Exelon	$0	$0	$0[e]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Terrestrial Resources				
32. Implement the Bald Eagle Management Plan filed with the license application.	Exelon	$0	$2,670	$1,740
33. Implement Exelon's proposed Bald Eagle Management Plan with the addition of a provision to minimize recreation-related disturbance in proximity to roosting or foraging eagles.	Interior, Staff	$0	$2,670	$1,740[p]
34. Develop and implement a bog turtle management plan.	Interior, Staff	$0	$12,650	$8,240[q]
35. Develop and implement a northern map turtle protection plan.	Staff	$30,000	$19,370	$14,830[f]
36. Develop and implement a waterfowl nesting protection plan in consultation with FWS that would (a) identify specific project-related effects on waterfowl, such as flooding during nesting season causing nest failure; (b) identify which species of waterfowl are affected, if any; and, (c) if project-related effects are identified, establish appropriate protection or mitigation measures.	Interior, Staff	$50,000	$25,000	$19,980[f]
37. Implement the osprey management policy, as described in the SMP.	Exelon, Staff	$0	$0	$0[r]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
Recreation and Land Use				
38. Maintain several public recreation facilities within the project boundary.	Exelon, Staff	$0	$0	$0[e]
39. Implement the Recreation Management Plan filed as part of the license application to guide the operation and maintenance of Exelon's recreation facilities, and the implementation of recreation facility enhancements outlined below.	Exelon	$0	$0	$0[s]
40. Implement improvements at Lock 13 to install a trailhead directional sign at the Lock 12 parking area, and clear vegetation from within the lock to provide an unobstructed view on each side of the lock structure to protect visitors.	Exelon, Staff	$30,000	$500	$2,550
41. Implement improvements to Lock 15 to designate two ADA-compliant parking spaces in the existing parking area and install a dock on the shoreline near the picnic area to allow boaters to access the site; construct a concrete pad for portable restroom placement; stabilize the open shoreline area near the parking area to prevent erosion.	Exelon, Staff	$60,000	$1,200	$5,230[t]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
42. Implement improvements at Muddy Creek Boat Launch to designate two boat trailer spaces and one vehicle space for ADA-compliant parking in the existing parking lot; stabilize areas adjacent to the parking area to improve drainage and redirect flow away from the parking area and the river; install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out.	Exelon, Staff	$72,000	$6,000	$9,240[t]
43. Implement improvements to the Cold Cabin Boat Launch to improve access by designating a one-way directional traffic pattern through the site and constructing parking for 11 vehicles (five boat trailer and six vehicle spaces), including two ADA-compliant spaces; reinforce existing boat ramp to prevent undermining of the ramp and install a boat dock; install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out; provide two ADA-compliant picnic tables; install a concrete pad for the placement of two portable restrooms (one ADA-compliant, one standard).	Exelon, Staff	$210,000	$2,500	$17,190[t]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
44. Implement improvements to Dorsey Park to rebuild both boat ramps at Dorsey Park; designate one ADA-compliant boat trailer space and one ADA vehicle space in the existing lot; install a concrete pad for three portable restrooms (one ADA-compliant, two standard); install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out.	Exelon, Staff	$274,000	$18,000	$32,020[t]
45. Implement improvements to the Conowingo Creek boat launch to designate one ADA-compliant parking space in the existing parking area; stabilize a roadside ditch along Mt. Zoar Road and construct a stone-lined drainage ditch along the south side of the parking lot to redirect runoff from the parking lot and boat ramp; install a sign providing information on the Conowingo dam canoe portage and the location of the portage take-out.	Exelon, Staff	$56,000	$3,600	$6,490[t]
46. Implement improvements to the Glen Cove Marina to expand the marina by adding seven additional trailer spaces (one ADA-compliant) and 11 vehicle (two ADA-compliant) spaces; repair the marina's bulkhead wall.	Exelon, Staff	$220,000	$1,700	$17,410[t]
47. Implement improvements at Funk's Pond to designate one ADA-compliant parking space in the existing parking area.	Exelon, Staff	$300	$500	$350[t]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
48. Implement improvements to Line Bridge to perform shoreline erosion control and stabilization at this unimproved carry-in boat access area.	Exelon, Staff	$9,000	$500	$490
49. Implement improvements at Conowingo swimming pool to install an ADA-compliant access facility at the swimming pool and an ADA-compliant access ramp at the wading pool.	Exelon, Staff	$173,000	$3,500	$15,100[t]
50. Implement improvements at Conowingo dam overlook to reopen the facility and designate three ADA-compliant vehicle spaces in the existing parking lot; demolish the existing pavilion and replace it with a new 24-foot by 24-foot wooden pavilion; remove pavement from the easterly corner of the existing paved parking area, loam and seed, and install three ADA-compliant pathways and picnic tables; install security fencing around the site to restrict unobstructed views from the pavilion and picnic area.	Exelon, Staff	$232,000	$3,000	$19,150[t]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
51. Implement improvements to Fisherman's Park and Shures Landing to widen the access road to the facility by 3 to 5 feet to allow construction of 12-foot-wide lanes; construct a retaining wall along the easterly 250 feet of the existing parking area along the access road; designate five additional ADA-compliant parking spaces in the existing parking lot; widen the access road leading to Shures Landing by 4 feet along the eastbound lane for 320 feet; and widen the access road from the trailhead parking north of the retaining wall by 2 feet; construct an additional 13-space parking area near the Lower Susquehanna Heritage greenway trailhead at the southerly end of Fisherman's Park; demolish the existing hard surface boat launch and asphalt access at Shure's Landing and place stone fill next to the existing wall down to existing grade along the Susquehanna River shoreline; and construct a new 20-foot-wide hard surface carry-in boat launch with a floating dock and breakwater at Shure's Landing to replace the existing launch area.	Exelon, Staff	$1,194,000	$2,900	$90,370[t]
52. Implement improvements at Peach Bottom access to construct a small (four vehicle) road-side parking area near the existing informal boat launch area south of Peter's Creek; install a sign providing information on Conowingo dam canoe portage and the location of the portage take-out.	Exelon, Staff	$20,000	$1,800	$2,650

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
53. Implement Exelon's proposed Recreation Management Plan with the addition of provisions to revise the plan in year 1 to include consultation with the Park Service, and also include both recreation use monitoring and plan updates every 12 years in concert with every other Form 80 reporting deadline; as part of the Recreation Management Plan, develop a debris management plan, in consultation with agency stakeholders and boating interest groups, that includes: debris management goals, methods of debris management (i.e., deployment of skimmer boat), frequency of operation, size criteria specifications, procedures for removal of stored debris, tracking procedures, and a schedule to update the plan.	Staff	$80,000	$2,280	$7,410[u]
54. Open the catwalk (at least on a limited basis) for angling with new security gate and check in/out procedures for anglers.	Staff	$1,908,000	$0	$141,390[v]
55. Conduct dredging at the Conowingo Creek, Peach Bottom Creek, and Broad Creek boat ramps.	Exelon, Staff	$6,653,230	$0	$493,030[w]

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
56. Implement the SMP filed with the license application including specific measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, BMPs for controlling sediment introduction from lands within the project boundary, and use of project lands.	Exelon, Interior	$0	$0	$0[x]
57. Implement Exelon's proposed SMP with the addition of a provision to update the SMP every 10 years in consultation with appropriate agencies and interested stakeholders.	Staff	$12,000	$840	$1,440[y]
58. Revise the project boundary by removing lands that are not necessary for the safe and efficient operation and maintenance of the project or for other specified project purposes, such as public recreation or protection of environmental resources.	Exelon, Staff	$0	$0	$0[z]
Cultural Resources				
59. Implement the HPMP filed with the Commission on December 28, 2012.	Exelon	$95,000	$21,150	$20,810

Enhancement/Mitigation Measure	Entity	Capital Cost[a] (2014$)	Annual Cost[a] (2014$)	Levelized Annual Cost[b] (2014$)
60. Revise and implement Exelon's proposed HPMP to include: (a) a revised APE to include the narrow strip of land in the current project boundary extending downstream from Spencer Island along the west side of the river to Havre de Grace; (b) a discussion of all 48 sites and 27 historic structures identified to date within the project APE or an explanation of why they are not considered; (c) a correction to identify the Susquehanna and Tidewater Canal and Columbia & Port Deposit Railroad eligible for listing; (d) requirements to inventory any lands within the revised APE, evaluate identified cultural resources for eligibility, and address potential effects before sale or transfer of those lands; (e) a requirement to make good faith effort to obtain access to private property to conduct studies if project effects on cultural resources on private lands are identified; (f) a revised list of project activities involving the Conowingo Project that can be completed without Maryland SHPO review; (g) a process for assessing project-related ground-disturbing activities to determine whether or not archaeological sites would be affected, particularly in areas that have not had archaeological surveys; (h) requirements to ensure confidentiality of cultural resources location information during implementation of public outreach programs; (i) a description of project-related activities that would require consultation with the Delaware Nation and the Onondaga Nation in accordance with section 106 of the NHPA and documentation of all consultation with the Delaware Nation and Onondaga Nation; and (j) the Park Service as a consulting party.	Staff	$105,000	$45,000	$37,080[f]

[a] All capital and annual costs were provided in 2011 dollars and were escalated to 2014 dollars for the purpose of this analysis. Annual costs typically include operational and maintenance costs and any other costs that occur on a yearly basis. All costs were provided by Exelon in its license application unless otherwise noted.

[b] All capital and annual costs are converted to equal annual costs over a 30-year period to give a uniform basis for comparing costs.

[c] Cost estimated by staff, which assumes $75,000 per year in years 2, 7, 12, 17, 22, and 27.

[d] The cost of the staff alternative plan would be the same as the cost of the proposed Sediment Management Plan plus the cost of the bathymetric surveys, with no additional cost to include the two additional provisions. The cost of the dredging is included with item 55 under *Recreation*.

[e] No additional cost; continuing measure.

[f] Staff estimated the cost.

[g] Cost based on energy estimates filed with the Commission by Exelon on September 29, 2014; gain of 13,116 MWh of generation.

[h] Cost based on energy estimates filed with the Commission by Exelon on September 29, 2014; loss of 2,450 MWh of generation.

[i] Cost estimated by staff assumes $100,000 per year in years 1-3 for the initial telemetry study; no cost was estimated beyond year 3 as the phase after year 3 is speculative and may not be needed.

[j] No cost estimated for this measure as it is speculative and may not be needed.

[k] Cost estimate by staff is a preliminary ballpark estimate. Actual cost would depend on the alternative selected and the design of the alternative.

[l] Staff estimated the cost; assumes $50,000 in year 3.

[m] Cost provided by Exelon in study report RSP 3.9, *Biological and Engineering Studies of East and West Fish Lifts*.

[n] Cost provided by Exelon in study report RSP 3.9, *Biological and Engineering Studies of East and West Fish Lifts*, for second hopper plus $200,000 estimated by staff for electrical and mechanical upgrades.

[o] Cost estimated by Exelon in study report RSP 3.3, *Biological and Engineering Studies of American Eel*.

[p] Staff estimates the slight differences between Interior's recommended measure and Exelon's proposed plans would not require additional costs to implement the differences.

[q] Staff assumed that the Muddy Run Bog Turtle Management Plan could be adapted for Conowingo and that the implementation costs would be comparable to the costs estimated by Exelon for Muddy Run.

[r] This measure is included in the SMP, and the cost is assumed to part of the ongoing costs of the project.

[s] Cost of enhancements to individual recreation facilities are shown below.

[t] Exelon proposes to construct facilities that are ADA-compliant; however, the staff alternative only requires that Exelon take into account persons with disabilities in the construction of its recreation facilities.

[u] Staff estimated the cost; annual cost assumes $50,000 in years 13 and 25 for updates to the plan.

[v] The cost was provided by Exelon in study RSP 3.32, *Re-evaluate the Closing of the Catwalk to Recreational Fishing*, filed with the Commission on January 31, 2012. Note that the report was filed as a Critical Energy Infrastructure Information document,

which is not directly available to the public. If the catwalk is updated instead of being replaced, the cost would be $1,484,000. In addition, Exelon based its cost estimates on a 12 hours per day and 365-day per year opening, and the capital cost included staffing for security personnel. If the catwalk is only open on a limited basis, the staffing costs would be less.

[w] Cost provided by Exelon in its March 25, 2014, filing.

[x] The only element of the SMP that would have additional cost is the Bald Eagle Management Plan, and the costs of that plan are listed separately above.

[y] Staff estimated the cost; capital cost to revise SMP, and annual cost assumes $15,000 in years 11 and 21 for updates to the plan.

[z] Staff assumed no additional cost would be required for this measure.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a)(1) of the FPA require the Commission to give equal consideration to the power development purposes and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Any license issued shall be such as in the Commission's judgment will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. This section contains the basis for, and a summary of, our recommendations for relicensing the York Haven, Muddy Run, and Conowingo Projects. We weigh the costs and benefits of our recommended alternative against other proposed measures.

Based on our independent review of agency and public comments filed on these projects and our review of the environmental and economic effects of the proposed projects and their alternatives, we selected the staff alternative as the preferred alternative for each of the projects. In each case, the staff alternative includes elements of the applicants' proposals, resource agency recommendations, and some additional measures. We recommend these alternatives because: (1) issuance of new hydropower licenses by the Commission would allow York Haven Power and Exelon to operate the projects as economically beneficial and dependable sources of electrical energy for their customers; (2) generation from the York Haven and Conowingo Projects, with total installed capacities of 19.62 and 574.54 MW, respectively, comes from a renewable resource that does not contribute to atmospheric pollution;[126] (3) the public benefits of these alternatives would exceed those of the no-action alternatives; and (4) the recommended measures would protect and enhance water, fish and wildlife resources, protect cultural resources, and provide improved recreation opportunities at the projects.

In the following sections, we make recommendations as to which environmental measures proposed by the applicants or recommended by agencies or other entities should be included in any new license issued for the projects, and discuss the rationale for the measures we are recommending or not recommending. In addition to the applicants' proposed environmental measures, we recommend additional staff-developed environmental measures to be included in any new license issued for the projects, and we describe these requirements in the draft license articles in appendices A, B, and C of this EIS.

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[126] The 800.25 MW of capacity from the Muddy Run Project cannot be considered renewable because power used for pumping may come from non-renewable sources.

5.1.1 York Haven Project

5.1.1.1 Measures Proposed by York Haven Power

Based on our environmental analysis of York Haven Power's proposal in section 3, *Environmental Effects*, and the costs presented in section 4, *Developmental Analysis*, we conclude that the following environmental measures proposed by York Haven Power would protect and enhance environmental resources and would be worth the cost. Therefore, we recommend including these measures in any license issued for the project. We discuss any modification to York Haven Power's proposed measures below under *Measures Recommended by Staff for the York Haven Project.*

Under the terms of the Settlement Agreement, York Haven Power would implement the following environmental measures at the York Haven Project:

- Construct, operate, and maintain a nature-like fishway in the vicinity of the apex of the main dam and Three Mile Island, in compliance with design criteria specified in appendix A of the Settlement Agreement, which would become the primary means of upstream fish passage at the project.
- Develop an erosion and sediment control plan for construction of the nature-like fishway.
- Operate and maintain the existing east channel fishway as the primary means for upstream fish passage until the proposed nature-like fishway is completed.
- Continue the existing downstream juvenile American shad passage protocol that calls for the operation of units 1-6 (Kaplan and propeller units) to be first online and last offline during the juvenile shad downstream migration period (which typically is from October 1 through November 30), and opening the forebay sluice gate at specific times for downstream fish passage. If river flows exceed the capacity of units 1-6, unit 14 would be operated, and if flows exceed the capacities of units 1-6 and 14, units 7-13 and 15-30 would be operated in ascending order.
- Provide a year-round, continuous, minimum-flow from the project of 1,000 cfs and an average daily minimum flow of 2,500 cfs, or inflow, whichever is less to protect and enhance aquatic resources downstream of the project.
- Continue to operate the project in a run-of-river mode when inflow to the project is less than 3,000 cfs.
- Pass about 370 cfs through the forebay sluice gate for 1 or 2 hours in the morning during weekdays if river flows exceed the sum of: (1) the turbine hydraulic capacity; (2) flows through the nature-like fishway, once constructed; (3) flows through the east channel; and (4) flows (if any) over

the main dam from May 1 through June 30, to facilitate downstream passage of post-spawning adult American shad; and any day that river flow exceeds the combined hydraulic capacity during the fall American shad emigration period, to facilitate downstream passage of juvenile American shad.

- Pass about 370 cfs through the forebay sluice gate between the hours of 5 p.m. and 11 p.m. during the entire fall juvenile American shad passage period to facilitate downstream passage of juvenile American shad.
- Develop designs within 4 years of license issuance for: (1) removal of obstructions in or deepening of the downstream plunge pool for the forebay sluice gate, and (2) a chute structure to convey flows beyond the roadway on the downstream side of the stone masonry forebay bulkhead wall, to protect outmigrating juvenile and adult American shad passing into the downstream plunge pool.
- Cooperate with resource agencies and other interested parties to conduct a lower Susquehanna River downstream eel migration study including monitoring silver eels at the project and providing \$25,000 to support the study.
- Conduct a site-specific silver eel route of passage study and a survival study at the project, including the potential for providing \$50,000 to resource agencies for collection and tagging of silver eels at upstream locations.
- Conduct a downstream eel passage improvement study if downstream eel passage goals are not achieved with provisions for subsequent monitoring and adjustments.
- Prior to construction of the proposed nature-like fishway:
    - Provide a minimum flow of 2,000 cfs at the east channel dam and a spillage flow of 4,000 cfs at the main dam during the American shad upstream passage season when the east channel fishway is in operation.
    - After the American shad upstream passage season until the end of the resident fish passage season, maintain a minimum flow of 400 cfs in the east channel downstream from the east channel fishway during the period that the east channel fishway is operated to allow upstream passage of resident fish species, per a June 2010 Consent Order and Agreement between York Haven Power Pennsylvania DEP.

- Conduct vegetation surveys, wetlands delineations, invasive species surveys, rare species surveys, bog turtle habitat assessments, and bald eagle surveys in the area of the nature-like fishway.[127]

- After construction of the nature-like fishway:
  - Conduct American shad upstream passage effectiveness studies using radio telemetry beginning the second year of the nature-like fishway operation. If the project area passage success criterion is not achieved, York Haven Power would implement corrective measures, followed by two additional years of radio telemetry studies to confirm achievement of the project area passage success criterion.
  - Conduct a juvenile American shad headrace turbine avoidance study.
  - If the juvenile American shad headrace turbine avoidance goals are not achieved, implement measures that would enhance the effectiveness of downstream passage and conduct a supplemental juvenile American shad headrace turbine avoidance study within 2 years of implementing the measures.
  - Provide an average daily minimum flow in the east channel below the east channel dam of 267 cfs year round to protect aquatic resources in the east channel and provide a minimum passage flow for fish ascending the east channel and using the east channel fishway.
  - Provide a minimum of 5 percent of the river flow through the nature-like fishway during the American shad upstream passage season such that when inflows to the project are between 5,000 and 150,000 cfs, total flow through the nature-like fishway ranges from about 1,000 to 7,500 cfs, depending on inflow.
  - Outside of the American shad upstream passage season, provide a minimum flow of 200 cfs through the nature-like fishway when the river elevation is at the crest of the main dam.
  - When flows exceed the hydraulic capacity of all available generating units, and to the extent controllable by York Haven Power, manage flows to maximize flow over the main dam and the nature-like

[127] These proposed measures, which are cited in the explanatory statement accompanying the Offer of Settlement, would be implemented prior to the construction of the nature-like fishway.

fishway to provide attraction flow to the vicinity of and from the nature-like fishway to maximize fishway effectiveness.

- To prevent a buildup of debris that could affect project and fish passage operations, remove non-natural debris from the forebay and sluice remaining natural debris downstream, after notifying the downstream PPL Brunner Island Station.

In addition to those measures specified in the Settlement Agreement, York Haven Power also proposes to implement the following measures included in its final license application:

- Maintain existing project recreation facilities, and consult with the resource agencies on recreation resources and management strategies every 10 years after the effective date of any new license.
- Continue the current permitting program for the approximately 300 recreational lots located within the project boundary, but terminate permits and remove lots from the program if structures are abandoned by the lessee, or when existing structures become damaged and are not replaced by conforming structures.
- Implement the HPMP filed with the Commission on December 28, 2012, to manage project effects on historic properties eligible for listing on the National Register.

5.1.1.2 Additional Measures Recommended by Staff for York Haven

We recommend the York Haven Power-proposed measures described above with the following additions or modifications:

- Develop a Recreation Management Plan that provides for York Haven's proposed maintenance of its existing recreation facilities with additional provisions to update the plan every 12 years consistent with every other 6-year Form 80 reporting period deadline, continuation of the licensing program for approximately 300 recreational lots within the project boundary, and implementation of revisions to the program to allow for the termination of permits and removal of lots from the program if structures are abandoned by the lessee, or when existing structures become damaged and are not replaced by conforming structures.
- Develop an SMP that includes specific measures and policies related to shoreline management at the project and a provision to update the plan every 10 years.
- Modify York Haven's proposed HPMP with the following additional provisions: (a) request access to sites on private lands within the project boundary if project impacts are identified during shoreline monitoring

activities, assess these effects, and evaluate the affected sites for listing on the National Register; (b) develop a plan and schedule to survey and record archaeological sites on York Haven-owned fee lands within the project boundary and evaluate them for their National Register eligibility to ensure that any effects on sites owned by York Haven Power are fully considered in accordance with section 106; (c) include two additional sites (36YO300, 36YO334) in the monitoring schedule, or clarification regarding why they were excluded; and (d) include the Park Service as a consulting party.

Below we discuss the rationale for recommending proposed measures, modified measures, and additional staff measures for the York Haven Project.

Erosion and Sediment Control Plan

York Haven Power, in the explanatory statement filed with the Settlement Agreement, states that it would develop and implement an erosion and sediment control plan prior to constructing the nature-like fishway. This measure, however, is not included in the Settlement Agreement. To protect water quality during construction, we recommend the development and implementation of an erosion and sediment control plan for the fishway construction as a condition of any license issued because it would minimize effects on the river's aquatic habitat. The water quality certification for the project also requires preparation of an erosion and sediment control plan for the fishway construction, so this plan would become a mandatory condition of any license issued. We estimate that the levelized annual cost of implementing this plan would be $370 and conclude the benefits of protecting the aquatic habitat justify the cost.

Instream Flows and Flow Distribution

York Haven Power is proposing to continue its current continuous minimum flow of 1,000 cfs from the powerhouse and an average daily flow of not less than 2,500 cfs; if inflow to the impoundment is less than these amounts, discharge from the project would not be less than the inflow. Under the Settlement Agreement, York Haven Power would provide further refinements to the minimum and other project flows, including redistribution of flows for enhancement of upstream and downstream fish passage as described below and summarized as follows: (1) operate the project in a run-of-river mode when inflow to the project is less than 3,000 cfs; (2) prior to completion of the nature-like fishway (see below), provide a minimum flow of 2,000 cfs at the east channel dam during the American shad upstream passage season and 400 cfs during the resident fish passage season, and a spillage flow of 4,000 cfs at the main dam during the shad upstream passage season when the east channel fishway is in operation; (3) after completion of the nature-like fishway, reduce the east channel minimum flow to 267 cfs year-round, reduce the flow at the main dam to a minimum of 1,000 cfs (through the nature-like fishway and supplemental attraction flow channel) during the shad upstream passage season, and further reduce the main dam flow (through the nature-like fishway) to 200 cfs during the resident fish passage season; (4) provide at least 5 percent of river flow through the nature-like fishway and supplemental attraction flow channel when flows entering the project during the American shad upstream passage season are between 5,000 and 150,000 cfs; (5) when flows exceed the hydraulic capacity of all available generating units, manage flows to maximize flow over the main dam and the nature-like fishway; and (6) pass about 370 cfs through the forebay sluice gate at specified times for downstream passage of adult and juvenile shad (see below). The main purpose of this flow redistribution is to shift the emphasis of upstream passage to the nature-like fishway, while still providing passage through the east channel fishway. Overall, flows past the project would not be substantially different than current conditions, and because of the low hydraulic capacity of the project, would on average continue to spill about 60 percent of the time. The flow redistribution to enhance fish passage should act to guide fish to the new main route for upstream fish passage, the nature-like fishway. We estimate that the proposed minimum flows and flow redistribution can be provided at no additional cost.

Nature-Like Fishway

York Haven Power proposes to construct a nature-like fishway in the vicinity of the apex of the main dam and Three Mile Island, consistent with the design criteria set forth in appendix A of the Settlement Agreement. While the east channel fishway would remain in operation, the nature-like fishway would become the main route for upstream passage at the project. In conjunction with the installation of the nature-like fishway, York Haven Power proposes to modify project flow releases that would provide fish passage attraction flows to the nature-like fishway and establish this fishway as the primary fish passage facility and the existing east channel fishway as the secondary passage facility. The proposed flow release changes, as described above, would redistribute minimum flow releases among the various project flow release structures (east channel spillway, east channel fishway, nature-like fishway, main dam, and powerhouse). The overall minimum flow releases downstream of the project would not change. The nature-like fishway would also be designed so that a full range of anadromous, catadromous, and resident species could use the facility for upstream passage. In addition, York Haven Power proposes to conduct vegetation surveys, wetlands delineations, invasive species surveys, rare species surveys, bog turtle habitat assessments, and bald eagle surveys in the area of the nature-like fishway prior to construction. These surveys, done in consultation with the state resource agencies and FWS, would identify if any terrestrial resource protection measures would be required prior to construction. In section 3.3.2.2, *Water Resources, Environmental Effects*, under Upstream Fish Passage, we conclude that the proposed location and design of the nature-like fishway would be a substantial enhancement of existing upstream fish passage facilities and should improve fish passage effectiveness at the project. We estimate the levelized annual cost of conducting the pre-construction surveys would be $3,700 and the levelized annual cost constructing the nature-like fishway would be $562,020, and the benefit to Susquehanna River migratory species would be worth the cost.

Fish Passage Effectiveness Study

York Haven Power proposes to conduct an effectiveness study, using radio-tagged shad, beginning in year 2 of the nature-like fishway operation and continuing for 2 years. We agree with the need for an effectiveness study for a new fish passage facility, and especially for the novel natural-like design, which has not been constructed at any hydroelectric project on a major Atlantic coast river. The establishment of passage targets and success criteria, used properly, allow a determination of whether the fishway is operating as designed. Caution is needed, however, because many factors beyond engineering design and hydraulics may affect effectiveness, particularly for shad. For example, York Haven Power's 2010 radio telemetry study found that only 70 percent of the tagged fish released at the downstream Safe Harbor Project reached the York Haven Project area, indicating that some fish used the habitat between the projects, or had no motivation to continue upstream migration to York Haven. The Settlement Agreement acknowledges this issue, and while the upstream shad passage target is that at least 75 percent of the shad counted at the downstream Safe Harbor Project be passed above York Haven dam, compliance is based on the project area passage success criteria that 85 percent of the shad that reach the York Haven Project area successfully pass upstream of the project. This properly recognizes that York Haven Power has no control over whether or not shad reach the project area, and the proposed fish passage effectiveness study would provide additional information on the behavior of shad approaching and ultimately passing the York Haven Project. We estimate that the proposed fish passage effectiveness study would have a levelized annual cost of $16,280, and would be worth the cost to ensure that the proposed fishway is effective for upstream passage.

Downstream Fish Passage

York Haven Power is proposing to continue its downstream fish passage protocol that it has been implementing for the past several years. This includes: (1) when river flow is less than the project hydraulic capacity, prioritization of powerhouse generation through units 1 through 6 (propeller units) on a first-on/last-off basis, followed by units 7 through 20 (Francis units); (2) opening the forebay sluice gate located in the lower forebay corner adjacent to unit 1 for downstream fish passage; and (3) using temporary lighting above the forebay sluice gate to aid in attracting alosine species to the sluice gate entrance. At river flow greater than project hydraulic capacity, which occurs about 60 percent of the time, downstream fish passage occurs via spillage over the dam. Under the Settlement Agreement, York Haven Power proposes a suite of additional measures for downstream passage, including: (1) passing about 370 cfs through the forebay sluice gate for 1 or 2 hours in the morning during weekdays if river flows exceed the sum of the turbine hydraulic capacity, flows through the nature-like fishway, once constructed, flows through the east channel, and flows (if any) over the main dam from May 1 through June 30 to facilitate downstream passage of post-spawning adult American shad, and during the juvenile American shad downstream passage period to facilitate downstream passage of juvenile American shad; (2) passing about 370 cfs through the forebay sluice gate between the hours of 5 p.m. and 11 p.m. during the entire juvenile American shad passage period to facilitate downstream passage of juvenile American shad; and (3) developing designs within 4 years of license issuance for: (a) removal of obstructions in or deepening of the plunge pool below the forebay sluice gate, and (b) a chute structure to convey flows beyond the roadway on the downstream side of the cable alley structure to protect outmigrating juvenile and adult American shad that pass into the downstream plunge pool. York Haven Power is also proposing to conduct studies on the downstream migration of juvenile shad, once the nature-like fishway is in operation, including a juvenile shad headrace turbine avoidance study consistent with design criteria included in appendix D of the Settlement Agreement. If the juvenile shad headrace turbine avoidance goals are not achieved, York Haven Power would implement measures that would enhance the effectiveness of downstream passage and conduct a supplemental juvenile shad headrace turbine avoidance study within 2 years of implementing the measures. All of these measures would enhance downstream fish passage survival at York Haven, would ensure that downstream passage survival goals are met, and should be implemented by York Haven Power. We estimate that these measures would have a levelized annual cost of $1,480, while the juvenile shad headrace turbine avoidance study would have a levelized annual cost of $3,700. These measures would be worth the cost to ensure that survival goals are met.

American Eel Study

York Haven Power proposes to cooperate with resource agencies and other interested parties to conduct a lower Susquehanna River downstream American eel study including site-specific silver eel route of passage and survival studies. American eels do not currently occur in the project area in any numbers, with those present being the result of experimental upstream stockings. Because upstream passage at downstream dams, discussed under the Muddy Run and Conowingo Projects below, would require several years to develop, it would be many years before upstream migrating eels arrive in the York Haven Project area through volitional migrations. If trap and trucking of eels is implemented at Conowingo as proposed, it is likely that eels would be trucked upstream of York Haven within 2 to 3 years of license issuance and would remain in the river for 10 to 20 years before reaching the silver eel phase and out-migrating to the ocean. The nature-like fishway and the low-head configuration of the dam would likely provide for adequate upstream passage once upstream migrating eels arrive at the project, either from trucking of eels to locations downstream of York Haven, or any future volitional passage at downstream projects. Once sufficient numbers of silver eels are migrating downstream at York Haven, downstream passage measures should be implemented to ensure safe and timely downstream passage. The Settlement Agreement includes provisions for the eventual downstream passage of eels at the project, including studying the migratory pathways at the project and survival through the turbine generators, and then implementing protective measures if needed. These provisions of the Settlement Agreement would adequately protect downstream migrating eels once they arrive at the project. We estimate that the levelized annual cost of the route of passage study and survival study would be $3,700 each, and the benefit to migrating eels would be worth the cost.

Recreation Management

York Haven Power proposes a number of operational and maintenance activities related to recreation, such as maintaining canoe portage trails, fishing access, and public boat access areas and consulting with the stakeholders on recreation resources about recreation management and strategies every 10 years after license issuance. However, York Haven Power does not propose a recreation management plan. Project recreation sites, including the four islands in Lake Frederic, and sites that are leased or managed by others, receive regular use by visitors at project lands and waters. The Commission requires these facilities to be maintained and available for public recreational uses throughout the term of any future license. Development of a formal recreation management plan that includes a facility inventory with ownership and management responsibilities for each site, as well as measures to provide for periodic monitoring, would ensure the recreation facilities and sites are managed to meet use and demand over the term of any future license. Consultation with the resource agencies, counties, and other interested stakeholders in the project, including Pennsylvania FBC and Pennsylvania DCNR, in the development of the plan would ensure that stakeholder interests are represented and the facilities meet regional needs. We also agree with York Haven Power's proposal to include the entirety of the Lock 15 facility within the project boundary because the site is associated with the project's East Shore Boat Launch. The benefit to recreation resources of the development of a recreation management plan would be worth the estimated levelized annual cost of $3,710.

Shoreline Management

Aquatic, recreational, and natural resources exist along the shorelines of the York Haven Project. Operation and management of project lands and waters would continue to affect the conditions of these shoreline resources. York Haven Power proposes to continue to provide public recreation access and lease recreational lots on the islands of the project. We conclude in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects,* that preparation of an SMP that combines the shoreline permit program, York Haven's proposed monitoring program, development of an enforcement program, and provides a classification system to ensure resources are balanced in a comprehensive manner would be beneficial and ensure that the shoreline development pattern is consistent with project purposes, objectives, and any future license requirements. Development of a final SMP in consultation with the Pennsylvania FBC, Pennsylvania DCNR, and FWS would help to ensure that the management of project lands and waters along Lake Frederic's shorelines is consistent with the latest *Guidance for Shoreline Management Planning at Hydropower Projects* (FERC, 2012). Updating the SMP every 10 years would recognize the potential for growth and development along the project reservoir over the term of the license. We estimate the levelized annual cost to develop and update an SMP every 10 years would be $6,750. The benefit to the environmental resources along the shoreline would be worth the cost.

Debris Removal

York Haven Power proposes, consistent with the Settlement Agreement, to continue to remove non-natural debris from the forebay and sluice remaining natural debris downstream, with advance notification to PPL BI. As discussed in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, and section 3.3.7.2, *Aesthetic Resources, Environmental Effects*, debris accumulation, removal, and passing are part of operating a hydroelectric project. The presence of debris in project reservoirs can present safety and aesthetic hazards; however, the dynamic nature of the volume and timing of debris within any reservoir at any given time makes managing it dynamic as well. The removal and/or passing of debris that has accumulated in front of the trashracks are important components of operating hydroelectric projects of any size. Given the size of the lower Susquehanna River watershed, the amount of debris arriving and passing these projects can be significant. Implementing the debris management as detailed in the Settlement Agreement and proposed by York Haven Power would ensure debris does not pose long-term hazards to people and project operation. Notification of PPL's Brunner Island steam plant would be a continuation of the courtesy York Haven Power provides to allow PPL opportunity to plan or prepare for any inconvenience from passing debris. The continuation of debris removal immediately downstream of the York Haven Project is a benefit to the project that would not add any additional cost.

Project Boundary

The East Shore boat launch and Lock 15 provide recreation access and opportunities to York Haven Project lands and waters; however, not all of the lands associated with these two project recreational features are currently within the project boundary. The Commission would not have jurisdiction over areas if they are located outside of the project boundary. Commission regulations require that all lands necessary for the operation and maintenance of the project and for other purposes, such as recreation, be included in the project boundary. Modifying the project boundary to include all of the lands associated with the East Shore boat launch and Lock 15 would ensure these recreation amenities are provided for the public's enjoyment for the term of any license issued for the project. We estimate that the cost of including these sites within the project boundary would be minimal, and the benefits would be worth the costs.

Cultural Resources

York Haven Power proposed to implement the HPMP, filed on December 28, 2012, that provides for the management of cultural resources and historic properties within the York Haven APE. Our analysis in section 3.3.6.1, *Cultural Resources, Affected Environment*, indicates that, while the HPMP includes many of the standard requirements of a historic properties management plan, some measures contained within the HPMP would benefit from clarification and/or more detail. In addition, there are other measures that would be worth inclusion in the HPMP, and inclusion of these measures would ensure that the York Haven Project would not adversely affect historic properties over the term of any license. As such, we recommend the implementation of York Haven's proposed HPMP, but with the following additions: (a) a requirement to request access to sites on private lands within the project boundary if project impacts are identified during shoreline monitoring activities, assess these effects, and evaluate the affected sites for listing on the National Register; (b) develop a plan and schedule to survey and record archaeological sites on York Haven-owned fee lands within the project boundary and evaluate them for their National Register eligibility to ensure that any effects on sites owned by York Haven Power are fully considered in accordance with section 106; (c) inclusion of two additional sites (36YO300, 36YO334) in the monitoring schedule, or clarification regarding why they were excluded; and (d) inclusion of the Park Service as a consulting party. Finally, because the Onondaga Nation has not expressed concerns or interest in the proposed York Haven Project, we do not recommend that York Haven Power consult with the Onondaga Nation as a consulting party in the future. We estimate that the levelized annual cost to revise and implement the HPMP for the project would be $4,840 and conclude the benefits of cultural resource protection justify the cost.

5.1.1.3 Measures Not Recommended

Debris Removal in the Lower Susquehanna River Watershed

York Haven Power proposes to provide $25,000 to an entity identified by Pennsylvania DEP to remove debris in the lower Susquehanna River watershed as provided for in the Settlement Agreement, and as also required by the water quality certification. As discussed in section 3.3.2.2, *Water Resources, Environmental Effects*, and section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, almost all of the debris arrives at the York Haven project and passes over the main dam during high-flow events when river flows far exceed the hydraulic capacity of the project. York Haven removes the non-natural debris that accumulates in the forebay, and the remaining debris is sluiced downstream. We find that, under these conditions, York Haven has no control over the quantity of debris that flows downstream or where it is deposited. This proposed measure appears not to be related to any specific project impact at York Haven, nor would the measures necessarily be implemented in the project area. With a lack of nexus to the project, and because providing funds is inconsistent with Commission's guidelines on environmental measures,[128] we do not recommend including this as a license condition. While York Haven is free to provide these funds, we do not include

[128] *See* Policy Statement on Hydropower Licensing Settlements, issued September 21, 2006.

this measure in our staff alternative; however, we recognize that the Commission must include this condition in any license issued due to its mandatory nature.

5.1.2 Muddy Run Project

5.1.2.1 Measures Proposed by Exelon

Based on our environmental analysis of Exelon's proposal in section 3, *Environmental Effects,* and the costs presented in section 4, *Developmental Analysis,* we conclude that the following environmental measures proposed by Exelon would protect and enhance environmental resources and would be worth the cost. Therefore, we recommend including these measures in any license issued for the project. We discuss any modification to Exelon's proposed measures below under *Measures Recommended by Staff for the Muddy Run Project.*

- Develop a DO monitoring plan no earlier than November 1, 2027, with measures designed to ensure that the project does not violate DO standards.
- Develop FPOP for minimizing delay and potential fish entrainment during upstream and downstream fish passage past the project tailrace during generating and pumping cycles.
- Develop a plan and schedule for a radio telemetry study or equivalent Tier II study of American shad passage and behavior within the Muddy Run Project boundary if resource agencies determine that operation of the Muddy Run Project is causing the Holtwood Project to fail to meet the Tier I upstream American shad target specified in the water quality certification for the Holtwood Project.
- Implement the Bald Eagle Management Plan filed with the license application to minimize impacts on bald eagles and their habitat within the project boundary in accordance with recommendations from *the National Bald Eagle Management Guidelines* (FWS, 2007a) and state agency guidance.
- Implement the Bog Turtle Management Plan filed with the license application to minimize impacts on bog turtles and that includes: (1) the restriction of mowing in the wetland documented to support bog turtles; (2) invasive and woody plant control, particularly for reed canary grass; and (3) limits on public access to the wetland without advertising the reason.
- Implement the Recreation Management Plan filed with the license application that includes the following improvements to project recreation facilities: an improved launching ramp and barrier-free dock; shoreline erosion measures; an improved retaining wall; electric upgrades; expanded playground area near the Visitor's Center; and construction of a 2,000-square-foot water spray park near the park entrance, along with paving

resurfacing (see section 2.2, *Applicants' Proposals*, for a full description of proposed capital improvements at each site).

- Implement the SMP filed with the license application that includes measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, and use of project lands and BMPs for controlling sediment introduction.
- Implement the osprey management policy described in Exelon's proposed SMP.

5.1.2.2 Additional Measures Recommended by Staff for Muddy Run

We recommend Exelon's proposed measures as described above with the following additions or modifications:

- Visit FWS' Chesapeake Bay Field Office and the Pennsylvania Field Office websites prior to any ground disturbance, and follow the bog turtle and bald eagle guidelines.
- Modify the restrictions for mowing areas C, D, and F in Exelon's proposed Bog Turtle Management Plan to state, "avoid mowing between April to October to avoid turtle's active period."
- Modify Exelon's proposed Recreation Management Plan to include recreation use monitoring and plan updates every 12 years in concert with every other 6-year Form 80 reporting deadline.
- Modify Exelon's proposed SMP to include a provision to update the plan every 10 years.
- Develop an HPMP that provides for the management of historic properties and unevaluated cultural resources within the project APE and includes: (a) a plan for further archaeological investigations of additional AOIs and other potentially affected areas as recommended in the Phase IB report; (b) a detailed discussion of the three sites (36LA67, 36LA103, 36LA368) identified during the Phase IA cultural resources survey and the two additional sites (36LA70, 36LA47) located outside of the project boundary that could be affected by the project; (c) requirements for National Register evaluation of affected sites in consultation with the Pennsylvania SHPO; (d) requirements for formal National Register evaluation of the Muddy Run Project; (e) documentation of all consultation with the Delaware Nation and Onondaga Nation; and (f) the Park Service as a consulting party.

Below we discuss the rationale for recommending proposed measures, modified measures, and additional staff measures for the Muddy Run Project.

DO Monitoring

Exelon proposes, consistent with the Pennsylvania DEP certification, to develop a DO monitoring plan no earlier than November 1, 2027, with measures designed to ensure that the project does not violate DO standards. While water quality monitoring at the project found that violations of state water quality standards are rare, implementing this plan would ensure that standards are maintained. We did not estimate a cost for developing and implementing a DO monitoring plan because it would be more than 10 years before the plan would be developed, and any estimated costs developed now may not be relevant in the future.

Fish Passage

Exelon proposes, consistent with the clarified Pennsylvania DEP certification filed on December 10, 2014, to develop and implement an FPOP for upstream and downstream fish passage, and to develop and implement a plan and schedule for a radio telemetry study or equivalent Tier II study of American shad passage and behavior within the Muddy Run Project boundary, although no such plan would be required if available data indicate that 75 percent of the shad that pass the downstream Conowingo Project also pass through the Holtwood Project fish passage facilities (Tier I requirement), and that 50 percent of the shad that pass the Conowingo Project pass the Holtwood Project within 5 days (Tier II requirement). The Tier II study, if required, would determine the percentage of shad that enter the Muddy Run Project area at the northern tip of Sicily Island and exit the Muddy Run Project area at the southern tip of Deepwater Island. At the end of the 4-year study period, or such longer time as established by Pennsylvania DEP, if the results indicate that, as a result of Muddy Run operations, less than 88 percent of the American shad that enter the Muddy Run Project area in turn exit the Muddy Run Project area, Exelon would propose a plan and schedule for operational modifications to the extent feasible, reasonable, and technically sound to enhance fish passage past the Muddy Run Project. As we describe in our discussion of upstream fish passage in section 3.3.2.2, *Water Resources, Environmental Effects*, the Muddy Run Project is not a blockage to upstream migration, but may affect migrating fish by causing flow patterns that may confuse or delay fish passing the project, or may entrain fish during the pumping cycle. While such effects may occur, information to date indicates that the project has not had a substantial effect on upstream and downstream shad movement past the project. Nonetheless, Exelon proposes to monitor future passage by the project by use of the FPOP and a possible Tier II study. These measures would provide a mechanism for determining whether passage objectives are met, and if not, would allow application of potential corrective measures. We estimate that implementation of an FPOP would not require additional costs above current operation and maintenance costs, while a future Tier II study is speculative and may or may not occur in the future.

Downstream Eel Passage Plan

Exelon proposes, consistent with the Pennsylvania DEP certification, to implement a downstream eel passage plan to ensure safe and effective downstream eel passage past the project. Exelon would maintain downstream eel passage efficiency rates of at least 85 percent through the Muddy Run Project area. However, our recommended compliance date when that would be required is October 1, 2026, consistent with the certification, once sufficient numbers of eels have been released into the Susquehanna River to produce a substantial number of downstream-migrating silver eels. Exelon would be required to conduct studies to demonstrate compliance with the passage rate, and if not achieved would be required to provide mitigation. We have not included an estimated cost for this measure because it would occur more than 10 years into the future, and any mitigation would be speculative and dependent on whether or not the target passage rates would be met.

Bald Eagle Management Plan

Exelon proposes to implement the Bald Eagle Management Plan filed with the license application that provides for the management of bald eagle habitat on Exelon lands at the Muddy Run Project based on recommendations from the FWS *National Bald Eagle Management Guidelines* and state agency guidance. This includes implementing distance and landscape buffers around nesting sites and avoiding certain activities during nesting season. In addition, the Bald Eagle Management Plan includes guidelines for activities around roosting and foraging areas. The plan also includes provisions for monitoring of nesting, roosting, and foraging sites every 5 years and injury and mortality reporting procedures. Interior also recommends, as a 10(j) measure, the development a bald eagle management plan based on the FWS *National Bald Eagle Management Guidelines* and state agency guidance. Our analysis in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*, provides our rationale for recommending the implementation of the Bald Eagle Management Plan, as proposed by Exelon and recommended by Interior, because it would benefit bald eagles within the Muddy Run Project boundary by complying with bald eagle management guidelines and state guidelines, ensuring that future bald eagle nest, roost, and foraging areas are also protected by the Bald Eagle Management Plan, and ensuring that FWS and Pennsylvania Game Commission are aware of any project-related bald eagle mortality for the term of any new license. We estimate that the levelized annual cost of implementing the Bald Eagle Management Plan would be $750 and conclude the benefits of protecting bald eagles justify this minimal cost.

Osprey Management Policy

Exelon proposes to implement the osprey management policy described in the SMP filed with the license application that states Exelon would work with state and federal agencies to provide appropriate buffers dictated by the types of activities carried out in either visual or auditory proximity to nests during breeding and nesting season

(January to late July). This includes implementation of: (1) nest buffers during the breeding season of 330 feet for most activities and larger buffers up to 600 feet for activities with the potential to emit excessive noise (which excludes routine project operation and maintenance activities), and (2) restriction on herbicide application within 330 feet of osprey nests during breeding season. Under the policy, Exelon would consult with FWS and Pennsylvania Game Commission to determine BMPs and obtain applicable permits in the event an osprey nest on project transmission line towers is identified as a problem nest that needs to be removed or relocated. We recommend adoption of Exelon's proposed osprey management policy. Our analysis in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*, indicates implementation of the osprey management policy would benefit the osprey by enacting protection measures and following BMPs. The costs associated with implementation of the osprey management policy are included in the cost estimate for implementing the SMP.

Bog Turtle Management Plan

Exelon proposes to implement the Bog Turtle Management Plan filed with the license application. The Plan is consistent with Interior's recommended measure to develop and implement, in consultation with FWS and Pennsylvania FBC, a bog turtle management plan for the Muddy Run Project; however, in its January 7, 2015, letter concurring with our not likely to adversely affect determination, FWS' Pennsylvania Field Office recommends the plan be modified to extend the restrictions for mowing areas C, D, and F to the time period from April to October to avoid the turtle's active period. Exelon's proposed Bog Turtle Management Plan includes: (1) a restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) possible limits on public access to the wetland without advertising the reason. We provide our rationale for recommending the Bog Turtle Management Plan, with FWS' recommended modification, in section 3.3.4.2, *Threatened and Endangered Species, Environmental Effects.* This section indicates the Bog Turtle Management Plan with FWS' recommended modification would ensure that invasive species are controlled in the area and bog turtles are not affected by vegetation management during their active period. We estimate that the levelized annual cost of the Bog Turtle Management Plan would be $8,240 and conclude the benefits of protecting the federally listed bog turtle justify the cost.

Recreation Management Plan

Exelon proposes to implement the Recreation Management Plan filed with the license application that also includes a schedule for implementing proposed recreational enhancements at the Muddy Run Project. A recreation plan would allow Exelon to implement facility improvements and install new facilities in a coordinated manner, and would ensure that the proposed recreational facility improvements meet the intended purposes. However, the plan does not include a specific provision for reviewing and updating the plan over the term of any license issued. The staff alternative would include revising the plan to specify visitation and sedimentation monitoring of the boat ramp to maintain boater access and consultation efforts as part of the plan. We recommend that the Recreation Management Plan include measures to conduct a recreation use study every 12 years, consistent with every other FERC Form 80 reporting deadline, as well as review and consultation with resource agencies, counties, and other interested stakeholders in the project area, such as Pennsylvania FBC, Pennsylvania DCNR, Maryland DOE, and Maryland DNR. We estimate the levelized annual cost of the revised plan would be $2,370. We conclude that these costs would be worth the substantial benefits that would be derived from implementing the revised plan.

Recreation Facility Improvements

As part of the Recreation Management Plan, Exelon proposes to upgrade a variety of amenities within Muddy Run Park and make repairs at Wissler's Run Park near the Muddy Run powerhouse. Exelon would replace the existing boat launch facility at the Recreation Lake with a new concrete plank ramp, a new gangway, and floating dock (accessible to persons with disabilities), and also make shoreline improvements to limit erosion. Exelon also proposes to upgrade the barrier-free picnic site, stabilize 150 feet of the shoreline at the Recreation Lake between the barrier-free picnic site and the rental boat dock, convert the timber retaining wall to sheetpile retaining wall, upgrade service to 50-ampere electrical service at 50 sites, expand the playground adding a "tot lot," construct a spray park, and provide Wi-Fi service to park users. Proposed improvements to Wissler's Run Park would include removing the non-functioning fish cleaning station, rebuilding and repaving the existing walkway along the top of the bank, and designating two parking spaces near the picnicking pavilion as accessible to persons with disabilities. As part of the plan, Exelon also proposes to erect and maintain FERC Part 8 signs at River Road and Furniss Road Muddy Run WMA parking areas. Exelon proposes to continue to lease these lands to the Pennsylvania Game Commission for the term of a future license.

In our analysis in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, we conclude that improvements to the Recreation Lake boat ramp, barrier-free picnic area, shoreline, and retaining walls would improve boater access and maintain water quality by reducing runoff from these areas. Further, improvements to the ramp would enhance boater access; a popular activity on the lake. Similarly, improvements to the campground electrical service that include more 50-ampere service campgrounds and Wi-Fi would address modern camper needs such as increased use of electronic devices (e.g., recreational vehicles with air conditioning, personal computers, and smart phone charging). Removal of the non-functioning fish cleaning station at Wissler's Park would eliminate the temptation for users to clean fish on site and leave the waste, which could negatively affect the aesthetics of the area. Enhancements to the pathway and designating two additional parking areas as accessible to persons with disabilities would improve the overall recreation experience. For these reasons, we recommend implementation of Exelon's proposed recreation facility improvements. The estimated levelized annual cost of these capital improvements would be $197,320. The benefit of upgrading and expanding recreational opportunities at the project recreation sites is worth the cost.

Shoreline Management Plan

Exelon proposes to implement the SMP filed with the license application that includes specific measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, and use of project lands and BMPs for controlling sediment loading from lands within the project boundary. In our analysis in section 3.3.5.2*, Recreation and Land Use Resources, Environmental Effects,* we conclude that implementation of the SMP would provide policies to manage the project's shorelines and protect the environmental resources, including bald eagle and osprey habitat and aesthetics along the Muddy Run Project's upper reservoir and would help to minimize effects from erosion on the reservoir's shoreline. Revising the SMP to include regular updates every 10 years in consultation with interested stakeholders consistent with the latest *Guidance for Shoreline Management Planning at Hydropower Projects* (FERC, 2012) would ensure the plan is harmonious with conditions at the project. We conclude that the addition of regular updates and consultation to the SMP would be worth the estimated levelized annual cost of $1,440 to revise the SMP.

Historic Properties Management Plan

Exelon proposes to develop a cultural resources management plan if cultural materials are identified during project-related activities. Interior, under section 10(a), recommends that Exelon develop and implement an HPMP that provides for the management of historic properties and unevaluated cultural resources within the project APE. The HPMP would be prepared in accordance with the Advisory Council and Commission's joint guidance document for preparing hydroelectric project HPMPs (FERC and Advisory Council, 2002) and would include: (a) a plan for further archaeological investigations of additional AOIs and other potentially affected areas as recommended in the Phase IB report; (b) a detailed discussion of the three sites (36LA67, 36LA103, 36LA368) identified during the Phase IA cultural resources survey and two additional sites (36LA70, 36LA47) located outside of the project boundary that could be affected by the project; (c) requirements for National Register evaluation of affected sites in consultation with the Pennsylvania SHPO; (d) requirements for formal National Register evaluation of the Muddy Run Project facility; (e) documentation of all consultation with the Delaware Nation and Onondaga Nation; and (f) the Park Service as a consulting party. Our analysis in section 3.3.6.2, *Cultural Resources, Environmental Effects*, concludes that implementation of this measure would ensure that the Muddy Run Project would not adversely affect historic properties during the term of any license. We estimate that the levelized annual cost of development and implementation of an HPMP for the project would be $31,150 and conclude the benefits of protecting cultural resources and historic properties justify the cost.

5.1.2.3 Measures Not Recommended

Eel Passage Plan

The certification requires implementation of Exelon's American Eel Passage Plan, in which Exelon would establish an Eel Passage Advisory Group to help implement the plan, and would trap, hold, and transport American eels from Conowingo dam to designated points in the Susquehanna River watershed. Exelon has agreed to this measure in the certification for the Muddy Run Project, and would also implement this plan as a measure for the Conowingo Project. While we are recommending these measures at Conowingo (see section 5.1.3.1, *Conowingo Project – Measures Proposed by Exelon*), we do not recommend those measures as requirements of any license for the Muddy Run Project because the Commission cannot require a condition in any Muddy Run license that would need to be implemented at another licensed project (Conowingo). In addition, there is a lack of nexus to the Muddy Run Project, because the Conowingo Project is blocking the upstream passage of American eels, not the Muddy Run Project.

Grants to Conservation Districts and Pennsylvania FBC

Consistent with the water quality certification, Exelon proposes to provide $450,000 total to be split between the Lancaster County and York County Conservation Districts through 2030 for the implementation of agricultural pasture and barnyard BMPs to control sediment introduction into the Susquehanna River. Exelon would provide another $50,000 to Pennsylvania FBC to perform habitat improvements, including the removal of small dams.

While the certification states that the compensation is for the entrainment of resident fish, the certification does not describe how the compensation amount was determined, or how it would mitigate for fish entrainment. Funds would be used for BMPs to reduce sediment loading to the river and for habitat improvement, including dam removal. This requirement appears not to be related to any specific project impact, nor would the measures necessarily be implemented in the project area. With a lack of nexus to the project, and because providing funds is inconsistent with Commission's guidelines on environmental measures,[129] we do not recommend it be included as a license condition. While implementing BMPs to reduce sediment loading to the river and for habitat improvement in the Susquehanna River basin would be beneficial, we do not include this funding measure in our staff alternative. We recognize, however, that these

[129] *See* Policy Statement on Hydropower Licensing Settlements, issued September 21, 2006.

measures are included in the certification for the Muddy Run Project, so they would be a mandatory condition of any license issued for the project.

Rare, Threatened, and Endangered Species Annual Evaluation

Exelon proposes a plan to evaluate all state and federal endangered or threatened species that may be present within the project boundary once every 10 years through the term of the license. If the evaluation identifies the presence, critical habitat, or critical dependence of endangered species, Exelon would propose and, following approval, implement a plan to ensure protection of endangered or threatened species. Our analysis in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*, indicates that although we agree that this measure would allow Exelon to continue to be aware of the current rare, threatened, and endangered species populations in the Muddy Run Project during the length of any license, the Commission typically includes in its licenses a standard license article with a fish and wildlife reopener provision that could be used to require changes to project facilities or operation upon Commission motion or as recommended by the appropriate federal and state fish and wildlife agencies after notice and opportunity for hearing. This standard reopener provision retains authority for the Commission to implement any measures that may be needed to protect threatened or endangered species or other fish and wildlife resources over the term of any license issued for the project. Although we have no objection to Exelon conducting this agency consultation, we feel that the standard license article would provide a similar level of protection as the proposed measure. We recognize, however, that this measure is included in Pennsylvania DEP's water quality certification for the Muddy Run Project, so it would be a mandatory condition of any license issued for the project.

Providing OASIS Model to SRBC

Exelon proposes to provide the version of the Lower Susquehanna OASIS model to SRBC within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become final (i.e., are no longer appealable or subject to ongoing litigation), as per the letter agreement filed November 19, 2013. Pennsylvania DEP's water quality certification for the Muddy Run Project also requires this provision of the OASIS model to SRBC, but we are not recommending this as a requirement of any license issued because it is not a specific measure for protection or enhancement of environmental resources, and instead appears to be a transfer of information to SRBC. While transfer of this model to SRBC would likely be beneficial to SRBC for its management responsibilities in the basin, this should not be a license condition. We recognize, however, that this measure is included in Pennsylvania DEP's water quality certification for the Muddy Run Project, so it would be a mandatory condition of any license issued for the project.

5.1.3 Conowingo Project

5.1.3.1 Measures Proposed by Exelon

Based on our environmental analysis of Exelon's proposal in section 3, *Environmental Effects,* and the costs presented in section 4, *Developmental Analysis,* we conclude that the following environmental measures proposed by Exelon would protect and enhance environmental resources and would be worth the cost. Therefore, we recommend including these measures in any license issued for the project. We discuss any modification to Exelon's proposed measures under *Measures Recommended by Staff for the Conowingo Project.*

- Operate the project with a normal range of operation of Conowingo Pond between elevations 101.2 and 110.2 feet, with a minimum elevation of 107.2 feet on weekends between Memorial Day and Labor Day, to meet recreational needs.
- Enhance DO at the project using the turbine venting systems on Units 1 through 7 and the aerating runners on Units 2 and 5, and continuously monitor DO levels from May 1 through October 1 at the Station 643 location about 0.6 mile downstream of Conowingo dam.
- Operate the east fish lift to pass American shad, river herring, and other migratory fishes, and the west fish lift for American shad egg collections and other research purposes.
- Manage debris to include clamming (with three gantry cranes with grapple attachments) to remove submerged debris from the area upstream of the powerhouse intakes and floating surficial debris in front of the powerhouse intakes, and sponsoring community-based clean-ups in the pond and downstream of the dam.
- Implement the Sediment Management Plan filed with the license application that identifies benchmarks and thresholds for action to address sediment issues that may affect project operation.
- Conduct a bathymetric survey of Conowingo Pond every 5 years to monitor sediment transport and depositional patterns.
- Implement a preventive maintenance program for the east fish lift to extend the useful life of the facility over the next license term.
- Use the project turbines as the route for downstream passage of American shad and river herring.

- Construct a permanent trap and transport facility for upstream passage of American eel, consisting of an eel ramp and collection facility on the west bank of the Conowingo tailrace and a similar facility on the east side of the river on Octoraro Creek.
- After 2030, construct volitional eel passage facilities on the west and east banks that consist of full eel ramps with resting pools.
- Implement the Bald Eagle Management Plan filed with the license application to minimize impacts on bald eagles and their habitat within the project boundary in accordance with recommendations from the National Bald Eagle Management Guidelines (FWS, 2007a) and state agency guidance.
- Implement the Recreation Management Plan filed with the license application that provides for improvements to 13 project recreation facilities, including directional signage to facilities and canoe portages, expanded parking, barrier-free boat trailer parking spaces, fencing, shoreline stabilization, new or repaired boat ramps, picnic tables, portable restrooms, and other amenities.
- Implement the SMP filed with the license application that includes measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, BMPs for controlling sediment introduction from lands within the project boundary, and use of project lands.
- Implement the osprey management policy described in Exelon's SMP.
- Implement the HPMP filed with the license application for the management of archaeological and historic resources, including: (1) a schedule and methodology for completing any additional recommended studies and implementing monitoring measures; (2) management measures for identified historic properties including Conowingo dam and powerhouse; (3) protection of any historic properties threatened by project-related activities, including project operation, shoreline and aquatic recreation, shoreline development, routine project maintenance, and other project activities or operations; and (4) public outreach, education, and signage for the purpose of reducing looting and vandalism of sites.

5.1.3.2 Additional Measures Recommended by Staff for Conowingo

We recommend Exelon's proposed measures as described above, with the following additions and modifications:

- Modify Exelon's proposed Sediment Management Plan to include periodic dredging at the Conowingo Creek, Peters Creek (Peach Bottom Marina), and Broad Creek boat ramps, where sediments have been accumulating, to improve and maintain recreational boating access; include metrics (magnitude or frequency of sediment loading storm events) that would trigger action to protect boating access between the 5 year monitoring interval; and include with the results of each bathymetric survey an analysis of any change in sediment deposition or scour in the pond from the previous survey(s).
- Modify Exelon's proposed minimum flow regime to enhance minimum flows from December through February, by eliminating periods with no minimum flow, and by increasing the minimum flow during the first 2 weeks of June, summarized as follows:
  - September 15 – March 31: 3,500 cfs or natural inflow (as measured at the USGS Marietta gage No. 0157600), whichever is less;
  - April 1 – April 30: 10,000 cfs or natural inflow, whichever is less;
  - May 1 – June 15: 7,500 cfs or natural flow, whichever is less;
  - June 16 – September 14: 5,000 cfs or natural inflow, whichever is less.
- Implement measures designed to improve upstream fish passage through modification to the existing west and east fish lifts, including: (a) replacing the existing hopper at the west fish lift with a 1,500 gallon hopper; (b) improving the west fish lift sorting and loading process to facilitate trap and truck operations, and implementing a trap and truck program for American shad; (c) conducting a feasibility study for adding attraction flow at the west fish lift and if feasible and beneficial, installing additional flow capacity; (d) restoring the original design for the 900-cfs attraction flow in the east fish lift; (e) adding a second 3,300-gallon hopper to the east fish lift in the space provided for in the original design, and upgrading the electrical and mechanical equipment to allow for a 15-minute lift cycle; and (f) if 2 years of effectiveness studies, after restoration of the 900-cfs attraction flow, show poor attraction at the east fish lift, conducting a feasibility study for modifying the locations of entrances A and B, and implementing the modifications, if feasible.
- Modify Exelon's proposed Bald Eagle Management Plan to include measures to minimize recreation-related disturbance in proximity to roosting or foraging eagles.
- Develop a northern map turtle protection plan to minimize project impacts on map turtles through monitoring, habitat management, and nest site protection.

- Develop a waterfowl nesting protection plan to identify waterfowl nesting habitat that is routinely flooded by project peaking operations during the breeding season, and where feasible, establish mitigation measures to minimize impacts on waterfowl nests.
- Develop a bog turtle management plan, in consultation with FWS and Maryland DNR, to minimize impacts on bog turtles, that includes: (1) the restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) limits on public access to the wetland without advertising the reason.
- Modify Exelon's proposed Recreation Management Plan to include recreation use monitoring and plan updates every 12 years in concert with every other 6-year Form 80 reporting deadline; inclusion of the Park Service as a consulting party; a provision to provide angler access to the catwalk on a limited basis and security measures in place that address the vulnerability of the facility and the safety of the users of the catwalk; a cross reference to the Sediment Management Plan to provide periodic dredging of tributary boat access areas; and development and implementation of a debris management program in consultation with Pennsylvania FBC, Maryland DNR, and Susquehanna River Boaters Association that includes: (1) debris management goals, (2) BMPs for debris management on Exelon-owned lands to minimize additional inputs into the pond, (3) methods of debris management (e.g., clamming in front of dam and by skimmer boat), (4) timeframes for when debris would be collected and frequency of skimmer boat and clamming operations, (5) size criteria specification, (6) removal of stored debris procedures, (7) tracking procedures, and (8) a hotline for boaters to directly link with Exelon staff.
- Modify Exelon's proposed SMP with the addition of a provision to update the plan every 10 years.
- Modify Exelon's proposed HPMP to include the following additional provisions: (a) a revised APE with the narrow strip of land in the current project boundary extending downstream from Spencer Island along the west side of the river to Havre de Grace, Maryland; (b) a discussion of all 48 sites and 27 historic structures identified to date within the project APE or an explanation of why they are not considered; (c) correction to identify the Susquehanna and Tidewater Canal and Columbia & Port Deposit Railroad eligible for listing; (d) requirements to inventory any lands within the revised APE, evaluate identified cultural resources for eligibility, and address potential effects before sale or transfer of those lands; (e) a requirement to make a good faith effort to obtain access to private property to conduct studies if project effects on cultural resources on private lands

are identified; (f) a revised list of project activities involving the Conowingo Project that can be completed without Maryland SHPO review; (g) a process for assessing project-related ground-disturbing activities to determine whether or not archaeological sites would be affected, particularly in areas that have not had archaeological surveys; (h) requirements to ensure confidentiality of cultural resources location information during implementation of public outreach programs; (i) a description of project-related activities that would require consultation with the Delaware Nation and the Onondaga Nation in accordance with section 106 of the NHPA and documentation of all consultation with the Delaware Nation and Onondaga Nation; and (j) inclusion of the Park Service as a consulting party.

Below we discuss the rationale for recommending proposed measures, modified measures, and additional staff measures for the Conowingo Project.

Reservoir Operations

Exelon is proposing to continue operating Conowingo Pond using the same reservoir operating limits as currently employed. Currently, Exelon operates Conowingo Pond between elevations 101.2 and 110.2 feet, with a minimum elevation of 107.2 feet on weekends between Memorial Day and Labor Day, to meet recreational needs. No entity made recommendations to change the current reservoir elevations, and our analysis found that current reservoir operation adequately protect aquatic resources and recreational use of the reservoir. Therefore, we are recommending continuation of existing reservoir operation, which can be implemented at no additional cost to the project.

DO Enhancement Measures

Exelon is proposing to continue DO enhancement at the project using turbine venting and aeration. Since placed into operation, these systems have been shown to maintain adequate DO levels downstream of the project nearly 100 percent of the time. Exelon would also continuously monitor DO levels from May 1 through October 1 at the Station 643 location about 0.6 mile downstream of Conowingo dam. No entities have recommended additional measures for protection or enhancement of DO levels, and because state standards are being met, we are recommending continuation of existing DO measures and DO monitoring. These measures and monitoring can be implemented at no additional cost to the project.

Sediment Management and Bathymetric Surveys

Exelon proposes to implement the Sediment Management Plan filed with the license application to identify benchmarks and thresholds for actions to address sediment issues that may affect project operation. Exelon also proposes to conduct bathymetric surveys every 5 years. In section 3.3.1.2, *Geology and Soils, Environmental Effects*, we conclude that these measures are relevant tools for managing the sediment accumulation issues in the reservoir, ensuring effective power generation, maintaining recreation facilities, as well as providing information for environmental management of the lower Susquehanna River system and the Chesapeake Bay. Implementation of the proposed Sediment Management Plan would include monitoring of the water depth at Peter's Creek (Peach Bottom Marina), Conowingo Creek, and Broad Creek (Harford County boat launch) every 5 years; however, the plan stops short of identifying at what depths the locations need to be dredged and scheduling dredging. These three boat ramps represent half of the boat ramps providing access to Conowingo Pond for motorized boating. As discussed in our analysis in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects,* cross referencing the bathymetric mapping proposed under the Sediment Management Plan at the three sites into the final Conowingo Recreation Management Plan would ensure bathymetric mapping results are included in discussions related to boater access to the reservoir. Development of a final Sediment Management Plan that includes detailed benchmarks for dredging, a schedule, and commitment to dredging the three access areas as soon as the benchmark water depths are reached would ensure that recreation access is not lost or compromised indefinitely. Including measures that account for high flows and sediment loading between the 5-year surveys would ensure recreational boating opportunities are not compromised longer than necessary. We estimate that the levelized annual cost of implementing regular bathymetric surveys at 5-year intervals and implementing the Sediment Management Plan would be $10,480 and $6,220, respectively. We estimate the levelized annual cost of dredging at the three boat ramps would be $493,030. We conclude that the benefits of understanding and managing sedimentation issues in the reservoir and ensuring accessing to the reservoir justify the cost of these measures.

Instream Flows

Exelon proposes to continue its current minimum flow releases from the project, which are an alternating 0/3,500 cfs (6 hours on/6 hours off) from December through February, 3,500 cfs in March, 10,000 cfs in April, 7,500 cfs in May, 5,000 cfs from June through September 14, and 3,500 cfs from September 15 through November.[130] Exelon is not proposing any changes in the current maximum generating flow rate from the project (86,000 cfs), or in project ramping rates. Interior, in its section 10(j) recommendation, stated that Exelon should finalize and implement a flow management plan and implement the flow recommendations of The Nature Conservancy or any more restrictive flows required by the Maryland certification (when issued), returning the river downstream of Conowingo to more natural conditions. The Nature Conservancy recommended flows be released downstream of Conowingo dam sufficient to achieve

[130] Exelon would provide the lesser of these flows or the natural inflow at the upstream Marietta, Pennsylvania USGS gage No. 0157600.

several habitat objectives for diadromous and resident fish species, mussels, map turtles, and submerged aquatic and emergent vegetation (the TNC Flow Regime). The Nature Conservancy also recommended that the EIS evaluate two operational alternatives: (1) run-of-river operation (passage of the daily average flow measured at the USGS Marietta, Pennsylvania, gage plus any intervening flows that enter the river between the Marietta gage and Conowingo dam); and (2) the set of operational constraints that The Nature Conservancy identified as a potential approach for meeting its performance goals.

Our revised flow analysis found that the amount of persistent aquatic habitat is similar and the ranges of persistent habitat actually overlap for some life stages between the current Exelon flow regime and the TNC Flow Regime. In addition, overall, the current and proposed Exelon operations generally bracket the range of flows that would provide 70 percent of MWUA (a primary goal of the TNC Flow Regime) for target species, as determined by Exelon's instream flow study. However, we also found that some small adjustments to Exelon's proposed flow regime would provide additional benefits to aquatic habitat. These adjustments include: (1) eliminating the 6-hour periods of zero minimum flow from December through February, resulting in a continuous minimum flow of 3,500 cfs from September 15 through March; 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.

While we conclude that the flow issue downstream of Conowingo dam is complex, our analysis found that Exelon's current flow regime is generally adequate for protection of aquatic resources downstream of the project, although the adjustments to these flows as we discussed would provide additional protection to aquatic habitat. Therefore, we recommend that Exelon provide, upon issuance of any new license, a modified minimum flow regime downstream of the project as follows:

- September 15 – March 31: 3,500 cfs or natural inflow (as measured at the USGS Marietta gage No. 0157600), whichever is less;
- April 1 – April 30: 10,000 cfs or natural inflow, whichever is less;
- May 1 – June 15: 7,500 cfs or natural flow, whichever is less;
- June 16 – September 14: 5,000 cfs or natural inflow, whichever is less.

This modified flow regime would provide the environmental benefits described above and would result in an energy loss at Conowingo (levelized annual value of \$65,030), and a small loss in energy (levelized annual value of \$14,590) at Muddy Run. This, however, would be worth the cost in providing additional protection to aquatic resources, and it would preserve the developmental benefits of the project, including peaking generation and ancillary services.

Upstream Fish Passage

The Conowingo Project currently operates two fish lifts at the project: the west fish lift first constructed in 1972, and now operated primarily for shad egg taking and experimental purposes, and the east fish lift constructed in 1991, which provides upstream volitional passage for American shad and other species. Exelon proposes to continue operating these facilities and to implement a preventive maintenance program at the east fish lift to extend the life of the facility through the new license term. Several commenting entities have stated that the current facilities are inadequate and outdated and fail to meet the current resource agency effectiveness targets to achieve successful anadromous fish restoration in the Susquehanna River. Both Interior and NMFS reserve their authority to prescribe additional fishways during the term of the license. Interior also recommends that Exelon prepare an operations and maintenance plan for Conowingo fish passage facilities, and an FEMP. Interior initially recommended as a section 10(j) measure that an alternative G be implemented to improve fish passage at the Conowingo Project.[131] As noted previously, Interior has since withdrawn its section 10(j) recommendation for alternative G; however, we retain our analysis of alternative G because Interior indicates that alternative G is its most developed alternative and its fishway prescription, when issued, may be similar. Alternative G includes: (1) construction of a new west fish lift with two lifts for both trap and trucking and direct volitional upstream shad passage; (2) modification of the east fish lift stilling basin to allow 900-cfs attraction flow, as originally designed, relocation and reconstruction of entrances A and B, and construction of a new entrance D and collection gallery; and (3) adjustment of minimum flows and turbine operations, construction of an east fish lift auxiliary water supply of 4,325 cfs, and upgrades to the east fish lift equipment to allow a 15-minute cycle time if FWS fish passage efficiency targets are not met after implementation of the above measures.

Exelon, in its reply comments, states that there is currently no need to construct additional fish passage facilities at Conowingo dam, that the recent shad population trends in the Susquehanna River and along the Atlantic coast do not indicate that large increases in shad populations are likely, and that there is no scientific basis for the target effectiveness rates that Interior and other agencies have recommended for fish passage facilities at Conowingo and the other Susquehanna River hydroelectric projects. Exelon also comments that past agency management decisions for the Susquehanna River have been flawed, including the decision to terminate shad trap and truck operations from Conowingo after 1996, resulting in a decrease in the number of spawners reaching upriver spawning habitat.

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[131] Alternative G was one of several alternatives that Interior evaluated for fish passage improvements at the project.

As part of our analysis, we assessed fish passage effectiveness for shad at Conowingo, other Susquehanna River Projects, and other hydroelectric projects in North America. We also assessed shad population trends on the Susquehanna River and elsewhere on the Atlantic coast, and analyzed the fish passage designs discussed by Interior, compared to alternative designs. Our analysis could not find any specific scientific basis for the agencies' effectiveness targets; however, those targets are specified in the Migratory Fish Management and Restoration Plan for the Susquehanna River Basin (SRAFRC, 2010).[132] We also could not find any examples where shad upstream passage effectiveness has consistently reached such high levels. Safe Harbor Project has the highest effectiveness on the Susquehanna River, averaging 71 percent of the fish passed at the downstream Holtwood Project, but in many years does not reach that effectiveness. On the Columbia River, which has an established large shad population on a multiple dam system, passage effectiveness is typically only about 50 to 55 percent of the next lower dam. While we do not dispute that high effectiveness should be an objective for any fish passage facility, the specific effectiveness targets of Interior and other agencies may not be realistic or achievable. Our review of the shad population in the Susquehanna River found that the river exhibited strong population growth from the 1970s into the early 2000s, as a result of restoration efforts, but has been in decline since 2001. Exelon and the agencies both comment that one of the major reasons for that decline was the suspension of shad trapping and trucking in 2000, and the switch to volitional passage in that year. We agree and found that the number of shad reaching prime upstream spawning habitat has declined significantly since trucking was eliminated. We also discuss other potential reasons for the decline in the population, including the very large increase in the gizzard shad population in the river since 2000, the introduction of predator species such as the flathead catfish, and the continuation of an offshore fishery for shad. The Susquehanna River shad population trends also mirror the trends in many other rivers tributary to the Chesapeake Bay and along the Atlantic coast, which has been acknowledged by ASMFC.

Even though the agency fishway effectiveness targets may be overly optimistic and shad populations are depressed coast-wide, we reviewed the fish passage designs at Conowingo in light of alternative G and other agency recommendations calling for fish

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[132] The SRAFRC (2010) effectiveness targets are: that 75 percent of the fish passed at a lower dam must be passed at the next upstream dam, and that the total passage should be 85 percent of those fish that arrive at each dam. Another recently developed agency target is that, of the fish that reach each dam, 80 percent of those fish must pass within 36 hours. The 80 percent passage within 36 hours effectiveness target was developed by the FWS as a result of theoretical modeling that evaluated the effects of migratory delays on shad spawning success in the Susquehanna River (Sweka and Eyler, 2013). Alternative G includes this target effectiveness as a goal for any fish passage improvements at the Conowingo Project.

passage improvements, and because fish passage effectiveness at Conowingo has been shown to be low in some years. Our assessment of alternative G is that the designs called for are overly ambitious and would require a major investment by Exelon in facilities that are not needed at present. In the draft EIS, we estimated that alternative G would have a high levelized annual cost of $2,334,260. We agree, however, with Interior and other commenters that improvements are needed at the fish lifts, because of maintenance requirements, the fact that these facilities are "showing their age," and that for the east fish lift, it has not been operating as it was originally designed. As such, we recommend a phased approach to these improvements. The following summarizes the improvements that we recommend: (1) replace the existing west lift hopper with a 1,500-gallon hopper, and associated structural, electrical, and mechanical upgrades; (2) improve the west lift fish sorting and loading process, to facilitate trap and trucking, and purchase trucks, transport tanks and associated equipment and implement trap and trucking at the west lift; (3) conduct a feasibility study on increasing the west lift attraction flow, and install additional attraction flow capacity if needed; (4) restore the original design of 900-cfs attraction flow in the east lift; (5) add a second 3,300-gallon hopper in the east lift in the space provided for in the original design, and upgrade electrical and mechanical equipment to allow a 15-minute lift cycle time; (6) after restoration of the 900-cfs attraction flow and if 2 years of effectiveness studies at that flow show poor attraction to the lift, conduct a feasibility study for modifying the locations of entrances A and B; and (7) implement changes to entrances A and B if the feasibility study indicates it would be technically feasible and result in improved effectiveness. We also recommend a study on effects of gizzard shad on passage efficiency, capacity, and interference with American shad use of the Conowingo fish lifts. This study may provide information on how lift operations may be modified to discourage gizzard shad use of the lifts, or potential sorting mechanisms to separate the two species.

Under the staff alternative, we recommend the above lift improvements so that trapping and trucking can be restored to the west lift as a primary function, along with the west lift's secondary functions for collection of shad eggs and other experimental purposes, while the east lift would continue to operate as a volitional passage facility, to supply fish to upstream fish passage facilities. We conclude that, while this alternative would involve substantial costs (levelized annual cost of $959,760 for identified engineering costs, and $260 levelized annual cost for the gizzard shad study), it would enhance American shad restoration in the Susquehanna River in a phased and economically reasonable manner.

American Eel Passage

At the Muddy Run Project, Exelon incorporated the Pennsylvania DEP certification into its proposal for the project, which requires Exelon to implement Exelon's American Eel Passage Plan, with all measures to occur at Conowingo. Thus, Exelon proposes upstream eel passage at Conowingo. That would include interim trap and truck facilities on the west side of the tailrace and another similar facility on the east side of the river on Octoraro Creek. Those facilities would operate until 2030, when the facilities would be replaced with volitional passage facilities. Interior also recommends construction of eel trapping and trucking and eventually volitional facilities on both shorelines at the Conowingo Project.[133] For downstream passage, Interior recommends that Exelon maintain downstream eel passage survival rates of at least 85 percent through the Conowingo Project, with follow-up effectiveness studies to determine whether downstream passage rates are achieved. If not achieved, Exelon would evaluate changes in operation and fish guidance systems to provide safe, timely, and effective downstream fish passage. We are in agreement with the proposed and recommended American eel passage measures and recommend that they become conditions of any license issued. One caveat that we recommend is that the transition to volitional passage at Conowingo not be set to a fixed date (in the year 2030), but be based on a specific need. A trap and trucking program may still be viable past 2030 and it would give managers the option to stock specific watersheds that may not be available with volitional passage, or in the event volitional passage facilities at the three lower Susquehanna River Projects are not highly effective. We estimate that the levelized annual cost for the trap and transport facilities would be $883,380, and the volitional facilities would be $467,400. While these costs would be substantial, they are justified because implementation of these measures would allow for upstream passage of the American eel, which has been excluded from the Susquehanna River since the original construction of Conowingo dam in 1928.

Bald Eagle Management Plan

Exelon proposes and Interior recommends a measure to finalize and implement the Bald Eagle Management Plan filed with the license application that provides for the management of bald eagle habitat on Exelon lands at the Conowingo Project. The Bald Eagle Management Plan is based on recommendations from the FWS *National Bald Eagle Management Guidelines* and state agency guidance. It includes implementing distance and landscape buffers around nesting sites and avoiding certain activities during nesting season. In addition, the Bald Eagle Management Plan includes general guidelines for activities around roosting and foraging areas. The plan also includes provisions for monitoring of nesting, roosting, and foraging sites every 5 years and injury and mortality procedures. Interior indicates two specific measures that Exelon should reconcile to avoid disturbance of eagle concentration areas: (1) enforcement of human traffic restrictions on both sides of Rowland Island, under the towers in the river, and on the Cecil County side of the river where current human activities disturb perching and

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[133] Interior's recommended terms and conditions filed January 31, 2014, include a statement that the Commission should require the conditions included in Attachment A to its letter in any license issued for the Conowingo Project. Attachment A includes measures for upstream eel passage as described herein.

foraging eagles; and (2) a requirement that Exelon release information pertaining to federal regulations that protect eagles and great blue heron rookeries, and other migratory birds if any lands are potentially donated by Exelon.

We provide our analysis for recommending Exelon's proposed Bald Eagle Management Plan in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*. This section indicates implementation of the Bald Eagle Management Plan, as proposed by Exelon and recommended by Interior, would benefit bald eagles within the Muddy Run and Conowingo project boundaries by complying with bald eagle management guidelines and state guidelines, ensuring that future bald eagle nest, roost, and foraging areas are also protected by the bald eagle management plan, and ensuring that FWS and Pennsylvania Game Commission are aware of any project-related bald eagle mortality for the term of any new license. In addition, Interior's recommendations to enforce restrictions to human activity in the vicinity of eagle concentration areas would result in greater protection of foraging and communal roosting bald eagles from human disturbance. Although Exelon's proposed Bald Eagle Management Plan provides project-specific restrictions, buffers, and other measures to protect nests in accordance with the National Bald Eagle Management Guidelines, it only mentions general guidelines related to foraging and roosting areas. As such, we recommend the plan become a condition of any license issued for the project, with the addition of Interior's recommendations for Exelon to develop and implement measures to enforce restrictions on human activity in proximity to roosting or foraging eagles. Such measures could include increased signage, patrols of the area, or, possibly, physical restrictions. As Exelon has not proposed to donate lands as part of the proposed project, it is not necessary at this time to include a measure in the proposed Bald Eagle Management Plan that would require Exelon to release information on bald eagles or other migratory species to a recipient. We estimate that the levelized annual cost of implementing the bald eagle management plan would be $1,740 and conclude the benefits of protecting bald eagles justify the cost associated with implementing the revised plan.

Osprey Management Policy

Exelon's proposed osprey management policy, described in Conowingo's proposed SMP, states that Exelon would work with state and federal agencies to provide appropriate buffers dictated by the types of activities carried out in either visual or auditory proximity to nests during breeding and nesting season (January to late July). This includes implementation of: (1) nest buffers during the breeding season of 330 feet for most activities and larger buffers up to 600 feet for activities with the potential to emit excessive noise (which excludes routine project operation and maintenance activities); (2) restrictions on herbicide application within 330 feet of osprey nests during breeding season; and (3) consultation with FWS and Pennsylvania Game Commission to determine BMPs and obtain applicable permits in the event an osprey nest on project transmission line towers is identified as a problem nest that needs to be removed or relocated. Our analysis in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*, indicates implementation of the osprey management policy would benefit the osprey by enacting protection measures and following BMPs. Therefore, we recommend adopting this recommendation. The estimated annual cost of implementing the osprey management policy is included in the cost of implementing the SMP.

Waterfowl Nesting Protection Plan

Interior recommends under section 10(j) that Exelon develop and implement a waterfowl nesting protection plan in consultation with FWS and file it with the Commission for approval. Such a plan would: (a) identify specific project-related effects on nesting waterfowl, such as flooding during nesting season; (b) identify which species of nesting waterfowl are affected, if any; and (c) if project-related effects are identified, establish appropriate protection or mitigation measures, in consultation with FWS. In our analysis in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*, we conclude that implementation of a waterfowl nesting protection plan at the Conowingo Project would identify any specific project-related effects on waterfowl nesting and allow appropriate protection or mitigation measures to be established. Overall, implementation of a waterfowl nesting protection plan at the Conowingo Project, in consultation with FWS and the state agencies, would benefit nesting waterfowl. We recommend adopting the plan and estimate that the levelized annual cost of implementing the waterfowl nesting protection plan would be $19,980. We find that the benefits of protecting nesting waterfowl at the project warrant the cost of developing and implementing a plan.

Northern Map Turtle Protection Plan

Although Exelon did not propose any specific measures for the protection of northern map turtles at the project, Exelon has worked with Towson University and Maryland DNR to develop potential measures that could enhance the map turtle population; some of these measures (i.e., artificial basking platforms) are still experimental, however, and it may take several years to develop an optimal design. Other potential measures (i.e., restricting public access at Octoraro Beach during the nesting season and educating recreational boaters regarding the need to minimize disturbance of basking map turtles) may take several years to implement and additional time after that for any positive population trend to be documented. Negative effects, such as nest destruction and predation on incubation eggs, are likely to continue in the future. Consequently, a relatively long-term population monitoring program would be necessary to document whether implemented enhancements are resulting in the expected positive population effects. We recommend the development and implementation of a formal northern map turtle protection plan at the Conowingo Project, in consultation with Maryland DNR, that incorporates nest management and mitigation measures to create new alternative nesting and basking sites. There are numerous factors that contribute to the breeding success or failure of map turtles, and some may be project-related. The northern map turtle protection plan should include the development and implementation of nest management and alternate basking site mitigation and protection measures identified and studied during the ongoing Towson University map turtle studies; annual monitoring of the northern map turtle population at the Conowingo Project for 10 years; annual monitoring of the use and success of both the mitigation and protection measures for 10 years; an assessment of the northern map turtle's response to any changes in operating regime as a result of any license issued; and methods of altering or amending protection and mitigation measures as a result of the monitoring, in consultation with Towson University and Maryland DNR. Our analysis in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*, indicates that implementation of a northern map turtle protection plan would benefit the map turtle by increasing nesting success and providing more stable basking sites. We estimate that the levelized annual cost of implementing the northern map turtle protection plan would be $14,830 and conclude the benefits of protecting northern map turtles justify the cost.

Bog Turtle Management Plan

Interior recommends that Exelon develop and implement a bog turtle management plan, in consultation with FWS and Maryland DNR, for the Conowingo Project. Interior's recommended plan includes: (1) a restriction of mowing in the wetland documented to support bog turtles; (2) invasive plant and woody plant control, particularly for reed canary grass; and (3) possible limits on public access to the wetland without advertising the reason. We provide our rationale for recommending a bog turtle management plan in section 3.3.4.2, *Threatened and Endangered Species, Environmental Effects.* This section indicates a bog turtle management plan would ensure that invasive species are controlled in the area and the wetland is not affected by vegetation management during the emergence and breeding season. We estimate that the levelized annual cost of a bog turtle management plan would be $8,240 and conclude the benefits of protecting the federally listed bog turtle justify the cost.

Recreation Management Plan

The Conowingo Project provides a variety of recreational resources, and Exelon developed a Recreation Management Plan and schedule for implementing proposed recreational enhancements to enhance these resources. Exelon proposes to implement the proposed Recreation Management Plan to manage the project reaction facilities. As discussed in in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects,* a recreation plan would allow Exelon to implement facility improvements and install new facilities in a coordinated manner, and would ensure that the proposed recreational facility improvements meet the intended purposes while making a range of amenities accessible for persons with disabilities. However, the plan does not include a specific provision for reviewing and updating the plan over the term of any license issued. Similarly, the sedimentation of Peach Bottom Marina, Conowingo Creek, and Broad Creek on Conowingo Pond could compromise access at these locations. The staff alternative includes revising the plan to cross reference the Sediment Management Plan and specify visitation and sedimentation monitoring and dredging activities, as well as consultation efforts as part of the plan. We recommend that the final Recreation Management Plan for the project include measures for conducting a recreation use study every 12 years throughout the license term, consistent with every other 6-year FERC Form 80 reporting period, to ensure the proposed plans are current and the sites are meeting the demand. We also recommend that Exelon review and update the plan every 12 years in consultation with resource agencies, counties, and other interested stakeholders in the project area, such as Pennsylvania FBC, Pennsylvania DCNR, Maryland DOE, Maryland DNR, and the Park Service. We also agree with the current practice of maintaining a minimum level of 107.2 feet at Conowingo Pond during weekends between Memorial Day and Labor Day to ensure sufficient depths for recreational boating activities over the term of any future license; however, this operation can be reviewed as part of a future update. We estimate the levelized annual cost of the final Recreation Management Plan would be $7,410. We conclude that this cost would be worth the substantial benefits that would be derived from implementing the plan as revised.

Recreation Facility Improvements

Exelon proposes improvements at 13 recreation facilities. In our analysis in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects,* we conclude that Exelon's proposed boat ramp and boat launch enhancements at existing recreation facilities would provide significant improvements to the project's recreational resources. Implementation of the proposed Sediment Management Plan, as discussed in section 3.3.1, *Geology and Soils*, would, at a minimum, monitor the depth of sediment at Peter's Creek (Peach Bottom Marina), Conowingo Creek, and Broad Creek (Harford County boat launch) every 5 years; however, the plan stops short of identifying at what depths the locations need to be dredged and scheduling dredging. These three boat ramps represent half of the boat ramps providing access to Conowingo Pond for motorized boating. Visitor survey results indicate that 6 percent of the comments received at Conowingo Creek targeted shallow water/dredging needs. Similarly, maintaining the minimum pond elevation at 107.2 feet on weekends between Memorial Day and Labor Day as currently required would ensure the boating resources are maintained through the term of any license. Cross-referencing the sediment monitoring proposed at the three access sites under the Sediment Management Plan into the final Conowingo Recreation Management Plan would ensure sediment monitoring results are included in discussions related to boater access to the reservoir. Development of a final Sediment Management Plan that includes detailed benchmarks for dredging, a schedule, and commitment to dredging the three access areas as soon as the benchmark sediment depths are reached would ensure that recreation access is not lost or compromised indefinitely. Implementation of the proposed improvements at Exelon's recreation facilities would have an estimated levelized annual cost of $218,240 (not including the Sediment Management Plan, which is discussed separately above). The benefit of safe, accessible, and well-maintained recreation facilities at this highly used reservoir warrants the annual cost of implementing these measures.

Catwalk

Exelon has closed the catwalk for angling since October 2001, citing security concerns related to public access in proximity to the powerhouse. Maryland DNR and a number of citizens recommend reopening the catwalk for angler access. Exelon has denied these requests citing safety and security concerns and stated that the construction of the wharf at Fisherman's Park and the new access at Octoraro Creek Park were provided to mitigate for the closure of the catwalk. Recreation use numbers collected by Exelon for Fisherman's Park indicate the site is popular and provides shore-based fishing as well as boat launch opportunities to the river below the dam. Although not measured directly, the latent demand for angling from a re-opened catwalk could be comparable to, or higher than use at the upstream York Haven and Safe Harbor Projects. We conclude (see section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects)* that the catwalk provides exceptional angling opportunities different from those currently provided at the new access sites. Angling from similar structures at upstream hydropower projects is both allowed (with minimal security measures) and popular.

Comments during relicensing indicated that fishing from the shore at Fisherman's Park is difficult because the main channel is far away and lures are pushed downstream and to the shore. The proximity of Conowingo dam to large population centers offers more anglers opportunities to fish this unique and historically popular resource. Providing this opportunity at Conowingo, even on a limited basis, would expand the diversity of angler opportunities by providing anglers access to fish the main channel under a range of operating conditions. Therefore, we recommend that Exelon revise its Recreation Management Plan to include a plan to reopen the catwalk on a limited basis (e.g., the catwalk could be opened for fishing derbies, during holiday weekends, during peak fishing periods, or other occasions) that would be developed in consultation with interested stakeholders. We recommend that any plan to reopen the catwalk include security measures that address the vulnerability of the facility and the safety of the users of the catwalk. Such measures could include, but not be limited to, on-site inspections, video surveillance, pre-screening procedures, capacity limits, security personnel, and physical infrastructure modifications.

The cost to safely reopen the catwalk to anglers would depend upon the number of days that the facility would be open to the public and the specific measures that would be implemented to ensure a safe and secure environment. We estimate that opening the catwalk on a limited basis could cost less than the $141,390 levelized annual cost estimated by Exelon, which based its cost estimates on a 12 hours per day and 365-day per year opening and factored in reconstructing the catwalk to be accessible to persons with disabilities. We conclude that, from a recreational resource perspective, the costs would be worth the benefits. Nevertheless, the ultimate decision on whether the catwalk can be reopened to the public, even on a limited basis, would depend upon the Commission's evaluation of the plan and whether it satisfies public safety and security concerns.

Debris Management

In its July 18, 2014, letter to the Commission, Exelon confirmed it clears debris by two general methods: (i) operating three gantry cranes stationed on the head works with a clamming attachment to remove debris blown against the dam; and (ii) operating a new skimmer boat purchased in 2013, which is used to remove debris in the pond in the vicinity of the dam. The State of Maryland, Broad Creek Civic Association, and public testimony provided during the draft EIS comment period recommended Exelon increase the use of its skimmer boat to increase debris removal from the pond to improve boater safety and opportunities (e.g., water skiing). Exelon proposes to continue to operate its three gantry cranes with clamshell grapplers. Exelon also relies on community-sponsored clean-ups in the pond and downstream of the dam.

Debris is delivered to Conowingo Pond as a result of myriad inputs in the watershed above Conowingo dam and delivered downstream during storm events. Operation of the Conowingo and Muddy Run Projects results in fluctuating pond levels, which can mobilize debris from the shoreline to the pond and vice versa throughout the operation schedule, which is further influenced by river flows and wind direction. The presence of floating debris in the pond poses a risk to boaters and waterskiers. Review of Exelon's debris management study results indicates that, although the previous skimmer boat was retired in 2008, and it operated at times only a few days each year, it removed more volume of waste than the cranes in front of the dam for the amount of time in use. Debris management activities that utilize a new skimmer boat could remove more volume of debris, across more surface area of the reservoir, per unit of effort compared to using only the cranes. Therefore, we recommend that Exelon revise the Recreation Management Plan to include debris management to address the floating debris during the recreation boating season. Including it as part of the Recreation Management Plan would convey the important link with boater safety and allow for its evaluation during the recommended 12-year updates to the Recreation Management Plan.

We recommend the final debris management program be developed in consultation with the Pennsylvania FBC, Maryland DNR, Broad Creek Civic Association, Susquehanna River Boaters Association, and the Park Service. The debris management component of the Recreation Management Plan should include debris management goals, methods of debris management (e.g., clamming shells, skimmer boat), timeframes for when debris would be collected, the frequency of skimmer and clamming operations, specification of size criteria, storage and removal of stored debris procedures, tracking procedures, and coordination with community-based clean-up efforts. Implementing BMPs for debris management on Exelon-owned lands would prevent additional debris from entering Conowingo Pond from Exelon property. The cost to prepare and implement a debris management plan is included in the cost of the Recreation Management Plan discussed above. We conclude that, from a boater safety and opportunity perspective, the costs are worth the benefits.

Shoreline Management

The Conowingo Project provides access to many recreational, natural, and shoreline resources within the lower Susquehanna River. Through a collaborative process, Conowingo developed a single shoreline management document to address concerns while maintaining provisions to protect shoreline environmental resources.

Exelon proposes to implement the proposed SMP to manage the environmental resources around Conowingo Pond's shore. As discussed in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects,* the SMP would include specific measures and policies related to shoreline vegetation management, sediment and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, and use of project lands. We recommend including the SMP in any new license issued but with our recommended revisions for regular updates. Revising the SMP to include regular updates every 10 years in consultation with interested stakeholders, consistent with the latest Guidance for *Shoreline Management Planning at Hydropower Projects* (FERC 2012), would ensure the plan is harmonious with conditions at the project. We conclude that the addition of regular updates and consultation to the SMP would be worth the estimated levelized annual cost of $1,440.

Historic Properties Management Plan

Exelon proposes to implement the HPMP filed with the license application for the management of archaeological and historic resources throughout the term of any new license, including: (1) a schedule and methodology for completing any additional recommended studies and implementing monitoring measures; (2) management measures for identified historic properties including Conowingo dam and powerhouse; (3) protection of any historic properties threatened by project-related activities, including project operations, shoreline and aquatic recreation, shoreline development, routine project maintenance, and other project activities or operations; and (4) public outreach, education, and signage for the purpose of reducing looting and vandalism of sites, with staff modifications.

As discussed in section 3.3.6.2, *Cultural Resources, Environmental Effects,* we conclude that the following revisions would make the HPMP more comprehensive and complete: (a) revise the project APE to include the narrow strip of land located in the current project boundary that extends downstream from Spencer Island along the west side of the river to the city of Havre de Grace, Maryland that contains four additional previously recorded archaeological sites (18HA240, 18HA267, 18HA268, 18HA269); (b) inventory any lands within the project APE (particularly AOIs identified in the Phase IA study that were not subject to Phase IB study), evaluate any identified cultural resources for National Register eligibility, and address potential affects prior to any sale or transfer of those lands; (c) make a good faith effort to obtain access to private property to conduct appropriate studies should project effects of any kind to cultural resources on private lands be identified over a new license term; (d) discuss all 48 sites identified to date within the project APE; (e) discuss all 27 historic structures identified in the APE or an explanation regarding why they need not be considered in the HPMP; (f) correctly identify the Susquehanna and Tidewater Canal and Columbia & Port Deposit Railroad as eligible for listing on the National Register; (g) revise the list (as necessary) of project activities involving the Conowingo Project system that can be completed without Maryland SHPO review; (h) include a process for how project-related ground-disturbing activities would be assessed to determine whether or not archaeological sites would be affected, particularly in areas that have not been subject to previous archaeological survey; (i) ensure confidentiality of cultural resources locational information during implementation of public outreach programs; (j) include a description of project-related activities that would require consultation with the Delaware Nation and the Onondaga Nation in accordance with section 106 of the NHPA and documentation of all consultation with the Delaware Nation and Onondaga Nation; and (j) include the Park Service as a consulting party.

Our analysis in section 3.3.6.2, *Cultural Resources, Environmental Effects*, indicates implementation of the proposed HPMP with our recommended measures would ensure that the Conowingo Project would not adversely affect historic properties during the course of any license. We estimate that the levelized annual cost to revise and implement the HPMP for the project would be $37,080 and conclude the benefits of protecting cultural resources justify the cost.

Project Boundary

Exelon proposes to remove 1,965 acres from the Conowingo Project boundary that includes areas that were necessary during construction of the project but are no longer needed for project purposes. As discussed in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects,* removing these lands would remove four non-project recreation facilities from the project boundary, including the Lower Susquehanna Heritage Greenway, Deer Creek Access, Lapidum Boat Launch, and McLhinney Park. A relatively thin ribbon of land on the west bank of the Susquehanna River downstream of Conowingo dam was included in past licenses so as to include the railroad that was used to shuttle material to the dam during initial construction. While the lands in this area are now used for non-project recreation, these lands serve no direct project purpose. Project recreation demand is currently met through 15 project recreation sites located around Conowingo Pond and immediately downstream. Continuation of the lease agreements with the State of Maryland for Susquehanna State Park (which includes the Lower Susquehanna Heritage Greenway Trail, Deer Creek Access, and Lapidum Boat Launch) and the City of Havre de Grace for McLhinney Park would maintain recreation access at these locations. Removal of the 1,965 acres of lands would be consistent with FERC policy that only lands and waters needed for project purposes should be included in the project boundary. Lands and waters needed may include those for (1) construction and operation of its project, and (2) to carry out other project purposes such as recreation, wildlife protection, and enhancement. While these lands provide recreation opportunities, these opportunities are not related to the project. In addition, removing these non-project recreation sites from the project boundary would not limit the recreation opportunities available in the area downstream of Conowingo dam. Execution of a new lease with Maryland DNR would ensure these lands are maintained for public recreation purposes; however, they would not be under FERC jurisdiction. Because the lands proposed for removal from the Conowingo project boundary are no longer used for project purposes, removing these lands would be consistent with Commission policy.

5.1.3.3 Measures Not Recommended

TNC Flow Regime

We do not recommend adopting Interior's recommendation for implementing the TNC Flow Regime or a Maryland DOE certification, if more restrictive. Our reasons for not adopting are discussed in section 5.1.3.2, *Conowingo Project, Additional Measures Recommended by Staff for Conowingo, Instream Flows*. Our recommendation for a modified flow regime, however, is based on the TNC criteria for the habitat persistence analysis that the range of flows during peaking operation provides the TNC target of 70 percent of MWUA by month. Our primary reason for not adopting the TNC Flow Regime is the 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), with 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 loss of $1,989,490, or about 9 percent of the annual generation at the project.[134] Operation under the TNC Flow Regime would be restrained and would eliminate many of the peaking and ancillary services benefits to the PJM region from the Conowingo Project, and only provide minimal benefit to the downstream habitat for some species while negatively affecting other species. Ancillary services include those services necessary to maintain the reliability of the interconnected transmission system. Flow requirements of any future Maryland DOE certification are not known at this time, and cannot be analyzed.

Fish Stranding

Exelon is proposing to continue the same ramping rates of about 70,000 to 80,000 cfs per hour or less and maximum generating flows as currently operated. To address fish stranding, the Nature Conservancy recommends the implementation of ramping rates as part of its TNC Flow Regime. Under the TNC Flow Regime, the

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[134] The annual loss of $1,989,490 would be the net loss. There would be some cost savings related to a 9 percent reduction in pumping energy required, because less water would be available for pumping from Conowingo Pond as more flow would be released downstream to satisfy the TNC Flow Regime.

maximum generating flow would be limited to 65,000 cfs from March through September, upramping rates would be limited to 40,000 cfs per hour year-round, and downramping rates would be limited to 20,000 cfs per hour overall, and 10,000 cfs from July through September, if flows are less than 30,000 cfs. Interior's prescription includes a maximum downramping rate of 20,000 cfs/hour. Interior prescribes and the Pennsylvania FBC recommends channel modifications to eliminate stranding in the spillway channel. We provide our analysis of the effects of ramping rates and channel modifications on fish stranding downstream of the Conowingo dam in section.3.3.2.2, *Water Resources, Environmental Effects.* Our assessment of stranding below the project indicates that few fish are killed by stranding under existing operation, and about 90 percent of those killed were gizzard shad, carp, and catfish species, with few diadromous fish affected. We concluded that the existing changes in flow levels are not having significant adverse effects on aquatic resources, and that maximum flows from the project (86,000 cfs) generally remain within the TNC target of 70 percent of MWUA for the key life stages analyzed. Restraining ramping rates to those recommended in the TNC Flow Regime would adversely affect project operation by limiting the project's ability to respond to changes in load in the PJM system, reducing the ancillary services benefits of the project. There would also be minimal benefit in implementing the Pennsylvania FBC recommendation to extend the retaining wall at the east end of the east fish lift, add boulder fill in that area to prevent generation flow from flooding the spillway pool at high levels of generation, or dredge a channel(s) from the spillway pool area to downstream areas to provide egress for stranded fishes. Implementing these structural measures downstream of Conowingo dam would have a relatively high cost (levelized annual cost of $74,100), would involve in-river construction activities that would affect both fish and wildlife usage of the area, but would benefit only a small number of fish. Therefore, we are not recommending the imposition of ramping rates, lower maximum discharges, or structural measures to reduce the potential for fish stranding. While we do not find that stranding is an issue requiring mitigation downstream of Conowingo dam, we acknowledge that Interior's downramping provision in its final prescription would become a condition of any license issued for the project.

5.2 UNAVOIDABLE ADVERSE EFFECTS

Fluctuations in reservoir levels would continue to result in unavoidable minor bank erosion for all three projects (York Haven, Muddy Run, and Conowingo). In addition, natural high-flow events would continue to mobilize bed substrate downstream of Conowingo dam.

The sediment storage capacity of the reservoirs in the lower Susquehanna River (including Conowingo Pond) has been reached; these reservoirs are in a state of dynamic equilibrium (Corps and MDE, 2014). Averaged over time, the full sediment load carried by the Susquehanna River again reaches the Chesapeake Bay, as it did prior to the construction of the lower river reservoirs from 1910 to 1930. The only difference between the present and 1910 conditions is the periodic deposition and scouring in the reservoirs. As the LSRWA study (Corps and MDE, 2014) describes, the primary effect on living resources in the Bay is from nutrients associated with the sediment, primarily from sources in the Susquehanna River watershed and the rest of the Chesapeake Bay watershed.

The York Haven Project would result in the unavoidable loss of vegetation and wildlife habitat during construction of the nature-like fishway within the construction footprint. At both the Muddy Run and Conowingo Projects, the proposed projects would result in the unavoidable loss of vegetation and wildlife habitat during the expansion of recreation facilities.

5.3 FISH AND WILDLIFE AGENCY RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, and enhancement of fish and wildlife resources affected by the project. In response to our REA notice, Interior filed recommendations for all three projects on January 30 and 31, 2014.[135] Pennsylvania FBC filed recommendations for the Conowingo Project on December 11, 2013.

Section 10(j) of the FPA states that whenever the Commission believes that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency will attempt to resolve any such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency. Table 5-1 lists the federal and state recommendations filed subject to section 10(j), and whether the recommendations are adopted under the staff alternative. Environmental recommendations that we consider outside the scope of section 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource sections of this document and the previous section.

For the York Haven Project, Interior made two recommendations that we consider within the scope of section 10(j), and we adopt both. For the Muddy Run Project, Interior made five recommendations, two of which we consider within the scope of section 10(j), and we adopt all five recommendations. For the Conowingo Project, Interior made eight recommendations, five of which we consider within the scope of section 10(j), and Pennsylvania FBC made 13 recommendations, nine of which we consider within the scope of section 10(j). We adopt six of Interior's recommendation and seven of Pennsylvania FBC's recommendations.

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[135] In its comments on the draft EIS, Interior withdrew its section 10(j) recommendation to install and operate fishways as described in alternative G, which is an alternative described in its reservation of authority for the Conowingo Project,

The Commission staff makes a preliminary determination that three recommendations by Interior and five recommendations by Pennsylvania FBC for the Conowingo Project may be inconsistent with the purpose and requirements of the FPA or other applicable law.

Table 5-1. Fish and wildlife agency recommendations for the Susquehanna River Projects (Source: staff).

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
York Haven Project				
1. To help evaluate safe and effective passage of American eels through the project, cooperate with FWS and other interested parties in the funding, planning and conduct of a lower Susquehanna River downstream eel study to evaluate the timing, magnitude, duration, annual variation, and environmental conditions associated with the active migration of silver eels through the Susquehanna River to the Chesapeake Bay	Interior	Yes	$5,550	Yes
2. Operate to maintain an instantaneous minimum flow below the project of 1,000 cfs or inflow, whichever is less; an average daily flow of 2,500 cfs or inflow, whichever is less; whenever river flow is less than 3,000 cfs, operate as run of river; and provide for temporary modifications resulting from operating exigencies beyond the control of the licensee.	Interior	Yes	$0	Yes

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
		Muddy Run Project		
3. Before starting any ground-disturbing work, visit the FWS Chesapeake Bay Field Office and Pennsylvania Field Office websites and follow the Bog Turtle and Bald Eagle management guidelines.	Interior	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0	Yes
4. Develop and implement a bog turtle management plan.	Interior	Yes	$8,240	Yes
5. Finalize and implement the Bald Eagle Management Plan and as part of the licensee's compliance under the Bald and Golden Eagle Protection Act, FERC should require the licensee to follow conservation measures that protect bald eagles in addition to adopting the National Bald Eagle Management Guidelines.	Interior	Yes	$750	Yes
6. Develop and implement an SMP.	Interior	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0	Yes
7. The project shall be subject to inspection by FWS to ensure compliance with protection, mitigation, and enhancement measures.	Interior	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0	Yes

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
Conowingo Project				
8. Early in the planning process for any ground-disturbing work, visit the FWS Chesapeake Bay Field Office and Pennsylvania Field Office websites and follow the Bog Turtle and Bald Eagle Management Guidelines.	Interior	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0	Yes
9. Develop and implement a bog turtle management plan.	Interior	Yes	$8,240	Yes
10. Finalize and implement the Bald Eagle Management Plan and as part of the licensee's compliance under the Bald and Golden Eagle Protection Act, FERC should require the licensee to follow conservation measures that protect bald eagles in addition to adopting the National Bald Eagle Management Guidelines.	Interior	Yes	$1,740	Yes
11. Develop and implement an SMP.	Interior	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0	No

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
12. Prepare, develop, and implement a study to evaluate safe and effective downstream passage of American eels through the project. Coordinate with FWS and other interested parties in the funding, planning and conduct of a lower Susquehanna River downstream eel study to evaluate the timing, magnitude, duration, annual variation, and environmental conditions associated with the active migration of silver eels through the Susquehanna River to the Chesapeake Bay	Interior	Yes	$5,550	Yes
13. Project shall be subject to inspection by FWS to ensure compliance with protection, mitigation, and enhancement measures.	Interior	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0	Yes
14. Prepare and implement waterfowl nesting protection plan.	Interior	Yes	$19,980	Yes
15. Finalize and implement a flow management plan and implement the flow recommendations of The Nature Conservancy or the Maryland DOE certification, whichever is more restrictive to return river to more natural conditions downstream.	Interior	Yes	$1,644,320 (loss of generation and decreased pumping cost at Muddy Run, a gain of energy at Conowingo, plus cost of flow plan)	No

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
16. Incorporate performance criteria into new license where 80% of the shad that enter the project area must pass the project within 5 days, to be based on telemetry study of 150 shad per year for 3 years. If criterion is not reached, initiate operational changes as specified by the agencies and test for 3 years using telemetry study. If criterion is still not reached after 3 years, make structural changes to the fish lifts as specified by the agencies, and test for an additional 3 years using telemetry study. If criterion is still not reached within 3 years, additional structural changes may be required, depending on behavior of tagged shad.	Pennsylvania FBC	Yes	$22,230	No
17. Modify east fish lift to include a larger hopper, increased attraction flow, and addition of a collection gallery in front of units 8-11.	Pennsylvania FBC	Yes	$0	No[136]

[136] We are recommending a larger hopper and increased attraction flow, but are not recommending addition of a collection gallery.

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
18. Complete the rebuild of the west fish lift to include additional attraction water and provision to expand to volitional passage if needed. Ultimately, fish passage facilities at Conowingo will need to pass a design population of 5 million shad and other species, and fish lifts will be required on both sides of the tailrace.	Pennsylvania FBC	Yes	$0	No
19. Telemetry study of gizzard shad is needed to understand the issues of passage efficiency, capacity, and interference with American shad.	Pennsylvania FBC	No. Study could have been done pre-licensing.	$260	Yes
20. Telemetry study to understand recycling of gizzard shad in the west fish lift.	Pennsylvania FBC	No. Study could have been done pre-licensing.	$0[137]	Yes
21. Downstream passage survival of juvenile shad must be 95% or higher.	Pennsylvania FBC	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0	No

[137] We assume the studies recommended in Pennsylvania FBC recommendations 4 and 5 (table items 19 and 20) would be combined and conducted at the same time. As such, the estimated levelized cost for recommendation 4 (item 19) would cover the cost for recommendation 5 (item 20).

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
22. Construct eel passage facility near west fish lift, with capability to modify the location of the facility and to change to volitional passage.	Pennsylvania FBC	Yes	$442,340	Yes
23. Test additional locations for eel passage near the west fish lift.	Pennsylvania FBC	Yes	$0	Yes
24. Test additional locations for eel passage near the east fish lift and construct permanent traps as needed.	Pennsylvania FBC	Yes	$0	Yes
25. Test additional capture locations on Octoraro Creek at base of Octoraro reservoir dam, and install additional traps there.	Pennsylvania FBC	Yes	$0	Yes
26. Transport 1 million eels annually from 2015 to 2030 to sites above Conowingo and York Haven dams until permanent volitional facilities are operating effectively.	Pennsylvania FBC	Yes	$0	No
27. Once sufficient eels are in the system, cooperate with other utilities to conduct a study on eel downstream passage and ensure downstream passage survival of 80% at Conowingo for silver eels. Make operational and structural modifications as needed to achieve 80% survival.	Pennsylvania FBC	No. Not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$203,140	Yes

Recommendation	Agency	Within the Scope of Section 10(j)	Levelized Annual Cost	Adopted?
28. Exelon should 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 fishes.	Pennsylvania FBC	Yes	$74,100	No (see section 5.1.3.3)

We do not recommend adopting Interior's recommendation for a flow management plan and for implementing the flow recommendations of The Nature Conservancy or the Maryland DOE certification, whichever is more restrictive to return the river to more natural conditions downstream of Conowingo. As we discuss in section 5.1.3.3, *Conowingo Project, Measures Not Recommended*, our analysis found that the TNC Flow Regime would not provide substantially more aquatic habitat benefits than the staff-recommended flow regime, but would have a substantial levelized net annual cost of $1,641,260, when the operational impacts on the Muddy Run Project are considered, and would eliminate many of the peaking and ancillary services benefits to the PJM region from the Conowingo Project. Flow requirements of any future Maryland DOE certification are not yet known. Based on this information, we find that Interior's recommendation to implement a flow management plan and the TNC Flow Regime, or a yet unknown flow requirement of any Maryland DOE certification, may be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA.

We do not recommend adopting Pennsylvania FBC's recommendation to incorporate performance criteria into any new license for the Conowingo Project, where 80 percent of the shad that enter the project area must pass the project within 5 days, along with additional studies to test that performance that would be followed up by more studies and operational and structural changes over a period of 12 years. As we discuss in section 5.1.3.2, *Conowingo Project, Additional Measures Recommended by Staff for Conowingo, Upstream Fish Passage*, intensive fish passage studies have already been conducted at Conowingo dam over a period of decades, and we are recommending a suite of fish passage improvements at the project that would enhance upstream fish passage, and that would be implemented without further delay due to additional studies. Based on this information, we find that Pennsylvania FBC's recommendation to incorporate performance criteria and conduct many more years of studies may be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA.

We do not recommend adopting Pennsylvania FBC's recommendation to modify the Conowingo east fish lift by adding a collection gallery in front of units 8 to 11. As we discuss in section 5.1.3.2, *Conowingo Project, Additional Measures Recommended by Staff for Conowingo, Upstream Fish Passage*, there is insufficient justification to make major structural changes to the entrances to the east fish lift at this time; these changes would be costly with a levelized annual cost likely similar to that estimated for Interior's alternative G improvements to the east fish lift entrances ($852,190). We are recommending improvements to the entrances only if additional studies, after implementing our recommended improvements, find that effectiveness remains low. Based on this information, we find that Pennsylvania FBC's recommendation to construct a collection gallery on the east fish lift may be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA.

We do not recommend adopting Pennsylvania FBC's recommendation to complete the rebuild of the Conowingo west fish lift to include additional attraction water and provision to expand to volitional passage, if needed, with an ultimate total design population of 5 million American shad (plus other species) at the project. As we discuss in section 5.1.3.2, *Conowingo Project Resources, Additional Measures Recommended by Staff for Conowingo, Upstream Fish Passage*, implementing the full range of fish passage facilities recommended by Pennsylvania FBC, would not be needed at this time and would be costly with a levelized annual cost likely similar to that estimated for alternative G ($2,334,260). We are recommending fish passage improvements at the project that would still enhance upstream fish passage but at a substantially lower cost. Based on this information, we find that Pennsylvania FBC's recommendation to complete the rebuild of the west fish lift and install facilities with a total design population of 5 million shad (plus other species) may be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA.

We do not recommend adopting Pennsylvania FBC's recommendation to transport 1 million eels annually from 2015 to 2030 to sites above Conowingo and York Haven dams until permanent volitional facilities are operating effectively. There is no indication that 1 million eels are currently available in the lower Susquehanna River for capture and transport at the Conowingo Project, and requiring this specific design population for any eel trap and transport program would require Exelon to expend an unknown amount of effort and financial resources in an attempt to meet this requirement. Based on this information, we find that Pennsylvania FBC's recommendation to require an American eel design population of 1 million fish to transport may be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA.

We do not recommend adopting Pennsylvania FBC's recommendation to reduce stranding of migratory fish downstream of the Conowingo Project 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 fishes. As we discuss in section 5.1.3.3, *Conowingo Project, Measures not Recommended*, our analysis found that few fish are currently being stranded under existing project operation, and there would be no need for implementing measures to reduce stranding, at a relatively high levelized annual cost of $74,100. Based on this information, we find that Pennsylvania FBC's recommendation to make structural changes downstream of Conowingo dam to reduce fish stranding may be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA.

On August 12, 2014, following issuance of the draft EIS, Commission staff sent letters to both Interior and Pennsylvania FBC, requesting to resolve the preliminary inconsistencies described in the draft EIS. We invited both agencies to file comments in response to our preliminary determination of inconsistencies, including any modified recommendations, or to also request a meeting, telephone or video conference, or other additional procedure to attempt to resolve any preliminary determination of inconsistency. Neither Interior nor Pennsylvania FBC responded to our invitation to attempt to resolve the preliminary inconsistencies.

Although the noted inconsistencies for the Conowingo Project remain unresolved, we recommend numerous measures that would adequately and equitably protect, mitigate damage to, and enhance fish and wildlife resources affected by the project, including: increased minimum flows at the project, a suite of fish passage improvements at the project that would enhance upstream passage of American shad and other anadromous species, and provision of upstream passage facilities for American eel.

5.4 Consistency with Comprehensive Plans

Section 10(a)(2)(A) of the FPA, 16 U.S.C.§803(a)(2)(A) (2006), requires the Commission to consider the extent to which a project is consistent with the federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed 26 comprehensive plans listed below that are applicable to the Susquehanna River Projects, located in Pennsylvania and Maryland. No inconsistencies were found.

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APPENDIX A

DRAFT LICENSE ARTICLES

YORK HAVEN HYDROELECTRIC PROJECT

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Appendix A

Draft License Articles

York Haven Hydroelectric Project

Article 201. *Administrative Annual Charges*. The licensee must pay the United States annual charges, effective the first day of the month in which the license is issued, and as determined in accordance with provisions of the Commission's regulations in effect from time to time, for the purposes of:

(a) reimbursing the United States for the cost of administration of Part I of the Federal Power Act. The authorized installed capacity for that purpose is 19.62 megawatts.

Article 202. *Exhibit F Drawings*. Within 45 days of the date of issuance of this license, as directed below, the licensee must file two sets of the approved exhibit drawings in electronic file format on compact disks with the Secretary of the Commission, ATTN: OEP/DHAC.

Digital images of the approved exhibit drawings must be prepared in electronic format. Prior to preparing each digital image, the FERC Project-Drawing Number (i.e., P-1888-1001 through P-1888-###) must be shown in the margin below the title block of the approved drawing. Exhibit F drawings must be segregated from other project exhibits, and identified as Critical Energy Infrastructure Information (CEII) material under 18 CFR §388.113(c). Each drawing must be a separate electronic file, and the file name must include: FERC Project-Drawing Number, FERC Exhibit, Drawing Title, date of this license, and file extension in the following format [P-1888-####, F-1, Description, MM-DD-YYYY.TIF]. All digital images of the exhibit drawings must meet the following format specification:

IMAGERY - black & white raster file
FILE TYPE – Tagged Image File Format, (TIFF) CCITT Group 4
(also known as T.6 coding scheme)
RESOLUTION – 300 dpi desired, (200 dpi min)
DRAWING SIZE FORMAT – 22" x 34" (min), 24" x 36" (max)
FILE SIZE – less than 1 MB desired

Article 203. *Exhibit G Drawings*. Within 90 days of the date of issuance of this license date, the licensee must file, for Commission approval, revised Exhibit G drawings enclosing within the project boundary all principal project works necessary for operation and maintenance of the project, including all of the lands encompassing the East Shore Boat Launch and Canal Lock recreation area. The Exhibit G drawings must comply with sections 4.39 and 4.41 of the Commission's regulations.

Article 204. *Amortization Reserve*. Pursuant to section 10(d) of the Federal Power Act, a specified reasonable rate of return upon the net investment in the project must be used for determining surplus earnings of the project for the establishment and maintenance of amortization reserves. The licensee must set aside in a project amortization reserve account at the end of each fiscal year one-half of the project surplus earnings, if any, in excess of the specified rate of return per annum on the net investment. To the extent that there is a deficiency of project earnings below the specified rate of return per annum for any fiscal year, the licensee must deduct the amount of that deficiency from the amount of any surplus earnings subsequently accumulated, until absorbed. The licensee must set aside one-half of the remaining surplus earnings, if any, cumulatively computed, in the project amortization reserve account. The licensee must maintain the amounts established in the project amortization reserve account until further order of the Commission.

The specified reasonable rate of return used in computing amortization reserves must be calculated annually based on current capital ratios developed from an average of 13 monthly balances of amounts properly included in the licensee's long-term debt and proprietary capital accounts as listed in the Commission's Uniform System of Accounts. The cost rate for such ratios must be the weighted average cost of long-term debt and preferred stock for the year, and the cost of common equity must be the interest rate on 10-year government bonds (reported as the Treasury Department's 10-year constant maturity series) computed on the monthly average for the year in question plus four percentage points (400 basis points).

Article 205. *Headwater Benefits*. If the licensee's project was directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement during the term of the original license (including extensions of that term by annual licenses), and if those headwater benefits were not previously assessed and reimbursed to the owner of the headwater improvement, the licensee must reimburse the owner of the headwater improvement for those benefits, at such time as they are assessed, in the same manner as for benefits received during the term of this new license. The benefits will be assessed in accordance with Part 11, Subpart B, of the Commission's regulations.

Article 301. *Contract Plans and Specifications*. At least 60 days prior to the start of any construction, the licensee must submit one copy of its plans and specifications and supporting design document to the Commission's Division of Dam Safety and Inspections (D2SI) – New York Regional Engineer, and two copies to the Commission (one of these must be a courtesy copy to the Director, D2SI). The submittal to the D2SI New York Regional Engineer must also include as part of preconstruction requirements: a Quality Control and Inspection Program, Temporary Construction Emergency Action Plan, and Soil Erosion and Sediment Control Plan. The licensee may not begin construction until the D2SI-New York Regional Engineer has reviewed and commented on the plans and specifications, determined that all preconstruction requirements have been satisfied, and authorized start of construction.

Article 302. *Cofferdam Construction Drawings and Deep Excavations*. Before starting construction, the licensee must review and approve the design of contractor-designed cofferdams and deep excavations and must make sure that construction of cofferdams and deep excavations is consistent with the approved design. At least 30 days before starting construction of the cofferdam, the licensee must submit one copy to the Commission's Division of Dam Safety and Inspections (D2SI) - New York Regional Engineer and two copies to the Commission (one of these copies must be a courtesy copy to the Commission's Director, D2SI), of the approved cofferdam construction drawings and specifications, and the letters of approval.

Article 303. *As-built Drawings*. Within 90 days of completion of construction of the facilities authorized by this license, the licensee must file for Commission approval, revised exhibits A, F, and G, as applicable, to describe and show those project facilities as built. A courtesy copy must be filed with the Commission's Division of Dam Safety and Inspections (D2SI) - New York Regional Engineer, the Director, D2SI, and the Director, Division of Hydropower Administration and Compliance.

Article 304. *Project Modification Resulting From Environmental Requirements*. If environmental requirements under this license require modification that may affect the project works or operations, the licensee must consult with the Commission's Division of Dam Safety and Inspections—New York Regional Engineer. Consultation must allow sufficient review time for the Commission to ensure that the proposed work does not adversely affect the project works, dam safety, or project operation.

Article 401. *Commission Approval and Reporting*.

(a) Requirement to File Plans for Commission Approval

Various conditions of this license found in the Pennsylvania Department of Environmental Protection (Pennsylvania DEP) final section 401 Water Quality Certification (WQC) conditions (Appendix __) and the U.S. Department of the Interior (Interior) fishway prescription (Appendix __) require the licensee to prepare plans in consultation with other entities for approval by Pennsylvania DEP or Interior (U.S. Fish and Wildlife Service [FWS]) for submittal to the Commission 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.

WQC Condition No. [a]	**Interior Condition No.** [a]	**Description**	**Due Date**
III.A.1.a	9.8	Fishway operating procedures	90 days prior to the start of construction of the nature-like fishway (NLF)
III.A.2.b.i	9.9.1.b	Final plans and specifications for NLF [b]	January 31, 2016
III.A.2.b.ii	N/A	Erosion and sediment control plan for NLF construction	July 15, 2015
III.B.1.b.iv	9.9.3.b.iv	NLF monitoring plan	December 31, 2021
III.B.3	9.9.6.d	Juvenile American shad headrace turbine avoidance study plan	90 days prior to the start of construction of the NLF
III.B.3.e	9.9.6.e	Designs for removal of barriers to downstream migration	90 days prior to the start of construction of the NLF

WQC Condition No. [a]	Interior Condition No. [a]	Description	Due Date
III.C.2.c	9.9.7.c	Site specific silver eel route of passage study plan	90 days prior to the start of construction of the NLF
III.C.2.c	9.9.7.c	Eel survival study plan	90 days prior to the start of construction of the NLF

[a] The conditions shown in this table were filed by Pennsylvania DEP on August 19, 2014, and by Interior on February 7, 2014.

[b] Filing must include the results of the pre-construction environmental studies for the following: (a) vegetation cover-type mapping, (b) wetlands delineations, (c) invasive species surveys, (d) rare species surveys, (e) a bog turtle habitat assessment, and (f) a bald eagle survey. The filing must also include any state and federal agency comments on the completed studies, and any protection measures proposed as a result of the studies.

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

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

(b) Requirement to File Reports

Certain conditions of the Pennsylvania DEP WQC and Interior fishway prescription 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:

WQC Condition No.	Interior Condition No.	Description	Due Date
III.A.1.d	9.8.d	Fish passage operating procedures annual report	By December 31 of each year

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 operations or facilities based on information contained in the report and any other available information.

Article 402. *Reservation of Authority to Prescribe Fishways.* Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or provide for the construction, operation, and maintenance of, such fishways as may be prescribed by the Secretary of the Interior pursuant to section 18 of the Federal Power Act.

Article 403. *Recreation Management Plan.* Within 6 months of license issuance, the licensee must file, for Commission approval, a recreation management plan that details measures to ensure the recreation facilities and sites are managed to meet use and demand over the term of the license. The plan shall cover operation and maintenance of the following facilities: (a) York Haven Power Plant Recreation Area; (b) Battery Island Picnic Area; (c) Goodling Island Picnic Area; (d) Shelley Island Recreation Area; (e) Goosehorn Island Picnic Area; (f) East Shore Boat Launch; and (g) East Shore Canal Lock. The plan must include: (a) a facility inventory with ownership and management responsibilities for each site; (b) measures to provide for periodic monitoring; (c) details of how the licensee will continue the licensing program for approximately 300 recreational lots within the project boundary; (d) details on how the licensee will implement revisions to the program that allow for the termination of permits and removal of lots from the program if structures are abandoned by the lessee, or when existing structures become damaged and are not replaced by conforming structures; (e) provisions to update the recreation management plan every 12 years in concert with every other Form 80 reporting period; and (f) provisions to consult with the Pennsylvania Fish and Boat Commission, the Pennsylvania Department of Environmental Protection, the Pennsylvania Department of Conservation and Natural Resources, and the Susquehanna

River Basin Commission about recreation management and strategies every 10 years after the effective date of the new license. If the licensee proposes changes to the existing facilities, the licensee must file the changes with the Commission for approval.

The plan must be developed after consultation with resource agencies; York, Dauphin, and Lancaster counties; and other interested stakeholders, including the Pennsylvania Fish and Boat Commission, Pennsylvania Department of Conservation and Natural Resources, and the National Park Service. The licensee must include with the plan an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Article 404. *Shoreline Management Plan.* Within one year of license issuance, the licensee must file, for Commission approval, a shoreline management plan (SMP). The plan must be developed in accordance with the Commission's Guidance on Shoreline Management Planning at Hydroelectric Projects and include policies to ensure that the shorelines are managed for the scenic, recreational, and environmental values for the duration of the license term, including but not limited to: (a) a summary of the purpose, goals and objectives of the plan; (b) a description of the shoreline use classifications, which identifies allowable and prohibited uses for existing and future use of the shoreline; (c) a shoreline permitting program; (d) a monitoring and enforcement program; and (e) a provision to update the plan every 10 years.

As part of the SMP, the licensee must continue the licensing program for approximately 300 recreational lots at Cly Shore, Shelley Island, and Beshore Island. The licensee must implement revisions in the licensing program to allow the termination of permits and removal from the licensing program of existing recreational lots that are abandoned by the lessee, or when existing structures become damaged and are not replaced by structures conforming to all applicable federal, state, and local regulations.

The plan must be developed in accordance with the Commission's *Guidelines for Shoreline Management Planning at Hydropower Projects* dated July 2012. The plan must be developed in consultation with the Pennsylvania Fish and Boat Commission, Pennsylvania Department of Conservation and Natural Resources, and the Pennsylvania Department of Environmental Protection. The licensee must include with the plan an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

<u>Article 405</u>. *Programmatic Agreement and Historic Properties Management Plan.* The licensee must implement the *Programmatic Agreement Between the Federal Energy Regulatory Commission and the Pennsylvania Historic Preservation Officer for Managing Historic Properties that May be Affected by Issuing a New License to York Haven Power Company, LLC, for the Continued Operation of the York Haven Project in York, Dauphin, and Lancaster counties, Pennsylvania (FERC No. 1888-030),* executed on ____________, and including but not limited to the Historic Properties Management Plan (HPMP) for the project. Pursuant to the requirement of this Programmatic Agreement, the license must file, for Commission approval, a revised HPMP within six months of issuance of this order. The revised HPMP must be based on the draft HPMP filed with the Commission on December 28, 2012.

The Commission reserves the authority to require changes to the HPMP at any time during the term of the license. If the Programmatic Agreement is terminated prior to Commission approval of the HPMP, the licensee must obtain approval from the Commission and the Pennsylvania State Historic Preservation Officer, before engaging in any ground-disturbing activities or taking any other action that may affect any historic properties within the project's area of potential effects.

Article 406. *Use and Occupancy.* (a) In accordance with the provisions of this article, the licensee must have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee must also have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee must take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The type of use and occupancy of project lands and waters for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 water craft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee must require multiple use and occupancy of facilities for access to project lands or waters. The licensee must also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee must: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the impoundment shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project impoundment. No later than January 31 of each year, the licensee must file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 water craft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the licensee must file a letter with the Commission, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked Exhibit G map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Commission's authorized representative, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee must consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee must determine that the proposed use of the lands to be conveyed is not inconsistent with any approved report on recreational resources of an Exhibit E; or, if the project does not have an approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed must not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee must take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee must not unduly restrict public access to project waters.

(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised Exhibit G drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project must be consolidated for consideration when revised Exhibit G drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article must not apply to any part of the public lands and reservations of the United States included within the project boundary.

APPENDIX B

DRAFT LICENSE ARTICLES

MUDDY RUN PUMPED STORAGE PROJECT

Appendix B

Draft License Articles

Muddy Run Pumped Storage Project

Article 201. *Administrative Annual Charges*. The licensee must pay the United States annual charges, effective the first day of the month in which the license is issued, and as determined in accordance with provisions of the Commission's regulations in effect from time to time, for the purposes of:

(a) reimbursing the United States for the cost of administration of Part I of the Federal Power Act. The authorized installed capacity for that purpose is 800.25-megawatts.

Article 202. *Exhibit Drawings*. Within 45 days of the date of issuance of this license, as directed below, the licensee must file two sets of the approved exhibit drawings and GIS data in electronic file format on compact disks.

(a) Digital images of the approved exhibit drawings must be prepared in electronic format. Prior to preparing each digital image, the FERC Project-Drawing Number (i.e., P-2355-1001 through P-2355-###) must be shown in the margin below the title block of the approved drawing. The licensee must file two separate sets of exhibit drawings in electronic format on compact disks with the Secretary of the Commission, ATTN: OEP/DHAC. Exhibit F drawings must be segregated from other project exhibits, and identified as Critical Energy Infrastructure Information (CEII) material under 18 CFR §388.113(c). Each drawing must be a separate electronic file, and the file name must include: FERC Project-Drawing Number, FERC Exhibit, Drawing Title, date of this license, and file extension in the following format [P-2355-####, G-1, Project Boundary, MM-DD-YYYY.TIF]. All digital images of the exhibit drawings must meet the following format specification:

IMAGERY - black & white raster file
FILE TYPE – Tagged Image File Format, (TIFF) CCITT Group 4
(also known as T.6 coding scheme)
RESOLUTION – 300 dpi desired, (200 dpi min)
DRAWING SIZE FORMAT – 22” x 34” (min), 24” x 36” (max)
FILE SIZE – less than 1 MB desired

Each Exhibit G drawing that includes the project boundary must contain a minimum of three known reference points (i.e., latitude and longitude coordinates, or state plane coordinates). The points must be arranged in a triangular format for GIS georeferencing the project boundary drawing to the polygon data, and must be based on a standard map coordinate system. The spatial reference for the drawing (i.e., map projection, map datum, and units of measurement) must be identified on the drawing and each reference point must be labeled. In addition, each project boundary drawing must be stamped by a registered land surveyor.

(b) The licensee must file two separate sets of the project boundary GIS data on compact disks with the Secretary of the Commission, ATTN: OEP/DHAC. The data must be in a georeferenced electronic file format (such as ArcView shape files, GeoMedia files, MapInfo files, or a similar GIS format). The filing must include both polygon data and all reference points shown on the individual project boundary drawings. An electronic boundary polygon data file(s) is required for each project development. Depending on the electronic file format, the polygon and point data can be included in single files with multiple layers. The georeferenced electronic boundary data file must be positionally accurate to ±40 feet in order to comply with National Map Accuracy Standards for maps at a 1:24,000 scale. The file name(s) must include: FERC Project Number, data description, date of this license, and file extension in the following format [P-2355, boundary polygon/or point data, MM-DD-YYYY.SHP]. The data must be accompanied by a separate text file describing the spatial reference for the georeferenced data: map projection used (i.e., UTM, State Plane, Decimal Degrees, etc.), the map datum (i.e., North American 27, North American 83, etc.), and the units of measurement (i.e., feet, meters, miles, etc.). The text file name must include: FERC Project Number, data description, date of this license, and file extension in the following format [P-2355, project boundary metadata, MM-DD-YYYY.TXT].

<u>Article 203</u>. *Amortization Reserve*. Pursuant to section 10(d) of the Federal Power Act, a specified reasonable rate of return upon the net investment in the project must be used for determining surplus earnings of the project for the establishment and maintenance of amortization reserves. The licensee must set aside in a project amortization reserve account at the end of each fiscal year one-half of the project surplus earnings, if any, in excess of the specified rate of return per annum on the net investment. To the extent that there is a deficiency of project earnings below the specified rate of return per annum for any fiscal year, the licensee must deduct the amount of that deficiency from the amount of any surplus earnings subsequently accumulated, until absorbed. The licensee must set aside one-half of the remaining surplus earnings, if any, cumulatively computed, in the project amortization reserve account. The licensee must

maintain the amounts established in the project amortization reserve account until further order of the Commission.

The specified reasonable rate of return used in computing amortization reserves must be calculated annually based on current capital ratios developed from an average of 13 monthly balances of amounts properly included in the licensee's long-term debt and proprietary capital accounts as listed in the Commission's Uniform System of Accounts. The cost rate for such ratios must be the weighted average cost of long-term debt and preferred stock for the year, and the cost of common equity must be the interest rate on 10-year government bonds (reported as the Treasury Department's 10-year constant maturity series) computed on the monthly average for the year in question plus four percentage points (400 basis points).

<u>Article 204</u>. *Headwater Benefits*. If the licensee's project was directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement during the term of the original license (including extensions of that term by annual licenses), and if those headwater benefits were not previously assessed and reimbursed to the owner of the headwater improvement, the licensee must reimburse the owner of the headwater improvement for those benefits, at such time as they are assessed, in the same manner as for benefits received during the term of this new license. The benefits will be assessed in accordance with Part 11, Subpart B, of the Commission's regulations.

<u>Article 301</u>. *Project Modification Resulting From Environmental Requirements*. If environmental requirements under this license require modification that may affect the project works or operations, the licensee must consult with the Commission's Division of Dam Safety and Inspections—New York Regional Engineer. Consultation must allow sufficient review time for the Commission to ensure that the proposed work does not adversely affect the project works, dam safety, or project operation.

<u>Article 401</u>. *Commission Approval and Reporting*.

(a) Requirement to File Plans for Commission Approval

Various conditions of this license found in the Pennsylvania Department of Environmental Protection (Pennsylvania DEP) final section 401 Water Quality Certification (WQC) conditions (Appendix __) and U.S. Department of the Interior (Interior) fishway prescription (Appendix __) require the licensee to prepare plans in consultation with other entities for approval by Pennsylvania DEP or Interior (U.S. Fish and Wildlife Service [FWS]) for submittal to the Commission 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.

WQC Condition No.[a]	Interior Condition No.[a]	Description	Due Date
III.A.1.a	(not numbered)	Fish passage operating procedures	April 15, 2015
III.B.2.	(not numbered)	Downstream American shad passage survival plan and schedule	April 15, 2015
III.B.2.a	(not numbered)	Downstream American shad passage discrete passage study plan and schedule	May 15, 2026
III.C.2.c	(not numbered)	American eel downstream passage compliance study	Within 9 months of the trigger date for initiation of the downstream eel passage studies, which shall not occur prior to October 1, 2026
IV.A.2	NA	Dissolved oxygen monitoring plan	November 1, 2027

[a] The conditions shown in this table were filed by Pennsylvania DEP on December 15, 2014, and by Interior on January 31, 2014, and amended on February 28, 2014.

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

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

(b) Requirement to File Reports

Certain conditions found in the Pennsylvania DEP WQC conditions (Appendix __) and Interior fishway prescription (Appendix __) 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:

WQC Condition No.	Interior Condition No.	Description	Due Date
III.A.1.d	(not numbered)	Fish passage operating procedures annual report	By December 31 of each year
III.B.2.b	(not numbered)	Downstream American shad passage discrete passage study report	Within 180 days of the completion of the study
III.C.2.d	(not numbered)	American eel downstream passage compliance study report	Within 180 days of the completion of the study

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 operations or facilities based on information contained in the report and any other available information.

Article 402. *Reservation of Authority to Prescribe Fishways*. Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or provide for the construction, operation, and maintenance of, such fishways as may be prescribed by the Secretaries of the Interior and/or Commerce pursuant to section 18 of the Federal Power Act.

Article 403. *Bald Eagle Management Plan*. The Bald Eagle Management Plan, filed on August 29, 2012, is approved with the following modification: before any ground disturbance work begins within the project boundary, the licensee must visit the U.S. Fish and Wildlife Service's (FWS) Chesapeake Bay Field Office and Pennsylvania Field Office websites and comply with current bald eagle management guidelines. If there are updated guidelines, the licensee must revise the Bald Eagle Management Plan to incorporate any new guidelines issued by the FWS during the term of the license, and provide the revised Bald Eagle Management Plan to the Commission for approval. The licensee must implement the plan according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

Article 404. *Bog Turtle Management Plan.* The Bog Turtle Management Plan, filed on August 29, 2012, is approved with the following modifications: (a) before any ground disturbance work begins within the project boundary, the licensee must visit the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office and Pennsylvania Field Office websites and comply with current bog turtle management guidelines; if there are updated guidelines, the licensee must revise the Bog Turtle Management Plan to incorporate any new guidelines issued by the FWS during the term of the license and provide the revised Bog Turtle Management Plan to the Commission for approval; and (b) modify the restrictions for mowing areas C, D, and F to state, "avoid mowing between April to October to avoid turtle's active period." The licensee must implement the plan according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

Article 405. *Recreation Management Plan.* The Recreation Management Plan, filed on August 29, 2012, is approved with the following modification: (a) conduct a recreation use study every 12 years, starting in 2026 and continuing throughout the license term, consistent with every other 6-year Form 80 reporting period deadline (April 1), to ensure the proposed plans are current and the sites are meeting the demand; and (b) update the Recreation Management Plan every 12 years in concert with the recreation use study and every other 6-year Form 80 reporting period (report and plan update due April 1).

Each update to the plan must be developed in consultation with the U.S. Fish and Wildlife Service, the Pennsylvania Department of Conservation and Natural Resources, and the National Park Service. The licensee must include with the updated plans an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the updated plans for Commission approval. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The licensee must continue to operate and maintain the following existing facilities for the term of the license: Muddy Run Park and Campground, Wissler's Run Park, and Muddy Run Wildlife Management Area. If the licensee proposes changes to the existing facilities, the licensee must file the changes with the Commission for approval.

The licensee must implement the Recreation Management Plan, or updates to the plan, according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

<u>Article 406</u>. *Shoreline Management Plan.* The Shoreline Management Plan, filed on August 29, 2012, is approved with the following modification: the plan must be updated every 10 years from the date of issuance of this license, and filed for Commission approval.

Each updated plan must be developed in consultation with the U.S. Fish and Wildlife Service and the Pennsylvania Department of Conservation and Natural Resources. The licensee must include with the updated plans an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the updated plans with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The licensee must implement the Shoreline Management Plan, or updates to the plan, according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

<u>Article 407</u>. *Programmatic Agreement and Historic Properties Management Plan*. The licensee must implement the *Programmatic Agreement Between the Federal Energy Regulatory Commission and the Pennsylvania Historic Preservation Officer for Managing Historic Properties that May be Affected by Issuing a New License to Exelon*

Generation Company, LLC, for the Continued Operation of the Muddy Run Pumped Storage Project in Lancaster and York counties, Pennsylvania, (FERC No. 2355-018), executed on ____________, and including but not limited to the Historic Properties Management Plan (HPMP) for the project. Pursuant to the requirement of this Programmatic Agreement, the license must file, for Commission approval, an HPMP, within one year of issuance of this order.

The Commission reserves the authority to require changes to the HPMP at any time during the term of the license. If the Programmatic Agreement is terminated prior to Commission approval of the HPMP, the licensee must obtain approval from the Commission and the Pennsylvania SHPO, before engaging in any ground-disturbing activities or taking any other action that may affect any historic properties within the project's area of potential effects.

Article 408. *Use and Occupancy.* (a) In accordance with the provisions of this article, the licensee must have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee must also have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee must take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The type of use and occupancy of project lands and waters for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 water craft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee must require multiple use and occupancy of facilities for access to project lands or waters. The licensee must also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee must: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the impoundment shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project impoundment. No later than January 31 of each year, the licensee must file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 water craft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the licensee must file a letter with the Commission, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked Exhibit G map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Commission's authorized representative, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee must consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee must determine that the proposed use of the lands to be conveyed is not inconsistent with any approved report on recreational resources of an Exhibit E; or, if the project does not have an approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed must not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee must take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee must not unduly restrict public access to project waters.

(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised Exhibit G drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project must be consolidated for consideration when revised Exhibit G drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article must not apply to any part of the public lands and reservations of the United States included within the project boundary.

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APPENDIX C

DRAFT LICENSE ARTICLES

CONOWINGO HYDROELECTRIC PROJECT

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Appendix C

Draft License Articles

Conowingo Hydroelectric Project

Article 201. *Administrative Annual Charges*. The licensee must pay the United States annual charges, effective the first day of the month in which the license is issued, and as determined in accordance with provisions of the Commission's regulations in effect from time to time, for the purposes of:

(a) reimbursing the United States for the cost of administration of Part I of the Federal Power Act. The authorized installed capacity for that purpose is [the authorized capacity was previously determined to be 574,540 kW; but the value needs to be re-computed per the latest regulations after the ratings of each of the turbines and generators are verified] _______ megawatts.

Article 202. *Exhibit F Drawings*. Within 45 days of the date of issuance of this license, as directed below, the licensee must file two sets of the approved exhibit drawings in electronic file format on compact disks with the Secretary of the Commission. ATTN: OEP/DHAC.

Digital images of the approved exhibit drawings must be prepared in electronic format. Prior to preparing each digital image, the FERC Project-Drawing Number (i.e., P-405-1001 through P-405-###) must be shown in the margin below the title block of the approved drawing. Exhibit F drawings must be segregated from other project exhibits, and identified as Critical Energy Infrastructure Information (CEII) material under 18 CFR §388.113(c). Each drawing must be a separate electronic file, and the file name must include: FERC Project-Drawing Number, FERC Exhibit, Drawing Title, date of this License, and file extension in the following format [P-405-####, F-1, Description, MM-DD-YYYY.TIF]. All digital images of the exhibit drawings must meet the following format specification:

IMAGERY - black & white raster file
FILE TYPE – Tagged Image File Format, (TIFF) CCITT Group 4
(also known as T.6 coding scheme)
RESOLUTION – 300 dpi desired, (200 dpi min)
DRAWING SIZE FORMAT – 22” x 34” (min), 24” x 36” (max)
FILE SIZE – less than 1 MB desired

Article 203. *Exhibit G Drawings*. Within 90 days of the license issuance date, the licensee must file, for Commission approval, revised Exhibit G drawings enclosing within the project boundary all principal project works necessary for operation and maintenance of the project, and reflecting the removal of 1,965 acres of lands from the current project boundary that do not contain existing project facilities and are not necessary for the operation and maintenance of the project. The Exhibit G drawings must comply with sections 4.39 and 4.41of the Commission's regulations.

Article 204. *Amortization Reserve*. Pursuant to section 10(d) of the Federal Power Act, a specified reasonable rate of return upon the net investment in the project must be used for determining surplus earnings of the project for the establishment and maintenance of amortization reserves. The licensee must set aside in a project amortization reserve account at the end of each fiscal year one half of the project surplus earnings, if any, in excess of the specified rate of return per annum on the net investment. To the extent that there is a deficiency of project earnings below the specified rate of return per annum for any fiscal year, the licensee must deduct the amount of that deficiency from the amount of any surplus earnings subsequently accumulated, until absorbed. The licensee must set aside one-half of the remaining surplus earnings, if any, cumulatively computed, in the project amortization reserve account. The licensee must maintain the amounts established in the project amortization reserve account until further order of the Commission.

The specified reasonable rate of return used in computing amortization reserves must be calculated annually based on current capital ratios developed from an average of 13 monthly balances of amounts properly included in the licensee's long-term debt and proprietary capital accounts as listed in the Commission's Uniform System of Accounts. The cost rate for such ratios must be the weighted average cost of long-term debt and preferred stock for the year, and the cost of common equity must be the interest rate on 10-year government bonds (reported as the Treasury Department's 10-year constant maturity series) computed on the monthly average for the year in question plus four percentage points (400 basis points).

Article 205. *Headwater Benefits*. If the licensee's project was directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement during the term of the original license (including extensions of that term by annual licenses), and if those headwater benefits were not previously assessed and reimbursed to the owner of the headwater improvement, the licensee must reimburse the owner of the headwater improvement for those benefits, at such time as they are assessed, in the same manner as for benefits received during the term of this new license. The benefits will be assessed in accordance with Part 11, Subpart B, of the Commission's regulations.

Article 301. *Public Safety Plan*. At least 60 days prior to reopening of the Conowingo powerhouse catwalk or installation of any new recreation facilities, the licensee must submit one copy to the Commission's Division of Dam Safety and Inspections (D2SI) - New York Regional Engineer and two copies to the Commission (one of these copies must be a courtesy copy to the Commission's Director, D2SI) of an updated Public Safety Plan. The plan must include an updated evaluation of public safety concerns at the project site, including all updated designated recreation areas, and assess the need for the installation of safety devices or other safety measures. The submitted plan must include a description of all public safety devices and signage, as well as a map showing the location of all public safety measures. For guidance on preparing public safety plans the licensee can review the *Guidelines for Public Safety at Hydropower Projects* on the FERC website.

Article 302. *Project Modification Resulting From Environmental Requirements*. If environmental requirements under this license require modification that may affect the project works or operations, the licensee must consult with the Commission's Division of Dam Safety and Inspections—New York Regional Engineer. Consultation must allow sufficient review time for the Commission to ensure that the proposed work does not adversely affect the project works, dam safety, or project operation.

Article 401. *Sediment Management Plan.* The Sediment Management Plan, filed on August 31, 2012, is approved with the following modifications:

a) Include a provision to conduct dredging with the frequency and depth needed to maintain the navigation channel at the Conowingo Creek, Peters Creek (Peach Bottom Marina), and Broad Creek boat ramps, where sediments have been accumulating, in order to improve and maintain recreational boating access.

b) Beginning in 2016, the licensee must conduct a bathymetric survey of Conowingo Pond at 5-year intervals to monitor sediment transport and depositional patterns within the pond. The licensee must file the results of each bathymetric survey with the Commission by March 31 of the following year. The results of each bathymetric survey must include an analysis of any change in sediment deposition or scour in the pond from the previous survey(s), including the 2011 survey,[1] so that any changes in sediment depositional or scour patterns in the pond over time since the 2011 survey can be monitored.

c) Include measures (e.g., metrics for magnitude or frequency of sediment loading following high flows and storm events) that would trigger action to maintain boating access between the 5-year monitoring intervals.

The licensee must implement the plan according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

Article 402. *Conowingo Pond Level Management.* Upon license issuance, the licensee must operate the project with a normal range of operation for Conowingo Pond between elevations 101.2 feet National Geodetic Vertical Datum of 1929 (NGVD 29) and 110.2 feet NGVD 29, with a minimum elevation of 107.2 feet NGVD 29 on weekends between Memorial Day and Labor Day, to meet recreational needs.

Conowingo Pond level may be temporarily modified if required by operating emergencies beyond the control of the licensee, and for short periods upon mutual agreement among the licensee, the Pennsylvania Department of Environmental Protection, and Maryland Department of the Environment. If pond levels are so modified, the licensee must notify the Commission, in writing, as soon as possible, but no later than 10 days after each such incident.

Article 403. *Minimum Flow Requirements.* Upon license issuance, the licensee must provide minimum flow releases from the project, as described below, or a minimum flow equal to the natural inflow as measured at the Marietta U.S. Geological Survey gage (No. 01576000), whichever is less, according to the following schedule:

a) September 15 – March 31: 3,500 cubic feet per second (cfs) or natural inflow;

b) April 1 – April 30: 10,000 cfs or natural inflow;

c) May 1 – June 15: 7,500 cfs or natural inflow; and

d) June 16 – September 14: 5,000 cfs or natural inflow.

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[1] Exelon Generation Corp. conducted a bathymetric survey of Conowingo Pond in support of Conowingo Revised Study Plan 3.15: Sediment Introduction and Transport study, and filed with the Commission on February 23, 2012.

Minimum flow releases may be temporarily modified if required by operating emergencies beyond the control of the licensee, and for short periods upon mutual agreement among the licensee and the Maryland Department of the Environment. If minimum flows are so modified, the licensee must notify the Commission, in writing, as soon as possible, but no later than 10 days after each such incident.

Article 404. *Dissolved Oxygen Enhancements and Monitoring.* Upon license issuance, the licensee must continue dissolved oxygen (DO) enhancement at the project using the existing turbine venting systems on units 1 through 7 and the aerating runners on units 2 and 5. DO levels must be continuously monitored from May 1 through October 1 at the existing Station 643 location, about 0.6 mile downstream of Conowingo dam. By January 1 of each year, the licensee must file, with the Commission and Maryland Department of the Environment, a report on the results of the previous year's DO monitoring at the project.

Article 405. *Reservation of Authority to Prescribe Fishways.* Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or provide for the construction, operation, and maintenance of, such fishways as may be prescribed by the Secretaries of the Interior and/or Commerce pursuant to section 18 of the Federal Power Act.

Article 406. *Continued Fish Passage Operation*. The licensee must continue to operate the east fish lift as the primary facility for volitional upstream fish passage, with a preventive maintenance program to extend the useful life of the facility through the license term, along with other improvements required by Article 407. The licensee must continue to operate the project turbines as the primary route for downstream fish passage of American shad and river herring. The licensee must also continue to coordinate annual fish passage operations with the Susquehanna River Anadromous Fish Restoration Cooperative and its member agencies and other entities.

Article 407. *Upstream Fish Passage Improvements Plan*. Within 6 months of license issuance, the licensee must file with the Commission for approval, an upstream fish passage improvements plan. The plan must include the following modifications to the existing east and west fish lifts at the project to improve the effectiveness of upstream fish passage at the project:

a) replace the existing hopper at the west fish lift with a 1,500-gallon hopper;
b) improve the west fish lift sorting and loading process to facilitate trap and truck operations, and implement a trap and truck program for American shad;

c) conduct a feasibility study for adding attraction flow at the west fish lift and, if feasible and beneficial, install additional flow capacity;
d) restore the original design for the 900-cubic feet per second (cfs) attraction flow in the east fish lift;
e) add a second 3,300-gallon hopper to the east fish lift in the space provided for in the original design, and upgrade the electrical and mechanical equipment to allow for a 15-minute lift cycle; and
f) if 2 years of effectiveness studies, after restoration of the 900-cfs attraction flow, show poor attraction at the east fish lift for adult American shad, conduct a feasibility study for modifying the locations of entrances A and B, and implement those modifications if feasible.

The licensee must prepare the plan after consultation with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Pennsylvania Fish and Boat Commission, and Maryland Department of Natural Resources. The licensee must include with the plan an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it was prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Article 408. *Upstream American Eel Passage Plan*. Within 6 months of license issuance, the licensee must file with the Commission for approval, an upstream American eel passage plan. The plan must include detailed design drawings together with a schedule to construct and install the following facilities to provide for the upstream passage of American eel at the project:

a) an American eel trap and transport facility that consists of a limited-length eel ramp and a collection facility in the vicinity of the existing west fish lift;
b) no sooner than 2030, an American eel volitional passage facility near the west fish lift that consists of a full eel ramp with resting pools from the tailrace to the Conowingo Pond elevation;

c) an American eel trap and transport facility that consists of a limited-length eel ramp and a collection facility located on Octoraro Creek;
d) an American eel volitional passage facility (after 2030) that consists of a full eel ramp with resting pools from the downstream river elevation to the Conowingo Pond elevation located on the east bank of the project tailrace or on Octoraro Creek.

The licensee must prepare the plan after consultation with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Pennsylvania Fish and Boat Commission, and Maryland Department of Natural Resources. The licensee must include with the plan an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it was prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Article 409. *Bald Eagle Management Plan.* The Bald Eagle Management Plan, filed on August 29, 2012, is approved with the following modifications:

a) require enforcement of human traffic restrictions on both sides of Rowland Island, under the towers in the river, and on the Cecil County side of the river where current human activities disturb perching and foraging eagles at eagle concentration areas; and

b) before any ground-disturbing work begins within the project boundary, the licensee must visit the U.S. Fish and Wildlife Service's (FWS) Chesapeake Bay Field Office and Pennsylvania Field Office websites and comply with current bald eagle management guidelines. If there are updated guidelines, the licensee must revise the Bald Eagle Management Plan to incorporate any new guidelines issued by the FWS during the term of the license and provide the revised Bald Eagle Management Plan to the Commission for approval.

The licensee must implement the plan according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

Article 410. *Northern Map Turtle Protection Plan.* Within 6 months of license issuance, the licensee must file, for Commission approval, a northern map turtle protection plan for the protection and enhancement of the map turtle population.

The plan must include, at a minimum:

a) nest management and alternative basking site mitigation and protection measures identified and studied during the ongoing Towson University map turtle studies;
b) annual monitoring of the northern map turtle population at the project for 10 years;
c) annual monitoring of the use and success of both the mitigation and protection measures for 10 years;
d) an assessment of the northern map turtle's response to any change in operating regime as a result of the license; and
e) methods of altering or amending protection and mitigation measures as a result of the monitoring, in consultation with the Maryland Department of Natural Resources (Maryland DNR).

The plan must be developed after consultation with the Maryland DNR and Towson University. The licensee must include with the plan an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Article 411. *Waterfowl Nesting Protection Plan.* Within 6 months of license issuance, the licensee must file, for Commission approval, a waterfowl nesting protection plan. The plan must: (a) identify specific project-related effects on nesting waterfowl, such as flooding during the nesting season; (b) identify which species of nesting waterfowl are affected, if any; and (c) if project-related effects are identified, establish appropriate protection or mitigation measures.

The plan must be developed after consultation with the U.S. Fish and Wildlife Service, Pennsylvania Fish and Boat Commission, and the Maryland Department of Natural Resources. The licensee must include with the plan an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Article 412. *Bog Turtle Management Plan.* Within 6 months of license issuance, the licensee must file, for Commission approval, a bog turtle management plan for the protection and enhancement of the bog turtle population.

The plan must include, at a minimum:

a) the restriction of mowing in the wetland(s) documented to support bog turtles;
b) invasive plant and woody plant control, particularly reed canary grass, in the areas around the wetland(s) documented to support bog turtles; and
c) limits on public access to the wetland(s) documented to support bog turtles without advertising the reason.

The plan must be developed after consultation with the U.S. Fish and Wildlife Service and the Maryland Department of Natural Resources. The licensee must include with the plan an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

Article 413. *Recreation Management Plan.* The Recreation Management Plan, filed on August 31, 2012, is approved with the following modifications:

a) include a provision to review the results of the bathymetric mapping and dredging occurring periodically at the Conowingo Creek, Peters Creek (Peach Bottom Marina), and Broad Creek boat ramps as required by the Sediment Management Plan (Article 401) intended to ensure boater access to the reservoir at these locations;
b) conduct a recreation use study every 12 years, starting in year 2026, and continuing throughout the license term (consistent with every other 6-year Form 80 reporting period deadline), to ensure the proposed plans are current, the sites are meeting the demand, and boating access and season lengths are sufficient; update the Recreation Plan every 12 years in concert with the recreation use study and every other Form 80 reporting period (report and update due April 1);
c) develop a plan to provide limited access to the catwalk for anglers, with security measures in place that address the vulnerability of the facility and the safety of the users of the catwalk; such measures could include, but not be limited to, on-site inspections, video surveillance, pre-screening procedures, capacity limits, security personnel, and physical infrastructure modifications; the ultimate decision on whether the catwalk can be reopened to the public, even on a limited basis, is dependent upon the Commission's evaluation of the plan and whether it satisfies public safety and security concerns; and
d) implement a debris management program that includes: (1) debris management goals; (2) a description of debris management methods, including clamming in front of the dam and deploying a marine trash skimmer boat to remove floating debris that poses hazards to recreational boating; (3) best management practices for the storage of the debris materials at Hopkins Cove and other Exelon-owned lands; (4) timeframes for when debris will be collected and frequency of skimmer and clamming operations; (5) specific size criteria for target floating debris; (6) procedures for removal of stored debris; (7) the sponsorship of community-based clean-ups in the pond and downstream of the dam as described in the final license application and the debris

management study report filed with the Commission on August 31, 2012; (8) a public hotline for boaters to link directly to Exelon to report areas of hazardous floating debris; and (9) an annual report due every April 1 throughout the license term, summarizing the previous year's debris removal efforts, hotline action items, and outcomes.

Each recreation use study and update to the Recreation Management Plan must be developed in consultation with the U.S. Fish and Wildlife Service, the Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Fish and Boat Commission, the Maryland Department of the Environment, the National Park Service, and the Susquehanna River Boaters Association. The licensee must include with the study and updated plans an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the study and updated plans with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The licensee must continue to operate and maintain the following existing facilities for the term of the license: (a) Lock 13, (b) Lock 15, (c) Muddy Creek Boat Launch, (d) Cold Cabin Boat Launch, (e) Dorsey Park, (f) Line Bridge, (g) Broad Creek Public Landing, (h) Glen Cove Marina, (i) Conowingo swimming pool and visitor's center, (j) Peach Bottom Marina, (k) Conowingo Creek Boat Launch, (l) Funks Pond, (m) Fisherman's Park/Shures Landing, and (n) Octoraro Creek Access. If the licensee proposes changes to the existing facilities, the licensee must file the changes with the Commission for approval.

The licensee must implement the plan according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

<u>Article 414</u>. S*horeline Management Plan.* The Shoreline Management Plan filed on August 31, 2012, is approved, with the following modification: update and file the plan, for Commission approval, every 10 years.

Each update to the plan must be developed in consultation with the U.S. Fish and Wildlife Service, the National Park Service, the Pennsylvania Department of Conservation and Natural Resources, and the Maryland Department of Natural Resources. The licensee must include with the updated plans an implementation schedule, documentation of consultation, copies of recommendations on the completed plan after it has been prepared and provided to the entities above, and specific descriptions of how the entities' comments are accommodated by the plan. The licensee must provide a minimum of 30 days for the entities to comment and to make recommendations before filing the updated plans with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The licensee must implement the Shoreline Management Plan, or updates to the plan, according to the schedule included in the plan. The Commission reserves the right to require any additional changes to the plan.

<u>Article 415</u>. *Programmatic Agreement and Historic Properties Management Plan.* The licensee must implement the *Programmatic Agreement Between the Federal Energy Regulatory Commission, the Pennsylvania Historic Preservation Officer, and the Maryland Historic Preservation Officer for Managing Historic Properties that May be Affected by Issuing a New License to Exelon Generation Company, LLC, for the Continued Operation of the Conowingo Project in Lancaster and York counties, Pennsylvania, and Cecil and Harford counties, Maryland (FERC No.405-106)*, executed on ____________, and including but not limited to the Historic Properties Management Plan (HPMP) for the project. Pursuant to the requirements of this Programmatic Agreement, the licensee must file, for Commission approval, a revised HPMP within six months of issuance of this order. The revised HPMP must be based on the HPMP filed with the Commission on August 31, 2012.

The Commission reserves the authority to require changes to the HPMP at any time during the term of the license. If the Programmatic Agreement is terminated prior to Commission approval of the HPMP, the licensee must obtain approval from the Commission and the Pennsylvania and Maryland SHPOs, before engaging in any ground-disturbing activities or taking any other action that may affect any historic properties within the project's APE.

<u>Article 416</u>. *Use and Occupancy.* (a) In accordance with the provisions of this article, the licensee must have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee must also

have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee must take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The type of use and occupancy of project lands and waters for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 water craft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee must require multiple use and occupancy of facilities for access to project lands or waters. The licensee must also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee must: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the impoundment shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project impoundment. No later than January 31 of each year, the licensee must file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 water craft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the licensee must file a letter with the Commission, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked Exhibit G map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Commission's authorized representative, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee must consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee must determine that the proposed use of the lands to be conveyed is not inconsistent with any approved report on recreational resources of an Exhibit E; or, if the project does not have an approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed must not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee must take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee must not unduly restrict public access to project waters.

(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised Exhibit G drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project must be consolidated for consideration when revised Exhibit G drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article must not apply to any part of the public lands and reservations of the United States included within the project boundary.

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APPENDIX D

PRELIMINARY FISHWAY PRESCRIPTION

YORK HAVEN HYDROELECTRIC PROJECT

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United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Custom House, Room 244
200 Chestnut Street
Philadelphia, Pennsylvania 19106-2904

IN REPLY REFER TO:

February 7, 2014

9043.1
ER/ 0275

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St., NE
Washington, DC 20426

RE: Review of Notice of Application Ready for Environmental Analysis, York Haven Power Company Hydroelectric Project (FERC #1888-030)

COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS, AND PRELIMINARY PRESCRIPTION FOR FISHWAYS

Dear Ms. Bose:

The U.S. Department of the Interior (Department) filed a timely response to the *Notice of Application Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions* for the York Haven Hydroelectric Project (FERC #1888-030), located on the Susquehanna River in Dauphin and Lancaster Counties, Pennsylvania. That filing contained inadvertent word processing artifacts. Please replace our initial filing with this corrected version of our comments, recommendations, and preliminary Prescription for Fishways.

We appreciate the opportunity to provide comments, recommendations, terms and conditions, and prescriptions on this application for new license.

Sincerely,

Lindy Nelson
Regional Environmental Officer

cc: York Haven Service List

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Custom House, Room 244
200 Chestnut Street
Philadelphia, Pennsylvania 19106-2904

IN REPLY REFER TO:

January 30, 2014

9041.3
ER 13/0275

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St., NE
Washington, DC 20426

RE: Review of Notice of Application Ready for Environmental Analysis, York Haven Power Company Hydroelectric Project (FERC #1888-030)

COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS, AND PRELIMINARY PRESCRIPTION FOR FISHWAYS

Dear Ms. Bose:

The U.S. Department of the Interior (Department) has reviewed the April 29, 2013, *Notice of Application Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions* for the existing York Haven Hydroelectric Project (Project) (FERC #1888-030), located on the Susquehanna River in Dauphin and Lancaster Counties, Pennsylvania. The Department offers the comments herein on behalf of itself and its component Bureaus, the U.S. Fish and Wildlife Service (Service) and the National Park Service (NPS). The Department, through the Service, has reached settlement with York Haven Power Company. The Service is signatory to a settlement Agreement with York Haven Power Company (license applicant). That Settlement Agreement was filed as an offer of Settlement with the Commission pursuant to Rule 602 of the Commission's Rules of Practice and Procedure by York Haven Power Company on January 30, 2014. Wherever the Settlement differs from the License Application, our comments, recommendations, and preliminary prescription provided herein reflect the Settlement. We note that the Commission has indicated its intention to prepare one basin-wide Environmental Impact Statement (EIS) for the relicensing of three projects on the lower Susquehanna River, of which this is only one. See, e.g. Notification of Updated Schedule, December 19, 2013. The other two are the Exelon – owned Muddy Run (P-2355-018) and Conowingo (P-405-106) Projects some distance downstream from this Project. Accordingly some of the comments presented herein relate to the preparation of this EIS rather than specifically to this Project.

This letter is submitted under the following statutory authorities: Fish and Wildlife Coordination Act as amended; Federal Power Act as amended; Endangered Species Act as amended; Bald and Golden Eagle Protection Act as amended; Migratory Bird Treaty Act as amended; Outdoor Recreation Act of 1963; National Trails and System act of 1968; and the National Park Service Organic Act.

GENERAL COMMENTS

Background

The Department has participated throughout the Integrated Licensing Process for the York Haven Project. The Settlement was developed through discussions among the Service, the Pennsylvania Fish and Boat Commission (PFBC), and the Pennsylvania Department of Environmental Protection (PADEP) (collectively the “Resource Agencies”) and the York Haven Power Company (collectively “the Parties”).

Project Setting

The Susquehanna River is one of America's largest rivers and is approximately 410 mi (715 km) long. The river forms in upstate New York and west-central Pennsylvania and drains a watershed area of over 27,000 square miles. It is the largest tributary to the Chesapeake Bay, providing over 60 percent of the freshwater to the Bay. The name of the river comes from an Algonquian word for "muddy water." This term may still be an appropriate description of the Susquehanna River today as it can be very turbid, particularly during higher flow events. There is also considerable run-off from agricultural areas that have long been a major contributor to nutrient loading in the Chesapeake Bay. Mean monthly flows are highest in March and April and lowest in August and September.

Dam construction in the lower Susquehanna River began in the early 1900’s. A low level (8 to 16') hydroelectric dam was constructed in 1904 at Conewago Falls near the village of York Haven (river mile 55). The first of the high dams, the Holtwood or McCalls Ferry project (55') at river mile 25, was completed in 1910. The 75' high Safe Harbor Dam (river mile 32) completed in 1931. The 100' high Conowingo Dam (river mile 10) was completed in 1928 (SRAFRC 2010).

The construction of the dams altered river habitat by creating impoundments that inundated and eliminated riverine spawning and rearing habitat for migratory fish in the lower portion of the Susquehanna River. Conowingo, Holtwood, Safe Harbor and York Haven dams inundated 14, 8, 10, and 4 miles of habitat, respectively, resulting in the loss of 36 miles of riverine habitat. The Conowingo Reservoir (Conowingo Pool) extends to the Holtwood tailrace and the Holtwood Reservoir (Lake Aldred) extends to the Safe Harbor tailrace, resulting in a 32 mile stretch of impounded water with little flowing water habitat. Above Lake Clarke (the Safe Harbor impoundment) there is 15 miles of free-flowing river to York Haven Dam (SRAFRC 2010).

Project Works

The existing York Haven Project (Project) consists of a headrace wall, main dam, east channel dam, powerhouse, and forebay bulkhead. The stone masonry headrace wall extends 3,000 feet upstream from the north end of the powerhouse and, with an average height of 20 feet, directs flow to the powerhouse. The main dam is attached to the north end of the headrace where it runs diagonally across the main channel of the river approximately 4,970 feet to the west shore of Three Mile Island. The main dam is constructed of concrete fill, and has a maximum height at the crest of 17 feet and an average height of 10 feet. The east channel dam consists of a concrete gravity dam that extends approximately 950 feet east from the east shore of Three Mile Island to the east bank of the river. The east channel dam has an average height of 10 feet. The stone masonry forebay bulkhead wall, 155 feet long, extends west from the south end of the powerhouse to the transformer building, perpendicular to the shoreline. From the transformer building, the forebay bulkhead wall extends 475 feet north along the property line to the west bank of the river. A 14-foot-wide by 10.5-foot-tall trash sluice gate and associated spillway are located adjacent to the southern end of the powerhouse at the eastern end of the forebay wall.

The Project's main dam and east channel dam impound the Susquehanna River, forming Lake Frederic, extending 3.5 miles upstream from the dam. Total storage in the 1,849-acre reservoir is approximately 8,000 acre-feet, and total useable storage is approximately 1,980 acre-feet. The current FERC license allows a 1.1-foot fluctuation in the Project impoundment, but is not used under normal run-of-river operation. The normal water surface elevation of the Project impoundment is 276.5 feet. The elevation of the normal river surface below the dam is approximately 251.4 feet. The impoundment provides approximately 22.5 feet of net head for power generation purposes.

The brick and stone masonry powerhouse has approximate dimensions of 470 feet by 48 feet and is located at the southern end of the headrace wall and at the eastern end of the forebay bulkhead wall. The powerhouse includes 20 turbine-generator units and appurtenant equipment. The hydraulic equipment for units 1- 3 are vertical-shaft, fixed-blade, Kaplan turbines; unit 4 is a vertical-shaft, manually adjustable blade, Kaplan turbine; units 5 and 6 are vertical-shaft, fixed-blade, propeller-type turbines; units 7, 8, 10-13, and 15-20 each consist of two vertical-shaft, Francis turbines connected through bevel gears to a single horizontal shaft; unit 9 is a two vertical-shaft, Francis turbine connected through a gearbox to a single horizontal shaft; and unit 14 is a vertical-shaft, Francis turbine. Units 1-5 have 1.6-megawatt (MW) generators; unit 6 has a 1.32-MW generator; unit 14 has a 1.2-MW generator; and units 7-13 and 15-20 have 0.7-MW generators. The Project has an authorized nameplate generating capacity of 19.65 MW and generates and average of 130,812 megawatt hours annually. Water flowing through the turbines is discharged into the tailrace immediately below the powerhouse and downstream of the dam.

There is no primary transmission lines included as part of the Project. The Project interconnects with the 115-kilovolt (kV) grid at the substation located immediately downstream of the Project's forebay wall. A secondary service feed comes into the Project substation via Line No. 722 at 13.2 kV. The Licensee is currently studying the feasibility of providing a nature-like fishway to enhance fish passage facilities at the Project. No other new developments or changes in operation are being proposed at this time.

Fishery Resources

The Susquehanna River in the vicinity of the Project supports a warmwater fishery. Among the common riverine fish species are smallmouth bass (*Micropterus dolomieu*), largemouth bass (*M. salmoides*), walleye (*Sander vitreus*), and white perch (*M. americana*). In addition, anadromous species found in the Project vicinity include blueback herring (*Alosa aestivalis*), alewife (*A. pseudoharengus*), and American shad (*A. sapidissima*). The catadromous American eel (*Anguilla rostrata*) is also found in the vicinity of the Project.

High Value Land Resources

The Lower Susquehanna River and Upper Chesapeake Bay region have a long history of recreational access and use. As stated in Executive Order 13508 (the EO), the Administration has set a goal of 300 additional public access sites and 2 million acres of land to be conserved to ensure adequate protection of the resources associated with the Chesapeake Bay Watershed and its tributaries including the Susquehanna River. As was accomplished in the PPL Holtwood (FERC #1881) proceeding[1], Exelon in particular has an exceptional opportunity to preserve and protect significant land under their ownership and enhance recreational use and access, both within and outside the project boundaries associated with the Conowingo and Muddy Run Hydroelectric Projects.

Four units of the National Trail System, including two National Historic Trails, administered by the NPS, are located in, adjacent to, or near the collective project boundaries and all have strong bearing on the position of the Department regarding the future use and disposition of those lands whose condition and status may affect the visitor’s experience in those units as set out below.

The Chesapeake Bay Watershed Public Access Plan (Access Plan) was published in direct response to the President's Executive Order 13508, Strategy for Protecting and Restoring the Chesapeake Bay. The primary purpose of the Access Plan was to "access the demand for public access; describe existing public access facilities; assess barriers to public access; determine gaps in the public access system; identify opportunities for new access sites; and help direct federal, state and local funding toward public access opportunities.[2] Importantly, the plan is updated annually to include newly identified potential public access sites.[3]

The Access Plan has been certified by FERC as a Comprehensive Plan as defined by Section 10(a)(2)(A) of the Federal Power Act (FPA), 16 U.S.C. section 803 (a)(2)(A) which requires FERC to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the

[1] See FERC Order Amending Project Boundary issued 21 December 2012 (FERC 1881-066)
[2] The 2013 Access Plan was prepared by the National Park Service in collaboration with the Commonwealths of Pennsylvania and Virginia, the States of Delaware, Maryland, New York, and West Virginia, and the District of Columbia.
[3] Issued January 7, 2014.
http://executiveorder.chesapeakebay.net/file.axd?file=2014%2F1%2F14_15+WQ+milestones_010714+FINAL+Version.pdf

project.[4] In this case, the Final License Applications (FA) for all three subject projects should be evaluated for their consistency with the Access Plan.

On May 16, 2012, the Secretary of the Interior designated four water trails in five states as new historic connecting components of the Captain John Smith Chesapeake National Historic Trail (Captain John Smith Trail), among them the Susquehanna River. In our efforts to determine how development of presently undeveloped lands within the viewshed of the Captain John Smith Trail would affect the visitor's experience, the NPS prepared a viewshed map which is intended to evoke consideration of how the lands and features surrounding the water trail (the Lower Susquehanna River and environs) would have looked to Captain John Smith during his voyage. That map is set out below. It was developed as a result of the Captain John Smith Trail being extended to include the Susquehanna River in Pennsylvania and New York.

The Captain John Smith Trail commemorates Smith's voyages of exploration of the Chesapeake in 1607-1609, shares knowledge of the Native American societies and cultures of the Chesapeake region at the time, and interprets the past and present natural history of the Chesapeake Bay and its rivers.

The National Park Service completed a Comprehensive Management Plan (CMP, NPS 2011) for the trail in 2011[5]. The CMP states: "The promise of the Captain John Smith Chesapeake National Historic Trail, then, is to help the millions of people in the region and elsewhere experience, envision, come to understand, and care to protect what the explorers and the inhabitants of the region saw 400 years ago by expanding access to the Bay and rivers; by protecting special places reminiscent or evocative of those times; by educating the public of the importance and exceptional nature of the region, its people, and its resources; by providing recreational experiences throughout the region; by creating partnerships amongst the many citizens, groups and jurisdictions to realize the vision; by instilling awe and reverence for the special places in the Chesapeake region. Visitor experiences on the trail will include journeys on land – walking, bicycling, motoring – and sojourns on water – paddling, sailing and cruising, in craft large and small. The trail will provide national park quality experiences through NPS partnerships with state and local governments, and non-profit and for profit organizations."

Core trail-related resources identified in the CMP include "evocative landscapes - places possessing a feeling that expresses the aesthetic or historic sense of a particular period of time. This feeling results from the presence of physical features that, taken together, convey a landscape's historic character." The CMP further defines this as "visible shoreline generally evocative of the 17th century - primarily composed of forests and wetlands."

Evocative landscapes and other trail resources are the foundation of the visitor experience along the trail, an experience that for many visitors takes place from the water in self-guided or guided boating trips using a variety of watercraft.

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[4] FERC letter dated December 4, 2013, docket ZZ09-5-000.

[5] http://www.nps.gov/cajo/parkmgmt/planning.htm

The NPS prepared a map of evocative landscape along the Lower Susquehanna River segment of the Captain John Smith Trail using computer assisted viewshed analysis. This map identifies lands which contribute to the trail's visitor experience and is shown below.

This map helps guide identification of trail resources, prioritizes conservation efforts and development of interpretation opportunities and materials. It provides a broad brush illustration of general areas that merit consideration for protection within the context of the CMP and that may be able to be accomplished through the current relicensing processes. The CMP has been certified by the FERC as a Comprehensive Plan as defined by Section 10(a)(2)(A) of the Federal Power Act (FPA), see fn4 above.). In addition, the Onondaga Nation, in their comments dated December 13, 2013, noted their support for the establishment of the Captain John Smith Trail.

The Star-Spangled Banner National Trail (Star-Spangled Trail) connects the places, people and events that led to the birth of the National Anthem during the War of 1812.This Trail includes the Susquehanna River from immediately below the Conowingo Dam to the Chesapeake Bay, and therefore, while it should be considered by the Commission in its EIS, will be affected more by actions at the lower Exelon Projects than this one. NPS and its partners completed a Comprehensive Management Plan (CMP) for the trail in 2012 (NPS 2012)[6]. The Star-Spangled Trail CMP includes a framework and action plan for interpreting the history and legacy of the War of 1812 in the Chesapeake in ways that are meaningful and relevant to the general public. Visitors will be accessing this trail using both land and water routes. As with the Captain John Smith Trail, there are evocative landscapes along the Susquehanna River that support the Star-Spangled Trail. The Star-Spangled Trail CMP has been certified by FERC as a Comprehensive Plan as defined by Section 10 (a) (2) (A) of the FPA, see fn3 above.

In its comprehensive assessment of the Lower Susquehanna River hydroelectric projects under NEPA, we request that the Commission evaluate how this project affects the landscape goals of the NPS for the various National Historic Trails, National Recreation Trails and National Natural Landmarks and require project specific changes, if necessary, that would ameliorate the project's ongoing and potential future impacts on those landscape goals and resources. In this way, the Commission can condition the project pursuant to section 10(a) of the FPA, and thereby license the project to conform to applicable comprehensive plans for the watershed.

Native American Consultation

We recommend the Licensee consult with any Native American Tribe or Nation whose treaty rights may be affected by the Project. Potentially affected tribes can provide guidance in developing the project in a manner that seeks to preserve, protect, and enhance fish, wildlife and other tribal-interest resources and environmental values in the project area. It is especially important for the Licensee to initiate consultation so that any future studies may begin in a timely fashion and delays may be avoided.

SPECIFIC COMMENTS

Settlement Agreement

The Department, through the Service, reached settlement with the Licensee on resolution of operational, fisheries and aquatic resources, wildlife, and water quality issues, particularly including terms for fish passage that would fall under the Department's authority under Section 18 of the Federal Power Act. The Settlement Agreement was signed by several parties in December 2013 and was filed with the Commission on January 30, 2014. Each of the impacts of Project operations was carefully considered in developing the Settlement. Representatives of the

[6] http://starspangledtrail.net/about-the-trail/planning-process/

Service worked diligently with Licensee and the other Parties to develop a mutually agreeable Settlement for long-term Project management, primarily regarding fish passage. The Department supports the Settlement and requests that that the Commission include license conditions consistent with it and reflective of its terms.

As is explained in the Settlement, the expectation of the signatories is that the Commission will incorporate all of the terms and conditions in Section 3 of the Settlement, as express license articles in any license it may issue, such that all of the Settlement terms and conditions are enforced by the Commission. Further, we request that the Commission approve the Settlement broadly and incorporate it by reference into, and attach it to, the Order Issuing License. To the extent that any of the Settlement's terms and conditions are not incorporated as express license articles, or the Commission, for some reason, determines the terms and conditions and/or express license articles are not enforceable, the Department requests that the Commission expressly identify in its licensing order each Settlement term and condition that it believes is not enforceable. Any Settlement term and condition not so expressly identified by the Commission as unenforceable will be deemed, by all Parties, as enforceable by the Commission. The Department expects that the agreement of the Parties to consult with one another before undertaking various actions before the Commission (i.e., certain amendment applications) will be enforced by the Commission to the extent of requiring evidence of compliance before accepting such applications. Retention of Settlement terms such as these, as enforceable license conditions, is a necessary and bargained-for part of the agreement.

Fish Passage

The Licensee has agreed to provide fish protection and upstream and downstream passage for anadromous and catadromous species.

Among other things, the Licensee has agreed to construct, operate, and maintain a nature-like fishway at the upstream terminus of the mainstem dam at Three-Mile Island to provide safe, timely, and effective upstream passage for American shad, river herring, and American eel. Riverine fish species are expected to also use the nature-like fishway. The Licensee has also agreed to provide a downstream migrant facility (bypass) in the headrace and operational measures for out-migrating juvenile and post-spawned adult shad and river herring. Studies will be performed for up and downstream migration for the purpose of evaluating the effectiveness of fish passage through the Project. No other new material developments or changes in operation are being proposed at this time.

Pursuant to Section 18 of the FPA, the Department is providing herewith, in Attachment A, it's Preliminary Prescription for Fishways, and supporting Decision Document, which is consistent with the measures agreed upon in the Settlement. As said in Attachment A, the Administrative Record and its Index in support of the Decision Document will be filed separately.

Federally Protected Species

On August 8, 2007, the bald eagle (*Haliaeetus leucocephalus*) was removed from the Federal Endangered Species List and is no longer protected under Section 7 of the Federal Endangered

Species Act (ESA). However, bald eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755). Bald eagles are known to nest, forage and communally roost along the Susquehanna River, including Dauphin County. As part the Licensee's compliance under BGEPA, the FERC should require the Licensee to follow conservation measures that protect bald eagles in addition to adopting the National Bald Eagle Management Guidelines.

The federally threatened bog turtle (*Clemmys muhlenbergii*) is also known to occur along the Susquehanna River in Dauphin County. As part of the Licensee's compliance with Section 7 of the ESA, the FERC should require the Licensee to contact the Service's Pennsylvania Field Office before any land clearing activity is initiated. If there are any questions regarding bald eagles or bog turtles, please contact Ms. Kagel at 814-234-4090.

RECOMMENDATIONS

In accordance with the Fish and Wildlife Coordination Act and pursuant to Section 10(j) of the Federal Power Act, as amended, the Department recommends that the following special articles for the protection, mitigation, and enhancement of fish and wildlife resources be included in any license the Commission may issue for this Project.

1. To help evaluate safe and effective downstream passage of American eels through the Project, the Licensee shall cooperate with the Service and other interested parties in the funding, planning, and conduct of a Lower Susquehanna River Downstream Eel Study to evaluate the timing, magnitude, duration, annual variation and environmental conditions associated with active migration of silver eels through the lower Susquehanna River to the Chesapeake Bay.

2. The Project shall be operated to maintain the following minimum flows below the Project (the total of flows through the Powerhouse, over the Main Dam and East Channel Dam) as indicated in the Final License Application:
    a. 1,000 cfs or inflow from upstream, whichever is less, at all times.
    b. An average daily minimum flow of 2,500 cfs or inflow from upstream, whichever is less.
    c. Whenever inflow from upstream is less than 3,000 cfs, the Project shall be operated on a run-of-river basis, adding or suspending operations at turbines to reflect, to the extent practicable, inflow from upstream and without adding or suspending turbine operations to deliberately drawdown or store water for purposes of generating electricity in particular time periods.
    d. Minimum flows may be temporarily modified if required by operating exigencies beyond the control of the Licensee.

* * * * *

We appreciate the opportunity to provide comments, recommendations, terms and conditions, and prescriptions on this application for new license.

Sincerely,

Lindy Nelson
Regional Environmental Officer

cc: York Haven Service List

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National Park Service (NPS). 2010. The Strategy for Protecting and Restoring the Chesapeake Bay.

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Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC). 2010. Migratory fish management and restoration plan for the Susquehanna River Basin. 124pp.

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Attachment A

BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Olympus Power, LLC Applicant	)	York Haven Power Company
	)	FERC No. 1888-030

UNITED STATES DEPARTMENT OF THE INTERIOR'S
DECISION DOCUMENT,
PRELIMINARY PRESCRIPTION FOR FISHWAYS
PURSUANT TO SECTION 18 OF THE FEDERAL POWER ACT

Approved this 31st day of January, 2014, by:

G. La Rouche

Genevieve LaRouche, Field Office Supervisor
U.S. Fish and Wildlife Service
United States Department of the Interior

Table of Contents

UNITED STATES DEPARTMENT OF THE INTERIOR'S
DECISION DOCUMENT,
PRELIMINARY PRESCRIPTIONS FOR FISHWAYS
PURSUANT TO SECTION 18 OF THE FEDERAL POWER ACT

1. Introduction

The United States Department of the Interior (Department) hereby submits its Decision Document and Preliminary Prescription for Fishways for the York Haven Hydroelectric Project (Project), FERC No. 1888 to the Federal Energy Regulatory Commission (Commission or FERC) pursuant to Section 18 of the Federal Power Act, as amended. The Department will separately submit its supporting administrative record including an index.

The Department developed its preliminary prescription for fishways through a review process that included consultation among fisheries biologists and fishway engineers from the Department's U.S. Fish and Wildlife Service (Service), Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Environmental Protection (PADEP), Maryland Department Natural Resources (MDDNR), Susquehanna River Basin Commission (SRBC), as well as Olympus Power, LLC , and other interested parties.

The Department has considered the record before the Commission, as well as scientific evidence not already included in the record before the Commission. Copies of any supporting documents not previously filed with the Commission or publically available will be filed via electronic digital media and delivered by express mail service. Copies of the administrative record will be provided by the Service.

2. Administrative process, hearing rights, and submission of alternatives

This Preliminary Prescription was prepared, and will be processed, in accordance with the Department’s regulations at 43 C.F.R. Part 45. These regulations provide that any party to a license proceeding before the Commission in which the Department exercises mandatory authority is provided both the right to trial-type hearings on issues of material fact and the opportunity to propose alternatives to the terms contained in the Preliminary Prescription.

Therefore, the Department hereby provides notice that any party to the License Application Process before the Commission may request a trial-type hearing on any issue of fact material to this Preliminary Prescription pursuant to, and in conformance with, the regulations of the Department at 43 C.F.R. § 45.21. Such a request for a trial-type hearing must be filed with the Office of Environmental Policy and Compliance, Department of the Interior, 1849 C Street, NW, Mail Stop 2342, Washington, DC, within 30 days of the submission of this document. Should any request for trial-type hearing be filed, other parties may file interventions and responses within 15 days of the date of service of the request for a hearing. 43 C.F.R. § 45.22. Trial-type hearings will be conducted, and a Modified Prescription for Fishways developed, in accordance with the terms and time limits of 43 C.F.R. part 45.

The Department further provides notice that any party to the License Application Process before the Commission may submit alternatives to the terms contained in the Preliminary Prescription by filing them pursuant to, and in conformance with, the Department's regulations at 43 C.F.R. § 45.71. Any such alternative proposals must be filed with the Office of Environmental Policy and Compliance, Department of the Interior, 1849 C Street, NW, Mail Stop 2342, Washington, DC 20240 within 30 days of the submission of this document. Such alternative proposals will be analyzed in accordance with 45 C.F.R. § 45.73.

Finally, the Department will accept and consider any comments on the Preliminary Prescription filed by any member of the public, State or Federal Agency, the Licensee, or other entity or person. Comments should be filed within 30 days of the filing of this Preliminary Prescription, and should be sent to: Genevieve LaRouche, Field Supervisor, Chesapeake Bay Field Office, Annapolis, MD.

If no hearing is requested or alternative submitted, the Department will finalize its Prescription for Fishways, with accompanying analysis, when the Commission requires parties to file Modified Terms and Conditions and Prescriptions in accordance with 43 C.F.R. 45.73.

3. Resource Description

3.1 Project Description

The Project is located on the Susquehanna River in Dauphin and Lancaster Counties in southeastern Pennsylvania (Figure 1). The Project is located upstream of Chesapeake Bay at river mile 55, immediately downstream of Three Mile Island Nuclear Power Plant, 17 miles downstream of Harrisburg, Pennsylvania and 22 miles upstream of the Safe Harbor Hydroelectric Station (river mile 33). The Project is the fourth dam on the Susquehanna River upstream of Chesapeake Bay and the fifth hydroelectric project in the lower River.

The Project includes 20 similarly sized hydroelectric turbine units with a current licensed capacity of nearly 20 Megawatts. A brick and stone masonry powerhouse approximately 472 feet by 48 feet is located parallel to the west bank of the Susquehanna River housing the turbines, generators, and appurtenant equipment. Steel trashracks with four-inch clear spacing are installed at the intakes for each of the 20 turbines. The forebay includes a trash sluice with gate dimensions of 14 feet wide by 10.5 feet tall that discharges approximately 600 cubic feet per second (cfs). The Project operates as run of river with an allowable 1.1 foot headpond fluctuation. Mean monthly flows are highest in March and April and lowest in August and September. The Project is capable of maintaining run-of-river operations and impoundment water levels under low to moderate stream flow conditions. During periods of moderate to high runoff (>17,000 cfs), the Project turbines cannot control water levels in the impoundment.

The normal maximum water surface elevation is 277.91 feet (NGVD29) with the value of 277.91 feet representing the low point of the Main Dam, which under current operations is considered the normal elevation when river flows are less than maximum turbine capacity. The Project impoundment, Lake Frederic, is approximately 3.5 miles long with a surface area of 2,218 acres and all elevations are reference to the 1929 National Geodetic Vertical Datum. The impoundment is approximately 9,600 acre-feet of gross storage capacity and a usable storage capacity within its allowable 1.1 feet of fluctuation of about 1,700 acre-feet, or approximately 1 hour of storage at the plant’s maximum hydraulic capacity. The Project is operated with a year-round continuous minimum flow requirement of 1,000 cfs and an average daily minimum flow requirement of 2,500 cfs, or inflow, whichever is less, both of which can be delivered through the powerhouse. Project currently maintains the minimum flow requirement through spillage over the existing dam structures in combination with the operation of a minimum of two turbine-generator units. Additionally, Project is required to provide a minimum flow of 2,000 cfs at the East Channel Dam and spill 4,000 cfs at the Main Dam during the American Shad passage season while the upstream fish passage facility is operating.

Lake Frederic, which falls within the Project’s boundary, has approximately 29 miles of total shoreline length, including islands. The average maximum depth of Lake Frederic is approximately 18 feet with a mean average depth of 6 feet. Lake Frederic is a popular recreation site and provides numerous recreational opportunities including fishing, boating, picnic facilities, a playground, and tennis and basketball courts. Lake Frederic contains five significant islands (Battery, Beshore, Goodling, Goosehorn, and Shelley) with picnic facilities and nature trails provided and maintained by the Licensee. In addition, Lake Frederic contains several smaller islands which do not have facilities, but may be accessed by boaters. Fishing platforms and designated fishing areas are provided in the headrace and tailrace areas. Portages for canoes and small boats are provided around the dams. Recreational lot sites are available through a licensing program administered by the Licensee, on which annual license holders may place trailers or recreational vehicles (with some lots containing pre-existing cabins). The Project also includes a recreation site adjacent to the powerhouse, which provides a large grassy area with playground and picnic facilities as well as tennis and basketball courts and ample parking.

The Susquehanna River is one of America's largest rivers and is approximately 444 miles (747 km) long. The river forms in upstate New York and west-central Pennsylvania and drains a watershed area of over 27,000 square miles. It is the largest tributary to the Chesapeake Bay, providing over 60 percent of the freshwater to the Bay. The name of the river comes from an Algonquian word for "muddy water". This term may still be an appropriate description of the Susquehanna today as the River can be very turbid - particularly during higher flow events. There is also considerable run-off from agricultural areas that have long been a major contributor to nutrient loading in the Chesapeake Bay.

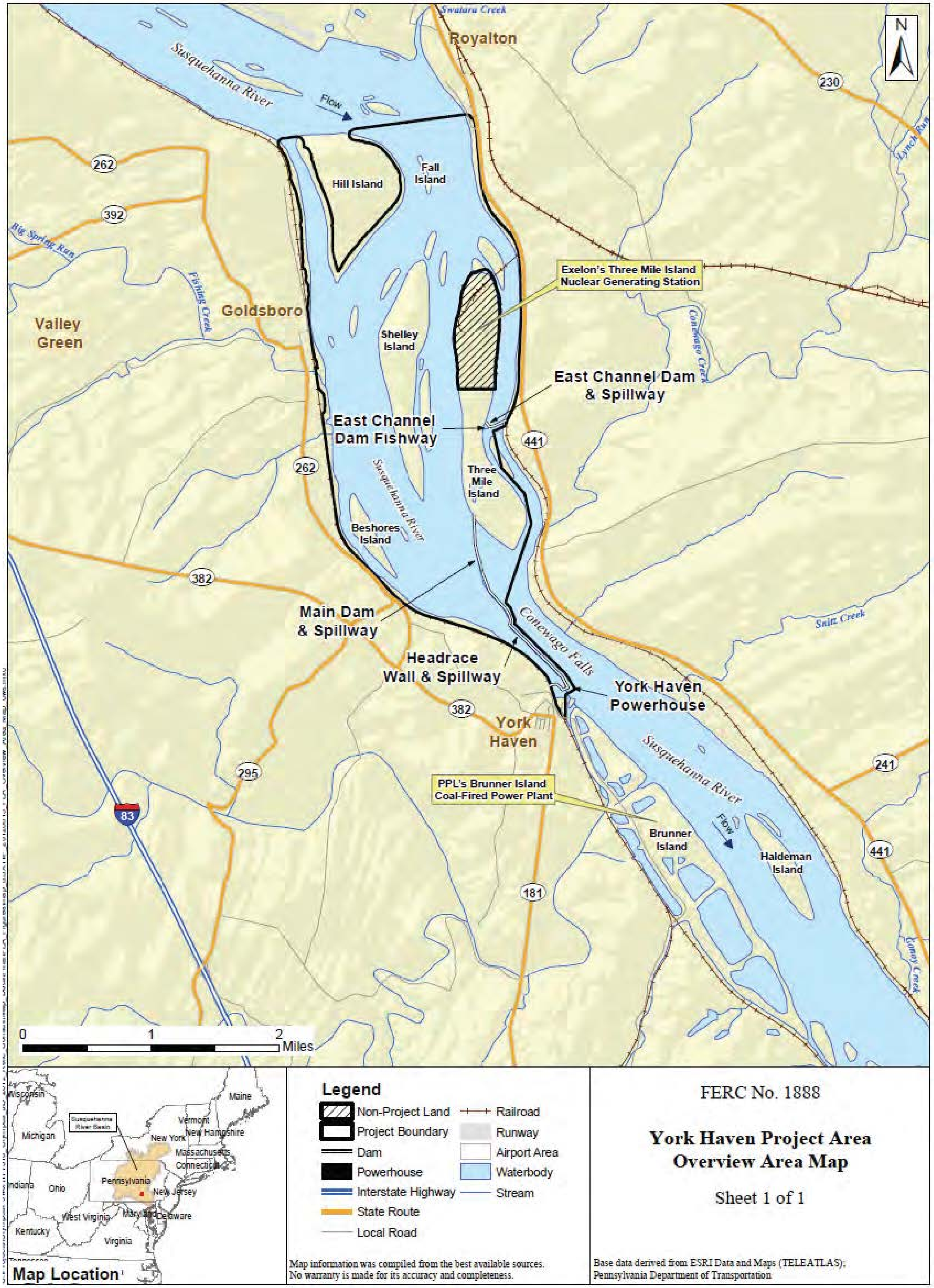

Figure 1. York Haven Hydroelectric Project Boundary and Overview

3.2 Historic Fishery Resources

3.2.1 Anadromous Fish

The Susquehanna River historically supported large numbers of migratory anadromous fish. These were members of the herring family Clupeidae; including the American shad *(Alosa sapidissima*), hickory shad (*A. mediocris*), blueback herring (*A. aestivalis*), and alewife (*A. pseudoharengus*), the latter two species being collectively referred to as river herring. Populations of sea-run migratory fish have been severely impacted by human activities, primarily due to habitat loss from dam construction, habitat degradation and overfishing (ASMFC 2007 Vol. I). Construction of canal dams on the Susquehanna River in the mid-1800's restricted access to ancestral spawning grounds, but the construction of the four large, hydroelectric dams on the lower mainstem river in the early 1900's eliminated access to spawning habitat and nursery habitat to all but the lowermost 10 miles of the river (SRAFRC 2010). In response to serious declines in harvest, all shad fisheries in Chesapeake Bay were closed (Maryland in 1980; Virginia in 1994).

In the United States, the need for fish passage was recognized in the late 19th century and various methods were attempted in the early years. Technology in fishway design improved with time and experimentation and by the 1940's, successful passage of shad was demonstrated at Bonneville Dam on the Columbia River, Oregon. In the 1950's, inspired by improvements in fish passage technology, resource agencies began the process of restoring migratory fish to the Susquehanna River, focusing on American shad. Much progress has been made in the restoration effort, including construction of fish passage facilities at all four lower mainstem dams; stocking of pre-spawned adult shad into suitable spawning waters above dams; development of methods to rear American shad in the hatchery; the development of marking methods to distinguish hatchery reared fish from naturally produced fish; and the stocking of tens of millions of cultured American shad larvae.

Around 1970, the utility companies owning the dams along the Susquehanna River began working with Federal and state agencies to stock the upper Susquehanna River with shad eggs and built a facility at Conowingo Dam to trap and transfer American shad and river herring upstream to spawning areas near Middletown and Columbia, Pennsylvania. The Conowingo trapping facility had limited success, however, collecting only 945 shad between 1972 and 1980 (SRAFRC 2010).

As part of a 1984 Settlement agreement, Pennsylvania Power and Light (PPL), Safe Harbor Water Power Corporation (SHWPC) and the Licensee provided $3.7 million over the period from 1985-1994 to fund the trap and transfer program for American shad, expand hatchery operations and conduct studies related to American shad restoration. By the late 1980s, the catch of returning adult shad at Conowingo had increased to several thousand American shad per year. As a result, a new fish passage facility capable of passing 1.5 million shad and 10 million river herring was completed in 1991 at Conowingo Dam. In 1993, SHWPC, PPL, and the Licensee reached a Settlement Agreement with various agencies (Settlement 1993). This agreement required Safe Harbor and Holtwood to have fish passage facilities in place by 1997 and required the Licensee to install facilities no later than three years after the in service date of the facilities at Holtwood and Safe Harbor. The Holtwood fishway was completed in spring 1997. The fish lift has a design capacity of 2,700,000 shad and 10,000,000 river herring. Since the first year of operation at Safe Harbor in 1997, performance beat expectations with the facility lifting over 200,000 fish past the dam, including nearly 21,000 American shad. Even though counts are low today at the Conowingo Dam, Safe Harbor successfully passes 80% of the fish upstream of the fish swimming from the Holtwood Dam.

3.2.2 Catadromous Fish

The American eel (*Anguilla rostrata*) is the only catadromous fish in the Susquehanna River. Unlike American Shad and river herring, American eel spawn at sea and return as juveniles to seek out upstream nursery and foraging habitats. Eel maturation may take 5 to 20 years before adult eels migrate downstream in the rivers, returning to the ocean to spawn (ASMFC 2012a). Historically, American eels were very abundant throughout the Susquehanna River, and supported a commercial fishery in the Susquehanna River Basin that exceeded the American shad harvest in the late 19th century (SRAFRC 2010). Construction of the mainstem dams in the early 20th century precluded juvenile eels from accessing the majority of the Susquehanna River Basin. The PFBC collected a total of about 17 million juvenile eels below Conowingo Dam for stocking in the Susquehanna River Basin between 1936 and 1980. The fish lifts at Conowingo Dam collected a high of 90,000 juvenile American eels in 1974, but those catches have declined dramatically in more recent years with less than 10 eels having been captured each year (SRAFRC 2013a).

3.3 Current Fisheries

3.3.1 American Shad

3.3.1.1 Coast-Wide American Shad Status

The current status of American shad along the Atlantic coast is summarized by the Atlantic States Marine Fisheries Commission (ASMFC) in Amendment 3 to the Interstate Fishery Management plan for Shad and River Herring (ASMFC 2010) and the most recent American Shad Stock Assessment (ASMFC 2007, Vol. I). Historically, American shad, hickory shad, alewife, and blueback herring (collectively termed Alosines) were an extremely important fishery resource and supported very large commercial fisheries along the Atlantic coast of both the United States and Canada. Coast-wide landings of American Shad at the turn of the century were approximately 50 million pounds. However, by 1980 the landings decreased dramatically to 3.8 million pounds. Total landings of river herring (alewife and blueback herring) varied from 40-65 million pounds from 1950-1970, then declined steadily thereafter to less than 12 million pounds by 1980. These dramatic declines in commercial landings were perceived as an indication that a coordinated management action would be required to restore Alosine stocks to their former levels of abundance. Therefore, in 1981, the members of the ASMFC recommended the preparation of a cooperative Interstate Fishery Management Plan (FMP) for American shad and river herrings. The initial FMP was completed in 1985 and recommended management measures that focused primarily on regulating exploitation and enhancing stock restoration efforts.

In spite of the efforts to develop and implement the FMP, Alosine stocks continued to decline and in 1994, ASMFC determined that the original FMP was no longer adequate for protecting and restoring remaining shad and river herring stocks. They concluded that the declines may have been the result of overharvest by in-river and ocean-intercept fisheries; excessive striped bass predation; biotic and abiotic environmental changes; and loss of essential spawning and nursery habitat due to water quality degradation and blockages of spawning reaches by dams and other impediments. A coast wide assessment was completed in 1998 and Amendment 1 to the FMP was adopted in 1999 and additional addendums were added in 2000 and 2002. Amendment 1 and the addendums focused on maintaining directed fishing mortality below set benchmarks which defined ASMFC shad management until the adoption of Amendment 3 in 2010.

The 2007 stock assessment (ASMFC 2007, Vol. I) found that American shad stocks were at all-time low levels and did not appear to be recovering to acceptable levels. Commercial landings declined to 574,300 pounds in 2005 (a reduction of approximately 85% since 1980). The primary causes for continued stock declines were attributed to a combination of excessive total mortality, habitat loss and degradation, and migration and habitat access impediments. The 2007 stock assessment also concluded that management based on fishing mortality benchmarks, as in Amendment 1, was no longer valid for American shad stocks since they are subjected to several sources of human-induced mortality including direct and indirect fisheries as well as fish passage mortality at dams and river pollution. Since the components of human-induced mortality (direct and indirect fisheries, dam-induced, and pollution) are difficult or impossible to partition, and difficult to separate from natural mortality, the 2007 stock assessment suggested the use of a total instantaneous mortality rate that preserves 30% of unexploited spawning biomass per recruit as a benchmark (Z_{30}) to help guide management and gauge restoration progress.

General conclusions from the 2007 stock assessment were:

- Ocean mixed stock harvest has been a large component of total American shad harvest over the last 25 years and since the late 1980s it was the dominant component of shad harvest from north of Virginia.
- The expected benefits resulting from the ocean intercept fishery closure were not obvious in this assessment and might take one or more generations of American shad before they are realized.
- Available total mortality estimates generally exceeded Z_{30} for most years in rivers where data were suitable for catch curve analysis and where data supported spawning stock biomass per recruit modeling.
- Data on annual number of fish passing upriver at dams on several Atlantic coastal rivers exhibited a coast-wide pattern of an increase followed by a decrease. Interestingly, most fish passage numbers declined at about the same time (late 1990s to early 2000s).This synchronous decline suggests a coast wide change in environmental conditions or mortality factors that affected stocks from South Carolina to Maine within a five year period.
- Continuous fishery dependent and independent catch-per-unit-effort series generally only provide insight into recent stock dynamics, except for the Delaware River Lewis haul seine index.

- Trends in juvenile production do not show consistent patterns coast-wide; however, regional patterns and some local trends were noteworthy:
- Recruitment has increased in the upper Chesapeake Bay, including the Potomac River, and Merrymeeting Bay, Maine in recent years,
- Recruitment patterns in the lower Chesapeake Bay (James, York, and Rappahannock Rivers) and in Albemarle Sound have been similar,
- Relatively low young-of-year production was observed in all New England juvenile surveys in 1998 and 2001, and
- There has been consistent low recruitment in the Hudson River since 2002.

In response to the 2007 stock assessment, Amendment 3 to the FMP was adopted in 2010. Amendment 3 called for the adoption of Z_{30} as a benchmark to evaluate observed levels of total mortality and whether or not population restoration was occurring. It also called for the states or jurisdictions to submit sustainability plans for commercial and recreational fisheries. States or jurisdictions without an approved plan in place would have their fisheries closed by January 1, 2013. Currently, Connecticut, the Delaware River Basin, Potomac River Fisheries Commission, North Carolina, South Carolina, Georgia and Florida have an approved sustainability plan. Some states such as Maryland have chosen to close their shad and herring fisheries.

In addition to regulating fisheries via sustainability plans, Amendment 3 recommended states and jurisdictions develop habitat plans for American shad to reduce or mitigate the impact of dams and other obstructions and water quality and contamination. Some recommendations for fish passage included working with Federal agencies and to target hydropower dams for appropriate recommendations during FERC relicensing; prioritize barriers in need of fish passage based on ecological criteria; develop new technologies to improve fish passage efficiency; design passage facilities that work under all water levels; and implement measures to pass fish via routes with the best survival. Although the development of habitat restoration and protection programs was proposed in Amendment 3, implementation of these programs is not required as it is beyond the authority of ASMFC.

3.3.1.2 Mid-Atlantic Region American Shad Status

Although there has been an overall coast-wide decline in American shad stocks, the 2007 ASMFC stock assessment found much variation in population trends along the coast. Regional trends were apparent with rivers in close geographic proximity showing similar population trends. When assessing the status of the Susquehanna River and attempting to give context to these trends, it is useful to compare them to rivers of similar size that are also located in the mid-Atlantic region such as the Delaware River and the Potomac River.

3.3.1.2.1 The Susquehanna River

The Susquehanna River once supported large numbers of migratory fish including the American shad (*Alosa sapidissima*), blueback herring (*A. aestivalis*), alewife (*A. pseudoharengus*), and hickory shad (*A. mediocris*), striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrinchus*), and shortnose sturgeon (*Acipenser brevirostrum*). These stocks have been severely impacted by human activities, especially dam building. In the 1950s, the resource agencies implemented a program to restore access for migratory fish to the upper Susquehanna River basin, focusing on American shad.

As stated above, in response to harvest declines that signaled critically low fish stock levels, the directed American shad fisheries in the Chesapeake Bay region were closed (Maryland in 1980 and Virginia in 1994). The American shad stock in the Susquehanna River improved slowly and made an impressive comeback by 2001 when over 200,000 adult shad were counted at the Conowingo Dam fish lifts. However, since 2001, adult numbers have decreased most likely due to a variety of factors including: poor efficiency of fish passage measures and facilities; low hatchery production in recent years; low numbers of spawning fish accessing quality habitat; poor young-of-year recruitment upstream of Conowingo Dam; ocean and Chesapeake Bay mortality; turbine mortality; and predation (SRAFRC 2010).

The decline over the past decade in adult shad counted at Conowingo Dam fish lifts also coincides with declines seen downstream of the Conowingo Dam tailrace. Abundance estimates from mark-recapture and a surplus production model conducted from 1988 through 2012 both showed an increase through 2001 followed by a decrease (SRAFRC 2013b). Also, catch-per-unit-effort (fish per boat hour) from the Conowingo Dam tailrace showed similar trends (SRAFRC 2013b). The percentage of repeat spawning American shad in the Conowingo Dam tailrace also increased from 1984 to 2002, but has remained fairly stable since then with 34% of males and 73% of females being repeat spawners in 2012.

3.3.1.2.2 The Delaware River

In the late 1890s, the Delaware River had the largest annual commercial shad harvest of any river on the Atlantic Coast with estimates ranging up to 19 million pounds in a given year. The harvest began to decline rapidly in the early 1900s due to water pollution, overfishing, and dams on major tributaries (ASMFC 2007, Volume II). Despite improved state legislation and regulation, and a massive program of artificial propagation of shad stocks in the late 1800s, the shad fishery eventually collapsed under the combined pressures. By the 1940s, the commercial shad fisheries were mainly limited to the lower reaches of the Delaware River and Delaware Bay downstream of Pennsylvania by 1950. The urban reach of the Delaware River was one of the most polluted stretches of river in the world (ASMFC 2007, Volume II).

The Delaware River stock of American shad rebounded from the 1960s through the 1980s, but declined again. It is evident that the Delaware River stock of American shad declined through the 1990s and remains at low levels (ASMFC 2007, Volume II). The catch-per-unit-effort (fish/haul) in the Lewis haul seine fishery in the lower Delaware River had a recent peak in 1989 with a 52.20 fish/haul, but declined to only 2.89 fish/haul in 2005. Relative abundance measures of juvenile American shad increased from 1980 through 1996 and have since varied without trend. There does not seem to be an identifiable cause of the decline nor an indication as to why the stock has remained at low levels in recent years. Although recent high abundances of striped bass have been hypothesized to be a reason for continued low abundance of American shad in the Delaware River, the 2007 stock assessment found no empirical data to attribute the shad decline in the Delaware River solely to striped bass.

3.3.1.2.3 The Potomac River

Among Chesapeake Bay stocks of American shad, the Potomac River population shows the most promising signs of recovery. The gill-net index, the pound net index, and the juvenile abundance index used in the 2007 ASMFC stock assessment (ASMFC 2007, Volume III) depict increasing trends in relative abundance. Age structure has broadened and the mean age has increased. Estimates of total mortality have declined from 2002 to 2005. Benchmark values Z_{30} (the total mortality that preserves 30% of unexploited spawning stock biomass per recruit) in the Chesapeake Bay region (York River, Virginia) derived from a yield model ranged from 0.62 to 0.86 depending on the assumed level of natural mortality. Total instantaneous mortality estimated in 2005 from catch curve (0.82) and repeat spawning (0.66) data were within this range indicating that total mortality was not excessive.

Another benchmark for American shad in the Potomac River is the geometric mean of pound net catch rates reported in Walburg and Sykes (1957) for the years 1944 to 1952, a value of 31.1 pounds per net-day. Although pound net catch rates remain below the benchmark, catch rates have steadily increased from 0.94 in 1988 to 12.21 in 2005 (ASMFC 2007, Volume III). To continue stock rebuilding, there should be no new expansion of the fishery until the benchmark is reached.

It appears the decline in American shad seen on the Susquehanna River over the past decade coincides with a decline seen on the Delaware River. However, the American shad population in Potomac River is increasing and we would expect that the Susquehanna population should show trends more similar to the Potomac River since both are major Chesapeake Bay tributaries.

3.3.2 American Eels

The ASMFC completed a stock assessment in 2012 and concluded that the coast-wide stock of eel is depleted, due to a combination of historical overfishing, habitat loss, food web alterations, predation, turbine mortality, environmental changes, toxins and contaminants, and disease (ASMFC 2012a). Currently, ASMFC is considering changes to its Interstate Fishery Management Plan for American Eel. The American Eel Management Board (state directors) recently reviewed advice from the American Eel Technical Committee with respect to potential management changes needed to address modern population declines. In addition to the management actions by ASMFC, the Service was petitioned in 2004 to review the status of American eel under the ESA. The Service concluded that the petition warranted further consideration, however the Service determined that listing was not warranted at the end of their review in 2007. The Service was petitioned again in 2010 by the Council for Endangered Species Act Reliability to re-consider listing the American eel under the ESA based on new information. In 2011, the Service concluded that the species warrants a more extensive status review which is expected to be completed in September 2015.

American eels have been largely excluded from the Susquehanna River Basin above Conowingo Dam since the early 1900’s (SRAFRC 2010). Although PFBC conducted an intermittent trap and transfer program through 1980, by 2000 there were essentially no eels remaining in the watershed. Fish lifts at the four lower mainstem dams have passed few to no American eels in the past 10 years. In 2008, the Service initiated an experimental trap and transfer program at Conowingo Dam. This program has released over 300,000 juvenile eels from 2008 through 2012 at various locations throughout the Susquehanna River Basin (SRAFRC 2013a). A portion of these eels have been stocked in areas where freshwater mussels are present, because American eel are the primary host species for successful reproduction of the eastern elliptio mussel

(*Elliptio complinata*) (Lellis et al. 2013). Freshwater mussels have the potential to reduce suspended solids and dissolved nutrients (Vaughn 2010, Atkinson et al. 2013, Spooner et al. 2013).

3.3.3 River Herring

On August 5, 2011, the National Marine Fisheries Service (NMFS) received a petition from the Natural Resources Defense Council (NRDC) requesting that they list alewife (*Alosa pseudoharengus*) and blueback herring (*A. aestivalis*) under the ESA as threatened throughout all or a significant portion of their ranges. Alternatively, NRDC requested the designation of distinct population segments of alewife and blueback herring as specified in the petition, including the Chesapeake Bay for both species.

The petition contained information on the two species, including population status and trends, and factors contributing to the species' decline. The petition was determined to be warranted and NMFS published a positive 90-day finding on November 2, 2011. NMFS initiated a status review of the species to determine if listing under the ESA is warranted by forming an internal status review team (SRT) to compile the best commercial and scientific data available for alewife and blueback herring throughout their ranges. In May 2012, the ASMFC completed a river herring stock assessment, which covers over 50 river-specific stocks throughout the ranges of the species in the United States (ASMFC 2012b). NMFS identified the missing data required for their review and held workshops/working group meetings focused on addressing information on stock structure, extinction risk analysis, and climate change. Reports from each workshop/working group meeting were compiled and independently peer reviewed (Carvalho 2012; Chaput 2012; Hutchings 2012). On August 12, 2013, the NMFS concluded that "listing alewife or blueback herring as threatened or endangered under the ESA is not warranted at this time" (78 FR 48944). Based on the data available (NEFSC 2013), the SRT concluded that alewife are at low risk of extinction and blueback herring are at low to moderate risk of extinction.

Although listing under the ESA was determined not warranted, the conclusions of the SRT indicated that both species are at low abundance compared to historical levels and continued monitoring is warranted (NEFSC 2013). Hall et al. (2012) noted the loss of anadromous fish productivity in Maine was reduced by 90% by the mid-1800s, a loss attributed to lost habitat access due to dam construction. By the author's estimates, this loss of habitat contributed to the loss of billions of juvenile alewife and blueback herring annually (Hall et al. 2012). While many factors affect anadromous fish returns during any given year, including incidental and direct harvest, climate change, and pollution, dams on historical anadromous rivers remain a significant impediment to restoration efforts (ASMFC 2012b; Hall et al. 2011).

The abundance trends analysis for alewife and blueback herring evaluated returns across the species entire range and for specific stock complexes (NEFSC 2013). The results indicated that all alewife stock complexes range wide have significantly increased over the past 30 years. Range-wide, the observed increase in blueback herring was not significant. While the observed stock of alewife and blueback herring are either increasing or stable range wide, stock specific trends indicate areas of concern. Specifically, the Mid-Atlantic stock complex for alewife is stable, neither significantly increasing nor decreasing. While stable, the abundance of all stocks are greatly diminished compared to historical landings records (Hall et al. 2012). The Mid-Atlantic stock complex for blueback herring was determined to be significantly decreasing, as compared to the other blueback herring stocks that were considered stable.

3.4 Existing Fish Passage Facilities

The Licensee entered into a Settlement Agreement in 1993 (67 FERC ¶ 62,291) with other hydroelectric operators on the Susquehanna River, Federal and state resource agencies, and local organizations to provide upstream and downstream fish passage facilities. This 1993 Agreement was subsequently modified by a 1997 Settlement Agreement approved by FERC (81 FERC ¶61,214). The agreed upon upstream fish passage facility was installed and became operational in April 2000 and is located at the western end of the East Channel Dam. The fishway includes two sections; a “weir cut” and a 250-foot long vertical-notch fish ladder. The “weir cut” consisted of an upper portion with three independent groups of 25-foot-diameter coffer cells between which two 20-foot fixed-wheel gates are installed and a lower section with a 67-foot adjustable weir and a stop gate. The fish ladder has an entrance diffuser, serpentine baffles that form eight pools, and an exit flume. The design population (annual passage capacity) of the fish ladder is 500,000 shad equivalents[7]. East Channel Dam attraction flows are provided through the gated openings and a 17-foot-high by 67-foot-long weir constructed on the East Channel Dam immediately adjacent to the fish passage facility. A total of 200 cfs is passed through the fishway entrance (approximately 40 cfs through the ladder itself and 160 cfs in supplemental attraction flow through a rectangular conduit located under the ladder). The serpentine baffles enclose eight, four-foot-deep elevated pools that form the fish ladder to the impoundment. A counting station is located in the exit channel just upstream of the last fish ladder pool. A minimum flow of 2,000 cfs at the East Channel Dam is required during the upstream fish migration season from mid-April to mid-June, with specific dates for each year determined jointly by dam operators, the Service, and the PFBC. The fishway stays open in flows up to 150,000 cfs. Due to safety concerns, the fish passage is closed when flows exceed 150,000 cfs. During the upstream migration season, the licensee maintains the lake level at an elevation not lower than 277.8 feet as measured at the entrance to the headrace. No dedicated downstream bypass facilities are installed. Downstream fish passage is provided through the turbines, over the spillway, and through the trash sluice located at the powerhouse.

Under the terms of the 1993 and 1997 Settlement Agreements, the Project is required to provide a minimum flow of 2,000 cfs at the East Channel Dam and spill 4,000 cfs at the Main Dam, as well as maintaining the lake level at 277.8 feet or above while the upstream fish passage facility is operating. In addition, the Licensee and the PADEP entered into a Consent Order and Agreement dated June 10, 2010, under which the Licensee committed to: (1) operate and maintain the east channel fish passage system to allow passage of resident fish species from April 1 through the earlier of December 15 or until the average daily river temperature is 40° F for three consecutive days; (2) provide a minimum stream flow of 400 cfs in the east channel fish passage system after the American shad upstream passage season and during the resident fish passage period; (3) provide flows over the main channel dam and through the east channel after the American shad upstream passage season and when river flows exceed the Project’s hydraulic

[7] A shad equivalent is the measure of body volume whereby ten alewife or blueback herring equals the volume of one shad..

capacity, in accordance with objectives and details to be developed through further consultations between the Licensee and the PFBC; (4) manage debris to maintain the functioning and operability of the passage system during the period of operation of the east channel fish passage system; and (5) conduct certain monitoring and allow the Resource Agencies with access to the east channel fish passage system counting room to conduct fish monitoring.

Existing mainstem Susquehanna River upstream fish passage facilities (lifts and ladder) were designed, sized and operated to pass anadromous adult shad and herring, and are not effective in passing juvenile American eels upstream of the mainstem dams. Specialized fishways designed to accommodate eels are needed to allow them access to the watershed above these dams.

3.5 Agreements Affecting Future Fish Passage Operations

The Licensee has agreed in settlement to implement fish passage enhancements at the Project in cooperation and consultation with the Resource Agencies. The Licensee and Resource Agencies have focused on constructing a nature-like fishway located at the apex of the Main Dam where it abuts Three Mile Island. Preliminary designs of the nature-like fishway are included in Appendix B of the Settlement Agreement with the Licensee.

3.6 Downstream Fish Passage

Safe and timely downstream passage of post-spawned adult and juvenile American shad past hydroelectric projects has long been of considerable concern to the Service and state resource agencies. An optimal condition for increasing American shad production in the Susquehanna River basin is for all adult and juvenile American shad to out-migrate (downstream) safely (without mortality or injury) past all of the hydro, coal, and nuclear electric generation facilities on this River. With regard to hydroelectric projects, flow in the impoundment sufficient to guide fish; and operational measures, downstream migrant facilities, sluices, bypasses, and physical barriers at the dam and/or powerhouse have had measures of success. Operational measures can include sequential or selective turbine operation, sequential shutdown, controlled spills, opening a gate or sluice, or a combination. Facilities can include devices and structures, sometimes in combination, such as pipes, gates, turbine intake screening, and plunge pools. Fish behavior modification has been tested and employed at this and other projects with limited success. Improvements in turbine design have been presented to increase the safety of turbine passage. Laboratory and field testing is in various stages. As a policy matter, the Service does not favor turbine passage. A combination of techniques can be used to provide safe and timely passage of various life stages of fish migrating downstream. At this time, the goal for downstream passage survival at each project for juvenile American shad is 95%, 80% for adult American shad, and 85% for adult American eel (SAFRAC 2010, SAFRAC 2013a)[8].

In the spirit of settlement, the Service has agreed with the Licensee to implement a combination of sluice/bypass, turbine passage, and dam spillage as the initial means of meeting the

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[8] The goals apply to each project individually rather than two or more projects cumulatively. They also apply to the entire project, rather than separately to any subset of the project operation or works. For example, the goal for the American eel is for 85% of all eels that enter the project to exit the project alive and with no injury due to the project operation or works.

downstream passage survival goals for the target species. Studies will be completed to determine the effectiveness of these measures in meeting the goal. A study is not required for survival of adult American shad because previous radio telemetry studies on Adult shad conducted by the Licensee at the Project have indicated that current project operations are meeting the passage goals. In the event that studies provide evidence that 95% of juvenile American shad and 85% of adult American eel are not passing safely downstream, then other operational measures will be implemented and tested as described in the Settlement. If they fail, the addition of some type of fish guidance system will probably be needed to meet the above stated goals.

4. Management Goals

The Service utilized the 2010 Migratory Fish Management and Restoration Plan for the Susquehanna River Basin (SAFRAC 2010) developed by the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) Technical Committee and adopted by the SAFRAC Policy Committee. The SAFRAC 2010 Plan was peer reviewed by a panel of experts, released in draft form for public comment, and all comments were addressed in an appendix to the SAFRAC 2010 Plan. Following final approval by the SRAFRC Policy Committee, the SAFRAC 2010 Plan was filed with the Commission as a comprehensive plan. An addendum to the 2010 Migratory Fish Management and Restoration Plan was developed and approved by the SRAFRC Policy Committee in 2013 (SRAFRC 2013a). The 2013 Addendum specifically addresses American eel restoration to the Susquehanna River Basin. The 2013 SRAFRC American Eel Restoration Plan for the Susquehanna River Basin was submitted to FERC in December 2013 to be considered as a comprehensive plan.

Section 10(a)(2)(A) of the Federal Power Act (FPA), 16 U.S.C. section 803 (a)(2)(A), requires the Commission to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by a project.

On April 27, 1988, the Commission issued Order No. 481-A, revising Order No. 481, issued October 26, 1987, establishing that the Commission will accord FPA section 10(a)(2)(A) comprehensive plan status to any Federal or state plan that: (1) is a comprehensive study of one or more of the beneficial uses of a waterway or waterways; (2) specifies the standards, the data, and the methodology used; and (3) is filed with the Secretary of the Commission.

The Commission determined that the SAFRAC 2010 Plan satisfied the FERC Order No. 481-A criteria for comprehensive plans and the SAFRAC 2010 Plan was listed as a comprehensive plan for the states of Maryland, Pennsylvania, and New York.

As part of its independent environmental analysis, the Commission will identify and review comprehensive plans relevant to a proposed project and include a discussion of the proposed project’s consistency or inconsistency with the plans. The Commission may recommend measures to reduce a proposed project's conflict with the goals of accepted plans. These measures may be included in the final licensing order. When there are major project-plan conflicts that cannot be resolved with mitigation, the FERC may recommend an alternative project design or license denial.

4.1 Published Plans

A number of published State, Federal and regional fishery plans contain management goals that pertain to the Susquehanna River, which the Service has considered.

4.1.1 Resource Agency Plans

Atlantic States Marine Fisheries Commission. 1998. Interstate fishery management plan for Atlantic striped bass. (Report No. 34). January 1998.

Atlantic States Marine Fisheries Commission. 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*). (Report No. 31). July 1998.

Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.

Atlantic States Marine Fisheries Commission (ASMFC). 2000. Interstate fishery management plan for American Eel. Fishery Management Report No. 36 of the Atlantic States Marine Fisheries Commission. 79pp.

Atlantic States Marine Fisheries Commission. 2000. Technical Addendum 1 to Amendment 1 of the Interstate Fishery Management Plan for shad and river herring. February 9, 2000.

Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.

Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998. 104 pages.

Susquehanna River Anadromous Fish Restoration Committee (U.S. Fish and Wildlife Service). 2010. Migratory Fish Management and Restoration Plan for the Susquehanna River Basin. Harrisburg, Pennsylvania. November 15, 2010.

Susquehanna River Anadromous Fish Restoration Committee (U.S. Fish and Wildlife Service). 2013. American Eel Restoration Plan for the Susquehanna River Basin; Addendum to the 2010 Migratory Fish Management and Restoration Plan for the Susquehanna River Basin. Harrisburg, Pennsylvania. December 5, 2013.

Susquehanna River Basin Commission. 2012. Comprehensive plan for the water resources of the Susquehanna River Basin. Harrisburg, Pennsylvania. June 2012.

4.1.2 Susquehanna River Settlement Agreements

Settlement Agreement. April 1, 1981. Pennsylvania Power & Light Company, and Safe Harbor Water Power Corporation, AND Pennsylvania Fish Commission, and Susquehanna River Basin Commission.

Settlement Agreement. December 1, 1984. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, Pennsylvania Fish Commission, Maryland Department of Natural Resources, Pennsylvania Department of Environmental Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

Settlement Agreement. August 26, 1988. Philadelphia Electric Power Company, and Susquehanna Power Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, Pennsylvania Fish Commission, Maryland Department of Natural Resources, Pennsylvania Department of Environmental Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

Settlement Agreement. June 1, 1993. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Fish and Wildlife Service – U.S. Department of the Interior, Pennsylvania Fish and Boat Commission, Pennsylvania Department of Environmental Resources, Maryland Department of Natural Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

Settlement Agreement. June 1, 1997. York Haven Power Company, AND U.S. Fish and Wildlife Service – U.S. Department of the Interior, Pennsylvania Fish and Boat Commission, Pennsylvania Department of Environmental Protection, Maryland Department of Natural Resources, and Susquehanna River Basin Commission.

4.2 Restoration Objectives

4.2.1 Anadromous Fish

In November 2010 the Policy Committee of the Susquehanna River Anadromous Fish Restoration Cooperative adopted the *Migratory Fish Management and Restoration Plan for the Susquehanna River Basin* (SRAFRC 2010 Plan) that serves as a plan for future efforts to restore important migratory fish resources to the Susquehanna River Basin.

The goal of the SRAFRC 2010 Plan relating to American shad and river herring is 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 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. Goals for American eel and other migratory species are yet to be determined.

The steps to achieve this goal are partitioned into five objectives, each with a series of tasks. The tasks include a brief description along with timelines, costs, potential sources of funding and an assessment of task status. Brief overviews of the five objectives are provided immediately below:

1. Restore access to historic habitats for juvenile and adult migratory fish. This objective calls for development of passage plans and performance measures to achieve specified minimum passage efficiency for American shad, American eels, and other migratory fish species at major basin dams. Specified minimum passage efficiencies are much higher than currently experienced at major Susquehanna River barriers.

2. Maintain or improve existing migratory fish habitat. This objective focuses on essential habitat issues by inventorying blockages and assessing the impact of fish passage impediments through active involvement of SRAFRC in watershed project reviews while supporting monitoring and improving water quality.

3. Enhance migratory fish spawning stock biomass and maximize juvenile recruitment through natural and/or artificial means. This objective includes a variety of tasks designed to directly or indirectly improve migratory fish stocks in the Susquehanna River.Tasks focus on improving current techniques for artificial augmentation of American shad stocks, developing new techniques for augmenting river herring and eel populations, restoring non-Alosine migratory fish, improving instream migration, spawning and rearing habitat, and maintaining existing regulatory framework restricting harvest of migratory fish.

4. Evaluate the migratory fish restoration effort and adjust programs or processes as needed. This objective stresses the importance of data dissemination and analysis. Tasks included in this section will continue to collect baseline data essential to monitor restoration progress while researching and experimenting with technologies to improve survival, reproduction and spawning biomass.

5. Ensure cooperation among all restoration partners while generating support for migratory fish restoration among the general public and potential funding sources. This objective stresses the importance of a watershed approach to restoration and emphasizes the need to include coastal states and ocean waters.

The SRAFRC, through its policy and technical committees, member agencies and partners will rely on this plan as the foundation of its restoration activities while also recognizing that changes in fish stocks, threats, and management techniques will require flexibility and adaptation.

4.2.2 Catadromous Fish

The ASMFC has developed an American Eel Fishery Management Plan (ASMFC 2000) to involve both marine and inland stakeholders in the American eel management process. The American Eel Fishery Management Plan for the Atlantic Coast of the United States is intended to aid in restoring a healthy and viable American eel population while providing surplus resources for a sustainable eel fishing industry. Loss of access to habitat is a primary factor in the current status of the stock (ASMFC 2012a). An objective of the American Eel Fishery Management Plan is to provide adequate upstream passage and escapement to inland waters of American eel elvers and juvenile eels as well as provide adequate downstream passage and escapement to the ocean of pre-spawn adult eels.

Declines in the American eel population in Susquehanna River Basin and elsewhere are attributed to a combination of causes, including commercial harvest, pollution, changes in oceanic currents, and the negative effects of dams and hydropower facilities (Castonguay et al 1994, Haro et al 2000). More specifically, hydropower facilities block or restrict migration routes, alter freshwater rearing habitats, and cause mortality to eels both during their residency in freshwater and as they migrate to the Sargasso Sea to spawn. Passage through multiple hydropower dams, as is the case on the Susquehanna River, results in significant cumulative mortality of eels. Currently there are no American eel passage facilities or measures in place at any of the Susquehanna River hydroelectric projects, although the Service has been stocking eel in the Susquehanna Basin since 2008. American Eel in the Susquehanna River would benefit from installation of upstream and downstream fishways or implementation of operational measures to minimize and avoid impacts associated with upstream passage delays and turbine passage entrainment injury or mortality during downstream passage at Susquehanna River hydroelectric projects.

The SRAFRC recently drafted an addendum to its 2010 Migratory Fish Management and Restoration Plan for the Susquehanna River Basin relating specifically to the goals for American eel restoration in the Basin (SRAFRC 2013a). Between the original plan and the addendum, they specifically address the restoration goals for American eel in the Susquehanna River Basin.

The goal of the American Eel Restoration Plan is to ensure that every American eel that approaches Conowingo Dam is passed upstream into the Susquehanna River Basin in order to restore American eels to the watershed, to provide a net increase of out-migrating American eel, and restore the ecosystem functions provided by healthy American eel populations, including their role as predator and prey as well as acting as hosts for the glochidia of E. complinata.

The goal will be achieved through ensuring upstream passage for American eels throughout the Basin, increasing survival and escapement of American eels passing barriers and hydroelectric facilities during their downstream spawning migration, evaluating efforts to reintroduce American eels throughout the Susquehanna River Basin and document the influences on American eel on freshwater mussel populations, and increasing public awareness, appreciation, and knowledge of American eels.

Specifically, the SRAFRC 2010 Plan states that upstream passage plans will need to be developed and implemented at FERC-licensed dams to ensure adequate passage of American eels. The 2013 addendum suggests that a trap and transport program may be initially the most effective method to support American eel restoration efforts in the basin, through elimination of the cumulative upstream passage inefficiencies as a result of passing multiple mainstem dams.

With regard to downstream protection, the 2010 Plan recommends that FERC-licensed dams must implement downstream passage plans and performance measures for silver eels to ensure at least 85 percent survival at each hydroelectric development. The Service has developed an Egg Per Recruit Model to evaluate the effects of upstream passage efficiency and downstream survival on the population of American eel in the Susquehanna River (Sweka et al. 2013). The model output provides evidence that with trap and transport of juvenile eels, at least 80% downstream survival is required at each of the lower four mainstem dams and one pumped storage facility to produce as many eggs from the Susquehanna River compared to what is currently being produced by not moving eels upstream of Conowingo Dam. The 85% downstream survival target was selected to be slightly more restrictive than the "break-even" point in Sweka et al. (2013) and result in a slight increase in eel egg production from the Susquehanna River above what is currently occurring with no upstream passage.

5. Statutory Authority

Section 18 of the Federal Power Act, 16 USCS §811, states in pertinent part:

> *The Commission shall require the construction, maintenance and operation by the Licensee at its own expense of such fishways as may be prescribed by the Secretary of Commerce or the Secretary of the Interior.*

Section 1701(b) of the National Energy Policy Act of 1992, P.L. 102-486, Title XVII, §1701(b), 106 Stat. 3008, states:

> *The items which may constitute a 'fishway' under section 18 [16 USCS §811] for the safe and timely upstream and downstream passage of fish shall be limited to physical structures, facilities, or devices necessary to maintain all life stages of such fish, and project operations and measures related to such structures, facilities or devices necessary to ensure the effectiveness of such structures, facilities, or devices for such fish.*

6. Administrative Record

Evidence to support the Department's Preliminary Prescription for Fishways is contained in the administrative record before the Commission, and citations to the extant record are provided herein. The Department has developed an administrative record in support of its Preliminary Prescription for Fishways.

7. Alternatives Considered

In development of this Preliminary Prescription for Fishways for the York Haven Project both upstream and downstream fish passage alternatives were analyzed. Upstream alternatives included expanding the existing fishway located on the East Channel, constructing a new fishway at the York Haven Powerhouse on the west side of the river, and the fisheries agencies preferred alternative of constructing a nature-like fishway at the apex of the existing dam. A 2012 telemetry study that was conducted on upstream migrating American shad indicating poor passage efficiency of the bypass channel and East Channel Fishway, providing evidence and need for additional fish passage facilities at the eastern apex location at the upstream end of the dam for American shad (YHPC 2012). The re-licensing team including state, federal, non-governmental, and power company representatives considered the construction of the nature-like fishway primarily for American shad and other riverine species to have the highest fish passage priority deferring construction of screening, racks, overlays, guide nets, and other high expense downstream facilities. For downstream fish passage alternatives, louvers, guidewalls, angled bar racks, reduced rack spacing, overlay racks, and inclined screens or racks were conceptualized and found to be costly and have unknown or less than needed effectiveness and efficiency to be able to justify or require construction at this time. The positive flow field, increased attraction and bypass flows, and improved trash sluice were selected as the cost effective interim alternative for downstream passage until technology improves and incremental need is established for downstream fish passage.

8. Reservation of Authority to Prescribe Fishways

In order to allow for the timely implementation of fishways, including effectiveness measures, the Department requests that the Commission include the following condition in any license(s) it may issue for the Project:

Pursuant to section 18 of the Federal Power Act, the Secretary of the Interior herein exercises her authority under said Act by reserving that authority to prescribe fishways during the term of these licenses and by prescribing the fishways described in section 9 of the Department of the Interior's Prescription for Fishways at the Project.

9. Preliminary Prescription for Fishways

Pursuant to section 18 of the Federal Power Act, as amended, the Secretary of the Department of the Interior, as delegated to the Service, proposes to exercises her authority to prescribe the construction, operation and maintenance of such fishways as deemed necessary, subject to the procedural provisions contained in Section 2 above.

The Department's Preliminary Prescription for Fishways reflects a number of issues and concerns related to fish restoration and passage that have been raised by the Licensee, Commission staff, state resource agencies, and other parties involved in these proceedings. Moreover, the Department, through the Service, reached settlement with the Licensee on matters of fish passage. The full range of issues settled are described in the Settlement Agreement, which includes its appendices.

Fishways shall be constructed, operated, and maintained to provide safe, timely and effective passage for American shad, alewife, blueback herring, and American eels and other designated resident riverine fish species at the Licensee's expense.

To ensure the immediate and timely contribution of the fishways to the ongoing and planned anadromous and catadromous fish restoration and enhancement program in the Susquehanna River, the following are included and shall be incorporated by the Commission to ensure the effectiveness of the fishways pursuant to section 1701(b) of the 1992 National Energy Policy Act (P.L. 102-486, Title XVII, 106 Stat. 3008).

9.1 Design Population: American Shad

Fish passage needs to be adequate to maintain self-sustaining annual populations of two million American shad reproducing in the free-flowing Susquehanna River above York Haven Dam and in suitable tributaries.

9.2 Design Population: River Herring (Alewife and Blueback Herring)

Fish passage needs to be adequate to maintain self-sustaining annual populations of five million river herring, reproducing in the free-flowing Susquehanna River above York Haven Dam and in suitable tributaries.

9.3 Design Population: American Eel

Fish passage needs to be adequate to pass all available upstream migrating eels that arrive to York Haven Dam to the mainstem of the Susquehanna River above the Project. Downstream migration of adult eels must be safe, timely and effective, achieving an 85% survival rate past the Project.

9.4 Operational Flows

Licensee shall operate the Project consistent with the flow management targets set forth below. The flow values set forth in this section are understood to be approximate and based upon reasonable engineering estimates.

9.4.1 Prior to NLF Facility Completion

Prior to completion and operation of the NLF Facility, Licensee shall operate the Project consistent with the following flow management criteria.

a. During the American Shad Upstream Passage Season

   i) An average daily minimum flow in East Channel below East Channel Dam of 2,000 cfs.

   ii) Spill over the Main Dam of equal to or greater than 4,000 cfs.

b. After the American Shad Upstream Passage Season until end of resident fish passage season (earlier of December 15 or until the average daily river temperature is less than or equal to 40 degrees Fahrenheit for three consecutive days)

i) The Project shall be operated to provide a minimum stream flow in the East Channel below East Channel Dam of 400 cfs.

ii) When river flows exceed hydraulic capacity of all available hydroelectric generating units, Licensee shall manage flows above the hydraulic capacity of available units in accordance with the following objectives:

(1) To maintain the minimum flow in the East Channel of 400 cfs.

(2) To maintain sufficient flow at the Main Dam to assure flow is released to the main channel in accordance with the existing Fish Passage Operational Plan (FPOP), except during times of maintenance work on the Main Dam when reservoir levels are lowered to permit such maintenance to occur safely.

(3) To provide additional attraction flows to the East Channel Fish Passage System through operation of the wheel gates within their design capacity.

9.4.2 After NLF Facility Completion

After completion and operation of the NLF Facility, Licensee shall operate the Project consistent with the following flow management criteria

a. During the American Shad Upstream Passage Season:

i) An average daily minimum flow in East Channel below East Channel Dam of a minimum of 267 cfs, understanding that as river flow increases above 21,000 cfs, flows over the East Channel Dam will occur in excess of the minimum of 267 cfs.

ii) Flow through the NLF Facility (passage channel plus supplement attraction flow channel) equal to at least 5% of river flow when river flows above the Project are between 5,000 and 150,000 cfs.

b. During the remainder of the year, the project shall be operated to provide:

i) An average daily minimum flow in the East Channel below the East Channel Dam of 267 cfs.

ii) The NLF Facility will be designed and operated to convey a minimum of 200 cfs when the river elevation is at the elevation of the Main Dam

iii) When river flows exceed the hydraulic capacity of all available hydroelectric generating units, the Licensee shall manage flows above the hydraulic capacity of available units in accordance with the following objectives:

(1) To maintain a minimum flow in the East Channel of 267 cfs, understanding that as river flow increases above 21,000 cfs, flows over the East Channel Dam will occur in excess of the minimum of 267 cfs.

(2) To maximize the remainder of flows abo ve hydraulic capacity flowing over the Main Dam and through the NLF facility. Within the limits of available flows in excess of the hydraulic capacity, except during the period of December 15 to the earlier of April 1 or the start of the American Shad Upstream Passage Season, the supplemental attraction flow channel will be operated with the objective of maintaining a maximum attraction flow through the NLF Facility.

9.5 Scheduling

The timely installation of the prescribed fishway structures, facilities, or devices is a measure directly related to those structures, facilities, or devices and is necessary to ensure the effectiveness of such structures, facilities, or devices. Therefore, the Department's Prescription includes the express requirement that the Licensee notify and obtain approval from the Service for any extensions of time to comply with the provisions included in the Department's Prescriptions for fishways.

Regarding the timing of seasonal fishway operations, fishways shall be maintained and operated, at the Licensee's expense, to maximize fish passage effectiveness throughout the upstream and downstream migration periods for American shad, alewife, blueback herring, American eel, and designated resident riverine fish.

Table 1. Upstream and downstream migration periods for species covered in this Prescription for Fishways. (*)

Species	**Upstream Migration Period**	**Downstream Migration Period**
American shad	April 1 through June 15	July 1 through November 15 (juv.) April 15 through July 1 (adult)
Alewife & blueback herring	March 1** through June 15	June 15 through October 14 (juv.) April 15 through July 1 (adult)
American eel	April 1 through December 1, or whenever river temperature is above 50 degrees F ***	September 15–February 15, or whenever river temperature is above 37 degrees F ****

* Any of these migration periods may be changed during the term of the license by the Department, based on new information, and in consultation with the other fishery agencies and the licensee.

** This operational period is based on Alewife migration timing from other tributaries to the Chesapeake Bay (Sutherland 2000, Eyler et al. 2002, Slacum 2003)

***This initial operational period is based on preliminary data on American eel migration timing from other tributaries to the Chesapeake Bay.

**** The Department is calling for the licensee to study the magnitude and timing of downstream eel migration through the project so that the effectiveness of a reduced period can be evaluated. This initial operational period is based on preliminary data on American eel migration timing from other tributaries to the Chesapeake Bay (Welsh et al. 2009).

9.6 Specific Prescriptions for the York Haven Project

9.7 General Requirements

9.8 Fishway Operating Procedures (FOP)

a. The FOP will include, for each fishway, schedules for routine maintenance, procedures for routine operations (including: seasonal and daily periods of operation, dam and powerhouse operational measures) detailing with how the plant shall be operated during fish passage season including sequencing of turbine start-up and operation, debris management as well as any other necessary provisions for plant operation and related to attraction flow as a component of the fish passage system to the operation of the NLF, procedures for monitoring and reporting on the operation, and procedures for use in case of emergencies and Project outages significantly affecting fishway operations.

b. The Licensee shall implement the FOP consistent with the approval of the Service. The Licensee shall provide written documentation to the Resource Agencies that all fishway operational personnel have reviewed and understand the FOP signed by the operations manager of the Amended Project.

c. Copies of the approved FOP and all modifications will be provided to the Resource Agencies.

d. By December 31 of each year, following commencement of the Amended Project, the Licensee shall provide an annual report detailing; the implementation of the FOP, including any deviations from the FOP and a process to prevent those deviations in the future to the Resource Agencies; any proposed modifications to the FOP, or in the case of emergencies or Project outages, the steps taken by the Licensee to minimize adverse effects on fishway operation or fish passage measures; and any proposed modifications to those steps to further enhance their effectiveness in the future. The Licensee shall meet with the Resource Agencies by January 31 of each year unless a different date is mutually agreed upon by the Licensee and the Resource Agencies. Any required modifications to the FOP shall be submitted to the Resource Agencies within 30 days of receipt of a request for the modification unless a longer period is approved by the Service. The modifications to the FOP shall be implemented consistent with the approval of the Service. Nothing herein shall require the Licensee to make operational or structural changes related to the fish passage facilities and measures beyond those changes provided for in Section 9.9 hereof.

e. For fish passage system enhancements and facilities that do not begin operation with the entry into operation of the Amended Project, 60 days prior to operation of the enhancements and/or facilities, the Licensee shall submit FOP provisions for any such new fish passage enhancements, facilities and measures to the Resource Agencies for review and approval and shall implement the FOP as approved by the Service.

9.9 Fish Protection and Passage

9.9.1 Upstream Fish Passage / Nature-Like Fishway Construction

a. Licensee shall finance, design, permit and install a nature-like fishway facility (NLF Facility) in the vicinity of the apex of the Main Dam and Three Mile Island (TMI) in substantial compliance with the design criteria for the NLF Facility set forth in the Settlement Agreement. Licensee shall complete engineering design, apply for and obtain required governmental approvals, construct, and place into operation the NLF Facility by November 30, 2021.

b. In consultation with the Resource Agencies, Licensee shall develop the final plans and specifications for the NLF consistent with the design concept and design criteria in Appendix A[9], and shall submit such plans and specifications to the Resource Agencies, Licensee shall provide a minimum of 60 days for the Resource Agencies to submit comments on such plans and for review by the Service and PADEP. Such comments, review and approval shall not result in a material change. After approval of such plans by PADEP and the Service, Licensee shall submit such plans to the Commission for approval. Licensee shall include the final plans submitted to the Commission evidence of Licensee does not adopt a recommendation made by a Resource Agency other than PADEP and the Service, the filing shall include the Licensee's reasons together with supporting information. The plans shall not be implemented until the Licensee is notified that the plans are approved by the Commission. Upon Commission approval and the receipt of all other required governmental approvals, the Licensee shall implement the plans, including any changes required by the Commission.

9.9.2 NLF Facility Operations

Following construction of the NLF Facility, Licensee shall perform all required routine maintenance of the NLF Facility. Licensee shall conduct periodic inspections of the NLF Facility; and manage and remove debris from the NLF Facility to maintain the functioning and operability of the NLF Facility sufficient to allow and not significantly impede the passage of fish.

Licensee shall prepare an NLF Facility operations and maintenance plan (the "NLF O&M Plan"), and will submit the NLF O&M Plan for review by the Resource Agencies and for approval by PADEP and the Service. Following review and comment by the Resource Agencies, and approval by PADEP and Service, the Licensee shall submit the NLF O&M Plan to FERC, and shall implement the NLF O&M Plan for the duration of the License. Licensee shall include in the NLF O&M Plan submitted to the Commission documentation of approval by PADEP and the Service, consultation with the other Resource Agencies, copies of the Resource Agencies' comments and recommendations, and a description of how the other Resource Agencies' comments are accommodated. Licensee shall provide a minimum of 30 days for review and approval of the NLF O&M Plan by PADEP and the Service and for review and comment by the other Resource Agencies.

Any amendment to the NLF O&M Plan that materially alters the operation, maintenance, monitoring or reporting procedures relating to the NLF Facility shall be subject to review and approval by PADEP and the Service, and review and comment by the other Resource Agencies.

Licensee shall provide copies of the approved NLF O&M Plan and all amendments thereto to the Commission and the Resource Agencies.

[9] Appendix A, D, E, G, and H are included by reference. They are integral to and attached to the Settlement Agreement on which this Preliminary Prescription for Fishways is based.

9.9.3 Monitoring of Shad Passage Effectiveness & Subsequent Actions

The Licensee shall perform post-construction monitoring of the NLF Facility in accordance with the following provisions in consultation with the Resource Agencies and submit the results of such monitoring to the Resource Agencies and the Commission.

(a) The period from completion of construction through the end of the first American shad upstream shad passage season following completion of the NLF Facility will be a “shake-down” period, during which Licensee shall conduct visual observations and make adjustments to the NLF Facility to address any unanticipated inhibitions or barriers that impede the NLF Facility’s performance.

(b) Starting in the second American shad upstream passage season following completion of the NLF Facility, Licensee shall commence telemetry studies to monitor the overall effectiveness of the NLF Facility, consistent with the following:

(i) The telemetry studies will be conducted for at least two years, and potentially a third year if, after consultation with the Resource Agencies, determined to be necessary by the Licensee or either the Service or PADEP in order to obtain observations over a range of high and low flows typical of American shad passage seasons on the Susquehanna River. In general, the range defining typical high and low flows during the American shad upstream passage season would be anticipated to be as follows:

- Typical low flow range: 22,000 to 35,300 cfs.
- Typical high flow range: 35,300 cfs to 55,600 cfs.

(ii) The telemetry studies will be planned to be conducted during successive shad passage seasons, but may be performed on a non-successive basis under the following circumstances:

1. Licensee may postpone conduct of the telemetry studies, after consultation with the Resource Agencies and with the concurrence of the Service and PADEP, in the event that extenuating circumstances (such as the unusual flows, construction at downstream dams or other conditions) are interfering or expected to interfere with upstream shad passage. The Resource Agencies agree that in the event that they become aware of circumstances that would warrant postponement of the telemetry studies, they will promptly notify the Licensee, with the objective of providing notice to the Licensee to the extent practicable at least 90 days prior to the anticipated start of the shad passage season.

2. Licensee may postpone a successive season’s telemetry study if Licensee determines, after consultation with the Resource Agencies and with the concurrence of Service and PADEP, that some physical adjustment to the NLF Facility is advisable based on the observations during the prior shad

passage seasons, in which case Licensee shall will implement the physical adjustments and perform the telemetry study in the American shad upstream passage season following implementation of the physical adjustment.

(iii) The telemetry studies will utilize American shad tagged at the Safe Harbor Project, provided that access is granted by the owner of such Project.

(iv) The telemetry studies shall utilize radio telemetry, acoustic telemetry, or such other technologies as Licensee proposes and PADEP and the Service, after consultation with the other Resource Agencies, approve. The general parameters and protocols for such telemetry studies (number of fish, fish release sites, target areas for telemetry antennas) are described in Appendix D. At least 10 months prior to the start of the second Upstream American Shad Passage Season following completion of the NLF Facility, Licensee shall prepare and submit to the Resource Agencies for review an NLF Facility Monitoring Plan (the "NLF Monitoring Plan") containing detailed protocols for the telemetry studies. Licensee shall confer with the Resource Agencies regarding the NLF Monitoring Plan, and shall provide for at least 90 days for PADEP and the Service to review and approve, and for the other Resource Agencies to review and comment on, the NLF Monitoring Plan. At least five (5) months prior to the start of the second American shad upstream passage season following completion of the NLF Facility, Licensee shall submit the NLF Monitoring Plan to the Commission for approval. If Licensee does not adopt a recommendation made by a Resource Agency, the filing with the Commission shall include the Licensee's reasons together with supporting information.

(c) Upstream American Shad Passage Target and Effectiveness Criteria:

(i) The target established by the Resource Agencies is for at least 75% of the upstream migrating American shad passing the Safe Harbor Dam to pass upstream of the Project through the combination of the NLF Facility and the East Channel Fishway (the "Upstream Shad Passage Target").The NLF Facility shall be designed and operated to be capable of achieving the Upstream Shad Passage Target, provided that adequate numbers of upstream migrating American shad reach the Project Area.The Licensee shall not be deemed in violation of this condition if the Upstream Shad Passage Target is not achieved for reasons beyond the reasonable control of the Project, provided that the Licensee complies with Sections 9.9.3(c)(ii)-(v) and (d)-(f) below.

(ii) The NLF Monitoring Plan will be designed to investigate several issues: (i) whether the upriver migrating American shad passing the Safe Harbor Dam are reaching the Project Area; (ii) whether upriver migrating American Shad entering the Project Area are attracted to the downstream entrance of the NLF Facility; and (iii) whether there are barriers to American shad entering into and passing through the NLF Facility (e.g., velocity barriers or other constraints).

(iii) The NLF Facility will be deemed to be effective if: (1) in two consecutive years after installation or subsequent modification of the NLF Facility, (A) the Upstream Shad Passage Target is achieved or (B) 85% of the tagged American shad that enter the Project Area exit the combination of the NLF Facility and the East Channel Fishway (the "Project Area Passage Success Criterion"); and (2) Licensee complies with Section 9.9.3(d) below.

(iv) If the telemetry studies show that the Project Area Passage Success Criterion is achieved in two successive American shad upstream passage seasons which reflect a range of flows typical of shad passage seasons on the Susquehanna River, the Project Area Passage Success Criterion will be deemed achieved and the Licensee may terminate the telemetry studies.

(v) If the telemetry studies show that the Project Area Passage Success Criterion is not achieved in two successive American shad upstream passage seasons, and such failure was not due to unusual or extenuating circumstances (such as unusual flow or temperature conditions), the Licensee will undertake the actions set forth in Section 9.9.3(e) and then perform a telemetry study for at least two additional American shad upstream passage seasons to confirm achievement of the Project Area Passage Success Criterion.

(d) Licensee shall, in consultation with the Resource Agencies, evaluate the fish movement data from the NLF Monitoring Plan to determine if there are barriers to timely passage of upstream migrating American shad within the Project Area. If such barriers to timely passage of upstream migrating American shad are identified within the Project Area, Licensee shall prepare and submit to the Resource Agencies a plan and schedule for those actions to address such conditions that are feasible, appropriate under the circumstances, reasonable and technically sound, provided that the Project shall not be required to undertake the curtailment of electric generating operations. Such plan shall be subject to review and approval by PADEP and the Service and review and comment by the other Resource Agencies. Following approval by PADEP and the Service, and as necessary FERC, Licensee shall implement the approved plan in accordance with the approved schedule.

(e) If the Project Area Passage Success Criterion is not achieved, Licensee shall take the following measures, as appropriate and necessary, after consultation with the Resource Agencies:

- Evaluate fishway hydraulics and access for velocity and shear stress barriers, recognizing that hydraulics of the NLF Facility will vary with river flow and flow through the NLF Facility.
- Adjust positions of rock weirs and attraction water discharge if necessary.
- Adjust timing of supplemental attraction flows.

- Install ultrasound to deter fish from an area (such as the Powerhouse or East Channel).

- Reduce flows in the East Channel to reduce attraction of American shad to the East Channel.

- Adjust amount of supplemental attraction flows in the NLF Facility up to the Potential Increased Attraction Flow Value.

- Evaluate whether potential barriers exist in the channel downstream of the Main Dam hindering fish movement to the entrance of the NLF Facility, and if reasonably necessary undertake feasible and cost-effective modifications to the channel to remove such barriers.

(f) The upstream end of NLF Facility shall be designed to accommodate installation of Passive Integrated Transponder ("PIT") tag monitoring devices at such time as such PIT tag monitoring devices become available and feasible for reliably monitoring American shad exiting the NLF Facility. At such time as requested by PADEP or the Service, Licensee shall conduct a feasibility study to evaluate whether a PIT tag monitoring facility can be successfully installed and maintained near the upper end of the NLF Facility to reliably monitor American shad exiting the NLF Facility. Licensee shall install PIT tag readers, or such other monitoring technology as may be agreed upon, after consultation with the Resource Agencies, by the Licensee, the Service and PADEP, at the upstream end of the NLF Facility when such technology becomes available, feasible, and technically sound for measuring American shad passage in the conditions of the NLF Facility as mutually agreed to, after consultation with the Resource Agencies, by Licensee, the Service and PADEP. The Parties contemplate that such monitoring will use American shad tagged at Conowingo or Safe Harbor to monitor overall effectiveness of American shad upstream passage within the lower Susquehanna River.

9.9.4 Upstream Passage of Eels

Licensee shall provide for upstream passage of juvenile American eels through maintenance of the existing Project and installation of the NLF Facility. Based upon their present understanding of the behavior of juvenile American eels and the design of the NLF Facility, the Service expects that the existing design of the Project in conjunction with the installation of the NLF Facility will be adequate to provide for successful upstream passage of juvenile American eels past the Project, and no other PM&E measures are presently believed to be necessary for such upstream passage of juvenile American eels.

9.9.5 Downstream Post-Spawning Adult American Shad Passage

(a) Licensee shall provide for downstream passage of post-spawning adult American shad through maintenance of the existing Project, installation and operation of the NLF Facility, and implementation of the protocol set forth in Section 9.9.5(b).

(b) During the period of May 1 to June 30, if River Flow exceeds the sum of Project Hydraulic Capacity, required flows through the NLF Facility, required flows through the East Channel, and required flows (if any) over the Main Dam, the Licensee will open and spill water via the Forebay Sluice Gate (~370 cfs) to the extent practicable during one to two hours during the morning during weekdays, subject to Project personnel availability and access requirements for operations and maintenance purposes. Such spilling may be provided in connection with opening of the Forebay Sluice Gate for purposes of passing debris, it being understood by the Parties that during the passage of debris, it will not be feasible to utilize the chute structure referenced in Section 9.9.6(e).

9.9.6 Downstream Juvenile American Shad Passage

(a) After issuance of the New License and until completion of the NLF Facility, Licensee shall implement the following protocol to facilitate downstream passage of juvenile American shad during the Downstream Juvenile American Shad Passage Period:

(i) During the entire Downstream Juvenile American Shad Passage Period, the Licensee will operate the Project units in the following order of priority, depending upon available River flow: (1) Unit 1-6 (Propeller units) may be operated without restriction up to available river flow; (2) Unit 14 (larger single Francis unit) may be operated if river flow exceeds capacity of Units 1-6; (3) Units 7-13 and 15-30 (double Francis units) may be operated in ascending order if river flow exceeds capacity of Unit 1-6 and 14.

(ii) During the entire Downstream Juvenile American Shad Passage Period, the Licensee will open and spill water via the forebay sluice gate (~ 370 cfs) between the hours of 5 pm to 11 pm Eastern Standard Time ("EST").[10]

(iii) If River flow exceeds the sum of Project Hydraulic Capacity, required flows through the East Channel, and required flows (if any) over the Main Dam, the Licensee will open and spill water via the forebay sluice gate (~370 cfs) to the extent practicable for one to two hours during the morning, subject to Project access requirements for operations and maintenance purposes, in order to provide for downstream juvenile American shad passage.

(b) After completion of the NLF Facility, Licensee shall implement the following protocol to facilitate downstream passage of juvenile American shad during the Downstream Juvenile American Shad Passage Period:

(i) During the entire Downstream Juvenile American Shad Passage Period, the Licensee will operate the Project units in the following order of priority, depending upon available River flow: (1) Unit 1-6 may be operated without restriction up to available river flow); (2) Unit 14 may be operated if river flow exceeds capacity of Units 1-6; (3) Units 7-13 and 15-30 may be operated in ascending order if river flow exceeds capacity of Unit 1-6 and 14.

(ii) During the entire Downstream Juvenile American Shad Passage Period, the Licensee will open and spill water via the forebay sluice gate (~ 370 cfs) between the hours of 5 pm to 11 pm EST.

(iii) The NLF Facility will be operated to maintain a flow through the fishway of approximately 200 cfs.

(iv) If river flow exceeds the sum of Project Hydraulic Capacity, required flows through the NLF Facility, required flows through the East Channel, and required flows (if any) over the Main Dam, the Licensee will open and spill water via the forebay sluice gate (~370 cfs) to the extent practicable for one to two hours during the morning, subject to Project access requirements for operations and maintenance purposes, in order to provide for downstream juvenile American shad passage.

(c) The overall goal for juvenile American shad downstream passage is to achieve survival of 95% of juvenile American shad from above the Project powerhouse and dam to below the Project powerhouse and dam (the "Downstream Juvenile American Shad Passage Goal"). Measurement of such passage effectiveness and survival is subject to a margin of error. The effectiveness of downstream passage operations for juvenile American shad will be determined based upon (1) a route

[10] Note: During the Downstream Juvenile American Shad Passage Season, a portion of the period is in daylight savings time and a portion is in standard time. All timeframes stated in this Offer of Settlement are stated in Eastern Standard Time. During October, sunset in the central Pennsylvania area is in a range of 5:50-5:05 pm EST. During November, sunset in central Pennsylvania occurs in a range of 5:05 pm to 4:42 pm EST.

of passage analysis as described in Section 9.9.6(d), and (2) confirmation that Forebay Sluice Gate provides for safe passage as described in Section 9.9.6(e).

(d) For purposes of the route of passage analysis, the Service will assume that (1) juvenile American shad will pass through the NLF Facility, through the East Channel past the East Channel Dam, over the Main Dam, and into the head race in direct proportion to the amount of flow via each such route; (2) any juvenile American shad passing through the NLF Facility, through the East Channel past the East Channel Dam, over the Main Dam, or through the forebay sluice gate will survive; (3) juvenile American shad that do not pass through the NLF Facility, through the East Channel past the East Channel Dam, over the Main Dam, or through the forebay sluice gate will pass through the turbines that are being operated in accordance with the priorities set forth in Section 9.9.6(b), and absent observations to the contrary, are allocated between the operating turbines in proportion to the flow through each turbine; and (4) the survival rate of juvenile American shad passing through individual turbines (based on previous balloon tag and blade strike analyses) are as stated in Appendix D. Based upon the foregoing assumptions and confirmation that Forebay Sluice Gate provides for safe passage as described in Section 9.9.6(f), the juvenile American shad passage goal of 95% would be met if at least 60% of the tagged juvenile American shad released into the headrace exit via the Forebay Sluice Gate (that is, pass downstream of the Project headrace without passing through the turbines) (the "Headrace Shad Turbine Avoidance Target"). Licensee shall test the downstream passage efficiency of the operating protocols described above by a PIT tag monitoring study. Licensee shall, in consultation with the Resource Agencies, prepare a plan and schedule for the Headrace Shad Turbine Avoidance Study for review and approval of the Resource Agencies, consistent with the design criteria set forth in Appendix D. The Project will be deemed to meet the Downstream Juvenile American Shad Passage Goal if (1) the Headrace Shad Turbine Avoidance Study shows that the Headrace Shad Turbine Avoidance Target is achieved and (2) the Licensee complies with the provisions of Section 9.9.6(f) to establish conditions under which the Forebay Sluice Gate provides for safe passage of juvenile American shad.

(e) Within four (4) years following License issuance and prior to performance of the downstream juvenile American shad studies referenced in Section 9.9.6(d), License shall prepare and submit to the Resource Agencies: (i) designs for a chute structure to convey flows beyond the roadway on the downstream side of the Cable Alley structure, meeting the design criteria set forth in Appendix E allowing juvenile and adult American shad to land unimpeded in the downstream pool; and (ii) removal of obstructions in or deepening of the downstream pool into which flows from the Forebay Sluice Gate land to provide an adequate depth of 1 foot for each 4 feet of drop into which juvenile or adult American shad may land. Licensee shall submit any design plans for improvements as described in this Section 9.9.6(e) and a proposed implementation schedule to the Service and PADEP for review and approval and to the other Resource Agencies for review and comment, and shall implement the proposed improvements in accordance with the approved designs and schedule. Any such required improvements shall be completed coincident with completion of the NLF Facility, and in advance of commencement of the monitoring described in Section 9.9.6(d) .

(f) If the effectiveness monitoring conducted pursuant to Section 9.9.6(d) shows that the Headrace Shad Turbine Avoidance Target is not achieved, Licensee shall implement the following sequence of adaptive measures in the next passage season:

(i) Open the NLF supplemental flow gate (800 cfs) during the same schedule as the Forebay Sluice Gate is opened.

(ii) Suspend operation of certain Francis turbine units during the hours of 5-11 pm EST when river flows are between 15,000 cfs and 22,000 cfs during the Downstream Juvenile American Shad Passage Period, up to a total generation loss of 1,000 Megawatt hours ("MWh").

(iii) Such other measures as may be agreed to by the Licensee, the Service and PADEP, after consultation with the other Resource Agencies, and (to the extent required) approved by the Commission.

(g) Within two years of implementing the adaptive measures referenced in Section 9.9.6(f), Licensee shall conduct a follow-up Headrace Shad Turbine Avoidance Study following the protocols referenced in Section 9.9.6(d) . If the follow-up Headrace Shad Turbine Avoidance Study shows that Headrace Shad Turbine Avoidance Target is achieved, such adaptive measures shall continue to be implemented for the duration of the License.

(h) If by January 1, 2028, (a) the Headrace Shad Turbine Avoidance Studies have not shown that Headrace Shad Turbine Avoidance Target is being achieved by adaptive measures implemented at the Project, and (b) based on all available information and after consultation with Licensee and the other Resource Agencies, the Service renders a determination on the basis of the record reasonably finding that (i) Licensee has not demonstrated that the adaptive measures implemented at the Project are reasonably anticipated to meet the Downstream Juvenile American Shad Passage Goal, and (ii) additional measures that are reasonably required to achieve the Downstream Juvenile American Shad Passage Goal (the "Additional Measures Determination") (which Additional Measures Determination shall be subject to the dispute resolution / appeal procedures set forth in the Settlement):

(i) Within 12 months of the Additional Measures Determination, Licensee shall, in consultation with the Resource Agencies, prepare a design and schedule for implementation of additional structural and operational measures reasonably anticipated to meet the Downstream Juvenile American Shad Passage Goal that are feasible, appropriate under the circumstances, reasonable and technically sound. Licensee shall evaluate, among other options, options for a Fish Guidance System ("FGS") as described in the report entitled *Evaluation of Fish Guidance Systems* (Draft April 2013), or other appropriate technology to achieve the Downstream juvenile American shad Passage Goal. As part of the evaluation report, Licensee shall provide sufficient information to demonstrate the reasonably likelihood of the proposed option and measures to meet the Downstream Juvenile American Shad Passage Goal.

(ii) Following approval of the design and schedule by the Service and PADEP, after consultation with the other Resource Agencies, Licensee shall prepare and submit the applications for all required governmental approvals, including FERC approvals, and procure, install and implement the approved structural and/or operational measures in accordance with the approved schedule. Such approved measures shall be implemented by December 31, 2030 or such other date as agreed to by Licensee and the Service, after consultation with the other Resource Agencies, or as approved by FERC.

(iii) If Licensee does not present a design and schedule for implementing additional structural and operational measures reasonably anticipated to meet the Downstream Juvenile American Shad Passage Goal that are feasible, appropriate under the circumstances, reasonable and technically sound, or based on all available information and after consultation with Licensee and the Resource Agencies, the Service does not approve the Licensee's design and schedule for additional measures submitted pursuant to Section 9.9.6(h)(i), the Service may elect to exercise its reserved authority to prescribe such measures as the Service determines are necessary for safe and effective passage of downstream migrating American shad; and Licensee retains all rights to challenge any such exercise of reserved authority.

(i) Within one year after the implementation of the structural and operational measures implemented under Section 9.9.6(h), Licensee shall perform a follow-up Headrace Shad Turbine Avoidance Study to evaluate the number of tagged juvenile American shad that exit the Forebay without exposure to the turbines.

9.9.7 Downstream Passage for Silver Eels

Licensee shall provide for the downstream passage of silver eels in accordance with this Section.

(a) The overall goal for silver American eel passage shall be to achieve effective passage and survival of 85% of silver eels from above the Project dams and powerhouse to below the Project dams and powerhouse (the "Downstream Eel Passage Goal"). Measurement of such passage effectiveness and survival is subject to a margin of error.

(b) Licensee shall cooperate with the Resource Agencies and other interested parties in the conduct of (1) a Lower Susquehanna River Downstream Eel Study to evaluate the timing, magnitude, duration, annual variation and environmental conditions associated with active migration of silver eels from tributaries stocked with elvers, through the lower Susquehanna River to the Chesapeake Bay; and (2) a Site-Specific Route of Passage Study to evaluate the route of passage selected migrating silver eels in the vicinity of the Project. The design criteria for the

Lower Susquehanna River Downstream Eel Study and the Site-Specific Route of Passage Study are described in Appendix G.

(c) At least 12 months prior to the anticipated date for completion of the NLF Facility, in consultation with the Resource Agencies, Licensee shall prepare a plan and schedule for conducting a discrete downstream passage effectiveness study ("Site-Specific Downstream Eel Study"), consisting of a Site Specific Route of Passage Study as described in Appendix G and an Eel Survival Study as described in Appendix H. Licensee shall submit the Site-Specific Downstream Eel Study plan and proposed schedule to the Resource Agencies, for review and approval by the Service and PADEP and for review and comment by the other Resource Agencies. Licensee, in cooperation with the Resource Agencies, shall conduct the Site-Specific Route of Passage Study following completion of the NLF Facility in accordance with the approved plan and schedule, and Licensee shall conduct the Eel Survival Study in accordance with the approved plan and schedule.

(d) If the results of the Site-Specific Downstream Eel Passage Study indicate that the then existing Project operating measures and protocols achieve the Downstream Eel Passage Goal, then the Licensee shall continue to implement those protocols and measures.

(e) If the results of the Site-Specific Downstream Eel Passage Study do not indicate that the Project's existing operating measures and protocols do not achieve the Downstream Eel Passage Goal, the Licensee will prepare and submit to the Resource Agencies a plan and schedule for evaluating the feasibility and costs of potential physical and/or operational modifications to the Project to facilitate downstream eel passage (the Downstream Eel Improvements Study). The Downstream Eel Improvements Study plan and schedule shall be subject to review and approval by PADEP and the Service and review and comment by the other Resource Agencies. Licensee shall conduct the Downstream Eel Improvements Study in accordance with the approved plan and schedule. The Downstream Eel Improvements Study will consider and evaluate whether any of the following adaptive measures to facilitate downstream eel passage, which may be implemented in a sequence or in combination, are feasible, appropriate under the circumstances, reasonable and technically sound and are reasonably expected to contribute toward achievement of the Downstream Eel Passage Goal:

(i) Adjustment to NLF Facility operations.
(ii) Installation of current inducers.
(iii) Modifications to the juvenile American shad protection measure.
(iv) Installation of a fish guidance system.
(v) Replacement of turbine runner systems with units designed to have a lower mortality impact upon silver eels.
(vi) Other measures mutually agreed to by the Licensee, the Service and PADEP, after consultation with the other Resource Agencies.

(f) If the Downstream Eel Improvements Study identifies physical or operational adaptive measures listed in Section 9.9.7(e) to facilitate downstream eel passage that are feasible, appropriate under the circumstances, reasonable and technically sound, Licensee shall prepare a plan and schedule for implementing such measures and an estimation as to the ability of such measures to achieve the Downstream Eel Passage Goal, and will submit the plan and schedule to the Resources Agencies for review and approval by the Service and PADEP and review and comment by the other Resource Agencies. Following approval of such plan and schedule, Licensee shall implement the measures described in the approved plan in accordance with the approval schedule. If Licensee does not present such a plan and schedule for implementing physical or operational adaptive measures listed in Section 9.9.7(e) that are feasible, appropriate under the circumstances, reasonable and technically sound, and reasonably anticipated to meet the Downstream Eel Passage Goal, or based on all available information and after consultation with Licensee and the Resource Agencies, the Service does not approve the Licensee's plan and schedule for such measures submitted pursuant to this Section, the Service may elect to exercise its reserved authority to prescribe such measures as the Service determines are necessary for safe and effective passage of downstream migrating American eel; and Licensee retains all rights to challenge any such exercise of reserved authority.

(g) Within 12 months following implementation of any such improvements, Licensee shall evaluate and provide a report to the Resource Agencies regarding the effectiveness of the measures in relation to achievement of the Downstream Eel Passage Goal.

(h) If the adaptive measures implemented pursuant to the Downstream Eel Improvements Study do not result in achievement of the Downstream Eel Passage Goal, the Licensee and the Resource Agencies shall on an annual basis consult as to potential additional studies or adaptive measures that are or may become feasible, appropriate under the circumstances, reasonable and technically sound, and reasonably expected to contribute toward achievement of the Downstream Eel Passage Goal.

10. Scientific Names

American eel (*Anguilla rostrata*)
American shad (*Alosa sapidissima*)
Alewife *(Alosa pseudoharengus)*
Blueback herring *(Alosa aestivalis)*
Hickory shad *(Alosa mediocris)*
Shortnose sturgeon *(Acipenser brevirostrum)*
Atlantic sturgeon (*Acipenser oxyrinchus)*
Striped bass (*Morone saxatilis*)

11. References Cited

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Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC). 2010. Migratory fish management and restoration plan for the Susquehanna River Basin. 124pp.

11.2 Documents Incorporated by Reference

Settlement Agreement. December 1, 1984. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, Pennsylvania Fish Commission, Maryland Department of Natural Resources, Pennsylvania Department of Environmental Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

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12. Administrative Record

The administrative record in support of this Preliminary Prescription of Fishways will be filed with the Commission under a separate cover.

*   *   *   *   *

Any written inquiries, comments, or other correspondence related to this Preliminary Fishway Prescription for the York Haven Hydroelectric Project should be sent to:

Field Supervisor, Chesapeake Bay Field Office
U.S. Fish and Wildlife Service
177 Admiral Cochrane Drive
Annapolis, MD 21401

APPENDIX E

PRELIMINARY FISHWAY PRESCRIPTION

MUDDY RUN PUMPED STORAGE PROJECT

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Custom House, Room 244
200 Chestnut Street
Philadelphia, Pennsylvania 19106-2904

IN REPLY REFER TO:

January 31, 2014

9043.1
ER 13/0273

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First St., NE
Washington, DC 20426

RE: Review of Notice of Application Ready for Environmental Analysis, Muddy Run Hydroelectric Project, Federal Energy Regulatory Commission (FERC No. 2355-018)

COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS, AND PRELIMINARY PRESCRIPTIONS

Dear Ms. Bose:

The U.S. Department of the Interior (Department) has reviewed the April 29, 2013, *Notice of Application Accepted for Filing, Soliciting Motions to Intervene and Protests, Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions* for the existing Muddy Run Hydroelectric Project (Muddy Run Project) FERC No. 2355-018, located on the Susquehanna River in Lancaster and York Counties, Pennsylvania.

GENERAL COMMENTS

Background

The Department has participated in the Integrated Licensing Process for the Muddy Run Project. The Terms and Conditions were developed through discussions among the Department, the Pennsylvania Fish and Boat Commission, the Pennsylvania Department of Environmental Conservation, the Maryland Department Natural Resources, the Susquehanna River Basin Commission, and the National Marine Fisheries Service and Exelon Corporation (“Licensee”).

Project Setting

The Muddy Run Project is a large pump-storage hydroelectric project that began operation in 1966 and is located in Lancaster County, Pennsylvania. It has a generating capacity of 800 megawatts (MW) and generates an average of 1,610,611 MW hours annually. It is situated on the lower Susquehanna River, 22 miles upstream of Chesapeake Bay, and 11 miles upstream of the Conowingo Hydroelectric Dam. The Muddy Run Project utilizes Susquehanna River water withdrawn from the impoundment formed by the Conowingo Hydroelectric Dam. The impoundment is referred to as Conowingo Pond, Conowingo Reservoir, Conowingo Pool, Lake Conowingo, and lower reservoir. The Holtwood Hydroelectric Dam is located on the Susquehanna River 3 miles upstream of the Muddy Run Project.

The Muddy Run Project uses upper and lower storage reservoirs for the generation of hydroelectric power. The upper reservoir is the 900-acre Muddy River Reservoir, which is 411 feet higher than Conowingo Pond when both are at their normal, full-water-surface elevations. The upper reservoir is formed by four dams described below (Figure 1). Its useable storage capacity and total storage capacity are estimated to be 35,500 and 60,000 acre-feet at its maximum pool elevation of 520 feet. The lower reservoir is the 9,000-acre Conowingo Pond with design storage of 310,000 acre-feet at its normal, full-pool elevation of 109.2 feet. The Muddy Run Project operates on a daily pump-storage cycle to generate electricity. The powerhouse turbines are reversible and can pump large quantities of water from the Susquehanna River (lower reservoir) to the upper reservoir, through underground water conduits, for storage at the higher elevation. It can later release water down through water conduits to the eight large powerhouse turbines to generate electricity. The discharge water is released back into the Susquehanna River (Conowingo Pond).

The upper reservoir water storage consists of two water bodies: the Power Reservoir and the Recreational Pond (Figure 1). The Power Reservoir is nearest the river, is formed by three dams, and has one spillway. They are the Main Dam Embankment, Canal Embankment, East Dike, and Upper Reservoir Spillway - which is on the Canal Embankment. The Recreational Pond is formed by the Recreational Pond Dam, which has a spillway. The physical features of each structure are described as follows:

- **Main Dam Embankment** is a rock-filled structure across the Muddy Run ravine with a central impervious core. It has a maximum height of approximately 260 feet, and a total length of 4,800 feet.

- **Canal Embankment** has a maximum height of approximately 35 feet.

- **East Dike** is a zoned-earth and rock-filled embankment with a maximum height of approximately 12 feet and a total length of 800 feet.
- **Upper Reservoir Spillway** is a non-gated, concrete ogee-type structure that is 200 feet long, 20 feet high, and has a crest elevation at 521 feet. Any spill is directed down through a vegetated natural ravine.
- **Recreation Pond Dam** is a zoned earth and rock-filled embankment with a maximum height of approximately 90 feet and a total length of 750 feet.
- **Recreation Pond Spillway** is a rock-cut channel approximately 140 feet wide with a crest elevation of 520 feet.

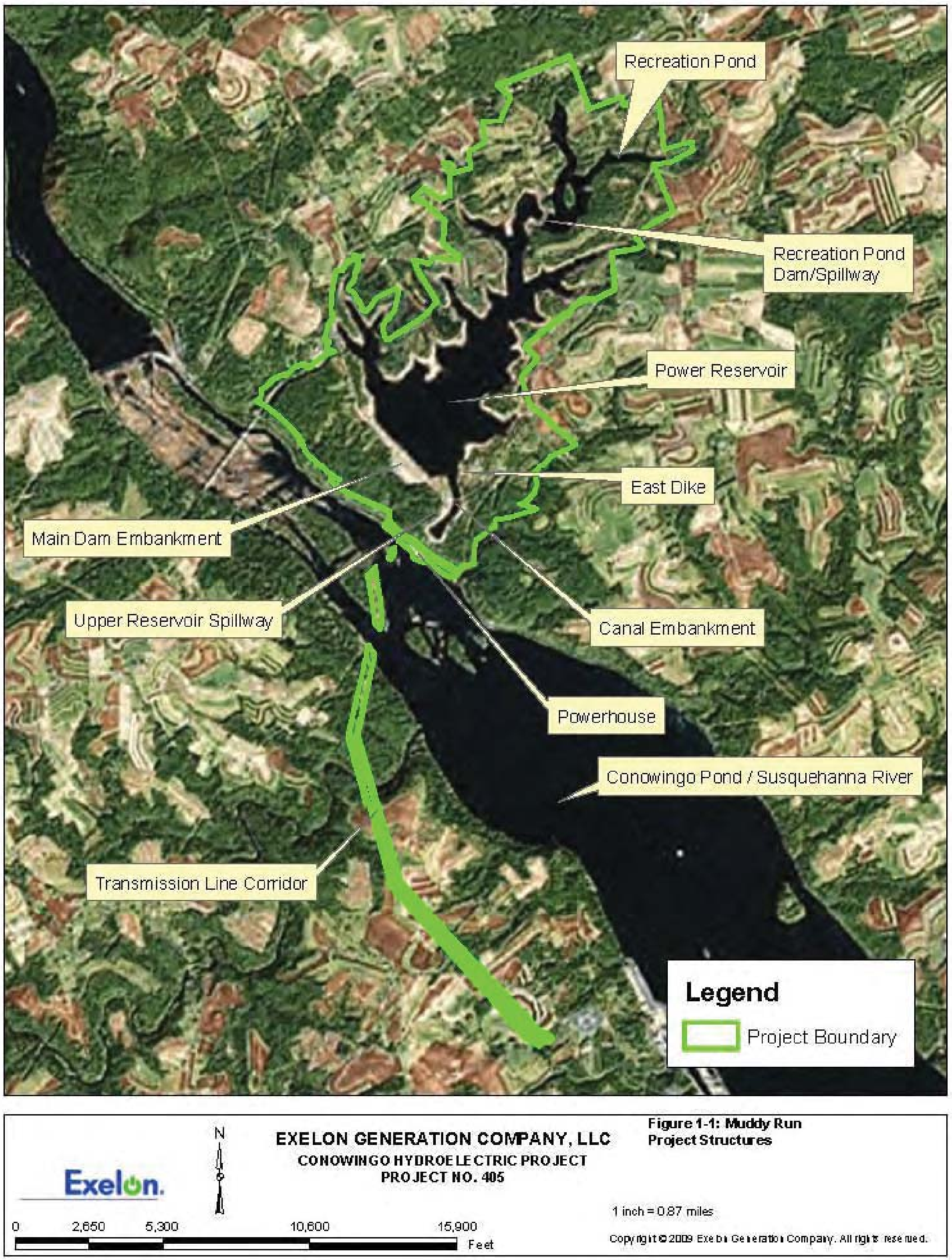

Figure 1. Muddy Run Project.

To generate power, project operations allow water stored in the power reservoir to flow into power intake facilities in the canal, descend over 400 feet through the water conduits to the powerhouse, flow through the turbines, and discharge through the draft tubes and trash racks into the tailrace constructed in Conowingo Pond. These project works consist of a system of physical structures, facilities, and devices that control the timing and volume of water discharged into the river.

Specifically, there are four intake facilities in the upper reservoir power canal. Each consists of a cylindrical tower with four cylinder gates with trash racks. Water entering the intake facility flows 430 feet down a vertical shaft to a horizontal power tunnel that divides into two sections. Each section transitions to a penstock through which the water flows to one of eight Francis turbines in the powerhouse, each of which is equipped with a 100-MW generator.

The powerhouse is located on the bank of the Susquehanna River. It is constructed of concrete and is 133 feet wide and 600 feet long. The turbines housed in it are reversible and can pump water or generate electricity. When generating, the hydraulic capacity of each turbine to discharge is 4,000 cubic feet per second (cfs). The total discharge capacity from the powerhouse is 32,000 cfs (8 turbine units x 4,000 cfs). When pumping, the hydraulic capacity of each turbine to withdraw water from the river is 3,500 cfs. Therefore, the total powerhouse withdrawal (pumping) capability is 28,000 cfs. Discharging and withdrawing such large volumes of water changes the instantaneous flow in the Susquehanna River and under some conditions may impede fish migrating through that zone of passage.

When the Muddy Run Project withdraws water from Conowingo Pond, by pumping it to the upper reservoir to replenish its store of useable water, it reduces the amount and velocity of flow (instream flow) in the Susquehanna River downstream of the powerhouse. A negative instream flow (i.e., water flowing upstream) can be experienced downstream of the Muddy Run Project when pumping (withdrawal) flows exceed the instantaneous instream flow in the Susquehanna River. The Muddy Run Project pumping capacity exceeds the median monthly flow of the Susquehanna River for six months of the year (June through November).

When the Muddy Run Project is generating, water flowing through the turbines is discharged via the draft tubes into the tailrace, which is in the Susquehanna River and is an integral physical feature of the powerhouse. The effect of the discharged generation flow is additive; i.e., the instream flow in the Susquehanna River at the powerhouse at that moment is increased. The possible effects of these phenomena on fish migrating upstream and downstream, through that zone of passage, are described below in this document.

Electricity generated at the Muddy Run Project is transmitted approximately 4.25 miles across the Conowingo Pond to the Peach Bottom Atomic Power Station's North Substation in York County, via two individual 220-kilovolt (kV) transmission lines from the Project switching station.

The Licensee is not proposing any new physical structures, facilities, or devices to the Muddy Run Project in its application for a new license.

Resource Description

The Susquehanna River is one of America's largest rivers and is approximately 410 miles (715 kilometers) long. The river forms in upstate New York and west-central Pennsylvania and drains a watershed area of over 27,000 square miles. It is the largest tributary to Chesapeake Bay, providing over 60 percent of the freshwater to the Bay. The name of the river comes from an Algonquian word for "muddy water". This term may still be an appropriate description of the Susquehanna River today as it can be very turbid, particularly during higher flow events. There is also considerable run-off from agricultural areas that have long been a major contributor to nutrient loading in Chesapeake Bay. Mean monthly flows are highest in March and April and lowest in August and September.

Fishery Resources

Anadromous Fish

The Susquehanna River was once home to large numbers of migratory anadromous fish. The most important of these were members of the herring family Clupeidae; including the American shad (*Alosa sapidissima*), blueback herring (*A. aestivalis*), alewife (*A. pseudoharengus*), and hickory shad (*A. mediocris*). Populations of migratory fish have been severely impacted by human activities, the most serious being the impacts due to dam-building[1,2]. Construction of canal dams in the mid-1800's restricted access to ancestral spawning grounds, but the construction of the four large, lower river hydroelectric dams in the early 1900's completely eliminated access to the river and the migratory fish runs were lost[3].

In addition to eliminating migratory fish access to upstream spawning and nursery habitat, these dams also altered river habitat by creating impoundments that inundated and eliminated riverine spawning and rearing habitat in the lower portion of the Susquehanna River. Conowingo, Holtwood, Safe Harbor and York Haven dams inundated 14, 8, 10, and 4 miles of habitat, respectively, resulting in the cumulative loss

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[1] Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC). 2010. Migratory fish management and restoration plan for the Susquehanna River Basin. 124pp.

[2] Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

[3] St. Pierre, R., undated. History of the American Shad Restoration Program on the Susquehanna River. Harrisburg, PA.

of 36 miles of riverine habitat. The Conowingo Reservoir extends from the Conowingo Dam to the Holtwood tailrace and the Holtwood Reservoir (Lake Aldred) extends from the Holtwood Dam to the Safe Harbor tailrace, resulting in a 32 mile stretch of impounded water with little flowing water habitat. Above the Safe Harbor impoundment (Lake Clarke) there is 15 miles of free-flowing river to York Haven Dam. The majority (95%) of the remaining free-flowing river habitat is located upstream of York Haven Dam.

Hydroelectric project operations also negatively impact migratory fish habitat by altering the river flow regime. The mainstem Susquehanna River hydroelectric projects (with the exception of York Haven which operates instantaneous run-of-river) and the Muddy Run Project tend to generate power during the daytime peak use period, and refrain from generation at night when water storage in mainstem impoundments is replenished with incoming river flows, and water from the Susquehanna River is pumped up to the Muddy Run Project upper storage reservoir. This results in unnatural flow conditions downstream for the hydroelectric projects which can vary from flood to drought flow conditions within minutes during any given day. For the Muddy Run Project, pumping flows can exceed instream flows in the river resulting in reverse flow in the project area which can disorient fish using flow as a migration queue and interfere with normal migration, or lead to entrainment of fish attempting to pass through the project area[4,5]. Few aquatic organisms are adapted to these drastic and abrupt fluctuations in flows, and the result is a highly perturbed aquatic ecosystem that is often not suitable for migratory fish spawning, nursery habitat, or fish passage.

In the years following construction of dams on the mainstem of the Susquehanna River, fishway design, technology, and operation improved and by the 1940's, successful passage of American shad was demonstrated at Bonneville Dam on the Columbia River, Oregon. In the 1950's, inspired by improvements in fish passage technology, resource agencies began the process of restoring migratory fish to the Susquehanna River, focusing on American shad, the largest and locally most important of the herrings. At the urging of Pennsylvania sportsmen and the Pennsylvania Fish Commission, the U.S. Congress appropriated funds specifically to study the potential to recover American shad fisheries in dammed rivers. Ensuing studies, many funded by the hydroelectric dam owners/operators on the lower Susquehanna River included: an assessment of the migratory response of American shad placed into riverine habitat upstream of hydroelectric impoundments (Walburg 1954, Whitney 1961)[6]; assessment of the suitability of the Susquehanna River for American shad reproduction and survival

[4] Sweka, J.A. 2013. Re-analysis of the 2008 American Shad telemetry study. Internal USFWS Report drafted December 2, 2013.
[5] Exelon. 2009. Assessing the Impacts of Muddy Run Pumped Storage Station and Holtwood Hydroelectric Station Operations on the Upstream Migration of Adult American Shad (*Alosa sapidissma*) in Conowingo Pond, Susquehanna River, Spring 2008.
[6] As cited in: Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC). 2010. Migratory fish management and restoration plan for the Susquehanna River Basin. 124pp.

(Carlson 1968)[7]; and the assessment of the engineering feasibility of American shad passage at high dams (Bell and Holmes 1962)[8].

Anadromous fish restoration on the Susquehanna River was a cooperative venture from the beginning. The Pennsylvania Fish Commission (now Pennsylvania Fish and Boat Commission), Maryland Board of Natural Resources (now Maryland Department of Natural Resources), New York State Department of Environmental Conservation and the U.S. Fish and Wildlife Service (Service) developed an Administrative Committee for American shad studies on the Susquehanna River in February 1963 for the purpose of determining habitat suitability above dams to support American shad reproduction and survival. The study was funded by the lower river hydroelectric dam owners/operators during 1963 to 1966. The study results determined that over 300 miles of the mainstem Susquehanna River upstream of the York Haven Dam, most of the Juniata River, and the lower West Branch of the Susquehanna River were entirely suitable for American shad spawning and rearing (Carlson 1968)[9].

Around 1970, the first modern effort to restore the American shad population in the Susquehanna River began. The utility companies owning the dams along the Susquehanna River worked with various federal and state agencies to stock the upper Susquehanna River with shad eggs, and to build a facility at Conowingo Dam to trap fish, from which the shad and herring would be transported upstream to spawning areas near Middletown and Columbia, Pennsylvania. The Conowingo facility had limited success, however, passing only 945 shad between 1972 and 1980.

As part of a 1984 Settlement Agreement, the Licensee, Safe Harbor Water Power Corporation (SHWPC) and York Haven Power Company (YHP) provided $3.7 million over the period from 1985 to 1994 to fund a trap and transfer program for shad, expand hatchery operations and conduct studies related to shad restoration[10]. By the late 1980s, the catch of returning adult shad at Conowingo had increased to several thousand shad per year. As a result a new fish passage facility capable of passing 1.5 million shad and 10 million herring was completed in 1991 at the Conowingo Dam.

In 1993, SHWPC, the Licensee, and YHP reached a settlement agreement with various agencies[11]. This agreement required Safe Harbor and Holtwood to have fish passage

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[7] *Id* at 6.
[8] *Id* at 6.
[9] *Id* at 6.
[10] Settlement Agreement. December 1, 1984. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, Pennsylvania Fish Commission, Maryland Department of Natural Resources, Pennsylvania Department of Environmental Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.
[11] Settlement Agreement. June 1, 1993. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Fish and Wildlife Service – U.S. Department of the Interior, Pennsylvania Fish and Boat Commission, Pennsylvania Department of Environmental Resources, Maryland Department of Natural Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

facilities in place by 1997 and required York Haven to install facilities no later than three years (2000) after the in service date of the facilities at Holtwood and Safe Harbor.

Upstream fish passage has been installed at all mainstem dams on the Susquehanna River; however American shad restoration has not met expectations. While the Conowingo Dam fishway has passed large numbers of shad, studies indicate the effectiveness to be inadequate. A 2012 radio telemetry study conducted as part of the Conowingo Hydroelectric Project relicensing indicated that only 44% of American shad attempting to pass the dam made it through the fishway[12]. Analysis of data from a radio telemetry conducted at the Muddy Run Project in 2008 indicated considerable delay and fall back of shad attempting to pass through the project area[13].

Calculation of upstream passage efficiencies at the other three hydroelectric facilities is based on the counts at each facility relative to the number passed at the adjacent downstream facility. American shad passage efficiencies for Holtwood, Safe Harbor, and York Haven have averaged 32%, 71%, and 11%, respectively, over the period from 1997 through 2009. Based on the results of a 2008 radio telemetry study[14] the passage efficiency for American shad that entered the Muddy Run Project area and eventually made it past the project was 88%. The cumulative impact of fish passage inefficiencies at each of the FERC licensed hydroelectric projects on the lower Susquehanna River results in an overall passage efficiency of less than 1% of the American shad attempting to migrate upstream of York Haven Dam. The key to increasing wild juvenile recruitment (i.e., young fish produced from natural spawning in the Susquehanna River and not hatchery reared origin) is directly related to effectively passing pre-spawn anadromous fish into the quality spawning and nursery habitat located upstream of the York Haven Dam where the majority (95%) of spawning habitat is located. The target passage number for adult American shad into spawning habitat upstream of York Haven Dam is 2 million fish[15]. Consequently, overall passage efficiencies must be significantly improved past the lower Susquehanna River hydroelectric projects in order to achieve the goal of successful restoration of American shad to the Susquehanna River[16].

Catadromous Fish

American eel (*Anguilla rostrata*) occupy a significant and unique niche in the estuarine and freshwater habitats of the Atlantic coast. Eels are a catadromous species that ascend freshwater environments as juveniles. These fish reside in riverine and connected lake habitats until reaching maturity at which time they migrate to the Sargasso Sea where they spawn once and die. Larval eels are transported by ocean currents to rivers along the eastern seaboard of the continent. Unlike anadromous shad and herring, they have no particular homing instinct. Historically, American eels were very abundant in East Coast

[12] Exelon. 2012. Upstream fish passage effectiveness study RSP 3.5. Conowingo Hydroelectric Project, FERC Project Number 405. Prepared by Normandeau and Associates, Inc. with Gomez and Sullivan Engineers, P.C. September 2012. 69 pages + Appendices.
[13] *Id* at 4.
[14] *Id* at 5.
[15] *Id* at 6.
[16] *Id* at 6.

streams, comprising more than 25 percent of the total fish biomass in many locations[17]. This abundance has declined from historic levels but remained relatively stable until the 1970s. More recently, fishermen, resource managers, and scientists have noticed a further decline in abundance from harvest and assessment data (ASMFC 2012). Status of the American eel population is currently under consideration for protection under the Endangered Species Act (ESA; 50 FR 60431). There is currently no commercial harvest and very few eels are taken by anglers from the Susquehanna River.

Although the Chesapeake Bay and tributaries support a large portion of the coastal American eel population, eels have been essentially extirpated from the largest Chesapeake Bay tributary, the Susquehanna River. The Susquehanna River basin comprises 43 percent of the Chesapeake Bay watershed. Construction of Conowingo Dam in 1928 effectively closed the river to upstream migration of elvers (i.e., juvenile eel hatched in the ocean that migrate upstream to grow and mature) at river mile 10. Historically, American eel were found throughout the watershed and supported commercial fisheries in Pennsylvania, New York, and Maryland[18]. Currently no upstream or downstream eel passage measures are required, or in place at any of the hydroelectric projects in the Susquehanna River basin. The Service is currently studying American eel occurrence and passage needs at hydroelectric projects on the lower Susquehanna River[19].

Riverine Fish

The lower Susquehanna River watershed has a fishery consisting of a number of resident species. Several important species within the Muddy Run Project area use the near-shore areas of the Conowingo Pond for spawning and rearing habitat.

SPECIFIC COMMENTS

Reservation of Authority

The Department will reserve the authority of the Secretary of the Interior to require the Licensee to construct, operate, and maintain fish passage facilities and operations that may be prescribed in the future by the Secretary. The appropriate language, identified below under "Prescriptions," in Attachment A should be included in any license issued for this Project.

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[17] Ogden, J.C. 1970. Relative abundance, food habits, and age of the American Eel, *Anguilla rostrata* (LeSueur), in certain New Jersey streams. Transactions of the American Fisheries Society 99(1):54–59.

[18] Dittman, D. E., L.S. Machut and J.H. Johnson. 2009. Susquehanna River drainage: American Eel history, status, and management options. Final Report for New York State Contract # C005548, comprehensive study of the American Eel. State Wildlife Grant T-3, Project 3. Submitted to NYSDEC Bureau of Fisheries. 95 p.

[19] Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC). 2013a. Susquehanna River Basin American Eel restoration plan, Addendum to the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) 2010 migratory fish management and restoration plan for the Susquehanna River Basin. 18 p.

Fish Passage Prescription

The Department's assessment of the Muddy Run Project operations indicates impacts to migratory diadromous fish that can negatively impact efforts to restore these fish to the Susquehanna River. Therefore, the Department will exercise its authority to prescribe fish passage measures for inclusion in any FERC license that may be issued for continued operation of the Muddy Run Project.

As part of the fish passage prescription the Service will require the Licensee to develop a Fish Passage Operating Plan (FPOP) and submit it to the Resource Agencies for review and approval. The FPOP shall describe Muddy Run Project operations during the fish passage seasons, and will address regular maintenance activities as well as emergency procedures to accommodate safe, timely, and effective fish passage. The Licensee will meet on an annual basis with the Service and the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) to discuss the FPOP. This meeting will occur well before the start of the fish migration season and no later than the month of January each year. This meeting is a continuation of the traditional SRAFRC Fish Passage Technical Committee (FPTC) meetings with the dam owners on the river to review FPOPs, fish passage results from the previous year, and discuss plans for the upcoming passage season. Participants at these meetings include: staff biologists from the state natural resource agencies of Maryland, Pennsylvania and New York; the Susquehanna River Basin Commission; the National Marine Fisheries Service; and the Service.

The Licensee will also develop a Fish Passage Monitoring Plan (Plan) in consultation with the Service and submit it to the FERC for approval within 6 months of license issuance. The Plan will consist of a post FPOP implementation monitoring of the ongoing effectiveness of fish passage measures for juvenile and adult American shad, and American eels. For the Muddy Run Project successful passage criteria shall not be inconsistent with the goal and objectives set forth in the Susquehanna River Anadromous Fish Restoration Plan (SRAFRC 2010, "SRAFRC Plan")[20]. The SRAFRC Plan calls for assessment and mitigation of impacts to migratory fish associated with hydroelectric projects and their operation. The SRAFRC Plan also calls for monitoring and annual reporting of adult upstream passage of migratory fish at all hydroelectric projects to ensure that fish passage measures and/or facilities are providing safe, timely, and effective passage. A monitoring plan will be part of the fish passage prescription developed of the Muddy Run Project.

Federally Protected Species

On August 8, 2007, the bald eagle (*Haliaeetus leucocephalus*) was removed from the Federal Endangered Species List and is no longer protected under Section 7 of the Federal Endangered Species Act (ESA). However, bald eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755). Bald eagles are known to nest, forage and communally roost along the Susquehanna River, including

[20] *Id* at 1.

Dauphin County. As part the Licensee's compliance under BGEPA, the FERC should require the Licensee to follow conservation measures that protect bald eagles in addition to adopting the National Bald Eagle Management Guidelines.

The federally threatened bog turtle (*Clemmys muhlenbergii*) is also known to occur along the Susquehanna River in Dauphin County. As part of the Licensee's compliance with Section 7 of the ESA, the FERC should require the Licensee to contact the Service's Pennsylvania Field Office before any land clearing activity is initiated. If there are any questions regarding bald eagles or bog turtles, please contact Ms. Kagel at 814-234-4090.

High Value Land Resources

The National Park Service (NPS) has previously filed comments in association with the current relicensing (NPS July 6, 2012 Draft Application Comments, NPS April 25 2011 Initial Study Report Comments, NPS April 23 2012 Updated Study Report Catwalk Closing Re-Evaluation Comments). While the Final Applications (FA) have referenced the issues and recommendations provided by the NPS, the proposals contained in them still leave several important issues to be adequately addressed. Primary among them is the proposal to remove considerable lands of high value habitat and recreational use from the Conowingo project boundary. Additionally, the future use and demand for active and passive recreational activities outside and in several cases, abutting project lands as well as non-project lands owned or otherwise controlled by Exelon which abut the project boundaries, needs to be more fully evaluated. In some cases, these lands are adjacent to lands currently under development protection or of high value in terms of their desirability for conservation and/or recreational use.

The Lower Susquehanna River and Upper Chesapeake Bay region have a long history of recreational access and use. As stated in Executive Order 13508 (the EO), the Administration has set a goal of 300 additional public access sites and 2 million acres of land to be conserved to ensure adequate protection of the resources associated with the Chesapeake Bay Watershed and its tributaries including the Susquehanna River. As was accomplished in the PPL Holtwood (FERC 1881) proceeding[21], Exelon has an exceptional opportunity to preserve and protect significant land under their ownership and enhance recreational use and access, both within and outside the project boundaries associated with the Conowingo and Muddy Run Hydroelectric Projects.

Four units of the national trail system, including two national historic trails NPS administers, are located in, adjacent to or near the collective project boundaries and all have strong bearing on the position of the Department regarding the future use and disposition of those lands whose practice and status can affect the visitor's experience in those units as set out below.

The Chesapeake Bay Watershed Public Access Plan (Access Plan) was published in direct response to the President's Executive Order 13508, Strategy for Protecting and Restoring the Chesapeake Bay. The primary purpose of the Access Plan was to "access

[21] See FERC Order Amending Project Boundary issued 21 December 2012 (FERC 1881-066)

the demand for public access; describe existing public access facilities; assess barriers to public access; determine gaps in the public access system; identify opportunities for new access sites; and help direct federal, state and local funding toward public access opportunities.[22] Importantly, the plan is updated annually to include newly identified potential public access sites.[23]

The Access Plan has been certified by FERC as a Comprehensive Plan as defined by Section 10(a)(2)(A) of the Federal Power Act (FPA), 16 U.S.C. section 803 (a)(2)(A) which requires FERC to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project.[24] In this case, the FAs for all three subject projects should be evaluated for their consistency with the Access Plan.

On May 16, 2012, the Secretary of the Interior designated four water trails in five states as new historic connecting components of the Captain John Smith Chesapeake National Historic Trail (John Smith Trail, or CAJO), among them the Susquehanna River. In our efforts to determine how development of presently undeveloped lands within the viewshed of the John Smith Trail would affect the visitor's experience, the NPS prepared a viewshed map which is intended to evoke consideration of how the lands and features surrounding the water trail (the Lower Susquehanna River and environs) would have looked to Captain John Smith during his voyage. That map is set out below. It was developed as a result of the CAJO Trail being extended to include the Susquehanna River in Pennsylvania and New York.

The Captain John Smith Chesapeake National Historic Trail commemorates Smith's voyages of exploration of the Chesapeake in 1607 to1609, shares knowledge of the American Indian societies and cultures of the Chesapeake region at the time, and interprets the past and present natural history of the Chesapeake Bay and its rivers.

The National Park Service completed a Comprehensive Management Plan (CMP) for the trail in 2011. http://www.nps.gov/cajo/parkmgmt/planning.htm The CMP states: "The promise of the Captain John Smith Chesapeake National Historic Trail, then, is to help the millions of people in the region and elsewhere experience, envision, come to understand, and care to protect what the explorers and the inhabitants of the region saw 400 years ago: by expanding access to the Bay and rivers; by protecting special places reminiscent or evocative of those times; by educating the public of the importance and exceptional nature of the region, its people, and its resources; by providing recreational experiences throughout the region; by creating partnerships amongst the many citizens, groups and jurisdictions to realize the vision; by instilling awe and reverence for the special places in the Chesapeake region. Visitor experiences on the trail will include journeys on land – walking, bicycling, motoring – and sojourns on water – paddling,

[22] The 2013 Access Plan was prepared by the National Park Service in collaboration with the Commonwealths of Pennsylvania and Virginia, the States of Delaware, Maryland, New York, and West Virginia, and the District of Columbia.
[23] Issued January 7, 2014.
http://executiveorder.chesapeakebay.net/file.axd?file=2014%2F1%2F14_15+WQ+milestones_010714+FINAL+Version.pdf
[24] FERC letter dated December 4, 2013, docket ZZ09-5-000.

sailing and cruising, in craft large and small. The trail will provide national park quality experiences through NPS partnerships with state and local governments, and non-profit and for profit organizations."

Core trail-related resources identified in the CMP include "evocative landscapes - places possessing a feeling that expresses the aesthetic or historic sense of a particular period of time. This feeling results from the presence of physical features that, taken together, convey a landscape's historic character." The CMP further defines this as "visible shoreline generally evocative of the 17th century - primarily composed of forests and wetlands."

Evocative landscapes and other trail resources are the foundation of the visitor experience along the trail, an experience that for many visitors takes place from the water in self-guided or guided boating trips using a variety of watercraft.

The NPS has prepared a map of evocative landscape along the Lower Susquehanna River segment of the John Smith Trail using computer assisted viewshed analysis. This map identifies lands which contribute to the trail's visitor experience and is shown below.

This map helps guide identification of trail resources, prioritizes conservation efforts and development of interpretation opportunities and materials. It provides a broad brush illustration of general areas that merit consideration for protection within the context of the CMP and that may be able to be accomplished through the current relicensing processes. Some of these lands are owned by Exelon both within and outside the project boundaries. Others abut existing protected lands. The CMP is referenced and has been certified by FERC as a Comprehensive Plan as defined by Section 10(a)(2)(A) of the FPA. In addition, the Onondaga Nation, in their comments dated December 13, 2013, noted their support for the establishment of the John Smith Trail.

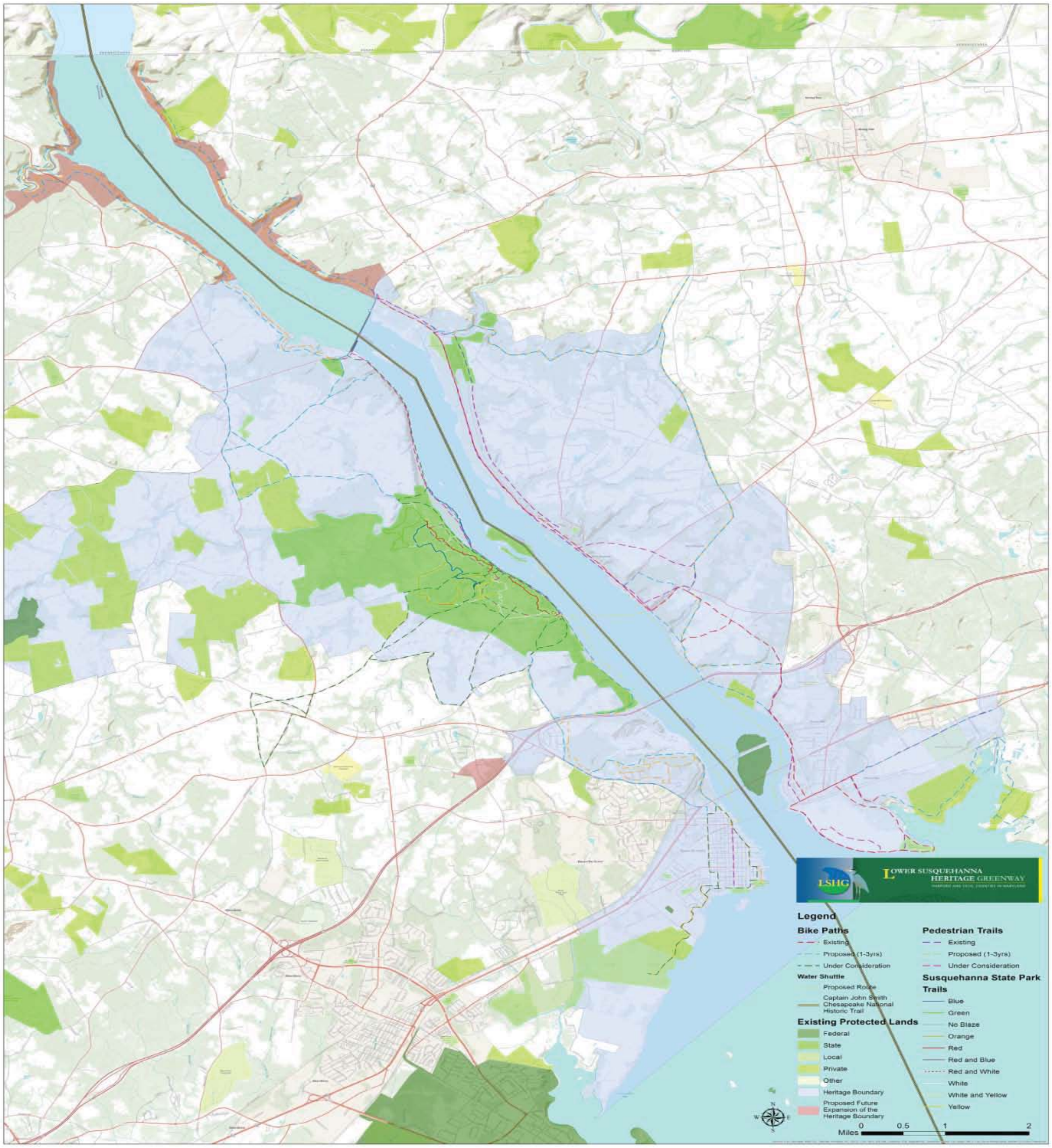
The Star-Spangled Banner National Trail (Star-Spangled Trail) connects the places, people and events that led to the birth of the National Anthem during the War of 1812. This trail includes the Susquehanna River from immediately below the Conowingo Dam to the Chesapeake Bay. NPS and its partners completed a Comprehensive Management Plan (CMP) for the trail in 2012. http://starspangledtrail.net/about-the-trail/planning-process/ The Star-Spangled Trail CMP includes a framework and action plan for interpreting the history and legacy of the War of 1812 in the Chesapeake in ways that are meaningful and relevant to the general public. Visitors will be accessing this trail using both land and water routes. As with the John Smith Trail, there are evocative landscapes along the Susquehanna River that support the Star-Spangled Trail. The Star Spangled Trail CMP is referenced and has also been certified by FERC as a Comprehensive Plan as defined by Section 10 (a) (2) (A) of the FPA.

Captain John Smith Chesapeake National Historic Trail
Lower Susquehanna River Viewshed
National Park Service | Chesapeake Bay Office
November 2013
Evocative Viewshed from CAJO and Selected Sites
Data Sources:
2006 National Land Cover Dataset (30 meter resolution)
2006 National Elevation Dataset (30 meter resolution)
0 4 8 12 16
Miles

The NPS' previous comments referred to above relative to the Mason Dixon Trail (MDTS) should also be considered in the context that the MDTS is a designated National Recreation Trail, with several sections within and connecting to the Conowingo Project boundary. As set out in the NPS comments on the Draft Application for Conowingo (and herein incorporated by reference), several opportunities exist to provide safer and more desirable routings, and significantly improve trail user's experiences. A routing connecting existing sections of the MDTS around the Conowingo Dam on the West side has been identified by the Lower Susquehanna Heritage Greenway (LSHG) and the MDTS. In addition, LSHG is working with Vulcan to develop a trail route that circumvents the Arundel Quarry to connect the City of Havre de Grace with the Lower Susquehanna Heritage Greenway, the Mason Dixon Trail and ultimately to the Appalachian Trail at Whisky Springs. Details of both these rerouted and new trail segments, along with renderings associated with upgraded riverfront park facilities in Havre de Grace will be included in comments to be filed on or before January 31, 2014 by the Lower Susquehanna Heritage Greenway. The map below illustrates the number and variety of trails and links along the Lower Susquehanna River.

There are numerous Exelon owned parcels within and abutting the project boundaries of Conowingo and Muddy Run which the NPS, the Commonwealth of Pennsylvania and the State of Maryland, numerous conservation organizations, local and county government entities[25] believe are of such high value to their host communities and well beyond in terms of remaining undeveloped, that public control (or permanent conservation) of those lands and the resources they contain, should be accomplished through or concurrent with, these relicensing proceedings.

[25] Including, but not limited to The Chesapeake Conservancy, The Wildlife Management Institute, The Lancaster County Conservancy, The Nature Conservancy, The Conservation Fund, The Susquehanna Gateway Heritage Area, The Harford County Land Trust, The Lower Susquehanna Heritage Greenway.



The Lower Susquehanna has been nationally recognized as a valuable resource by the Obama Administration through the EO and was identified as an America's Great Outdoors priority for the Commonwealth of Pennsylvania through their Conservation Landscape Initiative (CLI) program. The State of Maryland is also currently engaged in efforts to protect riverfront lands and public access from the Conowingo Dam to the river's confluence with the Chesapeake Bay. The NPS has not at this time identified specific Exelon owned parcels (either inside or outside the existing project boundaries of the Conowingo and Muddy Run projects) that should be permanently protected, as this is a task properly left to the local, county and state government entities, their residents and NGOs to decide. However, there are a number of conservation principles the NPS proposes for application to the subject proceedings as the relicensings have national implications and represent a once in a generational opportunity to make lasting conservation measures across a broad range of resources, from historic and cultural, to aesthetic, to recreational, to habitat and water quality protection and enhancement. This set of principles, and the methodology behind them (attached as Appendix C, Prioritization Tool)[26], has been jointly developed by the NPS and numerous state, county and local entities along with several non-governmental organizations (NGOs) which have or are expected to file comments on the subject FAs. Page 3 of the Prioritization Tool lists the five datasets that were used to set the priorities. They include the presence of Historic and Cultural Resources, Important Terrestrial Habitats, Ecological Connectivity, Relationship to Existing Protected Lands and the Proximity to Existing Public Access Points.

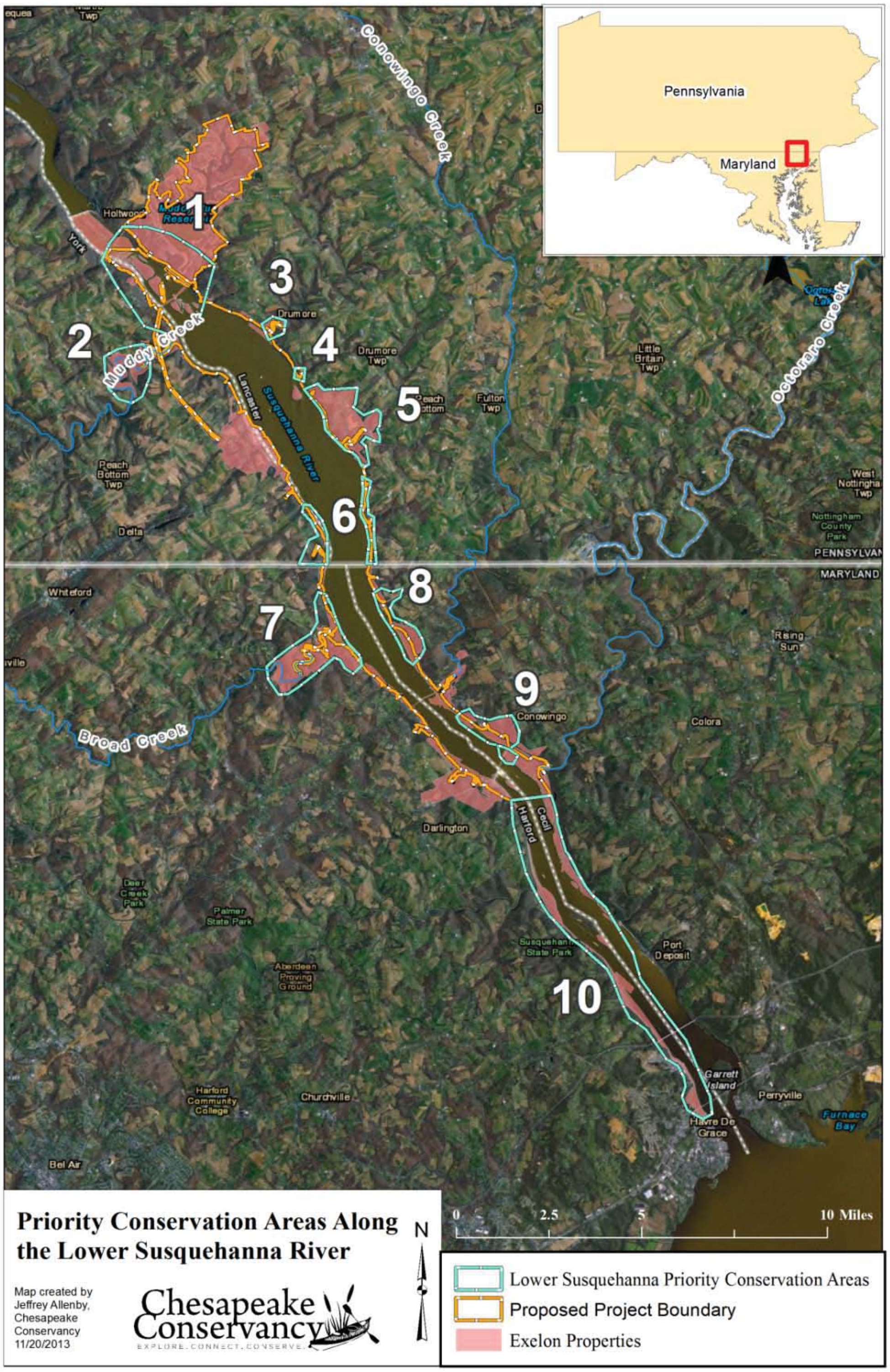
The tool led to the identification of priority conservation areas along the Lower Susquehanna River, which will then be used to identify specific Exelon owned parcels that are deemed to have the highest conservation values. This allowed for an empirical valuation to enable the conservation partners to align their priorities in these critical areas and to determine the highest value conservation opportunities along the lower Susquehanna River corridor. Specific justifications for each priority area, the rationale behind their identification and how they fit within the overall land protection framework are set out in the documents entitled Lower Susquehanna Land Conservation Opportunities. The December 12, 2013 comments filed by the Chesapeake Conservancy set out in detail the rational for and process used to develop the priorities for land protection. The NPS fully supports and endorses the permanent protection of lands within the areas so identified. Although not shown on the map below, several of the priority areas contain bald eagle and map turtle (*Graptemys geographica*), a Maryland State listed species, habitat.

All the islands and riparian areas owned by Exelon in the Lower Susquehanna River should receive permanent protection and are considered a conservation priority for the NPS and the Service. Regardless of their relationship to the project boundaries, these lands possess extremely high value habitat, cultural, historic and archaeological resources and in some areas are suitable for recreational use. Any such lands to be removed from the existing project boundaries or subject to a change in ownership should be accompanied by an endowment or the like to the grantee to help pay for ongoing monitoring of easements and maintenance of important habitat and/or recreational use areas, including bald eagle and map turtle habitat.

Exelon should continue to work with those entities involved in the relicensing process (see fn.3), to insure that all existing public access and recreation facilities are maintained, both within and outside the boundary on Exelon owned lands, and the potential for

[26] Chesapeake Conservancy: Developing a Web-based Prioritization Tool for the Lower Susquehanna River (2013). http://chesapeakeconservancy.org/images/TripsandTips/LSRCOA/Data_Assumptions_Methods.pdf

additional public access, recreation facilities, and trails should be considered on all lands that are or will be protected.



Exelon has stated at numerous meetings and forums that they will discuss land protection during Settlement Negotiations, which began subsequent to their filing of the Final

Application (FA), and are expected to continue after the filing of these and other comments on the FA. The NPS fully supports this initiative and is confident it will complement and build on the ongoing Conservation Landscape Initiative in Pennsylvania, the State of Maryland's efforts to improve public access to recreation and land protection in the Chesapeake Bay watershed and the Settlement Agreement reached in the Holtwood Hydroelectric Project License Amendment Application (FERC 1881).

Native American Consultation

We recommend the Licensee consult with any Native American Tribe or Nation whose treaty rights may be affected by the Muddy Run Project. Potentially affected tribes can provide guidance in developing the project in a manner that seeks to preserve, protect, and enhance fish, wildlife and other tribal-interest resources and environmental values in the project area. It is especially important for the Licensee to initiate consultation so that any future studies may begin in a timely fashion and delays may be avoided.

RECOMMENDATIONS

Pursuant to Section 10(a) of the FPA, as amended the Department recommends that the following special articles be included in any license the FERC issues for this Project. Reporting and further consultation requirements should be required by the FERC to ensure timely and adequate compliance with the license articles.

1. The Licensee shall develop and implement a Recreation Management Plan (RMP). The RMP will guide the operation and maintenance of Exelon's recreation facilities, and also include proposals for recreation facility enhancements outlined in Section 2.2.1.2 of the Licensee's Draft License Application.

2. The Licensee shall develop and implement a Historic Properties Management Plan (HPMP) for the management of archaeological and historic resources throughout the term of the new license. The HPMP will be prepared in consultation with the Department's National Park Service, the Pennsylvania State Historic Preservation Office, and other stakeholders in accordance with the Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects.

TERMS AND CONDITIONS

Pursuant to Section 10(j) of the FPA, as amended, and the Fish and Wildlife Coordination Act, the Department recommends the following special articles for the protection, mitigation, and enhancement of fish and wildlife resources be included in any license the FERC issues for this Project. Reporting and further consultation requirements should be required by the FERC to ensure timely and adequate compliance with the license articles.

1. Before starting any ground disturbing work, the Licensee shall visit the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office and Pennsylvania Field Office website and follow the Bog Turtle and Bald Eagle Management Guidelines.

2. The Licensee shall develop and implement a Bog Turtle Management Plan (BTMP) in consultation with the U.S. Fish and Wildlife Service and the Pennsylvania Fish and Boat Commission. This management plan shall include three components:

   - Restriction of mowing in the wetland documented to support bog turtles
   - Invasive plant and woody plant control, particularly for reed canary grass
   - Possible limits on public access to the wetland without advertising the reason

3. The Licensee shall finalize and implement a Bald Eagle Management Plan (BEMP) in consultation and cooperation with the U.S. Fish and Wildlife Service and Maryland Department of Natural Resources, and Pennsylvania Game Commission. The BEMP shall provide for the management of bald eagle habitat on Exelon lands in accordance with recommendations from the National Bald Eagle Management Guidelines and state agency guidance. Bald eagle habitat, including nest sites, forage sites, and communal roost sites on Exelon lands shall be managed through a range of conservation measures that meet the previsions of the Bald and Golden Eagle Protection Act, including incidental take of eagles. The range of measures is tailored to types of activities with potential to impact eagles and will include, but not be limited to, seasonal restrictions, distance buffers, and landscape buffers.

3. The Licensee shall develop and implement a Shoreline Management Plan (SMP) consistent with Guidance for Shoreline Management Planning at Hydropower Projects (FERC 2001). The SMP shall include specific measures and policies related to shoreline vegetation management and erosion control, woody debris management, game species management, sensitive natural resource protection, recreation use, and use of project lands. The Licensee shall adopt best management practices for controlling sediment introduction from lands within the project boundary.

4. The Muddy Run Project shall at all times be subject to inspection by representatives of U.S. Fish and Wildlife Service in order to ensure compliance with any fish and wildlife protection, mitigation and enhancements that may be contained in any FERC license issued for the project.

Attachment A

PRESCRIPTIONS

In order to allow for the timely implementation of fish passage, including effectiveness measures, the Department provides Attachment A to the FERC for inclusion in any new license it may issue for the Muddy Run Project.

* * * * *

We appreciate the opportunity to provide comments, recommendations, terms and conditions, and prescriptions on this application for new license.

Sincerely,

Lindy Nelson
Regional Environmental Officer

cc: Muddy Run Service List

Attachment A

BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Exelon Corporation, Applicant	)	**Muddy Run Pumped Storage Project**
	)	**FERC No. 2355**

United States Department of the Interior's
Decision Document,
Preliminary Prescription for Fishways
Pursuant to Section 18 of the Federal Power Act

Submitted this 31st day of January, 2014, by:

Genevieve LaRouche
Field Office Supervisor
U.S. Fish and Wildlife Service
United States Department of the Interior

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United States Department of the Interior's
Decision Document,
Preliminary Prescriptions for Fishways
Pursuant to Section 18 of the Federal Power Act

Introduction

The United States Department of the Interior (Department) hereby submits its Preliminary Prescription for Fishways for the Muddy Run Pumped Storage Project (Muddy Run Project, Project, or MRPSP), FERC No. 2355 pursuant to Section 18 of the Federal Power Act (FPA), as amended. The Department is submitting this Decision Document to the Federal Energy Regulatory Commission (Commission or FERC) with its supporting administrative record.

The Department developed its Preliminary Prescription for Fishways through a review process that included consultation among fisheries biologists and fishway engineers from the Department's U.S. Fish and Wildlife Service (Service), the National Oceanic and Atmospheric Administration (NOAA), the Pennsylvania Fish and Boat Commission (PFBC), the Pennsylvania Department of Environmental Protection (PADEP), the Maryland Department Natural Resources (MD DNR), the Susquehanna River Basin Commission (SRBC), collectively referred to as the "Resource Agencies", and other interested parties.

The Department is also filing an index to the administrative record in this proceeding. The Department has considered the record before the Commission, as well as scientific evidence not already included in the record before the Commission or publicly available. Copies of any supporting documents not previously filed with the Commission will be filed via electronic digital media delivered by regular mail service (due to the large size of the supplemental record). Copies of the administrative record will be provided by the Service.

Administrative Process, Hearing Rights, and Submission of Alternatives

This Preliminary Prescription was prepared, and will be processed, in accordance with the Department's regulations at 43 Code of Federal Regulations (C.F.R.) Part 45. These regulations provide that any party to a license proceeding before the Commission in which the Department exercises mandatory authority is provided both the right to trial-type hearings on issues of material fact and the opportunity to propose alternatives to the terms contained in the Preliminary Prescription.

Therefore, the Department hereby provides notice that any party to the License Application Process before the Commission may request a trial-type hearing on any issue of fact material to this Preliminary Prescription pursuant to, and in conformance with, the regulations of the Department at 43 C.F.R. § 45.21. Such a request for a trial-type hearing must be filed with the Office of Environmental Policy and Compliance, Department of the Interior, 1849 C Street, NW, Mail Stop 2342, Washington, DC, within 30 days of the submission of this document. Should any request for trial-type hearing be filed, other parties may file interventions and responses within 15 days of the date of service of the request for a hearing. 43 C.F.R. § 45.22. Trial-type hearings will be conducted, and a Modified Prescription for Fishways developed, in accordance with the terms and time limits of 43 C.F.R. Part 45.

The Department further provides notice that any party to the License Application Process before the Commission may submit alternatives to the terms contained in the Preliminary Prescription by filing them pursuant to, and in conformance with, the Department's regulations at 43 C.F.R. § 45.71. Any such alternative proposals must be filed with the Office of Environmental Policy and Compliance, Department of the Interior, 1849 C Street, NW, Mail Stop 2342, Washington, DC 20240 within 30 days of the submission of this document. Such alternative proposals will be analyzed in accordance with 45 C.F.R. § 45.73.

Finally, the Department will accept and consider any comments on the Preliminary Prescription filed by any member of the public, State or Federal Agency, the Licensee, or other entity or person. Comments should be filed within 30 days of the filing of this Preliminary Prescription, and should be sent to: Genevieve LaRouche, Field Office Supervisor, Chesapeake Bay Field Office, 177 Admiral Cochrane Drive, Annapolis, MD 21401, genevieve_larouche@fws.gov, 410.573.4573 – office, 410.266.9127 – fax.

If no hearing is requested or alternative submitted, the Department will finalize its Prescription for Fishways, with accompanying analysis, when the Commission requires parties to file Modified Terms and Conditions and Prescriptions in accordance with 43 C.F.R. 45.73.

Project Description

The Muddy Run Project is a large pump-storage hydroelectric project that began operation in 1966 and is located in Lancaster County, Pennsylvania. When it was completed, it was the largest pumped-storage hydroelectric power plant in the world. It has a generating capacity of 800 megawatts (MW) and generates an average of 1,610,611 MW hours annually. It is situated on the lower Susquehanna River, 22 miles upstream of Chesapeake Bay, and 11 miles upstream of the Conowingo Hydroelectric Dam. The Muddy Run Project utilizes Susquehanna River water withdrawn from the impoundment formed by the Conowingo Hydroelectric Dam. The impoundment is referred to as Conowingo Pond, Conowingo Reservoir, Conowingo Pool, Lake Conowingo, and lower reservoir. The Holtwood Hydroelectric Dam is located on the Susquehanna River, 3 miles upstream of the Muddy Run Project.

The Muddy Run Project uses upper and lower storage reservoirs for the generation of hydroelectric power. The upper reservoir is the 900-acre Muddy River Reservoir, which is 411 feet higher than Conowingo Pond when both are at their normal, full-water-surface elevations. The upper reservoir is formed by four dams described below (Figure 1). Its useable storage capacity and total storage capacity are estimated to be 35,500 and 60,000 acre-feet at its maximum pool elevation of 520 feet. The lower reservoir is the 9,000-acre Conowingo Pond with design storage of 310,000 acre-feet at its normal full-pool elevation of 109.2 feet. The Muddy Run Project operates on a daily pump-storage cycle to generate electricity. The powerhouse turbines are reversible and can pump large quantities of water from the Susquehanna River (lower reservoir) to the upper reservoir, through underground water conduits, for storage at the higher elevation. It can later release water down through the water conduits to the eight large powerhouse turbines to generate electricity. The discharge water is released back into the Susquehanna River (Conowingo Pond).

The upper reservoir water storage consists of two water bodies: the Power Reservoir and the Recreational Pond (Figure 1). The Power Reservoir is nearest the river, is formed by three dams, and has one spillway. They are the Main Dam Embankment, Canal Embankment, East Dike, and Upper Reservoir Spillway - which is on the Canal Embankment. The Recreational Pond is formed by the Recreational Pond Dam, which has a spillway. The physical features of each structure are described as follows:

- **Main Dam Embankment** is a rock-filled structure across the Muddy Run ravine with a central impervious core. It has a maximum height of approximately 260 feet, and a total length of 4,800 feet.

- **Canal Embankment** has a maximum height of approximately 35 feet.

- **East Dike** is a zoned-earth and rock-filled embankment with a maximum height of approximately 12 feet and a total length of 800 feet.

- **Upper Reservoir Spillway** is a non-gated, concrete ogee-type structure that is 200 feet long, 20 feet high, and has a crest elevation at 521 feet. Any spill is directed down through a vegetated natural ravine.

- **Recreation Pond Dam** is a zoned earth and rock-filled embankment with a maximum height of approximately 90 feet and a total length of 750 feet.

- **Recreation Pond Spillway** is a rock-cut channel approximately 140 feet wide with a crest elevation of 520 feet.

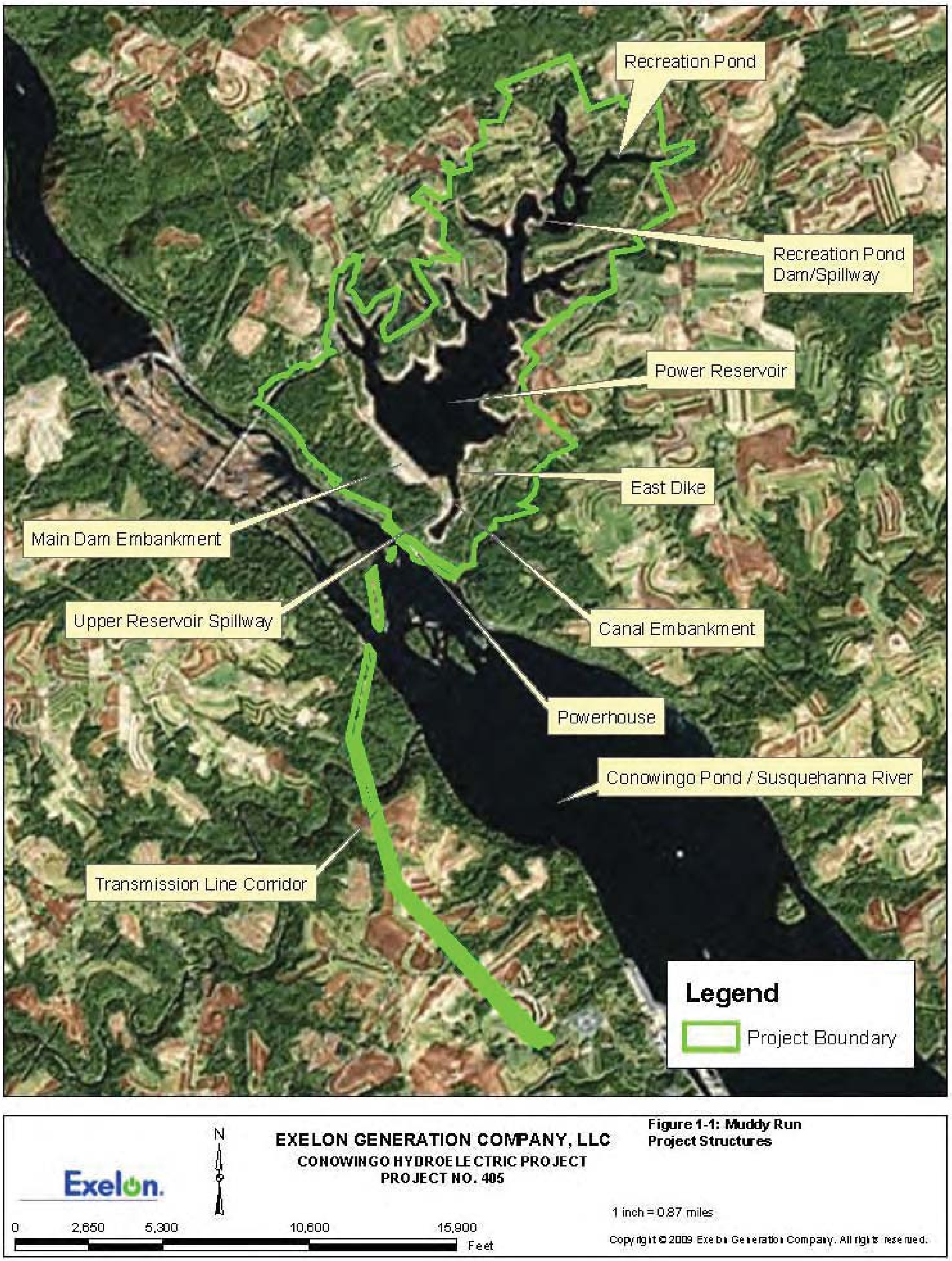

Figure 1. Muddy Run Project.

To generate power, project operations allow water stored in the power reservoir to flow into power intake facilities in the canal, descend over 400 feet through the water conduits to the powerhouse, flow through the turbines, and discharge through the draft tubes and trash racks into the tailrace constructed in Conowingo Pond. These project works consist of a system of physical structures, facilities, and devices that control the timing and volume of water discharged into the river.

Specifically, there are four intake facilities in the upper reservoir power canal. Each consists of a cylindrical tower with four cylinder gates with trash racks. Water entering the intake facility flows 430 feet down a vertical shaft to a horizontal power tunnel that divides into two sections. Each section transitions to a penstock through which the water flows to one of eight Francis turbines in the powerhouse, each of which is equipped with a 100 MW generator.

The powerhouse is located on the bank of the Susquehanna River. It is constructed of concrete and is 133 feet wide and 600 feet long. The turbines housed in it are reversible and can pump water or generate electricity. When generating, the hydraulic discharge capacity of each turbine tis 4,000 cubic feet per second (cfs). The total discharge capacity from the powerhouse is 32,000 cfs (8 turbine units x 4,000 cfs). When pumping, the hydraulic withdraw capacity of each turbine to is 3,500 cfs. Therefore, the total powerhouse withdrawal (pumping) capability is 28,000 cfs. Discharging and withdrawing such large volumes of water changes the instantaneous flow in the Susquehanna River and under some conditions may impede fish migrating through that zone of passage.

When the Muddy Run Project withdraws water from Conowingo Pond, by pumping it to the upper reservoir to replenish its store of useable water, it reduces the amount and velocity of flow (instream flow) in the Susquehanna River downstream of the powerhouse. A negative instream flow (i.e., water flowing upstream) can be experienced downstream of the Muddy Run Project when pumping (withdrawal) flows exceed the instantaneous instream flow in the Susquehanna River. The Muddy Run Project pumping capacity exceeds the median monthly flow of the Susquehanna River for six months of the year (June through November).

When the Muddy Run Project is generating, water flowing through the turbines is discharged via the draft tubes into the tailrace, which is in the Susquehanna River and is an integral physical feature of the powerhouse. The effect of the discharged generation flow is additive; i.e., the instream flow in the Susquehanna River at the powerhouse at that moment is increased. The possible effects of these phenomena on fish migrating upstream and downstream, through that zone of passage, are described below in this document.

Electricity generated at the Muddy Run Project is transmitted approximately 4.25 miles across the Conowingo Pond to the Peach Bottom Atomic Power Station's North Substation in York County, via two individual 220-kilovolt transmission lines from the Project switching station.

The licensee is not proposing any new physical structures, facilities, or devices to the Muddy Run Project in its application for a new license.

Existing Fish Passage Facilities and Measures at the Project

There are currently no fish passage facilities or measures in place at the Muddy Run Project.

Resource Description

Susquehanna River

The Susquehanna River is one of the oldest existing rivers in the world. It is far older than the mountain ridges through which it turns. It forms in upstate New York and west-central Pennsylvania. At about 460 miles, the Susquehanna River is the longest river on the American East Coast that drains into the Atlantic Ocean. With a drainage basin of 27,500 square miles, it is the largest watershed in the Northeast and the Nation's sixteenth largest river by volume (Figure 2). It is the largest tributary to the Chesapeake Bay, providing over 60 percent of the freshwater to the Bay.

Figure 2. The Susquehanna basin comprises 45.5 percent of the land area of Pennsylvania, 13 percent of New York, and a portion of northeastern Maryland.

For millennia, the Susquehanna River was accessible via the Chesapeake Bay to sea-run migratory fish from the mid-Atlantic Coast. Each year, millions of anadromous sea-run fish migrated far upstream to spawn and complete their life cycle. The Susquehanna River historically played an important role in sustaining coastal fish stocks of several species. The goals described in this document aim to restore in part the role the Susquehanna River played in contributing to the coastal fish stocks. The Susquehanna supported large numbers of diadromous migratory fish.

The Conejohela Valley formed a wide, flat valley through which the lower Susquehanna

River flowed for about 30 miles through Pennsylvania and Maryland to the Chesapeake Bay. The mixed marshy terrain contained rapids and small waterfalls, wetlands, and thick woods along both sides of the river within a ten-year floodplain. The varied terrain created many biological habitats. Three dams were built across the Conejohela Valley during the first four decades of the 20th century to provide hydroelectric power for the southern Pennsylvania/Maryland market, including Baltimore and Philadelphia. The first large dam across the lower Susquehanna, the Holtwood Dam, was completed in 1910 as McCalls Ferry Dam. The Conowingo Dam followed in 1928. The Safe Harbor Dam first closed its gates in 1931 and flooded over ten miles of the upper Conejohela Flats, creating the artificial lake Clarke. By then, most of the valley was flooded and the ecosystem of the lower Susquehanna River was changed. The river was essentially closed to sea run fish migrations.

The name of the river comes from an Algonquian word for "muddy water". This term may still be an appropriate description of the Susquehanna today as the river can be very turbid - particularly during higher flow events. There is also considerable run-off from agricultural areas that have long been a major contributor to nutrient loading in the Chesapeake Bay. Mean monthly flows are highest in March and April and lowest in August and September.

Energy Development on the Lower Susquehanna River

The large size of this watershed has provided a consistently large volume of water that has made the lower Susquehanna River an attractive reach for waterpower development, and for fossil and nuclear power plants which required large volumes of water for cooling. At this time, the generation capacity of all power projects on the lower Susquehanna River is between 6657 and 6927 MW. Today, there are five hydroelectric, two atomic (nuclear), and one fossil (coal) generation plants on the lower Susquehanna River. Four hydroelectric projects, each requiring a dam across the river, were under construction between 1901 and 1930. When Conowingo Dam was completed in 1928, producing 252 MW, it became the second largest hydroelectric project in the United States, behind Niagara Falls. No new energy plants were built on the river during the Great Depression, World War II, or the Korean Conflict. Then, between 1958 and 1968, construction of energy projects recommenced when one coal plant, two atomic plants, and a pump-storage hydroelectric project (Muddy Run) were built. Exelon owns or has an ownership interest in about 54.5 percent (3,628 MW) of the current generation capacity on the lower Susquehanna River.

Project	**Capacity in 2013 (MW)**	**Year Building Started**	**Present ownership interest (100 % unless stated otherwise)**
York Haven Hydro Project	19.6[a]	1901[a]	Olympus Power
Holtwood Hydro Project	233.0[b]	1905	PPL
Conowingo Hydro Project	572.0[c]	1926[c]	Exelon
Safe Harbor Hydro Project	417.5[d,e]	1930[f]	Exelon (66% - Constellation Generation) LSP Safe Harbor Holdings, LLC (33%)[g,e]
Brunner Island Power Plant	1490.0[h]	~1958[i]	PPL

Muddy Run Pump Storage	800.0[j] 1070.0[j]	1964[k]	Exelon
Three Mile Island Nuclear Plant	829.0[l]	1968[l]	Exelon – Unit 1
Peach Bottom Atomic Power Sta.	2296.0[m]	~1968[m]	Exelon (50%)[m] Public Service & Gas of New Jersey (50%)
Total Megawatts	6657.1		

Table 1: Energy Development on the Lower Susquehanna River in order of construction

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a YHPC. 2012. Final License Application. August. Exhibit A. P. 1.

b http://www.pplweb.com/ppl-generation/ppl-holtwood.aspx (accessed January 12, 2014)

c http://www.exeloncorp.com/PowerPlants/conowingo/Pages/profile.aspx (accessed January 12, 2014)

d 417.5 MW @ http://www.shwpc.com/facts_figures.html#station (accessed January 12, 2014)

e 417.0 MW @ http://www.shwpc.com/about.html (accessed January 12, 2014)

f http://www.shwpc.com/about.html (accessed January 12, 2014)

g http://www.shwpc.com/facts_figures.html#river.

h http://www.pplweb.com/ppl-generation/ppl-brunner-island/ppl-brunnerisland-plant-fact-sheet.aspx (accessed January 12, 2014)

i Construction start estimated; commercial operation began in 1961 according to reference at “g”

j 800 MW is the rated generation capacity for the Muddy Run Powerhouse based on the nameplate capacity of the 8 turbine/generator units combined. 1027 MW is the generating capacity identified in Exelon’s on-line Project Profile and the capacity the units are capable of generating identified in Exelon’s Application for New License filed with FERC August 2012 (Exhibit A, page 5, Footnote 1). See: http://www.exeloncorp.com/powerplants/muddyrun/Pages/profile.aspx and http://www.exeloncorp.com/assets/energy/powerplants/docs/MuddyRun/MR_Vol_1_Public_Part1.pdf

k Exhibit C, Page 2 of Exelon’s Application for New License for Major Water Power Project - Existing Dam filed with FERC August 2012 See: http://www.exeloncorp.com/assets/energy/powerplants/docs/MuddyRun/MR_Vol_1_Public_Part1.pdf

l http://www.exeloncorp.com/assets/energy/powerplants/docs/TMI/fact_tmi.pdf

m http://www.exeloncorp.com/assets/energy/powerplants/docs/Peach_Bottom/Fact_PeachBottom.pdf

Fishery Resources

There have been longstanding efforts to conserve and increase sea-run migratory fish use, including reproduction, in the lower Susquehanna River. The U.S. Fish and Wildlife Service’s Susquehanna River Coordinator from 1979 to 2005 wrote a paper that briefly recounts the history of the American shad restoration program on the Susquehanna River, which spans a large portion of the 20th century. That paper is incorporated by reference rather than recounting that history in this document[1].

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[1] St. Pierre, R., 2003. History of the American Shad Restoration Program on the Susquehanna

Anadromous Fish

The Susquehanna River was once home to large numbers of migratory anadromous fish. The most important of these were members of the herring family Clupeidae; including the American shad (*Alosa sapidissima*), blueback herring (*A. aestivalis*), alewife (*A. pseudoharengus*), and hickory shad (*A. mediocris*). Populations of migratory fish have been severely impacted by human activities, the most serious being the impacts due to dam-building[2,3]. Construction of canal dams in the mid-1800's restricted access to ancestral spawning grounds, but the construction of the four large, lower river hydroelectric dams in the early 1900's completely eliminated access to the river and the migratory fish runs were lost[1].

In addition to eliminating migratory fish access to upstream spawning and nursery habitat, these dams also altered river habitat by creating impoundments that inundated and eliminated riverine spawning and rearing habitat in the lower portion of the Susquehanna River. Conowingo, Holtwood, Safe Harbor and York Haven dams inundated 14, 8, 10, and 4 miles of habitat, respectively, resulting in the cumulative loss of 36 miles of riverine habitat. The Conowingo Reservoir extends from the Conowingo Dam to the Holtwood tailrace and the Holtwood Reservoir (Lake Aldred) extends from the Holtwood Dam to the Safe Harbor tailrace, resulting in a 32 mile stretch of impounded water with little flowing water habitat. Above the Safe Harbor impoundment (Lake Clarke) there is 15 miles of free-flowing river to York Haven Dam. The majority (95%) of the remaining free-flowing river habitat is located upstream of York Haven Dam.

Hydroelectric project operations also negatively impact migratory fish habitat by altering the river flow regime. The mainstem Susquehanna River hydroelectric projects (with the exception of York Haven which operates instantaneous run-of-river) and the Muddy Run Project tend to generate power during the daytime peak use period, and refrain from generation at night when water storage in mainstem impoundments is replenished with incoming river flows, and water from the Susquehanna River is pumped up to the Muddy Run Project upper storage reservoir. This results in unnatural flow conditions downstream of the hydroelectric projects which can vary from flood to drought flow conditions within minutes during any given day. For the Muddy Run Project, pumping water withdrawal flows can exceed instream flows in the river resulting in reverse flow in the project area which can disorient fish using flow as a migration queue and interfere with normal migration, or lead to entrainment of fish attempting to pass through the project area[4,5]. Few aquatic organisms are adapted to these drastic and abrupt fluctuations in

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River. U.S. Fish and Wildlife Service. Harrisburg, PA. 10pp.

[2] Susquehanna River Anadromous Fish Restoration Cooperative. 2010. Migratory fish management and restoration plan for the Susquehanna River Basin. 124pp.

[3] Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

[4] Sweka, J.A. 2013. Re-analysis of the 2008 American Shad telemetry study. Internal USFWS Report drafted December 2, 2013.

[5] Exelon. 2009. Assessing the Impacts of Muddy Run Pumped Storage Station and Holtwood Hydroelectric Station Operations on the Upstream Migration of Adult American Shad (*Alosa sapidissma*) in Conowingo Pond, Susquehanna River, Spring 2008.

flows, and the result is a highly perturbed aquatic ecosystem that is often not suitable for migratory fish spawning, nursery habitat, or fish passage.

In the years following construction of dams on the mainstem of the Susquehanna River, fishway design, technology, and operation improved and by the 1940s, successful passage of American shad was demonstrated at Bonneville Dam on the Columbia River, Oregon. In the 1950s, inspired by improvements in fish passage technology, resource agencies began the process of restoring migratory fish to the Susquehanna River, focusing on American shad, the largest and locally most important of the herrings. At the urging of Pennsylvania sportsmen and the Pennsylvania Fish Commission, the U.S. Congress appropriated funds specifically to study the potential to recover American shad fisheries in dammed rivers. Ensuing studies, many funded by the hydroelectric dam owners/operators on the lower Susquehanna River included: an assessment of the migratory response of American shad placed into riverine habitat upstream of hydroelectric impoundments (Walburg 1954, Whitney 1961)[6]; assessment of the suitability of the Susquehanna River for American shad reproduction and survival (Carlson 1968)[7]; and the assessment of the engineering feasibility of American shad passage at high dams (Bell and Holmes 1962)[8].

Anadromous fish restoration on the Susquehanna River was a cooperative venture from the beginning. The Pennsylvania Fish Commission (now Pennsylvania Fish and Boat Commission), Maryland Board of Natural Resources (now Maryland Department of Natural Resources), New York State Department of Environmental Conservation and the Service developed an Administrative Committee for American shad studies on the Susquehanna River in February 1963 for the purpose of determining habitat suitability above dams to support American shad reproduction and survival. The study was funded by the lower river hydroelectric dam owners/operators during 1963 to 1966. The study results determined that over 300 miles of the mainstem Susquehanna River upstream of the York Haven Dam, most of the Juniata River, and the lower West Branch of the Susquehanna River were entirely suitable for American shad spawning and rearing (Carlson 1968)[9].

Around 1970, the first modern effort to restore the American shad population in the Susquehanna River began. The utility companies owning the dams along the Susquehanna River worked with various Federal and state agencies to stock the upper Susquehanna River with shad eggs, and to build a facility at Conowingo Dam to trap fish, from which the shad and herring would be transported upstream to spawning areas near Middletown and Columbia, Pennsylvania. The Conowingo facility had limited success, however, passing only 945 shad between 1972 and 1980.

As part of a 1984 Settlement Agreement, the licensee, Safe Harbor Water Power Corporation (SHWPC) and York Haven Power Company (YHP) provided $3.7 million over the period from

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[6] As cited in: Susquehanna River Anadromous Fish Restoration Cooperative. 2010. Migratory fish management and restoration plan for the Susquehanna River Basin. 124pp.
[7] *Id* at 6.
[8] *Id* at 6.
[9] *Id* at 6.

1985 to 1994 to fund a trap and transfer program for shad, expand hatchery operations and conduct studies related to shad restoration[10]. By the late 1980s, the catch of returning adult shad at Conowingo had increased to several thousand shad per year. As a result a new fish passage facility capable of passing 1.5 million shad and 10 million herring was completed in 1991 at the Conowingo Dam.

In 1993, SHWPC, the licensee, and YHP reached a settlement agreement with various agencies[11]. This agreement required Safe Harbor and Holtwood to have fish passage facilities in place by 1997 and required York Haven to install facilities no later than three years (2000) after the in service date of the facilities at Holtwood and Safe Harbor.

Upstream fish passage has been installed at all mainstem dams on the Susquehanna River; however American shad restoration has not met expectations. While the Conowingo Dam fishway has passed large numbers of shad, studies indicate the effectiveness to be inadequate. A 2012 radio telemetry study conducted as part of the Conowingo Hydroelectric Project relicensing indicated that only 44% of American shad attempting to pass the dam made it through the fishway[12]. Analysis of data from a radio telemetry conducted at the Muddy Run Project in 2008 indicated considerable delay and fall back of shad attempting to pass through the project area[13].

Calculation of upstream passage efficiencies at the other three hydroelectric facilities is based on the counts at each facility relative to the number passed at the adjacent downstream facility. American shad passage efficiencies for Holtwood, Safe Harbor, and York Haven have averaged 32%, 71%, and 11%, respectively, over the period from 1997 through 2009. Based on the results of a 2008 radio telemetry study[14] the passage efficiency for American shad that entered the Muddy Run Project area and eventually made it past the project was 88%. The cumulative impact of fish passage inefficiencies at each of the FERC licensed hydroelectric projects on the lower Susquehanna River results in an overall passage efficiency of less than 1% of the American shad attempting to migrate upstream. The key to increasing wild juvenile recruitment

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[10] Settlement Agreement. December 1, 1984. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, Pennsylvania Fish Commission, Maryland Department of Natural Resources, Pennsylvania Department of Environmental Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.
[11] Settlement Agreement. June 1, 1993. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Fish and Wildlife Service – U.S. Department of the Interior, Pennsylvania Fish and Boat Commission, Pennsylvania Department of Environmental Resources, Maryland Department of Natural Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.
[12] Exelon. 2012. Upstream fish passage effectiveness study RSP 3.5. Conowingo Hydroelectric Project, FERC Project Number 405. Prepared by Normandeau and Associates, Inc. with Gomez and Sullivan Engineers, P.C. September 2012. 69 pages + Appendices.
[13] *Id* at 4.
[14] *Id* at 5.

(i.e., young fish produced from natural spawning in the Susquehanna River and not of hatchery reared origin) is directly related to effectively passing pre-spawn anadromous fish into the quality spawning and nursery habitat located upstream of the York Haven Dam where the majority (95%) of spawning habitat is located. The target passage number for adult American shad into spawning habitat upstream of York Haven Dam is 2 million fish[15]. Consequently, overall passage efficiencies must be significantly improved past the lower Susquehanna River hydroelectric projects in order to achieve the goal of successful restoration of American shad to the Susquehanna River[16].

American Eel

American eel (*Anguilla rostrata*) occupy a significant and unique niche in the estuarine and freshwater habitats of the Atlantic coast. Eels are a catadromous species that ascend freshwater environments as juveniles. These fish reside in riverine and connected lake habitats until reaching maturity at which time they migrate to the Sargasso Sea where they spawn once and die. Larval eels are transported by ocean currents to rivers along the eastern seaboard of the continent. Unlike anadromous shad and herring, they have no particular homing instinct. Historically, American eels were very abundant in East Coast streams, comprising more than 25 percent of the total fish biomass in many locations[17]. This abundance has declined from historic levels but remained relatively stable until the 1970s. More recently, fishermen, resource managers, and scientists have noticed a further decline in abundance from harvest and assessment data[18]. Status of the American eel population is currently under consideration for protection under the Endangered Species Act (ESA; 50 FR 60431). There is currently no commercial harvest and very few eels are taken by anglers from the Susquehanna River.

Although the Chesapeake Bay and tributaries support a large portion of the coastal American eel population, eels have been essentially extirpated from the largest Chesapeake Bay tributary, the Susquehanna River. The Susquehanna River basin comprises 43 percent of the Chesapeake Bay watershed. Construction of Conowingo Dam in 1928 effectively closed the river to upstream migration of elvers (i.e., juvenile eel hatched in the ocean that migrate upstream to grow and mature) at river mile 10. Historically, American eel were found throughout the watershed and supported commercial fisheries in Pennsylvania, New York, and Maryland[19]. Currently no upstream or downstream eel passage measures are required, or in place at any of the

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[15] *Id* at 6.
[16] *Id* at 6.
[17] Ogden, J.C. 1970. Relative abundance, food habits, and age of the American Eel, *Anguilla rostrata* (LeSueur), in certain New Jersey streams. Transactions of the American Fisheries Society 99(1):54–59.
[18] Atlantic States Marine Fisheries Commission. 2012. American Eel benchmark stock assessment. Stock Assessment Report No. 12-01 of the Atlantic States Marine Fisheries Commission. 254pp.
[19] Dittman, D. E., L.S. Machut and J.H. Johnson. 2009. Susquehanna River drainage: American Eel history, status, and management options. Final Report for New York State Contract # C005548, comprehensive study of the American Eel. State Wildlife Grant T-3, Project 3. Submitted to NYSDEC Bureau of Fisheries. 95 p.

hydroelectric projects in the Susquehanna River basin. The Service is currently studying American eel occurrence and passage needs at hydroelectric projects on the lower Susquehanna River[20].

Current Fisheries

Coast-Wide American Shad Status

The current status of American shad along the Atlantic coast is summarized by the Atlantic States Marine Fisheries Commission (ASMFC) in Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring[21] and the most recent American Shad Stock Assessment (ASMFC 2007, Volume I). Historically, American shad, hickory shad, alewife, and blueback herring (collectively termed alosines) were an extremely important fishery resource and supported very large commercial fisheries along the Atlantic coast of both the United States and Canada. Coast-wide landings of American shad at the turn of the century were approximately 50 million pounds. However, by 1980 the landings decreased dramatically to 3.8 million pounds. Total landings of river herring (alewife and blueback herring) varied from 40-65 million pounds from 1950 to 1970, then declined steadily thereafter to less than 12 million pounds by 1980. These dramatic declines in commercial landings were perceived as an indication that a coordinated management action would be required to restore alosine stocks to their former levels of abundance. Therefore, in 1981, the members of the ASMFC recommended the preparation of a cooperative Interstate Fishery Management Plan (FMP) for American Shad and river herrings. The initial FMP was completed in 1985 and recommended management measures that focused primarily on regulating exploitation and enhancing stock restoration efforts.

In spite of the efforts to develop and implement the FMP, alosine stocks continued to decline and in 1994, ASMFC determined that the original FMP was no longer adequate for protecting and restoring remaining shad and river herring stocks. They concluded that the declines may have been the result of overharvest by in-river and ocean-intercept fisheries; excessive striped bass predation; biotic and abiotic environmental changes; and loss of essential spawning and nursery habitat due to water quality degradation and blockages of spawning reaches by dams and other impediments. A coast wide assessment was completed in 1998 and Amendment 1 to the FMP was adopted in 1999 and additional addendums were added in 2000 and 2002. Amendment 1 and the addendums focused on maintaining directed fishing mortality below set benchmarks which defined ASMFC shad management until the adoption of Amendment 3 in 2010.

The 2007 stock assessment (ASMFC 2007, Volume I) that found American shad stocks were at all-time low levels and did not appear to be recovering to acceptable levels. Commercial landings declined to 574,300 pounds in 2005 (a reduction of approximately 85% since 1980). The primary causes for continued stock declines were attributed to a combination of excessive

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[20] Susquehanna River Anadromous Fish Restoration Cooperative. 2013a. Susquehanna River Basin American Eel restoration plan, Addendum to the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) 2010 migratory fish management and restoration plan for the Susquehanna River Basin. 18 p.

[21] Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

total mortality, habitat loss and degradation, and migration and habitat access impediments. The 2007 stock assessment also concluded that management based on fishing mortality benchmarks, as in Amendment 1, was no longer valid for American shad stocks since they are subjected to several sources of human-induced mortality including direct and indirect fisheries as well as fish passage mortality at dams and river pollution. Since the components of human-induced mortality (direct and indirect fisheries, dam-induced, and pollution) are difficult or impossible to partition, and difficult to separate from natural mortality, the 2007 stock assessment suggested the use of a total instantaneous mortality rate that preserves 30% of unexploited spawning biomass per recruit as a benchmark (Z_{30}) to help guide management and gauge restoration progress (i.e., Z_{30} represents the total mortality that would yield a population size equivalent to 30% of a population that suffered no human-induced mortality (mortality due to fishing, pollution, dams, etc.). For example if the population level was 100 pounds of adult fish under a situation of no human-induced mortality, the population size would be 30 pounds of adult fish under a situation where total mortality (natural + human-induced) equaled Z_{30}))[22].

General conclusions from the 2007 stock assessment were:

- Ocean mixed stock harvest has been a large component of total American shad harvest over the last 25 years and since the late 1980s it was the dominant component of shad harvest from north of Virginia;

- The expected benefits resulting from the ocean intercept fishery closure were not obvious in this assessment and might take one or more generations of American shad before they are realized;

- Available total mortality estimates generally exceeded Z_{30} for most years in rivers where data were suitable for catch curve analysis and where data supported spawning stock biomass per recruit modeling;

- Data on annual number of fish passing upriver at dams on several Atlantic coastal rivers exhibited a coast-wide pattern of an increase followed by a decrease. Interestingly, most fish passage numbers declined at about the same time (late 1990s to early 2000s). This synchronous decline suggests a coast wide change in environmental conditions or mortality factors that affected stocks from South Carolina to Maine within the last five years;

- Continuous fishery dependent and independent catch-per-unit-effort series generally only provide insight into recent stock dynamics, except for the Delaware River Lewis haul seine index;

- Trends in juvenile production do not show consistent patterns coast-wide; however, regional patterns and some local trends were noteworthy;

[22] Kilduff, P., Carmichael, J., and Latour, R. 2009. Guide to Fisheries Science and Stock Assessment. Atlantic States Marine Fisheries Commission. June 2009.

- Recruitment has increased in the upper Chesapeake Bay, including the Potomac River, and Merrymeeting Bay, Maine in recent years;

- Recruitment patterns in the lower Chesapeake Bay (James, York, and Rappahannock Rivers) and in Albemarle Sound have been similar;

- Relatively low young-of-year production was observed in all New England juvenile surveys in 1998 and 2001; and

- There has been consistent low recruitment in the Hudson River since 2002.

In response to the 2007 stock assessment, Amendment 3 to the FMP was adopted in 2010. Amendment 3 called for the adoption of Z_{30} as a benchmark to evaluate observed levels of total mortality and whether or not population restoration was occurring. It also called for the states or jurisdictions to submit sustainability plans for commercial and recreational fisheries. States or jurisdictions without an approved plan in place would have their fisheries closed by January 1, 2013. Currently, Connecticut, the Delaware River Basin, Potomac River Fisheries Commission, North Carolina, South Carolina, Georgia, and Florida have an approved sustainability plan for shad, and Maine, New Hampshire, New York, North Carolina and South Carolina have an approved sustainability plan for river herring. Some states such as Maryland have chosen to close their shad and herring fisheries.

In addition to regulating fisheries via sustainability plans, Amendment 3 recommended states and jurisdictions develop habitat plans for American shad to reduce or mitigate the impact of dams and other obstructions and water quality and contamination. Some recommendations for fish passage included working with Federal agencies and to target hydropower dams for appropriate recommendations during FERC relicensing; prioritize barriers in need of fish passage based on ecological criteria; develop new technologies to improve fish passage efficiency; design passage facilities that work under all water levels; and implement measures to pass fish via routes with the best survival. Although the development of habitat restoration and protection programs was proposed in Amendment 3, implementation of these programs is not required as it is beyond the authority of ASMFC.

Mid-Atlantic Region American Shad Status

Although there has been an overall coast wide decline in American shad stocks, the 2007 ASMFC stock assessment found much variation in population trends along the coast. Regional trends were apparent with rivers in close geographic proximity showing similar population trends. When assessing the status of the Susquehanna River and trying to give context to these trends, it is useful to compare them to rivers of similar size that are also located in the mid-Atlantic region such as the Delaware River and the Potomac River.

The Susquehanna River

The Susquehanna River once supported large numbers of migratory fish including the American shad, blueback herring, alewife, and hickory shad, striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrinchus*), and shortnose sturgeon (*A. brevirostrum*). These stocks have been severely impacted by human activities, especially dam building. In the 1950s, the resource agencies implemented a program to restore access for migratory fish to the upper Susquehanna River basin, focusing on American shad. In response to harvest declines that signaled critically low fish stock levels, the directed American shad fisheries in the Chesapeake Bay region were closed (Maryland in 1980 and Virginia in 1994). The American shad stock in the Susquehanna River improved slowly and made an impressive comeback by 2001 when over 200,000 adult shad were counted at the Conowingo Dam fish lifts. However, since 2001, adult numbers have decreased most likely due to a variety of factors including: poor efficiency of fish passage measures and facilities; low hatchery production in recent years; low numbers of spawning fish accessing quality habitat: poor young-of-year recruitment upstream of Conowingo Dam; ocean and Chesapeake Bay mortality; turbine mortality and predation[23].

The decline over the past decade in adult shad counted at Conowingo Dam fish lifts also coincides with declines seen downstream of the Conowingo Dam tailrace. Abundance estimates from mark-recapture and a surplus production model conducted from 1988 through 2012 both showed an increase through 2001 followed by a decrease[24]. Also, catch-per-unit-effort (fish per boat hour) from the Conowingo Dam tailrace showed similar trends. The percentage of repeat spawning American shad in the Conowingo Dam tailrace also increased from 1984 to 2002, but has remained fairly stable since then with 34% of males and 73% of females being repeat spawners in 2012.

The Delaware River

In the late 1890s, the Delaware River had the largest annual commercial shad harvest of any river on the Atlantic Coast with estimates ranging up to 19 million pounds in a given year. The harvest began to decline rapidly in the early 1900s due to water pollution, overfishing, and dams on major tributaries (ASMFC 2007, Volume II). Despite improved state legislation and regulation, and a massive program of artificial propagation of shad stocks in the late 1800s, the shad fishery eventually collapsed under the combined pressures. By the 1940s, the commercial shad fisheries were mainly limited to the lower reaches of the River and Bay below Pennsylvania (Ellis in Delaware River Fish and Wildlife Cooperative 1982). By 1950, the urban reach of the Delaware River was one of the most polluted stretches of river in the world (ASMFC 2007, Volume II).

It is evident that the Delaware River stock of American shad declined through the 1990s and remains at low levels (ASMFC 2007, Volume II). The catch-per-unit-effort (fish/haul) in the Lewis haul seine fishery in the lower Delaware River had a recent peak in 1989 with a 52.20 fish/haul, but declined to only 2.89 fish/haul in 2005. Relative abundance measures of juvenile American shad increased from 1980 through 1996 and have since varied without trend. There does not seem to be an identifiable cause of the decline nor an indication as to why the stock has remained at low levels in recent years. Although recent high abundances of striped bass have been hypothesized to be a reason for continued low abundance of American shad in the

[23] *Id* at 2.
[24] *Id* at 20.

Delaware River, the 2007 stock assessment found no empirical data to attribute the shad decline in the Delaware River solely to striped bass.

The Potomac River

Among Chesapeake Bay stocks of American shad, the Potomac River population shows the most promising signs of recovery. The gill-net index, the pound net index, and the juvenile abundance index used in the 2007 ASMFC stock assessment (ASMFC 2007, Volume III) depict increasing trends in relative abundance. Age structure has broadened and the mean age has increased. Estimates of total mortality have declined from 2002 to 2005. Reference values Z_{30} (the total mortality that preserves 30% of unexploited spawning stock biomass per recruit) in the Chesapeake Bay region (York River, Virginia) derived from a yield model ranged from 0.62 to 0.86 depending on the assumed level of natural mortality. Total instantaneous mortality estimated in 2005 from catch curve (0.82) and repeat spawning (0.66) data were within this range indicating that total mortality was not excessive.

A benchmark for American shad in the Potomac River is the geometric mean of pound net catch rates reported in Walburg and Sykes (1957) for the years 1944 to 1952, a value of 31.1 pounds per net-day. Although pound net catch rates remain below the benchmark, these catch rates have steadily increased from 0.94 in 1988 to 12.21 in 2005 (ASMFC 2007, Volume III). To continue stock rebuilding, there should be no new expansion of the fishery until the benchmark is reached.

It appears the decline in American shad seen on the Susquehanna River over the past decade coincides with a decline seen on the Delaware River. The mainstem Delaware River is undammed and most of the historic habitat has remained available to American shad, so limited access to habitat is likely not the cause for the observed decline. However, the American shad population in Potomac River, where fish passage and access to additional habitat has improved, is increasing and we would expect that the Susquehanna River population should show trends more similar to the Potomac River since both are major Chesapeake Bay tributaries and both have had fishways installed at passage barriers in past two decades. As noted above the cumulative effectiveness of the fishways on the Susquehanna River has been documented to be less than 1%. We conclude that the poor passage effectiveness is the likely a major contributing cause for lack of increased American shad population response on the Susquehanna River when compared with the Potomac River.

American Eels

The ASMFC completed a stock assessment in 2012 and concluded that the stock of eel is depleted, due to a combination of historical overfishing, habitat loss, food web alterations, predation, turbine mortality, environmental changes, toxins and contaminants, and disease (ASMFC 2012). Currently, ASMFC is considering changes to its Interstate Fishery Management Plan for American Eel. The American Eel Management Board (state directors) recently reviewed advice from the American Eel Technical Committee with respect to potential management changes needed to address modern population declines. In addition to the management actions by ASMFC, the Service was petitioned in 2004 to review the status of American eel under the federal Endangered Species Act (ESA). The Service concluded that the petition warranted further consideration, however the Service determined that listing was not warranted at the end of its review in 2007. The Service was petitioned again in 2010 by the Council for Endangered Species Act Reliability to re-consider listing the American eel under the ESA based on new information. In 2011, the Service concluded that the species warrants a more extensive status review which is expected to be completed in September 2015.

American eels have been largely precluded from the Susquehanna River Basin above Conowingo Dam since the early 1900's (SRAFRC 2010). Although PFBC conducted an intermittent trap and transfer program through 1980, by 2000 there were essentially no eels remaining in the watershed. Fish lifts at the 4 lower mainstem dams have passed few to no American eels in the past 10 years. In 2008, the Service initiated an experimental trap and transfer program at Conowingo Dam. This program has released over 300,000 juvenile eels from 2008 through 2012 at various locations throughout the Susquehanna River Basin. A portion of these eels have been stocked in areas where freshwater mussels are present, because American eel are the primary host species for successful reproduction of the Eastern Elliptio mussel (*Elliptio complinata*) (Lellis et al. 2013). Freshwater mussels have the potential to reduce suspended solids and dissolved nutrients[25,26,27] via their filter feeding, and efforts are underway in the Susquehanna River to increase the number of known host fish species, such American eel, in order to enhance mussel habitat conditions and increase freshwater mussel populations,

River Herring

On August 5, 2011, the National Marine Fisheries Service (NMFS), received a petition from the Natural Resources Defense Council (NRDC), requesting they list alewife and blueback herring under the ESA as threatened throughout all or a significant portion of their ranges. Alternatively, NRDC requested the designation of distinct population segments of alewife and blueback herring as specified in the petition, including the Chesapeake Bay for both species.

The petition contained information on the two species, including population status and trends, and factors contributing to the species' decline. The petition was determined to be warranted and NMFS published a positive 90-day finding on November 2, 2011. NMFS initiated a status review of the species to determine if listing under the ESA is warranted by forming an internal status review team (SRT) to compile the best commercial and scientific data available for alewife and blueback herring throughout their ranges. In May 2012, the Atlantic States Marine Fisheries Commission completed a river herring stock assessment, which covers over 50 river-specific stocks throughout the ranges of the species in the United States (ASMFC 2012b). NMFS identified the missing data required for their review and held workshops/working group meetings

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[25] Atkinson, C.L., C.C. Vaughn, K.J. Forshay, and J.T. Cooper. 2013. Aggregated filter-feeding consumers alter nutrient limitation: consequences for ecosystem and community dynamics. Ecology 94:1359-1369.
[26] Spooner, D.E., P.C. Frost, H. Hillebrand, M.T. Arts, O. Puckrin, and M.A. Xenopoulos. 2013. Nutrient loading associated with agriculture land use dampens the importance of consumer-mediated niche construction. Ecology Letters 16:1115-1125.
[27] Vaughn, C.C. 2010. Biodiversity losses and ecosystem function in freshwaters: emerging conclusions and research directions. Bioscience 60:25-35.

focused on addressing information on stock structure, extinction risk analysis, and climate change. Reports from each workshop/working group meeting were compiled and independently peer reviewed (Carvalho 2012; Chaput 2012; Hutchings 2012). On August 12, 2013, the NMFS concluded that "listing alewife or blueback herring as threatened or endangered under the ESA is not warranted at this time" (78 FR 48944). Based on the data available (NEFSC 2013), the SRT concluded that alewife are at low risk of extinction and blueback herring are at low to moderate risk of extinction.

Although listing under the ESA was determined not warranted, the conclusions of the SRT indicated that both species are at low abundance compared to historical levels and continued monitoring is warranted (NEFSC 2013). Hall et. al. (2012) noted the loss of anadromous fish productivity in Maine was reduced by 90% by the mid-1800s, a loss attributed to lost habitat access due to dam construction. By the author's estimates, this loss of habitat contributed to the loss of billions of juvenile alewife and blueback herring annually (Hall et. al. 2012). While many factors affect anadromous fish returns during any given year, including incidental and direct harvest, climate change and pollution, dams on historical anadromous rivers remain a significant impediment to restoration efforts (ASMFC 2012; Hall et al 2012).

The abundance trends analysis for alewife and blueback herring evaluated returns across the species entire range and for specific stock complexes (NEFSC 2013). The results indicated that all alewife stock complexes range wide have significantly increased over time. Range-wide, the observed increase in blueback herring was not significant. While the observed stock of alewife and blueback herring are either increasing or stable range wide, stock specific trends indicate areas of concern. Specifically, the Mid-Atlantic stock complex for alewife is stable, neither significantly increasing nor decreasing. While stable, the abundance of all stocks are greatly diminished compared to historical landings records (Hall e.t al. 2012). The Mid-Atlantic stock complex for blueback herring was determined to be significantly decreasing, as compared to the other blueback herring stocks that were considered stable.

Licensee Proposed Fish Passage

Anadromous Fish Passage

In the Muddy Run Project Draft Application for New License the license applicant is not proposing any upstream or downstream anadromous fish passage facilities or measures other than the continued operation of the project in the same manner as during the previous FERC license.

Catadromous Fish Passage

For the catadromous American eel, in the Muddy Run Project Draft Application for New License the licensee proposes to work with other licensee on the Susquehanna River to implement both an upstream and downstream trap-and-transport program to provide American eel passage for upstream migrating juveniles and downstream migrating adults between the Conowingo and York Haven dams. No specific plans for the program were provided in the Draft Application for New License. We generally consider trap-and-transport to be an interim fish passage measure during the initial phase of a restoration. However, it is appropriate for these initial stages, and this Prescription provides specific plans for a trap and transport program. As efforts to increase the Susquehanna River population of American eel expand the capacity of a trap-and-transport operation to capture and move sufficient numbers of eel upstream will likely be exceeded and additional facilities and measures may be needed to accommodate adequate, safe, timely and effective passage past the Muddy Run Project area.

Pennsylvania Department of Environmental Protection Proposed 401 Water Quality Certification Fish Passage

On December 21, 2013 the PADEP published notice of the availability of the Proposed Water Quality Certification (PWQC) for Muddy Run Project in the Pennsylvania Bulletin noting there will be a 30 day public comment period. The PWQC contained several fish passage provisions, and an applicant-prepared *American Eel Passage Plan* (Eel Plan) as a condition of, and incorporated into, the PA DEP Water Quality Certification for the Muddy Run Project. We note that under Section 401(d) of the Clean Water Act, the Eel Plan would become a condition of the FERC license for the Muddy Run Project if it is included in the Final Water Quality Certification. Accordingly the Department has considered the PWQC fish passage provisions and the Eel Plan as an alternative for fish passage, and has adopted parallel requirements in many areas.

Management Plans

A number of published State, Federal and regional fishery plans contain management goals that pertain to the Susquehanna River.

Comprehensive Plans Recognized by the Federal Energy Regulatory Commission's Licensing Process

Atlantic States Marine Fisheries Commission. 1995. Interstate fishery management plan for Atlantic striped bass. (Report No. 24). March 1995.

Atlantic States Marine Fisheries Commission. 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*). (Report No. 31). July 1998.

Atlantic States Marine Fisheries Commission. 1998. Interstate fishery management plan for Atlantic striped bass. (Report No. 34). January 1998.

Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.

Atlantic States Marine Fisheries Commission (ASMFC). 2000. Interstate fishery management plan for American Eel. Fishery Management Report No. 36 of the Atlantic States Marine Fisheries Commission. 79pp.

Atlantic States Marine Fisheries Commission. 2000. Technical Addendum 1 to Amendment 1 of the Interstate Fishery Management Plan for shad and river herring. February 9, 2000.

Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.

Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.

National Oceanic and Atmospheric Administration. 1980. Pennsylvania coastal zone management program and final environmental impact statement. Department of Commerce, Washington, D.C. August 1980.

National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998.

National Marine Fisheries Service. 2000. Fishery Management Report No. 36 of the Atlantic States Marine Fisheries Commission: Interstate Fishery Management Plan for American eel (*Anguilla rostrata*). Prepared by the American Eel Plan Development Team. April 2000.

National Park Service. 1982. The nationwide rivers inventory. Department of the Interior, Washington, D.C. January 1982.

Pennsylvania Department of Environmental Resources. 1983. Pennsylvania state water plan. Harrisburg, Pennsylvania. January 1983.

Pennsylvania Department of Environmental Resources. 1986. Pennsylvania scenic rivers inventory. Harrisburg, Pennsylvania. January 1986.

Pennsylvania Department of Environmental Resources. 1986. Pennsylvania's recreation plan, 1986-1990. Harrisburg, Pennsylvania.

Pennsylvania Department of Environmental Resources. 1988. Pennsylvania 1988 water quality assessment. Harrisburg, Pennsylvania. April 1988.

Pennsylvania Department of Environmental Resources. 1990. The Pennsylvania scenic rivers program scenic rivers inventory. Harrisburg, Pennsylvania. April 1990.

Susquehanna River Basin Commission. 1987. Comprehensive plan for management and development of the water resources of the Susquehanna River Basin. Harrisburg, Pennsylvania. June 1987.

Susquehanna River Basin Commission. 2012. Comprehensive plan for the water resources of the Susquehanna River Basin. Harrisburg, Pennsylvania. June 2012.

U.S. Fish and Wildlife Service. n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

U.S. Fish and Wildlife Service. 1989. Chesapeake Bay striped bass management plan. Annapolis, Maryland. December 1989.

U.S. Fish and Wildlife Service. 1989. Chesapeake Bay Alosid (shad and river herring) management plan. Annapolis, Maryland. July 1989.

U.S. Fish and Wildlife Service. 1992. Chesapeake Bay American eel fishery management plan. Annapolis, Maryland. December 18, 1992.

U.S. Fish and Wildlife Service. 2010. Migratory Fish Management and Restoration Plan for the Susquehanna River Basin. Harrisburg, Pennsylvania. November 15, 2010.

Susquehanna River Settlement Agreements

Settlement Agreement. September 29, 1970. Philadelphia Electric Power Company, Susquehanna Power Company, Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and Metropolitan Edison Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, New York Department of Environmental Conservation, Maryland Department of Natural Resources, and Pennsylvania Fish Commission.

Settlement Agreement. April 1, 1981. Pennsylvania Power & Light Company, and Safe Harbor Water Power Corporation, AND Pennsylvania Fish Commission, and Susquehanna River Basin Commission.

Settlement Agreement. December 1, 1984. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, Pennsylvania Fish Commission, Maryland Department of Natural Resources, Pennsylvania Department of Environmental Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

Settlement Agreement. August 26, 1988. Philadelphia Electric Power Company, and Susquehanna Power Company, AND U.S. Department of the Interior – U.S. Fish and Wildlife Service, Pennsylvania Fish Commission, Maryland Department of Natural Resources, Pennsylvania Department of Environmental Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

Settlement Agreement. June 1, 1993. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Fish and Wildlife

Service – U.S. Department of the Interior, Pennsylvania Fish and Boat Commission, Pennsylvania Department of Environmental Resources, Maryland Department of Natural Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

Settlement Agreement. June 1, 1997. York Haven Power Company, AND U.S. Fish and Wildlife Service – U.S. Department of the Interior, Pennsylvania Fish and Boat Commission, Pennsylvania Department of Environmental Protection, Maryland Department of Natural Resources, and Susquehanna River Basin Commission.

Resource Agency Plans

Policy Committee of the Susquehanna River Anadromous Fish Restoration Committee (SRAFRC). May 2002. Alosid Management and Restoration Plan for the Susquehanna River Basin.

Policy Committee of the Susquehanna River Anadromous Fish Restoration Committee (SRAFRC). November 2010. Migratory Fish Management and Restoration Plan for the Susquehanna River Basin.

Policy Committee of the Susquehanna River Anadromous Fish Restoration Committee (SRAFRC). December 2013. American Eel Restoration Plan for the Susquehanna River Basin. Addendum to the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) 2010 Migratory Fish Management and Restoration Plan for the Susquehanna River Basin.

Chesapeake Bay Program - Executive Council. January 2005. Fish Passage Goals.

Chesapeake Bay Program. February 2004. Restoring Fish Passages throughout the Chesapeake Bay Watershed.

Chesapeake Bay Program. February 2004. Shad and the Chesapeake Bay.

Chesapeake Bay Program. January 2000. Migratory Fish Restoration and Passage on the Susquehanna River.

Restoration Objectives

<u>Anadromous Fish</u>

In November 2010 the Policy Committee of the Susquehanna River Anadromous Fish Restoration Cooperative adopted the *Migratory Fish Management and Restoration Plan for the Susquehanna River Basin* (restoration plan) (SRAFRC 2010) that serves as a plan for future efforts to restore important migratory fish resources to the Susquehanna River Basin.

The goal of the Restoration Plan is:

"Restore self-sustaining, robust, and productive stocks of migratory fish capable of producing sustainable fisheries, to the Susquehanna River Basin throughout their historic 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. Goals for American eel and other migratory species are yet to be determined".

The steps to achieve this goal are partitioned into five objectives, each with a series of tasks. The tasks include a brief description along with timelines, costs, potential sources of funding and an assessment of task status. Brief overviews of the five objectives are:

A. **Restore access to historic habitats for juvenile and adult migratory fish**. This objective calls for development of passage plans and performance measures to achieve specified minimum passage efficiency for American shad, American eels, and other migratory fish species at major basin dams.

B. **Maintain or improve existing migratory fish habitat.** This objective focuses on essential habitat issues by inventorying blockages and assessing the impact of fish passage impediments through active involvement of SRAFRC in watershed project reviews while supporting monitoring and improving water quality.

C. **Enhance migratory fish spawning stock biomass and maximize juvenile recruitment through natural and/or artificial means.** This objective includes a variety of tasks designed to directly or indirectly improve migratory fish stocks in the Susquehanna River. Tasks focus on improving current techniques for artificial augmentation of American shad stocks, developing new techniques for augmenting river herring and eel populations, restoring non-Alosine migratory fish, improving instream migration, spawning and rearing habitat, and maintaining existing regulatory framework restricting harvest of migratory fish.

D. **Evaluate the migratory fish restoration effort and adjust programs or processes as needed.** This objective stresses the importance of data dissemination and analysis. Tasks included in this section will continue to collect baseline data essential to monitor restoration progress while researching and experimenting with technologies to improve survival, reproduction and spawning biomass.

E. **Ensure cooperation among all restoration partners while generating support for migratory fish restoration among the general public and potential funding sources.** This objective stresses the importance of a watershed approach to restoration and emphasizes the need to include coastal states and ocean waters.

The SRAFRC, through its policy and technical committees, member agencies and partners will rely on this plan as the foundation of its restoration activities while also recognizing that changes in fish stocks, threats, and management techniques will require flexibility and adaptation.

American Eel

In December 2013 the Policy Committee of the Susquehanna River Anadromous Fish Restoration Cooperative approved the *American Eel Restoration Plan for the Susquehanna River Basin* (SRAFRC 2013) that will serve as a plan for future efforts to restore American eel to the Susquehanna River Basin.

The goal of the American Eel Restoration Plan is:

> ***"Ensure that every American Eel that approaches Conowingo Dam is passed upstream into the Susquehanna River Basin in order to restore American Eels to the watershed, to provide a net increase of out-migrating American Eel, and restore the ecosystem functions provided by healthy American Eel populations, including their role as predator and prey as well as acting as hosts for the glochidia of E. complanata.".***

The objectives of the Draft Eel Restoration Plan are:

1. Ensure upstream passage of American eel throughout the Susquehanna River Basin.

2. Increase survival and escapement of American eels passing barriers and hydroelectric facilities during their downstream spawning migration.

3. Evaluate efforts to reintroduce American eels throughout the Susquehanna River Basin and document the influences of American eel on freshwater mussel populations.

4. Increase public awareness, appreciation, and knowledge of American eels.

The SRAFRC 2013 plan states that all available eel seeking passage at a hydroelectric project be passed upstream (i.e. no impact), and that there be 85% downstream passage survival at each hydroelectric project.

The Atlantic States Marine Fisheries Commission's American Eel Fisheries Management Plan goals are to maintain and enhance the abundance of American eels in inland and coastal waters, and contribute to the viability of the American eel spawning population. One objective is to provide adequate upstream passage and escapement to inland waters of elvers and juvenile eels as well as provide adequate downstream passage and escapement to the ocean of pre-spawn adult eels. American eel in the Susquehanna River would benefit from installation of upstream and downstream fishways or implementation of operational measures to minimize and avoid impacts associated with upstream passage delays and turbine passage entrainment injury or mortality during downstream passage at Susquehanna River hydroelectric projects.

Statutory Authority

Section 18 of the Federal Power Act, 16 USCS §811, states in pertinent part:

> *the Commission shall require the construction, maintenance and operation by a licensee at its own expense of...such fishways as may be prescribed by the Secretary of Commerce or the Secretary of the Interior.*

Section 1701(b) of the National Energy Policy Act of 1992, P.L. 102-486, Title XVII, §1701(b), 106 Stat. 3008, states:

> *the items which may constitute a 'fishway' under section 18 [16 USCS §811] for the safe and timely upstream and downstream passage of fish shall be limited to physical structures, facilities, or devices necessary to maintain all life stages of such fish, and project operations and measures related to such structures, facilities or devices necessary to ensure the effectiveness of such structures, facilities, or devices for such fish.*

Administrative Record

Evidence to support the Department's Preliminary Prescription for Fishways is contained in the Administrative Record before the Commission, and the additional materials are being provided under separate cover. Citations to the extant record are provided herein.

Impacts of Muddy Run Project on Migratory Fish

Migratory impediments to fish attempting to pass through the Muddy Run Project area are the direct result of project operations that alter the flow in Susquehanna River channel adjacent to, upstream and/or downstream of the Muddy Rum Powerhouse. Both generation and pumping operations at Muddy Run Project have been demonstrated to have negative impacts on migratory fish passage.

The operation of Muddy Run Project alters the instream river flow that enters the project area from upstream. This alteration elicits changes in migratory fish behavior that, as further explained below, result in delay or fall back of upstream migration, and entrainment of fish through the Muddy Run Project turbines that can kill, injure and or displace fish attempting to migrate through the Muddy Run Project area[28].

Migratory fish cannot reason their way through a problem or an impediment. They only respond to environmental stimulus in their immediate area (e.g., light, temperature, day length, vision, sound, physiological condition, flow). Their response to a stimulus is instinctual, and the result of thousands of years of evolution captured in genetic code. For migratory fish physiological condition (e.g., sexual maturation), along with environmental stimulus (e.g., day length, water temperature), elicit a response to begin the spawning migration.

For anadromous fish, the spawning migration result is to seek out freshwater spawning habitat in its natal watershed. To accomplish this, fish respond to freshwater flow stimulus from its natal stream (i.e., migratory fish imprint on the "smell" of their natal stream and later respond to the smell by swimming up that stream as adults to spawn) by swimming upstream against the current to reach spawning and juvenile rearing habitat[29]. If an instream flow is not present the fish

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[28] *Id* at 4.
[29] Quinn, T. P. and Adams, D. J., 1996. Environmental Changes Affecting the Migratory Timing of American Shad and Sockeye Salmon. Ecology, Vol. 77, No. 4 (Jun., 1996), pp. 1151-1162

cannot distinguish which way to swim to migrate upstream. If the instream flow is too strong the fish may not be able to effectively swim upstream, be forced back downstream, and/or seek flow velocity refuge until instream flows subside to acceptable levels. If the flow of the stream is reversed the fish will be confused and may swim in the wrong direction.

The catadromous American eel juvenile fish also swim upstream against the river flow and would experience the same conditions as the anadromous spawning fish, only the impacts of high and reverse flows would be greater due to small size and weaker swimming ability.

Both anadromous and catadromous species must also swim back downstream during portions of their life cycle. They respond to flow stimulus by swimming with the flow. Flows that reduce the current, head in the upstream direction, and/or lead to hazards (e.g., entrainment through a turbine, or dislocation into an off-stream water body) that kill, injure and/or misdirect fish will have negative impacts on migration.

Fish Passage Delays and Fallback

The licensee consultants Normandeau Associates Inc. (Normandeau) and Gomez and Sullivan Engineers' 2008 American shad radio telemetry report concluded that Muddy Run Pumped Storage Project had negligible impacts on the migration of American shad in the Susquehanna River (Normandeau Associates 2009). In the Department's assessment[30], the original telemetry data were reanalyzed in more detail to further examine potential impacts of MRPSP on upstream migration of American shad. The objectives of this assessment were to: (1) determine the effect of flow on travel time of American shad between Sicily Island, the telemetry station immediately downstream of MRPSP, and Deepwater Island, the telemetry station immediately upstream of MRPSP (both telemetry stations are approximately equidistant for the MRPSP powerhouse); (2) determine if there was a difference in travel times and swim speeds between Sicily Island and MRPSP, and MRPSP and Deepwater Island; and (3) determine what proportion of forays from Sicily Island were successful in making it past MRPSP.

It was observed that: median travel times from Sicily Island to Deepwater Island increased with the amount of flow experienced by migrating shad; travel times were longer, and swim speeds slower between Sicily Island and MRPSP than between MRPSP and Deepwater Island; and only 18% of upstream forays by migrating shad were successful at continued passage past MRPSP from Sicily Island to Deepwater Island with no fall back behavior, and some individual fish needed to make several forays prior to successfully passing MRPSP. Contrary to conclusions from the report by Normandeau Associates Inc., this assessment provides conclusive evidence that MRPSP does indeed impact upstream shad migration by unnaturally altering flow conditions in the MRPSP project area that result in migratory delays and possible termination of upstream migration by shad. Normandeau (2009) noted the impacts of increased flow on migrating American shad stating "…mid run segment in particular was subjected to an increase of river flow from 40,000 cfs to 65,000 cfs within 2 days after release, which most likely displaced some fish downstream for good. A spike in river flows can disrupt upstream migration of American shad." Peaking discharge flows from the Muddy Run Project elevated instream flows coming

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[30] *Id* at 4.

from Holtwood Dam to above 60,000 cfs on 50% of the days during the 2008 fish passage study. Table 1 shows delays in tagged shad passage past the Muddy Run Project for American shad monitoring during the 2008 Normandeau study. The passage times were estimated from the analysis contained in Sweka 2013. The information in the table indicates as flows below the Muddy Run powerhouse (represented as the combined flow from Holtwood Dam and Muddy Run Project operations) increase so does the delay in passage through the Muddy Run Project area. In 2006 the owner of the Holtwood Hydroelectric Project developed a 2-D numeric flow model for the area downstream of the Holtwood Dam that included modeling of flow effects from operation of the Muddy Run Project[31]. The study indicated that flows from the Muddy Run Project can develop passage bottlenecks in the Susquehanna River downstream of the Muddy Run powerhouse under certain river flow conditions, and it can also create flow conditions that prevent up migrating fish from locating the Holtwood tailrace, causing a temporary delay in upstream migration.

Table ~~1~~2. American shad upstream passage delays resulting as flow below the Muddy Run powerhouse increase (combined net flow resulting from flows Holtwood Dam and project operations at the Muddy Run Project, calculated from Sweka 2013).

Flow (cfs) below MR	Time (hours) Sicily Island to Deepwater Island
42,187	12
59,515	24
69,652	36
76,844	48

Sweka and Eyler (2013)[32] found that delays to upstream migration of American shad (*Alosa sapidissima*) at hydroelectric facilities can compromise their ability to successfully spawn by causing a mismatch between when shad arrive in suitable spawning habitat with optimal temperatures for spawning. Their model demonstrated that the passage efficiency and delays can have a large effect on the probability of shad reaching areas upstream of York Haven Dam when temperatures are optimal for spawning. This will in turn result in lower spawning success that leads to decreased juvenile fish recruitment to the Susquehanna River population which would be reflected in fewer mature adult fish returning to the river in future years. The impact of delay was also noted by the FERC (2004) when it stated "...Upstream-migrating fish may be delayed for hours or days searching for passage …This delay could reduce the fitness of spawning adults or the upstream extent of their migration."

Fish Entrainment

American Eel

[31] Gessler, D. and Sullivan, T. J. 2006. 2-D Numeric Modeling of Existing Flow Patterns and Velocities in the Susquehanna River Downstream of the PPL Holtwood Hydroelectric Project. Prepared for PPL Holtwood, LLC. By Alden Research Laboratory, Inc., December 2006.
[32] Sweka, J.A. and Eyler, S. 2013. Evaluation of Migratory Delays on the Success of American Shad in the Susquehanna River. Internal USFWS Report drafted December 6, 2013.

The licensee consultant Normandeau Associates Inc. (Normandeau 2012) study concluded that American eel entrainment at the Muddy Run Project was 7% percent for the tagged study fish. In the Department's assessment[33], a re-analysis of the original data used in the Normandeau 2012 study, we estimated the entrainment rate to be more than double (14.2%) that reported by Normandeau. The Department's modeled values are greater than the modeled value of 7% from Normandeau (2012) for two reasons. First, Normandeau (2012) only accounted for 41.7% of the migrating silver eel population which are assumed to pass by MRPS during the night time hours of 2200 – 0500. However, 58.3% of the population would be passing at other times of the day and there is still some level of pumping activity occurring at these other times, albeit lower. Second, the data provided in Table 5.3-1 of Normandeau (2012) showed that of the 38 eels exposed to pumping 30 were exposed to pumping when 1 – 4 units were pumping and 8 were exposed when 5 – 8 units were pumping. Although this was what occurred as these eels passed the MRPSP during the study, the relatively low sample size biased the data toward a situation which is not typical of what eels would experience during the course of an average day in October through November. Combining data in Tables 2.3-1 and 2.3-2 from Normandeau (2012) the proportion of time that 1 – 4 and 5 – 8 units are pumping is 21% and 32%, respectively. The ratio of these pumping times is approximately 2:3 and of the 38 eels exposed to pumping, 15 would be expected to be exposed when 1-4 units were running and 23 would be expected to be exposed when 5 – 8 units were pumping. Modeling entrainment rates as was done by the Department corrected for this bias in the data.

It can take up to 20 years for an American eel to mature in the Susquehanna River basin and begin its downstream migration out to the Atlantic Ocean to spawn and replenish the coastal population. An annual loss of 14% of the mature spawners at the Muddy Run project is substantial and will reduce the recruitment of juvenile eel to the Atlantic coastal population. This is compounded by the loss experienced by down migrating mature American eel at each of the other four lower Susquehanna River hydroelectric projects. If mortality at the other projects were similar to that estimated by Sweka for the Muddy Run Project the total mortality resulting from hydroelectric project passage on the lower Susquehanna River would be 53%.

American Shad

A similar re-assessment to Sweka (2013) was conducted by Don Pugh[34] for juvenile American shad entrainment data from the 2012 study conducted by Normandeau[35]. Normandeau estimated a juvenile shad entrainment rate of 9.4%. Pugh estimated higher entrainment rates from 10.3% to 13.8% and noted that the lower rates reported by Normandeau are due to the incorrect assignment of a high passage of shad during a period when Normandeau states that there was no pumping and consequently no entrainment. The Susquehanna River Anadromous Fish Restoration Cooperative adopted a target passage of 95 percent survival of juvenile alosines for

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[33] Sweka, J.A. 2013. American Eel entrainment at the Muddy Run Pump Storage Project. Internal USFWS Report drafted August 9, 2013.
[34] Pugh, D. 2013. Muddy Run Juvenile Shad Entrainment, Memo drafted June 29, 2013.
[35] Exelon 2012. Muddy Run RSP 3.3: Movement and Behavior of Telemetered Migrant American eels in the Vicinity of the Muddy Run Pump Storage Project. Prepared by Normandeau and Associates, Inc. with Gomez and Sullivan Engineers, P.C.

each hydroelectric facility on the Susquehanna River (SRAFRC 2010). All entrained fish are removed from the Susquehanna River and can no longer continue downstream migration.

A graphical review of the adult American shad entrainment information presented in the 2008 Normandeau radio telemetry study (Figure 2) revealed that all but one of the entrained adult American shad were entrained while the Muddy Run Project was pumping at a rate higher than the instream Susquehanna River flow passing through the Muddy Run Project area. Normandeau’s report notes that “…Virtually all shad entrained in the present study, based on time (early June) and prevailing water temperature (> 70° F, higher than the reported peak spawning temperatures of 65-68° F) were post-spawned.” And “…As in the previous study most entrainment occurred when MRPSS was pumping with 7 or 8 units (24,500 to 28,000 cfs) between 0100 and 1000 h in late May to early June.” We conclude that entrainment risks are highest for post-spawn American shad that are passing the Muddy Run Project area during pumping operations that are withdrawing more water than inflows from the upstream Holtwood Dam, usually when 7 to 8 units are pumping.

Two primary objectives of the Atlantic States Marine Fishery Commission’s (ASMFC) Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring are: to maximize the number of juvenile recruits emigrating from freshwater stock complexes; and to restore and maintain spawning stock biomass and age structure to achieve maximum juvenile recruitment. Similar objectives are also found in the SRAFRC plan for the Susquehanna River (SRAFRC 2010). Entrainment and its associated mortality at the Muddy Run Project are inconsistent with these objectives. American shad that spawn in the Susquehanna River are iteroparous (i.e., repeat spawners) and will attempt to migrate back downstream after the spawning season to reach the Atlantic Ocean where they can recover from the rigors of spawning, replenish egg and sperm reserves, and then return to the river in subsequent years and attempt to spawn again. Loss of these potential repeat spawners due to downstream passage mortality at hydroelectric projects not only reduces the spawning stock biomass but it also removes individual fish that have a proven ability to survive conditions in Chesapeake Bay/Atlantic Ocean and return to the Susquehanna as mature fish. They return as older larger fish that can produce more reproductive products (eggs and sperm) that can lead to higher juvenile recruitment per spawner.

The entrainment impacts on migratory adult American shad associated with the Muddy Run Project have been documented to occur during the downstream post-spawn outmigration period. The value of these out-migrants to restoration of American shad on the Susquehanna River warrants utmost protection of these fish during this phase of their life-cycle. If entrainment of out-migrating post-spawn American shad continues at the Muddy Run Project the licensee will need to consult with the Service regarding development of a plan for implementation of project operational measures and/or construction of facilities to avoid these impacts.

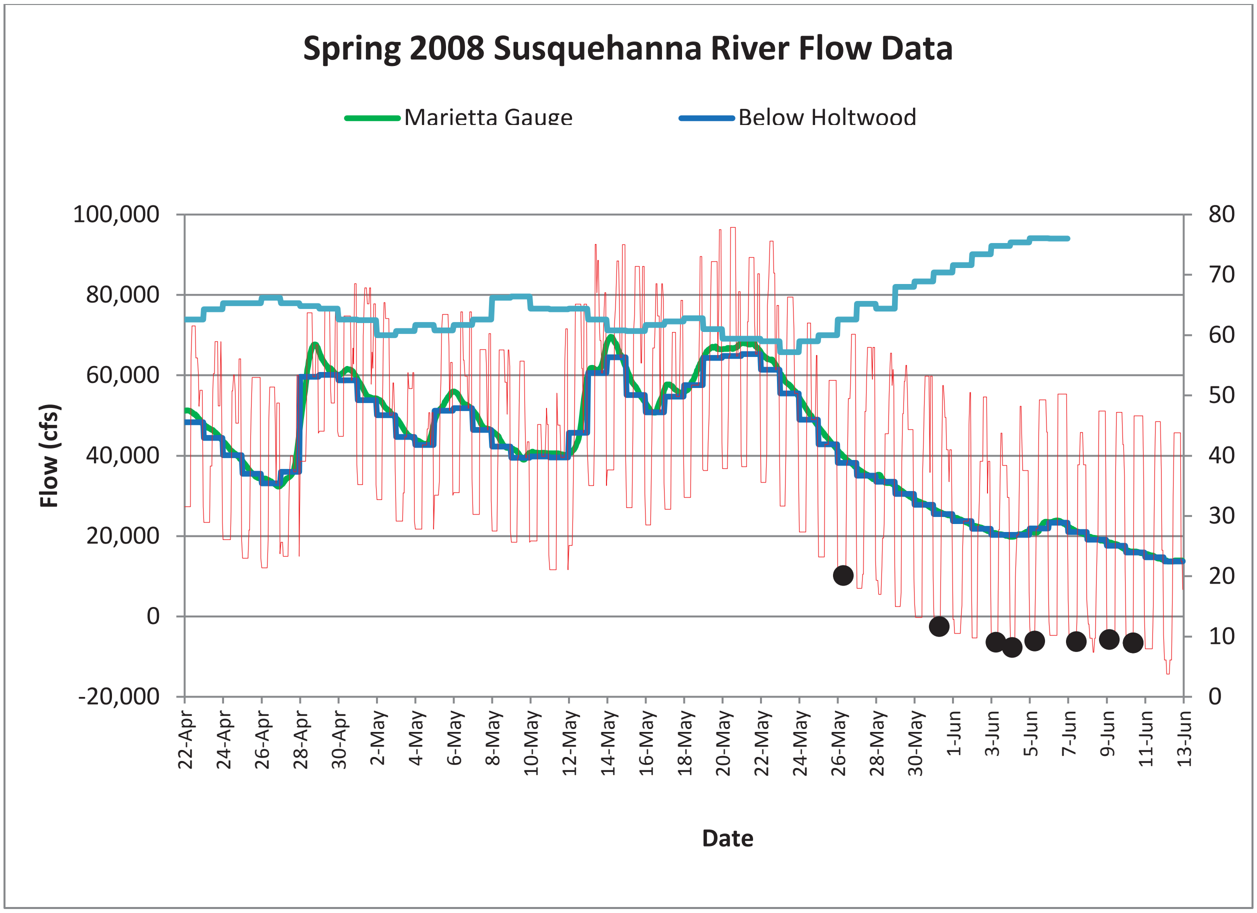

Figure ~~2~~3. Flows in the Susquehanna River during the 2008 Normandeau American shad migration study. Green line depicts natural river flows measured at the USGS Marietta Gauge Station (No. 01576000); Dark Blue line depicts flows from the Holtwood Dam just upstream of the Muddy Run Project (generation and spillage combined); Red line depicts flows below the Muddy Run Project (Holtwood discharge combined with Muddy Run operation), flow less than zero indicates that the Muddy Run Project is pumping more water than is available from Susquehanna River basin inflow from upstream of the project; Light Blue line depicts river temperature in degrees F (right axis) measured at Conowingo Dam; and the black circles depict the time when migrating American shad were entrained at the Muddy Run Project.

Alternatives Considered

In development of this preliminary prescription for the Muddy Run Project both upstream and downstream fish passage alternatives for anadromous and catadromous fish were analyzed.

Engineered Facilities and Structures

The Department considered engineered facilities and structures (e.g., intake screens, instream flow diverters and baffles), and the associated project operations and measures to eliminate or substantially reduce project operational impacts to migratory fish attempting to pass the Muddy Run Project area. These facilities and structure would require considerable time and expense to install. Post-construction measures would be required to evaluate the effectiveness of the structures and facilities to in achieve the desired level of protection, and to tune their operation. The facilities and structures would have to be designed to have a large enough intake area to allow approach velocities to be low enough to avoid impingement of fish during pumping. The Department is not requiring engineered facilities or structures at this time.

Operational Measures

The Department's assessment of Muddy Run Project impacts on migratory fish indicate that impacts are the direct result of projects generation discharge and pumping withdrawal flows. These impacts can be reduced by regulating operational activities during the annual periods of anadromous and catadromous fish migration. Limits on generation and pumping would be implemented upon license issuance and have the immediate positive effect on improving safe, timely, and effective migration of fish through the zone of passage in the Muddy Run Project area.

The Department considered requiring fish passage operational measures to eliminate upstream migratory passage delays and fall back; and downstream passage entrainment. These measures include reducing generation discharge during the upstream migration period as follows: when natural Susquehanna River flow as measured at the USGS Marietta gauge are less than 70,000 cfs (70,000 cfs flow is the flow shown to be delay the ability of American shad to migrate upstream by 36 hours or more); total flows downstream of the Muddy Run Project should be no greater than 70,000 cfs. This will limit the combined flow downstream of the Muddy Run Project to 70,000 cfs or less which would result in an average migration delay at the Muddy Run Project of 36 hours.

The pumping withdrawal during the downstream migration periods would be as follows: when natural Susquehanna River flow measured at the USGS Marietta gauge is less than 28,000 cfs (i.e., the maximum powerhouse pumping capacity), then the maximum flow withdrawn for pumping will be no more than the natural river flow measured at Marietta, minus 5,000 cfs. This will allow an instream flow of 5,000 cfs to pass by the Muddy Run Project, eliminate reverse flow conditions, and provide a downstream migration flow for fish. As an example, if the measured flow at Marietta is 25,000 cfs, the pumping withdrawal for the Muddy Run Project would be 25,000 cfs – 5,000 cfs = 20,000 cfs.

Pennsylvania Department of Environmental Protection 401 Conditions

Below is an excerpt of PA DEP's Proposed 401 Water Quality Certification (Section 401 of the Federal Clean Water Act) as pertains to upstream and downstream fish passage for anadromous and catadromous fish at the Muddy Run Project. The Proposed 401 Water Quality Certification was noticed on December 21, 2013 by the PA DEP for a 30-day public comment period prior to final action on the certification. Once finalized by the PA DEP the terms and conditions contained in the Final 401 Water Quality Certification will become terms and conditions of the any FERC license issued for the Muddy Run Project. Therefore, the Department considered the 401 Water Quality Certification terms and conditions as they pertain to fish passage as an alternative for consideration.

FISH PASSAGE

A. General Requirements

1. Fish Passage Operating Procedures ("FPOP")

a. By January 15, 2015, EXELON shall submit a FPOP to the DEP for review and approval. The FPOP will describe existing baseline operations during fish passage season, including schedules for routine maintenance, procedures for routine operation (including: seasonal and daily periods of operation, pump and turbine operations), sequencing of pump and turbine start-up and operation, procedures for monitoring and reporting flows, procedures for monitoring and reporting on the operation of the facility, procedures for start-up and shut-down, and procedures for use in case of emergencies and project outages significantly affecting the conditions of this certification.

b. EXELON shall implement the FPOP consistent with the approval of the DEP. EXELON shall provide written documentation to the Resource Agencies that operational personnel have reviewed and understand the FPOP signed by the operations manager of the Project.

c. Copies of the approved FPOP and all modifications will be provided to the Resource Agencies.

d. By December 31 of each year, EXELON shall provide an annual report to the Resource Agencies detailing: the implementation of the FPOP, including any deviations from the FPOP and a process to prevent those deviations in the future; any proposed modifications to the FPOP, or in the case of emergencies or project outages, the steps taken by EXELON to minimize adverse effects on fisheries including any proposed modifications to those steps to further enhance their effectiveness in the future. EXELON shall offer to meet with the Resource Agencies by January 31 of each year unless a different date is mutually agreed upon by EXELON and the Resource Agencies. Any required modifications to the FPOP shall be submitted to the Resource Agencies within 45 days of receipt of a request for the modification unless a longer period is approved by the DEP. The modifications to the FPOP shall be implemented consistent with the approval of the DEP. In the event EXELON fails to submit the modifications as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish modifications and EXELON shall implement the modifications consistent with the approval of the DEP.

B. American Shad Passage

1. Upstream Shad Passage

a. Cooperation with Holtwood. If the Holtwood Hydroelectric Facility fails to meet its Tier I upstream shad passage target described and included in the 401 Water Quality Certification for the Amended Holtwood Hydroelectric Facility, and DEP determines that EXELON's operation of the Muddy Run Project is a proximate cause of Holtwood failing to meet the Tier 1 target, EXELON shall meet with the Resource Agencies to establish and implement a plan and schedule for a radio telemetry study or equivalent (Tier II Study) of American shad passage and behavior within the Muddy Run project boundary. This meeting shall occur within one month of the DEP's determination that Holtwood failed to meet its Tier 1 upstream shad passage target or such longer time as established by the DEP in writing.

b. Evaluation of Muddy Run Shad Passage. If EXELON is a proximate cause of Holtwood's failure to meet its Tier I upstream shad passage target, EXELON shall develop a radio telemetry study plan and schedule or equivalent to determine: (1) the percentage of American shad that enter Muddy Run project at the northern tip of Sicily Island area and subsequently exit the Muddy Run project area at the southern tip of Deepwater Island; and (2) any delay or impedance of shad passage attributable to the redevelopment of the Holtwood Facility. EXELON shall coordinate development of this plan with the Holtwood Hydroelectric Facility and the Conowingo Hydroelectric Facility. The radio telemetry study shall be designed to insert the transmitter at the Conowingo facility or at such other location(s) approved by the DEP.

c. Within two months of the meeting described in Paragraph III.B.1.a. or such longer period approved by the DEP in writing, EXELON shall submit the fish passage study plan and schedule to the Resource Agencies for review and approval by DEP. EXELON shall implement the plan according to the schedule therein and consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP. EXELON shall continue implementation of fish passage study for a minimum of four years or such other time period as required by the DEP in consultation with the other Resource Agencies. EXELON shall provide an annual report of the monitoring results of fish passage study by December 31st of each year.

d. At the end of the four-year study period, or such longer time as established by the DEP, if the results indicate that, as a result of Muddy Run operations, less than 88% of the American shad that enter the Muddy Run project waters at the northern tip of Sicily Island exit the Muddy Run project waters at the southern tip of Deepwater Island, EXELON shall propose a plan and schedule for operational modifications to enhance fish passage at the project. EXELON shall not be responsible for mitigating any impacts attributable to PPL Holtwood. This plan and schedule shall be submitted to the DEP as an amendment to the FPOP for the following year. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

e. The average of the two highest years in the monitoring period will be used determine whether the 88% fish passage percentage is achieved. If EXELON implements operational modifications, only those years following the operational modifications shall be considered to determine whether the 88% passage percentage is achieved.

f. If at the end of the monitoring period, or such longer time as established by the DEP, the results indicate that the operational modifications have resulted in less than 88% of the American shad that enter the Muddy Run project waters pass through the Project, EXELON shall propose a plan and schedule for mitigation, as defined in 25 Pa. Code Section 105.1 for the failure to achieve the 88% fish passage target. This mitigation shall be: (1) in addition to the compensatory mitigation described in this certification; and (2) reasonably related and proportional to the identified impact. This plan and schedule shall be submitted to the Resource Agencies within 6 months from the end of the monitoring period. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

2. Downstream Shad Passage

a. Consistent with the relicensing studies for Muddy Run, by January 15, 2015, EXELON shall submit a plan and schedule to provide for 95% survival of the juvenile American shad and 80% survival of the adult American shad that pass through the project area. The schedule shall provide for full implementation of the plan by 2015. EXELON shall implement the approved plan and schedule. If EXELON fails to submit the plan, the DEP shall develop a plan and schedule, in consultation with the other resource agencies, and EXELON shall implement that plan and schedule.

b. By February 15, 2026 or such later date approved by the DEP in writing, EXELON shall submit a plan to measure the passage of American shad moving downstream past the project to the DEP for approval ("Discrete Passage Study"). EXELON shall implement the plan to measure the passage of American shad moving downstream past the project according to the schedule and consistent with the approval of the DEP ("Discrete Passage Study"). In the event EXELON fails to submit the plan and schedule required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

c. EXELON shall, in accordance with the plan, conduct the Discrete Passage Study. EXELON shall provide a report of the Discrete Passage Study within 180 days of its completion or such later date approved by the DEP in writing to the Resource Agencies.

d. If the results of the Discrete Passage Study indicate that EXELON can operate the Muddy Run project so that EXELON achieves at least 95% passage of the juvenile American shad and 80 % passage of the adult American shad that pass through the project area based on the likelihood of a shad being exposed to typical pumping operations and becoming entrained, then EXELON shall incorporate into the annual FPOP any required operational measures or protocols to meet the established percentages. These procedures will be subject to review at the annual meeting for the FPOP.

e. If the results of the Discrete Passage Study do not indicate that the project can be operated to achieve at least 95% passage of juvenile American shad and 80% passage of adult American shad based on the likelihood of a shad being exposed to typical pumping operations and becoming entrained, EXELON shall propose a plan and schedule for mitigation, as defined in 25 Pa. Code Section 105.1, for the failure to achieve the fish passage target or targets. This mitigation shall be: (1) in addition to the compensatory mitigation described in this certification; and (2) reasonably related and proportional to the identified impact. This plan and schedule shall be submitted to the Resource Agencies within 6 months from the end of the monitoring period or such later date approved by the DEP in writing. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

C. Eel Passage

1. Upstream Eel Passage

The terms and conditions of the EXELON Generation American Eel Passage Plan for the Muddy Run Pumped Storage Hydroelectric Project (P-2355), attached hereto as Appendix 1 (*Appendix 3 of the Department's Fish Pasage Prescription*), are incorporated as if fully set forth herein.

2. Downstream Eel Passage

a. The trigger date for initiation of downstream eel passage studies shall be the date on which the DEP, in consultation with the other Resource Agencies, determines that available data indicates that eels are present upstream of the project or other upstream areas in numbers appropriate to require downstream eel passage. 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.

b. EXELON shall achieve at least 85% eel passage through the project area based on the likelihood of an American eel being exposed to typical pumping operations and becoming entrained.

c. Within six months of the trigger date in Paragraph (a), or such later date approved by the DEP in writing, EXELON shall submit a plan to conduct a passage study to the Resource Agencies. The plan shall be designed to demonstrate continued compliance with the 85 % fish passage target. The plan shall include radio telemetry studies or such other studies approved by the DEP in consultation with the other Resource Agencies. EXELON shall implement the plan according to the schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

d. The study shall be initiated within 1 year of the trigger date unless a different time frame is approved by the DEP in writing. EXELON shall provide a report of the study results within 180 days of the date of completion of the study.

e. If the results of a discrete passage study indicate that EXELON can operate the project so that EXELON achieves at least 85% passage of the American eel that pass through the project area based on the likelihood of an American eel being exposed to typical pumping operations and becoming entrained, EXELON shall incorporate into the FPOP any operational measures needed to meet this percentage. These procedures will be subject to review at the annual FPOP meeting.

f. If the results of the studies do not indicate that the project can be operated to achieve at least 85% passage of American eel based on the likelihood of an American eel being exposed to typical pumping operations and becoming entrained, EXELON shall propose a plan and schedule for mitigation, as defined in 25 PA. Code Section 105.1, for the failure to achieve the 85% eel passage target. This mitigation shall be: (1) in addition to the compensatory mitigation described in this certification; and (2) reasonably related and proportional to the identified impact. This plan and schedule shall be submitted to the Resource Agencies within 6 months from the end of the monitoring period or such later date approved by the DEP in writing. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

Reservation of Authority to Prescribe Fishways

In order to allow for the timely implementation of fishways, including effectiveness measures, the Department proposes to reserve its authority by requesting that the Commission include the following condition in any license it may issue for the Project:

> *Pursuant to section 18 of the Federal Power Act, the Secretary of the Interior herein exercises her authority under said Act by reserving that authority to prescribe fishways during the term of this license and by prescribing the fishways described in the Department of the Interior's Prescription for Fishways at the Muddy Run Project.*

Preliminary Prescription for Fishways

Pursuant to section 18 of the Federal Power Act, as amended, the Secretary of the Department of the Interior, as delegated to the Service, proposes to exercise her authority to prescribe the construction, operation and maintenance of such fish passage facilities and measures as deemed necessary, subject to the procedural provisions contained above.

The Department's Preliminary Prescription for Fishways reflects a number of issues and concerns related to fish restoration and passage that have been raised by the applicant, Commission staff, State resource agencies, and other parties involved in these proceedings.

Fish passage facilities and or measures shall be constructed, operated, and maintained to provide safe, timely and effective passage for American shad, alewife, blueback herring, American eels and other designated resident riverine fish species at the licensee's expense.

To ensure the immediate and timely contribution of the fish passage facilities and measures to the ongoing and planned anadromous and catadromous fish restoration and enhancement program in the Susquehanna River, the following are included and shall be incorporated by the Licensee to ensure the effectiveness of the fishways pursuant to section 1701(b) of the 1992 National Energy Policy Act (P.L. 102-486, Title XVII, 106 Stat. 3008).

Fish Passage Requirements

Design Populations

American Shad

The design population at the Project for American shad is derived from the *1993 Settlement Agreement for the Development of Fish Passage Facilities at the Holtwood, Safe Harbor, and York Haven Projects on the Susquehanna River*[36]. Pursuant to that agreement the existing fishway at the Holtwood Dam immediately upstream of the Muddy Run Project was designed to pass 2,700,000 American shad. That same number of shad is the design population for the

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[36] Settlement Agreement. June 1, 1993. Pennsylvania Power & Light Company, Safe Harbor Water Power Corporation, and York Haven Power Company, AND U.S. Fish and Wildlife Service – U.S. Department of the Interior, Pennsylvania Fish and Boat Commission, Pennsylvania Department of Environmental Resources, Maryland Department of Natural Resources, Susquehanna River Basin Commission, Upper Chesapeake Watershed Association, and Pennsylvania Federation of Sportsmen's Clubs.

Muddy Run Project, as there is no spawning habitat between the two dams, and all fish need to continue migration upstream past Muddy Run Project to account for any migration fallout while attempting to pass through upstream hydroelectric projects.

Delays to upstream migration of American shad at hydroelectric facilities can compromise their ability to successfully spawn[37] through increasing energetic costs and causing a mismatch between when shad arrive in suitable spawning habitat and optimal temperatures for spawning. The Service developed a model to evaluate how rates of upstream shad migration (proportion of shad passed in a given number of hours) in the Susquehanna River affect the timing of when shad arrive in suitable spawning habitat upstream of York Haven Dam relative to optimal temperatures for spawning. Shad that reached areas above York Haven Dam prior to a time when temperatures would exceed those that are optimal for spawning were considered to have successful migrations.

The model estimated 97% of shad had successful migrations if there were no impediments (delays) to migration. As the number of hours to pass shad increased at each hydroelectric facility, successful migration approached 0% when delay times at a given facility reached 168 hours (7 days). The rate of passage in terms of percentage passed per time is also an important factor when determining the impact of migratory delays (USFWS 2013c). To minimize the impact of migratory delays on spawning success for migrating adult American shad, the Service is requiring successful passage of 80% of adult American shad at each project within 36 hours of arrival to the Project in addition to the SRAFRC Management Plan (2010) requirement of 85% overall upstream passage effectiveness for adult American shad[38].

Therefore American shad passage at Muddy Run Project shall be adequate (target number passed with minimal delay) so as not to interfere with passage objectives and targets established for the Susquehanna River. If fish passage monitoring require in this prescription indicates that American shad are not meeting the target passage of 80% of adult American shad at each project within 36 hours at the Muddy Run Project the licensee will need to consult with the Service regarding development of a plan for implementation of project operational measures and/or construction of facilities that will meet the passage target.

River Herring (Alewife and Blueback Herring)

The design population at the Project for river herring is derived from the *1993 Settlement Agreement for the Development of Fish Passage Facilities at the Holtwood, Safe Harbor, and York Haven Projects on the Susquehanna River*, and the existing fishway at Holtwood was designed to pass 10,00,000 river herring.

As such river herring passage at Muddy Run Project shall be adequate so as not to interfere with passage objectives and targets at the Holtwood Hydroelectric Project immediately upstream of

[37] Federal Energy Regulatory Commission, Division of Hydropower Administration and Compliance, Office of Energy Projects, 2004. Evaluation of Mitigation Effectiveness at Hydroelectric Projects: Fish Passage. September 2004.
[38] *Id* at 32.

the Muddy Run Project, or the Conowingo Hydroelectric immediately downstream of the Muddy Run Project.

American Eel

American eel do not currently have access to Project waters due to a lack of upstream passage at the Conowingo Hydroelectric Project located downstream, but the Department anticipates that passage to the Muddy Run Project area for juvenile eels will shortly become available through passage past the Conowingo Hydroelectric Project for migrating eels. While the Department does not have a precise estimate of the numbers of eels that would be expected to pass through the Muddy Run Project area, measures to achieve safe, timely and effective passage past the Muddy Run Project would enhance the eel stocks and help achieve overall management goals of federal and state resource agencies.

As such American eel passage at Muddy Run Project shall be adequate so as not to interfere with passage objectives at the Holtwood Hydroelectric Project immediately upstream of the Muddy Run Project, or the Conowingo Hydroelectric immediately downstream of the Muddy Run Project. The *American Eel Restoration Plan for the Susquehanna River Basin* (SRAFRC 2013) states that all available eel seeking passage at a hydroelectric project be passed upstream (i.e. no impact), and that there be 85% downstream passage survival at each hydroelectric project.

Fish Passage Operating Periods

Regarding the timing of seasonal fish passage operations, fish passage facilities and measures shall be maintained and operated, at the licensee's expense, to maximize fish passage effectiveness throughout the upstream and downstream migration periods for American shad, alewife, blueback herring, American eel, and designated riverine fish.

Table ~~1~~3: Upstream and downstream migration periods for species covered in this Prescription for Fishways. *

Species	**Upstream Migration Period**	**Downstream Migration Period**
American shad	April 1 through June 15	July 1 through November 15 (juv.) April 15 through July 1 (adult)
Alewife & Blueback herring	March 1** through June 15	June 15 through October 14 (juv.) April 15 through July 1 (adult)
American eel	May 1 through September 15***	September 15–February 15, whenever river temperature is above 37 degrees F ****

* Any of these migration periods may be changed during the term of the license by the Department, based on new information, and in consultation with the other fishery agencies and the licensee.

** This operational period is based on preliminary data on Alewife migration timing from other tributaries to the Chesapeake Bay (Sutherland 2000, Eyler et al. 2002, Slacum 2003).

***This initial operational period is based on preliminary data on American eel migration timing from other tributaries to the Chesapeake Bay.

**** The Department is requiring the licensee to study the magnitude and timing of downstream eel migration through the project so that the effectiveness of the reduced period can be evaluated. This initial operational period is based on preliminary data on American eel migration timing from other tributaries to the Chesapeake Bay (Welsh et al. 2009).

Fish Passage Operating Procedures

The timely and proper implementation of the fish passage measures is necessary to ensure the effectiveness of such measures. Therefore, the Department's Prescription includes the express requirement that the licensee develop Fish Passage Operating Procedures (FPOP) for implementation of operational measures during the migratory fish passage season.

By January 15, 2015, the licensee shall submit a FPOP to the Department for review and approval. The FPOP will describe prescribed baseline operations during fish passage season, including schedules for routine maintenance, procedures for routine operation (including: seasonal and daily periods of operation, pump and turbine operations), sequencing of pump and turbine start-up and operation, procedures for monitoring and reporting flows, procedures for monitoring and reporting on the operation of the facility, procedures for start-up and shut-down, and procedures for use in case of emergencies and project outages significantly affecting the conditions of this prescription.

The licensee shall implement the FPOP consistent with the approval of the Department. The licensee shall provide written documentation to the Resource Agencies that operational personnel have reviewed and understand the FPOP signed by the operations manager of the Muddy Run Project.

Copies of the approved FPOP and all modifications will be provided to the Resource Agencies.

By December 31 of each year, the licensee shall provide an annual report to the Resource Agencies detailing: the implementation of the FPOP, including any deviations from the FPOP and a process to prevent those deviations in the future; any proposed modifications to the FPOP, or in the case of emergencies or project outages, the steps taken by the licensee to minimize adverse effects on fisheries including any proposed modifications to those steps to further enhance their effectiveness in the future. The licensee shall offer to meet with the Resource Agencies by January 31 of each year unless a different date is mutually agreed upon by the licensee and the Resource Agencies. Any required modifications to the FPOP shall be submitted to the Resource Agencies within 45 days or receipt of a request for the modification unless a longer period is approved by the Department. The modifications to the FPOP shall be implemented consistent with the approval of the Department. In the event the licensee fails to submit the modifications as required by this paragraph, the Department, in consultation with the other Resource Agencies, may establish modifications and the licensee shall implement the modifications consistent with the approval of the Department.

The Licensee shall prepare the plan after consultation with the U.S. Fish and Wildlife Service, the Pennsylvania Fish and Boat Commission, the Pennsylvania Department of Environmental Protection, and the Pennsylvania Department of Conservation and Natural Resources.

The Licensee shall include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies’ comments are accommodated by the plan. The Licensee shall allow a minimum of 30 days for the agencies and other interested organizations to comment and to make recommendations.

Inspection

The licensee shall provide personnel of the Department, and other Department-designated representatives, access to the project site and to pertinent project records for the purpose of inspecting the fish passage measures to determine compliance with the fish passage Prescription.

Consultation

The licensee shall develop in consultation with and submit for approval by the Department, all fish passage plans, schedules, and any supporting information to the fish passage measures described herein.

American Shad Passage

Fish Passage Facilities and Structures

As indicated under “Alternatives Considered” section above the Department is not requiring the installation of any engineered facilities or structures (e.g., intake screens, instream flow diverters and baffles) to eliminate or substantially reduce project operational impacts to migratory fish attempting to pass the Muddy Run Project area at this time.

Fish Passage Measures

The Department concluded that that impacts migrating American shad are the direct result of the Muddy Run Project generation discharge and pumping withdrawal flows; and these impacts could be reduced or eliminated by regulating these operational activities during the annual periods of anadromous and catadromous fish migration.

The Department is requiring that the licensee develop Fish Passage Operating Procedures (FPOP) as described in detail above. The FPOP shall describe the licensee’s proposed baseline operations during fish passage season, including schedules for routine maintenance, procedures for routine operation (including seasonal and daily periods of operation, pump and turbine operations), sequencing of pump and turbine start-up and operation, procedures for monitoring and reporting flows, procedures for monitoring and reporting on the operation of the facility, procedures for start-up and shut-down, and procedures for use in case of emergencies and project outages significantly affecting the conditions of this prescription.

American Shad Passage Monitoring

The FERC determined that the process of mitigating adverse environmental impacts should include an assessment of the effectiveness of the mitigation that is implemented, and that in most cases, successful mitigation is dependent upon the development of such effectiveness monitoring plans (FERC 2004). The licensee shall implement an American Shad Passage Monitoring Plan (ASPMP) approved by Department in order to monitor the effectiveness of upstream shad passage at the Muddy Run Project. Fish passage monitoring is (or will be) a condition of FERC license for the other four hydroelectric projects on the lower Susquehanna River. Each of the hydroelectric projects has engineered facilities or structures, and the associated project operations and measures as the primary form of upstream fish passage. Each of the existing upstream passage facilities is equipped with a fish counting window where the number and species of fish passaging the project can be visually enumerated by an observer during the fish passage season. These counts are used to monitor the effectiveness of fish passage facilities at the FERC licensed hydroelectric project.

Since there are no engineered upstream fish passage facilities or structures at the Muddy Run Project provisions cannot be made for visual fish counts to monitor American shad passage at the Muddy Run Project. The only other method proven to be applicable to monitoring fish passage is tracking of a representative sample of migratory fish as was done during the licensee's 2008 and 2011 American shad radio telemetry study. FERC (2004) determined that a radio tagging study to estimate the proportion of fish that are passed upstream can be an appropriate method of assessing effectiveness, and that it is also an appropriate procedure for assessing the effectiveness of downstream passage.

Therefore the licensee monitoring plan shall include execution of the radio telemetry monitoring similar to that conducted in 2008 for adult American shad, and in 2011for juvenile American shad by the licensee's consultant, unless some other technique is approved in advance by the Service. The monitoring measures contained in the ASPMP shall be conducted during the 2018 fish passage season, and be repeated every ten years thereafter for the term of any new FERC license that may be issued for the project.

The licensee shall implement the ASPMP consistent with the approval of the Department. The licensee shall provide written documentation to the Resource Agencies that operational personnel have reviewed and understand the ASPMP signed by the operations manager of the Muddy Run Project.

Copies of the approved ASPMP and all modifications will be provided to the Resource Agencies.

By December 31 of each year in which studies are done, the licensee shall provide an annual report to the Resource Agencies detailing: the implementation of the ASPMP, including any deviations from the ASPMP and a process to prevent those deviations in the future; any proposed modifications to the ASPMP, or in the case of emergencies or project outages, the steps taken by the licensee to minimize adverse effects on fisheries including any proposed modifications to those steps to further enhance their effectiveness in the future. The licensee shall offer to meet with the Resource Agencies by January 31 of each year unless a different date is mutually agreed upon by the licensee and the Resource Agencies. Any required modifications to the ASPMP shall be submitted to the Resource Agencies within 45 days or receipt of a request for the modification unless a longer period is approved by the Department. The modifications to the ASPMP shall be implemented consistent with the approval of the Department.

The Licensee shall prepare the ASPMP after consultation with the U.S. Fish and Wildlife

Service, the Pennsylvania Fish and Boat Commission, the Pennsylvania Department of Environmental Protection, and the Pennsylvania Department of Conservation and Natural Resources.

The Licensee shall include with the ASPMP documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the ASPMP. The Licensee shall allow a minimum of 30 days for the agencies and other interested organizations to comment and to make recommendations.

The licensee shall meet with the Resource Agencies to discuss the results of the above ASPMP. The results of this study will be used to determine the need for and form of any additional fish passage measures or facilities. If the ASPMP results indicate that the Muddy Run Project is not meeting the passage goals prescribed herein, the licensee must propose measures calculated to meet the goals, and shall implement such measures upon approval by the Service, Pennsylvania DEP, and FERC, as needed. The licensee shall provide daily updates of monitoring results to the Resource Agencies. The licensee shall provide an annual report of the monitoring results to the Resource Agencies by December 31st of each year.

Downstream American Shad Passage Monitoring

The ASPMP described above will be used to monitor the downstream passage of adult out-migrating post-spawn American shad and assess the effectiveness of downstream passage measures at the Muddy Run Project. If the ASPMP results indicate that the Muddy Run Project is not meeting the passage goals prescribed herein, the licensee must propose measures calculated to meet the goals, and shall implement such measures upon approval by the Service, Pennsylvania DEP, and FERC, as needed.

American Eel Passage

Eel Passage Measures

For the catadromous American eel the licensee proposes to work with other licensees on the Susquehanna River to implement both an upstream and downstream trap-and-transport program to provide American eel passage for upstream migrating juveniles and downstream migrating adults between the Conowingo and York Haven dams. No specific plans for the program were provided in the Muddy Run Project Draft License Application. However the PA DEP Proposed 401 Water Quality Certification requires the implementation of trap and transport for juvenile American eel migrating upstream. We generally consider trap-and-transport to be an interim fish passage measure during the initial phase of a river restoration, and is appropriate for these initial stages, therefore this Prescription provides specific plans for a trap and transport program. As restoration efforts for American eel on the Susquehanna River progress, the capacity of PA DEP proposed trap-and-transport operation to move sufficient numbers of eel upstream will likely be exceeded and additional facilities and measures may be needed to accommodate adequate, safe, timely and effective passage through the Muddy Run Project area.

The licensee will need to develop a plan to assess placement, design and installation of facilities and measures needed to capture eel and provide safe, timely and effective eel passage past the Muddy Run Project. The plan should also include a description of studies to test the effectiveness of eel trap-and-transport as an interim means of passage at the Muddy Run Project. The licensee should develop this plan in consultation and cooperation with the Department and state resource agencies and provide it to the Department and state resource agencies for review and approval before submitting it to the FERC for its review and approval. This American Eel Passage Plan ("Eel Plan") is a condition of, and incorporated into this fish passage prescription.

To inform implementation of the Eel Plan, the licensee will establish an Eel Passage Advisory Group (EPAG) within 6 months of license issuance. EPAG will be chaired by the licensee and composed of a representative from each of the following (collectively, the "Resource Agencies"): the United States Fish and Wildlife Service (Service), Pennsylvania Department of Environmental Protection (PADEP), Pennsylvania Fish and Boat Commission (PFBC), the Maryland Department of Natural Resources (MD DNR), and the Susquehanna River Basin Commission (SRBC). Each designated representative shall be knowledgeable of American eel, the Susquehanna River, ongoing fisheries and other related resource programs being implemented in the Lower Susquehanna River (e.g., American shad restoration).

Consistent with the implementation plan set forth below, the licensee will trap and hold immigrating juvenile American eels from a point downstream of the Muddy Run Project, and transport them to designated points in the Susquehanna River watershed consistent with the level of effort established and described in the plan.

Trapping

Subject to required regulatory approvals, the licensee will design, install and operate eel trapping facilities according to the following schedule, unless an alternative schedule is approved by the Department in writing. In the event that the Resource Agencies or FERC determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, the licensee shall submit to the Department, the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications for a trapping facility at a location downstream of the Muddy Run Project to the Resource Agencies and FERC within one year of license issuance;
2. Hold preconstruction meeting with the Resource Agencies and Service within 150 days of approval of the design plans and designs by FERC, the Resource Agencies and Department;
3. Begin construction within 180 days of receipt of approval of the design plans and specifications by the Resource Agencies and the Department;
4. Begin operation on May 1 after construction is completed or immediately if construction is completed during the upstream passage period for American Eel.

Beginning immediately after license issuance and until the licensee's trapping facilities are completed, the licensee will work with the Service to trap eels using the Service trapping facility and will assist in the financial support of the Service trapping facility through a payment of $20,000 per year to an entity approved by the Department with the capability of providing financial support to the Service's Maryland Fisheries Resource Office for the eel trapping program. This payment will be made by April 1 of each year. Immediately upon license issuance the licensee will participate in this effort using the Service facilities, including the Service trapping facility, tanks and trucks. Beginning May 1 the first year after license issuance, the licensee will use its own holding and transport facilities and continue working with the Service to trap eels using the Service's trapping facility. The licensee will begin operating the program independently, subject to the Service supervision and input, using its own trapping facility when construction of that facility is completed.

Subject to required regulatory approvals, the licensee also will design, install and operate additional temporary eel trapping facilities downstream and upstream of the Muddy Run Project or at alternative locations approved by the Department in writing according to the following schedule, unless an alternative schedule is approved by the Department in writing. In the event that the Resource Agencies, FERC, or the Department determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, the licensee shall submit to the Department, the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Conduct field evaluation using visual observation, electrofishing and other methods approved by the Department and the Resource Agencies, in writing, to evaluate and rank trapping locations beginning on 1 May after construction is completed or immediately if construction is completed during the upstream passage period for American eel;
2. Submit complete design plans and specifications to the Resource Agencies by November 1withn the same year as field evaluations occurred;
3. Hold preconstruction meeting with Department and the Resource Agencies within 45 days of approval of the design plans and designs by FERC, and the Resource Agencies;
4. Begin construction within 90 days of receipt of approval of the design plans and specifications by Department and the Resource Agencies;
5. Begin operation by May 1 the year after field evaluations occur.

If, after three years of operation, the Department in consultation with EPAG determines the temporary eel trapping facility is successful, the licensee will design, install, and operate a permanent eel trapping facility at this location in accordance with a schedule established by Department in consultation with the other Resource Agencies.

If, after three years of operation, the Department in consultation with EPAG determines the temporary eel trapping facilities for juvenile eels are unsuccessful, site-determination studies for an additional permanent trap will be performed beginning the following May. Congregations of juvenile eels will be documented visually via bi-weekly nighttime surveys during the migration period; the locations surveyed will focus on areas that will allow for the collection of eels before they are exposed to impacts associated with the Muddy Run Project (i.e., generation and/or pumping flows). Based on the results of the site-determination studies, the licensee will design, install, and operate temporary mobile traps to inform the potential location of one additional permanent eel trapping facility. Temporary exploratory traps will be installed and operated at up to five locations determined by the Resource Agencies and the Department for a period of one to two additional years, in order to assess the ability to collect sufficient numbers of juvenile eels for the eel passage program. Collection facilities for the temporary site determination study will be similar to those used in the 2011 and 2012 studies conducted by the licensee for the Conowingo Hydroelectric Project.

Based on the results of the site-determination studies, the licensee, in consultation with EPAG, will determine if and where an additional permanent eel trap is justified in support of the Eel Passage Program. If a decision is made after the second site determination study to install an eel trap at the selected location, unless a different date is established by the Resource Agencies and the Department, that trap will be designed and constructed within one year of that determination, and operated beginning May 1 of the following year subject to required regulatory approvals. If a second year of study is needed, the dates would advance by a year.

The collection device(s) for the two permanent eel trapping facilities will consist of a ramp-style trap leading to a collection tank at the top of the ramp. The collection device(s) shall have a capacity to pass 50,000 eels over a 24 hour period accommodating a minimum size of 3 inches. One or more pumping systems will provide attraction flow at the entrance of the ramp, flow in the troughs to allow eels to climb the ramp, and water to the collection and holding tanks. The lower section of the ramp will be designed to have removable covers or grating to allow eels to enter at differing water surface elevations. The ramp will contain two side-by-side troughs to provide redundancy and allow for the potential use of different climbing media in each trough. For the ramp on the western shore, the entrance to the ramp will be designed to accommodate the normal range of tailwater elevation (El. 12 – 25 ft). The additional permanent collection facilities will contain elements of the facility on the western shore with the design modified to accommodate local conditions.

The trapping facilities will be operated continuously during the eel migration period from May 1 to September 15. The licensee will monitor and record days fished, hours fished and the weather. Daily counts of eels will be recorded. The method of counting under various capture scenarios will be developed in consultation with the EPAG. Temperature data will be obtained from Monitoring Station 643 (located approximately 0.6 miles below Conowingo Dam near the western shoreline) to examine river temperature in relation to catch rates of juvenile eels. Biweekly subsamples of collected eels will be examined for various life history parameters (e.g., length, weight, and condition factor). A portion of the subsampled eels will be sacrificed and examined for the presence of *Anguillicoloides crassus*. Some of the sacrificed eels will have the otoliths removed and retained for age analysis. *Anguillicoloides crassus* infection rates (proportion of eels infected), the number of parasites per eel, along with associated age, length, and weight data will be reported. Additionally, the licensee will pay to have 60 elvers/year sent to the Service or such other entity that the Department may approve in writing, for wild fish health screening. The screening shall occur once per year and can occur anytime during the eel upstream passage season.

Holding

Subject to required regulatory approvals, the licensee also will design, install and operate the holding facility for the traps according to the following schedule, unless an alternative schedule is approved by the Department in writing. In the event that the Resource Agencies, FERC, or the Department determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, the licensee shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications for holding facilities to the Resource Agencies within 1 year of license issuance;
2. Hold preconstruction meeting with Department and Service within 150 days of approval of the design plans and designs by FERC, Department and the Resource Agencies;
3. Begin construction within 180 days of receipt of approval of the design plans and specifications by Department and the Resource Agencies;
4. Begin operation by May 1, after construction is completed or immediately if construction is completed during the upstream passage period for American eel.

Periodically, consistent with standards established by the Department, and the Resource Agencies, eels will be transferred from the collection tank to the holding tank(s) where they will be held prior to being transported upstream. The holding tanks will have an automatically engaging back up pump and an alarm that sounds in a daily staffed location if the primary pump malfunctions. The holding tank will have continuous temperature, dissolved oxygen and gallon/minute water exchange monitoring devices with alarms that sound in a daily staffed location if levels of any parameter are outside of established limits. Upon observation, dead eels will be removed, enumerated, and reported. The holding tank shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by the Department in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks

Transport

Subject to required regulatory approvals, the licensee will design, construct and operate vehicle(s) to transport eels from the trap facilities according to the following schedule, unless an alternative schedule is approved by the Department in writing. In the event that the FERC, the Resource Agencies, or the Department determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, the licensee shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications to the Resource Agencies and FERC within one year of license issuance;
2. Begin construction within 180 days of receipt of approval of the design plans and specifications by the Department and the Resource Agencies;
3. Begin operation by May 1, after construction is completed or immediately if construction is completed during the upstream passage period for American eel.

Transport of juvenile eels will occur as necessary based on the capacity of holding tanks at the eel trapping facilities. All eels shall be moved within 1 week of capture. Eels from the holding tank(s) will be transferred to a transport vehicle equipped with an insulated transport container(s) that will be covered and aerated. The transport vehicle(s) will have an automatically engaging back up pump and an alarm that sounds in the cab of the vehicle(s). The transport vehicle taken will have continuous temperature and dissolved oxygen monitoring devices with alarms that sound in the vehicle(s) if levels of any parameter are outside of established limits. The transport vehicle(s) shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by the Department in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks on the transport vehicle(s). These eels will be trucked to appropriate release locations on the same day of removal from holding. Upon observation, dead eels will be removed, enumerated, and reported.

Release

The licensee will release eels at locations identified by the Department in amounts consistent with the release information provided to and approved by the Resource Agencies in writing. Where feasible, eels will be released at public access locations. Unless otherwise directed by the Resource Agencies in consultation with EPAG, eels will be released: (1) at least one hour after sunset to promote eel dispersal and minimize predation; and (2) into at least three feet of water at multiple locations within designated release areas in order to avoid concentrations of eels that could become potential targets for increased predation. If necessary due to time limitations established by the Resource Agencies in writing, the licensee shall release eels at alternative locations to avoid mortality. The estimated number of eels released at each location will be documented in writing and on a GPS device capable of being mapped in a database as approved by the Resource Agencies. After release, any dead eels remaining in the transport vehicle or observed at the stocking locations will be removed, enumerated, and reported.

Any modification of, or revisions to, the release locations shall occur after consultation with EPAG and consistent with the approval of the Resource Agencies.

Quality Assurance/Quality Control

The licensee will develop a detailed quality assurance/quality control (“QA/QC) program according to the following schedule, unless an alternative schedule is approved by the Department in writing. In the event that the Resource Agencies, or the Department determine that additional information, revisions, or amendments are necessary to the QA/QC program then within 60 days of receipt of written notice, the licensee shall submit to the Resource Agencies and the Department such information, revisions or amendments unless a longer period of time is approved by the requesting agency in writing.

1. Submit a draft QA/QC program to the Resource Agencies for approval by April 15, of the year in which a new license is issued;
2. Implement the QA/QC program approved by the Department when trapping and transport begin.

Important parameters associated with trapping, collecting, holding, transport, release, and stocking will be recorded to assure and control the quality of various program elements. The collection of these data will assure that the program will be conducted according to design parameters, will adhere to sound scientific principles, and will allow for any necessary adjustments. The results of these quality assurance and quality control measures will be included in annual reports to the Resource Agencies and EPAG. Changes to the QA/QC procedures shall be submitted as requested by the Department, or the Resource Agencies in writing.

At a minimum, the QA/QC program shall provide:

- Detailed description of the eel trapping and holding process to achieve a minimum 95% survival rate.

- Detailed description of the eel transport process to achieve a minimum 95% survival rate.

- Collection facilities will be visually inspected daily to ensure proper operation.

- Design parameters for flows and key critical components (e.g. attraction flow, spray bar, collection tank) that will be measured weekly and qualitatively assessed daily to ensure that traps are operating within design parameters.

- Water temperature and dissolved oxygen and water exchange in the collection, holding, and transport tanks will be monitored continuously to ensure that water quality remains suitable for juvenile eels.

- Information on the periodic checks on the accuracy of the estimates of volumetric counts.

- Information on the cleaning and disinfection of the collecting, holding, and transportation tanks.

- Protocols for monitoring, removing, enumerating, and reporting eel mortality.

Reporting, Monitoring, and Periodic Evaluation

Reporting and EPAG Meetings

During the eel passage season, the licensee shall provide a daily email to designated members of EPAG describing the status of trapping and trucking at each facility, the numbers of eels trapped and transported, any deviations from normal facility operations, and the timing and substance of the resolution of any deviations.

On or before December 10 annually, the licensee will submit a report to EPAG summarizing data from the trapping, collection, holding, transport, and stocking components of the Eel Plan for the calendar year. This report will provide program data to EPAG at the earliest practicable date, and provide EPAG with an opportunity to inform development of the Annual Report. On or before January 15 of the following year, the licensee will file an Annual Report with EPAG that analyzes annual data, including results from QA/QC.

Upon request, the licensee will meet with EPAG on or before February 15 of each year in which the Annual Report is filed.

Periodic Evaluation

Every three years, unless a different period is established by the Department in writing beginning in in the year following issuance of a new license, the licensee will conduct stream segment evaluations through electrofishing or other method identified after consultation with EPAG. Representative stream segments will include tributaries and shorelines of the main-stem river. The licensee will propose locations and methods for this survey at least one year in advance to the Resource Agencies. The licensee shall implement the survey based on approval of the Department of the proposed locations and methods.

To implement the evaluations, eels will be captured by electrofishing, or other methods approved by the Department in consultation with the Resource Agencies. Sampling will be performed at block-netted transects along river shorelines and at block-netted segments of small tributaries using backpack electrofishing. The exact number, length, and location of transects sampled will be approved by the Department in consultation with EPAG. Associated water quality parameters such as temperature and dissolved oxygen, as well as habitat characteristics, including mussel numbers observed, will be collected at each sampling location.

During sampling, the number of eels captured will be documented and data will be collected from a representative subsample of eels. A subsample of captured eels larger than 200 mm will be tagged with Passive Integrated Transponder (PIT) tags and released. Sampled eels will be scanned for PIT tags and data from recaptured eels will be recorded and included in the annual report. Data will include a variety of life history characteristics (e.g., length, weight, and condition factor) that can be assessed to determine how well stocked eels are utilizing the river and tributaries. A portion of the subsample will be sacrificed and examined for age (otolith analysis), gender, and level of *Anguillicoloides crassus* infection. Eels that are not sacrificed for further analysis will be measured, weighed, and released.

Results of stream segment evaluations will be included in the Annual Report and will document dispersal of the stocked eels, estimate the approximate density of stocked eels, and evaluate the growth, condition, age, gender and level of infestation with *Anguillicoloides crassus* of stocked eels.

Downstream Eel Passage Monitoring

Licensee shall conduct of a downstream eel passage study to evaluate the timing, magnitude, duration, annual variation and environmental conditions associated with active migration of silver eels from tributaries stocked with elvers, through the lower Susquehanna River and past the Muddy Run Project to the Chesapeake Bay. This study will be conducted for at least two years and will begin three years after license issuance. The licensee shall submit a draft study plan for Department review and approval within one year of license issuance. The plan shall include details of how licensee will collect and radio tag adult silver eels from the upper Susquehanna Basin for this study. The plan will also detail how the licensee will deploy radio telemetry monitoring equipment in the vicinity of Muddy Run Project so as to adequately track movement of radio tagged eels through the project area.

Concurrently with the downstream eel passage study or at a later date as approved by the Department, the licensee will also conduct a Site-Specific Route of Passage Study to evaluate the entrainment rate of silver eels migrating in the vicinity of the Project. If the results of the Site-Specific Downstream Eel Passage Study indicate that the Project’s existing operating measures do not meet the downstream passage criteria (survival of 85% of silver eels passing the Project), the Licensee will prepare and submit a plan and schedule for evaluating the feasibility and costs of potential physical and/or operational modifications to the Project to facilitate downstream eel passage.

Correspondence Regarding the Preliminary Prescription for Fishways

Any written inquiries, comments or other correspondence related to this Preliminary Fish Passage Prescription for the Muddy Run Project should be sent to:

Field Supervisor, Chesapeake Bay Field Office
U.S. Fish and Wildlife Service
177 Admiral Cochrane Drive
Annapolis, MD 21401

Appendix 1. Scientific Names

American eel (*Anguilla rostrata*)
American shad (*Alosa sapidissima*)
alewife (*Alosa pseudoharengus*)
blueback herring (*Alosa aestivalis*)
hickory shad (*Alosa mediocris*)
Alabama shad (Alosa alabamae)
gizzard shad (*Dorosoma cepedianum*)
shortnose sturgeon (*Acipenser brevirostrum*)
Atlantic sturgeon (*Acipenser oxyrhynchus*)
striped bass (*Morone saxatilis*)
walleye (*Stizostedion vitreum*)
smallmouth bass (*Micropterus dolomieu*)
channel catfish (*Ictalurus punctatus*)

Appendix 2. Administrative Record

The Administrative Record is being filed electronically under a separate cover due to its size.

Appendix 3. Proposed Water Quality Certification Eel Management Plan

Exelon Generation
American Eel Passage Plan

Muddy Run Pumped Storage Hydroelectric Project (P-2355)

Table of Contents

I. Introduction

Pursuant to the Federal Power Act, Exelon Generation (Exelon) filed new license applications with the Federal Energy Regulatory Commission (FERC) in August 2012 for the Muddy Run Pumped Storage Hydroelectric Facility (Muddy Run) and the Conowingo Hydroelectric Project (Conowingo). This American Eel Passage Plan ("Eel Plan") is a condition of, and incorporated into, the Water Quality Certification for the Muddy Run Project. Under Section 401(d) of the Clean Water Act, the Eel Plan becomes a condition of the FERC license for the Muddy Run project.

II. Eel Passage Advisory Group

To inform implementation of the Eel Plan, Exelon will establish an Eel Passage Advisory Group (EPAG) by May 1, 2014. EPAG will be chaired by Exelon and composed of a representative from each of the following (collectively, the "Resource Agencies"): the Pennsylvania Department of Environmental Protection (PADEP), Pennsylvania Fish and Boat Commission (PAFBC), United States Fish and Wildlife Service (USFWS), the Maryland Department of Natural Resources (MDNR), and the Susquehanna River Basin Commission (SRBC). Each designated representative shall be knowledgeable of American eel, the Susquehanna River, and ongoing fisheries and other related resource programs being implemented in the Lower Susquehanna River (*e.g.*, American shad restoration).

III. Upstream Passage for American Eel (2015-2030)

Consistent with the implementation plan set forth below, Exelon will trap, hold and transport American eels from the Conowingo Dam and transport them to designated points in the Susquehanna River watershed consistent with the level of effort established and described in this plan. Any trapping, holding, transportation or monitoring of eels or other eel related activities addressed in this plan that occurs in Maryland waters is expressly subject to any permits, licenses or authorizations that may be required by the State of Maryland related to such activities.

A. Trapping

Subject to required regulatory approvals, Exelon will design, install and operate an eel trapping facility along the western shore of the Conowingo Dam at the location of the current USFWS trapping location and facility according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, USFWS or FERC determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, EXELON shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications for a trapping facility to the Resource Agencies and FERC by October 15, 2014;
2. Hold preconstruction meeting with MD and USFWS within 150 days of approval of the design plans and designs by FERC, MDNR and USFWS;
3. Begin construction within 180 days of receipt of approval of the design plans and specifications by the MDNR and USFWS;
4. Begin operation by May 1, 2016.

Beginning in 2014 and until Exelon's trapping facility along the western shore of the Conowingo Dam is completed, Exelon will work with the USFWS to trap eels using the USFWS trapping facility and will assist in the financial support of the USFWS trapping facility through a payment of $20,000 per year to an entity approved by the PADEP with the capability of providing financial support to the USFWS Maryland Fisheries Resource Office for the eel trapping program. This payment will be made by April 1 of each year. In 2014, Exelon will participate in this effort using USFWS facilities, including the USFWS trapping facility, tanks and trucks. Beginning May 1, 2015, Exelon will use its own holding and transport facilities and continue working with the USFWS to trap eels using the USFWS trapping facility. Exelon will begin operating the program independently, subject to USFWS supervision and input, using its own trapping facility when construction of that facility is completed.

Subject to required regulatory approvals, Exelon also will design, install and operate a temporary eel trapping facility on Octoraro Creek at a location approved by the PADEP in writing according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, FERC, PADEP or the USFWS determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, EXELON shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Conduct field evaluation using visual observation, electrofishing and other methods approved by the PADEP and USFWS, in writing, to evaluate and rank trapping locations on Octoraro Creek by September 15, 2014.
2. Submit complete design plans and specifications to the Resource Agencies by November 1, 2014;
3. Hold preconstruction meeting with PADEP and USFWS within 45 days of approval of the design plans and designs by FERC, PADEP and USFWS;
4. Begin construction within 90 days of receipt of approval of the design plans and specifications by PADEP and USFWS;
5. Begin operation by May 1, 2015.

If, after three years of operation, PADEP in consultation with EPAG determines the temporary eel trapping facility at Octoraro Creek is successful, Exelon will design, install, and operate a permanent eel trapping facility at this location in accordance with a schedule established by PADEP in consultation with the other Resource Agencies.

If, after three years of operation, PADEP in consultation with EPAG determines the temporary eel trapping facility at Octoraro Creek is unsuccessful, site-determination studies for an additional permanent trap will be performed beginning in 2017. Congregations of juvenile eels will be documented visually via bi-weekly nighttime surveys during the migration period; the locations surveyed will focus on the East Fish Lift area, the river banks and possibly lower-river tributaries, but will exclude the Conowingo Dam spillway. Based on the results of the site-determination studies, Exelon will design, install, and operate temporary mobile traps to inform the potential location of one additional permanent eel trapping facility. Temporary exploratory traps will be installed and operated at up to five locations determined by PADEP, MDNR and USFWS during 2018 and, if necessary, 2019, to assess the ability to collect sufficient numbers of juvenile eels for the eel passage program. Collection facilities for the temporary site determination study will be similar to those used in the 2011 and 2012 studies conducted by Exelon.

Based on the results of the site-determination studies, Exelon, in consultation with EPAG, will determine if and where an additional permanent eel trap is justified in support of the Eel Passage Program. If a decision is made in 2018 to install an eel trap at the selected location, unless a different date is established by the PADEP, MDNR and USFWS, that trap will be designed and constructed in 2019-2020, and operated beginning in 2021 subject to required regulatory approvals. If a second year of study is needed, the dates would advance by a year. Exelon will not be required to maintain and operate more than two permanent eel traps at any time during the term of the new license.

The collection device(s) for the two permanent eel trapping facilities will consist of a ramp-style trap leading to a collection tank at the top of the ramp. The collection device(s) shall have a capacity to pass 50,000 eels over a 24 hour period accommodating a minimum size of 3 inches. One or more pumping systems will provide attraction flow at the entrance of the ramp, flow in the troughs to allow eels to climb the ramp, and water to the collection and holding tanks. The lower section of the ramp will be designed to have removable covers or grating to allow eels to enter at differing water surface elevations. The ramp will contain two side-by-side troughs to provide redundancy and allow for the potential use of different climbing media in each trough. For the ramp on the western shore, the entrance to the ramp will be designed to accommodate the normal range of tailwater elevation (El. 12 – 25 ft). The additional permanent collection facility will contain elements of the facility on the western shore with the design modified to accommodate local conditions.

The trapping facilities will be operated continuously during the eel migration period from May 1 to September 15. Exelon will monitor and record days fished, hours fished and the weather. Daily counts of eels will be recorded. The method of counting under various capture scenarios will be developed in consultation with the EPAG. Temperature data will be obtained from Monitoring Station 643 (located approximately 0.6 miles below Conowingo Dam near the western shoreline) to examine river temperature in relation to catch rates of juvenile eels. Biweekly subsamples of collected eels will be examined for various life history parameters (*e.g.*, length, weight, and condition factor). A portion of the subsampled eels will be sacrificed and examined for the presence of *Anguillicoloides crassus.*[39] Some of the sacrificed eels will have the otoliths removed and retained for age analysis. *Anguillicoloides crassus* infection rates (proportion of eels infected), the number of parasites per eel, along with associated age, length, and weight data will be reported. Additionally, Exelon will pay to have 60 elvers/year sent to the USFWS or such other entity that the PADEP may approve in writing, for wild fish health screening. The screening shall occur once per year and can occur anytime during the eel upstream passage season.

[39] This introduced parasite has been documented in juvenile eels collected at Conowingo Dam (Minkkinen and Park 2012) and could affect the overall success of adult outmigration due to reduced swimming ability and potentially higher mortality of migrating silver eels (Szekely et al 2009).

B. Holding

Subject to required regulatory approvals, Exelon also will design, install and operate the holding facility for the west shore Conowingo Dam and the Octoraro Creek traps according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, FERC, PADEP or the USFWS determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, EXELON shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications for holding facilities to the Resource Agencies by April 15, 2014;
2. Hold preconstruction meeting with PADEP and USFWS within 150 days of approval of the design plans and designs by FERC, PADEP and USFWS;
3. Begin construction within 180 days of receipt of approval of the design plans and specifications by PADEP and USFWS;
4. Begin operation by May 1, 2015.

Periodically, consistent with standards established by the PADEP, MDNR and USFWS, eels will be transferred from the collection tank to the holding tank(s) where they will be held prior to being transported upstream. The holding tanks will have an automatically engaging back up pump and an alarm that sounds in a daily staffed location if the primary pump malfunctions. The holding tank will have continuous temperature, dissolved oxygen and gallon/minute water exchange monitoring devices with alarms that sound in a daily staffed location if levels of any parameter are outside of established limits. Upon observation, dead eels will be removed, enumerated, and reported. The holding tank shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by PADEP in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks.

C. Transport

Subject to required regulatory approvals, Exelon will design, construct and operate vehicle(s) to transport eels from the western shore and Octoraro facilities according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the FERC, MDNR, PADEP or the USFWS determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, EXELON shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications to the Resource Agencies and FERC by April 15, 2014;
2. Begin construction within 180 days of receipt of approval of the design plans and specifications by PADEP, MDNR and USFWS;
3. Begin operation by May 1, 2015.

Transport of juvenile eels will occur as necessary based on the capacity of holding tanks at the eel trapping facilities. All eels shall be moved within 1 week of capture. Eels from the holding tank(s) will be transferred to a transport vehicle equipped with an insulated transport container(s) that will be covered and aerated. The transport vehicle(s) will have an automatically engaging back up pump and an alarm that sounds in the cab of the vehicle(s). The transport vehicle taken will have continuous temperature and dissolved oxygen monitoring devices with alarms that sound in the vehicle(s) if levels of any parameter are outside of established limits. The transport vehicle(s) shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by PADEP in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks on the transport vehicle(s). These eels will be trucked to appropriate release locations on the same day of removal from holding. Upon observation, dead eels will be removed, enumerated, and reported.

D. Release

Exelon will release eels at locations identified in Appendix A in amounts consistent with the release information provided to and approved by the PFBC in writing. Where feasible, eels will be released at public access locations. Unless otherwise directed by PFBC in consultation with EPAG, eels will be released: (1) at least one hour after sunset to promote eel dispersal and minimize predation; and (2) into at least three feet of water at multiple locations within designated release areas in order to avoid concentrations of eels that could become potential targets for increased predation. If necessary due to time limitations established by the Resource Agencies in writing, Exelon shall release eels at alternative locations to avoid mortality. The estimated number of eels released at each location will be documented in writing and on a GPS device capable of being mapped in a database as approved by the Resource Agencies. After release, any dead eels remaining in the transport vehicle or observed at the stocking locations will be removed, enumerated, and reported.

Modification of, or revisions to, the release locations in Appendix A shall occur after consultation with EPAG and consistent with the approval of the PFBC.

E. Quality Assurance/Quality Control

Exelon will develop a detailed quality assurance/quality control ("QA/QC) program according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, PADEP or the USFWS determine that additional information, revisions, or amendments are necessary to the QA/QC program, then within 60 days of receipt of written notice EXELON shall submit to the Resource Agencies and such information, revisions or amendments unless a longer period of time is approved by the requesting agency in writing.

1. Submit a draft QA/QC program to the Resource Agencies for approval by April 15, 2014;
2. Implement the QA/QC program approved by the PADEP when trapping and transport begins.

Important parameters associated with trapping, collecting, holding, transport, release, and stocking will be recorded to assure and control the quality of various program elements. The collection of these data will assure that the program will be conducted according to design parameters, will adhere to sound scientific principles, and will allow for any necessary adjustments. The results of these quality assurance and quality control measures will be included in annual reports to the Resource Agencies and EPAG. Changes to the QA/QC procedures shall be submitted as requested by the PADEP, MDNR or USFWS in writing.

At a minimum, the QA/QC program shall provide:

- Detailed description of the eel trapping and holding process to achieve a minimum 95% survival rate.

- Detailed description of the eel transport process to achieve a minimum 95% survival rate.

- Collection facilities will be visually inspected daily to ensure proper operation.

- Design parameters for flows and key critical components (e.g. attraction flow, spray bar, collection tank) that will be measured weekly and qualitatively assessed daily to ensure that traps are operating within design parameters.

- Water temperature and dissolved oxygen and water exchange in the collection, holding, and transport tanks will be monitored continuously to ensure that water quality remains suitable for juvenile eels.

- Information on the periodic checks on the accuracy of the estimates of volumetric counts.

- Information on the cleaning and disinfection of the collecting, holding, and transportation tanks.

- Protocols for monitoring, removing, enumerating and reporting eel mortality.

F. Reporting, Monitoring, and Periodic Evaluation

1. Reporting and EPAG Meetings

During the eel passage season, Exelon shall provide a daily email to designated members of EPAG describing the status of trapping and trucking at each facility, the numbers of eels trapped and transported, any deviations from normal facility operations and the timing and substance of the resolution of any deviations.

On or before December 10 annually from 2015 through 2030, Exelon will submit a report to EPAG summarizing data from the trapping, collection, holding, transport, and stocking components of the Eel Plan for the calendar year. This report will provide program data to EPAG at the earliest practicable date, and provide EPAG with an opportunity to inform development of the Annual Report. On or before January 15 of the following year, Exelon will file an Annual Report with EPAG that analyzes annual data, including results from QA/QC.

Upon request, Exelon will meet with EPAG on or before February 15 of each year in which the Annual Report is filed.

2. Periodic Evaluation

Every three years, unless a different period is established by the PADEP in writing beginning in 2018 through 2030, Exelon will conduct stream segment evaluations through electrofishing or other method identified after consultation with EPAG. Representative stream segments will include tributaries and shorelines of the main-stem river. Exelon will propose locations and methods for this survey at least one year in advance to the Resource Agencies. Exelon shall implement the survey based on approval of the PADEP of the proposed locations and methods.

To implement the evaluations, eels will be captured by electrofishing, or other methods approved by the PADEP in consultation with the Resource Agencies. Sampling will be performed at block-netted transects along river shorelines and at block-netted segments of small tributaries using backpack electrofishing. The exact number, length, and location of transects sampled will be approved by the PADEP in consultation with EPAG.[40] Associated water quality parameters such as temperature and dissolved oxygen, as well as habitat characteristics, including mussel numbers observed, will be collected at each sampling location.

During sampling, the number of eels captured will be documented and data will be collected from a representative subsample of eels. A subsample of captured eels larger than 200 mm will be tagged with Passive Integrated Transponder (PIT) tags and released. Sampled eels will be scanned for PIT tags and data from recaptured eels will be recorded and included in the annual report. Data will include a variety of life history characteristics (e.g., length, weight, and condition factor) that can be assessed to determine how well stocked eels are utilizing the river

[40] It is anticipated that two weeks of electrofishing will be conducted during each third-year evaluation.

and tributaries. A portion of the subsample will be sacrificed and examined for age (otolith analysis), gender, and level of *Anguillicoloides crassus* infection. Eels that are not sacrificed for further analysis will be measured, weighed, and released.

Results of stream segment evaluations will be included in the Annual Report and will document dispersal of the stocked eels, estimate the approximate density of stocked eels, and evaluate the growth, condition, age, gender and level of infestation with *Anguillicoloides crassus* of stocked eels.

III. Upstream Passage (2031 - Term of New License)

If the upstream American eel passage trap and transport program terminates in 2030, Exelon will construct and operate a volitional upstream eel facility at Conowingo Dam through the term of the new license. Exelon will design and construct the volitional upstream eel facility, which will be operated in consultation with EPAG. In no event will Exelon be required to participate in the trap and transport program once the volitional upstream eel passage facility is operational.

If the upstream eel trap and transport and periodic evaluation program continues beyond 2030, Exelon will continue to provide access to the Conowingo eel collection facilities for as long as the program continues. Exelon, however, shall bear no cost responsibility for the trap and transport and periodic evaluation program until 2046, at which time cost responsibility shall be shared among all participants in the program.

APPENDIX A
LOCATIONS OF EEL RELEASE

Site Number	Location	Water	County
1	Conowingo Pool	Susquehanna River	Lancaster
2	Between Holtwood and Safe Harbor	Susquehanna River	Lancaster/York
2	Between Safe Harbor and York Haven Dam	Susquehanna River	Lancaster
3	Upstream of York Haven Dam	Susquehanna River	Dauphin
4	West Fairview Access (Route 11/15)	Susquehanna River	Cumberland
5	Fort Hunter Access	Susquehanna River	Perry
6	Shikellamy State Park	Susquehanna River	Northumberland
7	Route 487 Bloomsburg	North Branch Susquehanna River	Columbia
8	Route 29 Bridge (Wilkes	North Branch	Luzerne

	Barre)	Susquehanna River	
9	Upstream of Hepburn Street Dam (Williamsport)	West Branch Susquehanna River	Lycoming
10	Upstream of Grant Street Dam	West Branch Susquehanna River	Clinton

Path: X:\GISMaps\Kiraly\Eel Stocking\Eel Stocking Locations Updated 6-4.mxd

References Cited

Minkkinen, S. and I. Park. 2012. American eel sampling at Conowingo Dam, 2012. U.S. Fish and Wildlife Service – Maryland Fishery Resources Office.

Székely, C., A. Palstra, K. Molnár, and G. van den Thillart. 2009. Impact of the swim-bladder parasite on the health and performance of European Eels, Chapter 9 in Spawning Migration of the European Eel, Fish & Fisheries Series, Volume 30, pages 201-226.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, Maryland 21401
http://www.fws.gov/chesapeakebay

February 28, 2014

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

RE: Amendment of Preliminary Prescription for Fishways Muddy Run Pumped Storage Project (No. P-2355-018), Exelon Generation Company LLC

Dear Secretary Bose:

Attached, please find an amendment to the Preliminary Prescription for Fishways filed by the U.S. Department of the Interior pursuant to Section 18 of the Federal Power Act on January 31, 2014. Should you have any questions about this matter, please call Larry Miller of the U.S. Fish and Wildlife Service at 814-726-0890, or Andrew Tittler of the Department's Solicitor's office at 617-527-3400.

Sincerely,

Genevieve LaRouche
Supervisor

cc: Service list

BEFORE THE
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Exelon Generation Company LLC	)	
Muddy Run Pumped Storage Project	)	Project No. 2355-018
	)	

AMENDMENT TO PRELIMINARY PRESCRIPTION
OF
U.S. DEPARTMENT OF THE INTERIOR

The U.S. Department of the Interior filed a Preliminary Prescription for Fishways for the Muddy Run Project (FERC no. 2855) on January 31, 2014. Subsequent to discussions with its agency partners, the Department hereby amends its Preliminary Prescription for Fishways by replacing the last sentence of the third full paragraph of page 42 of the Preliminary Prescription. This sentence previously read:

> If fish passage monitoring required in this prescription indicates that American shad are not meeting the target passage of 80% of adult American shad at each project within 36 hours at the Muddy Run Project the licensee will need to consult with the Service regarding development of a plan for implementation of project operational measures and/or construction of facilities that will meet the passage target.

It is amended to read:

> If the fish passage monitoring required in this Prescription, or other available information, demonstrates that Muddy Run is limiting the safe, timely and effective upstream passage of American shad, the Service may exercise its reserved authority under Section 18 of the Federal Power Act.

This change is made in view of the fact that, although the Department's analysis reveals that the Muddy Run project is currently delaying the upstream migration of shad, it is not presently clear that this delay is sufficient to prevent the achievement of the fisheries agencies' goals for this stretch of the Susquehanna River, which depend on safe, timely, and effective passage of American shad between the Conowingo and Holtwood Projects. The study required by the Preliminary Prescription, in concert with studies being conducted at the Holtwood Project is expected to further clarify this issue, providing a better assessment of the significance of the delay and assessment of what standard ought to be set for passage past the Muddy Run Project.

Based on the Department's interpretation of its regulations, the filing of this amendment extends the deadline for license parties to file an alternative prescription and/or a trial-type hearing request by 30 days. Accordingly, the Department will consider as timely filed comments and requests for alternatives and requests for trial-type hearings on issues of material fact concerning the Preliminary Prescription, as amended, filed within 30 days from the date of this determination, pursuant to its regulations at 43 C.F.R. Part 45.

Genevieve LaRouche
Field Office Supervisor
U.S. Fish and Wildlife Service
Chesapeake Field Office.

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APPENDIX F

WATER QUALITY CERTIFICATION

YORK HAVEN HYDROELECTRIC PROJECT

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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

WATER QUALITY CERTIFICATION
FOR YORK HAVEN HYDROELECTRIC PROJECT
AND RELATED MITIGATION

DEP File No.--EA 67-023: York Haven Power Company, LLC

FERC PROJECT NO. P-1888-030

York Haven Power Company Contacts:

David R. David
York Haven Power Company, LLC.
York Haven Hydro Station
P.O. Box 67
York Haven, Pennsylvania 17370

Dennis T. O'Donnell
Olympus Power, LLC
67 Park Place East
Morristown, New Jersey 07960

Dauphin, Lancaster and York Counties

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WATER QUALITY CERTIFICATION
FOR YORK HAVEN HYDROELECTRIC PROJECT
AND RELATED MITIGATION
DEP File No.- EA 67-023
FERC PROJECT NO. P-1888-030

I. PROJECT DESCRIPTION

A. EA67-023 York Haven Power Company, LLC. York Haven Power Company contacts: David R. David, York Haven Power Company, LLC, York Haven Hydro Station ("YORK HAVEN" or "YHPC") P.O. Box 67, York Haven, Pennsylvania 17370 and Dennis T. O'Donnell, Olympus Power, LLC, 67 Park Place East, Morristown, New Jersey. YORK HAVEN Hydroelectric Project is located on the Susquehanna River in York, Dauphin, and Lancaster Counties, Pennsylvania. The project is operated as a run-of-river hydroelectric facility with a total plant capacity of 19.65 megawatts (MW) from its 20 turbines. The average annual generation of YORK HAVEN Project is 130,812 megawatt-hours (MWh).

B. Impacts to migration and movement of aquatic species will result from the continued operation of the facility. YHPC will mitigate the impact to aquatic species by constructing a nature-like fishway at or near the eastern end of the main dam apex in Londonderry Township, Dauphin County and abutment with the west shore of Three Mile Island ("TMI"). The fishway will facilitate movement of aquatic species over the dam and re-establish upstream/downstream river connectivity by creating a series of steps that will distribute the change in water surface and riverbed elevations caused by the dam over approximately 450 feet of the Susquehanna River. Maintenance of the fishway to its approved design configuration shall be conducted for the duration of the operation of YHPC as an electric generation facility.

II. PROVISIONS APPLICABLE TO ALL WATER QUALITY CERTIFICATION CONDITONS

A. Final Agency Action. Any action taken by the Pennsylvania Department of Environmental Protection ("DEP" or "PADEP") in response to any submission required or authorized under this certification or any action taken by DEP to require YORK HAVEN to undertake any action that affects YORK HAVEN's personal or property rights, privileges, immunities, duties, liabilities or obligations including, but not limited to, any action to approve, approve with conditions, disapprove, modify or establish operational or structural changes, plans, schedules, studies or monitoring programs shall constitute a "final agency action" and may be challenged in accordance with applicable law.

B. Operational modifications are a component of the adaptive management system to implement the approved plans, including the performance requirements of this certification. Operational modifications include modifications of seasonal and daily periods of operation of the fishways, dam and powerhouse, detailing how the plant shall be operated during fish passage season and throughout the year. These operational modifications may include:

- sequencing of turbine start-up and operation;
- procedures for estimating, monitoring and reporting flow management through the power house, in the tailrace, above, through and downstream of the nature-like fishway, and through the East Channel fishway as described in the Fishway Operating Procedures ("FOP");
- any other necessary provisions to implement elements of this certification for plant operation, to ensure attraction to and operation of the fishways or to meet other provisions of this certification and its procedures for monitoring and reporting on the

operation of each fish passage facility or other provisions of this certification or measure;

- procedures for annual fish passage facilities start-up and shut-down; and,
- procedures for use in case of emergencies and project outages significantly affecting fishway operations or other provisions of this certification.

C. **Structural modifications** are changes to project infrastructure, tailrace, fishways or other areas of the Susquehanna River pursuant to the provisions of this certification. No substantial alteration or addition not in conformity with the plans approved by the Federal Energy Regulatory Commission shall be made to any dam or other project works, constructed under the Federal Power Act without the prior approval or authorization of the Federal Energy Regulatory Commission.

D. **Resources Agencies** – Pennsylvania Department of Environmental Protection ("DEP" or "Department"), Pennsylvania Fish and Boat Commission ("PFBC"), Susquehanna River Basin Commission ("SRBC"), Maryland Department of Natural Resources ("MDDNR"), and the United States Fish and Wildlife USFWS ("USFWS").

E. **General Requirements**

1. The work authorized under this certification shall, at all times, be subject to oversight and inspection by representatives of DEP, and no changes in the maps, plans, profiles, and specifications as approved shall be made except with the written consent of DEP. DEP, however, reserves the right to require such changes or modifications in the maps, plans, profiles, and specifications as may be considered necessary to assure compliance with the Pennsylvania Clean Streams Law, Dam Safety and Encroachments Act and other appropriate requirements of state law. DEP further reserves the right to suspend or revoke this certification for failure to comply with appropriate requirements of state law, an administrative order of DEP or a term or condition of this certification.

2. YORK HAVEN shall notify DEP, in writing, of the proposed time for commencement of earth disturbance activity, under this certification at least 15 days prior to the commencement of the work.

3. YORK HAVEN shall prepare, implement and monitor the Erosion and Sedimentation Control Plan prepared in accordance with Chapter 102 so as to minimize erosion and prevent excessive sedimentation into the receiving watercourse or body of water.

4. All wetlands within the project area shall be accurately delineated and marked in the field prior to the start of construction activities and such field marking shall be maintained up to the time that earth disturbance activities are completed and the site has been stabilized. An acceptable means of field-identification is the use of an orange construction safety fence.

5. YORK HAVEN shall obtain either coverage under a general NPDES Permit or an individual NPDES Permit for Stormwater Discharges Associated with Construction Activity for earth disturbance activities requiring an NPDES permit, prior to conducting such earth disturbance activities.

6. Any additional information or revisions to any submittal required under this certification requested by the DEP in writing or any changes to implementation of any plans requested in writing by the DEP shall be submitted or completed within 15 business days of the request or such longer period of time approved by the DEP in writing.

F. Temporary stream crossings

1. All necessary causeway and/or cofferdams shall be constructed of rock, clean granular fill materials, or other materials meeting specifications approved by DEP reasonably free of fines, silts and other erodible material.

2. All temporary cofferdams shall be completely removed and the area restored and stabilized upon completion of the project in accordance with 25 Pa. Code Chapter 102 and the approved Erosion and Sedimentation Control Plan.

3. Roads shall cross all watercourses at a right angle to the stream, unless an alternative configuration is otherwise approved in writing by DEP.

4. A culvert, having as large a diameter as possible, must be provided to minimize placement of excessive fill and excavation of the streambanks. If the bank height prohibits a large diameter pipe culvert, the crossing could consist of a bridge. The minimum size diameter culvert to be used is 12 inches.

5. Road and causeway embankments shall consist of rock, clean granular fill materials, or other materials meeting specifications approved by DEP, reasonably free of fines and silt or other erodible material, to minimize stream channel sedimentation during placement, removal, and periods of overtopping. No construction materials or equipment shall be stockpiled or stored overnight on crossings or causeways.

6. Unless otherwise approved by DEP, approach roads to temporary road crossings shall utilize original grades. However, clean rock material or gravel to a depth of six inches above original grade shall be utilized for approaches as necessary.

7. Temporary road crossings shall be kept open and functioning at all times by maintaining the crossings free of debris and other obstructions.

8. Construction of the temporary roads and cofferdams at any public boat launching ramp along a waterway shall take place between September 15 and May 15.

G. Reasonable Assurance of Compliance – DEP supports issuance of a 46 year license by FERC for the project. Because of changes in the characteristics of the Susquehanna River that will occur by 2030 and because the FERC licenses for the Holtwood Hydroelectric

Facility and the Safe Harbor Hydroelectric Facility expire in 2030, this certification may be revised in 2030, as necessary, to establish requirements consistent with Section 401 of the Clean Water Act, 33 U.S.C Section 1341.

III. FISH PASSAGE

A. General Requirements

1. Fishway Operating Procedures ("FOP")

a. YORK HAVEN shall establish and maintain a FOP for the operation and maintenance of facilities related to migratory and resident fish passage, which shall be subject to review and approval by DEP and review and comment by the other Resource Agencies. The FOP will include, for each fishway, schedules for routine maintenance, procedures for routine operations (including: seasonal and daily periods of operation, dam and powerhouse operational measures) detailing with how the plant shall be operated during fish passage season including sequencing of turbine start-up and operation, debris management as well as any other necessary provisions for plant operation and related to attraction flow as a component of the fish passage system including the NLF provisions for the operation of the NLF, procedures for monitoring and reporting on the operation, and procedures for use in case of emergencies and Project outages significantly affecting fishway operations.

b. YORK HAVEN shall implement the FOP consistent with the approval by the DEP. YORK HAVEN shall provide written documentation to the Resource Agencies that all fishway operational personnel have received training concerning the content of the approved FOP, which documentation shall be signed by the Project's operations manager.

c. Copies of the approved FOP and all modifications will be provided to the Resource Agencies.

d. By December 31 of each year, YORK HAVEN shall provide to the Resource Agencies an annual report detailing: (1) the implementation of the FOP, including any deviations from the FOP and a process to prevent or minimize those deviations in the future, or in the case of emergencies or Project outages, the steps taken by YORK HAVEN to minimize or mitigate adverse effects on fishway operation or fish passage measures; and (2) any proposed modifications to the FOP to further enhance its effectiveness in the future. YORK HAVEN shall meet with the Resource Agencies by January 31 of each year unless a different date is mutually agreed upon by YORK HAVEN and the Resource Agencies. Any required modifications to the FOP requested by DEP or the USFWS shall be submitted to the Resource Agencies within 30 days of receipt of such request for the modification unless a longer period is approved by DEP. The modifications to the FOP shall be implemented consistent with the approval of the DEP.

e. Except as otherwise specifically provided, for fish passage system enhancements and facilities that do not begin operation with the entry into operation of the Project under the new FERC license, 60 days prior to operation of the enhancements and/or facilities, YORK

HAVEN shall submit FOP provisions for any such new fish passage enhancements, facilities and measures to the Resource Agencies for review and approval by DEP and review and comment by the other Resource Agencies, and YORK HAVEN shall implement the FOP as approved by the DEP.

f. The FOP shall also include the procedures for resident fish passage.

2. **Nature-Like Fishway Construction** – YORK HAVEN will finance, design, permit and install a nature-like fishway facility ("NLF Facility") in the vicinity of the apex of the Main dam and Three Mile Island ("TMI") in accordance with the conditions set forth below.

a. Unless a different plan is approved by the DEP in writing, the NLF Facility shall be in substantial compliance with the design concept and criteria for the NLF Facility set forth in Appendix A and B hereto.

b. The NLF Facility shall be authorized, constructed and operated consistent with the following schedule unless the DEP approves a different schedule in writing. YORK HAVEN shall respond to all Resource Agency and FERC requests for additional information within 60 days from receipt of the request unless a different response time is approved by the DEP in writing.

i. By March 31, 2015, YHPC shall prepare and submit to the Resource Agencies a functional design of the NLF Facility, including hydrologic and hydraulic analyses, NLF configuration and dimensions, general arrangements drawings with plan and profile views, and draft elements of applications for an ACOE Clean Water Act §404 Permit, a §401 Water Quality Certification, an Erosion and Sedimentation Control Plan and an NPDES Permit for Stormwater Discharge Associated with Construction Activities.

ii. By July 15, 2015, YORK HAVEN shall prepare and submit (a) a complete application to the ACOE for a Clean Water Act §404 Permit; (b) an application to DEP for a §401 Water Quality Certification; (c) an Erosion and Sedimentation Control Plan and application to DEP for an NPDES Permit for Stormwater Discharge Associated with Construction Activities; and (d) engineering designs and a request for construction approval from FERC.

iii. The process of issuing bid requests, evaluating bids, finalizing costs and completing procurement of construction contracts for the NLF Facility shall be completed within 150 days from issuance of all necessary governmental approvals for NLF Facility construction, including the Clean Water Act §404 permit, the related DEP water quality certification, the NPDES Permit for Stormwater Associated with Construction Activities, and the FERC approval for the NLF Facility.

iv. The NLF Facility shall be constructed and placed into operation within 3 full construction seasons after the date specified in ¶ iii above.

vi. Except as otherwise provided herein, other than facility and operations modifications to the NLF as provided in Sections III.B.1.d and e, YORK HAVEN shall not be required to design, construct or install any additional fish passage structure at the project prior to 2041.

c. YORK HAVEN shall implement the NLF operation and maintenance plan consistent with the approval of the DEP as part of the FOP.

B. American Shad Passage

1. Upstream Shad Passage

a. The period from completion of construction through the end of the first American shad upstream shad passage season following completion of the NLF Facility will be a "shake-down" period, during which YORK HAVEN shall conduct visual observations and make adjustments to the NLF Facility to address any unanticipated inhibitions or barriers that impede the NLF Facility's performance.

b. Starting in the second American shad upstream passage season following completion of the NLF Facility, YORK HAVEN shall commence telemetry studies to monitor the overall effectiveness of the NLF Facility, consistent with the following:

i. The telemetry studies will be conducted for at least two years, and potentially a third year if, after consultation with the Resource Agencies, it is determined to be necessary by YORK HAVEN or either the USFWS or PADEP in order to obtain observations over a range of high and low flows typical of

American shad passage seasons on the Susquehanna River. In general, the range defining typical high and low flows during the American shad upstream passage season would be anticipated to be as follows:

(1) Typical low flow range: 22,000 cfs to 35,300 cfs.

(2) Typical high flow range: 35,300 cfs to 55,600 cfs.

ii. The telemetry studies will be planned to be conducted during successive shad passage seasons, but may be performed on a non-successive basis under the following circumstances:

(1) YORK HAVEN may postpone conducting the telemetry studies, after consultation with the Resource Agencies and with the approval of the USFWS and DEP, in the event that extenuating circumstances (such as the unusual flows, construction at downstream dams or other conditions) are interfering or expected to interfere with upstream shad passage. The PADEP agrees that in the event that it becomes aware of circumstances that would warrant postponement of the telemetry studies, it will promptly notify YORK HAVEN, with the objective of providing notice to YORK HAVEN, to the extent practicable, as soon as possible prior to the anticipated start of the shad passage season.

(2) YORK HAVEN may postpone a successive season's telemetry study if YORK HAVEN determines, after consultation with the Resource Agencies and with the approval of USFWS and PADEP, that some physical adjustment to the NLF Facility is advisable based on the observations during the prior shad passage seasons, in which case YORK HAVEN shall implement the physical adjustments and perform the telemetry study during the American shad upstream passage season following implementation of the physical adjustment.

iii. The telemetry studies will utilize American shad tagged at the Safe Harbor Project, provided that access is granted by the owner of such Project or at such other location as required or approved by the PADEP in writing.

iv. The telemetry studies shall utilize radio telemetry, acoustic telemetry, or such other technologies as YORK HAVEN proposes and PADEP and the USFWS, after consultation with the other Resource Agencies, approve. The general parameters and protocols for such telemetry studies (number of fish, fish release sites, target areas for telemetry antennas) are described in Appendix C. At least 10 months prior to the start of the second Upstream American Shad Passage Season following completion of the NLF Facility, YORK HAVEN shall prepare and submit to the Resource Agencies for review an NLF Facility Monitoring Plan (the "NLF Monitoring Plan") containing detailed protocols for the telemetry studies. YORK HAVEN shall confer with the Resource Agencies regarding the NLF Monitoring Plan, and shall provide for at least 90 days for PADEP and the USFWS to review and approve, and for the other Resource Agencies to review and comment on, the NLF Monitoring Plan.

c. Upstream American Shad Passage Target and Effectiveness Criteria:

i. The target established by the Resource Agencies is for at least 75% of the upstream migrating American shad passing the Safe Harbor Dam to pass upstream of the Project through the combination of the NLF Facility and the East Channel Fishway (the "Upstream Shad Passage Target"). The NLF Facility shall be designed and operated to be capable of achieving the Upstream Shad Passage Target, provided that adequate numbers of upstream migrating American shad reach the Project Area. YORK HAVEN shall not be deemed in violation of this condition if the Upstream Shad Passage Target is not achieved for reasons beyond the reasonable control of the Project. ("Project Area" is defined as the area upstream of a line drawn across the Susquehanna River from the downstream end of the powerhouse to the east bank of the river as depicted in Exhibit 1 to Appendix C hereto)

ii. The NLF Monitoring Plan is designed to investigate several issues: (i) whether the upriver migrating American shad passing the Safe Harbor Dam are reaching the Project Area; (ii) whether upriver migrating American Shad entering the Project Area are attracted to the downstream entrance of the NLF Facility; and (iii) whether there are barriers to American shad entering into and passing through the NLF Facility (e.g., velocity barriers or other constraints). Unless a different plan is approved by the DEP and the USFWS, the NLF Monitoring Plan shall be consistent with Appendix C, attached hereto.

iii. The NLF Facility will be deemed to be effective if: (1) in two consecutive years after installation or subsequent modification of the NLF Facility, (A) the Upstream Shad Passage Target, identified in paragraph B.1.c.i. above, is achieved or (B) 85% of the tagged American shad that enter the Project Area exit the combination of the NLF Facility and the East Channel Fishway (the "Project Area Passage Success Criterion").

iv. If the telemetry studies show that the Project Area Passage Success Criterion is achieved in two successive American shad upstream passage seasons which reflect a range of flows typical of shad passage seasons on the Susquehanna River, the Project Area Passage Success Criterion will be deemed achieved and YORK HAVEN may terminate the telemetry studies.

v. If the telemetry studies show that the Project Area Passage Success Criterion is not achieved in two successive American shad upstream passage seasons, and such failure was not due to unusual or extenuating circumstances (such as unusual flow or temperature conditions), YORK HAVEN will undertake the actions set forth in Section B.1.d. below and then perform a telemetry study for at least two additional American shad upstream passage seasons to confirm achievement of the Project Area Passage Success Criterion.

d. YORK HAVEN shall, in consultation with the Resource Agencies, evaluate the fish movement data from the NLF Monitoring Plan to determine if there are barriers to timely passage of upstream migrating American shad within the Project Area. The Project area is the area from the downstream end of the powerhouse extending to the upstream exit of the NLF or East Channel Fishway, or such other area established by the DEP in writing after consultation with the Resource Agencies and York Haven. If such barriers to timely passage of upstream migrating American shad are identified within the Project Area, YORK HAVEN shall prepare and submit to the Resource Agencies a plan and schedule for those actions to address such conditions that are feasible, appropriate under the circumstances, reasonable and technically sound, provided that the

Project shall not be required to undertake the curtailment of electric generating operations. Such plan shall be subject to review and approval by PADEP and the USFWS and review and comment by the other Resource Agencies. Following approval by PADEP and the USFWS, YORK HAVEN shall implement the approved plan in accordance with the approved schedule.

e. If the Project Area Passage Success Criterion is not achieved, YORK HAVEN shall take the following measures, as appropriate and necessary, after consultation with the Resource Agencies:

i. Evaluate fishway hydraulics and access for velocity and shear stress barriers, recognizing that hydraulics of the NLF Facility will vary with river flow and flow through the NLF Facility.

ii. Adjust positions of rock weirs and attraction water discharge if necessary.

iii. Adjust timing of supplemental attraction flows.

iv. Install ultrasound to deter fish from an area (such as the Powerhouse or East Channel).

v. Reduce flows in the East Channel to reduce attraction of American shad to the East Channel.

vi. Adjust amount of supplemental attraction flows in the NLF Facility up to the Potential Increased Attraction Flow Value.

vii. Evaluate whether potential barriers exist in the channel downstream of the Main Dam hindering fish movement to the entrance of the NLF Facility, and if reasonably necessary undertake feasible and cost-effective modifications to the channel to remove such barriers.

f. The upstream end of NLF Facility shall be designed to accommodate installation of Passive Integrated Transponder ("PIT") tag monitoring devices at such time as such PIT tag monitoring devices become available and feasible for reliably monitoring American shad exiting the NLF Facility. At such time as requested by PADEP or the USFWS, YORK HAVEN shall conduct a feasibility study to evaluate whether a PIT tag monitoring facility can be successfully installed and maintained near the upper end of the NLF Facility to reliably monitor American shad exiting the NLF Facility. YORK HAVEN shall install PIT tag readers, or such other monitoring technology as may be required by the PADEP, after consultation with the Resource Agencies, at the NLF Facility when such technology has become available, feasible, and technically sound for measuring American shad passage in the conditions of the NLF Facility as mutually agreed to, after consultation with the Resource Agencies. Upon installation of the PIT tag readers, YORK HAVEN shall implement a PIT tag monitoring plan, or other monitoring techniques approved by the DEP in consultation with the other Resource Agencies, on a schedule approved by the DEP.

g. If at the end of implementation of the measures described above, or such longer time as established by the DEP, the results indicate that as measured as described above, less than 75% of the American shad that pass the Safe Harbor Dam pass through the Project and the Project Area Passage Success Criterion is not being achieved, within 6 months thereafter, YORK HAVEN shall propose a plan and schedule for mitigation, as defined in 25 Pa. Code Section 105.1 that is feasible, appropriate under the circumstances, reasonable and technically sound, provided that the Project shall not be required to undertake the curtailment of electric generating operations. This plan and schedule shall be submitted to the Resource Agencies for review and comment and to DEP for approval. YORK HAVEN shall implement the plan and schedule consistent with the approval of the DEP. In the event YORK HAVEN fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and YORK HAVEN shall implement that plan and schedule consistent with the approval of the DEP.

2. **Downstream Shad Passage of Post-Spawning Adult American Shad**

   a. YORK HAVEN shall provide for downstream passage of post-spawning adult American shad through maintenance of the existing Project and installation and operation of the NLF Facility, which shall achieve an 80% survival rate as demonstrated by implementation of the protocol set forth in Section b. below.

   b. During the period of May 1 to June 30, if river flow exceeds the sum of Project Hydraulic Capacity, required flows through the NLF

Facility, required flows through the East Channel, and required flows (if any) over the Main Dam, YORK HAVEN will open and spill water via the Forebay Sluice Gate (~370 cfs) to the extent practicable for a period of one to two hours during the morning on weekdays, subject to Project personnel availability and access requirements for operations and maintenance purposes. Such spilling may be provided in connection with opening of the Forebay Sluice Gate for purposes of passing debris, it being understood by the Parties that during the passage of debris, it will not be feasible to utilize the chute structure.

c. If after operational modifications are implemented YORK HAVEN cannot achieve 80% survival of adult American shad, YORK HAVEN shall propose a plan and schedule for mitigation, as defined in 25 Pa. Code Section 105.1 that is feasible, appropriate under the circumstances, reasonable and technically sound, provided that the Project shall not be required to undertake the curtailment of electric generating operations This plan and schedule shall be submitted to the Resource Agencies within 6 months from the date the DEP determines that YORK HAVEN failed to achieve the 80% survival target. YORK HAVEN shall implement the plan and schedule consistent with the approval of the DEP. In the event YORK HAVEN fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and YORK HAVEN shall implement that plan and schedule consistent with the approval of the DEP.

3. **Downstream Juvenile American Shad Passage**

a. After issuance of the New License and until completion of the NLF Facility, YORK HAVEN shall implement the following protocol to facilitate downstream passage of juvenile American shad during the Downstream Juvenile American Shad Passage Period:

i. During the entire Downstream Juvenile American Shad Passage Period from October 1 until November 30, YORK HAVEN will operate the Project units in the following order of priority, depending upon available river flow: Unit 1-6 (Propeller units) may be operated without restriction up to available river flow; (2) Unit 14 (larger single Francis unit) may be operated if river flow exceeds capacity of Units 1- 6; (3) Units 7-13 and 15-30 (double Francis units) may be operated in ascending order if river flow exceeds capacity of Unit 1-6 and 14.

ii. During the entire Downstream Juvenile American Shad Passage Period, YORK HAVEN will open and spill water via the Forebay Sluice Gate (~ 370 cfs) between the hours of 5 pm to 11 pm Eastern Standard Time.

iii. If during the Downstream Juvenile American Shad Passage Period river flow exceeds the sum of Project Hydraulic Capacity, required flows through the East Channel, and required flows (if any) over the Main Dam, YORK HAVEN will open and spill water via the Forebay Sluice Gate (~370 cfs) to the extent practicable for one to two hours during the morning, subject to Project access requirements for operations and maintenance purposes, in order to provide for downstream juvenile American shad passage.

b. After completion of the NLF Facility, unless a different protocol is approved by the USFWS and the PADEP, YORK HAVEN shall implement the following protocol to facilitate downstream passage of juvenile American shad during the Downstream Juvenile American Shad Passage Period:

i. During the entire Downstream Juvenile American Shad Passage Period, YORK HAVEN will operate the Project units in the following order of priority, depending upon available River flow: (1) Unit 1-6 may be operated without restriction up to available river flow; (2) Unit 14 may be operated if river flow exceeds capacity of Units 1-6; (3) Units 7-13 and 15-30 may be operated in ascending order if river flow exceeds capacity of Unit 1-6 and 14.

ii. During the entire Downstream Juvenile American Shad Passage Period, YORK HAVEN will open and spill water via the Forebay Sluice Gate (~ 370 cfs) between the hours of 5 pm to 11 pm EST.

iii. The NLF Facility will be operated to maintain a flow through the fishway of approximately 200 cfs.

iv. If during the Downstream Juvenile American Shad Passage Period river flow exceeds the sum of Project Hydraulic Capacity, required flows through the NLF Facility, required flows through the East Channel, and required flows (if any) over the Main Dam, YORK HAVEN will open and spill water via the Forebay Sluice Gate (~370 cfs) to the extent practicable for one to two hours during the morning, subject to Project access requirements for operations and maintenance purposes, in order to provide for downstream juvenile American shad passage.

c. The overall goal for juvenile American shad downstream passage is to achieve survival of 95% of juvenile American shad from above the Project powerhouse and dam to below the Project powerhouse and dam (the "Downstream Juvenile American Shad Passage Goal"). The effectiveness of downstream passage operations for juvenile American shad will be determined based upon (1) a route of passage analysis, and (2) confirmation that Forebay Sluice Gate provides for safe passage.

d. For purposes of the route of passage analysis, the DEP will assume that (1) juvenile American shad will pass through the NLF Facility, through the East Channel past the East Channel Dam, over the Main Dam, and into the head race in direct proportion to the amount of flow via each such route; (2) any juvenile American shad passing through the NLF Facility, through the East Channel past the East Channel Dam, over the Main Dam, or through the Forebay Sluice Gate will survive; (3) juvenile American shad that do not pass through the NLF Facility, through the East Channel past the East Channel Dam, over the Main Dam, or through the Forebay Sluice Gate will pass through the turbines that are being operated in accordance with the priorities set forth above, and absent observations to the contrary, are allocated between the operating turbines in proportion to the flow through each turbine; and (4) the survival rate of juvenile American shad passing through individual turbines (based on previous balloon tag and blade strike analyses) are as stated in Appendix D. Based upon the foregoing assumptions and confirmation that Forebay Sluice Gate provides for safe passage as described in Section f. below, the juvenile American shad passage goal of 95% would be met if at least 60% of the tagged juvenile American shad released into the headrace exit via the Forebay Sluice Gate (that is, pass downstream of the Project headrace without passing through the turbines) (the "Headrace Shad Turbine Avoidance Target"). Unless a different method is approved by the USFWS and the DEP in writing, YORK HAVEN shall test the downstream passage efficiency of the operating protocols described above by a PIT tag monitoring study. YORK HAVEN shall, in consultation with the Resource Agencies, prepare a plan and schedule for the Headrace

Shad Turbine Avoidance Study for review and approval of the Resource Agencies, consistent with the design criteria set forth in Appendix F. The Project will be deemed to meet the Downstream Juvenile American Shad Passage Goal if (1) the Headrace Shad Turbine Avoidance Study shows that the Headrace Shad Turbine Avoidance Target is achieved and (2) YORK HAVEN complies with the provisions of Section III.B.3.e. below to establish conditions under which the Forebay Sluice Gate provides for safe passage of juvenile American shad.

e. Within four (4) years following License issuance and prior to performance of the downstream juvenile American shad studies referenced in Section III.B.3.d. above, YORK HAVEN shall prepare and submit to the Resource Agencies: (i) designs for a chute structure to convey flows beyond the roadway on the downstream side of the Cable Alley structure, meeting the design criteria set forth in Appendix E allowing juvenile and adult American shad to land unimpeded in the downstream pool; and (ii) removal of obstructions in or deepening of the downstream pool into which flows from the Forebay Sluice Gate land to provide an adequate depth of 1 foot for each 4 feet of drop into which juvenile or adult American shad may land. YORK HAVEN shall submit design plans for improvements and a proposed implementation schedule to the USFWS and PADEP for review and approval and to the other Resource Agencies for review and comment, and shall implement the proposed improvements in accordance with the approved designs and schedule by the PADEP. Any such required improvements shall be completed coincident with completion of the NLF Facility, and in advance of commencement of the monitoring described in Section III.B.3.d. above.

f. If the effectiveness monitoring conducted pursuant to Section III.B.3.d. above shows that the Headrace Shad Turbine Avoidance Target is not achieved, unless the USFWS and the DEP approve alternative measures, YORK HAVEN shall implement the following sequence of adaptive measures in the next passage season:

   i. Open the NLF supplemental flow gate (800 cfs) during the same schedule as the Forebay Sluice Gate is opened.

   ii. Suspend operation of certain Francis turbine units during the hours of 5-11 pm EST when river flows are between 15,000 cfs and 22,000 cfs during the Downstream Juvenile American Shad Passage Period, up to a total generation loss of 1,000 Megawatt hours ("MWh").

   iii. Such other measures as may be agreed to by YORK HAVEN, the USFWS and DEP, after consultation with the other Resource Agencies.

g. Unless the DEP and the USFWS approve a different time in writing, within two years of implementing the adaptive measures referenced in Section 3.f. above, YORK HAVEN shall conduct a follow-up Headrace Shad Turbine Avoidance Study following the protocols referenced in Section III.B.3.d. above . If the follow-up Headrace

Shad Turbine Avoidance Study shows that Headrace Shad Turbine Avoidance Target is achieved, such adaptive measures shall continue to be implemented for the duration of the License.

h. If by January 1, 2028, (a) the Headrace Shad Turbine Avoidance Studies have not shown that Headrace Shad Turbine Avoidance Target is being achieved by adaptive measures implemented at the Project, and (b) based on all available information and after consultation with YORK HAVEN and the other Resource Agencies, the USFWS renders a final determination on the basis of the record reasonably finding that (i) YORK HAVEN has not demonstrated that the adaptive measures implemented at the Project are reasonably anticipated to meet the Downstream Juvenile American Shad Passage Goal, and (ii) additional measures that are reasonably required to achieve the Downstream Juvenile American Shad Passage Goal (the "Additional Measures Determination") then:

i. Within 12 months of the Additional Measures Determination, YORK HAVEN shall, in consultation with the Resource Agencies, prepare a design and schedule for implementation of additional structural and operational measures reasonably anticipated to meet the Downstream Juvenile American Shad Passage Goal that are feasible, appropriate under the circumstances, reasonable and technically sound. YORK HAVEN shall evaluate, among other options, options for a Fish Guidance System ("FGS") as described in the report entitled *Evaluation of Fish Guidance Systems* (Draft April 2013), or other appropriate technology to achieve the Downstream juvenile American Shad Passage Goal. As part of the evaluation report, YORK HAVEN shall provide sufficient information to demonstrate the reasonable likelihood of the proposed option and measures to meet the Downstream Juvenile American Shad Passage Goal.

ii. Following approval of the design and schedule by the USFWS and DEP, after consultation with the other Resource Agencies, YORK HAVEN shall prepare and submit the applications for all required governmental approvals, including FERC approvals, and procure, install and implement the approved structural and/or operational measures in accordance with the approved schedule. Such approved measures shall be implemented by December 31, 2030 or such other date as agreed to by YORK HAVEN and the USFWS, after consultation with the other Resource Agencies, or as approved by FERC.

iii. If YORK HAVEN does not present a design and schedule for implementing additional structural and operational measures reasonably anticipated to meet the Downstream Juvenile American Shad Passage Goal that are feasible, appropriate under the circumstances, reasonable and technically sound, or based on all available information and after consultation with

YORK HAVEN and the Resource Agencies, the DEP does not approve YORK HAVEN's design and schedule for additional measures submitted pursuant to Section III.B.3.h. above, the DEP may prescribe such measures as the DEP determines are necessary for safe and effective passage of downstream migrating American shad and YORK HAVEN shall implement those measures within the schedule established by the DEP.

iv. Within one year after the implementation of the structural and operational measures implemented under Section III.B.3.h. above, YORK HAVEN shall perform a follow-up Headrace Shad Turbine Avoidance Study to evaluate the number of tagged juvenile American shad that exit the Forebay without exposure to the turbines.

C. Eel Passage

1. Upstream Eel Passage

YORK HAVEN shall provide for upstream passage of juvenile American eels through maintenance of the existing Project and installation of the NLF Facility. Based upon their present understanding of the behavior of juvenile American eels and the design of the NLF Facility, the USFWS expects that the existing design of the Project in conjunction with the installation of the NLF Facility will be adequate to provide for successful upstream passage of juvenile American eels past the Project, and no other measures are presently believed to be necessary for such upstream passage of juvenile American eels.

2. **Downstream Eel Passage**

a. The overall goal for silver American eel passage shall be to achieve effective passage and survival of 85% of silver eels from above the Project dams and powerhouse to below the Project dams and powerhouse (the "Downstream Eel Passage Goal").

b. YORK HAVEN shall cooperate with the Resource Agencies and other interested parties in the conduct of (1) a Lower Susquehanna River Downstream Eel Study to evaluate the timing, magnitude, duration, annual variation and environmental conditions associated with active migration of silver eels from tributaries stocked with elvers, through the lower Susquehanna River to the Chesapeake Bay; and (2) a Site-Specific Route of Passage Study to evaluate the route of passage selected by migrating silver eels in the vicinity of the Project. The design criteria for the Lower Susquehanna River Downstream Eel Study and the Site-Specific Route of Passage Study are described in Appendix G.

c. At least 12 months prior to the anticipated date for completion of the NLF Facility, in consultation with the Resource Agencies, YORK HAVEN shall prepare a plan and schedule for conducting a discrete downstream passage effectiveness study ("Site-Specific Downstream Eel Study"), consisting of a Site Specific Route of Passage Study as described in Appendix G and an Eel Survival Study as described in Appendix H. YORK HAVEN shall submit the Site-Specific Downstream Eel Study plan and proposed schedule to the Resource Agencies, for review and approval by the USFWS and PADEP and for review and approval. YORK HAVEN, in cooperation with the Resource Agencies, shall conduct the Site-Specific Route of Passage Study following completion of the NLF Facility in accordance with the approved plan and schedule, and YORK HAVEN shall conduct the Eel Survival Study in accordance with the approved plan and schedule.

d. If the results of the Site-Specific Downstream Eel Passage Study indicate that the then existing Project operating measures and protocols achieve the Downstream Eel Passage Goal, then YORK HAVEN shall continue to implement those protocols and measures.

e. If the results of the Site-Specific Downstream Eel Passage Study indicate that the Project's existing operating measures and protocols do not achieve the Downstream Eel Passage Goal, YORK HAVEN will prepare and submit to the Resource Agencies a plan and schedule for evaluating the feasibility and costs of potential physical and/or operational modifications to the Project to facilitate downstream eel passage (the Downstream Eel Improvements Study). The Downstream Eel Improvements Study plan and schedule shall be subject to review and approval by PADEP and the USFWS and review and comment by the other Resource Agencies. YORK HAVEN shall conduct the Downstream Eel Improvements Study in accordance with the approved plan and schedule. The Downstream Eel Improvements Study will consider and evaluate whether any of the following adaptive measures to facilitate downstream eel passage, which may be implemented in a sequence or in combination, are feasible, appropriate under the circumstances, reasonable and technically sound and are reasonably expected to contribute toward achievement of the Downstream Eel Passage Goal:

i. Adjustment to NLF Facility operations.

ii. Installation of current inducers.

iii. Modifications to the juvenile American shad protection measure.

iv. Installation of a fish guidance system.

v. Replacement of turbine runner systems with units designed to have a lower mortality impact upon silver eels.

vi. Other measures mutually agreed to by YORK HAVEN, the USFWS and PADEP, after consultation with the other Resource Agencies.

f. If the Downstream Eel Improvements Study identifies physical or operational adaptive measures listed in Section III.C.2.e. above to facilitate downstream eel passage that are feasible, appropriate under the circumstances, reasonable and technically sound, YORK HAVEN shall prepare a plan and schedule for implementing such measures and an estimation as to the ability of such measures to achieve the Downstream Eel Passage Goal, and will submit the plan and schedule to the Resources Agencies for review and approval by the USFWS and DEP and review and comment by the other Resource Agencies. Following approval of such plan and schedule, YORK HAVEN shall implement the measures described in the approved plan in accordance with the approval schedule.

g. Within 12 months following implementation of any such improvements, YORK HAVEN shall evaluate and provide a report to the Resource Agencies regarding the effectiveness of the measures in relation to achievement of the Downstream Eel Passage Goal.

h. If the adaptive measures implemented pursuant to the Downstream Eel Improvements Study do not result in achievement of the Downstream Eel Passage Goal, YORK HAVEN and the Resource Agencies shall on an annual basis consult as to potential additional studies or adaptive measures that are or may become feasible, appropriate under the circumstances, reasonable and technically sound, and reasonably expected to contribute toward achievement of the Downstream Eel Passage Goal.

D. Resident Fish Passage

1. General Requirements

a. The term "resident fish species" means those fish species that occur in that portion of Susquehanna River that includes YORK HAVEN Project area, excluding anadromous and catadromous fish species.

b. The term "East Channel" means the channel of the Susquehanna River that lies between Three Mile Island and the eastern shore of the Susquehanna River.

c. The term "East Channel Fish Passage System" means the existing fish passage facilities maintained by YORK HAVEN Project on the East Channel.

d. YORK HAVEN Project shall operate and maintain the East Channel Fish Passage System to allow passage of resident fish species each year from April 1 through the earlier of December 15 or until the average daily river temperature, measured at either the United States Geological Survey gage at Harrisburg or at the temperature sensor at YORK HAVEN Project is equal to or less than 40 degrees Fahrenheit for three consecutive days.

e. The East Channel Fish Passage System shall be operated as required by this certification and the FOP.

f. During the period that the East Channel Fish Passage System is in operation for the passage of fish, YORK HAVEN Project shall manage debris to maintain the functioning and operability of the East Channel Fish Passage System sufficient to allow and not significantly impede the passage of fish.

g. The provisions of this resident fish passage condition shall be included in the FOP for YORK HAVEN Project.

2. **Prior to Operation of the NLF**

a. After the American shad upstream passage season and during the resident fish passage period referenced above, YORK HAVEN shall operate the East Channel Fish Passage System to allow for passage of resident fish species and provide for corresponding flows in the East Channel as set forth in Section IV. below.

3. **Subsequent to Completion of the NLF Facility**

a. YORK HAVEN shall operate the NLF Facility as described in the FOP.

b. Except when the East Channel Fish Passage System must be closed for repairs and maintenance or except as otherwise approved by the PADEP in writing, YORK HAVEN shall leave the East Channel Fish Passage System open for passage of resident fish during the period April 1 through the end of the resident fish passage season (earlier of December 15 or until the average daily river temperature is $\leq$ 40 degrees Fahrenheit for three consecutive days).

IV. MINIMUM STREAM FLOW ("MSF")

A. Prior to Operation of the NLF

Unless alternative flows are approved by the DEP in writing, YORK HAVEN shall achieve the following.

1. Prior to completion and operation of the NLF Facility, Licensee shall operate the Project consistent with the following flow management criteria:

a. During the American Shad Upstream Passage Season, the Project shall be operated to provide:

i. An average daily minimum flow in East Channel below East Channel Dam of 2,000 cfs.

ii. Spill over Main Dam of equal to or greater than 4,000 cfs.

b. After American Shad Upstream Passage Season until end of resident fish passage season (earlier of December 15 or until the average daily river temperature is ≤ 40 degrees Fahrenheit for three consecutive days):

i. The Project shall be operated to provide a minimum stream flow in East Channel below East Channel Dam of 400 cfs.

ii. When river flows exceed hydraulic capacity of all available hydroelectric generating units, Licensee shall manage flows above the hydraulic capacity of available units in accordance with the following objectives:

a. To maintain the minimum flow in the East Channel of 400 cfs.

b. To maintain sufficient flow at the Main Dam to assure flow is released to the main channel in accordance with the existing FOP, except during times of maintenance work on the Main Dam when reservoir levels are lowered to permit such maintenance to occur safely.

c. To provide additional attraction flows to the East Channel Fish Passage System through operation of the wheel gates within their design capacity.

d. In the event that the flow is not sufficient to meet all such objectives 1-3 above, such objectives will be implemented in the order of precedence listed above.

c. The Project shall be operated to maintain the following minimum flows below the Project (the total of flows through the Powerhouse, over the Main Dam and East Channel Dam):

i. 1,000 cfs or inflow from upstream, whichever is less, at all times.

ii. An average daily minimum flow of 2,500 cfs or inflow from upstream, whichever is less.

iii. Whenever inflow from upstream is less than 3,000 cfs, the Project shall be operated on a run-of-river basis, adding or suspending operations at turbines to reflect, to the extent practicable, inflow from upstream and without adding or suspending turbine operations to deliberately drawdown or store water for purposes of generating electricity in particular time periods.

iv. Minimum flows may be temporarily modified if required by operating exigencies beyond the control of the YORK HAVEN.

B. After NLF Facility Completion.

Unless an alternative minimum stream flow is approved by the DEP, after completion and operation of the NLF Facility, Licensee shall operate the Project consistent with the following flow management criteria:

1. During the American Shad Upstream Passage Season, the Project shall be operated to provide:

   i. An average daily minimum flow in East Channel below East Channel Dam of a minimum of 267 cfs, understanding that as river flow increases above 21,000 cfs, flows over the East Channel Dam will occur in excess of the minimum of 267 cfs.

   ii. Flow through the NLF Facility (passage channel plus supplemental attraction flow channel) equal to at least 5% of river flow when river flows above the Project are between 5,000 and 150,000 cfs.

2. During the remainder of the year (other than the American Shad upstream passage season), the Project shall be operated to provide:

   i. An average daily minimum flow in East Channel below the East Channel Dam of 267 cfs.

   ii. The NLF Facility will be designed and operated to convey a minimum of 200 cfs when the river elevation is at the elevation of the Main Dam.

   iii. When river flows exceed the hydraulic capacity of all available hydroelectric generating units, YORK HAVEN shall manage flows above the hydraulic capacity of available units in accordance with the following objectives:

      a. To maintain a minimum flow in the East Channel of 267 cfs, understanding that as river flow increases above 21,000 cfs, flows over the East Channel Dam will occur in excess of the minimum of 267 cfs.

b. To maximize the remainder of flows above hydraulic capacity flowing over the Main Dam and through the NLF Facility. Within the limits of available flows in excess of the hydraulic capacity, except during the period of December 15 to the earlier of April 1 or the start of American Shad Upstream Passage Season, the supplemental attraction flow channel will be operated with the objective of maintaining a maximum attraction flow through the NLF Facility.

3. The Project shall be operated to maintain the following minimum flows below the Project (the total of flows through the Powerhouse, over the Main Dam and East Channel Dam):

   i. 1,000 cfs or inflow from upstream, whichever is less, at all times.

   ii. An average daily minimum flow of 2,500 cfs or inflow from upstream, whichever is less.

   iii. Whenever inflow from upstream is less than 3,000 cfs, the Project shall be operated on a run-of-river basis, adding or suspending operations at turbines to reflect, to the extent practicable, inflow from upstream and without adding or suspending turbine operations to deliberately drawdown or store water for purposes of generating electricity in particular time periods.

   i. Minimum flows may be temporarily modified if required by operating exigencies beyond the control of YORK HAVEN.

V. DEBRIS MANAGEMENT

A. Except as otherwise provided by the DEP in writing, YORK HAVEN shall (1) continue to implement its existing debris management program as described below; and (2) on or before January 15 of each calendar year, provide an annual contribution of $25,000 per year to the York County Conservation District or such other entity identified in writing by the DEP for the purposes of debris removal in the Lower Susquehanna River Watershed. The amount of the annual contribution shall be adjusted every ten years over the term of this certification. The amount of such adjustment shall be calculated to reflect the aggregate increase in the annual U.S. Department of Labor Consumer Price Index – (All Urban Consumers, All Items) over the ten year period. It is the understanding of the Parties that the York County Conservation District or such other identity identified by the DEP shall administer and utilize such funds for the sole purpose of debris removal in the Lower Susquehanna River Watershed.

B. Under the Project's debris management program, almost all of the debris arrives at the Project during high flow events when river flows far exceed the Project Hydraulic Capacity. Under such debris management program, much of that debris passes over the Main Dam and East Channel Dam, and debris that does not pass over the Main Dam or East Channel Dam accumulates in the forebay. Of the debris that enters the forebay, non-natural debris is removed from the accumulated debris in the forebay to the extent that safety considerations permit, and the remaining (primarily organic) debris material is sluiced downstream through the Forebay Sluice Gate in the masonry non-overflow "cable alley" wall located at the downstream end of the forebay. Prior to opening the Forebay Sluice Gate for debris passage, YORK HAVEN shall notify PPL's Brunner Island Station that debris is to be sluiced at least one-hour prior to debris sluicing, absent extraordinary or emergency circumstances.

8/19/14

Scott Williamson
Program Manager
Waterways and Wetlands Program
Department of Environmental Protection

Date

APPENDIX A - DESIGN CRITERIA FOR NATURAL LIKE FISHWAY

The NLF Facility will be designed and constructed consistent with the following requirements:

1. The NLF Facility shall consist of an in-river nature-like fishway with its downstream terminus at or near the toe of the Main Dam at or near the apex between the Main Dam and TMI, reaching upstream from the Main Dam, with a varying width of approximately 300 feet, a thalweg channel width of approximately 65 feet, and a supplemental attraction flow channel on the TMI side of the NLF Facility, as described in Section 3.0 (Option 4 Conceptual Design) of YORK HAVEN Project Nature-Like Fishway Conceptual Design Report, submitted by YHPC to FERC on March 15, 2013 (the "NLF Conceptual Design Report"). Refer to the conceptual plans provided in Appendix B for additional detail on the design of the NLF Facility.

2. The fishway channel in combination with the supplemental attraction flow facility shall be designed to be capable of conveying during the Upstream American Shad Passage Season at least 5% of the River flow when River flows are between 5,000 and 150,000 cfs. Of this amount, the supplemental attraction flow channel and related control structures shall be designed to convey variable attraction flow volumes of up to 800 cfs (the "Planned Attraction Flow Maximum Value"), but with the capacity to be readily modified to convey, if needed, a variable flow volume of up to 1,000 cfs ("Potential Increased Attraction Flow Value").

3. The NLF shall include a supplemental attraction water facility (SAWF) that will be capable of providing additional flows within and/or near the entrance to the fish passage channel.

   a. The SAWF shall be located on the land side of the fish passage channel and have a maximum discharge capacity of 1,000 cfs (i.e., accommodating both the Planned Attraction Flow Maximum Value and the Potential Increased Attraction Flow Value) when the reservoir is at its normal headwater elevation of 277.2 ft.

   b. The upstream entrance to the SAWF shall be located approximately 75 ft upstream of the nearest constructed upstream exit from the fish passage channel to minimize the chance for fall back through the SAWF. The upstream entrance to the SAWF shall contain a trash rack to impede debris passage into the SAWF.

c. An inlet gate structure of either the underflow or overflow type shall control and regulate flow to the SAWF, allowing some adjustment of flow volumes available for attraction flow purposes. The current plan is to install two inlet gates; however, the final number of gates will be subject to operational and economic considerations, but in no case shall the SAWF design discharge capacity be less than 1,000 cfs at normal pond level (and thus able to accommodate both the Planned Attraction Flow Maximum Value and the Potential Increased Attraction Flow Value).

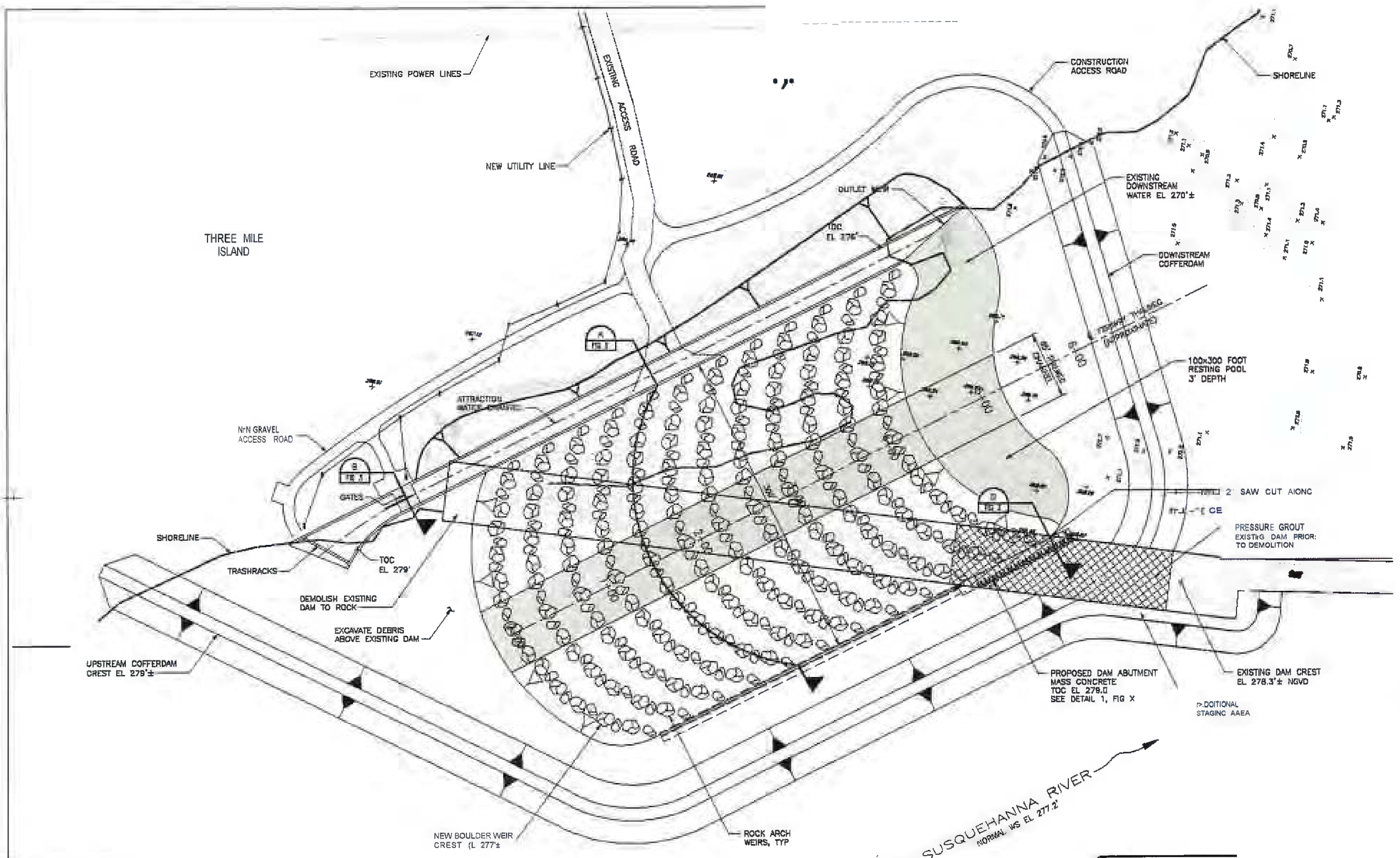
d. Downstream of the inlet gates, flow in the SAWF will travel in a rectangular concrete channel approximately 25 to 30 feet wide and 6 to 8 feet deep. Water from the SAWF may be delivered along the length of the SAWF channel through a series of weirs fitted with stop logs discharging to different points within the fish passage channel, over a sharp-crested weir or weirs at the downstream end of the SAWF delivering water to the holding pool at the entrance to the fish passage channel, and/or to a combination of both of these delivery mechanisms.

e. The final design of the flow dispersal mechanisms shall (1) minimize the chance for delay to American shad entering the fish passage channel from the resting pool; and (2) prevent or minimize the entry of American shad into the SAWF though creation of a localized flow disturbance zone over the sharp-crested weir, creating an elevation difference between the SAWF water elevation and tailwater of at least 2 feet, and/or providing an exclusion rack between the weir and the resting pool. The final design of the SAWF shall also allow for flexibility in the delivery of the attraction water by adjusting flow directly into the fish passage channel or to the downstream end of the SAWF channel. The downstream end of the SAWF shall also provide for flexibility in the direction of flow delivery ranging from parallel to perpendicular to the resting pool, allowing for varying the direction of a portion of the flow away from discharge directly into the resting pool.

4. The upstream end of the NLF Facility will be designed to accommodate installation of Passive Integrated Transponder ("PIT") tag monitoring devices at such time as such PIT tag monitoring devices become available and feasible for reliably monitoring American shad exiting the NLF Facility.

APPENDIX B - CONCEPTUAL DESIGN FOR NLF FACILITY

See attached



PRELIMINARY

REFERENCE COORDINATE METAOATA
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NOTES:
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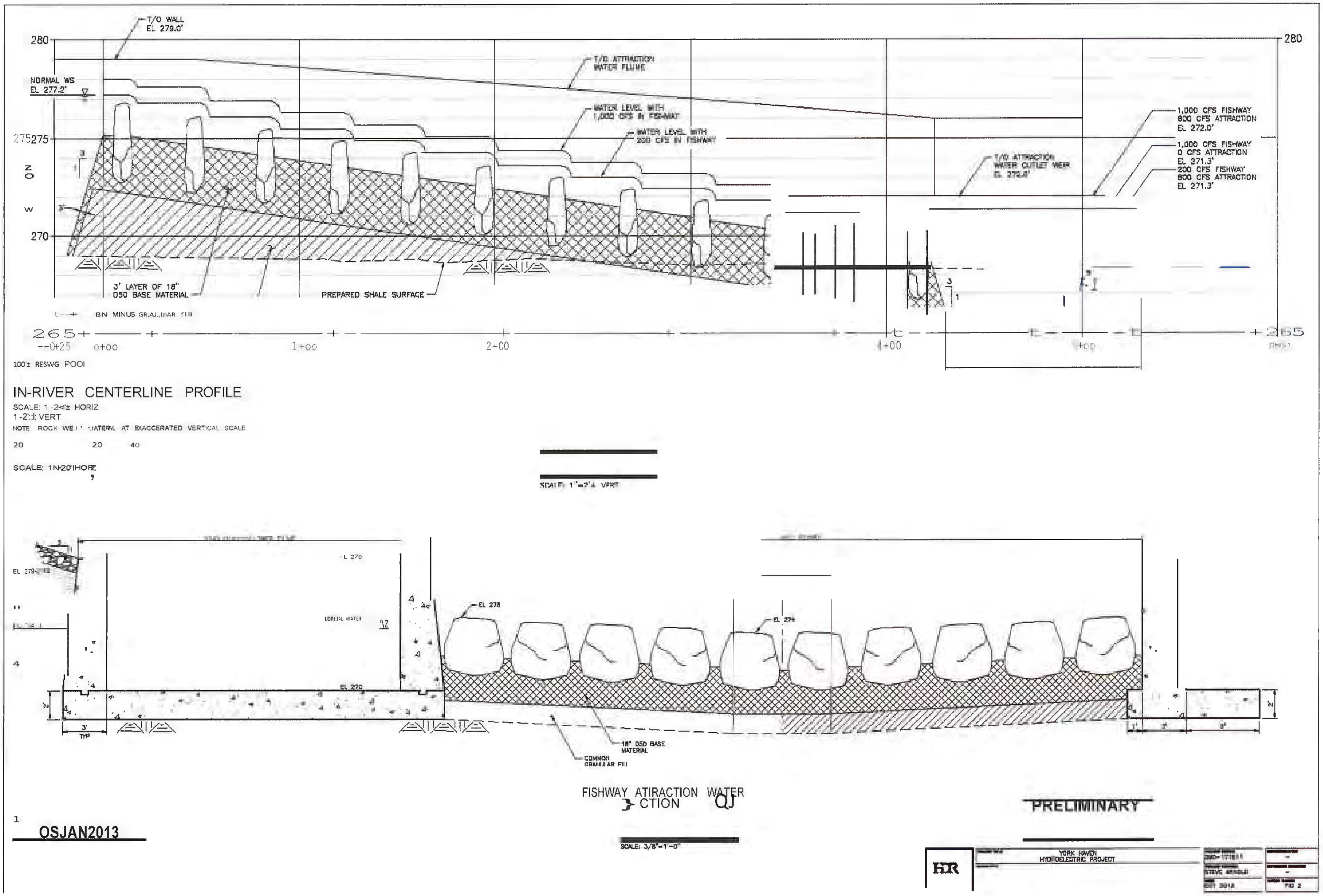
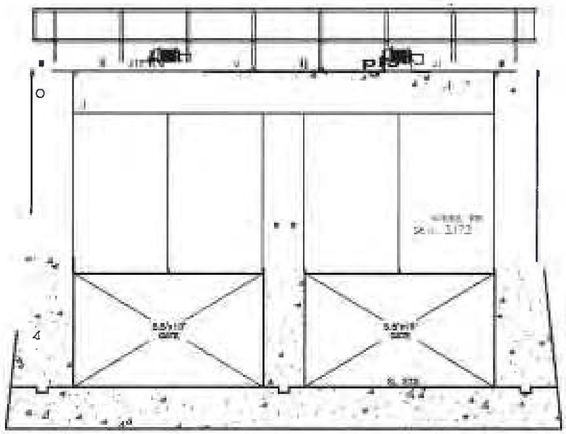
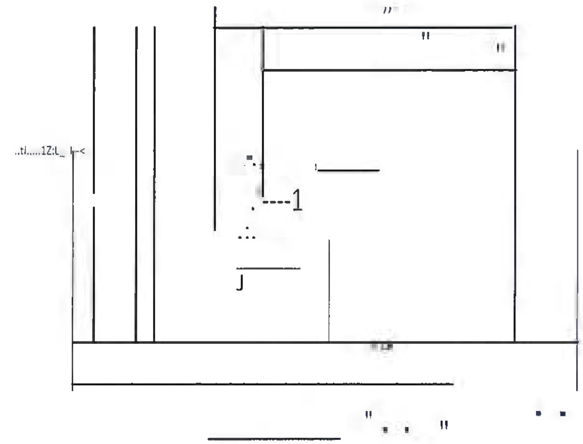
FIG 1

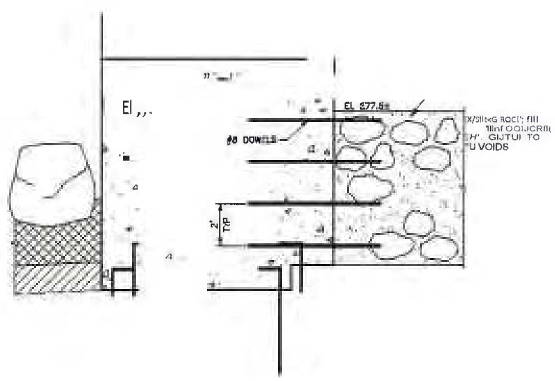
C:\pwworking\ptrr\d0573606\In-River Nature-Like Fishway - Upstream Option 4.dwg, Plan, 1/5/2013 12:07:44 PM, mnapolasone


T/O WALL
EL 279.0'
280
NORMAL WS
EL 277.2'
275
270
T/O ATTRACTION WATER FLUME
WATER LEVEL WITH 1,000 CFS IN FISHWAY
WATER LEVEL WITH 200 CFS IN FISHWAY
T/O ATTRACTION WATER OUTLET WEIR EL 272.0'
1,000 CFS FISHWAY
800 CFS ATTRACTION
EL 272.0'
1,000 CFS FISHWAY
0 CFS ATTRACTION
EL 271.3'
200 CFS FISHWAY
800 CFS ATTRACTION
EL 271.3'
3' LAYER OF 18" D50 BASE MATERIAL
PREPARED SHALE SURFACE
BN MINUS GRANULAR FILL
265
0+00
1+00
2+00
100± RESWG POOL
IN-RIVER CENTERLINE PROFILE
SCALE: 1"=20' HORIZ
1"=2' VERT
NOTE: ROCK WEIR MATERIAL AT EXAGGERATED VERTICAL SCALE
SCALE: 1"=20' HORIZ
SCALE: 1"=2' VERT
EL 278
EL 276
EL 270
NORMAL WATER
EL 279.2
18" D50 BASE MATERIAL
COMMON GRANULAR FILL
3' TYP
2'
FISHWAY ATTRACTION WATER SECTION
SCALE: 3/8"=1'-0"
05JAN2013
PRELIMINARY
HDR
YORK HAVEN HYDROELECTRIC PROJECT
FIG 2





GATE SECTION



MASS CONCRETE SECTION

PRELIMINARY
05JAN2013

FIG 3

APPENDIX C - DESIGN CRITERIA FOR NLF FACILITY MONITORING

Monitoring of NLF Facility effectiveness for upstream passage of American shad will be conducted consistent with the following general parameters and protocols:

1. INTRODUCTION

The Nature-Like Fishway (NLF) effectiveness study will be performed with telemetry tracking and monitoring techniques, building upon the site-specific experience and results of successful adult American shad tracking studies performed at YORK HAVEN in 2010 and 2012. American shad will be tagged at the Safe Harbor Dam fish lift required or approved by PADEP in writing, approximately 25 miles downstream and allowed to migrate upstream to YORK HAVEN Project on their own volition. Based on the results of the 2010 study, 70 percent of the shad tagged at Safe Harbor are expected to arrive at YORK HAVEN. Once at YORK HAVEN, a series of 10 monitoring station antennae will record tagged shad as they arrive at the Project, monitor their movements within the Project area, document the tagged shad that arrive at the NLF fishway entrance and document the tagged shad that exit the NLF fishway. Monitoring will also be performed below and above the East Channel Fishway to document tagged shad upstream passage via the East Channel. The study will be performed for at least two years following NLF construction.

2. STUDY GOALS

- Determine the proportion of American shad tagged at Safe Harbor arriving at YORK HAVEN Project.
- Of the tagged shad arriving at YORK HAVEN, determine the proportion arriving at the lower entrance of the new NLF.
- Of the tagged shad arriving at YORK HAVEN, determine the proportion exiting the NLF into YORK HAVEN impoundment.

- Of the tagged shad arriving at YORK HAVEN, determine the proportion that passes upstream via the East Channel Fishway.
- Evaluate movement patterns and travel times of tagged shad within YORK HAVEN Project area.

3. STUDY EQUIPMENT

Radio telemetry techniques, similar to those utilized for the 2010 and 2012 YORK HAVEN shad telemetry studies, are envisioned as the primary equipment for the fishway effectiveness studies. However, similar tracking technologies (e.g., acoustic telemetry) or new fish tracking technologies that are functionally equivalent (or superior) to and of comparable cost to radio telemetry techniques may be substituted upon consultation with the Resource Agencies and the approval of USFWS and PADEP.

4. FISH TAGGING

American shad will be tagged at the fish lift at Safe Harbor Dam (assuming owner approval) , unless an alternate location for the source of American shad is approved by PADEP in writing, similar to the 2010 American shad telemetry study. A target sample size of 150 American shad will be tagged for study. Assuming a drop-off rate similar to that observed in 2010 during volitional migration from Safe Harbor to YORK HAVEN (30%), this would result in a sample size of approximately 100 tagged shad arriving at YORK HAVEN. Two telemetry receivers will be installed at Safe Harbor during shad tagging operations; one at the fishway exit to confirm tagged shad have traveled through the fishway flume and entered into Lake Clarke, and a second in the Safe Harbor tailrace to detect any tagged shad that fall back downstream through Safe Harbor Dam. Efforts will be made to spread out tagging over the early, middle, and later portions of the shad run and to tag representative numbers of both male and female shad.

5. YORK HAVEN MONITORING

A network of 10 remote telemetry monitoring locations is proposed as illustrated in the attached Project area map. The location and purpose of each is described below:

1. Cross river monitoring at south end of powerhouse; documenting downstream Project study reach entry and exit
2. Tailrace monitoring; documenting tailrace presence, subdivided in to a) southern half and b) northern half of tailrace
3. Cross river monitoring just above the powerhouse; documenting movement upstream out of the tailrace or downstream into tailrace area
4. Cross river monitoring at upper end of headrace wall; documenting arrival/departure at the base of a steeper gradient channel reach
5. Cross mouth of East Channel; documenting arrival/departure at the lower end of the East Channel
6. TMI to Main Dam spillway; documenting arrival/departure to the Main Dam apex region at the upper extent of the steeper gradient channel reach
7. Across lower end of NLF; documenting tagged shad entry into NLF
8. Across upper end of NLF; documenting passage above YORK HAVEN Dam
9. Cross channel monitoring immediately below the East Channel Dam; documenting arrival at base of dam
10. Cross channel monitoring just above the East Channel Dam; documenting passage above the dam.

Monitoring will be performed from the day the first shad are tagged and released until the end of the upstream passage season. Manual ground-based tracking with a hand held receiver may also be conducted on an as-needed, discretionary basis, if it is deemed helpful to better define tagged shad locations or behavior within the Project area.

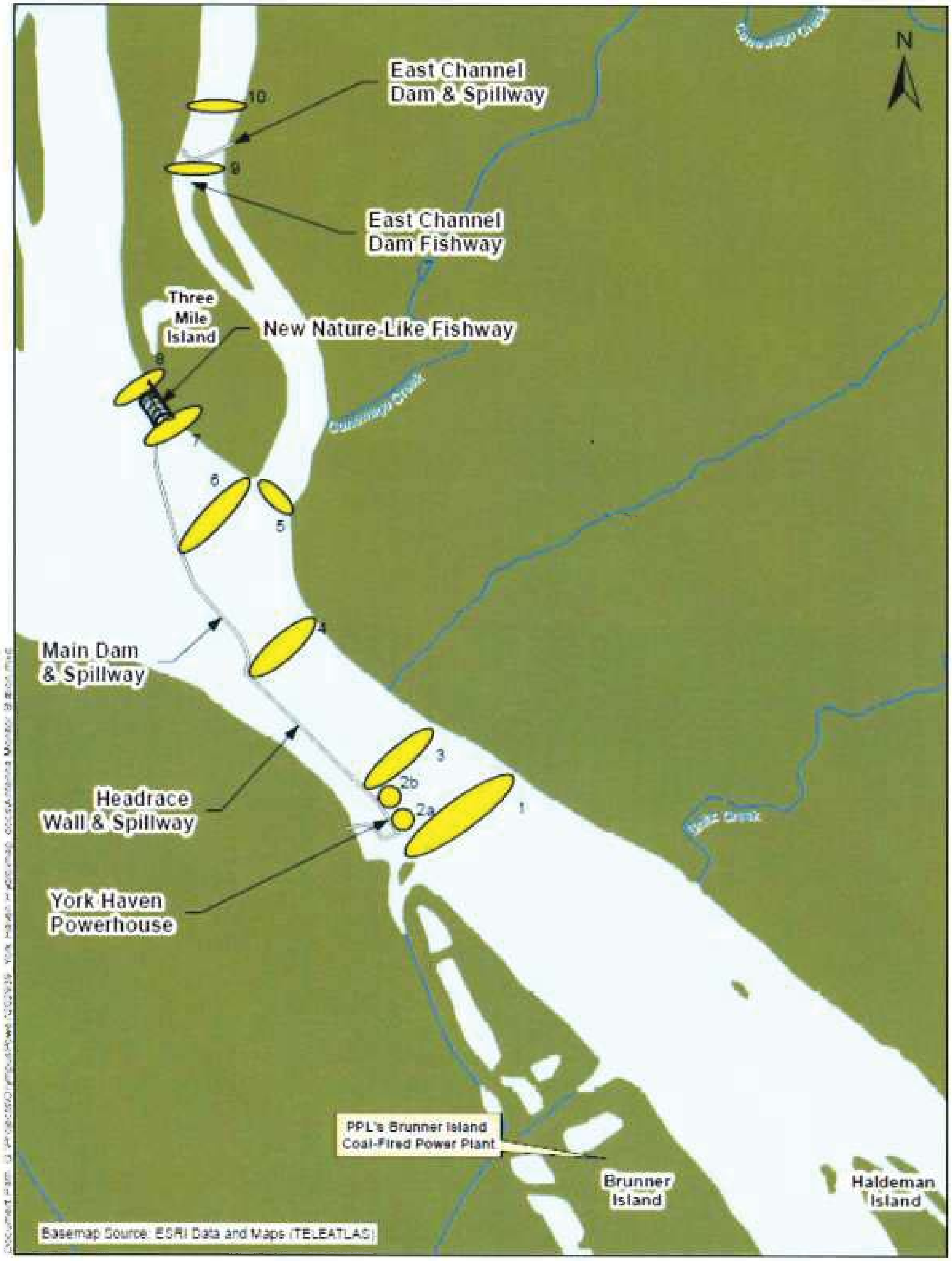
6. DATA MANAGEMENT AND ANALYSIS

Telemetry receiver data will be periodically downloaded and detection capabilities will be checked with a hand held transmitter on weekly intervals, and more frequently as appropriate during peak migration periods. Downloaded data files will be backed-up with duplicate files the same day. Upon completion of the field season data will be QC checked and processed for analysis.

7. REPORTING

A study summary report will be prepared and submitted for agency review within six (6) months following the completion of each year's monitoring program. Individual fish movement graphics, data summary graphics, and appropriate statistical treatment similar to the 2010 study supplemental data analysis, will be prepared and presented in the study report.

EXHIBIT 1 TO APPENDIX C



APPENDIX D - JUVENILE AMERICAN SHAD SURVIVAL RATES FOR PROJECT TURBINES

Turbine Type (Unit Nos.)	Survival Percentage *					
	Empirical Studies American Shad Juveniles			Turbine Blade Strike American Shad Juveniles		
	Mean	Min	Max	Mean	Min	Max
Kaplan (1-4)	**92.7%**	82.0%	100.0%	95.9%	91.6%	98.0%
Propeller (5)	-	-	-	**95.3%**	91.3%	97.4%
Propeller (6)	-	-	-	**96.5%**	93.5%	98.0%
Double-Francis (7-13 and 15-20)	**77.1%**	66.0%	88.0%	93.6%	92.4%	94.9%
Single Francis (14)	-	-	-	**92.5%**	90.9%	94.1%

* Mean values in **underlined bold** to be used in calculations of overall Project survival rates.

APPENDIX E - FOREBAY SLUICE GATE CHUTE DESIGN CRITERIA

The Forebay Sluice Gate Chute improvements shall be designed constructed consistent with the following requirements.

1. The Forebay Sluice Gate Chute shall be capable of maintaining a depth of water of at least 12 inches.
2. The landing pool below the downstream end of the Forebay Sluice Gate Chute shall have a depth of at least 1 foot for each 4 feet of drop, with a minimum of 4 feet of depth, in which adult or juvenile American shad may land.

APPENDIX F – HEADRACE JUVENILE AMERICAN SHAD TURBINE AVOIDANCE STUDY DESIGN

1. INTRODUCTION

The purpose of this study is to document the proportion of juvenile American shad arriving in YORK HAVEN powerhouse forebay that pass downstream via the Forebay Sluice Gate during the outmigration season. This information will be used in turn to evaluate whether or not the Project is achieving the desired overall juvenile American shad downstream survival goal of 95 percent. Modeling of juvenile American shad downstream passage has shown that the required sluice gate passage rate, to reach the overall Project survival goal of 95 percent, varies widely with river discharge and Project turbine operations. The worst case scenario is when no spill is occurring and all turbines are operating (17,000 cfs), plus the Nature-Like Fishway flow (200 cfs), East Channel minimum flow (200 cfs), and sluice gate flow (370 cfs), or approximately 18,000 cfs total river flow. Under this worst case condition 68 percent of shad in the fore bay must pass through the sluice gate to achieve the overall 95 percent survival goal. The required Forebay Sluice Gate passage rate to achieve the 95 percent goal declines at flows both above and below 18,000 cfs as illustrated in the summary table below of model results:

Estimated sluiceway bypass effectiveness metrics at various river flows of 6,000 to 30,000 cfs.

Total River Flow	**30,000**	**27,000**	**24,000**	**21,000**	**18,000**	**15,000**	**12,000**	**9,000**	**6,000**
Flow at Forebay	17,275	17,275	17,275	17,275	17,275	14,533	11,533	8,533	5,533
Total Project Survival	95%	95%	95%	95%	95%	95%	95%	95%	95%
Number of Total Shad Approaching the Project	100	100	100	100	100	100	100	100	100

Number of Shad Approaching the Forebay	58	64	72	82	96	97	96	95	92
Percent of Total Shad Passing through the Sluiceway	27	33	42	52	65	63	58	42	20
Percent of Forebay Shad Passing through the Sluiceway	**47**	**52**	**58**	**63**	**68**	**66**	**60**	**44**	**22**

Based on this analysis, an overall target of 60 percent of fore bay juvenile American shad passing through the sluice gate has been established to represent the overall conditions necessary to meet the 95 percent total survival goal under the variable river flows throughout the entire October through November downstream passage season.

2. STUDY GOAL

The study goal will be to determine the proportion of juvenile American shad confined to the fore bay that will pass through the fore bay sluicegate (avoiding turbine entrainment) under river flows and operations representative of the October through November downstream passage season.

3. STUDY EQUIPMENT

Due to their small size and fragile nature, out-migrating juvenile American shad are easily injured during handling, and are generally too small to be tagged with conventional telemetry transmitters. However, recent studies have had some success using abdominal implant PIT tags and new smaller radio transmitters (nano-tags) on juvenile American shad and river herring. Generally, the larger the fish the better the post tagging survival and therefore the use of juvenile American shad greater than 100 mm in length is recommended for tagging. Obtaining 100 mm juvenile American shad will likely require the assistance of PFBC to grow juvenile

American shad to this size in their shad hatchery facility or obtaining juvenile American shad from another hatchery, since only a small portion of the wild population reaches this size before outmigration. Fish used for the study will be tested for latent tagging mortality to establish a correction factor, which shall be discussed with the Resource Agencies during the performance of the study.

YHPC anticipates using abdominal implant PIT tags or possibly radio transmitter "nano-tags" or both. Telemetry equipment and methods are constantly improving, therefore new equipment that accomplishes the same study purpose and goals may be substituted, after consultation with the Resources Agencies, and approval by USFWS and PADEP.

4. STUDY METHODOLOGY

Sluice gate passage rates will be determined by releasing three groups of at least 100 tagged juvenile American shad into the powerhouse forebay and counting those that pass through the sluice gate on each of three separate (but not necessarily consecutive) days in the period of mid-October through mid-November. At least two days will be targeted to a period when river flows equal or exceed the hydraulic capacity of the Project (17,000 cfs) and the Project is operating normally. For purposes of this study, "operating normally" means that no more than two turbine units are temporarily out of operation for maintenance or other reasons. Monitoring for tagged shad passage will be performed with an antenna and receiver at the forebay sluice gate and monitoring will continue for at least two weeks after the release of test fish. Test shad will be released at a point far enough upstream of the headrace to avoid bias to their movements downstream.

5. DATA ANALYSIS

Since monitoring the 20 generating turbines for tagged juvenile American shad passage at YORK HAVEN Powerhouse is not practical with current tagging and detection technologies, shad that are not detected passing through the sluice gate will be assumed, by default, to have been entrained through a turbine. This assumption creates the risk of overstating entrainment, as it would not account for potential predation by larger fish on test fish in the forebay, if any tagged fish swim upstream out of the forebay and pass downstream at other locations, or mortality due to handling and tagging. Some of this risk will be managed by keeping a number of control fish that are handled identically to the test fish captive for observation to provide for a handling mortality control estimation. If radio transmitter nano-tagging of some test fish is practical, tracking these fish may provide insight into upstream escape or predation sources of bias.

However, eliminating the study bias to overestimate entrainment is not possible with currently available methodologies and study results must be reviewed with this possibility in mind.

6. REPORT

A study report describing study methods and results will be prepared and submitted for Resource Agency review within 90 days following the completion of the field study.

APPENDIX G - DESIGN CRITERIA AND ELEMENTS OF THE LOWER SUSQUEHANNA RIVER DOWNSTREAM EEL STUDY AND SITE-SPECIFIC ROUTE- OF-PASSAGE STUDY

1. Lower Susquehanna River Downstream Eel Study

a. The Lower Susquehanna River Downstream Eel Study will consist of those elements developed by the USFWS, in consultation with YORK HAVEN and other Resource Agencies.

b. During the Lower Susquehanna River Downstream Eel Study, YORK HAVEN shall cooperate and participate by monitoring the tagged eels as they pass YORK HAVEN Project, gathering site specific data on timing and duration of silver eel migration at the Project over a period 2 or more years while the Lower Susquehanna River Downstream Eel Study is being conducted.

2. Site-Specific Downstream Eel Study

a. The Site-Specific Downstream Eel Study will consist of the following elements:

(1) The study will include a site-specific route-of-passage evaluation using radio telemetry, Didson monitoring, or other methods to evaluate the passage routes taken by silver eels migrating in the vicinity of the Project, specifically including passage via the East Channel, through the NLF Facility, over the Main Dam, down the headrace, through powerhouse turbines, and through the Forebay Sluice Gate. The Site Specific Route of Passage study will be conducted during the primary anticipated silver downstream eel passage period(s) as determined by the earlier Lower Susquehanna River Downstream Eel Study.

(2) A study of silver eel survival through the following representative Project turbines: Propeller (Units 1-6), Francis (Units 7-20). Testing shall be conducted in one representative turbine within each category via balloon tag tests or other methods approved by the Resource Agencies.

(3) An analysis based on the results of the route-of-passage and survival evaluations, as to anticipated overall downstream eel passage effectiveness at the Project.

3. Source of Silver Eels.

(a) An in-basin source of silver eel will be utilized for both the Lower Susquehanna River Downstream Eel Study and the Site-Specific Route-of-Passage Study.

(b) Current tributary stocking is conducted in Pine Creek ~165 mi upstream from YORK HAVEN Project and Buffalo Creek ~80 mi upstream from YORK HAVEN Project. These eels may be suitable for the Lower Susquehanna River Downstream Eel Study if a sufficient number of silver phase eels can be located, captured, and radio tagged.

(c) For purposes of Site-Specific Route-of-Passage Study and survival study, a local source of silver eels is needed (avoiding long transit times with higher potential for loss of tagged eels, and long distance transport of eels). For these purposes, the Resource Agencies will consider stocking of Swatara Creek and Conodoguinet Creek, major tributaries entering the Susquehanna River upstream of the Project. Such a stocking program, if commenced in 2014-15, should result in a local supply of silver eels around the 2020 – 2025 timeframe, which would be an ideal source of silver eels for the site- specific route of passage study. The timing and performance of the Site-Specific Route- of-Passage Study is dependent upon the ability to collect and tag an adequate number of such silver eels.

4. Collection and Tagging of Silver Eels for Study.

(a) To facilitate consistency, the Parties contemplate that that the Resource Agencies will perform the collection and tagging of silver eels for studies, using similar tags and techniques; however, the USFWS cannot promise to do so.

(b) It is assumed that the Lower Susquehanna River Downstream Eel Study will utilize silver eels from Buffalo and/or Pine Creeks as these tributaries have been stocked with elvers since 2010 and will be the first available in-basin source of silver eels.

(c) The Site-Specific Route of Passage study would be performed in the year following NLF Facility completion, utilizing silver eels collected from Swatara Creek or Conodoguinet Creek.

(d) In both studies, the preference would be to collect actively outmigrating silver eels by fyke nets. Alternatively, electrofishing or other active sampling methods may be used to pursue eels. Radio tags would be surgically inserted in those eels that exhibit physical characteristics of silver outmigration (movement, size, color, eye size/darkness).

(e) All silver eels captured will be tagged with radio telemetry tags, and released at a site agreed upon by YORK HAVEN, USFWS and PADEP, after consultation with the Resource Agencies.

(f) It is assumed that the Lower Susquehanna River Downstream Eel Study would involve tagging of approximately 100 silver eels in each of two years.

(g) For the Site-Specific Route-of-Passage study, the goal would be to collect and radio tag at least 100 and not more than 150 actively out-migrating silver eels in the months of September – November, with timing related to the start of silver eel natural migration as indicated by results from the Lower Susquehanna River Downstream Eel Study.

5. Monitoring.

(a) During the Lower Susquehanna River Downstream Eel Study, YORK HAVEN will perform monitoring via antenna arrays targeted to monitor downstream migrating silver eels at the following locations:

(i) East Channel

(ii) Main Dam

(iii) The Powerhouse Headrace Channel

(b) During the Site-Specific Route-of-Passage Study, YORK HAVEN will perform monitoring via antenna arrays targeted to monitor silver eels at the following locations:

(i) NLF Facility

(ii) East Channel Dam

(iii) Main Dam

(iv) Forebay entrance

(v) Forebay Sluice Gate

(vi) Tailrace (in an array to distinguish between Francis and Propeller Turbine Passage)

(vii) Brunner Island.

(c) In both studies:

(i) Monitoring for passage at YORK HAVEN Project would be continued until river water temperature falls to 4° C (approximately mid to late December).

(ii) If a large portion of the tagged eels are missing during the initial fall migration period, consider mobile surveys to locate eels/transmitters and possibly monitoring during spring and following fall.

(iii) During subsequent years of study, the monitoring period may be further reduced in time if data gathered indicates it is reasonable to do so without missing significant portions of the migration.

5. Analyze data and report.

(a) For the Lower Susquehanna River Downstream Eel Study, YORK HAVEN will collect, analyze and share radio telemetry data gathered at the 3 YORK HAVEN monitoring stations with the Resource Agencies within 90 days of the date of completion of the field work each year. Earlier informal sharing of preliminary data may also be arranged.

(b) For the Site-Specific Route-of-Passage Study, YORK HAVEN will collect and analyze the radio telemetry data and submit a report with a report to the Resource Agencies and FERC within 90 days of the date of completion of the field work associated with the study.

APPENDIX H - DESIGN CRITERIA FOR EEL SURVIVAL STUDY

Eel survival studies will be performed according to balloon tagging techniques developed by Normandeau Associates, Inc. at several locations in the USA and France. Based on the frequency of individual turbine passage determined in the route of passage studies, one representative propeller unit and one representative Francis unit will be selected for testing. American eels of similar size to Susquehanna River silver eels will be tested. The number of eels tested at each representative turbine (minimum of 50 each turbine) will be sufficient to calculate appropriate statistical bounds around each survival estimate. Control eels for estimation of tagging-induced mortality will also be held for observation and subsequent adjustment of turbine mortality estimates, as appropriate.

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APPENDIX G

WATER QUALITY CERTIFICATION

MUDDY RUN PUMPED STORAGE PROJECT

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pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

WATERWAYS & WETLANDS PROGRAM

December 9, 2014

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E. Rom 1-A
Washington, D.C. 20426

Re: 401 Water Quality Certification
Exelon Generation Company, LLC
DEP File No. EA 36-033
FERC Project P-2355-018

Dear Ms. Bose:

Enclosed is a clarified version of the Section 401 Water Quality Certification for the Muddy Run Pumped Storage Facility, FERC Project P-2355-018.

Sincerely,

Scott Williamson
Program Manager
Waterways & Wetlands Program

SW/MDP/lmt

cc: Shelia Eyler at USFWS Chesapeake Bay Field Office
Shawn Seaman at MDNR
Joshua Tryninewski at PFBC
Drew Dehoff at SRBC
Colleen E. Hicks at Exelon Power

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

WATER QUALITY CERTIFICATION
FOR MUDDY RUN PUMPED STORAGE PROJECT
AND RELATED MITIGATION
FERC PROJECT NO. P-2355-018

EA 36-033: EXELON GENERATION COMPANY, LLC,

Colleen E. Hicks
Manager Regulatory and Licensing, Hydro
Exelon Generation Company, LLC
300 Exelon Way
Kennett Square, PA 19346

Drumore, Martic and Peach Bottom Townships
York and Lancaster Counties
United States Army Corps Of Engineers, Baltimore District

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**PENNSYLVANIA WATER QUALITY CERTIFICATION
FOR MUDDY PUMPED STORAGE PROJECT
AND RELATED MITIGATION
FERC PROJECT NO. 2355-018**

I. PROJECT DESCRIPTION

A. EA 36-033:

The Muddy Run Pumped Storage Project ("Muddy Run") is an existing 800 MW (nameplate capacity) hydroelectric project located on the eastern shore of Conowingo Pond on the Susquehanna River in Lancaster County that has operated since 1966. Muddy Run is owned and operated by Exelon Generation Company, LLC ("EXELON"), a wholly-owned subsidiary of Exelon Corporation. EXELON has filed a Final License Application ("FLA") for Muddy Run with the Federal Energy Regulatory Commission ("FERC") seeking to relicense the project for a 46-year term.

Muddy Run is located on the Susquehanna River in Martic and Drumore Townships, Lancaster County. EXELON proposes to continue operation of the facility, including the main dam embankment, east dike, recreation pond dam and spillway, canal dam embankment, upper reservoir spillway, intake structure, powerhouse, primary transmission line, 900-acre Muddy Run Power Reservoir and 100-acre recreation lake (Holtwood, PA Quadrangle; Latitude: 39° 48' 33.34"N Longitude: -76° 17' 49.29" W). Continued operation of the facility is expected to have entrainment effects on resident and migratory fish (including bluegill, rock bass, smallmouth bass, white crappie, channel catfish, walleye, American shad, alewife and blueback herring) as well as American eel and other aquatic species.

EXELON will mitigate the impacts on these aquatic resources by implementing a program to trap approximately one million (1,000,000) eels per year from below the Conowingo Dam in Maryland and in the Octoraro Creek and transport them to multiple locations in the Susquehanna Watershed in Pennsylvania. EXELON will also provide five hundred thousand dollars ($500,000.00) per year for habitat/sediment improvement projects in Lancaster and York Counties. This will include the implementation of agricultural pasture and barnyard best management practices to address sediment introduction, stream improvement projects, riparian buffers and small dam removal projects. This mitigation will continue through 2030 when it will be revisited through a re-evaluation of the water quality certification. Finally, EXELON will assist the SRBC with modeling efforts in the Susquehanna River.

EXELON will also achieve certain fish passage targets for migratory fish and eels passing through the project area, and will take corrective action if the fish passage targets are not achieved. EXELON will conduct dissolved oxygen testing and endangered species evaluation.

This water quality certification will be revised in 2030, as appropriate, to address demonstrated project impacts and subject to the provisions of this certification, to establish requirements consistent with Section 401 of the Clean Water Act, 33 U.S.C Section 1341.

II. PROVISIONS APPLICABLE TO ALL WATER QUALITY CERTIFICATION CONDITIONS

A. Final Agency Action. Notwithstanding any other provision of this certification to the contrary, any action taken by the Pennsylvania Department of Environmental Protection ("DEP" or "Department") in response to any submission required or authorized under this certification, any action taken by DEP to revise, modify, reopen, or revoke this certification, or any action taken by DEP to require EXELON to undertake any action that affects EXELON's personal or property rights, privileges, immunities, duties, liabilities or obligations including, but not limited to, any action to approve, approve with conditions, disapprove, modify or establish operational or structural changes, plans, schedules, studies or monitoring programs shall constitute a "final agency action" and may be challenged in accordance with applicable law.

B. **Operational modifications** are a component of the adaptive management system to implement the approved plans, including the performance requirements of this certification. Operational modifications include modifications of seasonal and daily periods of operation of the project detailing how the plant shall be operated during fish passage season and throughout the year including the sequencing of pump and turbine start-up and operation, procedures for monitoring and reporting flows as well as any other necessary provisions for plant operation to meet the provisions of this certification, procedures for monitoring and reporting on the operation of the facility or other provisions of this certification or any measures, procedures for start-up and shut-down, and procedures for use in case of emergencies and project outages affecting the provisions of this certification. No substantial alteration or addition to the Muddy Run project not in conformity with the plans approved by the FERC shall be made to any project works constructed under the Federal Power Act without the prior approval or authorization of the FERC.

C. **Structural modifications** are changes to project infrastructure, pursuant to the provisions of this certification. No substantial alteration or addition to the Muddy

Run project not in conformity with the plans approved by the FERC shall be made to any project works constructed under the Federal Power Act without the prior approval or authorization of the FERC.

D. Resource Agencies - "Resource Agencies" shall mean the DEP, Pennsylvania Fish and Boat Commission ("PFBC"), Pennsylvania Department of Conservation and Natural Resources ("DCNR"), Susquehanna River Basin Commission ("SRBC"), Maryland Department of Natural Resources ("MDNR"), and United States Fish and Wildlife Service ("USFWS").

E. General Requirements

1. The Muddy Run project shall at all times be subject to inspection by representatives of DEP. DEP reserves the right to require such operational and structural changes as may be considered necessary to assure compliance with the Federal Water Pollution Control Act ("Clean Water Act"), the Pennsylvania Clean Streams Law, the Dam Safety and Encroachments Act, and other appropriate requirements of state law. Subject to applicable law, DEP further reserves the right to alter this certification for failure to comply with the Clean Water Act and/or appropriate requirements of the state law, an administrative order of DEP, or a term or condition of this certification.

2. Any additional information or modifications to any plans or schedules required under this certification requested by the DEP shall be submitted within the time frame established by the DEP in writing.

F. Reasonable Assurance of Compliance - DEP supports issuance of a 46 year license for the project. Because certain conditions of this certification expire in 2030, because of changes in the characteristics of the Susquehanna River that will occur by 2030, and because the FERC licenses for the Holtwood Hydroelectric Facility and the Safe Harbor Hydroelectric Facility expire in 2030, this certification will be revised in 2030, as necessary to address demonstrated project impacts and subject to the provisions of this certification, to establish requirements consistent with Section 401 of the Clean Water Act, 33 U.S.C Section 1341.

III. FISH PASSAGE

A. General Requirements

1. Fish Passage Operating Procedures ("FPOP")

a. By January 15, 2015, EXELON shall submit a FPOP to the DEP for review and approval. The FPOP will describe existing baseline operations during fish passage season, including schedules for routine maintenance, procedures for routine operation (including: seasonal and daily periods of operation, pump and turbine operations), sequencing of pump and turbine start-up and operation, procedures for monitoring and reporting flows, procedures for monitoring and reporting on the operation of the facility, procedures for start-up and shut-down, and procedures for use in case of emergencies and project outages significantly affecting the conditions of this certification.

b. EXELON shall implement the FPOP consistent with the approval of the DEP. EXELON shall provide written documentation to the Resource Agencies that operational personnel have reviewed and understand the FPOP signed by the operations manager of the Project.

c. Copies of the approved FPOP and all modifications will be provided to the Resource Agencies.

d. By December 31 of each year, EXELON shall provide an annual report to the Resource Agencies detailing: the implementation of the FPOP, including any deviations from the FPOP and a process to prevent those deviations in the future; any proposed modifications to the FPOP, or in the case of emergencies or project outages, the steps taken by EXELON to minimize adverse effects on fisheries including any proposed modifications to those steps to further enhance their effectiveness in the future. EXELON shall offer to meet with the Resource Agencies by January 31 of each year unless a different date is mutually agreed upon by EXELON and the Resource Agencies. Any required modifications to the FPOP shall be submitted to the Resource Agencies within 45 days of receipt of a request for the modification unless a longer period is approved by the DEP. The modifications to the FPOP shall be implemented consistent with the approval of the DEP. In the event EXELON fails to submit the modifications as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish modifications and EXELON shall implement the modifications consistent with the approval of the DEP.

B. American Shad Passage

1. Upstream Shad Passage

a. Shad Passage Monitoring. In 2018, or such later date established by DEP, EXELON shall meet with the Resource Agencies to develop a plan and schedule for a radio telemetry study or equivalent (Tier II Study) of American shad passage and behavior within the Muddy Run project boundary; provided, however, that no such plan will be required if available data demonstrates that: (1) 75% of upstream migrating American shad that pass Conowingo Hydroelectric Project also pass the Holtwood Hydroelectric Project; and (2) 50% of American shad that pass the Conowingo Hydroelectric Project pass the Holtwood Hydroelectric Project within (5) days.

b. Tier II Study. The radio telemetry study plan and schedule or equivalent will determine the percentage of American shad that enter the Muddy Run project at the northern tip of Sicily Island area and subsequently exit the Muddy Run project area at the southern tip of Deepwater Island. The radio telemetry study shall be designed to insert the transmitter at the Conowingo facility or at such other location(s) approved by the DEP.

c. Within two months of the meeting described in Paragraph III.B.1.a. or such longer period approved by the DEP in writing, EXELON shall submit the fish passage study plan and schedule to the Resource Agencies for review and approval by DEP. EXELON shall implement the Tier II Study, consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP. EXELON shall continue implementation of a fish passage study for a minimum of four years or such other time period as required by the DEP in consultation with the other Resource Agencies. EXELON shall provide an annual report of the monitoring results of the fish passage study by December 31st of each year.

d. At the end of the four-year study period, or such longer time as established by the DEP, if the results indicate that, as a result of Muddy Run operations, less than 88% of the American shad that enter the Muddy Run project waters at the northern tip of Sicily Island exit the Muddy Run project waters at the southern tip of Deepwater Island, EXELON shall propose a plan and schedule for operational modifications to the extent feasible, appropriate under the circumstances, reasonable and technically sound to enhance fish passage at the project. EXELON shall not be responsible for mitigating any impacts to American Shad not caused, in whole or in part, by EXELON's operation of the Muddy Run project. This plan and schedule shall be submitted to the DEP as an amendment to the FPOP for the following year. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

e. The average of the two highest years in the monitoring period will be used determine whether the 88% fish passage percentage is achieved. If EXELON implements operational modifications, only those years following the operational modifications shall be considered to determine whether the 88% passage percentage is achieved.

f. If at the end of the monitoring period, or such longer time as established by the DEP, the results indicate that the operational modifications have resulted in less than 88% of the American shad that enter the Muddy Run project waters pass through the Project, EXELON shall propose a plan and schedule for mitigation, as defined in 25 Pa. Code Section 105.1 for the failure to achieve the 88% fish passage target. This mitigation shall be: (1) in addition to the compensatory mitigation described in this certification; and (2) reasonably related and proportional to the identified impact. This plan and schedule shall be submitted to the Resource Agencies within 6 months from the end of the monitoring period. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

2. **Downstream Shad Passage**

Consistent with the relicensing studies for Muddy Run, by January 15, 2015, EXELON shall submit a plan and schedule to provide for 95% survival of the juvenile American shad and 80% survival of the adult American shad that pass through the project area. The schedule shall provide for full implementation of the plan by 2015. EXELON shall implement the approved plan and schedule. If EXELON fails to submit the plan, the DEP shall develop a plan and schedule, in consultation with the other resource agencies, and EXELON shall implement that plan and schedule.

a. By February 15, 2026 or such later date approved by the DEP in writing, EXELON shall submit a plan to measure the passage of American shad moving downstream past the project to the DEP for approval ("Discrete Passage Study"). EXELON shall implement the plan to measure the passage of American shad moving downstream past the project according to the schedule and consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

b. EXELON shall, in accordance with the plan, conduct the Discrete Passage Study. EXELON shall provide a report of the Discrete Passage Study within 180 days of its completion or such later date approved by the DEP in writing to the Resource Agencies.

c. If the results of the Discrete Passage Study indicate that EXELON can operate the Muddy Run project so that EXELON achieves at least 95% passage of the juvenile American shad and 80 % passage of the adult American shad that pass through the project area based on the likelihood of a shad being exposed to typical pumping operations and becoming entrained, then EXELON shall incorporate into the annual FPOP any required operational measures or protocols to meet the established percentages. These procedures will be subject to review at the annual meeting for the FPOP.

d. If the results of the Discrete Passage Study do not indicate that the project can be operated to achieve at least 95% passage of juvenile American shad and 80% passage of adult American shad based on the likelihood of a shad being exposed to typical pumping operations and becoming entrained, EXELON shall propose a plan and schedule for mitigation, as defined in 25 Pa. Code Section 105.1, for the failure to achieve the fish passage target or targets. This mitigation shall be: (1) in addition to the compensatory mitigation described in this certification; and (2) reasonably related and proportional to the identified impact. This plan and schedule shall be submitted to the Resource Agencies within 6 months from the end of the monitoring period or such later date approved by the DEP in writing. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

C. Eel Passage

1. Upstream Eel Passage

The terms and conditions of the EXELON American Eel Passage Plan for the Muddy Run Pumped Storage Hydroelectric Project (P-2355-018), attached hereto as Appendix 1, are incorporated as if fully set forth herein.

2. Downstream Eel Passage

a. The trigger date for initiation of downstream eel passage studies shall be the date on which the DEP, in consultation with the other Resource Agencies, determines that available data indicates that eels are present upstream of the project or other upstream areas in numbers appropriate to require downstream eel passage. 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.

b. EXELON shall achieve at least 85% eel passage through the project area based on the likelihood of an American eel being exposed to typical pumping operations and becoming entrained.

c. Within six months of the trigger date in Paragraph (a), or such later date approved by the DEP in writing, EXELON shall submit a plan to conduct a passage study to the Resource Agencies. The plan shall be designed to demonstrate continued compliance with the 85% fish passage target. The plan shall include radio telemetry studies or such other studies approved by the DEP in consultation with the other Resource Agencies. EXELON shall implement the plan according to the schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

d. The study shall be initiated within 1 year of the trigger date unless a different time frame is approved by the DEP in writing. EXELON shall provide a report of the study results within 180 days of the date of completion of the study.

e. If the results of a discrete passage study indicate that EXELON can operate the project so that EXELON achieves at least 85% passage of the American eel that pass through the project area based on the likelihood of an American eel being exposed to typical pumping operations and becoming entrained, EXELON shall incorporate into the FPOP any operational measures needed to meet this percentage. These procedures will be subject to review at the annual FPOP meeting.

f. If the results of the studies do not indicate that the project can be operated to achieve at least 85% passage of American eel based on the likelihood of an American eel being exposed to typical pumping operations and becoming entrained, EXELON shall propose a plan and schedule for mitigation, as defined in 25 Pa. Code Section 105.1, for the failure to achieve the 85% eel passage target. This mitigation shall be: (1) in addition to the compensatory mitigation described in this certification; and (2) reasonably related and proportional to the identified impact. This plan and schedule shall be submitted to the Resource Agencies within 6 months from the end of the monitoring period or such later date approved by the DEP in writing. EXELON shall implement the plan and schedule consistent with the approval of the DEP. In the event EXELON fails to submit the plan and schedule as required by this paragraph, the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

D. Resident Fish Passage

1. Resident fish species include all fish species that occur in the Susquehanna River excluding anadromous and catadromous fish.

2. From 2015 through 2030, EXELON shall implement the mitigation measures described in Section VI to compensate for the entrainment of resident fish species.

IV. DISSOLVED OXYGEN ("DO")

A. Dissolved Oxygen Limitation.

1. EXELON shall operate the project in such manner that it does not cause a violation of the dissolved oxygen criteria in the DEP water quality standards (currently a minimum daily average dissolved oxygen concentration of 5 mg./l. and a minimum of 4 mg./l.) at a location downstream of Muddy Run.

2. To assess compliance with Section IV. A. I. above, EXELON shall, at DEP's request but no earlier than November 1, 2027 submit a DO monitoring plan to the DEP. The plan shall propose a plan and schedule for monitoring dissolved oxygen in the Conowingo Reservoir below the project during the months of April through September for a period sufficient to characterize the impact of the project operations on DO levels. Appropriate flow and temperature criteria suitable to trigger the two year period will be developed in consultation with DEP. Such studies will be developed after consultation with the owner of the upstream Holtwood Project such that any water quality impacts of the Muddy Run facility can be isolated. The plan shall include data collection, analysis and reporting.

3. EXELON shall implement the plan and schedule as approved by the DEP.

4. If the monitoring conducted under the plan identifies violations, defined as meeting less than 99% of the daily average or instantaneous standards (or the alternative regulatory standard in place at the time of the study), resulting from operation of the project, EXELON shall, within 30 days, consult with the DEP and within 90 days submit a plan to resolve any DO violations resulting from operation of the project.

5. In the event EXELON fails to submit the DO monitoring plan as required by Section IV. A. 2., the DEP, in consultation with the other Resource Agencies, may establish a plan and EXELON shall implement the plan consistent with the approval of DEP.

V. ENDANGERED SPECIES AND SPECIES OF SPECIAL CONCERN

A. Once every 10 years throughout the term of the license or such longer period approved by the DEP in writing, EXELON shall conduct an evaluation of all state and federal endangered or threatened species that may be present within the project boundary.

B. Where that evaluation identifies the presence, critical habitat, or critical dependence of endangered species, EXELON shall propose a plan and schedule to the Resource Agencies to ensure protection of the endangered or threatened species within 180 days from completing the evaluation. EXELON shall implement the plan and schedule as approved by the DEP.

C. In the event EXELON fails to submit the plan and schedule as required by Section V. B., the DEP, in consultation with the other Resource Agencies, may establish a plan and schedule and EXELON shall implement that plan and schedule consistent with the approval of the DEP.

VI. COMPENSATORY MITIGATION

A. Habitat Improvement Projects

1. By October 1 of each year from 2014 through 2030, EXELON shall provide a total of FIVE HUNDRED THOUSAND DOLLARS ($500,000.00) annually in compensatory mitigation to the Lancaster County Conservation District

("LCCD"), the York County Conservation District ("YCCD") and the PFBC, or to such other conservation district, resource agency or 501(c)(3) organization as directed by the DEP, for the implementation of agricultural pasture and barnyard best management practices to address sediment introduction and other habitat improvement projects including small dam removals ("HIPs").

2. This annual compensatory mitigation shall be by corporate checks, or the like, one made payable to the LCCD in the amount of TWO HUNDRED TWENTY FIVE THOUSAND DOLLARS ($225,000.00), one made payable to the YCCD in the amount of TWO HUNDRED TWENTY FIVE THOUSAND DOLLARS ($225,000.00) and one made payable to the PFBC in the amount of FIFTY THOUSAND DOLLARS ($50,000.00) for HIP funding in Lancaster or York Counties or in such other combination or to such other entities as the PADEP shall direct. In addition, by March 1, 2014, EXELON shall provide a total FIFTY THOUSAND DOLLARS ($50,000) to the PFBC to be used for HIPs in Lancaster and York Counties. EXELON and DEP shall receive from LCCD, YCCD and PFBC an annual accounting of fund expenditures. The funds shall be deposited by the LCCD, the YCCD and the PFBC into a special non-lapsing interest bearing account established and to be used only for the HIPs required by this Water Quality Certification ("Exelon HIP Funds"). Funds provided to the PFBC shall be used solely for dam removal projects.

DEP shall ensure that each project proposed by the LCCD, the YCCD and the PFBC shall be submitted to the DEP South-central Regional Office Waterways and Wetlands Program Manager, or the successor position, for approval. No single project shall receive more than $75,000.00 in compensatory mitigation funding from the Exelon

HIP Fund. Funding priority shall be given for projects that include stream forested buffers of at least 50 feet in width and wetland creation projects. Project funding shall not include any indirect administrative costs and, except where specifically authorized by the DEP, shall not include direct administrative costs. In no case shall direct administrative costs be greater than 5% of the project funding. At EXELON's option, and subject to land owner approval, for each project signage shall be displayed acknowledging EXELON's funding of the habitat improvement.

B. **Flow Modeling**

EXELON shall provide the version of the Lower Susquehanna River OASIS Model to the Susquehanna River Basin Commission as provided in the "Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRBC" dated November 19, 2013 and attached to this certification as Appendix 2.

12/9/14

Scott Williamson
Program Manager
Waterways and Wetlands Program

Date

PENNSYLVANIA WATER QUALITY CERTIFICATION EA 36-033

APPENDIX 1

Exelon Generation
American Eel Passage Plan

Muddy Run Pumped Storage Hydroelectric Project (P-2355-018)

Table of Contents

I. Introduction

Pursuant to the Federal Power Act, Exelon Generation (Exelon) filed new license applications with the Federal Energy Regulatory Commission (FERC) in August 2012 for the Muddy Run Pumped Storage Hydroelectric Facility (Muddy Run) and the Conowingo Hydroelectric Project (Conowingo). This American Eel Passage Plan ("Eel Plan") is a condition of, and incorporated into, the Water Quality Certification for the Muddy Run project. Under Section 401(d) of the Clean Water Act, the Eel Plan becomes a condition of the FERC license for the Muddy Run project.

II. Eel Passage Advisory Group

To inform implementation of the Eel Plan, Exelon will establish an Eel Passage Advisory Group (EPAG) by May 1, 2014. EPAG will be chaired by Exelon and composed of a representative from each of the following (collectively, the "Resource Agencies"): the Pennsylvania Department of Environmental Protection (PADEP), Pennsylvania Fish and Boat Commission (PAFBC), United States Fish and Wildlife Service (USFWS), the Maryland Department of Natural Resources (MDNR), Maryland Power Plant Research Project (PPRP) and the Susquehanna River Basin Commission (SRBC). Each designated representative shall be knowledgeable of American eel, the Susquehanna River, and ongoing fisheries and other related resource programs being implemented in the Lower Susquehanna River *(e.g.,* American shad restoration).

III. Upstream Passage for American Eel (2015-2030)

Consistent with the implementation plan set forth below, Exelon will trap, hold and transp0lt American eels from the Conowingo Dam and transport them to designated points in the Susquehanna River watershed consistent with the level of effort established and described in this plan. Any trapping, holding, transportation or monitoring of eels or other eel related activities addressed in this plan that occurs in Maryland waters is expressly subject to any permits, licenses or authorizations that may be required by the State of Maryland related to such activities.

A. Trapping

Subject to required regulatory approvals, Exelon will design, install and operate an eel trapping facility along the western shore of the Conowingo Dam near the location of the current USFWS trapping location and facility, unless an alternate location is approved by the PADEP and MDNR in writing, according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, USFWS or FERC determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, Exelon shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications for a trapping facility to the Resource Agencies and FERC by October 15, 2015;
2. Hold preconstruction meeting with MD and USFWS within 150 days of approval of the design plans and designs by FERC, MDNR and USFWS;
3. Begin construction within 180 days of receipt of approval of the design plans and specifications by the MDNR and USFWS;
4. Begin operation by May 1, 2017.

Beginning in 2014 and until Exelon's trapping facility along the western shore of the Conowingo Dam is completed, Exelon will work with the USFWS to trap eels using the USFWS trapping facility and will assist in the financial support of the USFWS trapping facility through a payment of $20,000 per year to an entity approved by the PADEP with lhe capability of providing financial support to the USFWS Maryland Fisheries Resource Office for the eel trapping program. This payment will be made by May 1 of each year. In 2014, Exelon will participate in this effort using USFWS facilities, including the USFWS trapping facility, tanks and trucks. Beginning May 1, 2015, or such later date approved by the PADEP and MDNR, in writing, Exelon will use its own holding and transport facilities and continue working with the USFWS to trap eels using the USFWS trapping facility. Exelon will begin operating the program independently, subject to USFWS supervision and input, using its own trapping facility when construction of that facility is completed.

Subject to required regulatory approvals, Exelon also will design, install and operate a temporary eel trapping facility on Octoraro Creek at a location approved by the PADEP in writing according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, FERC, PADEP or the USFWS determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, Exelon shall submit to the Resource Agencies and FERC such information, revisions or amendments miless a longer period of time is approved by the requesting agency or FERC in writing.

1. Conduct field evaluation using visual observation, electrofishing and other methods approved by the PADEP and USFWS, in writing, to evaluate and rank trapping locations on Octoraro Creek by September 15, 2014.
2. Submit complete design plans and specifications to the Resource Agencies by November 1, 2014;
3. Hold preconstruction meeting with PADEP and USFWS within 45 days of approval of the design plans and designs by FERC, PADEP and USFWS;
4. Begin construction within 90 days of receipt of approval of the design plans and specifications by PADEP and USFWS;
5. Begin operation by May 1, 2015.

If, after three years of operation, PADEP in consultation with EPAG determines the temporary eel trapping facility at Octoraro Creek is successful, Exelon will design, install, and operate a permanent eel trapping facility at this location in accordance with a schedule established by PADEP in consultation with the other Resource Agencies.

If, after three years of operation, PADEP in consultation with EPAG determines the temporary eel trapping facility at Octoraro Creek is unsuccessful, site-determination studies for an additional permanent trap will be performed beginning in 2017. Congregations of juvenile eels will be documented visually via bi-weekly nighttime surveys during the migration period; the locations surveyed will focus on the East Fish Lift area, the river banks and possibly lower-river tributaries, but will exclude the Conowingo Dam spillway. Based on the results of the site-determination studies, Exelon will design, install, and operate temporary mobile traps to inform the potential location of one additional permanent eel trapping facility. Temporary exploratory traps will be installed and operated at up to five locations determined by PADEP, MDNR and USFWS during 2018 and, if necessary, 2019, to assess the ability to collect sufficient numbers of juvenile eels for the eel passage program. Collection facilities for the temporary site determination study will be similar to those used in the 2011 and 2012 studies conducted by Exelon.

Based on the results of the site-determination studies, Exelon, in consultation with EPAG, will determine if and where an additional permanent eel trap is justified in support of the Eel Passage Program. If a decision is made in 2018 to install an eel trap at the selected location, unless a different date is established by the PADEP, MDNR and USFWS, that trap will be designed and constructed in 2019-2020, and operated beginning in 2021 subject to required regulatory approvals. If a second year of study is needed, the dates would advance by a year. Exelon will not be required to maintain and operate more than two permanent eel traps at any time during the term of the new license.

The collection device(s) for the two permanent eel trapping facilities will consist of a ramp-style trap leading to a collection tank at the top of the ramp. The collection device(s) shall have a capacity to pass 50,000 eels over a 24 hour period accommodating a minimum size of 3 inches. One or more pumping systems will provide attraction flow at the entrance of the ramp, flow in the troughs to allow eels to climb the ramp, and water to the collection and holding tanks. The lower section of the ramp will be designed to have removable covers or grating to allow eels to enter at differing water surface elevations. The ramp will contain two side-by-side troughs to provide redundancy and allow for the potential use of different climbing media in each trough. For the ramp on the western shore, the entrance to the ramp will be designed to accommodate the normal range of tailwater elevation (EL 12 – 25 ft). The additional permanent collection facility will contain elements of the facility on the western shore with the design modified to accommodate local conditions.

The trapping facilities will be operated continuously during the eel migration period from May 1 to September 15. Exelon will monitor and record days fished, hours fished and the weather. Daily counts of eels will be recorded. The method of counting under various capture scenarios will be developed in consultation with the EPAG. Temperature data will be obtained from Monitoring Station 643 (located approximately 0.6 miles below Conowingo Dam near the western shoreline) to examine river temperature in relation to catch rates of juvenile eels. Biweekly subsamples of collected eels will be examined for various life history parameters (*e.g.*, length, weight, and condition factor). A portion of the subsampled eels will be sacrificed and examined for the presence of *Anguillicoloides crassus.*[1] Some of the sacrificed eels will have the otoliths removed and retained for age analysis. *Anguillicoloides crassus* infection rates (proportion of eels infected), the number of parasites per eel, along with associated age, length, and weight data will be reported. Additionally, Exelon will pay to have 60 elvers/year sent to the USFWS or such other entity that the PADEP may approve in writing, for wild fish health screening. The screening shall occur once per year and can occur anytime during the eel upstream passage season.

[1] This introduced parasite has been documented in juvenile eels collected at Conowingo Dam (Minkkinen and Park 2012) and could affect the overall success of adult outmigration due to reduced swimming ability and potentially higher mortality of migrating silver eels (Szekely et al 2009).

B. Holding

Subject to required regulatory approvals, Exelon also will design, install and operate the holding facility for the west shore Conowingo Dam and the Octoraro Creek traps according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, FERC, PADEP or the USFWS determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, Exelon shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications for holding facilities to the Resource Agencies by April 15, 2015;
2. Hold preconstruction meeting with PADEP and USFWS within 150 days of approval of the design plans and designs by FERC, PADEP and USFWS;
3. Begin construction within 180 days of receipt of approval of the design plans and specifications by PADEP and USFWS;
4. Begin operation by May 1, 2016.

Periodically, consistent with standards established by the PADEP, MDNR and USFWS, eels will be transferred from the collection tank to the holding tank(s) where they will be held prior to being transported upstream. The holding tanks will have an automatically engaging back up pump and an alarm that sounds in a daily staffed location *if* the primary pump malfunctions. The holding tank will have continuous temperature, dissolved oxygen and gallon/minute water exchange monitoring devices with alarms that sound in a daily staffed location if levels of any parameter are outside of established limits. Upon observation, dead eels will be removed, enumerated, and reported. The holding tank shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by PADEP in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks.

C. Transport

Subject to required regulatory approvals, Exelon will design, construct and operate vehicle(s) to transport eels from the western shore and Octoraro facilities according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the FERC, MDNR, PADEP or the USFWS determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, Exelon shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

1. Submit complete design plans and specifications to the Resource Agencies and FERC by April 15, 2015;
2. Begin construction within 180 days of receipt of approval of the design plans and specifications by PADEP, MDNR and USFWS;
3. Begin operation by May 1, 2016.

Transport of juvenile eels will occur as necessary based on the capacity of holding tanks at the eel trapping facilities. All eels shall be moved within 1 week of capture. Eels from the holding tank(s) will be transferred to a transport vehicle equipped with an insulated transport container(s) that will be covered and aerated. The transport vehicle(s) will have an automatically engaging back up pump and an alarm that sounds in the cab of the vehicle(s). The transport vehicle taken will have continuous temperature and dissolved oxygen monitoring devices with alarms that sound in the vehicle(s) if levels of any parameter are outside of established limits. The transport vehicle(s) shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by PADEP in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks on the transport vehicle(s). These eels will be trucked to appropriate release locations on the same day of removal from holding. Upon observation, dead eels will be removed, enumerated, and reported.

D. Release

Exelon will release eels at locations identified in Appendix A in amounts consistent with the release information provided to and approved by the PFBC in writing. Where feasible, eels will be released at public access locations. Unless otherwise directed by PFBC in consultation with EPAG, eels will be released: (1) at least one hour after sunset to promote eel dispersal and minimize predation; and (2) into at least three feet of water at multiple locations within designated release areas in order to avoid concentrations of eels that could become potential targets for increased predation. If necessary due to time limitations established by the Resource Agencies in writing, Exelon shall release eels at alternative locations to avoid mortality. The estimated number of eels released at each location will be documented in writing and on a GPS device capable of being mapped in a database as approved by the Resource Agencies. After release, any dead eels remaining in the transport vehicle or observed at the stocking locations will be removed, enumerated, and reported.

Modification of, or revisions to, the release locations in Appendix A shall occur after consultation with EPAG and consistent with the approval of the PFBC.

E. Quality Assurance/Quality Control

Exelon will develop a detailed quality assurance/quality control ("QA/QC) program according to the following schedule, unless an alternative schedule is approved by the PADEP in writing. In the event that the MDNR, PADEP or the USFWS determine that additional information, revisions, or amendments are necessary to the QA/QC program, then within 60 days of receipt of written notice Exelon shall submit to the Resource Agencies and such information, revisions or amendments unless a longer period of time is approved by the requesting agency in writing.

1. Submit a draft QA/QC program to the Resource Agencies for approval by April 15, 2014;
2. Implement the QNQC program approved by the PADEP when trapping and transport begins.

Important parameters associated with trapping, collecting, holding, transport, release, and stocking will be recorded to assure and control the quality of various program elements. The collection of these data will assure that the program will be conducted according to design parameters, will adhere to sound scientific principles, and will allow for any necessary adjustments. The results of these quality assurance and quality control measures will be included in annual reports to the Resource Agencies and EPAG. Changes to The QA/QC procedures shall be submitted as requested by the PADEP, MDNR or USFWS in writing.

At a minimum, the QA/QC program shall provide:

- Detailed description of the eel trapping and holding process to achieve a minimum 95% survival rate.
- Detailed description of the eel transport process to achieve a minimum 95% survival rate.
- Collection facilities will be visually inspected daily to ensure proper operation.
- Design parameters for flows and key critical components (e.g. attraction flow, spray bar, collection tank) that will be measured weekly and qualitatively assessed daily to ensure that traps are operating within design parameters.
- Water temperature and dissolved oxygen and water exchange in the collection, holding, and transport tanks will be monitored continuously to ensure that water quality remains suitable forjuvenile eels.
- Information on the periodic checks on the accuracy of the estimates of volumetric counts.

- Information on the cleaning and disinfection of the collecting, holding, and transportation tanks.

- Protocols for monitoring, removing, enumerating and reporting eel mortality.

F. Reporting. Monitoring. and Periodic Evaluation

1. *Reporting and EPAG Meetings*

During the eel passage season, Exelon shall provide a daily email to designated members of EPAG describing the status of trapping and trucking at each facility, the numbers of eels trapped and transported, any deviations from normal facility operations and the timing and substance of the resolution of any deviations.

On or before December 10 annually from 2015 through 2030, Exelon will submit a report to EPAG summarizing data from the trapping, collection, holding, transport, and stocking components of the Eel Plan for the calendar year. This report will provide program data to EPAG at the earliest practicable date, and provide EPAG with an opportunity to inform development of the Annual Report. On or before January 15 of the following year, Exelon will file an Annual Report with EPAG that analyzes annual data, including results from *QA/QC*.

Upon request, Exelon will meet with EPAG on or before February 15 of each year in which the Annual Report is filed.

2. *Periodic Evaluation*

Every three years, unless a different period is established by the PADEP in writing beginning in 2018 through 2030, Exelon will conduct stream segment evaluations through electrofishing or other method identified after consultation with EPAG. Representative stream segments will include tributaries and shorelines of the main-stem river. Exelon will propose locations and methods for this survey at least one year in advance to the Resource Agencies. Exelon shall implement the survey based on approval of the PADEP of the proposed locations and methods.

To implement the evaluations, eels will be captured by electrofishing, or other methods approved by the PADEP in consultation with the Resource Agencies. Sampling will be performed at block-netted transects along river shorelines and at block-netted segments of small tributaries using backpack electrofishing. The exact number, length, and location of transects sampled will be approved by the PADEP in consultation with EPAG.[2] Associated water quality parameters such as temperature and dissolved oxygen, as well as habitat characteristics, including mussel numbers observed, will be collected at each sampling location.

[2] It is anticipated that two weeks of electrofishing will be conducted during each third-year evaluation.

During sampling, the number of eels captured will be documented and data will be collected from a representative subsample of eels. A subsample of captured eels larger than 200 mm will be tagged with Passive Integrated Transponder (PIT) tags and released. Sampled eels will be scanned for PIT tags and data from recaptured eels will be recorded and included in the annual report. Data will include a variety of life history characteristics (e.g., length, weight, and condition factor) that can be assessed to determine how well stocked eels are utilizing the river and tributaries. A portion of the subsample will be sacrificed and examined for age (otolith analysis), gender, and level of *Anguillicoloides crassus* infection. Eels that are not sacrificed for further analysis will be measured, weighed, and released.

Results of stream segment evaluations will be included in the Annual Report and will document dispersal of the stocked eels, estimate the approximate density of stocked eels, and evaluate the growth, condition, age, gender and level of infestation with *Anguillicoloides crassus* of stocked eels.

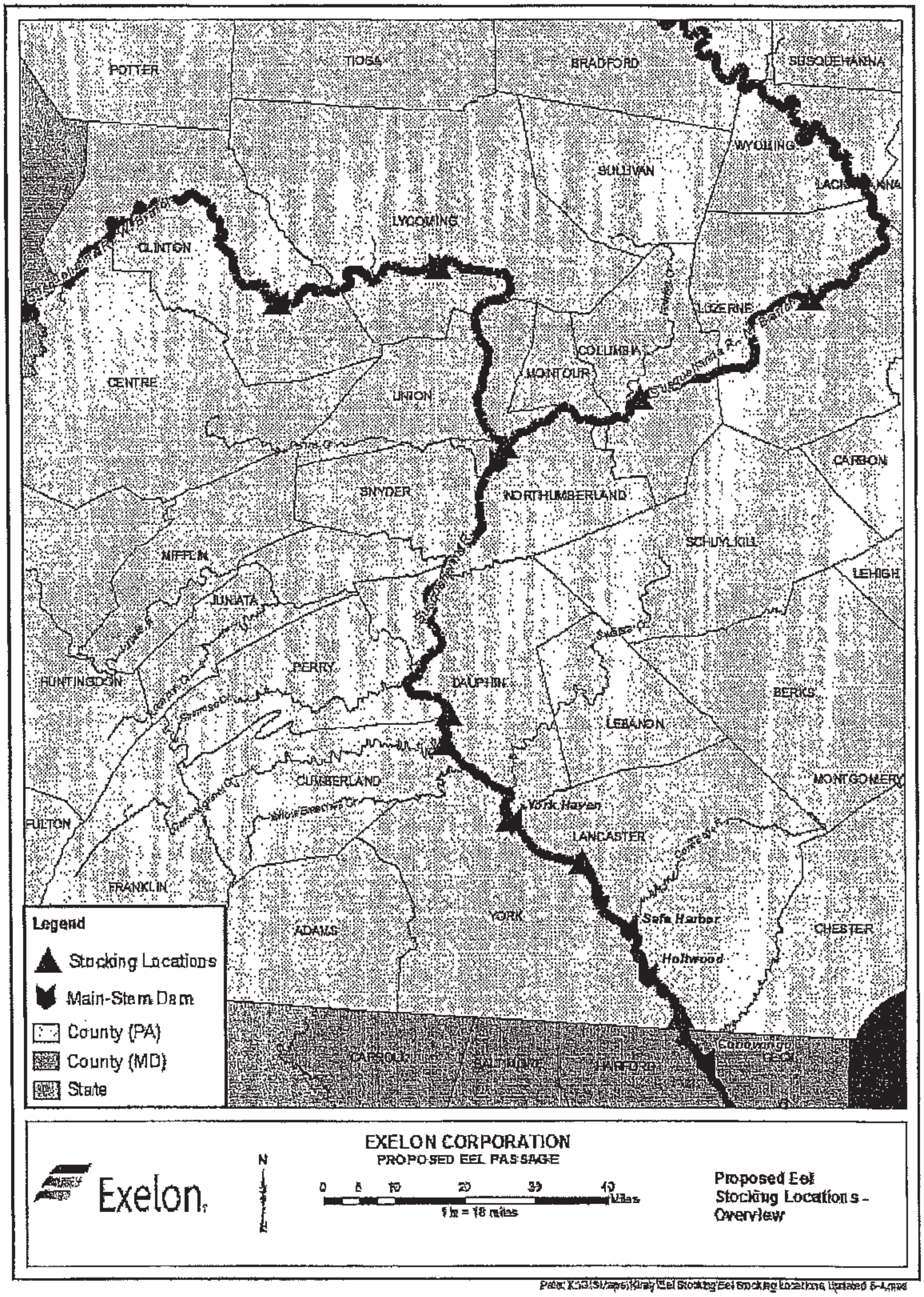
III. Upstream Passage (2031 - Term of New License)

If the upstream American eel passage trap and transport program terminates in 2030, Exelon will construct and operate a volitional upstream eel facility at Conowingo Dam through the term of the new license. Exelon will design and construct the volitional upstream eel facility, which will be operated in consultation with EPAG. In no event will Exelon be required to participate in the trap and transport program once the volitional upstream eel passage facility is operational.

If the upstream eel trap and transport and periodic evaluation program continues beyond 2030, Exelon will continue to provide access to the Conowingo eel collection facilities for as long as the program continues. Exelon, however, shall bear no cost responsibility for the trap and transport and periodic evaluation program until 2046, at which time cost responsibility shall be shared among all participants in the program.

APPENDIX A
LOCATIONS OF EEL RELEASE

Site Number	Location	Water	County
1	Conowingo Pool	Susquehanna River	Lancaster
2	Between Holtwood and Safe Harbor	Susquehanna River	Lancaster/York
2	Between Safe Harbor and York Haven Dam	Susquehanna River	Lancaster
3	Upstream of York Haven Dam	Susquehanna River	Dauphin
4	West Fairview Access (Route 11/15)	Susquehanna River	Cumberland
5	Fort Hunter Access	Susquehanna River	Perry
6	Shikellamy State Park	Susquehanna River	Northumberland
7	Route 487 Bloomsburg	North Branch Susquehanna River	Columbia
8	Route 29 Bridge (Wilkes Barre)	North Branch Susquehanna River	Luzerne
9	Upstream of Hepburn Street Dam (Williamsport)	West Branch Susquehanna River	Lycoming
10	Upstream of Grant Street Dam	West Brillkh Susquehanna River	Clinton


POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WYOMING
SULLIVAN
LYCOMING
CLINTON
LUZERNE
COLUMBIA
MONTOUR
CENTRE
UNION
CARBON
SNYDER
NORTHUMBERLAND
SCHUYLKILL
MIFFLIN
LEHIGH
JUNIATA
PERRY
HUNTINGDON
DAUPHIN
BERKS
LEBANON
CUMBERLAND
MONTGOMERY
FULTON
York Haven
LANCASTER
FRANKLIN
YORK
ADAMS
Safe Harbor
Holtwood
CHESTER
Conowingo
CARROLL
BALTIMORE
HARFORD
CECIL
Legend
Stocking Locations
Main-Stem Dam
County (PA)
County (MD)
State
EXELON CORPORATION
PROPOSED EEL PASSAGE
Exelon
N
0 5 10 20 30 40 Miles
1 in = 18 miles
Proposed Eel Stocking Locations - Overview

References Cited

Minkkinen, S. and I. Park. 2012. American eel sampling at Conowingo Dam, 2012. U.S. Fish and Wildlife Service -Maryland Fishery Resources Office.

Szekely, C., A. Palstra, K. Molnar, and G. van den Thillart. 2009. Impact of the swim-bladder parasite on the health and performance of European Eels, Chapter 9 in Spawning Migration of the European Eel, Fish & Fisheries Series, Volume 30, pages 201-226.

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November 19, 2013

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Thomas W. Beauduy
Special Counsel
Susquehanna River Basin Commission
4423 North Front Street
Harrisburg, PA 17110-1788

Re: Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRBC

Dear Mr. Beauduy:

Exelon Corporation, on behalf of its wholly-owned subsidiary, Exelon Generation Company, LLC ("Exelon") is in the process of relicensing the Muddy Run Pumped Storage Hydroelectric Project located in Lancaster County, Pennsylvania. Prior to obtaining a new license from the Federal Energy Regulatory Commission ("FERC"), Exelon must obtain a water quality certification from the Pennsylvania Department of Environmental Protection ("PADEP").

Exelon also is in the process of relicensing the Conowingo Hydroelectric Project ("Conowingo") located in Harford and Cecil counties, Maryland. Prior to obtaining a new license from FERC, Exelon must obtain a water quality certification from the Maryland Department of the Environment.

The water quality certificate issued by PADEP will require Exelon to provide a version of the Lower Susquehanna River OASIS Model ("OASIS Model") to the Susquehanna River Basin Commission ("SRBC"). Exelon will provide the OASIS Model to SRBC in accordance with the following terms:

(1) Exelon will provide the OASIS Model within thirty (30) days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become "final" (*i.e.*, are no longer appealable or subject to ongoing litigation).

(2) The OASIS Model provided to SRBC will include the following components: (a) Susquehanna River Basin daily flow; (b) Safe Harbor hourly hydroelectric generation and revenue optimization; (c) PPL Holtwood hourly hydroelectric generation and revenue optimization; (d) Conowingo and Muddy Run hydroelectric generation and revenue optimization; (e) SRBC abridged daily model; and (f) Three Mile Island water withdrawals.

PA Water Quality Certification
EA 36-033--Appendix 2

(3) Exelon will develop, and include in the OASIS Model provided to SRBC, a Conowingo and Muddy Run generation node 2013 Real Time pricing file.

(4) The OASIS Model will be available for SRBC's long-term non-exclusive use.

(5) Exelon will have no obligation to update the OASIS Model, including the 2013 PJM pricing file, after the model has been provided to SRBC.

Please note that the model utilized by Exelon during the relicensing process incorporated Exelon's proprietary forward price curve. This proprietary pricing file will not be included in the OASIS Model provided to SRBC.

If the foregoing is acceptable to the SRBC, please so acknowledge by signing below in the space indicated and return the executed agreement to me at your convenience.

With kind regards,

Jay Ryan
Counsel to Exelon

ACKNOWLEDGED AND AGREED TO:

SUSQUEHANNA RIVER BASIN COMMISSION

By: Thomas W Beauduy

Name: Thomas W. Beauduy

Title: Special Counsel

Date: November 21, 2013

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

WATERWAYS & WETLANDS PROGRAM

December 10, 2014

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E. Rom 1-A
Washington, D.C. 20426

Re: 401 Water Quality Certification
Exelon Generation Company, LLC
DEP File No. EA 36-033
FERC Project P-2355-018

Dear Ms. Bose:

Yesterday, the Commonwealth of Pennsylvania, Department of Environmental Protection ("Department") mailed to you a clarified version of the Section 401 Water Quality Certification for the Muddy Run Pumped Storage Facility, FERC Project P-2355-018, ("Certification") which may have contained an incomplete, misprinted page 5 of the signed Certification. Please find enclosed a corrected page 5 of the signed Certification. Please replace page 5 of the version that was mailed to you yesterday with the enclosed version page 5 of the Certification. The correct version will also be filed electronically and emailed to the service list.

Sincerely,

Curtis C. Sullivan, Esq.
Assistant Counsel
Commonwealth of Pennsylvania
Department of Environmental Protection

CCS/lmt

cc: Shelia Eyler at USFWS Chesapeake Bay Field Office
Shawn Seaman at MDNR
Joshua Tryninewski at PFBC
Drew Dehoff at SRBC
Colleen E. Hicks at Exelon Power
Scott Williamson at PA DEP

by 2030, and because the FERC licenses for the Holtwood Hydroelectric Facility and the Safe Harbor Hydroelectric Facility expire in 2030, this certification will be revised in 2030, as necessary to address demonstrated project impacts and subject to the provisions of this certification, to establish requirements consistent with Section 401 of the Clean Water Act, 33 U.S.C Section 1341.

III. FISH PASSAGE

A. General Requirements

1. Fish Passage Operating Procedures ("FPOP")

a. By January 15, 2015, EXELON shall submit a FPOP to the DEP for review and approval. The FPOP will describe existing baseline operations during fish passage season, including schedules for routine maintenance, procedures for routine operation (including: seasonal and daily periods of operation, pump and turbine operations), sequencing of pump and turbine start-up and operation, procedures for monitoring and reporting flows, procedures for monitoring and reporting on the operation of the facility, procedures for start-up and shut-down, and procedures for use in case of emergencies and project outages significantly affecting the conditions of this certification.

b. EXELON shall implement the FPOP consistent with the approval of the DEP. EXELON shall provide written documentation to the Resource Agencies that operational

APPENDIX H

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE SUSQUEHANNA RIVER PROJECTS

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APPENDIX H

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE SUSQUEHANNA RIVER PROJECTS

York Haven Project—FERC Project No. 1888-030–Pennsylvania

Muddy Run Project—FERC Project No. 2355-018–Pennsylvania

Conowingo Project—FERC Project No. 405-106–Maryland/Pennsylvania

The Federal Energy Regulatory Commission (Commission or FERC) issued its draft environmental impact statement (EIS) for the licensing of the Susquehanna River Projects (Projects) on July 30, 2014. The Commission requested comments be filed by September 30, 2014. In addition, the Commission conducted three public meetings on September 16 and 17, 2014. In this appendix, we summarize the written comments received on the draft EIS; provide responses to those comments; and indicate, where appropriate, how we have modified the text of the final EIS. We group the comment summaries and responses by topic for convenience. We do not summarize comments that point out minor edits to the draft EIS; however, we have made those edits in the final EIS. The following entities filed comments on the draft EIS:

Commenting Entity	Filing Date
York Haven Project	
Pennsylvania Game Commission	August 14, 2014
Hugh Rogers	September 15, 2014
New Energy Capital Partners	September 26, 2014
York Haven	September 26, 2014
U.S. Fish and Wildlife Service/Susquehanna River Anadromous Fish Restoration Cooperative	September 29, 2014
Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy	September 29, 2014
Onondaga Nation	September 29, 2014
U.S. Department of the Interior[1]	September 29, 2014
Exelon	September 29, 2014
State of Maryland	September 29, 2014
Dr. Amy Roe	September 29, 2014
National Marine Fisheries Service	September 29, 2014
U.S. Environmental Protection Agency	September 29, 2014
Susquehanna River Basin Commission	September 29, 2014

[1] Interior filed a comment letter for the Susquehanna River Projects that includes comments on behalf of the National Park Service and the U.S. Fish and Wildlife Service.

Commenting Entity	Filing Date
The Nature Conservancy	September 29, 2014
American Rivers	September 29, 2014
Stewards of the Lower Susquehanna, Lower Susquehanna Riverkeeper, Waterkeepers Chesapeake	September 29, 2014
Clean Chesapeake Coalition	September 29, 2014
Muddy Run Project	
Pennsylvania Game Commission	August 14, 2014
Hugh Rogers	September 15, 2014
Patrick Kelly	September 19, 2014
New Energy Capital Partners	September 29, 2014
U.S. Fish and Wildlife Service/Susquehanna River Anadromous Fish Restoration Cooperative	September 29, 2014
Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy	September 29, 2014
Onondaga Nation	September 29, 2014
U.S. Department of the Interior	September 29, 2014
Exelon	September 29, 2014
State of Maryland	September 29, 2014
Dr. Amy Roe	September 29, 2014
Susquehanna River Basin Commission	September 29, 2014
The Nature Conservancy	September 29, 2014
American Rivers	September 29, 2014
Stewards of the Lower Susquehanna, Lower Susquehanna Riverkeeper, Waterkeepers Chesapeake	September 29, 2014
Clean Chesapeake Coalition	September 29, 2014
National Marine Fisheries Service	September 29, 2014
Onondaga Nation	October 17, 2014
Conowingo Project[2]	
James Byrne	August 8, 2014
Pennsylvania Game Commission	August 14, 2014
Matt Teffeau	August 21, 2014
Maryland Farm Bureau	September 9, 2014
Susquehanna River Boaters Association[3]	September 10, 2014
Hugh Rogers	September 15, 2014

[2] On January 9, 2015, an organization called "Support Conowingo Dam" filed a petition of support for the project that included 11,500 signatures. The organization, however, did not include any specific comments on the draft EIS.

[3] Motion to Intervene.

Commenting Entity	Filing Date
The Honorable Benjamin L. Cardin	September 19, 2014
Patrick Kelly	September 19, 2014
Broad Creek Civic Association	September 26, 2014
New Energy Capital Partners	September 26, 2014
Pennsylvania Fish & Boat Commission	Septembers 29, 2014
Susquehanna River Boaters Association[4]	September 29, 2014
U.S. Fish and Wildlife Service/Susquehanna River Anadromous Fish Restoration Cooperative	September 29, 2014
Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy	September 29, 2014
Onondaga Nation	September 29, 2014
U.S. Department of the Interior	September 29, 2014
Exelon Corporation	September 29, 2014
State of Maryland	September 29, 2014
Citizens for Pennsylvania's Future	September 26, 2014
Dr. Amy Roe	September 29, 2014
U.S. Environmental Protection Agency	September 29, 2014
Susquehanna River Basin Commission	September 29, 2014
The Nature Conservancy	September 29, 2014
American Rivers	September 29, 2014
Stewards of the Lower Susquehanna, Lower Susquehanna Riverkeeper, Waterkeepers Chesapeake	September 29, 2014
Clean Chesapeake Coalition	September 29, 2014
National Marine Fisheries Service	September 29, 2014
Onondaga Nation	October 17, 2014

GENERAL AND PROCEDURAL

Comment: The Susquehanna River Basin Commission (SRBC) requests that we modify footnote 24 on page 19 of the draft EIS to:

> SRBC was established by the Susquehanna River Basin Compact, a federal interstate agreement among New York, Pennsylvania, Maryland, and the United States. Pursuant to the Compact, SRBC has specific duties which include developing and effectuating plans, policies, and projects relating water resources; adopting, promoting, and coordinating policies and standards for water resources conservation, control, utilization, and management; and promoting

[4] Susquehanna River Boaters Association filed a second Motion to Intervene on September 29, 2014.

and implementing the planning, development, and financing of water resources projects.

Response: We modified the indicated footnote in the final EIS.

Comment: The Chesapeake Bay Foundation and the Midshore Riverkeeper Conservancy take exception to the Commission's denial of Interior's request for a 60-day extension to the comment period for the draft EIS given the document's length and complexity. The Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy state that the Commission has a duty under the National Environmental Policy Act (NEPA) to obtain comments from federal agencies with jurisdiction by law over a project or with special expertise. The Clean Chesapeake Coalition similarly objects to the draft EIS' short comment period and the denial of Interior's request for an extension of time.

Response: As the Director of the Office of Energy Projects stated in his September 8, 2014, letter denying the extension of time request, Commission staff is committed to processing license applications expeditiously and granting a 60-day extension of the comment period could affect timely completion of other licensing milestones. The periods for commenting on the Commission's NEPA documents prepared under the Integrated Licensing Process are specified in the regulations at 18 CFR §5.25. In addition, the standard time frame for comments under NEPA is 45 days, and we provided a longer 60-day period for this draft EIS.

Comment: The National Marine Fisheries Service (NMFS) comments that table 1-1 in section 1.3 fails to include NMFS and its jurisdiction over shortnose sturgeon and Atlantic sturgeon under the Endangered Species Act (ESA).

Response: We revised table 1-1 of the EIS to include NMFS.

Comment: SRBC disagrees with the conclusion in section 1.3.6 of the draft EIS, which was based on correspondence from NMFS, that the projects do not affect essential fish habitat. SRBC states that, given the very existence of the Susquehanna River Projects and that there is essential fish habitat for anadromous species in the river, habitat is affected.

Response: Essential fish habitat under the Magnuson-Stevens Fishery Conservation and Management Act applies only to species managed by NMFS and for which Fishery Management Plans are in place. This is not the case for anadromous species that occur in the Susquehanna River, and we note that NMFS did not dispute our conclusions in section 1.3.6. While SRBC may consider the Susquehanna River to be "essential fish habitat" under its own definition, this does not invoke the requirements of the Magnuson-Stevens Fishery Conservation and Management Act.

Comment: The State of Maryland comments that the draft EIS fails to state the proposed term of a new Conowingo Project license.[5] Although the applicant has requested a 46-year license for the project, it is not clear from the draft EIS that Commission staff supports a license term of that duration.

Response: Consistent with all licensing proceedings, the Commission makes the final determination on the license term in the license order. This determination will be based on a review of the record at the time the order is issued.

Comment: The State of Maryland states that any new license should include reopeners that would allow for optimal coordination of environmental measures among all hydroelectric projects on the lower Susquehanna River to adequately address cumulative impacts.

Response: The State of Maryland already has the ability to petition the Commission to reopen any license that may be issued for the projects. The Commission's standard reopener article would be included in any licenses that may be issued for these projects, and would be the vehicle for making changes to the license if unforeseen and unanticipated environmental effects should occur. The requesting entity would be expected to provide support for its request and establish the need to reopen the license and the nexus to the project of the actions requested.

Comment: The Clean Chesapeake Coalition believes that public opinion was left out of most studies used as a basis for the draft EIS language, including the Lower Susquehanna River Watershed Assessment (LSRWA). It states that hand-picked stakeholders drove the LSRWA, often ignoring the lack of meaningful data or ignoring meaningful data, and this study is incomplete and inadequate.

Response: As described in section 1.4 of the draft EIS, the Commission provides multiple opportunities for the public to provide input to all aspects of the relicensing process. The Integrated Licensing Process used in this proceeding includes identifying studies that all stakeholders believe should be undertaken and assessing each one based on the record provided by the study advocates and making a determination regarding which studies would be required of the applicants. The Commission oversees whether the studies are implemented in accordance with the approved study plan. During scoping for the Susquehanna River Projects, the Commission requested, among other things, that stakeholders and the general public identify available information on the resources at issue. The LSRWA is one such source of information that was offered. The Commission has no authority over the U.S. Army Corps of Engineers (Corps) (the lead agency in this assessment) in regards to the study implementation or schedule. It is up to Commission staff to determine the credibility of any information, including the draft report of the LSRWA (Corps and MDE, 2014) that is entered into the record for this proceeding.

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[5] The State of Maryland filed on behalf of Maryland DNR and Maryland DOE but we use State of Maryland in our comment summaries and responses.

Based on our review of Corps and MDE (2014), we find that the report provides credible information that we have used in our analysis.

Comment: The U.S. Environmental Protection Agency (EPA) comments that 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 EIS to be consistent with the equal consideration provision of the Federal Power Act (FPA), section 4(e). EPA suggests including the U.S. Fish and Wildlife Service (FWS) and Pennsylvania Fish and Boat Commission (FBC) recommendations as license conditions because these commitments and activities are critical to maintaining or restoring ecosystems affected by the hydropower facilities.

Response: Pursuant to section 10(j) of the FPA, Commission staff gives due weight to the recommendations, expertise, and statutory responsibilities of fish and wildlife agencies. Nevertheless, we are still required to conduct an independent analysis of all 10(j) recommendations. If we find that the environmental benefits of a 10(j) recommendation do not warrant the associated cost, based on the available record, we can find the recommendation to be inconsistent with the comprehensive planning standard of section 10(a) and the equal consideration provision of section 4(e) of the FPA. We find this to be the case for the flow management plan and the adaptive management plan (by this we assume EPA is referring to Pennsylvania FBC's recommendation to establish performance criteria for shad passing through the Conowingo Project and make adjustments at 3-year intervals if the criteria are not met). We explain why we reached our conclusions regarding these two measures in section 5.3 of the draft EIS. The Commission is required by the FPA to attempt to resolve these inconsistencies prior to issuing the final EIS. On August 12, 2014, the Commission issued letters to both Pennsylvania FBC and Interior offering to resolve the inconsistencies through meetings or further consultations. Neither Pennsylvania FBC nor Interior have responded or requested further consultations. We did not find a recommendation from Pennsylvania FBC or Interior for an endangered species management plan that applies to fish passage.

Comment: Senator Cardin comments that it is well-documented that the Conowingo dam's effects on flow and volume in the Susquehanna River extend well beyond the limited area assessed in the draft EIS. Citing the preliminary findings of the LSRWA, Senator Cardin strongly conveys that downstream impacts and the dam's effect on the Chesapeake Bay water quality must be considered when evaluating the environmental impacts of Conowingo dam. EPA also finds the project study area to be overly limited and, as a result, the draft EIS does not consider adverse water quality and aquatic life impacts on the greater tidal Chesapeake Bay.

Response: We carefully considered the geographic limits of our effects analysis in the draft EIS and determined that, although the 10 miles of the lower Susquehanna River may be affected by Conowingo Project operation, those effects generally do not extend downstream of the mouth of the river. The river becomes tidal about 5 miles downstream of the dam, and an additional 5 miles of tidal river from this point to the mouth of the river tends to dampen any project effects. However, based on the results of the recently released draft LSRWA report (Corps and MDE, 2014), we revised the final EIS to include additional discussion of water quality effects on the upper Chesapeake Bay.

NO ACTION AND ACTION ALTERNATIVES

Comment: SRBC, EPA, and the Onondaga Nation comment that the natural characteristics of the original unaltered river system and not its current state of significant alteration should be used as the baseline for the analysis of project effects.

Response: The Commission's environmental baseline on relicensing is the environment as it exists at the time of relicensing, not pre-project conditions. Our use of the existing condition as the baseline for comparing proposed actions and recommendations, and evaluating the effects of the proposed and recommended measures on the projects' environmental resources, is a well-established Commission practice that has been affirmed in the courts. However, we do consider knowledge of pre-project conditions to help inform certain environmental mitigation or enhancement measures. For example, knowledge of the historic use of the Susquehanna River for spawning of various anadromous fish species may help in the design of appropriate fish passage structures.

Comment: The Onondaga Nation questions the definition of no action and comments that the appropriate no action should be the denial of a new license. It also comments that the baseline for comparison should not be continued operation but instead should be an assessment of the significance of any environmental harm that would continue or increase with ongoing project operations.

Response: Licensing proceedings require the Commission to take an action of whether or not to license a proposed or existing project. In the case of an existing license, the FPA Section 15(a)(1) (16 U.S.C. §805(a)(1)) provides for the issuance of a continuation of operations if a license expires during a licensing proceeding. Under this provision, no action by the Commission is the continued operation of the project. Denial of a new license would be an action alternative. As noted in our response to SRBC, our use of the existing condition as the baseline for comparing proposed and recommended measures is well-established. We address ongoing, adverse effects under our discussion of unavoidable adverse effects in the EIS.

Comment: SRBC questions why section 2.1.2, *Public Safety*, does not include details on the safety measures in place at any of the facilities as part of baseline conditions at the projects. SRBC suggests expanding this section to articulate those existing safety measures, including safety-related planning efforts such as Exelon's and York Haven's involvement in ICEJAMS.[6]

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[6] ICEJAMS is a model that was developed at the University of Alberta. The ICEJAM model (Flato and Gerard, 1986) was developed to calculate the thickness and

Response: The purpose of section 2.1.2 of the EIS is to identify any ongoing safety issues at the projects and explain the Commission's safety inspection program. York Haven Power's and Exelon's safety-related programs at these projects are detailed in exhibit H of their license applications.

Comment: SRBC suggests that the Commission make edits in section 2.1.3.3 to better describe the temporary variance for minimum flow releases during low-flow conditions.

Response: We revised the language in section 2.1.3.3 of the final EIS, as suggested, and included a footnote on the Consumptive Use Mitigation Plan for the Peach Bottom Atomic Power Station.

Comment: American Rivers and The Nature Conservancy comment that the draft EIS fails to analyze two complete alternatives – American Rivers' ecologically preferred alternative with and without run-of-river operation that was provided in comments during scoping and presented again in its motion to intervene filed on January 31, 2014, and The Nature Conservancy's ecosystem restoration and ecosystem enhancement alternative. Because these two complete alternatives are not identified and analyzed as stand-alone alternatives in the draft EIS, American Rivers and The Nature Conservancy contend that the document fails to include a reasonable set of alternatives.

Response: The complete alternatives described in American Rivers' motion to intervene focus on project operation, instream flows, and fish passage sediment management. The measures included in the alternatives are similar to recommended measures submitted by both resource agencies and non-governmental organizations, specifically The Nature Conservancy. We reference and analyze American Rivers' recommended measures along with the similar measures recommended by The Nature Conservancy in sections 3.3.1, *Geology and Soils,* and 3.3.2, *Water Resources*, of this final EIS. We treat the measures as alternative flow regimes and measures to address sediment management and fish passage, however, and not as stand-alone alternatives. We fully analyze American Rivers and The Nature Conservancy's recommendations in this final EIS.

Comment: American Rivers and The Nature Conservancy request that the Commission approve and add the 2010 Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus, and Sediment (Bay TMDL) to the Commission's list of comprehensive plans.

Response: Because 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 (see section 2.19 of the Commission's regulations). Because the Bay TMDL document was prepared by

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water surface profiles for a cohesionless, wide channel ice jam with a floating toe (Source: Flato, G.M. and R. Gerard. 1986. Calculation of ice jam profiles. Proceedings, 4th Workshop on River Ice, Montreal. Paper C-3 CGU-HS Committee on River Ice Processes and the Environment. Edmonton, Canada).

EPA, we sent a letter to EPA on March 7, 2014, requesting that the agency confirm the Bay TMDL is current and that it should be considered under section 10(a)(2)(A) of the FPA as a comprehensive plan for the states of Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia. To date, we have not received a response from EPA. Regardless of whether or not the Bay TMDL is a comprehensive plan as defined under section 2.19, it is fully considered in this final EIS. We reference the Bay TMDL in our analysis of sediment transport in section 3.3.1.2 of the document and cite the Bay TMDL in section 6, *Literature Cited*.

Comment: Citing the cost calculator of the National Renewable Energy Laboratory, Dr. Roe comments that, with a conservative average of 8.38 acres/megawatt, the Conowingo reservoir would be capable of generating 1.07 gigawatts of solar energy. She further notes that converting just a portion of the Conowingo reservoir to solar would be more efficient and alleviate the negative impacts on wild fish. She asks that the Commission include a comparative analysis of hydroelectric versus solar power in the EIS.

Response: We agree that solar energy is a reasonable energy source; however, the proceeding before us is whether or not to relicense the hydroelectric facility. The proposal before the Commission is for the relicensing of the existing Conowingo Project and is not to decide whether to license a hydroelectric project versus an alternative project that operates using an alternative fuel source, such as solar power, which would be outside of the Commission's jurisdiction under the FPA.

GEOLOGY AND SOILS

Comment: Patrick Kelly comments on the Muddy Run compensatory mitigation funding proposed by Exelon and specified in the water quality certification. This funding would be for implementation of agricultural pasture and barnyard best management practices to address sediment loading in the Susquehanna River and small dam removals. Mr. Kelly states that these projects should occur within the river's watershed.

Response: Although the condition specifies that mitigation projects would occur in Lancaster and York counties, the Commission has no authority over the Lancaster County Conservation District, York County Conservation District, or Pennsylvania FBC. Consequently, the Commission cannot ensure that projects implemented by others would occur within the Susquehanna River watershed. As stated in the Commission's *Policy Statement on Hydropower Licensing Settlements*, issued on September 21, 2006, a basic principle of measures considered for inclusion in a project license is that "actions required under measures should occur physically/ geographically as close as possible to the project." This principle would apply to measures pertaining to the Muddy Run Project. Although we did not recommend this measure, it would be included in a new license because it is a mandatory condition in the water quality certification (see section 5.1.2.3 of this final EIS).

Comment: The Clean Chesapeake Coalition raises several questions pertaining to suspended sediment entering and leaving the reservoir of the Muddy Run Project, including settling of sediment in the reservoir, potential flushing of sediment from the reservoir back into Conowingo Pond, and scour in Conowingo Pond from the release of water from the Muddy Run Project during generation.

Response: Water that is pumped from Conowingo Pond into the reservoir of the Muddy Run Project contains predominantly fine-grained, suspended sediment. Fine-grained suspended sediment particles settle out of the water column only very slowly. Thus, most of the suspended sediment that enters the Muddy Run reservoir is released back into the Conowingo Pond during power generation. Sediment accumulation in the Muddy Run reservoir is expected to be minor. Scour in Conowingo Pond from water released from the Muddy Run reservoir is also not a concern because the volume of water released from the Muddy Run Project remains relatively constant.

Comment: The Onondaga Nation, the Chesapeake Bay Foundation, Midshore Riverkeeper Conservancy, SRBC, the Maryland Farm Bureau (letter from Charles Fry), American Rivers, and The Nature Conservancy commented that the final EIS should incorporate information from the LSRWA to be issued by the Corps, to provide a better understanding of sediment deposition and transport processes in Conowingo Pond. Similarly, in a joint comment letter, the Stewards of the Lower Susquehanna, the Lower Susquehanna Riverkeeper, and the Waterkeeper Chesapeake (collectively, SOLS et al.) stated that they will provide additional comments when the LSRWA becomes available to the public. The Onondaga Nation also requested that the public review period for the draft EIS be held open until the LSRWA report is issued to allow for incorporation of findings into reviewable environmental analysis. The Maryland Farm Bureau requested a short-term extension of the current license to Exelon to allow for review of the LSRWA report. Mr. James Byrne also requested a temporary license extension (by 1 year) so that the issue of sediment buildup can be addressed. American Rivers suggested incorporating the findings of the LSRWA in a supplemental EIS. SRBC requested that comments from the LSRWA report be included in Exelon's proposed Sediment Management Plan.

Response: A draft LSRWA study report was issued on November 13, 2014 (Corps and MDE, 2014). We reviewed the findings from the report and have incorporated relevant information into sections 3.3.1, *Geology and Soils,* and 3.3.2*, Water Resources* of this final EIS. The public review period for the draft EIS was not extended, but because the draft LSRWA report was issued on November 13, 2014, the findings of the study were considered in this final EIS, including in our analysis of Exelon's proposed Sediment Management Plan, and a supplemental EIS will not be necessary. Regarding the requests for license extension, by notice issued September 10, 2014, the Commission authorized the continued operation of the Conowingo Project after September 1, 2014 (the expiration date of the current license), under an annual license that will be issued year to year until a new license is issued. In cases where the Commission is unable to issue a new license by the expiration of a license term, the Commission is required by statute to issue to the licensee an annual license authorizing continued project operation under the terms and conditions of the current license until the Commission acts upon the licensee's relicense application.

Comment: EPA also comments that the draft EIS did not consider the recent findings of the LSRWA study. The Clean Chesapeake Coalition commented at the public meeting that the draft EIS relied on an internal version of the LSRWA report that had not been peer-reviewed or available to the public for review.

Response: The draft EIS was based on information available on the LSRWA website at the time of preparation of the draft EIS. A peer-reviewed draft LSRWA report was not available to the Commission at that time. However, findings of the draft LSRWA report that was released by the Corps on November 13, 2014, are included in this final EIS.

Comment: SRBC comments about a statement in the draft EIS regarding the placement of coarser substrate below Conowingo dam. Specifically, SRBC questions if the term 'mitigate' used in the statement "we find that any attempt to mitigate that effect by placement of coarser grained sediments downstream of the dam would likely have limited success…" implies an adverse effect.

Response: We revised this final EIS to clarify that higher flow velocities in the stretch of the river below Conowingo dam are expected to limit the available substrate independent of the dam.

Comment: SRBC comments that two statements in the draft EIS (on page 69) may provide conflicting information about the storage capacity considered by EPA. A similar comment was made for paragraph 2 on page 71. SRBC also suggests revisions to the text in the first paragraph of the draft EIS on page 70 pertaining to a review of various options to manage sediment in the lower Susquehanna River reservoirs. SRBC further suggests revising text in the third paragraph in the draft EIS on page 70 pertaining to sediment management through agitation dredging in the Conowingo Pond and a bypass tunnel.

Response: The entire section 3.3.1.2, *Geology and Soils*, *Environmental Effects*, is substantially revised in this final EIS and now incorporates the LSRWA (2014) study findings. The issues raised by SRBC are addressed by our revisions in this final EIS.

Comment: SRBC comments that the basin-wide approach to meet the TMDL for the Chesapeake Bay should be inclusive of incremental actions at Conowingo dam.

Response: We revised section 3.3.1.2, *Geology and Soils*, *Environmental Effects,* which now includes information from the draft LSRWA (2014) report, which recommends further study on nutrient reduction. We state in the EIS that 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.

Comment: SRBC comments that the draft EIS, in section 5.2, *Unavoidable Adverse Effects*, neglects to address the unnatural effects of the dam in place, trapping sediments and resulting in sediment mobilization during high-flow events, and affecting sediment and nutrient loading to the lower Susquehanna River and the Chesapeake Bay.

Response: This section in this final EIS was updated to reflect the findings of the draft LSRWA study report (Corps and MDE, 2014) and addresses SRBC's comment. Specifically, the study concludes that all three lower Susquehanna River reservoirs (Lake Clarke, Lake Aldred, and Conowingo Pond) are no longer trapping sediment over the long term. The reservoirs have reached a state of dynamic equilibrium in which the net change in sedimentation (i.e., deposition during low-flow periods and scour during floods) remains relatively constant. On a long-term basis, the full sediment load carried by the river is transported into the Chesapeake Bay, as would have occurred prior to construction of the lower Susquehanna River reservoirs. The lower Susquehanna River and the Chesapeake Bay are affected by sediment transport (including sediment scoured from Conowingo Pond). The draft LSRWA study report finds that the nutrients associated with scoured sediment are more harmful to the Bay's aquatic life than the sediment itself. Particle-bound nutrients settle to the bottom of the Bay and under certain conditions can recycle back into the water column in dissolved form where they contribute to algae growth. Excessive algae growth in turn may result in dissolved oxygen depletion.

Comment: The Chesapeake Bay Foundation disagrees with the findings in the draft EIS that there is "…no justification at this time for requiring Exelon to implement measures such as dredging to help control sediment and nutrient loading to the Bay…." Similarly, SOLS et al. comment that it is premature to eliminate dredging as an alternative and that Exelon should be required to remove at least 4 million tons of sediment annually from Conowingo Pond to remove all material vulnerable to scouring, rather than only conduct bathymetric surveys in Conowingo Pond at 5-year intervals.

Response: The LSRWA (2014) report drops operational measures to manage sediment in Conowingo Pond from further consideration in the assessment. Other sediment management options considered by the LSRWA study include dredging. The LSRWA report finds that dredging is feasible but very expensive. In addition, the LSRWA study finds that the primary effect on the Chesapeake Bay is from nutrients and not from sediment; the LSRWA study suggests that nutrient delivery reduction opportunities are likely more cost-effective than sediment reduction opportunities to reduce water quality and aquatic life effects on the Chesapeake Bay. Applicable findings from the LSRWA study pertaining to the issue of sediment management are included in sections 3.3.1, *Geology and Soils*, and 3.3.2, *Water Resources*, of this final EIS.

Comment: NMFS asks for Commission staff to clarify a statement in the draft EIS that suggests that Exelon would only take action if sediment deposition impedes project operation. NMFS also suggests considering a review of the cumulative effects of potential dredging of Conowingo Pond on load reduction requirements for jurisdictions.

Response: Exelon plans to evaluate conditions in Conowingo Pond based on the 5-year bathymetric surveys for potential management activities. These bathymetric surveys are designed to provide physical benchmarking needed to develop action benchmarks at the powerhouse intakes. A more detailed analysis of load reduction requirements for jurisdictions from dredging, if deemed feasible, would depend on many variables. In essence, because the reservoirs are now filled (i.e., in a state of dynamic equilibrium), any sediment removed from the lower Susquehanna River reservoirs and stored upland would not be transported into the Chesapeake Bay. However, a watershed-wide approach, as specified in the Chesapeake Bay TMDL, would reduce the sediment loading to the Susquehanna River and thus to the Bay but would be outside the Commission's jurisdiction to require or enforce.

Comment: The Clean Chesapeake Coalition comments that Exelon's proposed 5-year bathymetric monitoring surveys of Conowingo Pond are 'entirely meaningless.'

Response: The 5-year bathymetric surveys are designed to provide physical benchmarking needed to develop action benchmarks at the powerhouse intakes. The surveys would further provide information on storage conditions within Conowingo Pond to help understand its present state of dynamic equilibrium, and on conditions for boat access to recreational facilities along the shore.

Comment: The Clean Chesapeake Coalition asserts that the draft EIS fails to consider much of the literature that discusses the scour phenomenon and its impacts. The Clean Chesapeake Coalition lists 10 reports it states were not considered in the draft EIS.

Response: Preparation of this final EIS considered relevant literature that addresses scour. Sediment transport from scour is described in section 3.3.1.1, *Geology and Soils, Affected Environment*, based on publicly available information, including information from the LSRWA study. One of the references listed by Clean Chesapeake Coalition as missing (Hirsch, 2012), was reviewed and is cited in the *Literature Cited* section of this final EIS. Other literature listed by Clean Chesapeake Coalition was reviewed but not cited; to avoid redundancy, only key, representative documents are cited in this final EIS to support a specific statement, as appropriate.

Comment: Clean Chesapeake Coalition comments that the percentage of sediment from high flow events was not discussed.

Response: Percentages of scour are described in section 3.3.1.1, *Geology and Soils, Affected Environment*, of this final EIS, providing the overall sediment load in the river during high-flow events with three different recurrence intervals (10-year, 25-year, and 80-year). This section has been updated in this final EIS with information from the LSRWA (2014).

Comment: Clean Chesapeake Coalition comments that more recent reports by Langland/Hirsch establish that Conowingo Pond is so full that it no longer has any significant trapping capacity.

Response: A preliminary draft PowerPoint presentation by the U.S. Geological Survey (USGS) (Langland, 2013; available on the LSRWA website, and cited in the draft and final EIS) states that "Conowingo Reservoir is in or close to equilibrium phase (approximately 93 percent filled)." The draft and final EIS include information from Langland (2009), a peer-reviewed USGS report. According to this report, 174 million tons of sediment was stored in Conowingo Pond in 2008, with 30 million tons of storage remaining. However, the draft LSRWA report, released on November 13, 2014, was also reviewed and storage capacity estimates from that report were used to update this final EIS, reflecting that Conowingo Pond is now filled (i.e., in a state of dynamic equilibrium).

Comment: York Haven Power comments that its proposed erosion and sediment control plan is adequately covered in the water quality certification issued by the Pennsylvania Department of Environmental Protection (DEP). York Haven Power questions the need to separately require an erosion and sediment control plan in draft license article 401 and also require that the plan be submitted to and approved by the Division of Dam Safety and Inspections, as called for in draft license article 301.

Response: We agree that the water quality certification, issued in August 2014 (after the issuance date of the draft EIS), requires that York Haven Power submit an erosion and sediment control plan as part of its application for state permits to construct the nature-like fishway. That requirement, as well as draft license article 301, which would require an erosion and sediment control plan for any construction involving ground disturbance at the project, would ensure that an erosion and sediment control plan is prepared for the proposed nature-like fishway. We agree that there would be no need for another separate article requiring the plan.

Comment: Dr. Roe requests that the EIS account for the long-term management of sediment at Conowingo dam, including a cost-benefit analysis of scenarios for addressing sediment with a drawdown of water in the reservoir and dam removal.

Response: The transport of sediment into the Chesapeake Bay is a natural process throughout the Susquehanna River watershed that would occur with or without the dams in place. A wide range of sediment management options are discussed in the publicly available draft LSRWA study report (Corps and MDE, 2014), released on the Maryland Department of Natural Resource (Maryland DNR) website on November 13, 2014 (http://mddnr.chesapeakebay.net/LSRWA/report.cfm). We incorporated findings from this report, as relevant for sediment management of the Conowingo Project, in this final EIS.

WATER RESOURCES

Water Quantity

Comment: Interior disagrees with the draft EIS conclusions on its 10(j) recommendations. Interior objects that the draft EIS does not adopt its 10(j) recommendations to: (1) finalize and implement a flow management plan, (2) implement the flow recommendations of The Nature Conservancy or the Maryland 401 water quality certification permit, and (3) return the river to more natural conditions downstream. While Interior agrees with parts of the flow analysis in the draft EIS that describe potential effects of the current flow regime downstream of Conowingo dam, Interior states that the staff minimum flow alternative fails to address the important spring and fall periods for habitat and fish passage. Interior continues to recommend a flow management plan and the TNC Flow Regime, or the flows to be specified in the Maryland water quality certification.

Response: Any flows to be specified in the Maryland water quality certification are not yet known, because Maryland has not yet acted on the Exelon request for water quality certification. However, in response to several comments on the flow analysis in the draft EIS, we now provide additional analysis in this final EIS in support of our recommended flow regime downstream of the Conowingo Project.

Comment: The Nature Conservancy states that the draft EIS mischaracterizes and misrepresents the biological objectives developed by The Nature Conservancy. The Nature Conservancy requests that the final EIS address three major points of clarification: (1) the representation of persistent habitat in articulating The Nature Conservancy's biological objectives and comparing alternative operating scenarios, (2) the inaccurate values reported in table 3-21, and (3) the basis for and conclusion that "Exelon's current flow regime is generally adequate for protection of aquatic resources downstream of the project." The Nature Conservancy disagrees that Exelon's current flow regime is adequate for the protection of downstream aquatic resources. EPA strongly supports Interior and The Nature Conservancy's flow recommendations because of the critical spawning and nursery habitat for important species in the lower Susquehanna River and upper Chesapeake Bay.

Response: We revisited our analysis of Exelon's habitat persistence and maximum weighted usable area (MWUA) analyses and added additional discussion to this final EIS. We revised table 3-21 (table 3-22 in this final EIS), to provide more details on the range of flows that would provide 70 percent of MWUA for evaluation species. We also checked all values in table 3-22 against table 5.1-1 of the Exelon instream flow report (Gomez and Sullivan and Normandeau, 2012a) to ensure accuracy. The Nature Conservancy cites a table 3-1 in the Exelon report, which we were unable to find, although we note that table 5.1-1 of the Exelon instream flow report has the results of the MWUA analysis. Our revised analysis provides more support for our conclusion that Exelon's flow regime, with the staff-recommended modifications to that regime, would adequately protect aquatic resources downstream of Conowingo dam. We acknowledge that some of the modeling analyses show that more aquatic habitat would be provided downstream of Conowingo dam with the TNC Flow Regime and with run-of-river operation, but conclude that such additional habitat may not necessarily result in enhancement of the fishery, and may not be worth the costs that would be incurred by affecting the operation of both the Conowingo and Muddy Run Projects.

Comment: NMFS encourages the Commission to consider additional flow and ramping alternatives to benefit downstream aquatic habitat and upstream fish passage.

Response: We consider several flow alternatives in the draft and final EIS, including the TNC Flow Regime, run-of-river operation, and a staff-recommended alternative. We also analyze the effects of ramping downstream of Conowingo dam and conclude that current ramping is not having a major, adverse effect on the fishery.

Comment: SRBC states that alternative flow management scenarios developed by the stakeholders focused on three major components: minimum flows, ramping rates, and constraints on maximum flows. A thorough alternatives analysis for the flow management scenarios must be done before approving a new flow management plan for the Conowingo Project. This analysis must include a baseline run-of-river alternative and other alternatives recommended by the stakeholders. SRBC does not agree that the staff alternative related to flow management strikes an appropriate balance between power generation and instream flow protection. Nor does the applicant's proposal or staff alternative demonstrate that existing project operations, or slight modifications thereto, are best adapted for all beneficial uses of the Susquehanna River. Both alternatives entail continued significant hydrologic alteration and do not provide adequate persistent habitat downstream of the project. Exelon's flow modeling for RSP 3.11 was delayed, and the final report only included 3 of the 9 modeling runs requested by stakeholders, resulting in insufficient information to assess alternative operational scenarios that could balance power production and environmental impacts. The report also fails to provide any cost information for the modeling runs, or information on persistent habitat.

Response: As we discuss above, we consider several flow alternatives in the draft and final EIS, and have revised our instream flow analysis to provide more information and support for our conclusion that Exelon's flow regime, with the staff-recommended modifications to that regime, would adequately protect aquatic resources downstream of Conowingo dam. Our revised flow analysis (section 3.3.2.2, *Environmental Effects, Alternative Flow Regime*) found that the amount of persistent aquatic habitat is similar and the ranges of persistent habitat actually overlap for some life stages between the current Exelon flow regime and the TNC Flow Regime. In addition, overall, the current and proposed Exelon operations generally bracket the range of flows that would provide 70 percent of MWUA (a primary goal of the TNC Flow Regime) for target species, as determined by Exelon's instream flow study. Exelon has updated its flow modeling and provided adequate information for our evaluation of the effects of the primary flow alternatives on project economics. While Exelon did make available the results of the additional six modeling runs, none of those alternatives were recommended by any entities and did not require analysis.

Comment: The State of Maryland agrees with staff recommendations to eliminate periods with no minimum flow, but Maryland DNR believes that these flows should be adaptive and not rigid guidelines as presented in the draft EIS. Current operations and flow releases have had adverse effects on fish migration, habitat availability, fish stranding, and listed species, and the State of Maryland states that Exelon's proposal to continue these releases is unacceptable.

Response: Minimum flows required in project licenses are typically specific values so that licensees may plan their operations and so that Commission staff may ensure compliance with license conditions. Minimum flows may vary seasonally in consideration of specific fishery needs, and current Conowingo flows do so. Our revised analysis of minimum flows in this final EIS provides additional information on effects of flow releases from Conowingo dam, and additional support for staff's modifications to Exelon's proposed regime.

Water Quality

Comment: Interior considers the information provided on the reduction of sediment storage capacity of the Conowingo Pond as a potentially significant change in the impoundment, and notes water quality and fish passage concerns.

Response: Effects of sediment storage on water quality are discussed previously in this appendix under *Geology and Soils*. There is no information to indicate that reduction of the reservoir storage capacity has had an adverse effect on fish passage.

Comment: EPA notes that the draft EIS does not consider the effects of polychlorinated biphenyls (PCB) in Conowingo Pond and the effect of those PCBs on surrounding waters (Susquehanna River, Chesapeake Bay). Although characterization of PCBs in Conowingo Pond is not complete, current information shows that PCB contamination should be considered in future plans for both Conowingo dam and pond.

Response: PCB impairment was not an issue previously raised during the relicensing proceeding for the Conowingo Project. Much of the mainstem Susquehanna River within Pennsylvania has a fish consumption advisory for PCBs in channel catfish (also for quillback, carp, and walleye in the North Branch Susquehanna River) (Pennsylvania FBC Fish Consumption Advisories, 2014), indicating that this is a basin-wide issue and not specifically related to the Conowingo Project.

Comment: The Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy state that, based on preliminary results from the LSRWA, they find that Conowingo dam operations are contributing to the violation of downstream water quality because of the accumulated sediments and nutrients behind Conowingo dam, and Exelon should be required to mitigate those effects.

Response: Effects of sediment transport and the results of the LSRWA are discussed previously in this appendix under *Geology and Soils*.

Comment: Senator Cardin comments that the Chesapeake Bay's water quality and sediment transport model indicates that increased nutrient loading resulting from scour events behind Conowingo dam results in serious impairments for dissolved oxygen in three segments of the middle Chesapeake Bay, and asks that these impacts not be overlooked in the EIS and in the relicensing process.

Response: The draft EIS devotes considerable discussion to water quality in the area of influence of the projects and on the TMDL plans to improve water quality downstream of the projects. We also have been following the progress of the LSRWA throughout these proceedings and reviewed the draft report released on November 13, 2014 (Corps and MDE, 2014). Based on the results of the recently released report, we added additional discussion of water quality effects on the upper Chesapeake Bay to this final EIS (section 3.3.2.2, *Environmental Effects, Sediment and Nutrient Loading*).

Aquatic Resources

Upstream Fish Passage

Comment: Senator Cardin asks that the EIS include measures to improve and modernize the fish lift and other fish passage facilities, to improve fish passage past Conowingo dam, and include measures to improve the efficiency of American eel passage.

Response: Section 3.3.2.2, *Environmental Effects*, of this final EIS provides our analysis of alternative measures recommended by stakeholders, resource agencies, and Commission staff to improve diadromous fish passage upstream and downstream of the Conowingo Project, and section 5.1.3.2, *Additional Measures Recommended by Staff for Conowingo*, recommends a suite of measures designed to modernize and improve the efficiency of the project's upstream fish passage facilities.

Comment: Dr. Roe comments that the draft EIS disregards the problem of fish passage. She states that the draft EIS acknowledges the failure of shad restoration programs and seems to establish a new, lower baseline for appropriate fish passage on the Susquehanna River. She comments that it would be irresponsible to relicense the projects because American shad passage is at an unacceptable level and asks that the EIS be revised to include restoration of American shad.

Response: As noted above, the draft EIS does not disregard the fish passage issue on the Susquehanna River. To the contrary, we provide a detailed analysis in section 3.3.2.2 of the effects of the lower river dams on the passage of American shad and American eel, we consider numerous agency recommendations on measures to enhance passage of American shad and American eel, and in sections 5.1.3.2 and 5.1.1.2 we recommend a suite of measures designed to modernize and improve fish passage at both the Conowingo and York Haven Projects.

Comment: Exelon and Interior comment that the draft EIS mischaracterizes Interior's Conowingo Project recommendations as a preliminary section 18 fishway prescription that, if finalized, would be mandatory. Exelon and Interior state that Interior only reserved its authority to prescribe fishways during the term of the license, but also offered a range of potential action alternatives for improving fish passage, including an alternative G that would involve complete rebuilding of the existing fish lifts. Exelon states that it considers Interior's recommendations as comments and that the final EIS should be corrected. Interior states that its final fishway prescription will supersede the section 10(j) recommendation previously made (that alternative G be implemented), and is likely to present requirements slightly different than alternative G. Therefore, Interior withdraws that section 10(j) recommendation and will consider the views of FERC staff when developing its final fishway prescription. Interior states that when and if it amends its preliminary fishway prescription to include measures other than a reservation of authority, it will notify the Commission.

Response: Staff acknowledges that the Interior preliminary fishway prescription is only a reservation of authority and that Interior has withdrawn its section 10(j) recommendation to implement alternative G. We have made corrections to this final EIS to reflect these changes. However, we retain our analysis of alternative G in this final EIS, even though the Interior final fishway prescription may differ somewhat from alternative G. We appreciate Interior's consideration of the staff alternative for fish passage improvements at Conowingo, and understand that Interior's final fishway prescription would be mandatory; as such, the final prescription would become a requirement of any license issued.

Comment: Exelon believes that Interior's fish passage recommendations for Conowingo are overly ambitious and unjustified. Exelon states that its fish passage proposals offer a balanced and measured investment in fish passage that reflects both project impacts and other non-project-related impacts on the American shad. While Exelon states that the fish passage measures proposed by the staff alternative are grounded in substantial evidence and appropriately account for the technological and environmental limitations on improving fish passage on the Susquehanna River, Exelon also points out that while it may implement a trap and truck program for shad as recommended in the Staff Alternative for a limited period, Exelon notes that such a measure would involve four other licensed projects and questions FERC's authority to impose this condition in the new license.

Response: We note Exelon's general support for the staff alternative. We do not recommend a trap and truck program from Conowingo dam as a long-term measure at the project, or that fish passage at Conowingo dam should only consist of a trap and truck program. We continue to recommend volitional passage at the east fish lift, after improvements are made, while trap and trucking from the west lift would serve as a jump start to the American shad population. We anticipate that, once the shad population shows an increasing trend and reaches a sustainable level as determined by Commission staff in consultation with the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC), trap and trucking can be phased out, and only volitional passage restored. We updated our analysis of fish passage at the Conowingo Project in section 3.3.2.2, *Water Resources, Aquatic Biota, Environmental Effects*, and clarify our trap and trucking recommendation in section 5.1.3.2, *Additional Measures Recommended by Staff for Conowingo*, of this final EIS.

Comment: Interior comments that: (1) fish passage efficiency at Conowingo is affected by project operations (flow fluctuations, peaking flows), and it continues to recommend a criterion of 80 percent passage within 36 hours; (2) Interior will continue to recommend the SRAFRC restoration plan goals for each project of 75 percent passage of shad passed at the next downstream project or 85 percent of the fish entering a project's tailrace area, and because there are no other projects downstream of Conowingo, they use the 85 percent criterion in the tailrace as the target passage efficiency for Conowingo dam; (3) the timing of fish passage on the river is more important than the overall percent passage when evaluating fish passage effectiveness; and (4) Interior's criterion of 80 percent passage within 36 hours is based on an FWS model, which indicates that delaying that passage from 36 to 120 hours (5 days) would result in few fish reaching upstream spawning grounds, eliminating any chance of shad restoration in the river.

Response: We agree with Interior that upstream fish passage at all the Susquehanna River Projects should be as efficient and timely as possible so that restoration goals are met. However, when Commission staff makes specific recommendations for requirements for any licenses that may be issued (such as fish passage modifications or efficiency requirements), those recommendations must be based on sound scientific justification that any modifications made are needed and would likely be successful. While theoretical modeling may be a part of any studies used to support staff findings, they should not be the only basis for making recommendations, such as for achieving target fish passage efficiencies. In addition, measuring specific fish passage efficiency rates can be problematic, particularly at Conowingo dam where lower river/Chesapeake Bay shad stocks may be mixed with upriver stocks in the tailrace, so not all shad in the tailrace would necessarily have the "drive" to move upstream, confounding any efficiency estimates. In addition, weather-related decreases in water temperature, particularly at the beginning of the run, may temporarily pause migrations, affecting attainment of time-of-travel criteria. We expect that any license conditions would likely require that fish passage efficiencies be as high as possible, with probable requirements for follow-up effectiveness monitoring. It would be problematic, however, to tie specific target efficiency rates to potential future requirements to make major capital expenditures (lift modifications) to achieve those rates, as studies have shown that fish passage efficiency rates can be highly variable from year to year.

Comment: Interior comments that it is appropriate to make some comparisons to the shad run on the Columbia River, but that passage on the Columbia is influenced by high volumes of attraction flow and high downstream passage efficiency that over-compensates for the low upstream passage efficiency.

Response: We agree that conditions on the Columbia River do not duplicate those on the Susquehanna River, in regard to the higher volume of attraction water provided at the Columbia River Projects, the highly developed downstream passage facilities for salmon (also used by shad), and the presence of suitable spawning habitat between the dams. However, the Columbia River remains as the best example of a multi-project river system with a large shad population, and the experience with shad on the Columbia River should not be overlooked.

Comment: Interior agrees that trap and trucking from Conowingo would be a good tool to mitigate for poor upstream passage efficiency at Susquehanna River dams, with a suggested capacity of 50,000 shad per year, but trap and trucking is not a good long-term solution that would achieve restoration goals.

Response: We agree that trap and trucking should not be a long-term measure at Conowingo dam, and that trap and trucking should be phased out as the shad population recovers and volitional passage becomes the primary means of upstream passage.

Comment: Interior comments that Conowingo dam fish lift operations may need to begin prior to April 1, to accommodate the earlier running alewife that may begin migrations by March 1, and that attraction flows should be provided continuously during the migration season.

Response: We expect that these aspects of fish lift operations at Conowingo would continue to be directed by SRAFRC in consultation with Exelon.

Comment: Interior comments that only about half of the fish that enter the east lift successfully exit the lift, indicating internal mechanical and hydraulic problems that have plagued the lifts at Conowingo dam since they were built.

Response: We agree that there are deficiencies in the internal components of the existing fish lifts at the Conowingo Project, and we are recommending a suite of measures to improve those facilities, as described in section 5.1.3.2 of this final EIS.

Comment: SRAFRC states that if restoration of the American shad population is to occur in the foreseeable future, the upstream passage efficiency goals established by SRAFRC (75 percent passage of shad passed at the next downstream project or 85 percent of the fish entering a project's tailrace area) must be met. SRAFRC also recommends that the hopper capacity at Conowingo should be sized to accommodate both the American shad and the large population of gizzard shad and other non-target species, and that structural and operational deficiencies with the Conowingo fish lifts be addressed. SRAFRC further recommends that turbine operation and sequencing be considered while fish lifts are operating to reduce competing flows and improve fish passage efficiency.

Response: As stated above, we agree that any fish passage facility should be as efficient as possible, but are not inclined to include specific efficiency rates as requirements of any license issued. We also agree that the capacity of the Conowingo fish lifts should be increased and that structural and operational deficiencies should be addressed (see section 5.1.3.2 of the final EIS).

Comment: SRAFRC does not support the no-action alternative because the current state of fish passage in the lower Susquehanna River has not been sufficient to restore migratory fish populations. SRAFRC, however, agrees with the draft EIS that trap and transport should be reinstated from Conowingo dam.

Response: We agree with SRAFRC that existing fish passage facilities at the Conowingo and York Haven Projects need to be improved, and the staff alternative includes the construction of a nature-like fishway at York Haven and a suite of improvements at the Conowingo dam fish lifts. We are recommending reinstatement of trap and transport at Conowingo, but only at the west lift, with volitional passage continuing at the east lift.

Comment: NMFS states that the staff recommendations for fish passage at Conowingo dam do not sufficiently address fish volume, attraction flow, or entrance siting design features necessary for meeting short- and long-term restoration goals of anadromous fish. NMFS comments that staff recommendations appear to be a minimalist approach with many intermediate steps. Under the staff alternative, improving fish passage would require several studies over many years and entail a great deal of bureaucratic bargaining. While that process may be consistent with past methods used by resource agencies to incrementally make fish passage improvements, that methodology was inadequate over four decades. The present relicensing proceeding is an opportunity for a paradigm shift that more equitably balances development with resource interests. FWS' alternative G for improving fish passage is based on lessons learned for implementing fishway measures, reflects current science, and balances development needs.

Response: We do not agree with NMFS' characterization of the staff alternative. Staff's recommended fish passage measures would address the primary issues associated with fish passage at Conowingo dam at a capital cost of more than $7 million for major fish lift improvements. We also note that FWS has withdrawn its section 10(j) recommendation to implement alternative G and indicates its final fishway prescription may differ; however, we continue to analyze this alternative in this final EIS.

Comment: EPA concurs with an adaptive management approach for improving upstream fish passage at Conowingo dam, but recommends that the Commission should adopt the upstream passage recommendations of Interior and the Pennsylvania FBC.

Response: Staff recommends an adaptive management approach to making fish passage improvements at Conowingo dam, but does not involve the additional major capital expenditures for complete reconstruction of both the east and west fish lifts at the project as the first steps in the program (as specified in alternative G) that would have a high levelized annual cost of $2,334,260. Our recommended improvements described in section 5.1.3.2 of this final EIS should result in more effective and efficient fish passage at Conowingo at a fraction of the cost.

Comment: The Onondaga Nation has concerns about the assessment of fish passage in the draft EIS. The Onondaga Nation notes that FERC staff do not adopt Interior's recommendations, the draft EIS does not include a cumulative impact assessment of all the dams on the lower Susquehanna River, and the draft EIS lacks information regarding the capture and transport plans for eels and shad (such as survival rate for transported fish). The Onondaga Nation recommends including more information regarding the trucking program.

Response: While staff carefully considers the recommendations of Interior and other entities, we still must provide our independent analysis of all issues associated with potential relicensing. However, should Interior *prescribe* specific fishway designs under section 18 of the FPA, then those designs would become a requirement of any license issued, regardless of whatever staff analysis and recommendations were made in the EIS. The draft EIS did include a cumulative effects analysis of fish passage on the lower river (see section 3.3.2.3). In addition, our draft EIS analysis of fish passage for all three projects in itself included an analysis of fish passage on the entire lower Susquehanna River. Regarding additional information on any trucking program that may be implemented, those details are not required for this stage of the relicensing process. We expect that any future trucking program would draw upon the expertise of agency personnel and Exelon's consultants involved with past trucking operations on the lower Susquehanna River.

Comment: Pennsylvania FBC comments that it supports some of FERC staff's recommendations for fish passage improvements at Conowingo dam, but staff's recommendations are not comprehensive because they do not incorporate fish passage performance criteria or fish passage evaluation requirements. Staff-recommended measures generally accepted by Pennsylvania FBC include improvements to the east and west fish lifts and American eel passage measures at Conowingo dam that are also consistent with the Pennsylvania DEP water quality certification for the Muddy Run Project. Pennsylvania FBC recommends fish passage performance criteria to guide the development of adaptive management strategies and to efficiently and effectively address fish passage issues at Conowingo dam and other hydroelectric projects on the Susquehanna River. Pennsylvania FBC notes that performance criteria have been adopted at other lower Susquehanna River Projects. Pennsylvania FBC also recommends that FERC staff address future shad population growth by including provisions for volitional fish passage at the west fish lift, and continues to recommend measures to reduce stranding downstream of Conowingo dam. Pennsylvania FBC sees fish stranding as a result of Conowingo dam operations as a substantial threat to migratory and resident fish that warrants not only mitigation but more thorough investigation(s). Evaluations should address frequency of strandings (especially during spring spawning migrations); occurrence and impact of fish kills from stranding; stranding mortality estimates for fish species targeted for restoration, with assessment of impacts on Susquehanna River populations; and identifying potential operational and structural modifications to mitigate stranding effects.

Response: We appreciate Pennsylvania FBC's support for several of the staff-recommended measures for improving fish passage at Conowingo dam. We also agree that evaluation of the performance of the improved fish passage facilities should be included, and we recommend an evaluation period for the east lift. In addition, we expect that both fish lifts would continue to be monitored (passage counts), as they have been for the past 42 years, so passage data would be available as part of SRAFRC's required monitoring. While other licensees on the lower Susquehanna River may have voluntarily agreed to specific criteria as part of settlement agreements, in contested proceedings, imposition of specific performance criteria (that may later require fish lift modifications with high capital costs) must be based on substantial evidence. Although any facilities should be as efficient as possible, there is insufficient information to specify what those efficiencies should be at the Conowingo Project. We do not recommend future volitional passage at the west lift because there would be substantial engineering challenges in transitioning to volitional passage that would have a high cost. While we acknowledge that some shad stranding may occur downstream of Conowingo dam, available data do not show a major adverse effect on shad or other target species. Pennsylvania FBC recommends another stranding study, but Exelon already conducted a stranding study that showed few target species are being affected, and that most of the fish killed were non-target species. Some commenters have extrapolated the number of American shad observed stranded to much higher numbers, making the assumption that fish stranded below the dam are represented in the same proportion as fish collected in the fish lifts, which may or may not be the case. In any event, as Pennsylvania FBC states, less than half of the shad stranded (42.6 percent) were observed as mortalities.

Comment: The State of Maryland makes several comments on the analysis of fish passage in the draft EIS, in particular fish passage at Conowingo dam, including: (1) the west lift gizzard shad counts in 2013 and 2014 exceeded Maryland DNR's estimated capacity of a 1,500-gallon hopper, indicating that a new 1,500-gallon hopper would be inadequate for safely lifting American shad in the west lift; (2) river herring should be included in a trap and transport program, attraction flows should be calibrated to optimize fish passage, and the 42-year-old west lift needs major improvements; (3) restoring a 900-cfs attraction flow at the east lift, as recommended by staff, would not meet current FWS specifications of 3 to 5 percent of station capacity, which would be an attraction flow of 2,580 to 4,300 cfs; (4) the east lift's life expectancy would be only 25 to 30 years if proper maintenance is performed (which has not been performed in the past 10+ years), while the requested license term is for 46 years; (5) the staff recommendation provides no requirement for a volitional fish lift during the entire requested license term of 46 years; (6) the gizzard shad population has increased steadily since 2000, with the potential for the passage of 2.1 million gizzard shad by 2030, and FERC staff failed to consider this additional biomass when analyzing hopper capacity; (6) efficiency inside the east lift has been poor and may be more problematic than effectiveness in attracting fish into the lift; (7) FERC staff's analysis of passage time to York Haven does not consider that shad would also need to access and use hundreds of miles of additional river habitat upstream of York Haven for the restoration program to meet its goals; and (8) even though the Safe Harbor Project has demonstrated a long-term upstream passage efficiency of 71 percent, and both Holtwood and York Haven have agreed to 75- to 85-percent passage goals in settlement agreements, staff looks to Columbia River data to justify not requiring 80 percent passage efficiency at Conowingo, and only recommends minor improvements at Conowingo.

Response: We agree with the State of Maryland that current upstream fish passage facilities at Conowingo dam should be upgraded, including increased hopper capacity and attraction flows at both fish lifts. Our recommendations for improvement would initially require substantial improvements in the lifts at a capital cost of more than $7 million, with later improvements depending on effectiveness studies of the initial improvements. It is incorrect to say that the staff alternative would have no requirement for a volitional fish lift during the entire requested license term of 46 years. Our recommendation is that the west lift be used for interim trap and trucking, and the east lift continue to be used for volitional upstream passage. We provide clarification of this in section 5.1.3.2, *Additional Measures Recommended by Staff for Conowingo*, of this final EIS. Our analysis of upstream passage time does consider that shad would require passage to habitat well upstream of York Haven, although any discussion of passage time generally refers to the average time because some fish would be faster and some slower. However, the poor upstream passage now shown on the river is a primary basis for our recommendation to restore interim trap and trucking. Regarding upstream passage efficiency, staff used the Columbia River data to demonstrate that large runs can be maintained with somewhat lower efficiencies, with the understanding that spawning habitat does occur between Columbia River dams. While the licensees for the Holtwood and York Haven Projects may have agreed to high efficiencies as part of settlement agreements, specific requirements in contested proceedings must not be based only on theoretical modeling. We do agree that upstream fish passage at all the Susquehanna River Projects should be as efficient and timely as possible so that restoration goals are met.

Comment: The Nature Conservancy states that the findings of fact with regard to fish passage measures at the project as described in the draft EIS are not supported by substantial evidence as required by FPA section 313(b), and do not describe how recommended fish passage measures would be consistent with applicable comprehensive plans, e.g., amendment 3 of the Interstate Fishery Management Plan for shad and river herring (February 2010). It is also unclear how the staff-recommended fish passage improvements are related to or consistent with biological performance goals established through existing comprehensive plans. Staff comparisons to Columbia River shad passage are not appropriate because the shad there are an introduced and invasive species and not a management target for passage. The Nature Conservancy also disagrees that shad populations have not responded to dam removal, citing recent assessments that the Rappahannock River has exceeded 80 percent of the restoration goals for the past three years and the Potomac River has exceeded its goals. The Nature Conservancy states that the passage efficiency at Conowingo dam has declined over the past decade, but that the progress shown with other Chesapeake Bay tributary rivers indicates that restoration on the Susquehanna River is possible. The Nature Conservancy also requests that the final EIS include a comparative analysis of the extent that the staff alternative and Interior's alternative G would achieve the biological performance goals articulated in existing comprehensive plans.

Response: We reviewed amendment 3 of the Interstate Fishery Management Plan for shad and river herring, prepared by the Atlantic States Marine Fisheries Commission, and find no inconsistencies between our recommended measures and the plan. As is typical for such interstate plans, the goals, objectives, and recommended measures are generalized (e.g., improve fish passage at barriers to migration, improve spawning and rearing habitat). Because staff-recommended measures would improve fish passage at 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. As noted above, the Columbia River continues to be a good example of the success of shad passage on a multiple-dam river system, notwithstanding that they are an introduced species in the Columbia River. The Nature Conservancy's comments on the good success of shad restoration on the Potomac and Rappahannock Rivers failed to mention that other major tributaries to the Chesapeake Bay (the York and James Rivers) have not met their restoration goals, indicating that the low success on the Susquehanna River is not an anomaly (see http://www.chesapeakebay.net/images/maps/Shad_Abundance_2013.pdf).

We also note that success on the Potomac River may have little to do with providing fish passage or removing migration barriers. While the low-head Little Falls dam just upstream of Washington, D.C., was equipped with a fishway in 1999, that fishway made available only an additional 10 miles of riverine habitat, and because fish counts are not made at the facility, the number of fish passing upstream is not known. The current biological performance goal for the Susquehanna River is described in SRAFRC (2010), which states:

> Restore self-sustaining, robust, and productive stocks of migratory fish capable of producing sustainable fisheries, to the Susquehanna River Basin throughout their historic 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. Goals for American eel and other migratory species are yet to be determined.

Comparing whether the staff alternative or Interior's alternative G would achieve the biological performance goals of SRAFRC (2010) 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.

Comment: SRBC states that it supports the comments and recommendations made by Interior, SRAFRC, Pennsylvania FBC, Maryland DOE, and Maryland DNR regarding deficiencies in fish passage that should be corrected at the Conowingo Project. The Chesapeake Bay Foundation and the Midshore Riverkeeper Conservancy also note that FERC recommendations deviate from the recommendations of Interior regarding measures to improve fish passage. The Chesapeake Bay Foundation concurs with the SRAFRC (2010) restoration goals and states that the capacity of the fish lifts should be based on an expectation of someday achieving the restoration goals. The Chesapeake Bay Foundation recommends including Interior's recommendations in the final EIS.

Response: As we describe above, staff is required to do an independent analysis of all issues associated with potential relicensing, including fish passage. However, should Interior *prescribe* specific fishway designs under section 18 of the FPA, then those designs would become a requirement of any license issued. Interior's recommendations are described and analyzed in detail in the EIS.

Comment: The Clean Chesapeake Coalition comments that the current Conowingo dam fish lifts and overall project operation are not adequate for upstream passage of migratory fish and adversely affect fish movement downstream of the dam. The Coalition notes that the draft EIS fails to discuss any of the ongoing impacts in a concise, scientific, and meaningful way and fails to fashion and discuss alternatives for compensating for such negative impacts.

Response: Section 3.3.2.2 of the draft and final EIS includes a comprehensive analysis of fish passage at Conowingo dam, and section 5.1.3.2 presents staff's recommendation for major improvements in the existing fish lifts at a capital cost of more than $7 million.

Comment: The Citizens for Pennsylvania's Future (The Citizens) state that measures recommended in the draft EIS fail to provide adequate protection to the Susquehanna River's vulnerable fish populations. The Citizens recommend: (1) improved up-and downstream passage for American eel and American shad, (2) a reasonable time frame with appropriate measures for the implementation of up-and-downstream passage, and (3) the use of trap and trucking only as an interim measure. The final EIS should include requirements for volitional passage of both American shad and American eel within the next 5 years. The Citizens also support requiring a higher survival rate (85 percent) for American shad at each lower Susquehanna River hydroelectric dam. The Citizens note that the staff recommendations do not follow the current restoration plan and that staff fails to show that its plan would ensure adequate passage.

Response: As we note previously, the draft and final EIS include a comprehensive analysis of fish passage at Conowingo dam, which concludes that Exelon should make major improvements in the existing fish lifts. We recommend reinstating trap and trucking of shad at Conowingo dam from the west lift, as an interim measure, as well as trap and trucking of American eel. We also recommend continuing volitional upstream passage of shad at the east lift, with improvements to that lift, and establishing eel volitional passage in the future once studies indicate that volitional passage would be a better option than trucking.

Comment: York Haven Power comments that section 2.2.3.1 of the draft EIS appears to confuse the distinction between before and after completion of the nature-like fishway and makes reference to the 2010 Consent Order and Agreement between York Haven Power and Pennsylvania DEP that also appears to misstate its applicability. York Haven Power suggests revisions to three of the bullets in that section.

Response: We revised section 2.2.3.1 of this final EIS to clarify the distinction between before and after completion of the nature-like fishway and the applicability of the 2010 Consent Order and Agreement.

Downstream Fish Passage

Comment: Interior states that, while downstream passage survival is relatively high at Conowingo dam, juvenile shad passage through the Francis units is about 5 percent lower than the 95 percent survival goal. Interior remains concerned about safe, timely, and effective downstream fish passage, and continues to recommend periodic downstream efficiency testing and studies to determine the operational scenarios that would optimize downstream fish passage.

Response: We note that Interior also comments that FWS evaluated the potential benefits of turbine screening and/or a fish guidance system at Conowingo dam and concluded that such alternatives were premature. We agree that systems may not be available or feasible to improve survival by the relatively small 5 percent shortfall to reach the program goals for the Francis turbines, so we continue to question the value of conducting additional testing.

American Eel

Comment: Based on site-specific studies at Muddy Run and Conowingo, and agency consultations, including with FWS, Exelon no longer proposes downstream trap and trucking of American eel from upstream tributaries as a component of its licensing proposal. Exelon requests that Commission staff withdraw this measure from the staff alternative in the final EIS.

Response: We revised this final EIS to show Exelon's change in its licensing proposal in section 2, and we update our analysis throughout section 3. We no longer include this downstream passage measure in the staff alternative because of the unlikely success of this measure.

Comment: York Haven Power comments that the description in the executive summary and section 2.2.3 of Exelon's proposal for downstream passage of silver stage American eel could be misinterpreted to suggest that York Haven Power is participating in Exelon's downstream eel passage program.

Response: As noted above, Exelon has requested that we delete the measure from its licensing proposal. We removed that measure in this final EIS and revised all associated text. We no longer include this measure in the staff alternative.

Comment: Interior and SRAFRC agree with most of the eel measures recommended in the draft EIS, including trap and trucking from Conowingo dam, but Interior states that trap and transport for downstream silver eel passage is infeasible and unreasonable.

Response: We acknowledge Interior's and SRAFRC's general support for the recommended eel passage measures, and revised this final EIS to reflect that Interior no longer supports downstream trap and transport for silver eels and that Exelon no longer proposes that measure.

Comment: NMFS disagrees with the staff recommendation on the timing of the silver eel downstream effectiveness study at the Muddy Run Project, which would be after 2026, the same as required by the water quality certification. Instead, NMFS supports Interior's recommendation that the study begin within 3 years of license issuance, citing the anticipation of the outmigration of the 300,000 juvenile eels trucked upstream since 2008. NMFS believes that silver eels resulting from the upstream trucking program would begin outmigrations during 2016 to 2022.

Response: We agree that it is possible that some of the eels transported upstream since 2008 may begin outmigration in 2016 to 2022, but it would be more prudent to wait until 2026, so that more silver eels would be available for capture and use in any studies.

Comment: EPA comments on Pennsylvania FBC'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." EPA recommends that FERC, the resource agencies, and Exelon define "operating effectively" prior to issuance of the final EIS. EPA also recommends that FERC consult with the resource agencies and require annual population surveys of eels downstream of the dams and then require upstream transport of an ecologically significant portion of the population on an annual basis.

Response: We expect that the operational details of the American eel restoration plan (including the need for any annual surveys) would be determined by SRAFRC and the licensees on the Susquehanna River, and should not be specified in any licenses issued because the details of the program would depend on ongoing success. We recommend a flexible date for transition to volitional passage at Conowingo dam (instead of a specific year – 2030) because program results may find that trap and trucking may or may not be viable after 2030. Again, those details should be worked out among SRAFRC and the licensees.

Comment: The State of Maryland believes that it is premature to recommend volitional eel passage at Conowingo in 2030, and that licensing terms should be flexible to allow for modifications to optimize restoration methods, especially in areas with ongoing research such as passage of the American eel.

Response: We agree that the date for transition to volitional passage should not be set to a specific date, but should instead depend on program results.

Comment: SOLS comments that Conowingo dam blocks American eel passage in the Susquehanna River and impedes restoration efforts on the river. Eel restoration would also benefit mussel restoration because eels are known hosts for eastern elliptio (*Elliptio complanata*) glochidia, resulting in water quality enhancement because of increased filtering by a restored mussel population. SOLS states that Exelon's analysis of eel passage is flawed, and its plan for eel passage is not adequate and is not consistent with the restoration plan. The license should require measures that are consistent with the SRAFRC eel restoration plan, including permanent volitional upstream and downstream passage for eels, and a trap and transport program for upstream passage in the interim. SOLS states that the Commission should require measures to allow establishment of a population of 11 million eels in the river, with eel passage facilities on both sides of the Conowingo tailrace, but not on the east shore of the spillway. FERC should also establish a downstream passage efficiency of 90 percent and require Exelon to provide permanent volitional American eel downstream and upstream passage program because a trap and truck program may result in adverse effects on eels and would be more costly than volitional passage. SOLS states that Exelon's plans for downstream trucking of silver eels are inadequate, and that analysis of downstream passage in the draft EIS is inadequate. Staff fails to provide an analysis of the date by which downstream passage must be in place, which SOLS recommends should be by 2019, which means studies would need to begin in 2017. The Citizens also recommend permanent upstream and downstream volitional passage for eels and a trap and transport program for upstream passage in the interim. A plan for upstream and downstream volitional passage must be implemented within the next 5 years, and a timetable established before a new license is issued. The Citizens also cite reports on stress and densities in trap and trucking operations that may cause fresh water populations of eel to become male dominated, as another reason to not delay volitional passage.

Response: As noted above, Exelon no longer proposes downstream trucking of silver eels. Staff's recommendations for eel passage measures at Conowingo dam are consistent with the water quality certification eel passage requirements for the Muddy Run Project (which are being implemented at Conowingo dam), and those requirements are consistent with the SRAFRC American eel restoration plan. Our recommendation includes a transition to volitional passage, when appropriate. We have not specified a date when downstream passage must be in place because that date cannot be predicted and would depend on the success of the upstream passage program. We expect that most of the details of the eel restoration program would be developed by SRAFRC and the licensees, as has occurred with the American shad restoration program over the past 40 years.

<u>Freshwater Mussels</u>

Comment: York Haven Power comments that it agrees with the conclusions in section 3.3.2.2 of the draft EIS regarding potential effects of continued operation of the lower Susquehanna River hydroelectric projects on freshwater mussels, but suggests revisions to the text to clarify the east channel minimum flows before and after the completion of the nature-like fishway. Prior to construction of the fishway, the minimum flow would be 400 cfs during the spring fish migration season, but after construction would be 267 cfs year-round, which should benefit low-mobility mussels.

Response: We revised this final EIS to clarify the east channel minimum flows before and after the completion of the nature-like fishway.

Comment: The Chesapeake Bay Foundation and Midshore Riverkeeper Conservancy express concern about nitrogen, phosphorus, and sediments that have accumulated behind Conowingo dam that could be scoured during high water and transported into the Chesapeake Bay. They recommend appropriate mitigation as part of the new license for the Conowingo Project, including selective dredging of Conowingo Pond, and nutrient reduction projects upstream of the dam and in Maryland. These would include improved agricultural practices, wastewater treatment plant upgrades, green infrastructure, as well as restoration of the system's "natural filters" such as freshwater mussels and oysters.

Response: Freshwater and marine bivalves feed by circulating water over their gills and then removing or filtering out bits of organic material. Therefore, we agree that riverine and estuarine bivalves can reduce particulate organic and inorganic material in the water column; however, in large systems their contributions to this process can be difficult to measure. We also agree that nutrient reduction projects in the watershed would be appropriate, but as we previously discussed in our responses regarding sediment transport and management, dredging of Conowingo Pond would not be a cost effective alternative for mitigating sediment and nutrient transport to the Bay.

Comment: SOLS notes that the Conowingo dam blocks American eel passage in the Susquehanna River and impedes restoration efforts on the river. SOLS comments that eel restoration would benefit mussels because eels are known hosts for eastern elliptio glochidia, and that dense mussel populations can positively affect water quality because these organisms filter organic and inorganic particulate matter out of the water column.

Response: We revised section 3.3.2.2, *Water Resources, Environmental Effects*, of this final EIS to include a discussion of the findings by Lellis et al. (2013), who investigated the importance of the American eel as a host for the eastern elliptio. Analysis of the restoration plans for the American eel, the most important host fish for the eastern elliptio, is also provided in section 3.3.2.2, *Water Resources, Environmental Effects*, of this final EIS, and we specifically respond to an earlier SOLS' comment on American eel restoration above. That is, staff's recommendations for eel passage measures at Conowingo dam are consistent with the water quality certification eel passage requirements for the Muddy Run Project (which are being implemented at Conowingo dam), and those requirements are consistent with the SRAFRC American eel restoration plan.

Comment: The Nature Conservancy comments that the statement that mussels downriver of the Conowingo dam are limited by shear stress during spring runoff was not supported in the draft EIS.

Response: We provide additional supporting documentation on the distribution of mussels downstream of Conowingo dam in section 3.3.2.2, *Water Resources, Environmental Effects*, of this final EIS.

Comment: SRBC comments that staff should further evaluate the effects of peaking operations at the Conowingo Project on mussel distribution and abundance, as well as the effects of peaking operations on downstream velocity, shear stress, substrate, and dewatered habitat. SRBC requests that staff discuss methods to mitigate the adverse effects of peaking operations on mussel populations in the final EIS.

Response: One of the objectives of Exelon's instream flow study, described in the draft EIS, was to examine mussel distribution in the project area as influenced by shear stress. The study concluded that mussels were most abundant in areas of comparatively low shear stress, assuming that appropriate substratum conditions for bivalves were met. However, any riverine modification, whether for commercial navigation, hydropower, recreational use, or flood control, can negatively affect the native aquatic and riparian species. Regardless, it would be virtually impossible to quantitatively evaluate effects of the project-induced changes in sediment composition and flow patterns on mussel assemblages, particularly in separating the scouring effects of peaking operations from those of natural high-flow events. Staff finds no basis to require mitigation for project effects on the freshwater mussels because proposed project operation would not result in large operational changes that would negatively affect current freshwater mussel populations and distribution. Further, we find that there would be some beneficial effects associated with any new license for the Conowingo Project. For example, staff-recommended improvements to project minimum flows, and the restoration plans for American eel, a host species for the eastern elliptio mussel, could have a positive effect on this mussel species.

Comment: SRBC also comments that staff should further evaluate the effects of peaking operations at the Conowingo Project on submerged aquatic vegetation distribution downstream of the dam, associated with peaking operations creating artificial high-flow events during average and low inflow conditions, which also result in high velocities, shear stress, and scouring and redistribution of finer grained sediments.

Response: Flows during normal peaking operation at the Conowingo Project, which typically range from 70,000 to 80,000 cfs, are likely to have less of an effect on scouring and substrate redistribution than typical annual high-flow events. For example, monthly 10-percent exceedance flows are greater than 80,000 cfs in 6 months of the year (December through May), while maximum recorded flows representing natural high-flow events exceed 200,000 cfs in all months of the year, reaching the range of 400,000 to 600,000 cfs in the spring months (see table 3-6 in this final EIS). These natural high-flow events that are several magnitudes greater than normal project discharges would logically have a greater effect on scouring and substrate redistribution, and therefore affect the distribution of substrate suitable for growth of submerged aquatic vegetation.

TERRESTRIAL RESOURCES

Comment: The State of Maryland agrees with the concept of the Commission's recommendation to protect the state-endangered northern map turtle through monitoring, habitat management, and nest site protection; however, any plan should include provisions that require taking adaptive measures in response to routine population studies throughout the license term.

Response: We appreciate Maryland DNR's support of the development and implementation of a northern map turtle protection plan and recognize the need for adaptive measures in response to ongoing monitoring. Staff's recommended plan would include, as stated in the draft and final EIS, "methods of altering or amending protection and mitigation measures as a result of the monitoring, in consultation with Towson University and Maryland DNR." This would allow for adaptive management in response to population studies.

Comment: The Onondaga Nation notes that the draft EIS rejects a proposal by Exelon to conduct a survey of the project area every 10 years to assess threatened and endangered species in the area. The Onondaga Nation states that this provision would only miss the species that are lost in this time frame, and a more regular review of the project area should not only be implemented but treated like the other management plans that require a review every 10 years.

Response: We appreciate the Onondaga Nation's comment; however, the standard reopener clause, as discussed in the draft and final EIS, is sufficient for protecting rare species that may occur in the project area in the future under any new license. Under the reopener clause, if Exelon proposes to change project operation or conduct any activity that is not included in the license, Exelon would be required to complete an assessment of potential impacts on rare species. Nevertheless, we recognize that this measure is included in Pennsylvania DEP's water quality certification for the Muddy Run Project, so it would be a mandatory condition of any license issued for that project.

Comment: Exelon states that the staff alternative includes Interior's recommended modifications to its proposed Bald Eagle Management Plan and believes that the additional measures proposed by Interior are unsupported and too vague to enforce. Exelon further notes that the current Bald Eagle Management Plan was developed in coordination with Interior and in accordance with recommendations from the National Bald Eagle Management Guidelines. Exelon notes that neither Interior nor the draft EIS articulate what the revisions to the enforcement protocol of the Bald Eagle Management Plan would entail.

Response: Although Exelon's proposed Bald Eagle Management Plan provides project-specific restrictions, buffers, and other measures to protect nests in accordance with the National Bald Eagle Management Guidelines, it only mentions general guidelines related to foraging and roosting areas. Although Exelon has current restrictions below Conowingo dam, information provided by Interior indicates that Exelon is not implementing protection measures to avoid or minimize disturbance to the large core of non-breeding, overwintering eagles present on structures, rocky shoreline, and forested habitats downstream of Conowingo dam, and that FWS receives inquiries from the public about disturbances to eagles at Conowingo dam. Staff and Interior's recommendation would require Exelon to develop measures as part of the Bald Eagle Management Plan to enforce the existing restrictions, as they relate to foraging, perching, and roosting bald eagles. We revised section 3.3.3.2, *Terrestrial Resource, Environmental Effects*, of this final EIS to more clearly state this objective.

Comment: Exelon does not agree with the draft EIS recommendation that Exelon develop a waterfowl nesting protection plan based on the lack of evidence that the project operation affects waterfowl and the fact that concerns over project effects on waterfowl were not raised during earlier study-plan stages of the Integrated Licensing Process. Exelon states that that the Commission should not include a waterfowl nesting protection plan in the staff alternative in the final EIS and should reject Interior's proposed 10(j) condition. Exelon also states that the TNC Flow Regime would do little to minimize water-level fluctuations in Conowingo Pond and downstream of Conowingo dam, and Commission staff should, therefore, remove references to the TNC Flow Regime as related to waterfowl nesting.

Response: We acknowledge Exelon’s comment on the waterfowl nesting protection plan. However, we note that, although the licensing proceeding did not include specific studies or focus on project impacts on waterfowl nesting, staff continue to recommend a waterfowl nesting protection plan. Staff’s recommendation is based on the potential for project-related flow fluctuations in areas susceptible to inundation during the nesting season (i.e., around Conowingo Pond and downstream of Conowingo dam) to affect waterfowl nesting success. Staff’s recommended plan would allow for a measured approach to the issue by identifying, through consultation with FWS and appropriate resource agencies, specific project-related effects on nesting waterfowl, and determining what (if any) protection or mitigation measures would address the issues. Additionally, our analysis in section 3.3.3.2, *Terrestrial Resources, Environmental Effects*, indicates that the TNC Flow Regime would minimize water-level fluctuations downstream of Conowingo Pond, so references to the TNC Flow Regime remain in this final EIS, where appropriate. We have, however, removed references to the TNC Flow Regime reducing fluctuations around Conowingo Pond.

Comment: Exelon indicates that the reference in section 3.3.3.1; page 197 “(URS et al., 2012)” is not included in the literature cited section of the draft EIS.

Response: We corrected the citation in this final EIS. The citation is URS and Gomez and Sullivan, 2012b, which appears with complete bibliographic information in section 6, *Literature Cited*.

Comment: In reference to a statement in the draft EIS that invasive species identified at York Haven have the potential to occur also at Muddy Run and Conowingo, Exelon commented that species with the potential to occur at Conowingo and Muddy Run also may occur at York Haven.

Response: Thank you for your comment; we have revised this final EIS to include this specific information.

Comment: Exelon comments on the following statement on page 223 of section 3.3.3.2 of the draft EIS: "For example, vegetation in the upstream reaches of Conowingo Pond is generally shorter and less abundant than downstream vegetation, as the upstream, more-constricted reach is subjected to higher water levels and velocities than lower reaches. As the energy conditions diminish downstream, the vegetation becomes more prominent, growing on most available rock surfaces." Exelon's comment is that this statement is incorrect because it is describing the bedrock-dominated reach of the pond instead of the alluvial-dominated reach, which is affected by the 9-foot water level fluctuation.

Response: We revised section 3.3.3.1, *Terrestrial Resources, Affected Environment*, in this final EIS to correct this error in the description of the bedrock-dominated reach.

THREATENED AND ENDANGERED SPECIES

Comment: The Onondaga Nation states that, given the documented presence of bog turtles in the adjacent and hydrologically connected Muddy Run Project area and the presence of bog turtle habitat near Conowingo dam, it believes that the bog turtle management plan recommended by Interior should be recommended by staff. The bog turtle is under serious threat and there is evidence suggesting that this species is or could be present in the Conowingo area. The Onondaga Nation supports development and implementation of a bog turtle management or protection plan for the Conowingo area. Maryland DNR, Maryland DOE, Interior, and EPA all recommend the development of a bog turtle management plan for the Conowingo Project. Maryland provided information to Commission staff on the bog turtle presence at the Conowingo Project. Senator Cardin also notes that the draft EIS questions Interior's findings that bog turtles are present at the Conowingo Project and asks Commission staff to give more credence to the agency's assessment of the habitat and wildlife present in the area.

Response: Subsequent to the issuance of the draft EIS, Maryland DNR provided information on the presence of bog turtles near the Conowingo Project. As a result, we revised section 3.3.4.2, *Threatened and Endangered Species, Environmental Effects*, in this final EIS to re-analyze Interior's recommendation that Exelon develop a bog turtle management plan as a condition of any license issued for the project, and adopt the measure in section 5.1.3.2, *Additional Measures Recommended by Staff for Conowingo*.

Comment: Exelon requests clarification on the staff-recommended measure that calls for Exelon to visit FWS' Chesapeake Bay Field Office and the Pennsylvania Field Office websites prior to any ground disturbance and follow the bog turtle and bald eagle guidelines. Exelon states that this is vague and would like to know if this could require surveys to be completed.

Response: Exelon would need to conduct a Pennsylvania Natural Diversity Inventory Review prior to ground-disturbing activities that could require either National Pollutant Discharge and Elimination System or wetland or stream permits. This review can be done on-line, and if the presence of bog turtles or bald eagles is indicated, Exelon would need to follow bog turtle and bald eagle guidelines to determine what further activities, if any, are required. The Interior and staff-recommended measure simply calls for Exelon to comply with the most current Pennsylvania permit and inventory review requirements prior to commencing any ground-disturbing activities.

Comment: The Nature Conservancy, Chesapeake Bay Foundation, and Midshore Riverkeeper Conservancy support NMFS' request that the Commission prepare a biological assessment to evaluate the effects of the continued operation of the Conowingo Project on shortnose and Atlantic sturgeon for the reasons stated in NMFS' letter dated September 28, 2014.

Response: We responded to NMFS by letter dated October 23, 2014, indicating that, among other things, a stand-alone biological assessment is not necessary because most of the information that was requested for the biological assessment is already included in the EIS in multiple locations. We provided a table that listed the information requested and identified where in the EIS that information is found. We revised section 1.3.3, *Endangered Species Act*, in this final EIS to update the status of our consultation with NMFS under section 7 of the ESA.

RECREATION AND LAND USE RESOURCES

Comment: York Haven Power comments that it is not necessary to provide specific provisions in the Recreation Management Plan to address public safety during construction of the nature-like fishway. These provisions would be addressed as part of the Corps' Clean Water Act section 404 permit and associated Pennsylvania DEP section 401 water quality certification for the nature-like fishway.

Response: Staff agrees with York Haven Power that the permitting of the in-water construction would include public safety components, while the Recreation Management Plan would guide resource management over the entire term of a license not just during construction of the nature-like fishway. We have revised the staff alternative in section 5.1.1.2 and our analysis in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects,* in this final EIS accordingly.

Comment: York Haven Power comments on section 5.1.1.2 of the draft EIS and draft license article 407 (which is now draft license article 404) that no parties requested development of a Recreation Management Plan. York Haven Power indicates that, because there were no recommendations from stakeholders for a Recreation Management Plan, it must be reasoned that the existing recreation facilities are adequate and can be maintained over the next license term without the need for a formal Recreation Management Plan.

Response: As discussed in section 5.1.1.2, which is based on our analysis in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, of the draft EIS, York Haven proposes a number of operational and maintenance activities related to recreation, but does not propose a plan for implementing these measures or investigating whether or not the sites are meeting the demand over the course of a license.

Commission staff analyzed the recreation resources and proposed measures at the York Haven Project and concluded that, regardless of the number of stakeholder recommendations, there are a sufficient number of measures related to recreation resources that could be better managed through the implementation of a comprehensive Recreation Management Plan consistent with FERC's *Recreation Development at Hydropower Projects Guidelines* (1996).

Comment: York Haven Power comments on section 5.1.1.2 of the draft EIS and draft license article 408 (which is now draft license article 405) that no parties suggested there was a need for, or recommended development of, a Shoreline Management Plan. York Haven Power suggests that shoreline management and development at the project, which is currently managed by York Haven Power under existing standard land use article 35, remain the same under any future license. York Haven Power also notes that the Commission has discussed the inclusion of existing article 35 in the new license as article 410.

Response: We analyze the multiple recreation and lot lease policies associated with the York Haven Project in section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, of the EIS and conclude in section 5.1.1.2 that organizing all of the shoreline property-related management policies into a single comprehensive Shoreline Management Plan (SMP) would be beneficial. Draft license article 407 is a land use article that is helpful in allowing licensees to manage their shorelines; however, development and implementation of a comprehensive plan would provide clear direction for cottage leaseholders and Commission staff responsible for ensuring the project is in compliance with its license for the future term.

Comment: Exelon disagrees with the analysis related to reopening the catwalk. Exelon recently completed upgrades to Fisherman's Wharf and created new facilities along Octoraro Creek to compensate for the loss of catwalk access and asks why Exelon must modify its proposed Recreation Management Plan to provide access to the catwalk. Exelon notes that the only reason provided in the analysis to open the catwalk is to provide a different experience. Exelon finds this recommendation to be arbitrary and capricious because Commission staff provides no rationale for diverging from its past decision (to close the catwalk and enhance the Fisherman's Wharf) and believes this recommendation should be stricken from the final EIS. SOLS disagree with Exelon's proposal to keep the powerhouse catwalk closed to the public and believe the new fishing pier does not mitigate for the loss of the catwalk. Restoration of access to the catwalk was a major goal of stakeholders to this process because of the unique viewing and recreational opportunities provided by the catwalk. The State of Maryland and private citizens recommend that FERC should require restoration of this access. SOLS comments that it is encouraged by the analysis of reopening the catwalk. SRBC concurs with the State of Maryland and FERC staff that Exelon should re-open the catwalk at Conowingo dam. The National Park Service (Park Service) also agrees that the catwalk should be reopened and recommends that given the high level of public interest in this issue, the license order should set out specifically what will be required of the licensee to ensure adequate public access balanced with the need for fish passage improvements and facility safety.

Response: As noted, we evaluate reopening the catwalk in this final EIS and recommend Exelon develop a plan to provide limited access to the catwalk for anglers. Recommending a plan, rather than more concrete measures, allows Exelon time for consultation, design, and to make planning considerations regarding the timing of access and security measures. It also affords the Commission a review to ensure the plan satisfies public safety and security concerns. As described in section 3.3.5.1, *Affected Environment, Recreation and Land Use Resources*, of the draft and final EIS, reopening the catwalk on the downstream face of the Conowingo powerhouse was highest on the list of concerns reported by public users during interviews conducted as part of Exelon's recreation study (Exelon, 2012b). Staff maintains that angling from the catwalk offers a fundamentally different experience than fishing from the shore. From the catwalk, anglers would cast with the river flow and directly into the middle of the channel, targeting different species, as opposed to casting their lines across the flow from the shore, as happens from Fisherman's Wharf. This is analogous to anglers fishing from shore on a lake without a boat ramp; they can cast into the water but do not have access to fish the middle of the lake. In the EIS, we assess the types of fishing opportunities at this particular location relative to the entire suite of options and in concert with the recommendations from federal and state resource agencies and the public interviewed at the site, before recommending that the catwalk be reopened. In order to address Exelon's comments on the draft EIS, we revised the draft license articles to be more specific on what will be required in the plan to reopen the catwalk.

Comment: Exelon expresses its opinion that the Muddy Run and Conowingo Recreation Management Plans do not need to be updated every 12 years as recommended in the staff alternative of the draft EIS. Exelon states that the recreation study report and Recreation Management Plan document estimated future capacity that will extend through the proposed license terms and that Exelon's track record for maintaining recreation sites is well regarded. Exelon suggests that the standard Form 80 process is the appropriate method for monitoring recreation use and capacity at the projects. The Park Service recommends Exelon update the Recreation Management Plan for the Conowingo Project every 6 years (instead of every 12), which will coincide with all FERC Form 80 filings. The Park Service also wishes to be included in the list of parties to be consulted with on draft license article 413, *Recreation Management Plan*, for the Conowingo Project. SRBC recommends that many recreation sites would benefit from regular maintenance and support an adaptive Recreation Management Plan.

Response: Comprehensive recreation plans include measures to monitor recreation use and evaluate the existing plan for any modifications deemed necessary based on the monitoring. Given the facility upgrades proposed at the project, staff considers conducting larger monitoring efforts through a regular recreation use study that includes conducting user interviews and detailed site breakdown analysis every 12 years as a reasonable period of time to allow the site use to normalize. Because Exelon proposes upgrades to the majority of the recreation facilities, the goal should be to maintain the planned quality of experience at the sites through the term of a license. Providing periodic updates ensures the recreation facilities and opportunities are consistent with the desired experiences, expectations, and safety levels demanded by the public. As such, we continue to recommend conducting a recreation use and needs study every 12 years that would inform the Recreation Management Plan update. However, updating a plan and conducting a recreation use and needs study can be two independent activities. The Park Service does not describe what additional benefit would be realized by updating the plan without the supporting recreation use and needs study. While implementation of on-site surveys associated with updating the Recreation Management Plan is an important function of any Recreation Management Plan update, we also consider the overall cost and benefits, as well as the number of facilities relative to the information available, and do not believe there is enough evidence to suggest a need to conduct a use and need study more frequently than we recommended in the draft EIS (12 years). We revised this final EIS to add the Park Service to the list of stakeholders to consult on the Conowingo Recreation Management Plan.

Comment: The Park Service agrees that referencing bathymetric mapping and dredging procedures of the proposed Sediment Management Plan in the Recreation Management Plan would ensure continued access for the public; however, the Park Service notes that, given the frequency, magnitude, and duration of storm events, Exelon should be required to evaluate sediment loading after storm events of a particular magnitude and duration (to be determined by the appropriate agency) which are likely to cause deposition of additional sediments. The Park Service recommends that, at a minimum, an annual evaluation should be conducted at each location and a provision put in place to provide a trigger (based on storm event) for when additional dredging needs to be accomplished. Interior states that simply requiring periodic evaluations and dredging could result in situations where access is compromised for unacceptably long periods of time.

Response: The draft EIS recommends development of a final Sediment Management Plan that includes detailed benchmarks for dredging, a schedule, and a commitment to dredge the three access areas as soon as the benchmark sediment depths are reached to ensure that recreation access is not lost or compromised indefinitely. The final Sediment Management Plan would be developed with interested stakeholders that could inject into that process specific storm metrics (magnitude or frequency) as a benchmark that would trigger action to protect boating resources at the tributary access areas. Staff agrees that the goal of implementing a plan that triggers dredging is to ensure recreational boating access is not compromised for long periods of time. We revised section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, of this final EIS to clarify the analysis surrounding the development of the Sediment Management Plan.

Comment: Broad Creek Civic Association notes that, while the association appreciates the expansion of new recreation facilities around the project, most are rendered unusable by low water levels, siltation, and debris.

Response: Staff analyzes the recreation boating season water elevations in section 3.3.5.2 of the draft and final EIS at tributary access points, including Broad Creek, and concludes that Broad Creek marina is affected by siltation restricting boating access. The draft and final EIS also include an analysis of Exelon's floating debris management, reports on historical debris removal from the pond, and concludes that the amount of floating debris is dynamic from year to year and the removal in front of the intakes could be augmented by the deployment of a skimmer. We revised the staff alternative in this final EIS to include development of a debris removal plan that includes a skimmer as a resource to reduce floating debris during the recreation season as part of the Recreation Management Plan.

Comment: Susquehanna River Boaters Association comments that initiatives agreed upon between Susquehanna River Boaters Association and Exelon will be in place for the start of the 2015 boating season, including: (1) Exelon will create a time-line/action list with target dates for dredging at Peach Bottom Marina; (2) Exelon will seek approval to fund and begin the permitting process for dredging Peach Bottom Marina in 2015; and (3) Exelon will line the parking lot, upgrade the bathroom facility, and provide riverfront signage at Peach Bottom Marina.

Response: We revised this final EIS to include the agreed-upon updates in the discussion of the Peach Bottom Marina in section 3.3.5.2*, Recreation and Land Use Resources, Environmental Effects.*

Comment: Susquehanna River Boaters Association comments on the water levels and the duration of the boating season at Conowingo Pond, stating that the recreation season is not sufficient for recreational boating. Susquehanna River Boaters Association states that the recreation season is too short and raises issue that there is no minimum pond elevation in place for weekdays. Susquehanna River Boaters Association recommends: (1) extending the recreation boating season to May 1 - October 1 and that the recreational minimum water level is maintained on all holidays during the boating season, regardless of what day of the week they occur; (2) establishing a Peach Bottom Marina dredging plan; (3) measuring recreational minimum water levels at point of access *not* at the dam; (4) refunding two months to all Peach Bottom Marina members due to lack of dredging; (5) refunding lost revenue to the marina; and (6) adding new channel markers and update maps.

Response: The Susquehanna River Boaters Association's points are pertinent to the recreation resources at the Conowingo Project, and we revised section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, of this final EIS to include an analysis of some of these additional recommendations. The issue of dredging Peach Bottom Marina, and other tributary access areas, is currently addressed in the Sediment Management Plan with staff recommendations. Similarly, the topic of measuring the recreational minimum water levels at the point of access versus at the dam and deploying new channel markers and updating maps could be addressed in the Sediment Management Plan. We revised the EIS to address the recommendations to reimburse marina tenants and business owners. Exelon is ultimately responsible to manage project lands and waters, and any discussions related to lease agreements or violations of any lease it signs with local operators to assist them in managing the resources do not extend to FERC. As for the recommendation to extend the recreation boating season from Memorial Day to Labor Day to May 1 – October 1 and all holidays within this period regardless of the day of week, we do not believe extending the season is warranted at this time. We base our conclusion on several factors. The water level management study (URS and Gomez and Sullivan, 2012b) shows that, for the period between 2004 and 2010, water levels were above the 107.2-foot level (current minimum pond elevations for weekends between Memorial Day and Labor Day) the majority of the time between the recommended recreation boating season of May 1 to October 1. In addition, the ability to access the pond should improve after implementation of our recommended dredging at the tributary access sites. To ensure access to the pond, we recommend monitoring boating access issues and revisiting the definition of the recreation boating season as part of the Recreation Management Plan update.

Comment: Susquehanna River Boaters Association would like to remind both Exelon and FERC that the cottages on the Conowingo Project islands were part of the original license agreement and recreational plan. These cottages provide numerous recreational opportunities for a wide range of user groups; however, the leases are currently only month to month. Susquehanna River Boaters Association comments that leaseholders invested tens of thousands of dollars into the cottages to comply with new county wastewater regulations, and Susquehanna River Boaters Association would like to see a commitment from Exelon that lengthens the lease term to ensure the cottage leaseholders are guaranteed a lengthier use of their investment. Susquehanna River Boaters Association recommends cottage leases coincide with the staff-recommended recreation plan review and updates every 12 years and that the leases cannot be revoked without cause.

Response: We understand the concerns raised by Susquehanna River Boaters Association; however, as licensee, Exelon is ultimately responsible for the management of the project's lands and waters. The conditions of the lease term and revocation clauses are established by Exelon within the parameters of the Commission's standard use and occupancy license condition. If the Susquehanna River Boaters Association would like to see changes to the lease agreements, it should work directly with Exelon.

Comment: The Park Service recommends that the Conowingo SMP should be updated and filed on the same timeline as the Recreation Management Plan and FERC Form 80 (every 6 years). The Park Service also wishes to be included in the list of parties to be consulted with on draft license article 414, *Shoreline Management Plan*, for the Conowingo Project.

Response: As described in the Commission's *Guidance for Shoreline Management Planning at Hydropower Projects* (2012), the frequency with which an SMP should be reviewed depends upon several factors, including the rate of change on project lands and adjacent lands as well as the level of stakeholder interest in shoreline development and water access. An SMP for a project located in an area subject to heavy development pressure or high stakeholder interest will likely need to be reviewed and updated more often than an SMP for a project located in an area that is not experiencing rapid change or is not of particular concern to stakeholders. Given the nature of the shorelines at Conowingo, balanced with Exelon's current shoreline policies to not issue new leases for new or abandoned cottages, and combined with a lack of stakeholder comments specific to the policies within the SMP, increasing the frequency to every 6 years is not justified at this time. The Park Service is responsible for the Captain John Smith Chesapeake National Historic Trail and the Star-Spangled Banner National Trail and is involved in identifying national landscapes associated with the Captain John Smith Chesapeake National Historic Trail. As such, the Park Service has an interest in the management of project land resources. We revised section 3.3.5.2, *Recreation and Land Use Resources, Environmental Effects*, of this final EIS to include consultation with the Park Service in implementation of the Conowingo SMP.

Comment: The Park Service recommends that FERC take appropriate steps to ensure that the value of lands that would be removed from the Conowingo Project boundary (section 5.1.3.2) is not reduced in any way. The Park Service recommends that FERC require the licensee to include in its Recreation Management Plan and SMP a mechanism for ensuring the permanent protection of all lands proposed to be removed from the existing project boundary. The Delaware Nation and Onondaga Nation also comment on the removal of significant tracts of land, both upstream and downstream of Conowingo dam, and request that FERC take longer consideration of the impacts on cultural, historical, and environmental properties of these lands before boundary conditions change. The Delaware Nation also mentions that the draft EIS fails to address the Chesapeake Conservancy assessment regarding "priority conservation designations" for 10 specific areas of high ecological, cultural, historic, or recreational value. The Delaware Nation asks the Commission to specifically assess the potential long-term impacts of removing these sites from the project boundaries.

Response: Once lands are removed from the project boundary, FERC would no longer have jurisdiction over those lands and could not require Exelon to include them in the Recreation Management Plan and SMPs, as the Park Service suggests. Although FERC would no longer have jurisdiction, negotiated leases with recreation facility operators for the removed lands, as described in section 3.3.5.2 of the draft EIS, would ensure these lands are maintained for public recreation use. As also stated in the draft EIS, our analysis determined these lands are no longer required for project purposes. As such, removal of these lands would be consistent with FERC policy that only lands and waters needed for project purposes for the continued operation of the project should be included in the project boundary.

CULTURAL RESOURCES

Comment: The Park Service requests that, given its presence in association with the Captain John Smith Chesapeake National Historic Trail and the Star-Spangled Banner National Trail, and because of its involvement in numerous projects found in the project area, including working with the Pennsylvania Historical and Museum Commission, Maryland Historical Trust, and the Onondaga Nation to identify contact period landscapes associated with the Captain John Smith Chesapeake National Historic Trail, it be consulted on matters pertaining to the Recreation Management Plan, SMP, and Historic Properties Management Plans (HPMPs) for all projects. The Park Service also expresses concern with regard to cultural sites located on Exelon-owned lands that are proposed to be removed from the Conowingo Project boundary.

Response: We revised section 3.3.6.2, *Cultural Resources, Environmental Effects*, of this final EIS to include consultation with the Park Service in implementation of the HPMPs for all three projects. We continue to recommend that Exelon revise the HPMP to include in the project APE all lands proposed for removal from the Conowingo Project boundary and assess all potential adverse effects of removal in accordance with 36 CFR 800.5(a)(2)(vii) of the regulations implementing section 106 of the NHPA. We address the Park Service's request to be included on the consultation on matters pertaining to the Recreation Management Plan and SMP above under *Recreation and Land Use Resources*.

Comment: York Haven Power cites section 5.1.1.2 and draft license article 409 (which is now draft license article 406) and states that FERC recommendations to revise the HPMP to include (a) a requirement to request landowner permission to access sites on private lands within the project boundary and evaluate them for listing on the National Register if project impacts are identified during monitoring activities; and (b) a plan and schedule to evaluate archaeological sites on York Haven lands, are not warranted given the conservation archaeology approach reflected in the project's HPMP. With regard to the two sites not listed in the HPMP, York Haven Power states this was in error and that the HPMP will be revised to include these sites.

Response: York Haven Power's proposed conservation archaeology approach to site management is appropriate when all lands within a project's area of potential effects (APE) have been fully surveyed, all efforts have been made to document identified sites to current standards, and there are no project-related effects. In such situations, unevaluated sites are often treated as eligible in an HPMP until formal evaluation is necessary. Section 3.5 and appendix B of York Haven Power's HPMP call for specific known sites on private shorelines to be monitored to determine if project effects are present. However, in section 2.1.2 of the HPMP, York Haven Power states that sites on private lands are outside the management responsibilities of York Haven Power without right-of-entry permission and in section 3.6, York Haven Power also states that "all archaeological sites within *YHPC-owned lands* will be protected under the provisions of this HPMP. Archaeological evaluations may be warranted by monitoring recommendations in the future" to identify site boundaries and to determine National Register status (italics added). To clarify that all sites within the APE, including those located on private lands, are subject to the requirements of section 106 and equally considered in the HPMP, we recommend in the draft EIS that the HPMP require York Haven Power to request landowner permission to access sites on private lands within the project boundary and evaluate them for listing on the National Register if project impacts are identified during monitoring activities. We revised section 3.3.6.2, *Cultural Resources, Environmental Effects*, of this final EIS to further clarify that if project impacts are identified, requesting access to affected sites on private lands be requested at the same time that consultation with the State Historic Preservation Officer (SHPO) and others is initiated, and not after consultation has been completed, would ensure that property owners are aware of the situation at the onset and that their input is considered during subsequent consultation with the SHPO to determine a preferred preservation or mitigation measure.

While property owners may restrict access to privately held lands for surveys, this restriction does not apply to York Haven fee lands. As recommended in the draft EIS, section 5.1.1.2, the HPMP should include a plan and schedule to evaluate sites on York Haven lands for listing on the National Register in accordance with section 106. We revised section 3.3.6.2 of this final EIS to provide more guidance in this regard.

Comment: The Onondaga Nation notes that, although the cover letter for the draft EIS states that the draft EIS documents the view of affected Indian Nations, there has been no meaningful consultation between the Onondaga Nation, the licensee, or FERC. The Onondaga Nation states that it was able to review the HPMP for Conowingo and Muddy Run but was not consulted on any other matters, and that the draft EIS documents should be amended to reflect this fact.

Response: The Onondaga Nation did not express an interest in the Susquehanna River Projects until filing its motion to intervene on the Conowingo Project on December 24, 2013. The Onondaga Nation was included on the distribution list for the projects, and since that time, all public correspondence and cultural resources information related to the projects has been provided to the Onondaga Nation for review and comment. In the draft EIS, we acknowledged the Onondaga Nation as a consulting party, and the Programmatic Agreements (PAs) for the three Susquehanna River Projects (issued on September 8, 2014) invites the Onondaga Nation to sign the PAs as a concurring party. However, because the Onondaga Nation has only expressed an interest in Exelon's Muddy Run and Conowingo Projects, this final EIS now identifies the Onondaga Nation as a consulting party for only these two projects. Our PAs for the Muddy Run and Conowingo Projects require Exelon to consult with the Onondaga Nation during the development of the Muddy Run Project HPMP and revision of the Conowingo Project HPMP. The HPMPs would include descriptions of all project-related activities that would require consultation with the Onondaga Nation and the Delaware Nation in accordance with section 106 of the National Historic Preservation Act (NHPA) and would also include documentation of all Native American consultation.

Comment: The Onondaga Nation states that it has been invited to comment on the draft PA/HPMP and will do so at an appropriate time.[7] The Onondaga Nation notes that the draft EIS assesses environmental harms in comparison to current conditions and dismisses any new harm as minimal or non-existent and states that the draft EIS fails to show ongoing environmental damage to cultural and historic properties. The Onondaga Nation requests that FERC re-assess the potential environmental impacts.

Response: In the staff alternative presented in the draft and final EIS, we acknowledge that additional work to identify historic properties and assess project effects is needed. We also identify other potential effects on historic properties that have not been assessed, such as potential effects associated with transmission line construction and maintenance and the removal of lands from project boundaries. For these reasons, we recommend preparing an HPMP for the Muddy Run Project and revising the HPMP for the Conowingo Project to include additional requirements for archaeological survey, National Register evaluations as appropriate, and assessment of project effects (see sections 5.1.2.2 and 5.1.3.2).

Comment: The Onondaga Nation states that the Muddy Run and Conowingo Projects' PAs should be amended to provide the Native American Nation signatories similar power to terminate the PA upon consultation with other signatories.

Response: Pursuant to 36 CFR §§800.14(b)(3) and 800.6(c)(1), the only required signatories on a complex undertaking PA, such as the PAs for the Muddy Run or Conowingo Projects, are the agency that is triggering the relevant undertaking (in this case the Commission), through its issuance of a new license, the relevant state historic preservation officer, and the Advisory Council on Historic Preservation, if it is participating in the consultation. Furthermore, where historic properties may be affected, the Commission cannot issue licenses without executed PAs, and inviting other signatories would complicate our ability to execute PAs and issue licenses in a timely manner. As noted above, however, the Muddy Run and Conowingo Projects' HPMPs will require Exelon to consult with the Onondaga Nation, and not being a signatory to the PA will not limit this consultation.

AIR QUALITY

Comment: EPA comments that the draft EIS does not consider the effects of climate change on the Susquehanna River and the Chesapeake Bay over the course of the decades-long license for the Susquehanna River Projects.

Response: Few resources are available for the evaluation of future climate change effects as they specifically relate to the projects. The Commission's standard reopener

[7] The Onondaga Nation filed comments on the draft HPMP and draft PA on October 17, 2014. These comments are addressed in this final EIS and also will be addressed in the final PA.

article would be included in any licenses issued for the Susquehanna River Projects and would be the vehicle for making changes to the licenses should a material change in conditions occur that results in unanticipated environmental effects.

Comment: Dr. Roe comments that the draft EIS notes eutrophication and hypoxia in Conowingo Pond as a concern. She states that hypoxia-induced methane generation is a serious source of greenhouse gas emissions and requests that the EIS account for methane emissions at all three project reservoirs.

Response: Methane gas was not a parameter identified in the scoping process for the water qualities studies performed by Exelon. Therefore, there are no data available upon which to base an accounting of methane gas production in the Conowingo, Muddy Run, and York Haven Reservoirs. Water quality studies also indicated that DO levels in the three reservoirs are generally adequate most of the year except in deeper parts of Conowingo Pond in the summer months, so methane gas production is likely limited.[8] Methane gas production in reservoirs has become a topic of discussion and concern in recent years, but there is still much debate as to the magnitude of its effects on air quality and global warming.

Comment: Dr. Roe comments that the Muddy Run Project uses baseload power to pump water into its reservoir and that it is incorrect in the draft EIS to claim that the Muddy Run Project is a source of renewable energy that does not contribute to atmospheric pollution. She requests that the EIS include a calculation of the atmospheric emissions of the power plant based on the actual baseload consumption for pumping water.

Response: Exelon purchases pumping energy from the energy market. The actual source(s) of the pumping energy that would be used cannot be predicted. The power could come from a variety or combination of renewable or non-renewable fuel sources. Thus, the requested analysis cannot be performed.

DEVELOPMENTAL ANALYSIS

Comment: Interior comments that it is not clear if other ecosystem service values such as annual losses of fish and other offspring are considered in the analysis of the cost of individual environmental mitigation and enhancement measures for the Conowingo Project (table 4-9).

Response: The cost of each environmental measure associated with improved fish passage and other enhancements includes only the capital cost of constructing the fish passage facility or other measure, and the annual cost for operation and maintenance. The cost of any minimum flow modification was evaluated in terms of lost

[8] Methane gas is typically produced by microbial decomposition of organic matter in oxygen-poor environments, such as in swamps where DO levels may be low for long periods of time.

or gained annual generation (and pumping energy for Muddy Run). Valuation of any fish losses or enhancements was not considered in our developmental analysis.

Comment: Interior states that information provided in Exelon's March 24, 2014, filing, which updates section 5.0 of the application with an expanded description of how the estimated annual value of Conowingo Project power was derived, is inadequate to determine how the capacity values were derived.

Response: We reviewed Exelon's filing and consider the filing to be an adequate response to the Commission's additional information request. The response explains how the capacity value was computed and includes updated capacity rates for 2013. The 2013 value reflects the variability of the electric market rates over time.

Comment: Interior finds that it is unclear how the ancillary service value of $405,000 per year was calculated. It understands that the value is derived from spinning reserve and black start benefits from Conowingo, but Exelon's March 24, 2014, filing provides inadequate information on how the values are derived.

Response: We reviewed Exelon's filing and consider the filing to be an adequate response to the Commission's additional information request. While Exelon does not provide individual values for each of the two ancillary services provided by the project, it provides the updated total ancillary services value for 2013, as requested. The 2013 value reflects the variability of the electric market rates over time.

Comment: Interior comments that the rationale for the assumed interest and discount rates of 8 percent in table 4-3, *Parameters for Economic Analysis*, is unclear.

Response: Neither Exelon nor York Haven Power provided interest rates or discount rates for the economic analysis of their projects. In such cases, Commission staff must select and use reasonable proxy values. The interest and discount rates selected likely represent the high end of the range of reasonable values to be conservative. Because the values are applied to all three projects in the draft EIS and to all of the measures and alternatives evaluated, the values affect all costs equitably. While the specific proxy values that should be used could be debated, the values used do not significantly affect the outcome of the comparative economic analysis and, if changed, would not change any of the recommendations included in the staff alternative.

Comment: Interior and The Nature Conservancy comment that information related to the calculations of the annual cost of alternative power and the annual project cost provided in table 4-6 (Conowingo) of the draft EIS does not appear to be provided in the document.

Response: The alternative power value for Conowingo is the value of the energy, capacity, and ancillary services based on the energy rate, capacity rate, and ancillary services rates that are typical for the electric region in which the project is located, and the corresponding annual generation, capacity, and ancillary services provided by the project. These values were provided by Exelon and reflect actual 2013 values applicable to the Conowingo Project. The annual cost is the combined cost of all project expenses, including the costs to implement any operational and environmental measures required in the license for the project. The difference between these two values is computed to determine if the project cost is more or less than the value of alternative power.

Comment: Interior comments that documentation provided in Exelon's April 22, 2014, filing is inadequate to explain the calculation of the costs of implementing the TNC Flow Regime.

Response: We reviewed Exelon's filing and consider the filing to be an adequate response to the Commission's additional information request. The parameters of the TNC Flow Regime (modified storage and release – also referred to by The Nature Conservancy as the ecosystem enhancement alternative), as listed in table 1 of its January 31, 2014, letter filing, were input by Exelon into its OASIS model. The results of the model run were provided in attachment A, table 2, of Exelon's April 9, 2014, email to Monir Chowdhury (FERC), as filed in the record on April 22, 2014. Staff used the results of this filing for each flow alternative evaluated in the draft EIS. The relative gains or losses of annual generation at the Conowingo Project and of annual generation and pumping energy for the Muddy Run Project under the TNC Flow Regime and staff-recommended alternatives were compared to the no-action alternative, to value each of the flow alternatives. The capacity and ancillary services values were assumed to remain constant under all of the flow alternatives; only the annual generation was valued for each flow alternative.

Exelon has since updated the OASIS model runs and provided the results of the baseline/existing conditions alternative (no-action alternative), TNC-Proposed Alternative (TNC Flow Regime), and staff alternative to the Commission on September 29, 2014. We use the updated values in this final EIS.

Comment: SRBC comments that tables 4-4, 4-5, and 4-6 provide a summary of the annual cost of alternative power and annual project cost for three alternatives for each of the three projects seeking relicensing. Although it finds this comparison of the three alternatives to be insightful, SRBC states that a more comprehensive suite of possible alternatives should be thoroughly evaluated as part of an EIS covering projects of this significance. Because the applicants' proposals are identical, or nearly identical, to existing conditions, the alternatives analysis essentially only covers one action alternative (staff alternative) for each project. Furthermore, each action alternative (staff alternative) represents only very minor modifications to existing project operations and conditions. SRBC comments that a more expansive comparison of action alternatives is necessary within the scope of the draft EIS to thoroughly examine differences among the generation and cost attributes outlined in tables 4-4, 4-5, and 4-6.

Response: Developmental analysis sections in Commission NEPA documents always include a summary table of measures (e.g., draft EIS tables 4-7, 4-8, and 4-9) that present all of the measures recommended by the applicant, stakeholders, and staff. Review of these tables for the Susquehanna River Projects indicates that many applicant, stakeholder, and staff-recommended measures may be similar. Tables 4-4, 4-5, and 4-6 are summary tables of the alternatives considered in the draft EIS, and these alternatives are typically based on the recommending entities or may be a grouping of comparable measures. The Commission can and does include other alternatives that represent a comparable, complete alternative to the other action alternatives (such as a project retirement/dam removal alternative, or an alternative that presents a major modification to project structures or operations, such as adding a new powerhouse). That is not the case here. Agencies and non-governmental organizations offered different flow regimes for consideration but not a complete alternative that could be compared to the applicant's or staff alternatives. While the Susquehanna River Projects' draft EIS only includes three stand-alone alternatives, all measures recommended by all entities were analyzed in the draft EIS, both for their potential environmental benefits and their cost.

Comment: SRBC requests that, in table 4-8, under "Enhancement/Mitigation Measure" in the Aquatic Resources category, we add the proposed measure to provide the version of the Lower Susquehanna River OASIS Model to SRBC as proposed by Exelon and required by the water quality certification.

Response: Exelon has committed to provide (and reiterates this in its October 14, 2014, reply comments) the OASIS Model to SRBC within 30 days after the Conowingo and Muddy Run water quality certifications and new FERC licenses become final (i.e., are no longer appealable or subject to ongoing litigation), as set forth in a November 19, 2013, "*Letter Agreement Addressing Exelon's Provision of an OASIS Model to SRBC*" executed by SRBC and Exelon. We had not included this measure in the draft EIS because we consider this to be a binding agreement between SRBC and Exelon outside of the current licensing proceeding, and is not a specific measure for protection or enhancement of environmental resources. However, because this is a mandatory condition included in the water quality certification, it would become a requirement of any license issued. Therefore we have added it to list of measures in table 4-8.

Comment: SRBC comments that tables 4-8 and 4-9 provide a summary of the costs of environmental mitigation and enhancement measures considered in assessing the environmental effects of continuing to operate the Muddy Run and Conowingo Projects. Under the *Aquatic Resources* category, only two action alternatives (described as the TNC/Interior flow regime and the staff flow regime) are presented for comparison. Again, while this comparison of the two presented alternatives is insightful, it is far from being comprehensive of the suite of possible alternatives that should be thoroughly evaluated as part of a draft EIS covering projects of this significance. As commented on previously, there were nine production run requests, or additional alternative operations scenarios, and several other subsequent ones that were submitted by relicensing stakeholders during the relicensing process. A more expansive comparison of action alternatives is necessary within the scope of the draft EIS to thoroughly examine differences among the capital and annual cost attributes outlined in tables 4-8 and 4-9. Furthermore, the lack of an open process for modeling alternative operations scenarios and verifying the associated cost information, involving resource agencies and relicensing stakeholders, has precluded the opportunity to fully examine the balance between power generation and environmental flows.

Response: Exelon completed numerous OASIS model runs of variations to the existing flow regime at Conowingo (which also have effects on the operation of the Muddy Run Project) during the pre-filing Integrated Licensing Process, and some of those runs were updated after the license applications were filed. However, several stakeholders (including Interior) recommended adoption of the modified storage (also known as ecosystem restoration) alternative included in The Nature Conservancy's January 31, 2014, recommendations. None of the other alternatives evaluated in the Exelon model runs were specifically recommended by any stakeholders in their comments, terms, and conditions filed with the Commission, although many stakeholders asked that the various flow alternatives included in the Exelon model runs be considered by the Commission in its analysis. Commission staff did consider other potential flow alternatives, but chose to focus its analysis on the applicant's proposal, the TNC ecosystem restoration alternative (TNC Flow Regime), run-of-river operation (even though no one specifically recommended run-of-river operation), and a staff-recommended flow regime. In section 4, we presented only the flow alternatives that were recommended by the applicant (existing flow regime), stakeholders (TNC alternative), and by Commission staff.

COMMENTS ON DRAFT LICENSE ARTICLES

Comment: York Haven Power requests that the Commission revise our draft license article 406 regarding its pre-construction environmental studies for the nature-like fishway, to recognize that some studies (e.g., vegetation mapping, wetland delineation, invasive plant surveys, rare species surveys, and a bog turtle habitat assessment) are underway and scheduled for completion in November 2014.

Response: Because the pre-construction studies are a prerequisite of the construction of the facility, we have deleted this draft license article from Appendix A. Instead, Article 401, which requires the filing of final plans and specifications for the nature-like fishway for Commission approval, also includes a requirement to file the results of the pre-construction environmental studies, agency comments on the completed studies, and any protection measures proposed as a result of the studies. Any sensitive information, such as bog turtle location data, should be filed with the Commission as privileged information. Please note that, according to its letter filed January 7, 2015, FWS' Pennsylvania Field Office states that the bog turtle habitat assessment has not been submitted to its office, and that it will make a determination regarding project effects on the endangered bog turtle for the proposed nature-like fishway portion of the York Haven Project only after it reviews the survey report.

LITERATURE CITED

Corps and MDE. 2014. Lower Susquehanna River Watershed Assessment, Maryland and Pennsylvania. Phase I. October 2014 Draft. Prepared in partnership between the U.S. Army Corps of Engineers and the Maryland Department of Environment. Available online at: http://mddnr.chesapeakebay.net/LSRWA/report.cfm.

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May 12, 2016

VIA ELECTRONIC FILING

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: Conowingo Hydroelectric Project, FERC Project No. 405
Offer of Settlement and Explanatory Statement

Dear Secretary Bose:

Pursuant to Rule 602 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission ("FERC" or "Commission"),[1] Exelon Generation Company, LLC ("Exelon") hereby files its Offer of Settlement and Explanatory Statement for the relicensing of the Conowingo Hydroelectric Project ("Conowingo").

As set forth in the Explanatory Statement, the Offer of Settlement settles all remaining issues between Exelon and the U.S. Department of the Interior regarding the appropriate terms of the fishway prescription for Conowingo, satisfies all Federal statutory and regulatory requirements, and is in the public interest.[2] Further, the Offer of Settlement is supported by substantial evidence in the record, as required under Section 313(b) of the Federal Power Act.[3]

By copy of this letter, all participants are hereby notified, in accordance with Rule 602(f),[4] that comments on the Offer of Settlement must be filed on or before June 1, 2016. Reply comments must be filed on or before June 13, 2016.

Please do not hesitate to contact the undersigned if you have questions or require additional information regarding this matter.

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[1] 18 C.F.R. § 385.602 (2015).
[2] *See Policy Statement on Hydropower Licensing Settlements*, Docket No. PL06-5-000, PP 3-5 (2006).
[3] 16 U.S.C. 825l(b) (2015).
[4] 18 C.F.R. § 385.602(f) (2015).

Respectfully submitted,

/s/ Jay Ryan

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cc: Emily Carter (FERC)
Official Service List for Docket No. P-405

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

	)	
Exelon Generation Company, LLC	)	**Docket No. P-405-106**
	)	

CONOWINGO HYDROELECTRIC PROJECT RELICENSING OFFER OF SETTLEMENT AND EXPLANATORY STATEMENT

Pursuant to Rule 602 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission ("FERC" or "Commission"),[1] Exelon Generation Company, LLC ("Exelon"), owner and operator of the Conowingo Hydroelectric Project ("Conowingo" or "Project") hereby submits this Offer of Settlement and Explanatory Statement addressing the Settlement Agreement ("Settlement Agreement") executed between Exelon and the U.S. Department of the Interior, Fish and Wildlife Service ("Interior"). A copy of the Settlement Agreement is provided as Attachment 1.

The Settlement Agreement resolves issues between Exelon and Interior regarding the appropriate terms of the fishway prescription for Conowingo, satisfies all Federal statutory and regulatory requirements, and is in the public interest. Moreover, the Settlement Agreement is supported by substantial evidence, including 32 relicensing studies and the Final Environmental Impact Statement issued in the above-captioned docket. Accordingly, Exelon respectfully requests that the Commission: (1) approve the Offer of Settlement; and (2) issue a new 50-year license for Conowingo that incorporates, without modification or expansion, the terms and conditions of the Settlement Agreement.

[1] 18 C.F.R. § 385.602 (2015).

OFFER OF SETTLEMENT

I. BACKGROUND

Exelon formally initiated the relicensing process for Conowingo with the filing of a Notice of Intent and Pre-Application Document ("PAD") on March 12, 2009.[2] In the PAD, Exelon indicated that it would use the Integrated Licensing Process ("ILP") to relicense Conowingo. Since that time, Exelon has engaged in extensive stakeholder outreach with state and Federal resource agencies, non-governmental organizations, local municipalities, recreational users, and other individuals with an interest in the Project. As part of the ILP, Exelon conducted 32 resource studies for Conowingo. Information gained from these studies and stakeholder input informed the Final License Application ("FLA") for Conowingo and the terms and conditions of the Settlement Agreement.[3]

Throughout the relicensing process, Exelon and Interior actively engaged in discussions regarding a number of fish passage issues. The Settlement Agreement contained in this Offer of Settlement represents the formal resolution of all issues between Exelon and Interior pertaining to the fishway prescription for Conowingo.

The terms of the Settlement Agreement will provide measurable and immediate benefits to the American eel, river herring, and American shad populations of the Susquehanna River, and will ensure that any future impediments to fish passage will be addressed through the implementation of additional mitigation and enhancement measures. The terms of the Settlement Agreement also carefully balance resource issues with the need to maintain a low-cost and reliable source of clean power. Consequently,

[2] Pre-Application Document for the Conowingo Hydroelectric Project, Docket No. P-405 (filed Mar. 12, 2009).
[3] Exelon Generation Company, LLC's Final License Application for the Conowingo Hydroelectric Project and Request for Waiver of the Requirement to Include a Draft Biological Assessment, Docket No. P-405-106 (filed Aug. 30, 2012).

Exelon believes that the public interest will best be served if the Commission approves the Offer of Settlement as filed.

II. EXPLANATORY STATEMENT

A. LICENSING COMMITMENTS

The Settlement Agreement provides for the settlement of all pending issues between Exelon and Interior pertaining to the fishway prescription for Conowingo. By the terms of the Settlement Agreement, Exelon and Interior agree that Interior will file a modified prescription for fishways in a form identical to the modified prescription provided as Exhibit A to the Settlement Agreement ("Modified Prescription").[4]

1. Fish Passage Facilities

Exelon currently operates two fish lifts at Conowingo. The West Fish Lift, adjacent to the right dam abutment, was completed in 1972 and originally operated as part of a trap and transport facility. The East Fish Lift, located near the mid-point of the Conowingo Dam, was constructed in 1991 to allow for direct passage of fish to Conowingo Pond and interim trap and transport operations until upstream fish passage facilities were constructed at the remaining upstream dams. The trap and transport program was terminated once construction of the fish passage facility at York Haven was completed in 2000. The West Fish Lift currently operates for specific experiments conducted for resource agencies (*e.g.*, induced spawning, transport to specific tributaries). The East Fish Lift operates solely as a tailwater to headpond fish lift.

[4] Pursuant to the terms of the Settlement Agreement, Exelon has reserved its right to file comments on the Decision Document supporting Interior's Modified Prescription.

Under the Modified Prescription, Exelon will implement substantial improvements to the existing fish passage facilities within three years of license issuance ("Initial Construction Items"). The Initial Construction Items include:

- Modifying the East Fish Lift to provide 900 cubic feet per second ("cfs") of attraction flow.
- Replacing the current 3,300-gallon hopper at the East Fish Lift with two 6,500-gallon hoppers.
- Reducing cycle time at each hopper at the East Fish Lift to be able to lift fish four times per hour.
- Completing modifications to the East Fish Lift structure to allow for trapping and sorting fish at the East Fish Lift facility and transporting them to the western side of the dam to a truck for transport upstream.
- Modifying the West Fish Lift to facilitate trap and transport.
- Constructing and maintaining structures, implementing measures, and/or operating the Project to provide American shad and river herring a zone of passage to the fish passage facilities.
- Evaluating potential trapping locations for American eel on the east side of Conowingo Dam including Octoraro Creek starting in May of the first calendar year after license issuance or immediately if license issuance occurs during the upstream American eel migration period.

In addition to these Initial Construction Items, Exelon will commence trap and transport of American shad and river herring from Conowingo to above the York Haven Hydroelectric Project beginning the first fish passage season after license issuance.[5] Exelon also has committed to trap and transport American eels at the west side of Conowingo Dam.

Five years after issuance of the new license, Exelon will commence a three-year "Initial Efficiency Test" of fish passage at the Project. The Initial Efficiency Test will

[5] Exelon has agreed to annually trap and transport up to 80 percent of the run, up to a maximum of 100,000 fish for each species.

measure the passage efficiency of the improved facilities. If the facilities achieve an 85 percent upstream passage efficiency for adult American shad,[6] Exelon will continue to operate the facilities without further modification. Exelon will then conduct two-year "Periodic Efficiency Tests" every five years to ensure that the Project maintains an upstream passage efficiency of 85 percent for adult American shad throughout the term of the new license.

If the Project does not achieve an upstream passage efficiency of 85 percent after the Initial Efficiency Test or any Periodic Efficiency Test, Exelon will be required to implement measures to improve passage efficiency at the Project. Exelon and Interior have agreed on a tiered list of potential measures, which are designed to address fish passage impediments associated with attraction flow and capacity limitations. The degree of the shortfall from the 85 percent passage efficiency target determines the scope of the additional mitigation and enhancement measures that will be required.[7] As set forth in the Modified Prescription, these additional mitigation measures range from the implementation of preferential turbine operating schemes to the construction of a new West Fish Lift.

In the first fish passage season after Exelon implements any measure or measures to improve passage effectiveness, Exelon will commence a three-year Post-Modification Efficiency Test. The Post-Modification Efficiency Test will measure the passage efficiency of the improved facilities. If the Project achieves an upstream passage efficiency of 85 percent for American shad, Exelon will continue to operate the facilities

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[6] Pursuant to section 12.7.2.1 of the Modified Prescription, Exelon receives credit toward achieving the upstream passage target efficiency of 85 percent as a result of its trap and truck operations.

[7] For example, if Conowingo achieves an Adjusted Efficiency of 65 percent and Interior determines that the shortfall stems from an issue with attraction efficiency, Exelon will implement one of the improvements in Section 12.6.2.2 ("Improving Attraction Efficiency - Tier II (*Adjusted Efficiency* 55%-69%")).

without modification and will return to conducting two-year Periodic Efficiency Tests every five years. Again, if any Periodic Efficiency Test demonstrates that the Project is not achieving an 85 percent passage efficiency, Exelon will implement a measure or measure(s) from the tiered list of options, to be followed by a Post-Modification Efficiency Test. This cycle of testing and modifying, as necessary, will continue throughout the term of the license.

As a result of the agreed-upon tiered structure of future mitigation measures, the cost of the measures contained in the Modified Prescription range from $155 to $339 million.

2. Fishway Operation and Maintenance Plan

In addition to the improvements described above, Exelon will develop and implement a Fishway Operation and Maintenance Plan ("FOMP") that will provide extensive information about the operations of Conowingo's fish passage facilities.

The FOMP will be submitted to Interior, FERC, and the resource agencies (State of Maryland and Commonwealth of Pennsylvania, Susquehanna River Basin Commission, and National Marine Fisheries Service) for review and approval, and will include the following information:

- Schedules for routine maintenance, pre-season testing, and the procedures for routine fishway operations, including seasonal and daily periods of operation, and associated dam and powerhouse operational measures needed for proper fishway operation;
- Details of how the Project shall be operated during the migration season to provide for adequate fish passage conditions, including:
    - pre-season preparation and testing;
    - sequence of turbine start-up and operation under various flow regimes to enhance fishway operation and effectiveness;

    - debris management at the fishway entrance, guidance channels, and the exit;
    - plant operations to provide near- and far-field attraction flows required for the fishway zone of passage in the tailrace;

- Trap and transport logistics plan and design plans for west and east fish lift modifications needed for trap and transport, including provisions for planning trap and transport logistics so as to avoid, to the extent possible, trapping a population unrepresentative of the migrating population as a whole.
- Trap and transport logistics plan for American eel;
- Standard operating procedures for monitoring and enumerating fish passage by species, including the American eel passage facilities;
- Standard operating procedures for collecting biological samples from target species to assess restoration efforts;
- Standard operating procedures for monitoring and reporting operations that affect fish passage;
- Standard operating procedures in case of emergencies and Project outages to first, avoid, and second, minimize, potential negative impacts on fishway operations and the effectiveness of upstream and downstream passage for target species; and
- Plans for post season maintenance, protection, and winterizing the fish lifts and eel passage facilities.

By December 31 of each year, Exelon will submit an annual report to Interior, FERC, and the resource agencies detailing the implementation of the FOMP and operational data for both fishways and the Project. This data will allow the parties to examine correlations between particular operational patterns and successful or unsuccessful fishway operation, and to confirm, once an operational regime with known effectiveness is settled upon, that the Project continues to operate under that regime.

In addition to the annual report, Exelon will record data for daily flows, water quality, project operations, fishway operations, and fish passage in a database during the fish passage season. Interior will be provided open access to the database. Data will be entered into the database no later than one week after collection.

3. Fishway Effectiveness Monitoring Plan

In addition to the Initial Efficiency Test and Periodic Efficiency Tests described above, the Modified Prescription includes downstream American eel effectiveness monitoring, upstream American eel effectiveness testing, and downstream adult and juvenile American shad and river herring effectiveness testing. The plans for all the studies described in the Modified Prescription will be contained in the Fishway Effectiveness Monitoring Plan ("FEMP")—a document Exelon will develop in consultation with Interior, and which is subject to approval by Interior and FERC.

In any year that Exelon is conducting a study, it will submit a yearly interim study report to Interior and FERC following the conclusion of the study year. The interim and final reports for upstream passage studies will be submitted to Interior by December 31st of each study year. The interim and final reports for downstream passage studies will be submitted to Interior 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 Exelon's success or failure in achieving the passage efficiency criteria set forth in the Modified Prescription. In conjunction with submitting the final study report(s), Exelon also will provide Interior electronic copies of all data collected from the studies.

Further, Exelon agrees to meet with Interior and the Susquehanna River Anadromous Fish Restoration Cooperative ("SRAFRC") to discuss the FEMP and FOMP. This meeting will occur no later than January 31 each year unless Exelon and Interior agree on a different date. At this annual meeting Exelon will discuss with Interior and SRAFRC the fish passage results from the previous year, review regulatory requirements for fish lift and eel passage operations, and discuss any upcoming modification or testing Exelon proposes for the upcoming fish passage season.

Exelon has agreed to operate the Project to achieve a downstream survival efficiency of at least 80 percent of the adult and 95 percent of the juvenile American shad and river herring moving downstream past the Project. Exelon also has agreed to operate the Project to achieve a downstream survival efficiency criterion of at least 85 percent of the adult American eel moving downstream past the Project. If the results of the downstream studies indicate that the Project is not achieving these efficiency criteria, Interior may exercise its reservation of authority to address the issue.

B. EXELON'S PRE-LICENSING COMMITMENTS

Exelon and Interior also have agreed to five other provisions—Sections 3.1 through 3.5 of the Settlement Agreement—that memorialize Exelon's commitment to undertake certain activities prior to the issuance of a new license[8] to ensure that the Initial Construction Items will timely commence upon license issuance.

Specifically, Section 3.1 of the Settlement Agreement provides that, by December 31, 2017, Exelon will develop a detailed logistics plan and operating protocol for trap and transport of American shad and river herring from the East Fish Lift and the West Fish Lift at Conowingo. The logistics plan will address near-term operations, as well as the logistics necessary to support the transport of up to 100,000 American shad and 100,000 river herring. Under Section 3.2, Exelon commits to develop detailed computational fluid dynamics models of the zones of passage to the East Fish Lift and West Fish Lift to assess the ability of fish to reach both lifts. Exelon will develop these models by

[8] Given the schedule for completing ongoing work associated with Exelon's application for a water quality certification from the Maryland Department of the Environment, Exelon anticipates that FERC could issue a new license for Conowingo in 2018.

December 31, 2017. Section 3.3 of the Settlement Agreement requires that Exelon develop its initial FOMP by September 30, 2017. Exelon also commits, in Section 3.4, to finalize design plans for the Initial Construction Items by December 31, 2018. Finally, in Section 3.5 of the Settlement Agreement, Exelon has committed to implement a 900 cfs attraction flow at the East Fish Lift by 2021 if a new license is not issued by December 31, 2018. Exelon will file with FERC copies of all final plans provided to Interior as a result of these pre-licensing settlement commitments.[9]

III. REQUEST FOR A 50-YEAR LICENSE TERM

In recognition of the substantial investment Exelon has committed to make during the term of the new license, Interior and Exelon support the issuance of a new license for the Project for a term of 50 years.[10]

It is well-established that the Commission will grant a fifty-year license "for projects with proposed extensive redevelopment, new construction, new capacity, or mitigative and enhancement measures."[11] Under the Settlement Agreement with Interior, Exelon has proposed that extensive mitigative and enhancement measures be incorporated into the new license for Conowingo. These measures, discussed above, will have a total nominal cost ranging from $155 to $339 million over the term of the license depending on which measures are required and when those measures are implemented. Given the substantial investment that Exelon has committed to make during the new license term, the proposed license conditions represent extensive mitigative and enhancement measures that warrant a 50-year license term.

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[9] Exelon and Interior do not believe it is necessary to amend Exelon's current license to incorporate these pre-licensing commitments. *See* 18 C.F.R. § 4.200.

[10] Section 2.0 of the Settlement Agreement states that "The Parties agree that FERC should grant Exelon a New License for a term of 50 years because of the substantial investment Exelon will make during the new license."

[11] *Mead Corporation*, 72 FERC ¶ 61,027, at p. 61,077 (1995).

IV. CONCLUSION

This Offer of Settlement represents the successful culmination of years of negotiations between Exelon and Interior. The provisions of the Settlement Agreement were carefully crafted to ensure that Exelon would meet or exceed its regulatory obligations under the Federal Power Act, while providing additional substantial benefits to the Susquehanna River. The result is an Offer of Settlement that will help preserve and restore Susquehanna River resources. Accordingly, implementation of the measures contained in the Settlement Agreement is in the public interest.

For the foregoing reasons, Exelon respectfully requests that the Commission determine that the Offer of Settlement is in the public interest, accept the Offer of Settlement without modification or condition, and incorporate the provisions contained in the Modified Prescription into a new 50-year license for Conowingo.

Respectfully submitted,

/s/ Jay Ryan

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Counsel for Exelon Generation Company, LLC

Dated: May 12, 2016

Attachment 1

UNITED STATES OF AMERICA

BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Exelon Generation Co., LLC
Project No. 405

CONOWINGO HYDROELECTRIC PROJECT SETTLEMENT AGREEMENT

April 21, 2016

This agreement (the “Settlement Agreement”), effective as of the date of the last signature affixed hereto (the “Effective Date”), is made and entered into by and between Exelon Generation Company, LLC (“Exelon” or “Licensee”) and the United States Department of the Interior (“Department”) Fish & Wildlife Service (“USFWS”) (each, a “Party” and collectively, the “Parties”). This Settlement Agreement relates to the Conowingo Hydroelectric Project (“Project”), which is the subject of an ongoing relicensing proceeding before the Federal Energy Regulatory Commission (“FERC” or “Commission”) for a new license (“New License”).

1.0 GENERAL TERMS

1.1 Term of the Settlement Agreement

This Settlement Agreement shall remain in effect, in accordance with its terms, throughout the term of the New License, including any annual licenses thereafter.

1.2 Purpose and Goals

The purpose of this Settlement Agreement is to resolve among the Parties their disagreements over the appropriate terms of a Prescription for Fishways, and other related matters, to be included in the New License for the Project (“Prescription”) pursuant to section 18 of the Federal Power Act (16 U.S.C. § 811), and to document certain other agreements between the Parties concerning fish passage at the Project not appropriate for inclusion in the Prescription.

The goal of this Settlement Agreement is to establish mutually acceptable terms concerning passage of fish past the Project.

1.3 Parties to Support Regulatory Approvals

The Parties agree to support the issuance of a New License by FERC that is consistent with the terms of this Settlement Agreement. For those issues addressed herein, the Parties agree not to propose or otherwise communicate any comments, certification, or license conditions inconsistent with, or additive to, the terms of this Settlement Agreement to FERC or any other Federal or state resource agency with jurisdiction over fish passage at the Project. Notwithstanding the above, this Settlement Agreement shall not be interpreted to restrict: (i) Parties' participation in, or comments on, issues not addressed herein; (ii) Parties' participation in any future relicensing proceeding related to the Project; and (iii) Licensee's ability to file comments on sections of the Department's Decision Document and Modified Prescription ("Modified Prescription"), including the design populations for American shad and river herring, other than the Fish Passage Requirements in Attachment A.

1.4 Successors and Assigns

This Settlement Agreement shall be binding upon and shall inure to the benefit of the Parties hereto and their respective successors and assigns.

1.5 Agency Appropriations

Nothing in this Settlement Agreement shall be construed as: (i) obligating any Federal, state, or local government to expend in any fiscal year any sum in excess of appropriations made by Congress, state legislatures, or local governing body, or administratively allocated for the purpose of this Settlement Agreement for the fiscal year; or (ii) involving the Department or its Bureaus in any contract or obligation for the future expenditure of money in excess of such appropriations or allocations.

1.6 Establishes No Precedents

This Settlement Agreement is made with the express understanding that it constitutes a negotiated resolution of issues specific to the Project. Accordingly, nothing in this Settlement Agreement will be construed as a legal precedent that may be cited by the Parties to FERC or any court or administrative hearing process with regard to any other proceeding. This Section 1.6 shall survive any termination of this Settlement Agreement. Any Party withdrawing from this Settlement Agreement pursuant to Section 1.10 will continue to be bound by this Section 1.6.

1.7 Filing of Settlement Agreement

The Parties agree that within 21 days of the Effective Date, the Licensee shall file this Settlement Agreement with the Commission pursuant to 18 C.F.R. § 85.602.

1.8 Withdrawal of Trial-Type Hearing request

Within 7 days of the Effective Date, Exelon shall withdraw its Request for Trial-Type Hearing, filed with the Department September 11, 2015.

1.9 Filing of Modified Prescription

Within 30 days of the Effective Date, the Department shall file a modified prescription for fishways, as provided by 43 C.F.R. § 45.72, containing the operative terms agreed to herein and attached hereto as Exhibit A (“Modified Prescription”).

1.10 Withdrawal Rights

No Party may withdraw from this Settlement Agreement without the prior written consent of the other Parties, which consent may be withheld in another Party’s sole discretion; provided, however, a Party may unilaterally withdraw from this Settlement Agreement if: (i) FERC issues a New License and the New License contains conditions which are materially inconsistent with the terms of this Settlement Agreement as reflected in Attachment A, FERC issues a New License and the New License contains fish passage conditions that are materially additive to the terms of the Settlement Agreement, or MDE issues a water quality certification that contains fish passage conditions that are materially additive to, or materially inconsistent with, the terms of the Settlement Agreement; and (ii) the New License is not thereafter satisfactorily modified as a result of the filing of a request for rehearing as provided in Section 1.11 or the water quality certification issued by MDE is not thereafter satisfactorily modified after administrative and judicial appeals are pursued by Licensee. A Party withdrawing from this Settlement Agreement shall provide twenty (20) days' prior written notice, which notice shall include a written explanation of the reasons for withdrawing from this Settlement Agreement. In the event that a Party withdraws from this Settlement Agreement pursuant to this Section 1.10, this Settlement Agreement shall thereafter be null and void, and any Party may take the position that this Settlement Agreement is not available to support FERC's public interest determination.

1.11 Rehearing and Judicial Review

The Parties agree not to file a request with FERC for rehearing of the New License concerning matters addressed in this Settlement Agreement unless: (i) the New License contains conditions which are materially inconsistent with the terms of this Settlement Agreement; or (ii) the New License contains fish passage conditions that are materially additive to the terms of the Settlement Agreement. Notwithstanding the above, Exelon shall maintain its right to seek rehearing of the New License if the New License term is less than 50 years. In the event a Party decides to file a request for rehearing in accordance with the terms of this provision, it will provide the other Parties written notice of its intention to file a request for rehearing at the earliest practicable time. Any Party, following the issuance of a FERC Order on Rehearing, may elect to file a petition for judicial review with respect to the matters covered by this provision.

1.12 Counterparts

This Settlement Agreement may be executed in any number of counterparts, all of which taken together shall constitute one and the same instrument.

2.0 AGREEMENT ON THE TERM OF THE NEW LICENSE

The Parties agree that FERC should grant Exelon a New License for a term of 50 years because of the substantial investment Exelon will make during the New License.

3.0 MISCELLANEOUS PROVISIONS

3.1 Trap and Transport Logistics Plan and Operating Protocol

By December 31, 2017, Exelon will develop a detailed logistics plan and operating protocol for trap and transport of American shad from both the East Fish Lift and the West Fish Lift at Conowingo. The logistics plan will address near-term operations, as well as the logistics necessary to support the transport of up to 100,000 American shad and 100,000 river herring.

3.2 Computational Fluid Dynamics

By December 31, 2017, Exelon will develop, in consultation with the USFWS, detailed computational fluid dynamics models of the zones of passage to the East Fish Lift and West Fish Lift.

3.3 Fish Passage Operation and Maintenance Plan

Exelon will develop and submit to the USFWS its initial Fishway Operation and Maintenance Plan by September 30, 2017.

3.4 Design Plans

By December 31, 2018, Exelon will finalize design plans for the Initial Construction Items, as that term is defined in section 12.6.1 of the Modified Prescription.

3.5 Letter to FERC

Within 10 days of the Effective Date, the USFWS shall file with FERC in Docket P-405-116 a letter: (i) informing FERC that issues regarding attraction flows at the East Fish Lift have been addressed by the Settlement Agreement; and (ii) withdrawing its January 21, 2016 request that Exelon modify the East Fish Lift to support a 900 cubic feet per second ("cfs") attraction flow prior to the issuance of the New License. However, if the New License is not issued by the end of 2018, Exelon agrees to provide a 900 cfs attraction flow by 2021.

ACKNOWLEDGED AND AGREED TO:

DEPARTMENT OF THE INTERIOR

By: ______________________

Name: Wendi Weber

Title: Regional Director, Region 5

Date: April 1, 2016

EXELON GENERATION COMPANY, LLC

By: Victoria K. Will

Name: Vicky Will

Title: Vice President, Operations Support

Date: April 21, 2016

<u>ATTACHMENT A</u>

MODIFIED PRESCRIPTION FISH PASSAGE REQUIREMENTS

AND RELATED LICENSEE COMMITMENTS

12. Modified Prescription for Fishways

12.1 Design Criteria

12.1.1 Design Populations

12.1.1.1 American Shad

The goal for this fishway prescription is to ultimately be able to pass up to 5 million American shad annually in order to maintain self-sustaining populations of 2 million American shad annually migrating to and reproducing in the Susquehanna River upstream of York Haven Dam and in suitable tributaries.

12.1.1.2 River Herring

The goal for this fishway prescription is to ultimately be able to pass up to 12 million river herring annually in order to maintain self-sustaining populations of 5 million river herring annually migrating to and reproducing in the Susquehanna River upstream of York Haven Dam and in suitable tributaries.

12.1.1.3 American Eel

The Licensee shall construct, operate, and maintain fishway(s) at Conowingo Dam sufficient to pass upstream migrating eels that arrive to the Project into the mainstem of the Susquehanna River upstream of York Haven Dam.

12.1.2 Design Capacity

Capacity is determined by a given weight of fish transferred over a given period of time. Capacity calculations take into consideration all species of fish using a fish passage facility; e.g., fish lift(s), and their corresponding weights, and proportional availability.

12.1.2.1 Initial Capacity

Considering that American shad passage efficiency has been measured to be as low as 25 percent (Exelon 2012d, p. 26), and the Project has passed an average of 1.1 million gizzard shad per season from 2012 - 2014 (SRAFRC 2013a, p. 7; Normandeau Associates 2013, p. 3; Normandeau Associates 2014b, p. 3), the Service estimates that as many as 4.4 million gizzard shad could potentially be in the tailrace annually attempting to move upstream. Based on the estimated biomass of gizzard shad attempting to pass upstream at the current time (4.4 million gizzard shad = 5.3 million pounds of fish) as well as allowing additional capacity for growth of American shad and river herring populations, the Service estimates a fish lift biomass capacity of at least 7 million pounds of fish per season needs to be provided immediately after license issuance. Two 6,500-gallon hoppers sharing the same holding pool, with a cycle time of 15 minutes, provides capacity to move 7 million pounds of fish in a single season (assuming a peak day run of 5 percent of the seasonal run, a peak hour run of 15 percent of the peak day and hopper minimum water volume of 0.1 cubic feet per pound of fish). Based on projected numbers of a successful American shad restoration using the population model, a fish lift capacity of 7 million pounds of fish should provide safe passage at the Conowingo Project for approximately half of a fifty (50) year license term (assuming that the gizzard shad population does not grow larger than 4.4 million fish). For details on calculating fish lift capacity, refer to Appendix A.

12.1.2.2 Final Potential Capacity

The Service anticipates that restored populations of American shad and river herring may require passage capacity for up to 5 million American shad and 12 million river herring as well as other species at the Project. American shad and river herring would require 26 million pounds of hopper capacity in addition to the potential 5 million pounds that may be required by riverine species. However, the fishway prescription does not require construction of sufficient capacity to pass this number immediately; rather, capacity is added only as populations grow enough to impede efficiency in the event that fishway capacity becomes a bottleneck to future population growth. This fishway prescription incorporates a fish passage efficiency target and measures to assess fish passage efficiency throughout the term of the license in order to test for future conditions that would require corrective actions contained in this prescription. This fishway prescription includes measures providing for an ultimate fishway capacity of up to 18 million pounds per season (four 6,500-gallon hoppers with separate holding pools). The Department recognizes the potential lack of capacity for this current fishway prescription during the later years of American shad and river herring restoration, and may exercise its reservation of authority to address this issue at a later date if fishway capacity appears to be a limiting factor to population restoration, as reflected in declining upstream fish passage efficiency due to lack of fishway capacity.

12.1.3 Design Flows

The Licensee shall design new fishway(s) to ensure operation under river flows in the range of 6,330 cfs to 143,000 cfs. However, the Licensee shall not be required to operate the fishway(s) at flows greater than 113,000 cfs unless data available at the time demonstrates that operation of fishways at flows greater than 113,000 cfs is necessary to achieve the target efficiency. Furthermore, the fishways shall be designed with sufficient freeboard (or other protection) to minimize damage from river flows of up to the 50-year return interval.

12.2 Efficiency Criteria

The Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC 2010, 2013) and the Service (USFWS 2015b) have established upstream and downstream passage efficiency criteria for the Susquehanna River basin that are the basis for this Prescription for Fishways. The Service 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. Downstream fish passage efficiency is the proportion of the fish that approach the upstream side of the Project and survive unharmed as they pass the Project and continue downstream migrations. Definitions for fish passage terms used in this document are provided in Section 14. Where no numeric efficiency criteria were set, the Service's goal is to minimize Project impacts to migratory fish populations, with a goal of 100 percent passage and the understanding that no project is likely to fully achieve that goal despite application of the best available technology. Where the Service has information or modeling indicating that restoration may be achieved with less than 100 percent passage, the Service has been able to adopt numeric targets that will achieve restoration, and measures to reach those targets.

12.2.1 Criteria for Upstream American Shad Passage Efficiency[1]

The Licensee shall operate the Project to achieve the upstream passage efficiency criterion of passing 85 percent of all adult American shad that enter the Project tailwaters ("Target

[1] FWS has agreed to meet with the Licensee in 2043 if the upstream hydroelectric projects are not meeting their target passage efficiencies consistently by then, to discuss the passage efficiency criterion for American shad at the Conowingo project based on then available data. The Service may consider adjusting the passage efficiency criterion at that time.

Efficiency”). The tailwaters of the project are defined as extending to the downstream tip of Rowland Island.

The Licensee can receive additional credit toward achieving the upstream passage efficiency criterion for adult American shad by trapping at Conowingo and transporting American shad to upstream of York Haven Dam and thus avoiding upstream passage impediments at the intervening hydroelectric projects on the Susquehanna River (see Section 12.7.2.1).

12.2.2 Criteria for Downstream American Shad Passage Efficiency

The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 80 percent of the adult American shad moving downstream past the Project.

The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 95 percent of the juvenile American shad moving downstream past the Project.

12.2.3 Criteria for Upstream River Herring Passage Efficiency

In accordance with sections 12.5 and 12.6, the Licensee shall operate the Project to minimize the impact of the Project on upstream migration for adult river herring that approach the Project tailwaters.

Numerical criteria for upstream river herring passage efficiency may be developed in the future when additional information about Susquehanna River herring populations becomes available. Any needed change in fishway requirements resulting from such new targets is not provided for in this Prescription, and would be the subject of independent administrative processes.

12.2.4 Criteria for Downstream River Herring Passage Efficiency

The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 80 percent of the adult river herring moving downstream past the Project.

The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 95 percent of the juvenile river herring moving downstream past the Project.

12.2.5 Criteria for Upstream American Eel Passage Efficiency

The Licensee shall operate the Project to minimize the impact of the Project on upstream migration for juvenile American eel that approach the Project tailwaters.

Numerical criteria for upstream American eel passage efficiency may be developed in the future when additional information about the Susquehanna River American eel population becomes available. Any needed change in fishway requirements resulting from such new targets is not provided for in this Prescription, and would be the subject of independent administrative processes.

12.2.6 Criteria for Downstream American Eel Passage Efficiency

The Licensee shall operate the Project to achieve the downstream survival efficiency criterion of at least 85 percent of the adult (i.e., silver) American eel moving downstream past the Project.

12.3 Seasonal Implementation of Fish Passage

The Licensee shall operate a fishway for upstream passage of anadromous fish daily during the American shad and river herring upstream *Migration Period* (Table 9). The Licensee shall operate the fish lift(s) daily during the upstream *Migration Period*, and begin releasing attraction flows at least one hour prior to the start of daily lift operations. The fish lift(s) will operate at the following times during the *Migration Period*: (1) in March, from 7 a.m. to 7 p.m.; (2) in April, from 6:30 a.m. to 7.30 p.m.; and (3) in May and June from 6:00 a.m. to 8:00 p.m.

The Licensee shall provide attraction flow and operate fish passage facilities for continuous upstream American eel passage (i.e. 24 hours per day) during the entire upstream *Migration Period* (Table 9).

The Licensee shall ensure prior to the start of the *Migration Periods* that all mechanical elements of the fishway(s) are working properly. The Licensee shall repair, maintain, and test fishway(s) as necessary in advance of the migration period, in accordance with the *Fishway Operation and Maintenance Plan* (FOMP) so as to begin operations when required. The Licensee shall maintain and operate fishways to maximize fish passage effectiveness throughout the upstream and downstream *Migration Periods* (Table 9).

Table 9. Upstream and downstream *Migration Periods* for species covered in this Modified Prescription for Fishways.

Species	**Upstream Migration Period**[1]	**Downstream Migration Period**[1]
American shad	Starting when river temperature reaches 50 ^{o} F, until river temperatures rise above 72 ^{o} F for four consecutive days, but ending no earlier than June 1, and no later than June 15[2]	July 1 through November 15 (juv.) May 1 through July 1, as long as river temperature is above 65 ^{o} F[2] (adult)

Species	**Upstream Migration Period**[1]	**Downstream Migration Period**[1]
Alewife and blueback herring	Starting when river temperature reaches 48 ^{o} F for three consecutive days and no earlier than March 1, until river temperatures rise above 72 ^{o} F for four consecutive days, but ending no earlier than June 1, and no later than June 15[2,3,4]	June 15 through October 14 (juv.) April 15 through July 1 (adult)
American eel	May 1 through September 15[5]	September 15–February 15, whenever river temperature is above 37 ^{o} F for 4 consecutive days[2,6]

[1] Subject to notice and comment, any of these migration periods may be changed during the term of the license by the Department, based on new information, and in consultation with the other fishery agencies and the Licensee. At any time during the new license term, Licensee may submit new information to the Department in support of a request to change the migration periods. In the event the Department seeks to require downstream passage by means other than through the units, the downstream migration periods automatically will be reviewed jointly by the Department, other fishery agencies, and the Licensee.

[2] Water temperatures shall be monitored once daily at 11 a.m. at Monitoring Station 643 (Shure's Landing) or some other location agreed upon by the Licensee and the Service.

[3] This migration period is based on alewife migration timing from other tributaries to the Chesapeake Bay (Sutherland 2000, p. 9; Eyler et al. 2002, p. 59; Slacum et al. 2003, p. 13).

[4] The Service recognizes that, because of factors outside of the Licensee's control, safety considerations may preclude the Licensee's personnel from performing duties necessary to commence fish passage measures at Conowingo by the commencement date. When such conditions arise, the Licensee shall notify the Service and the Service and the Licensee shall consult regarding the anticipated schedule for commencing such measures.

[5] This initial operational period is based on preliminary data on American eel migration at Conowingo Dam (Minkkinen and Park 2014, Figure 4).

[6] This initial operational period is based on preliminary data on American eel migration timing from other tributaries to the Chesapeake Bay (Eyler 2014, pp. 44-46). Results from the "Downstream American Eel Effectiveness Monitoring" (Section 12.7.5) shall be used to further refine this migration period.

12.4 Fishway Operation and Maintenance Plan

The Licensee shall develop and submit a Fishway Operation and Maintenance Plan (FOMP) to the Service, FERC, and resource agencies (states of Maryland and Pennsylvania, Susquehanna River Basin Commission, and National Marine Fisheries Service) for review and approval by the Service. The Licensee shall keep the FOMP updated on an annual basis, to reflect any changes in fishway operation and maintenance planned for the year. If the Service requests a modification of the FOMP, the Licensee shall respond to the requested modification within 30 days of the request by filing a written response with the Service and serving a copy of the response on FERC and the resource agencies.[2] Any modifications to the FOMP by the Licensee shall require approval by the Service and, if necessary, FERC prior to implementation.

The FOMP shall include:

- Schedules for routine maintenance, pre-season testing, and the procedures for routine fishway operations, including seasonal and daily periods of operation, and associated dam and powerhouse operational measures needed for proper fishway operation;
- Details of how the Project shall be operated during the migration season to provide for adequate fish passage conditions, including:
    - pre-season preparation and testing;

[2] Requested modifications to the FOMP will not include changes to turbine operations. Any modifications to turbine operations shall be implemented only pursuant to Section 12.5.4.

  - sequence of turbine start-up and operation under various flow regimes to enhance fishway operation and effectiveness;
  - debris management at the fishway entrance, guidance channels, and the exit;
  - plant operations to provide near- and far-field attraction flows required for the fishway zone of passage in the tailrace;
- Trap and transport logistics plan and design plans for west and east fish lift modifications needed for trap and transport, including provisions for planning trap and transport logistics so as to avoid, to the extent possible, trapping a population unrepresentative of the migrating population as a whole.
- Trap and transport logistics plan for American eel;[3]
- Standard operating procedures for monitoring and enumerating fish passage by species, including the American eel passage facilities;
- Standard operating procedures for collecting biological samples from target species to assess restoration efforts;
- Standard operating procedures for monitoring and reporting operations that affect fish passage;
- Standard operating procedures in case of emergencies and Project outages to first, avoid, and second, minimize, potential negative impacts on fishway operations and the effectiveness of upstream and downstream passage for target species; and
- Plans for post-season maintenance, protection, and winterizing the fish lifts and eel passage facilities.

The Licensee shall provide written documentation to the Service, FERC, and resource agencies that all fishway operational personnel have reviewed and understand the FOMP and it shall be signed by the operations manager of the Project. Copies of the approved FOMP and any modifications shall be provided to the Service, FERC, and resource agencies on an annual basis.

By December 31 of each year, the Licensee shall provide an annual report to the Service, FERC, and resource agencies detailing: the implementation of the FOMP, including any deviations from

[3] The Licensee can incorporate by reference American eel plans and logistics developed pursuant to the Eel Passage Advisory Group.

the FOMP and a process to prevent those deviations in the future; any proposed modifications to the FOMP, or in the case of emergencies or project outages, the steps taken by the Licensee to minimize adverse effects on fisheries including any proposed modifications to those steps to further enhance their effectiveness in the future; and operational data for both fishways and the Project to allow the Parties to examine correlations between particular operational patterns and successful or unsuccessful fishway operation, and to confirm, once an operational regime with known effectiveness is settled upon, that the Project continues to operate under that regime. The Service understands that details of operation constitute confidential business information, and agrees to protect them from disclosure as such to the extent it is able to do so by law.

The annual report shall also include:

- Description of routine maintenance as well as repairs made to the fishways or eel passage facilities during the previous fish passage season;
- Average daily flows at the Marietta gauging station;
- Daily water temperature and dissolved oxygen readings[4] in the fish lift and tailwater areas;
- Hourly individual turbine unit operations and discharge, hourly total discharge from the powerhouse, hourly discharge over the spillway, and hourly passage counts of all fish species at each hopper;
- Daily counts of American eel collected at each facility;
- Thirty-minute recordings of total flow discharging from behind the hopper, total flow discharging from the attraction water supply diffuser, water surface elevation immediately upstream from the entrance gates, water surface elevation at the tailwaters, elevation to the crest of the entrance weir gates, and any irregularities such as the identification of a visible boil in the zone over the floor diffusers;
- Number of fish by species trapped and transported, including date, time, and location of release;

[4] The Licensee shall provide dissolved oxygen readings, commencing each year when the Project's NPDES permit requires annual data collection to begin, through the end of the upstream migration period.

- Weekly collection of a subsample of biological information from passing adult American shad and river herring consisting of sex ratio, spawning condition, length, weight, and age.

In addition to the annual report, the data for daily flows, water quality, project operations, fishway operations and fish passage as described above shall be recorded in a database during the fish passage season and the Service shall be provided open access to that database. Data shall be entered into the database no later than one week after collection.

These data shall be used to assess impacts of river conditions and hydropower operations on successful fish passage through the lifts, with the goal of achieving a better diagnosis of potential fish passage issues at the Project. The operational data will not provide the Service with an independent basis to require modifications and improvements beyond those that may be implemented through the process described below.

By January 31 of each year, the Licensee shall meet with the Service and the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) to discuss the FOMP (and FEMP – See Section 12.7.1). This meeting shall occur no later than January 31 of each year unless the Licensee and the resource agencies agree on a different date. At this annual meeting the Licensee shall discuss with the Service and SRAFRC the fish passage results from the previous year, review regulatory requirements for fish lift and eel passage operations, and discuss any upcoming modification or testing the Licensee shall conduct during the upcoming season.

12.5 Sequencing of Upstream Fish Passage Construction and Implementation

Timely construction, operation, and maintenance of fishways is necessary to ensure their effectiveness and to achieve restoration goals. Therefore, the Licensee shall (1) notify, and (2) obtain approval from the Service and FERC for any extension of time to comply with conditions the Department prescribes.

12.5.1 Trap and Transport of American Shad and River Herring

The Licensee has agreed to and will trap and transport American shad and river herring to areas upstream of York Haven Dam annually. The number of American shad and river herring trapped and transported annually will be up to 80 percent of the number of each species captured in the fish lifts up to a maximum of 100,000 of each species annually. Trap and transport operations shall continue until the Licensee can achieve a measured 85 percent upstream passage efficiency for American shad at the Project without reliance on the trap and truck credit provided for in Section 12.7.2.1.

12.5.2 Initial Construction

Unless otherwise stated, the Licensee shall implement the items defined in Section 12.6.1 "*Initial Construction Items*" within 3 years following license issuance. Construction shall be conducted in a way as to allow for trap and transport operations as well as volitional passage at the EFL to continue uninterrupted during this time period.

12.5.3 Operation in the First Passage Season after License Issuance

Within 1 year of license issuance, trap and transport operations from the EFL and WFL shall begin. A total of 80 percent of the run, up to 100,000 American shad and 100,000 river herring per year shall be trapped and transported to the mainstem Susquehanna River upstream of York Haven.

12.5.4 Efficiency Testing and Triggering of Subsequent Modifications

In the 5th year after license issuance, the Licensee shall begin the "*Initial Efficiency Test*" of fish passage at the Project. The Licensee shall conduct the *Initial Efficiency Test* as defined in Section 12.7.2 in order to evaluate passage performance relative to upstream efficiency criteria for American shad and river herring as described in Section 12.2. In the 5th year after license issuance, the Licensee shall also assess mortality of American shad during the trap and transport process.

If at the end of the *Initial Efficiency Test*, the combined results of the three-year study (the combination of measured efficiency of the *Initial Efficiency Test* and the *Trap and Transport Credit* resulting in an *Adjusted Efficiency*) meet the *Target Efficiency* of 85 percent for upstream passage of American shad, the Licensee shall operate the Project using the FOMP implemented during the *Initial Efficiency Test*. The Licensee shall then conduct a two-year "*Periodic*

Efficiency Test" as defined in Section 12.7.2 in every 5th year thereafter to ensure that the upstream-prescribed efficiency criterion continues to be met through the term of the license.[5]

If at the end of the *Initial Efficiency Test* or after any *Periodic Efficiency Test* thereafter during the license term, or after any subsequent "*Post-Modification Efficiency Test*" as defined in Section 12.7.2, the study results indicate that the Licensee is not meeting the required *Adjusted Efficiency,* the Licensee shall conduct an evaluation of the radio telemetry data and any other data available to the Service and/or the Licensee to determine if the passage inadequacy is related to fishway attraction or fish lift capacity. Concurrent with the submission of the final report from an efficiency study, the Licensee shall propose a course of action most likely to achieve the *Target Efficiency*. Both the Service and the Licensee have agreed on a tiered list of options and the types of either attraction or capacity problems which the tiers may address. If the reason for not achieving the *Target Efficiency* is insufficient fishway attraction, then the Licensee shall follow the actions in Section 12.6.2. If the reason for not achieving the *Target Efficiency* is lack of fish lift capacity, then the Licensee shall follow the actions in Section 12.6.3. In the event that both fishway attraction and fish lift capacity are limiting factors to achieving the *Target Efficiency,* the Licensee shall address items listed under both sections 12.6.2 and 12.6.3, but only to the extent both attraction and capacity measures are necessary to achieve the required *Target Efficiency*. The list of measures in sections 12.6.2 and 12.6.3 is not exclusive and does not preclude either party from identifying and proposing other measures commensurate with the required level of improvement and corresponding tier. The Service shall react to the Licensee's proposal for improving fish passage efficiency within 90 days of receipt. It may:

A. Say nothing, in which case the Licensee shall proceed with its proposed course of action;
B. Agree affirmatively with the Licensee's proposed course of action, in which case the Licensee shall proceed;
C. Propose a different option, not on the tiered list of options, which the Licensee shall proceed with if it agrees;
D. Require, instead, that the Licensee implement an option or options from the appropriate (or lower numbered) tier to address each problem. The Service will choose that option(s)

[5] At the Licensee's election, and with Service concurrence, the Periodic Efficiency Test may be extended an additional 1 year. Only after the efficiency tests are completed will the Licensee be required to propose, as may be necessary, a course of action to achieve the Target Efficiency.

it deems most likely to achieve the *Target Efficiency*. The Service may select an option from a higher-numbered tier only if all options from an appropriate or lower-numbered tier have been implemented. If two or more options appear equally likely to achieve the efficiency criterion, the Service will present the Licensee with the choice, and the Licensee may proceed with whichever it prefers. The Service shall explain, in writing, its reasons for finding that its choice(s) is more likely than the Licensee's to lead to the desired passage efficiency. The Licensee shall then proceed with the selected course of action.

12.5.5 General construction requirements.

All functional (i.e., 30 percent, 60 percent, and 90 percent) and final design plans, operation and maintenance plans, construction schedules, and hydraulic model studies for the new fishways or modifications to existing fishways described herein shall be developed in consultation with the Service and submitted to the Service and FERC for approval. The planning and design process for structures shall generally include CFD modeling prior to construction and post-construction shakedown and testing to confirm modeling.

12.6 Fish Passage Facilities

12.6.1 Initial Construction Items

East Fish Lift Modifications – The Licensee shall modify the EFL facility to provide 900 cfs attraction flow to the EFL. Modifications to the EFL facility will include replacing spillway gates A & B, replacing the crowder system, addressing structural vibration issues, replacing diffuser gates A and B, replacing the control system, and upgrading the electrical system to allow for a 15 minute lift cycle.

Replace the current 3,300-gallon hopper with two 6,500-gallon hoppers at the EFL

The Licensee shall remove the current hopper and install two 6,500-gallon hoppers within the existing superstructure of the EFL. One hopper will replace the current 3,300-gallon hopper and the second hopper will be located immediately upstream from the current location of the existing

EFL hopper (see Figure 10). Access to both hoppers will be provided by the current entrance gates (A, B, and C) and the hoppers will share the same holding pool.

Trap and Transport Facilities at the EFL

The Licensee shall reduce cycle time at each hopper at the EFL to be able to lift fish four times per hour and complete modifications to the EFL structure to allow for trapping and sorting fish at the EFL facility and transporting them to the western side of the dam to a truck for transport upstream. Modifications to the EFL shall include two new sorting tanks; a loading tank; and a hy-rail truck and forklift, or functionally similar equipment, to facilitate movement of American shad from sorting tanks at the EFL to the west shore. These improvements shall be accomplished without losing a season of the passage provided by the EFL.

Trap and Transport Facilities at the WFL

WFL modifications shall be made to facilitate trap and transport including: decreasing lift cycle time by replacing the crowder linkage system and raising the elevation of the sorting tank(s), and providing a mechanism to allow for direct sluicing of fish into tanks mounted on the transport vehicle. These initial improvements shall be accomplished without losing a season of the passage provided by the EFL or trap and transport from the WFL.

Provide a Zone of Passage (ZOP) to the Fish Passage Facilities

The Licensee shall construct and maintain structures, to provide American shad and river herring a ZOP (i.e., route of passage) as described in this section.

In advance of any ZOP development and/or construction, the Service and Licensee will review CFD modeling results from the tailrace. The Licensee shall run the model under a predetermined number of structures arrangements (e.g., different angles, different spacing between the weirs, different weir slopes). In consultation with the Service, the Licensee shall choose to construct the configuration of structures that provides the most conducive hydraulic conditions for fish passage of river herring. The area to be considered for potential ZOP improvements includes approximately 2,500 feet on the west bank and 3,500 feet on the east side of Rowland Island. Based on CFD modeling results that analyze discharge velocities and turbulence, the Licensee shall provide stone weirs, and/or other suitable alternatives or measures that provide a contiguous zone of passage (ZOP) from the southern tip of Rowland Island to one or both of the lifts. The Licensee shall install up to ten stone weirs, with the option of considering other configurations for structures, so long as the total cost does not exceed the cost estimated for up to ten weirs.[6] Model results will guide the placement and formation of these structures to provide for the hydraulic conditions necessary for the weakest swimmers (river herring) to reach the lifts. Specifically, the ZOP must be designed to maintain instantaneous velocities below 3 feet per second, separated only by brief regions of higher velocity that river herring may traverse in seconds at burst speeds up to 6 feet per second, over the full range of operational flows for the EFL, and in all generation scenarios.

After ZOP construction is completed, the Licensee shall assess the ZOP for upstream migrating river herring under the full range of the current fish passage design flows (i.e., up to 113,000 cfs of river flow).

Eel Passage – Eastern Location – The Licensee shall, consistent with the Eel Passage Plan established by Muddy Run license, evaluate potential trapping locations for American eel on the east side of Conowingo Dam including Octoraro Creek starting in May of the first calendar year after license issuance or immediately if license issuance occurs during the upstream American eel migration period. The plan and schedule for implementation of temporary and permanent eel passage facilities and other design criteria shall follow requirements established by the Muddy Run license and be approved by the Service and FERC following consultation with the Licensee and the respective resource agencies. The Licensee shall operate any temporary or permanent eel passage facility continuously (24 hours per day, 7 days per week) during the American eel Upstream Migration Period and shall submit proposed stocking locations for collected American eels to the Service and resource agencies for review and approval by the Service prior to beginning such measures.

Eel Passage – Western Location

[6] The estimated cost of ten weirs plus a contingency of 30% is no more than $2.3 million in 2016 dollars.

The Licensee shall conduct a trap and transport operation for American eels at the west side of Conowingo Dam beginning immediately after license issuance. The eel passage facility shall be designed to provide volitional passage for American eels no later than 2031, and will be sited taking into consideration the potential for a new West Fish Lift.[7]

Design criteria shall follow the components described in the Muddy Run license. The Licensee shall conduct trap and transport of American eels until 2030, and will implement volitional American eel passage starting in the 2031 season. The Licensee shall operate the eel passage facility continuously (24 hours per day, 7 days per week) during the American eel upstream Migration Period. The Licensee shall submit proposed stocking locations for collected American eels to the Service and resource agencies for review and approval by the Service prior to beginning trap and transport of American eels.

12.6.2 Improving Attraction Efficiency

Included is a list of physical and operational modifications to the Project intended to address observed deficiencies in fishway attraction efficiency. The tiered process for improving attraction efficiency is based on passage efficiency during the most recent efficiency test. The items included in the different tiers were developed to be commensurate with the degree of shortfall from the *Target Efficiency*. If, based on the *Adjusted Efficiency* of the current test, all appropriate options from the corresponding tier, including any option proposed by the Licensee and approved by the Service, have been exhausted, the items from the next highest numbered tier may be required, regardless of the current project passage efficiency. More than one item from a tier may be completed at one time depending on the degree of the *Adjusted Efficiency* shortfall.

12.6.2.1 Improving Attraction Efficiency – Tier I (*Adjusted Efficiency 70*%-85%)

In the year following any failure by the Licensee to reach the *Target Efficiency* due to inadequate fishway attraction, the Licensee shall implement one or more of the modifications to Project

[7] Consistent with the Eel Passage Plan established by the Muddy Run license, construction of the volitional passage facility will eliminate the Licensee's obligation to participate in the trap and transport program once the volitional upstream eel passage facility is operational. However, if the upstream eel trap and transport and periodic evaluation program continues beyond 2030, the Licensee will continue to provide access to the Conowingo eel collection facilities for as long as the program continues. The Licensee, however, shall bear no cost responsibility for the trap and transport and periodic evaluation program until 2046, at which time cost responsibility shall be shared among all participants in the program.

operations and facilities described in this section.

Correct any Technical Operational Problems and/or Implement Internal Modifications

The Licensee shall correct any technical operational problems that may have been detected during the fish passage season and/or implement internal modifications to the West and/or East fish lift (e.g., energy dissipation, hydraulic attraction).

Implementation of preferential turbine operating schemes

The Licensee shall develop a turbine operation scheme that can range from simply first on/last off to modification of specific Francis and Kaplan unit operation to ensure that fish are able to successfully locate and access the fish lift entrances.

12.6.2.2 Improving Attraction Efficiency – Tier II (*Adjusted Efficiency* 55%-69%)

Within 2 years following any failure to meet the *Target Efficiency* due to inadequate attraction to the fishway, the Licensee may implement either one of the modifications to the Project facilities described in this section to reach upstream passage efficiency.[8]

Relocate EFL Entrances A & B

If the CFD modeling results indicate modifications to Entrances A & B will improve guidance to and accessibility of the lift entrances, then the Licensee shall extend the entrance channel at entrance A with two 45-degree turns in the fish passage facility channel, so as to discharge into the area behind the catwalk piers and upstream from the Kaplan turbine discharge/boil. The attraction flow should be effective along the catwalk and through the space between the piers (Figure 10, USFWS 2013h). The Licensee shall also modify the existing entrance B so that the centerline of the discharge plume will be at a 45-degree angle to the river flow.

Construct a new Entrance D with a separate crowder and holding pool

[8] The Service may require relocation of Entrances A&B and, if the *Adjusted Efficiency* continues to be between 55%-69%, Entrance D at a later point, but then, per Tier III (and consistent with the "not before" dates), may only require the AWS, not the WFL. Alternatively, the Service may require the relocation of Entrance A&B, and in subsequent cycles proceed to choose the WFL (again, consistent with the "not before" dates) if (a) the *Adjusted Efficiency* is below 55% and Entrance D has not been constructed or (b) the *Adjusted Efficiency* is between 55%-69% and the Service determines that Entrance D is not likely to achieve the efficiency criterion.

The Licensee shall build a new additional entrance, Entrance D, with a separate crowder and holding pool (Figure 10). The hopper will be accessed from the new entrance and through a proposed collection gallery that will span the full length of the Kaplan turbine section of the powerhouse. Entrance D and the collection gallery are intended to provide access to the EFL from the Francis turbine section of the powerhouse. The new collection gallery will be located against and along the powerhouse wall. This improvement will not be required by the Service to be operational before year 15 of the license.

12.6.2.3 Improving Attraction Efficiency -Tier III (*Adjusted Efficiency* less than 55%)
Following any failure by the Licensee to reach upstream passage efficiency due to inadequate fishway attraction, the Licensee may implement one or more of the modifications to Project operations and facilities described in this section.

Construct an Auxiliary Water Supply at the EFL
The Licensee shall construct a new AWS stilling basin and system so the energy from up to 4,300 cfs can be dissipated and incorporated into effective attraction flows emanating from the multiple fish lift entrances. This improvement will not be required by the Service to be operational before year 25 of the license.

WFL Construction
Licensee shall construct a new WFL (as described below, in parts 1-5) in the west corner of the powerhouse tailrace. The Licensee shall operate the new WFL as a tailwater to headpond fish lift with a collection facility for fish sampling that, at the Licensee's option, could be used as a fish trap and transport facility. This improvement will not be required by the Service for reasons of attraction efficiency to be operational before year 25 of the license, and only if neither Entrance D nor the EFL AWS stilling basin and system have been constructed. If the Service requires construction of the WFL for reasons of attraction efficiency, it has agreed not to subsequently require the EFL AWS stilling basin and system under this Prescription.

WFL Construction – Part 1
The Licensee shall construct a facility that provides the capability of enumerating fish passage by

species, allows for the collection of and holding of fish for biological sampling, and that can also be used for trapping and transporting American shad and available river herring per year, with the potential for captured fish to be transported upstream of the York Haven Dam.

WFL Construction – Part 2

The Licensee shall install two 6,500-gallon hoppers, with separate crowders, in the new WFL, capable of operating simultaneously.

WFL Construction – Part 3

The Licensee shall construct the WFL to have the ability to provide up to 5 percent of hydraulic capacity of the Project (or up to 4,300 cfs) for attraction flow to the fishway entrance(s). During the design phase and during preconstruction, the Licensee shall conduct computational fluid dynamics (CFD) modeling and other supporting analysis to develop appropriate fish lift entrance attraction flows, velocities, and hydraulic conditions. The Licensee shall operate the WFL to provide attraction flow of at least 2,600 cfs (3 percent of hydraulic capacity of the Project) during the Upstream Migration Period for American shad and river herring. With the goal of improving fish passage efficiency at the WFL following initial start-up of the new WFL, the Service may require the lift operator to modify operation of the fish lift, the allocation of flows through its Auxiliary Water System (AWS), and/or the total amount of flow being supplied to the WFL (up to a maximum of 4,300 cfs or 5 percent of the Project hydraulic capacity).

WFL Construction – Part 4

The Licensee shall design and construct an AWS that meets Service criteria for energy dissipation of the attraction flow while maintaining water quality standards.

WFL Construction – Part 5

The Licensee shall conduct an assessment of the ZOP downstream of the WFL to ensure that it continues to be passable over the range of flows in which the WFL is operational.

12.6.3 Improving Fish Lift Capacity

Included is a list of physical and operational modifications to the Project intended to address possible deficiencies in fish lift capacity. The tiered process for improving capacity is based on passage efficiency during the most recent efficiency test. The items included in the different tiers were developed to be commensurate with the degree of missing the required 85 percent passage efficiency criterion. If, based on the *Adjusted Efficiency* of the current test, all options from the corresponding tier have been exhausted; the items from the next highest numbered tier may be required, regardless of the current project passage efficiency. Implementation of modifications in the capacity tiers is independent of the implementation of similar items used to improve attraction efficiency in section 12.6.2. Both attraction and capacity improvements can be required simultaneously if deemed appropriate from the most recent study results, but only to the extent both improvements are needed to meet the *Target Efficiency*.

12.6.3.1 Improving Fish Lift Capacity - Tier I (Adjusted Efficiency 70% – 85%)

Within 2 years following any failure by the Licensee to reach upstream passage efficiency due to inadequate fishway capacity, the Licensee shall implement the modification to Project facilities described in this section.

<u>Construct a new Entrance D with a separate crowder and holding pool</u>

The Licensee shall build a new additional entrance, Entrance D, with a separate crowder and holding pool (Figure 10). The new hopper will be accessed from the new entrance and through a proposed collection gallery that will span the full length of the Kaplan turbine section of the powerhouse. Entrance D and the collection gallery are intended to provide access to the EFL from the Francis turbine section of the powerhouse. The new collection gallery will be located against and along the powerhouse wall. This improvement will not be required by the Service under this Prescription to be operational before year 15 of the license.

12.6.3.2 Improving Fish Lift Capacity - Tier II (*Adjusted Efficiency* less than 70%)

Within 3 years following any failure by the Licensee to reach upstream passage efficiency due to inadequate fishway capacity, the Licensee shall implement the modifications to Project facilities described in this section.

<u>WFL Construction</u>

The Licensee shall construct a new WFL (as described in section 12.6.2.3) in the west corner of the powerhouse tailrace. The Licensee will operate the new WFL as a tailwater to headpond fish lift with a collection facility for fish sampling that, at the Licensee's option, could be used as a fish trap and transport facility. This improvement will not be required by the Service under this Prescription to be operational for reasons of capacity before year 25 of the license.

12.7 Fish Passage Effectiveness Monitoring

Efficiency testing of both upstream and downstream fish passage, and determining mortality rates of American shad when using trap and transport are critical to evaluating the success of fish passage structures and operations, diagnosing problems, and determining both when modifications are needed and what modifications are likely to be effective. These measures are essential to ensuring the effectiveness of fishways over the term of the license, particularly in cases where the increasing size of fish populations as a result of improved upstream passage may also lower upstream fish passage efficiencies due to migrating fish crowding and exceeding daily or annual lift capacity, thus keeping some fish from successfully passing the project and limiting net effectiveness.

12.7.1 Fishway Effectiveness Monitoring Plan

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 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.

The Licensee shall meet with the Service and the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) to discuss the FEMP and FOMP. This meeting will occur no later than January 31 each year unless the Licensee and the Service agree on a different date. At this annual meeting the Licensee shall discuss with the Service and SRAFRC the fish passage results from the previous year, review regulatory requirements for fish lift and eel passage operations, and discuss any upcoming modification or testing the Licensee proposes for the upcoming fish passage season.

12.7.2 Initial Efficiency Test, Post-Modification Efficiency Tests, and Periodic Efficiency Tests for Upstream Passage of American Shad and River Herring

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 Efficienc*y 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.

12.7.2.1 Trap and Transport Credit for American Shad

The 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. The Service will recognize 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.

Details of the credit toward the efficiency criterion are provided in Appendix B. Part of the calculation of the credit toward efficiency criterion requires an estimate of the mortality associated with trap and transport operations. 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.

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.

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.

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.

In the event the Licensee is unable to achieve the efficiency criteria for survival based on the results of the downstream studies, the Department may exercise its reservation of authority to address the issue.

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 (see USFWS 2014d). 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.[9]

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.

In the event the Licensee is unable to achieve the efficiency criterion for survival based on the results of the downstream studies, the Department may exercise its reservation of authority to address the issue.

12.8 Fishway Inspections

The Licensee shall provide Service personnel and other Service-designated representatives, timely access to the fish passage facilities at the Project and to pertinent Project operational records for the purpose of inspecting the fishways to determine compliance with the Fishway Prescription.

[9] Mobile tracking and data analysis for this study will be the responsibility of the Service. Annually, the Service will share with the Licensee all data collected as part of the basin-wide study.

13. Pre-License Actions Agreed to by the Licensee

13.1. Items to be completed in 2016 - 2017

The License Applicant has agreed to develop and finalize a detailed logistics plan and operating protocol for trap and transport of American shad and river herring from both the EFL and WFL. The Logistics plan will address near-term operations, as well as logistics necessary to support the collection and transport of up to 80 percent of the American shad and river herring passing the project with a maximum transport of 100,000 American shad and 100,000 river herring annually. This plan will be completed by December 31, 2017.

The License Applicant has agreed to develop detailed computational fluid dynamics (CFD) models of the zones of passage, in consultation with the Service, to the EFL and WFL to assess the ability of fish to reach them.

The License Applicant has agreed to develop its initial FOMP (as described in Section 12.4) and submit to the Service by September 30, 2017.

13.2. Items to be completed in 2017 - 2018

The License Applicant has agreed to finalize design plans for initial fishway improvement and improvements to facilitate the trap and transport program.

14. Definition of Technical Terms

Adjusted Efficiency– The calculated fish passage efficiency that accounts for the biological benefit of fish trapped and transported from the project to areas upstream of other mainstem dams. This calculated efficiency gives credit towards efficiency targets for the number of fish that are trapped and transported.

Alosines – collective term for American shad, blueback herring and alewife

Anadromous – migratory fish that spawn in freshwater rivers but spend most of their life in the ocean

Attraction Efficiency – The proportion of the migrating population that successfully passes a designated downstream point at the Project (i.e. the downstream end of Rowland Island), and successfully enters the fish lift

Barotrauma – trauma due to changes in barometric pressure such as the expansion and rupture of a fish's swim bladder

Biomass – pounds of fish

Catadromous – migratory fish that spawn in the ocean but spend most of their life in freshwater

Diadromous – includes both anadromous and catadromous migratory fish

Downstream Fish Passage Efficiency – the percentage of the fish that approach the upstream side of the Project and survive unharmed as they pass the Project and continue downstream migrations

Effective Passage – the combination of fish passage facilities and project operations that provide conditions where fish can approach and move past a barrier with little or no impact to their migration. Effectiveness may include both qualitative and quantitative components; however, a different term, efficiency, is typically reserved for quantitative evaluations of effectiveness.

Entrainment – fish passage via a particular structure, usually referring to directing fish passage through turbines or into downstream fish passage facilities

Fecund – more fertile, having more eggs

Fish Ladder – an engineered ramp-like structure, typically constructed of concrete and/or metal, used to provide upstream fish passage

Fish Lift – an elevator-like structure with a hopper used to convey fish from the tailwaters to the headpond of high dams

Fish Passage Facility – the physical structure of the fishway used to convey fish upstream; with the term being synonymous with "fish lift" at this Project

Fishway – shall have the definition provided in P.L. 102-486, § 1701(b) (1992)

Headpond – the body of water located on the upstream side of the dam

Hopper – the structural part of the fish lift used to hold fish as they are transported from the tailwaters to the head pond

Impingement – to trap fish against a structure, usually referring to intake screens

Nature-Like Fishway – a ramp-like structure, typically constructed of natural materials (rocks, logs), used to provide upstream fish passage

Panmictic – of one spawning population with no genetic differentiation between geographic areas

Peaking – a hydro-electric facility that rarely spills water has the ability to store water and release on demand for power generation, typically having the ability to significantly impact flows downstream of the project

Repeat Spawning – ability to spawn over multiple years

Run-of-River – a hydro-electric facility that has limited (if any) ability to store water, with water typically flowing over the crest of the dam at all times

Safe Passage – the movement of fish through the zone of passage that does not result in any unacceptable stress, incremental injury, or death of the fish.

Self-Sustaining - Ability to maintain migratory fish populations at the level of their restoration goal without supplementation from trap and transport or hatchery products.

Tailrace – the area downstream of the dam that is in the hydraulic influence of Project operations

Tailwaters – the area downstream of Conowingo Dam located between the dam and the downstream end of Rowland Island

Timely Passage – the successful movement through the zone of passage that proceeds without a delay that would impact the natural behavior patterns or life history requirements of a fish

Trap and Transport – fish that are collected at a downstream project and loaded in a tank truck and transported and released into some location upstream of that project

Upstream Fish Passage Efficiency – the percentage of the fish present in the Project tailwaters that successfully move through the fish lift and continue upstream migrations; e.g. the proportion of fish that start at point B (downstream end of Rowland Island in the case of Conowingo Dam) and passes point E in Figure 5

Volitional Passage – a fish passage facility that allows fish to swim unimpeded from the tailwaters to the headpond; fish lifts are not considered volitional passage because the fish rely on the operation of the lifts in order to pass upstream into the headpond

Zone of Passage (ZOP) – The contiguous area of sufficient lateral, longitudinal, and vertical extent in which adequate hydraulic and environmental conditions are maintained to provide a route of passage through a stream reach influenced by a dam (or stream barrier); e.g. the area between point A and point E in Figure 5.

Appendix A. Calculation of Fishway Capacity for a 6,500-Gallon Hopper

Biological Parameters		
	λ_m= 0.052 (season/day)	Season-to-Day run compression coefficient; empirically determined designed parameter
	β=0.15 (day/hr)	Hour-to-Day run compression coefficient; empirically determined design parameter
	T=15 min	Lift cycle time (recommended)
Hopper Size		
	Vol_H=868.9ft^3	Estimate of proposed hopper volume (6,500 gallons)
	V_{fH}=0.1 (ft^3/lbf)	Volume required per fish-pound; USFWS criterion; for lift times greater than 15 minutes, a 30 percent increase in V_{fH} is recommended
Allowable peak biological loadings		
Flb_h= (Vol_H/v_{fH}*T)	Flb_h= 34,756 lbf/hr	Allowable loading of fish in pounds per peak hour
Flb_d=Flb_h/ β	Flb_d= 231,706 lbf/day	Allowable loading of fish in pounds during the peak day
Flb_s = Flb_d/ λ_m	Flb_s= 4,455,897 lbf/season	Allowable loading of fish in pounds during an entire season

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 C. Trap and Transport Mortality Study

To assess the mortality associated with trap and transport (T&T) of American shad collected at Conowingo Dam and transported to areas upstream of York Haven Dam, a study design similar to that of Millard et al. (2005) will be employed. This study will have both a treatment (T&Ted shad) and a control group (shad not T&Ted). The purpose of having both a treatment and a control group is to evaluate both the immediate and delayed mortality associated with T&T operations while controlling for mortality associated with handling stress while carrying out the study.

Control groups will consist of shad that are caught in the lifts at Conowingo Dam, sorted from non-target species, and rather than being loaded into a truck and transported upstream, they will be released to a large holding tank located at Conowingo Dam (size to be determined) and monitored for 72 hours post-release.

Treatment groups will consist of shad that are caught in the lifts at Conowingo Dam, sorted from non-target species, loaded into a truck, and driven around in the truck for a length of time equivalent to the trip duration to areas upstream of York Haven Dam. After simulating transport, the shad will be placed into a holding tank located at Conowingo Dam and monitored for 72 hours post-release.

Experimental tanks for both treatment and control groups will be located at Conowingo Dam in order to eliminate any confounding effects of differences in water temperature/chemistry between treatment and control groups and to isolate the effects of transport. Experimental tanks will be set up with flow through conditions using water pumped from the tailrace of Conowingo Dam.

Each week throughout the fish passage season, a truck load’s worth of fish (exact number yet to be determined) will be used in both treatment and control groups. Thus, the experiment will be temporally replicated for 4 – 8 weeks depending on the duration of the spawning run in a given year. This will allow assessment of mortality over the range of water temperatures experienced by shad throughout the season.

During the 72 hour monitoring period, dead shad will be removed from the tank as soon as they are noticed. Mortality will be quantified as the number of dead shad divided by the number of shad that entered either the treatment or control group. Mortality in the treatment group will include all shad that died during the entire process from loading them into the truck to those found dead at the end of the 72 hour monitoring period.

Statistical Analysis

It will be assumed that total mortality of the treatment group consists of two components: 1) mortality associated with transport and release of the shad; and 2) mortality associated with experimental handling of the shad. Thus, total mortality of the treatment group = T&T mortality + handling mortality. The control group would only experience mortality associated with experimental handling. The instantaneous handling mortality rate (m_h) will be estimated from the control group as

$$M_h = -ln(S_c)$$

where S_c is the survival of the control group over all replicates throughout the season. The instantaneous total mortality in the treatment group will be estimated as

$$M_t = -ln(S_t)$$

where S_t is the survival of the treatment group over all replicates throughout the season. The conditional mortality associated with trap and transport (conditioned on handling mortality) is

$$u_{TT} = A - \left[\frac{A \cdot M_h}{-ln(1 - A)}\right]$$

where A is the fraction of fish that die from all causes (1-S_t). This equation is based on the traditional fisheries expression $u = A \cdot F/Z$ where u = the expectation of death from fishing, A = total mortality rate from all causes, F = the instantaneous fishing mortality rate, and Z = the total instantaneous mortality rate. Estimation of the conditional mortality associated with trap and transport (u_{TT}) according the above equation is preferred because it accounts for the probability that the two sources of mortality, trap and transport stress and handling stress, occur simultaneously over the monitoring period (Millard et al. 2005).

Literature Cited

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.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding. Dated this 12th day of May 2016 in Washington, D.C.

/s/ Marcia Hook

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April 21, 2017

VIA ELECTRONIC FILING

Kimberly Bose
Secretary
Federal Energy Regulatory Commission
Ofice of the Secretary
888 First Street, NE
Washington, D.C. 20426

Re: Conowingo Hydroelectric Project, FERC No. 405
Supplemental Information Regarding Exelon Generation Company, LLC's Application for a New License

Dear Secretary Bose:

On August 30, 2012, Exelon Generation Company, LLC ("Exelon"), licensee for the Conowingo Hydroelectric Project ("Conowingo") (FERC No. 405), filed with the Federal Energy Regulatory Commission ("FERC" or "Commission") an application for a new license for Conowingo ("Final License Application" or "FLA").[1] After consultation with FERC's Division of Hydropower Administration and Compliance, Exelon submits this letter to supplement the pending Conowingo license application to specifically incorporate certain eel passage requirements associated with the eel facility at Conowingo Dam.

The water quality certification for the Muddy Run Pumped Storage Project ("Muddy Run") (FERC No. P-2355) requires, in part, that Exelon design, install and operate an eel trapping and holding facility along the western shore of the Conowingo Dam near the location of the current United States Fish and Wildlife Service ("USFWS") trapping location and facility. These obligations are described in greater detail in Appendix 1 §§ III and IV of the water quality certification for Muddy Run.[2]

After consultation with FERC's Division of Hydropower Administration and Compliance and the Maryland Department of the Environment ("MDE"), Exelon is explicitly incorporating the requirements and design criteria for the eel facility at Conowingo contained in the Muddy Run water quality certification into the Final License Application for Conowingo. Exelon has provided the language to be incorporated into the new Conowingo license as Attachment A.[3] It is our understanding that MDE will review the eel passage facility

[1] Exelon Generation Company, LLC's Final License Application for the Conowingo Hydroelectric Project and Request for Waiver of the Requirement to Include a Biological Assessment, Docket No. P-405 (filed Aug. 30, 2012).

[2] The water quality certification is provided as Appendix A to the Muddy Run license. *Exelon Generation Company, LLC*, 153 FERC ¶ 62,232, at Appendix A (2015).

[3] The language provided as Attachment A is excerpted from the Muddy Run water quality certification, but incorporates certain modifications to the design criteria contained in the water quality certification. Specifically, neither the holding tank at the western location nor the transport vehicle(s) will have an automatically engaging back-up pump. In addition, eels will not be released within one hour after sunset into at least three feet of water. Instead, they will be released as soon as possible based on the timing of transport, but not after sunset, and into the

requirements as part of its review of the application for a water quality certification for Conowingo.

Please do not hesitate to contact the undersigned if you have any questions or require additional information regarding this matter.

Sincerely,

Colleen E. Hicks

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Todd Cutler (Exelon)
Al Ryan (Exelon)
Chris Wilson (Exelon)
Andrea Danucalov (Exelon)
Jay Ryan (Baker Botts)
Tom Sullivan (Gomez and Sullivan)

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deepest water available. These modifications were developed in consultation with and approved by the Pennsylvania Department of Environmental Protection and the Eel Passage Advisory Group.

ATTACHMENT A

Subject to required regulatory approvals, Exelon will design, install and operate an eel trapping facility and eel holding facility along the western shore of the Conowingo Dam near the location of the current United States Fish and Wildlife Service ("USFWS") trapping location and facility, unless an alternate location is approved by the Pennsylvania Department of Environmental Protection ("PADEP") and the Maryland Department of Natural Resources ("MDNR") in writing. The facilities will begin operation by May 1, 2017 unless an alternative schedule is approved by the PADEP in writing and approved by FERC. In the event that the MDNR, USFWS or FERC determine that additional information, revisions, modifications, or amendments are necessary to the plans, specifications or construction activities, then within 60 days of receipt of written notice, Exelon shall submit to the Resource Agencies and FERC such information, revisions or amendments unless a longer period of time is approved by the requesting agency or FERC in writing.

The trapping facilities will be operated by Exelon annually until 2030, and continuously during the eel migration period from May 1 to September 15. Exelon will monitor and record days fished, hours fished and the weather. Daily counts of eels will be recorded. The method of counting under various capture scenarios will be developed in consultation with the Eel Passage Advisory Group ("EPAG"), which is chaired by Exelon and composed of a representative from each of PADEP, Pennsylvania Fish and Boat Commission ("PAFBC"), USFWS, MDNR Maryland Power Plant Research Project ("PPRP") and the Susquehanna River Basin Commission ("SRBC") (collectively, the "Resource Agencies"). Temperature data will be obtained from Monitoring Station 643 (located approximately 0.6 miles below Conowingo Dam near the western shoreline) to examine river temperature in relation to catch rates of juvenile eels. Biweekly subsamples of collected eels will be examined for various life history parameters (*e.g.*, length, weight, and condition factor). A portion of the subsampled eels will be sacrificed and examined for the presence of *Anguillicoloides crassus*. Some of the sacrificed eels will have the otoliths removed and retained for age analysis. *Anguillicoloides crassus* infection rates (proportion of eels infected), the number of parasites per eel, along with associated age, length, and weight data will be reported. Additionally, Exelon will pay to have 60 elvers/year sent to the USFWS or such other entity that the PADEP may approve in writing, for wild fish health screening. The screening shall occur once per year and can occur anytime during the eel upstream passage season.

Periodically, consistent with standards established by the PADEP, MDNR and USFWS, eels will be transferred from the collection tank to the holding tank where they will be held prior to being transported upstream. The holding tank will have an alarm that sounds in a daily staffed location *if* the primary water supply malfunctions. The holding tank will have continuous temperature, dissolved oxygen and gallon/minute water exchange monitoring devices with alarms that sound in a daily staffed location if levels of any parameter are outside of established limits. Upon observation, dead eels will be removed, enumerated, and reported. The holding tank shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by PADEP in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks.

Transport of juvenile eels will occur as necessary based on the capacity of holding tanks at the eel trapping facilities. All eels shall be moved within 1 week of capture. Eels from the holding tank(s) will be transferred to a transport vehicle equipped with an insulated transport container(s) that will be covered and aerated. The transport vehicle taken will have continuous temperature and dissolved oxygen monitoring devices with alarms that sound in the vehicle(s) if levels of any parameter are outside of established limits. The transport vehicle(s) shall be designed and operated to hold eels at densities not exceeding 10 elvers per liter unless modified by PADEP in consultation with the other Resource Agencies. If necessary, aeration will be provided to the holding tanks on the transport vehicle(s). These eels will be trucked to appropriate release locations on the same day of removal from holding. Upon observation, dead eels will be removed, enumerated, and reported.

Exelon will release eels at locations identified below in amounts consistent with the release information provided to and approved by the PFBC in writing. Where feasible, eels will be released at public access locations. Unless otherwise directed by PFBC in consultation with EPAG, eels will be released: (1) as soon as possible, based upon timing of transport, but will not occur after sunset; and (2) into the deepest water available at multiple locations within designated release areas in order to avoid concentrations of eels that could become potential targets for increased predation. If necessary due to time limitations established by the Resource Agencies in writing, Exelon shall release eels at alternative locations to avoid mortality. The estimated number of eels released at each location will be documented in writing and on a GPS device capable of being mapped in a database as approved by the Resource Agencies. After release, any dead eels remaining in the transport vehicle or observed at the stocking locations will be removed, enumerated, and reported.

Modification of, or revisions to, the release locations below shall occur after consultation with EPAG and consistent with the approval of the PFBC.

LOCATIONS OF EEL RELEASE

Site Number	Location	Water	County
1	Conowingo Pool	Susquehanna River	Lancaster
2	Between Holtwood and Safe Harbor	Susquehanna River	Lancaster/York
2	Between Safe Harbor and York Haven Dam	Susquehanna River	Lancaster
3	Upstream of York Haven Dam	Susquehanna River	Dauphin
4	West Fairview Access (Route 11/15)	Susquehanna River	Cumberland
5	Fort Hunter Access	Susquehanna River	Perry

6	Shikellamy State Park	Susquehanna River	Northumberland
7	Route 487 Bloomsburg	North Branch Susquehanna River	Columbia
8	Route 29 Bridge (Wilkes Barre)	North Branch Susquehanna River	Luzerne
9	Upstream of Hepburn Street Dam (Williamsport)	West Branch Susquehanna River	Lycoming
10	Upstream of Grant Street Dam	West Branch Susquehanna River	Clinton

Exelon will implement a QA/QC program approved by the PADEP when trapping and transport begins. Important parameters associated with trapping, collecting, holding, transport, release and stocking will be recorded to assure and control the quality of various program elements. The collection of these data will assure that the program will be conducted according to design parameters, will adhere to sound scientific principles, and will allow for any necessary adjustments. The results of these quality assurance and quality control measures will be included in annual reports to the Resource Agencies and EPAG. Changes to the QA/QC procedures shall be submitted as requested by the PADEP, MDNR or USFWS in writing.

At a minimum, the QA/QC program shall provide:

- Detailed description of the eel trapping and holding process to achieve a minimum 95% survival rate.
- Collection facilities will be visually inspected daily to ensure proper operation.
- Design parameters for flows and key critical components (e.g. attraction flow, spray bar, collection tank) that will be measured weekly and qualitatively assessed daily to ensure that traps are operating within design parameters.
- Water temperature and dissolved oxygen and water exchange in the collection, holding, and transport tanks will be monitored continuously to ensure that water quality remains suitable for juvenile eels.
- Information on the periodic checks on the accuracy of the estimates of volumetric counts.
- Information on the cleaning and disinfection of the collecting, holding, and transportation tanks.
- Protocols for monitoring, removing, enumerating and reporting eel mortality.

During the eel passage season, Exelon shall provide a daily email to designated members of EPAG describing the status of trapping and trucking at each facility, the numbers of eels trapped and transported, any deviations from normal facility operations and the timing and substance of the resolution of any deviations.

On or before December 10 annually from 2015 through 2030, Exelon will submit a report to EPAG summarizing data from the trapping, collection, holding, transport, and stocking components of the Eel Plan for the calendar year. This report will provide program data to EPAG at the earliest practicable date, and provide EPAG with an opportunity to inform development of the Annual Report. On or before January 15 of the following year, Exelon will file an Annual Report with EPAG that analyzes annual data, including results from QA/QC. Upon request, Exelon will meet with EPAG on or before February 15 of each year in which the Annual Report is filed.

Every three years, unless a different period is established by the PADEP in writing beginning in 2018 through 2030, Exelon will conduct stream segment evaluations through electrofishing or other methods identified after consultation with EPAG. Representative stream segments will include tributaries and shorelines of the main-stem river. Exelon will propose locations and methods for this survey at least one year in advance to the Resource Agencies. Exelon shall implement the survey based on approval of the PADEP of the proposed locations and methods.

To implement the evaluations, eels will be captured by electrofishing, or other methods approved by the PADEP in consultation with the Resource Agencies. Sampling will be performed at block-netted transects along river shorelines and at block- netted segments of small tributaries using backpack electrofishing. The exact number, length, and location of transects sampled will be approved by the PADEP in consultation with EPAG. It is anticipated that two weeks of electrofishing will be conducted during each third-year evaluation. Associated water quality parameters such as temperature and dissolved oxygen, as well as habitat characteristics, including mussel numbers observed, will be collected at each sampling location.

During sampling, the number of eels captured will be documented and data will be collected from a representative subsample of eels. A subsample of captured eels larger than 200 mm will be tagged with Passive Integrated Transponder (“PIT”) tags and released. Sampled eels will be scanned for PIT tags and data from recaptured eels will be recorded and included in the annual report. Data will include a variety of life history characteristics (e.g., length, weight, and condition factor) that can be assessed to determine how well stocked eels are utilizing the river and tributaries. A portion of the subsample will be sacrificed and examined for age (otolith analysis), gender, and level of *Anguillicoloides crassus* infection. Eels that are not sacrificed for further analysis will be measured, weighed, and released.

Results of stream segment evaluations will be included in the Annual Report and will document dispersal of the stocked eels, estimate the approximate density of stocked eels, and evaluate the growth, condition, age, gender and level of infestation with *Anguillicoloides crassus* of stocked eels.

If the upstream American eel passage trap and transport program terminates in 2030, Exelon will construct and operate a volitional upstream eel facility at Conowingo Dam through the term of the new license. Exelon will design and construct the volitional upstream eel facility, which will be operated in consultation with EPAG. In no event will Exelon be required to participate in the trap and transport program once the volitional upstream eel passage facility is operational.

If the upstream eel trap and transport and periodic evaluation program continues beyond 2030, Exelon will continue to provide access to the Conowingo eel collection facilities for as long as the program continues. Exelon, however, shall bear no cost responsibility for the trap and transport and periodic evaluation program until 2046, at which time cost responsibility shall be shared among all participants in the program.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at Washington, D.C., this 21st day of April, 2017.

/s/ Marcia Hook

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